STUDY OF PONDS IN KATHMANDU VALLEY AND ANALYSIS OF THEIR PRESENT SITUATION

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ABSTRACT

Ponds in Kathmandu were constructed to feed the sub surface aquifers of stone spouts and dug wells at all seasons. The study focuses on how the ponds have been saved, reduced in size or completely lost. The causes behind the degradation of ponds are forces of intervention and disturbances that lead to the loss of the originality, quality and quantity of ponds throughout its timeline. Out of eight existing ponds in the study area, 10 samples were taken from eight different ponds for quality assessment. The historical significances and status, uses as of 2019 are tabulated based on field survey. The paper focuses on the study of pH, Total Solids, Electrical Conductivity, Ammonia, Nitrate, Phosphate, Ammonia, Dissolved Oxygen, Biological Oxygen Demand, Total Organic Matter, Chlorophyll, E. Coli, and dimensions of existing ponds. The physical, social stresses and lack of regular inspection of ponds have contributed to their degradation. However, the existing ponds require sustainable management. Proper safeguarding mechanism should be developed for the regular aeration of water in the ponds such as fountains so that the ponds have more dissolved oxygen eliminating faulty smell and control fish death.

Keywords: aquifers, water quality assessment, E. coli, degradation, aeration.

Introduction

Ponds are extraordinary artifacts that provide unique values and purposes. Ponds in Kathmandu Valley lie inside or outside settlements that are sources of surface water and are used for domestic purposes, irrigation, running water mills and even for dumping sewerage and garbage(Antony and G., 1985). Ponds in Kathmandu were basically constructed to feed the sub surface aquifers of stone spouts and dug wells at all seasons (Pant, 2009). The indigenous inhabitants in the valley preferred ponds within the settlement area to

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beautify the landscape and also to create feasible space. In modern days, ponds essentially have social and economic purposes besides religious and cultural significances such as Fishery and recreational activities. There are approximately one hundred ancient lakes and ponds in the valley (Sharma, 1992; Sharma, 1989). But as their usage has receded, their importance has receded due to which, their maintenance and renovation couldn't take place and gradually have started to fall. However, few ponds are still maintained well.

Lainchour Pokhari, which was the biggest pond of Kathmandu, has now taken the form of a building. It is now a place for Nepal Scouts building. Among the few ancient remaining ponds are Guita Pokhari, Patan and Lagankhel Pokhari. Taudaha, Nagdaha, Siddha Pokhari, Pim Bahal Pokhari, Rani Pokhari, Nag Pokhari, Kamal Pokhari and Gahana Pokhari are some of the better known ones carrying cultural significances (Amatya, 2003). Taudaha, Nag Pokhari and Nagdaha, for example, are visited during the Nag Panchami festival. Taudaha is the only natural lake that serves as ecological habitat for a significant number of wetland birds (Shrestha, 2003). In the past, Bhaktapur had numerous ponds out of which there are still 33 of them. Siddha Pokhari, a focalpoint during Dashain measuring 275 m by 90 m, is said to have been built in the 15th century. Barhe Pukhu is another big pond that lies in north-east of the city. Ancha Pukhu, to the north of the city, has a stone image of the reclining Lord Vishnu at its center, and it is a place where many religious events take place. The Lalitpur Sub-Metropolitan City Office (LSMC) states that there are 25 Pokharis in the city today with the major ones being Prayag, Jawalakhel and Pim Bahal. But according to Prayag Joshi, he listed 39 ponds in Patan, out of which 16: condition, 9: encroached reducing size and 14: completely lost. Pim Bahal Pokhari was built in the 14th century and is one of the more famous ponds in Patan. However, it had lain in a state of neglect for a long time. This ancient city has somehow had some trouble maintaining its historical ponds. According to a recent news report, however, three ponds – Nehoo, Saptapatal and Purnachandi – have been earmarked by the LSMC for extensive repair and renovation. This is mainly an attempt to recharge the ponds by harvesting rainwater in order to solve the city's acute drinking water problem.

The scenario of Kathmandu has changed from the last 50 years because it had to cope with large influx of people (Dixit and Upadhaya, 2005). As,the land of the city is regarded as an asset, there has had been insignificant protection initiatives. The profound knowledge of land use developed by Kirats, enriched during Lichhavi period and extended by the Mallas was overshadowed by the ignorance of state and later by the public mainly during Rana regime and Panchayat system (UN-HABITAT, 2008). Bal Mandir Pokhari in Naxal

is transformed to Bal Mandir School. Similarly, Hattisar Pond in Hattisar was encroached. Pond in Bhairabstan Margh was destroyed during Rana regime. The public land which was kept with state to safeguard its proposed use were either grasped by the influential people in the government and disciple of the palace or brought in use other than ecological use. Ponds in Bishal Nagar, Ganesthan and Baluwatar were granted by his Majesty's to the homeless people as caretakers for their shelter but they encroached and transferred the ownership to their name and ponds were destroyed. Ikha Pokhari of Nyokha visibly exists but the majority of the area is replaced by Kanya Mandir School. Similarly, Police Head Quarter Office has been established above Sinduwaal Pokhari in Naxal. The knowledge and skill of recharging ground water to serve wells and stone spouts was well established in earlier time. Some of the ponds also served as waste water management especially grey water (Maharjan, 2012). The ponds which collects surface water and recharge the aquifers are lost because of ignorance, change in habits and economy and greed of people. The second negative intervention into the system is the construction of large buildings which requires deep foundation. With deep foundation there is a good chance these water channels can be destroyed knowingly or unknowingly. Shallow dug wells became popular in Kathmandu Valley in last two decades with the availability of concrete rings, cheap electric water pumps, and convenient plastic water tanks. The regular uncertainty of city supply attracted people towards the construction of dug wells. In the absence of regulating mechanisms to manage ground water, dug wells became popular. Unfortunately, this became one of the major reasons for the decrease in the discharge (UN-HABITAT, 2008).

Materials and Methods

The methodology involved extensive review of secondary data and consultation with key stakeholders that led to identification of research questions, selection of the study objectives and identification of appropriate sets of variables for inquiries.

Table 1: Methodological tools

Objectives	Indicators	Research tools
1. Inventory of the ponds and the reasons for the construction of ponds	• Number of ponds in KMC • Sector where water was used and current usage	• Key Informants' survey • Literature review • Field visit • Secondary data
2 Stresses influencing in the degradation/disappearance of the ponds in KMC	• Stresses and pressures identification • Impacts of those threats	• Key Informants' survey • Literature review • Focus group discussion
3 Present day status of the ponds which are in existence	• Current state of ponds • Identification of potential threats • Water quality assessment	• Literature review • Key Informants' survey • Field visit • Focus group discussion
4 Study of the physical chemical and biological parameters of water quality	• Water quality assessment	• Water sample collection • Laboratory test

Study Area

The study area lies within 32 wards of Kathmandu Metropolitan City. The city stands at an elevation of approximately 1,400 metres (4,600 ft) in the bowl-shaped valley in Bagmati. The geographical location of the city is 27°38'32" to 27°45'7" North latitudes and 85°16'5" to 85°22'32"(Haack, 2009). East longitudes. According to the 2001 census, there are 671,846 inhabitants whereas increased to 975,453 inhabitants in 2011 (CBS, 2011; CBS, 2002; CBS, 2001). The Kathmandu valley with its three districts including Kathmandu District accounts for a population density of only 97 per square kilometer whereas Kathmandu metropolitan city has a density of 13,225 per square km and increased to 19,250 per square km (CBS, 2011; CBS, 2001).

Climate and precipitation

Kathmandu city has a warm temperate and humid climate. The average summer temperature varies from 24-28 °C with the maximum temperature as high as 37.2^0C in the month of June and the average winter temperature is 10-13 °C and the minimum temperature was recorded as low as -2.8^0 C in the month of January (DHM, 2015). The average annual rainfall is 1455 mm where 85% of rainfall occurs in May-September and the humidity is around 74% (DHM, 2015).

Land use

KMC land use is mainly divided into five types: Urban/Built-up, Open space, Water body, Cultivated land and Natural vegetation for the simplicity of study (Pradhan, 2003).Dominant land use type in Kathmandu municipality is built-up which mostly comprises of residential and commercial, administrative and transportation areas. It occupies 65.60% of the total area whereas agricultural area contributes 16.80%. Water resources consist of just 1.26% which consists of rivers and ponds. Ponds contribute just 0.12% of KMC (Pant, 2009).

Status of ponds

It is estimated that there are over 100 ponds inside the Kathmandu valley that includes Kathmandu, Patan, Bhaktapur, Sankhu and other villages (Pradhan, 2003). There are 16 traditional ponds in Kathmandu (Pradhan, 1990), 39 ponds in Patan (Joshi, 1992), 42 major ponds in Bhaktapur and 5 ponds in Sankhu. Sad but true, is the fact that the creation of ancestors are at high risk of falling and are deteriorating day by day. Like other heritages, ponds that are part of the culture are at major stress and on the way for its very deterioration unless proper actions are taken. The causes behind the degradation of ponds, in fact are stresses –forces of intervention and disturbance- that leads to the loss of the originality, quality and quantity of ponds throughout its timeline.

Research methods

Sampling for quality assessment

Out of eight existing ponds in the study area, 10 samples were taken from eight different ponds. Three samples were taken in four seasons, viz. pre-monsoon, monsoon, post-monsoon and winter. Two samples were taken from the larger ponds i.e. *Kamal Pokhari* and *Nag Pokhari* whereas one sample from each of the six smaller ponds in December, at 1 foot depth. Eight samples were taken 1 meter from the bank of the pond whereas two samples were taken from the center of the pond. The sampling sites were taken so that they represent the homogeneous water mass of the sampling sites. Following samples were taken from the eight sampling sites.

Site 1 (*Nag Pokhari*)

Site 2 (*Hiti Pokhari*)

Site 3 (*Kamal Pokhari*)

Site 4 (Raj Rajeshwori)

Site 5 (*Rani Pokhari*)

Site 6 (*Kamaladi Pokhari*)

Site 7 (*Ikha Pokhari*)

Site 8 (Dayashwor Mahadev)

Water quality assessment

The water samples collected from eight different ponds were subjected to physical chemical and biological water quality examinations at water quality analysis laboratory of Environment and Public Health Organization (ENPHO).

Table 2: Water Quality Parameters

Parameters	**Unit**	**Test Methods**
Physical Parameters		
Temperature	^{0}C	Thermometer
pH (19^{0}C)	-	pH meter
Electrical Conductivity	us/cm	Conductivity Meter
Total solid	mg/L	Gravimetric (filtration, weighing of residue)
Chemical Prameters		
Chloride	mg/L	Argentometric
Ammonia	mg/L	Spectrophotometric (Neslerization)
Nitrate	mg/L	UV Spectrophotometric (Screening)
Total Phosphate	mg/L	Ammonium molybdate ascorbic acid reduction
Total Organic matter	mg/L	Gravimetric
Dissolved Oxygen	mg/L	Atomic Absorption Spectrometer (AAS)
Biochemical Oxygen Demand for 5 days at 20 degree C	mg/L	5 days incubation at 20 degree C and tit^n of initial and final dissolved oxygen
Biological Parameters		
Chorophyll	mg/m3	Spectrophotometric
E.coli	CFU/100ml	Membrane Filtration

Field survey

The field survey involved key informants' survey and semi-structured interviews with different stakeholders. In order to put together an inventory of ponds and identify the causes and stresses behind the degradation of the ponds, interviews, sampling, Focused

Group Discussion(FGD) were done. To identify the key informant, snow ball sampling was done in the initial phase of the field survey. Key informants interviews were conducted with the personnel from KMC who are involved in the decision making. The interview also includes personnel from ward offices, local leaders, social and NGO activists and elderly persons. Other important key informants were academicians, journalists, Ghuti Sansthan and department of archeology. Focus Group Discussions (FGD) were carried out at five different wards i.e ward nos. 1, 3, 8, 28 and 31 in the month of September, 2019. The location of the FGD included: Kamal pokhari club in Kamal pokhari, Dayashwor Mahadev temple in Lazimpath, Siddhi Shaligram Briddhashram (Home for the Elderly) in Pashuptinath temple, Kanya mandir in Nyokha, Ganesh Mandir in Kamaladi, Naxal youth club in Naxal and Rani Pokhari in Kantipath. At each location 10-15 people from the area representing different age groups, caste/ethnicity, gender and occupation participated in the FGD. The participants were asked to provide information relating to the history and origin of ponds, ponds which disappeared in different time frame. They were also asked to help us know about the change in demography and settlement pattern, land use and land cover changes, water use and the changes in the water supply situation and issues regarding to the degradation of ponds.

Secondary data collection and Analysis

The secondary data of the study were collected from published and unpublished sources from government and non-governmental organization and analysis and computation were done.

Result and Discussions

Inventory of ponds

Based on the location, ponds can be divided in two categories-inner settlement ponds and external settlement ponds that are utilized for recharging the aquifers that are the sources of water for *hitis* and *tun(*Graney and Eriksen, 2004). *Rani Pokhari*, Lainchaur *Pokhari*, *Ikha Pukhu*, *Kamal Pokhari* are some external ponds whereas there are no inner settlement ponds remained in Kathmandu. The status of ponds and their uses are tabulated based on field survey.

Table 3: Ponds and their uses

S.No	Name of *Pokhari*	Status	Use	Place	Operation
1	*Rani Pokhari*	Existing	Cultural & fishery	*Kantipath*	Conserved
2	*Hiti Pokhari*	Existing	Recreational	*Narayanhiti Path*	Conserved
3	*Kamal Pokhari*	Reduced size	Recreational & fishery	Gyaneshwor	Conserved
4	*Gahana Pokhari*	Existing	Recreational	Tangal	Conserved
5	*Dayashwor* mahadev	Existing	Cultural & domestic use	Lainchour	Conserved
6	Kamaladi	Existing		Kamaladi	Abandoned
7	*Nag Pokhari*	Existing	Recreational and cultural	Naxal	Conserved
8	*Sinduwaal Pokhari*	Lost	Office	Naxal	Police Headquarter
9	*Ikha Pokhari*	Reduced size	School	Nyokha	*Kanya Mandir* School
10	*Bachha Pokhari*	Lost	Private	Naxal	Residential
11	*Kaitahiti mani Pokhari*	Lost	Public	Kalimati	Market
12	Nag *Pokhari*(Sundhara)	Lost	Private	Sundhara	Buildings
13	*Matule Pokhari*	Lost	Private	Teku	Ambe building
14	Lainchour *Pokhari*	Lost	Private		Buildings
15	*Bal Mandir Pokhari*	Lost	Public	Naxal	*Bal Mandir* School
16	Hattisar *Pokhari*	Lost	Private	Hattisar	Encroached
17	*Nag Pokhari (*Bhagwanstan)	Lost	Public	Chabahil	Monastry
18	*Lamh Pokhari*	Lost	Private	Chabahil	Lions Club
19	*Pachali Bhairav Pokhari* (3 in No.)	Lost	Public	Teku	Abandoned
20	*Ghoilesang pokhari*	Existing	Public	Boudha	Construction
21	*Khichha pokhari*	Lost	Private	Sundhara	Abandoned
22	*Sorekhutte Pokhari*	Lost	Public	Sorekhutte	*Guthi*
23	*Puwa pokhari*	Lost	Private	Hadigaun	Residential
24	*Bhimsenstan Pokhari*	Lost	Private	Hadigaun	Residential
25	*Raj Rajeshwari*	Existing	Public	Pashupati	Abandoned

Source: Field survey

Deterioration of ponds and related stresses

Many ponds couldn't be well preserved during Panchayat and early multi-party system. The physical stresses that are directly associated with the physical alternation of ponds either downsizing or removal of the vital water bodies over the period of time are water movement blockage, overuse of groundwater, dumping of waste and flow of domestic effluents, sediments' flow and improper management of religious waste in the water bodies (Mortimer, 1942). Most of the ponds in Kathmandu vanished due to the blockage of the water movement channel i.e. *Raj Kulos*. Most of the participants in the FGD stated that the construction activities like erection of foundation of large buildings, construction of drainage and pipe lines crossing the path of old channels feeding ponds, construction of roads, construction of shallow wells and also due to haphazard extraction of ground water through tube wells and hand pumps are the reasons which disturbed the movement of water movement. *Puwa Pokhari* in Hadigaun dried due to the excessive use of ground water which led the well in the pond to dry out resulting in the disappearance of the pond. Residents of Naxal dump their waste in *Narayan Chour* which is just 50 metres away from *Nag Pokhari.* Sediments not only decrease the size of the pond, also contributes to the biological activity leading to the disappearance of ponds. *Lamh Pokhari* which is also known as *Jumbu kunda* which is used to act as a buffer to protect from flooding which retained sediments which later vanished due to excessive sediment replaced water. *Rani pokhari* has been affected by the deposition of fine particles including organic matter. During the process of rain harvesting system from the roof of *Tri-chandra* College and *Durbar* High school, the soil particles are also transported to the pond. The religious offerings in the ponds aren't well managed either.

The societal stresses that led to destruction or obstruction in management of ponds are land encroachment and transfer of ownership, change of profession and habits like fetching water for household purposes, lack of organizational body and poor legislation and ineffective execution of rules and absence of deities in the pond. "Tragedy of Commons" and the principle of non exclusion seem to perfectly apply in terms of ponds and surrounding lands. People know that they are responsible for the degradation of the system but they think KMC and government are responsible to intervene and take necessary steps to restore the ponds. But, government organizations are seen to be reluctant to work to solve the issue is liable custodian according to Local Governance Act 1999 the liable custodian to conserve the national heritage is KMC and DDC.

Pond water quality concern

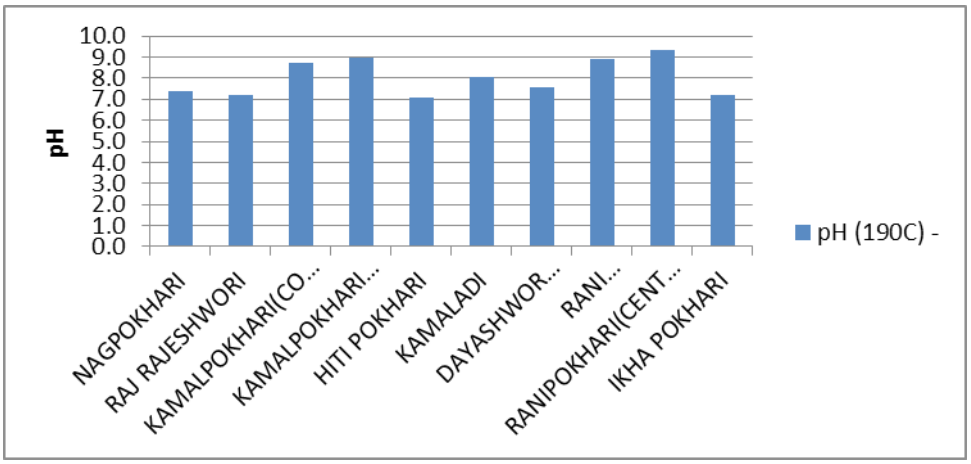

Figure 1 Variations in pH of pond water at different sampling sites

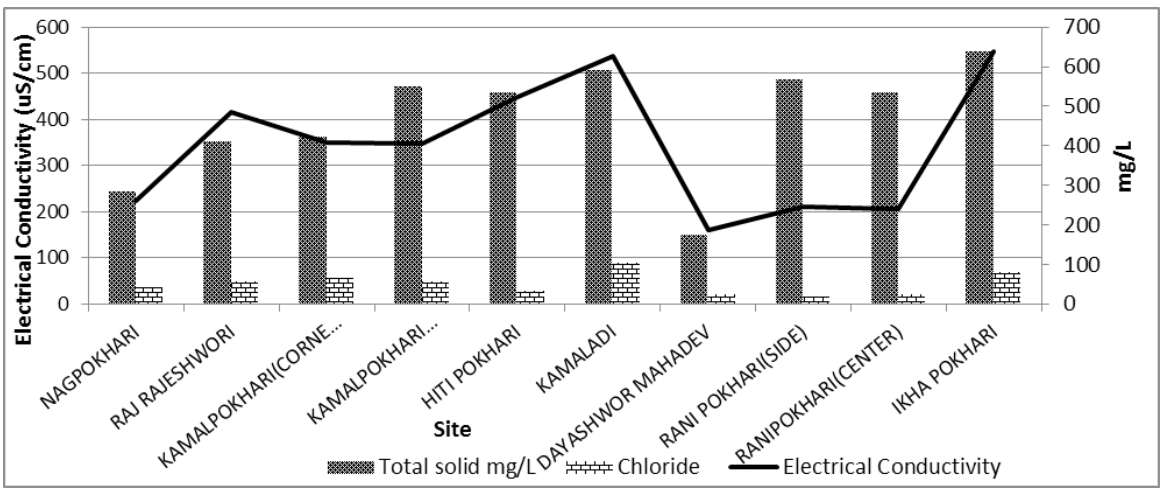

Figure 2 Comparative studies of EC, TS and Cl^- of pond water at different sampling sites

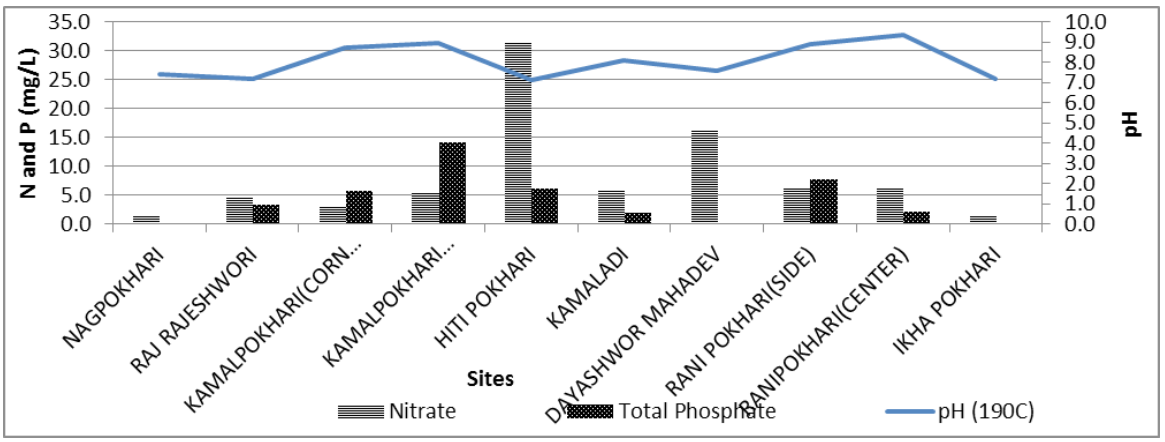

Figure 3 Comparative studies of nitrate and phosphate of pond water at different sampling sites

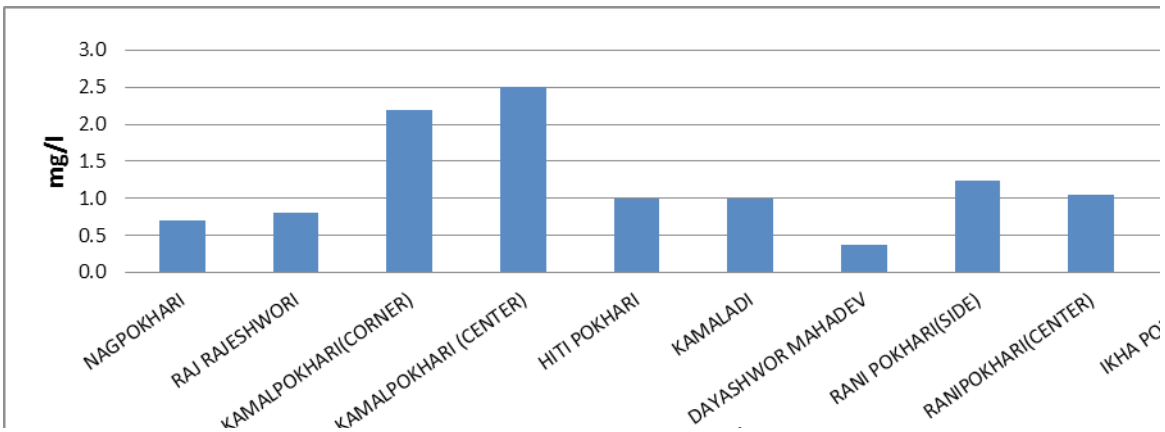

Figure 4 Variations in ammonia of pond water at different sampling sites.

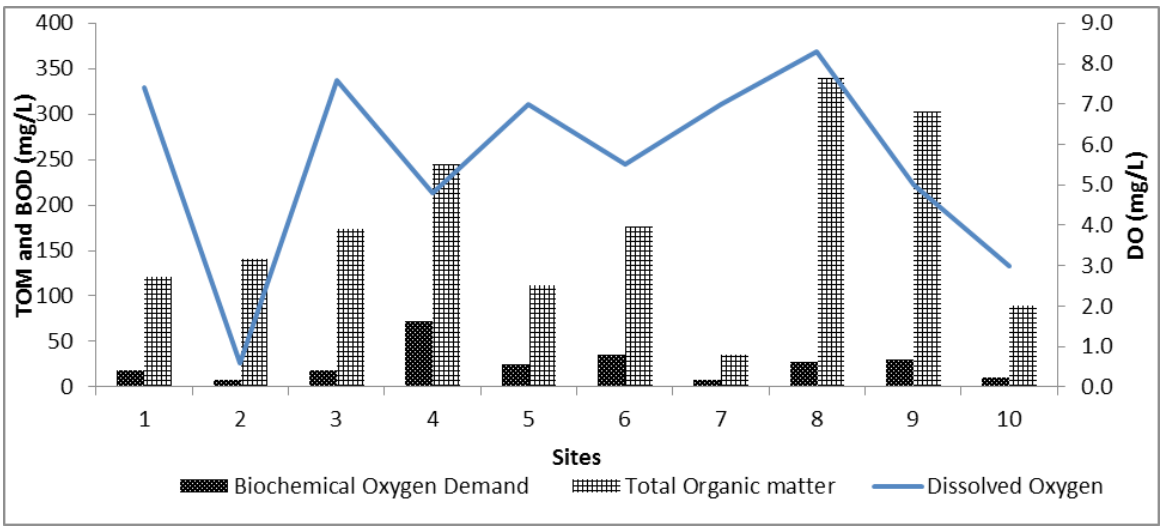

Figure 5 Comparative studies of DO, BOD and TOM of pond water at different sampling sites

Table 4: Variations in chlorophyll of pond water at different sampling sites

Name of the Ponds	Chlorophyll (mg/ m^3)
Nag Pokhari	188
Raj Rajeshwori	184
Kamal Pokhari (Corner)	233
Kamal Pokhari (Center)	1363
Hiti Pokhari	118
Kamaladi	208
Dayashwor Mahadev	3
Rani Pokhari (Corner)	727
Rani Pokhari (Center)	390
Ikha Pokhari	8

Table 5: Variations in *E. coli* of pond water at different sampling sites.

Name of the Ponds	*E. coli* count (CFU/100ml)
Nag Pokhari	26
Raj Rajeshwori	TNTC
Kamal Pokhari (Corner)	TNTC
Kamal Pokhari (Center)	TNTC
Hiti Pokhari	TNTC
Kamaladi	480
Dayashwor Mahadev	100
Rani Pokhari (Corner)	420
Rani Pokhari (Center)	TNTC
Ikha Pokhari	16

The data values of different parameters obtained fell below 10% in terms of Standard Deviation and are listed in the figures and tables as mean values. The value measurements did not alter significantly because during winter season, as there was so rainfall, water was supplied in the ponds so that it didn't get dried off.

Table 6: Physical status of the existing ponds in KMC in 1982

S. No	Name of pond	Location	Length (ft)	Breadth (ft)	Depth (ft)	Construction date	Status
1	*Kamaladi Pokhari*	Kamaladi, Ganeshstan	79.10	39.7	4	18th century	Protected
2	*Ikha Pokhari*	Nyokha	210	92	20	16th century	Neglected
3	*Nag Pokhari*	Bagdurbar	72	-	-	19th century	Neglected
4	*N/A*	Haribhawan	180	150	-	17th century	Neglected
5	*Sorekhutte Pokhari*	Sorekhutte	100	50	-	1864 (Kartik) BS (Bhote Pande)	Neglected
6	*Pachali Bhairav Pokhari*	Pachali Bhairav	200	25	-	20th century	Neglected
7	*N/A*	Teku, Rope way	180	100	-	20th century	Neglected
8	*Raj Rajeshwori Pokhari*	Raj Rajeshwori (Pashupati)	50	20	6	18th century	Protected
9	Nag Pokhari (Bhagwanstan)	Chabahil	80	50	-	18th century (Charumati)	Neglected

10	*Ghoilesang pokhari*	Boudha	200	50	-	19th century	Protected
11	*Puwa Pokhari*	Hadigaun	50	40	-	18th century	Neglected
12	*Gahana Pokhari*	Hadigaun	75	40		16th century	Protected
13	Dayeshwor Mahadev *Pokhari*	Lazimpath	7	4	12	N/A	Protected
14	*Nag Pokhari*	Naxal	125	65	7	17th century (Queen Subarna Prabha)	Protected
15	*Kamal Pokhari*	*Kamal Pokhari*	350	175	35	19th century	Neglected
16	*Rani Pokhari*	Ratna Park	590	460	3.7	17th century (Pratap Malla)	Protected

Source: KVTDP, 1982

Table 7 Physical Status of the existing ponds in KMC in 2010

S. No	Name of pond	Location	length (ft)	Breadth (ft)	Depth (ft)	Construction date	Status
1	*Kamaladi Pokhari*	Kamaladi, Ganeshstan	79.10	39.7	3	18th century	Protected
2	*Ikha Pokhari*	Nyokha	210	92	12	16th century	Neglected
3	*Raj Rajeshwori Pokhari*	Raj Rajeshwori (Pashupati)	50	20	4	18th century	Neglected
4	*Gahana Pokhari*	Hadigaun	75	40	4.5	16th century	Dried up
5	Dayeshwor Mahadev *Pokhari*	Lazimpath	59	23	12	N/A	conserved
6	*Nag Pokhari*	Naxal	125	65	5.5	17th century (Queen Subarna Prabha)	Protected
7	*Kamal Pokhari*	*Kamal Pokhari*	350	175	15	19th century	Protected
8	*Rani Pokhari*	Ratna Park	590	460	3.5	17th century (Pratap Malla)	Conserved
9	*Hiti Pokhari* (2 ponds)	*Narayanhiti path*	91/43	69/36	N/A	N/A	Protected

Source: Field Survey

Conclusion and Recommendations

The unplanned urbanization led to the vulnerability of the ponds and water spouts. The rampant construction of buildings and roads caused physical alteration of the ponds by downsizing or complete removal of ponds. The excess extraction of ground water brought fluctuations in the ground water level and the movement of water into ponds and local aquifers were largely reduced. Other impacts of construction works caused sedimentation lowering the depth of the ponds. The area of *Ikha Pokhari* and *Kamal Pokhari* has reduced by two third and by a quarter of its original area respectively. The presence of higher concentration of ions and salts indicates the water is more alkaline and increasing concentration of solids made water aesthetically poor. The concentration of phosphate and nitrate are comparatively high than the previous study carried by the ENPHO and TUTA, which is a clear indication of presence of domestic waste, human and animal excreta and religious waste. Except *Dayashwor* Mahadev *Pokhari* all other ponds are in the state of eutrophication since the concentration of nutrients and organic matters are high and N: P ratio is smaller. Most of the ponds have DO value less than 5mg/l which is less than what water can dissolve oxygen at standard temperature. The ponds have high amount of chlorophyll which indicate the unacceptable ecological status. All the ponds contain *E. coli* the primary cause of water borne disease. Social and legal structures are not keeping the same pace as urbanization. Only *Rani Pokhari, Nag Pokhari* and *Kamal pokhari* are given some attention for their conservation but other five ponds are not given any attention. *Kamal Pokhari* youth club looks after *Kamal Pokhari*, Naxal *Yuwa Mandal* looks after *Nag Pokhari* and KMC is directly involved in the conservation of *Rani Pokhari* but these intervention activities are not enough for the protection of ponds and pond area. If any defined interventions are not done from the government, community and development organization, there is a high chance of ponds to disappear from KMC in near future. Ponds which have vanished are gone and cannot be revived but the ponds which exist can be given enough attention and revived for recreational and emergency use.

Maintaining ponds in its original state not only preserve the environment but also conserve the cultural heritage. They are also very important to recharge the ground water. Ponds, network of canals and stone spouts have a close relationship and used to serve water for the population of Kathmandu both in quality and quantity before piped water system was introduced. Cautions were not taken in conserving the time proven technology and with the weak management of modern piped system people are looking back to old systems. These challenges require sustainable management of water resources which include local people in the decision making process. The water quality is found to be inappropriate for domestic

purposes nor suitable for fishery and swimming. Human activities which restrict the pond environment should be limited in the pond. The disposal of sewages, polluted rainwater, garbage, etc. should be controlled. Water quality assessment should be monitored at regular interval. Ponds are not only the site for aesthetic beauty but a very important entity of ecosystem and have diversified use. The Metropolitan City should organize awareness program for the local clubs, schools, and local leaders for the conservation of ponds and stone spouts. Effective rules and regulations should be formulated including the key stakeholders and local people for the management of ponds. It is a prime responsibility of the government to address the issue of land ownership and construction of house and infrastructure that damage or restricts the natural water flow. Proper mechanism should be developed for the regular aeration of water in the ponds such as fountains so that the ponds has more dissolved oxygen eliminating faulty smell and control fish death.

Conflict of Interest:

The authors confirm that the data supporting the findings of this study are available within the paper itself and is not published before.

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