

Towards Conservation of World Famous Dal Lake – A Need of Hour

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Abstract: *Lakes play an important role in the economy of a region. Dal Lake has historically been the centre of Kashmiri civilization and has played a major role in the economy of Kashmir through its attraction of tourists as well as its utilization as a source of food and water. Preservation of world famous Dal Lake hence, is need of hour. The aim of this study is identification and monitoring of effluent discharge and to suggest strategies for prevention of water pollution of Dal Lake. A descriptive methodology utilizing observational site survey, study of relevant records and interview technique for identification and monitoring of effluent discharge taking place into Dal Lake was carried out. Accordingly, Strategies for treatment of effluents discharged are suggested for prevention of water pollution of Dal Lake. The study revealed that effluent discharge taking place into the Dal Lake pollutes its water on daily basis. Pollutants that enter in Dal Lake are sewage and sullage, agriculture runoff, detergents and soaps, soil erosion from catchment areas, animal waste, solid wastes and wastes from houseboats, hotels and business establishments. The study is unique in that it reports on important issue of environmental degradation of world famous Dal Lake. Various measures proposed for conservation of lake including afforestation and control of grazing animals in the catchment area, removal of house boats and hotels and rehabilitation of their owners and inhabitants living in and around Dal at a suitable place, removal of excess weeds on continuous basis, construction of sanitation latrines for villagers, reducing use of chemical pesticides, avoiding use of commercial fertilizers, installation of STPs, restoring "Nallah Mar" and continuous monitoring of lake environment are expected to reduce the pollution and hence, preservation of the lake.*

Keywords: *Water, Water body, Pollution, Environment, Lake, Preservation, Effluent, Sewage, Sullage, Wastes*

INTRODUCTION

Fresh water is essential for agriculture, industry and human existence. Without adequate quantity and quality of fresh water sustainable development will not be possible. [1] (Kumar N, 1997)

As far as the environment is concerned, its quality has deteriorated drastically. The air that we breathe, the water that we drink, and the land that we walk on, is polluted. Pollution refers to the contamination of the environment with harmful and undesirable wastes. As water is scarce and its demand is likely to increase further, it needs more attention. After air pollution, water pollution is the most serious threat faced by the whole world. [2] (Hamnera S, et al. 2006)

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water, and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish.[3] (Denver CO, 1998)

Sources of surface water pollution can be point source and non point source. Point source refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Examples include discharges from a sewage treatment plant, a factory, or a city storm drain. The US Clean Water Act (CWA) defines point source for regulatory enforcement purposes. [4]

Non point source pollution refers to diffuse contamination that does not originate from a single discrete source. Non point source pollution is often the cumulative effect of small amounts of contaminants gathered from a large area.

A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in storm water from sheet flow over an agricultural field or a forest are also cited as examples of non point source pollution. [5] Sediment washed off fields is the largest source of agricultural pollution in the United States. [6]

Domestic wastes, industrial effluents, agricultural wastes, etc are the major pollutants entering our water bodies. Many rivers and other water bodies receive a heavy flux of pollutants in the form of sewage containing nutrients and toxins. Industrial discharge contains chemicals and organic compounds which enter the bodies of many aquatic animals. Even ground water is polluted from the soakage pits, septic tanks, manure, garbage, etc. [7] Most of the problems occur due to the lack of proper sanitation facilities and waste disposal system. [8] (WHO, 2011) Loading and unloading of oil and petroleum in the tankers along the sea shore results in oil spills that are a menace as they affect not only water but aquatic life as well. [9] (Akpofure EA, et al. 2000). Agricultural wastes contain pesticides and chemicals, which add to water pollution as by way of filling them up with nitrates and phosphates. These pollutants obviously create an ecological imbalance in the water bodies. [10] (Cook JL, et al.)

All the water pollutants are responsible for decreasing the self purifying ability of the water bodies. This means that these lose the capacity to recycle the wastes. Nutrients cause excessive weed growth and algal blooms. Despite spending crores on it, the result is inconspicuous. The repercussions of this issue are many. Water clarity is affected and the water bodies become shallower. Algae consume most of the available oxygen, thereby increasing what is termed as the biological oxygen demand and decreasing the dissolved oxygen level. The rate of photosynthesis is decreased, killing many aquatic plants. Soil erosion brings a lot of silt into the water bodies, thus decreasing the water quality. The lying of cow dung along the periphery of water bodies enriches them with undesirable chemicals. Water pollution leads to water borne diseases like cholera, typhoid, diarrhea, hepatitis, jaundice, dysentery, etc. [11] (Agrawal A, et al. 2010)

It is believed that more than a billion people living in the developing nations lack access to safe drinking water. About 90% of the sewerage water gets discharged into the

environment without any treatment in the third world nations. 90% of the river pollution is due to human wastes. 80% of the diseases in India are water related. About 15 lakh children die due to diarrhea every year. [12] (Pruss A, et al. 2002). All the 14 rivers in India are polluted. [13] (CPCB, 2003)

It was on 5th June, 1972 that the UN General Assembly established the world environment day. The message to prevent pollution is being spread since 1972 but still our environment is in a dismal state. Unfortunately in India, environmental issues don't receive the kind of attention they demand and deserve. [14] (UN General Assembly 1972)

Though many laws like the water pollution act, 1974 and control of water pollution were constituted in India, much more than mere passing of Acts and framing of laws needs to be done. [15] (Water Pollution Prevention and Control Act, 1974)

Almost 71% surface area of the earth is covered with water in the form of streams, lakes, rivers, Seas and oceans. Any depression or hollow of considerable size in the surface of the earth that is filled with water may be defined as a lake. Precisely speaking a lake is a body of stagnant, semi stagnant or fresh water, most lakes are temporary in character. Lakes show a great variation in size and shape. [16] (Singh P, 2004).

Lakes play an important role in the economy of a region and are of tremendous academic, societal and economic importance. They act as natural water reservoirs and store a large quantity of water, which can be used for drinking, industrial, irrigation, aesthetic and other purposes including generation of hydro-electricity. [17] (Sarh S, et al. 2011)

Jammu & Kashmir is one of the beautiful parts of this planet with rich water resources. There are many water bodies in Jammu & Kashmir and Dal Lake is a largest water body after Wular Lake situated in Srinagar, the capital of J & K which lies more than 5000 ft. above the sea level. Dal Lake is world famous water body which needs to be preserved. The Government of Jammu and Kashmir has commissioned an authority to save this water body from pollution called Jammu & Kashmir Lakes and Waterways Development Authority. [18] (JK LAWDA).

Climate of Kashmir is montane valley climate with a pronounced cold season from October to March (Average temperature 7.5°C) and warm summers (Average temperature 19.8°C). January is the coldest month (-2°C to

3 °C), and July the warmest (34 °C to 35 °C). The average annual rainfall is 551 mm. Most of the precipitation is in the form of snow (January–March). Summer monsoon rainfall is scanty. The maximum depth of Dal Lake is 6.5m, while the average depth is less than 3m. The waters of Dal Lake support a permanent floating population of some 7000 people, with whole villages having in effect been illegally created in the lake. The lake supports a huge floating market garden industry, an important fishery and a booming tourist industry. Weeds are harvested for cattle fodder. The lake also acts as a sump for a great deal of the waste products from Srinagar. Dal Lake, subjected to an ever increasing rate of eutrophication and siltation, has been estimated to totally disappear within the next 50 years. [19] (JK Tourism).

This lake has historically been the centre of Kashmiri civilization and has played a major role in the economy of the state through its attraction of tourists as well as its utilization as a source of food and water. [20] (Reddy MS, et al, 2004)

Review of Literature thus suggests that water pollution is a global problem and that this issue has attained a great significance as water pollution involves a great waste of this natural resource because of the damage it causes to the water ecology, environment and economy. Controlling Water pollution will prevent this damage besides maintaining quality of water for human consumption. Therefore, it is obligatory to be conscious by attending to the issues like water pollution, sources of water pollution, strategies for prevention of water pollution, protection of water bodies, domestic and industrial sewage treatment, need of coordination between different sectors, and awareness in the community about importance of saving this important component of this planet for future generations.

Materials and Methods

A descriptive study prospective in nature for a period of two years duration was conducted to identify and monitor the effluent discharge into the Dal Lake with effect from May 2011-April 2013 after proper permission from concerned authorities.

A mixed methodology utilizing observational site survey, study of relevant records available with Lakes and Water ways Development Authority (LAWDA) and interview technique was used for identification and monitoring of

effluents discharged into the Dal Lake. The researcher himself visited different areas of Dal lake as per predetermined program framed for the purpose. Effluent discharge occurring into Dal Lake was monitored by researcher throughout the study period at different sites and observations were recorded on a predesigned, standardized proforma. Interview with relevant functionaries was also conducted to obtain further information on the subject.

The study has been undertaken on following main nine sites for monitoring of effluent discharge as the major water discharge occurs in to the Dal lake at these sites.

1. Nishat pipe line bund (Drain),
2. Sheikh mohalla Brein (Sheikh Kul),
3. Laam village (Gam Kul),
4. Dalgate mohalla (Drain),
5. Khwaja mohallah (Khwaja Yarbal),
6. Entry of Telbal Nallah (Telbal Nallah),
7. Brarinambal (Brarinambal drain),
8. Saidakadal (Nallah),
9. Hotel Heemal (Discharge pipe)

Finally different strategies for treatment of effluents discharged are suggested for prevention of water pollution of Dal Lake, so that this world famous water body shall be preserved for future generations.

Results

Dal Lake is a Himalayan Urban Lake, located in the heart of Srinagar city at an average altitude of 5000 ft. above the sea level and with an area of about 1670 ha. The lake is one of a series of freshwater lakes of Kashmir valley. The main source of water for the lake is Telbal Nalla in the Dachigam area, numerous springs arising from the bottom of lake and outwash from surrounding mountains. It is drained through Pir Panjal mountainous range at Baramula to the plains of the Punjab. Main basins of lake are Nagain Lake, Hazratbal, Bod Dal and Gagribal. and main islands are Sona Lank and Rupa Lank.

The study revealed that the effluent discharge taking place into the Dal Lake pollutes its water on a daily basis. The sites from where effluent discharge occurs into Dal Lake are shown below.

Table 1: Showing different types of effluent discharge

S. No.	Name of Site surveyed	Name of water stream/Nallah draining into Dal Lake	Types of effluents discharged
01	Nishat pipe line bund	Drain	Sewage
02	Sheikh mohalla Brein	Sheikh Kul/Nallah	Agricultural runoff, Soaps, Detergents, suspended impurities (clay, slit, sand & mud)
03	Laam village	Gam kul	Agricultural runoff, Soaps, Detergents, suspended impurities (clay, slit, sand & mud)
04	Dalgate mohalla	Drain	Sewage
05	Khwaja mohallah	Khwaja Yarbhal	Human faeces, Soaps, Detergents
06	Entry of Telbal Nallah	Telbal Nallah	Agricultural runoff, Sewage, Soaps, Detergents and suspended impurities (clay, slit, sand & mud)
07	Brarinambal	Brarinambal drain	Agricultural runoff
08	Saidakadal	Nallah	Human faeces, Soaps, Detergents
09	Hotel Heemal	Discharge pipe	Sewage

During the survey it was observed that the large quantities of effluent discharge is taking place in to the Dal Lake on daily basis from human dwellings, agricultural practices and house boats which led to tremendous water pollution of Dal lake.

The number of houseboats and illegal constructions has increased in the Dal Lake in the recent past. Agricultural practices have also increased in some areas of lake. Most of the houseboats use the lake water and sewage and sullage waste in return is also discharged directly in the lake from these houseboats. Solid wastes such as vegetable scraps and paper are dumped into the lake. Toilets used by the local residents have been constructed in lake. Dal Lake receives pollutants from these point sources as well as non point sources. The point sources include (i) sewage and other human wastes from the houseboats and residential houses (ii) sewage outfalls from adjoining areas including some tourist spots. The non point sources include the runoff from agriculture fields and soil erosion from the

catchment areas. During summers the volume of pollutants increases, when over 1700 houseboats and hotels support about an extra five lach population of tourists every year.

It was observed that following main types of pollutants enter into the Dal Lake on daily basis.

1. Sewage and Sullage
2. Agriculture runoff
3. Detergents and soaps
4. Animal waste
5. Solid wastes (plastics, paper, polythene, rusted metal)
6. Wastes from houseboats, hotels and business establishments around Dal and
7. Soil erosion from catchment areas.

In order to minimize these pollutants, following measures should be adopted.

1. Removal of house boats and hotels from Dal Lake
2. Rehabilitation of house boat/hotel owners and people who live in and around Dal at a suitable place
3. Removal of excess weeds from Dal Lake on continuous basis
4. Construction of STPs at all inflow channels
5. Restoration of a natural outflow channel ("NallaMar") that will suck and drain extra pollutants from Dal Lake. It is pertinent to mention here that "Nalla Mar" was a long natural out flow drainage channel which was closed few years back (in 1960s) and turned in to a macadamized road.
6. Educating villagers about the importance of construction of sanitation latrines so that direct disposal of sewage into the Lake is prevented.
7. Reducing use of chemical pesticides and farmers should be encouraged to use biological pest controls instead of chemical pesticides.
8. Farmers may avoid using commercial fertilizers and animal dung in their farmlands in the catchment area. They should be encouraged to develop and implement nutrient management plans to reduce excess application of fertilizers.
9. Aforestation of the catchment area and
10. Control of grazing animals in the catchment area.

DISCUSSION

The large quantities of effluent discharge that is taking place in to the Dal Lake on daily basis from human dwellings, agricultural practices and house boats led to tremendous water pollution of Dal lake which should awake the government, the public as well as the concerned authority (LAWDA) to consider carefully how to prevent the pollution and hence preserve this world famous water body for future generations. The government has to consider carefully how to spend their money which is allocated for this purpose. The administration has to devote considerable time and energy to monitor and contain the pollution of Dal Lake. The common man knows very little or nothing about the disastrous effect of water pollution. Therefore, it is necessary to make them conscious about the issue and seeking their cooperation in containing the pollution.

Dal Lake contributes forty per cent of drinking water for the city's population. [19] (JK Tourism). It has been estimated that the size of the lake has shrunk from its

original area of 22 square kilometres to the present area of 18 square kilometres due to sediment deposition. [21] (Okpokwasili GC, et al. 1996). It is, therefore, imperative that the government should design both short and long term measures to address this important issue.

A descriptive methodology utilizing observational study, study of relevant records and interview technique was used to study the types of effluents discharged in Dal Lake and then accordingly remedial measures are suggested.

The different types of pollutants that enter into the Dal Lake as evident from our study are sewage and sullage wastes from human settlements, houseboats, hotels and business establishments around Dal Lake. Other wastes include agriculture runoff, detergents and soaps, animal waste (animal dung), solid wastes like rags of plastics, paper, polythene, rusted metal and soil erosion from catchment areas. In order to minimize these pollutants, following strategies should be adopted.

(1) Removal of house boats and hotels from Dal Lake and rehabilitation of owners at a suitable place (2) Rehabilitation of people who live in and around Dal somewhere else (3) Aforestation of the catchment area (4) Control of grazing animals in the catchment area (5) Removal of excess weeds from Dal on continuous basis (6) Construction of STPs at all inflow channels (7) Restoration of a natural outflow channel (drainage i.e. "Nalla Mar") that will suck and drain extra pollutants from Dal (8) Educating villagers regarding the importance of construction of sanitation latrines so that direct disposal of sewage into the Lake is prevented (9) Reducing use of chemical pesticides and farmers should be encouraged to use biological pest controls instead of chemical pesticides (10) Farmers should avoid use of commercial fertilizers and animal dung in their farmlands in the catchment area. They should be encouraged to develop and implement nutrient management plans to reduce excess application of fertilizers.

All these measures are expected to reduce the pollution, which is remarkably high at present, and will help in preservation of the lake for future generations.

Preservation of water bodies of Kashmir is a major challenge for the government. Huge money is needed for this purpose in view of increasing cost of new technology and manpower. Lakes and Water ways Development Authority (LAWDA) as an authorized body is expected to take this challenge and offer following services.

1. Surveys of different water bodies and identifying different types of pollutants that enters in water bodies.
2. Identification of extent of the problem.
3. Acquisition of manpower and technology and training of personnel for treatment of effluents and sewage.
4. Preventive measures with emphasis on mass awareness Programs, better sanitation and water hygiene.
5. Continuous monitoring of lake pollution and evaluation of its programs.
6. Supporting research on different water bodies of Kashmir.

The study may prove useful for providing preventive and treatment measures to be taken for preservation of Dal Lake. Besides, there is need of continuous monitoring of effluent discharge taking place into the Dal. The study will also help in providing data for environmental impact assessment.

It is pertinent to mention here that sediment washed off fields is the largest source of agricultural pollution in the United States. [6] (EPA, 2005) Farms with large livestock and poultry operations, such as factory farms, are called concentrated animal feeding operations or feedlots in the US and are being subject to increasing government regulation. Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologically sterile and friable manure for soil improvement. [22, 23] (EPA, 2008 & Des Moines IA). Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers. [24] (US NRCS)

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients. [25] (EPA, 2003) To minimize pesticide impacts, farmers may use integrated pest management techniques like biological pest control

to maintain control over pests, reduce reliance on chemical pesticides and protect water quality. [26] (EPA, 2008)

Conclusion

The study is unique in that it reports on the important issue of environmental deterioration of world famous Dal Lake. The study revealed that the effluent discharge taking place into the Dal Lake pollutes its water on a daily basis. Pollutants that enter in Dal Lake are sewage and sullage, solid wastes, agriculture wastes, detergents and soaps, soil erosion from catchment areas, animal waste and wastes from houseboats, hotels and business establishments.

Choking of lake has occurred due to closure of its natural drainage system called "Nalla Mar" which has been converted in to a macadamized road. Immediate remedial measures are needed to salvage the lake and long term rehabilitative measures are needed to preserve the lake for future generations. Preventive measures like control of wastes from entering the lake from different water channels should be adopted. Prevention is a cost-effective strategy. Continuous monitoring of lake pollution and evaluation of measures taken is necessary for satisfactory functioning.

Various measures proposed for conservation of lake including aforestation of catchment area, control of grazing animals in catchment area, installation of STPS, removal of house boats and hotels from Dal Lake and rehabilitation of their owners and inhabitants living in and around Dal at a suitable place. Removal of excess weeds from Dal on continuous basis. Restoration of a natural outflow channel "Nalla Mar" and educating villagers regarding the importance of construction of sanitation latrines to prevent direct disposal of sewage into the Lake. Reducing use of chemical pesticides by farmers and using biological pest controls instead. Avoiding use of commercial fertilizers and animal dung in farmlands. All these measures are expected to reduce the pollution and hence, preservation of lake.

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