

CONSERVATION OF PHEWA LAKE OF POKHARA, NEPAL

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ABSTRACT

Lake Phewa is the master piece of nature that has an added glamour of water, mountain, forest and snow-filled high mountains at one place. This is the largest lake of Pokhara valley amidst the heart of Pokhara city, and is the source of livelihoods apparently made out of lake tourism. However, conflicting governance structure built within prevailing policy and legal arrangements has victimized Phewa lake as common property element. Phewa lake environment is degrading. In the past, national and international supports particularly under the JICA, had extended in Pokhara for improving town improvement including restoration of Phewa lake environment. Such intervention partly contributed to improve town environment, but failed improving lake environment.

The Phewa remained as a hot-cake issue in national debates. In absence of continuity of such debate, issues of Phewa totally kept hadowed. Further, in absence of consensus among stakeholders, some intervention like JICA initiative had to pull out from its half-journey of implementation. It implies to a condition that the issue of Phewa conservation would still remain a hot issue and takes time to resolve them. Establishment of the National Lake Conservation Committee (NLCDC) - as a national lake governing body - has the history of debate discussed in the past, and is an excellent response of the government to conserve lakes of Nepal including conservation of Phewa for its high tourism value. Success of the NLCDC to deal issues of the Phewa therefore depends on the strategy it adopts and implements it in respect of concerns of diverse stakeholders of Phewa lake. An appropriate step towards this would be developing a lake conservation forum through consensus in the Pokhara valley empowered to undertake lake conservation activities in an integrated manner by incorporating best learning from conservation of lakes like Rupa. For this, the point of departure would be revitalizing Phewa Lake Endowment Fund followed by other recommended actions under the environmental study of Phewa lake conservation and its guidelines.

INTRODUCTION

The Phewa lake (hereafter called Phewa) is Nepal's second largest lakes, and the largest one in heart of Pokhara valley, a swiftly growing city and the second most visited tourist place in Nepal. Because of its natural beauty with glaring and magnificent views of Annapurna Himalaya range and with Fishtail peak-literally called Machhapuchhre - standing very close by (only 28 km), it is one of the most popular tourist destinations in Nepal. This lake has formation history of the tertiary period due to convergence of the Indian Peninsula and Tibetan plateau that resulted into upsurge of the Annapurna range of the Greater Himalaya when preglacial drain system was filled by outwashes drift materials like limestone, gneiss and quartzite.

Phewa is a stream fed dam regulated, semi- natural freshwater subtropical mountain lake lying at the Pokhara valley (28° 7'-28° 12'N-84° 7'-84° 19'E) that falls on a relative subsidence zone in between the Greater Himalaya and the Mahabharat Range. Administratively, Phewa lake watershed area is spread over, partially or fully, the jurisdiction of six Village Development Committees (Sarangkot, Kaskikot, Dhikurpokhari, Bhadaure Tamagi, Chapakot and Pumdi Bhumdi) and the south western part of Pokhara Sub-Metropolitan City under Kaski district in

Table 1. Physio-graphic features of Phewa lake

Formation	Tertiary Period (25-65 millions years ago)	Major inlet discharge	Harpan Khola with 5.58m ³ /s discharge
Watershed area	123 km ²	Mean rainfall	3,710 mm
Altitude	793 msl	Maximum rainfall	
Shoreline length	4 km	Minimum rainfall	
Mean depth	8.6 m	Maximum water area	4.43 km ²
Maximum depth	19 m	Capacity	46 X 10 ⁶ m ³
Depth variable		Storage volume (spill)	
Mean temperature	25.5°C	Maximum operating level	795.7 m
Minimum temperature	13.2°C	Normal operating level	793.7 m
Inlets	Harpan, Balaundi and Phirke Khola	Road bund level	

mid-western region of Nepal. The watershed area forms an unique geographical entity and represents the typical characteristics of the mountain environment, and has magnificent conjecture outlook of temperate high mountain in the north and humid subtropical climate of terai in a conical unique valley landscape of mid-hill Pokhara. The length and width of its east west oriented watershed is about 17 and 7 km, respectively (Oli 1997), and falls in humid subtropical monsoon region. It is characterized by moderate temperature with mean temperature peak in July-August and minimum in January, heavy monsoon rainfall and distinct seasonal variations.

The lake is a northwest-southeast running valley. The lake level varies seasonally depending on the withdrawal of water for power generation 1,000 Kilo Watt (KW) and irrigation purpose and water inflows. It extends about 4 km northwest to southeast and it is about 2 km at its widest and only a 100 meter at its narrowest.

The Phewa lake watershed is formed by complex and rugged ridges and spurs and valley bottoms. The hill terrain and valley bottoms stand out as distinct natural features in the landscape criss-crossed by a number of irregular ridges and spurs. The south facing slopes of watershed are comparatively gentler (around 30 to 50 percent) than the north facing slopes (above 50 percent). Panchase is the highest site (2,508 m) of the watershed.



The lake was obviously formed by the damming up of the tributary system by the overflow of superficial gravels along the main Seti Valley. Phewa lake has been enlarged by damming for irrigation and power generation. Harpan Khola is the main feeder to the Phewa Lake meandering about 5 km above lake mouth and makes a sharp southeastern turn on meeting the western edge of the plain and joins with another stream called Phurse Khola, the tributary of Seti

(Oli 1997). At the southern mouth of lake, at crown of Pardi Khola, a dam is built which has nearly double the water level of Phewa lake. In the north, Sarangkot and Kaskikot hills surround the lake and a sacred forest (called Rani Ban) runs parallel in the south. There are also some small torrents, mostly the seasonal ones that feed sediments to the lake. Phirke Khola also drains water in the lake that also carry sewerage and solid wastes from upstream city areas in the lake.

Trophically the lake changed from oligotrophic in '70s, to mesotrophic in '80s, and eutrophic by '90s (Shrestha and Jananuer, 2001). Biodiversity richness accounts for 7 vegetation types in watershed area, 104 bird including 14 migratory ones, 34 mammal, 16 fish, 4 exotic fish, 14 reptile and 6 amphibian species (IUCN,1995a) plus 39 aquatic macrophytes including 23 hydrophytes and 16 helophytes (Shrestha and Janauer, 2001).

The lake has multiple uses such as hydroelectricity, irrigation, fishery and a boating facility. By land use pattern the lake features contrast in terms of forested with sparse rural settlement on southern side, agricultural land with dense urban areas on northern side, silt trap zone in western side and river channel zone in eastern side of the lakeshore (Shrestha ...). The watershed of the lake constitute forest (44%), agricultural land (39%), urban and wetland area (5%), pasture and barren land (5%), lake area (4%) and shrub land (3%)(DSC, 1994).The population of Phewa watershed accounts 0.14 million with annual growth rate of 7.4% (CBS,1995). Percentile share of male and female is 49.7 and 51.3 per cent, respectively. The average family size is six and population density accounts for 258 persons per km². Brahman is the dominant caste group (about 48%), followed by occupational castes (27% Damai, Kami and Sarki), Gurung (14%), and

others (11%). About 50 % of people in the watershed are literate, with the male literacy rate approximately double to females. The level of literacy is low among the socio-economically backward groups.

The predominant occupation is agriculture (about 85%) followed by service (mostly outside the country), small business activities and both agricultural and construction labor. Agriculture includes both crop farming and animal husbandry. Business activities are mostly confined to the lake-side and along the trekking routes. In recent years, tourism has become a major industry, supplementing about 16% of the economy (Oli, 1997).

ISSUES AND PROBLEMS FACING THE LAKE

Major threats to lakes of the world include: extreme lake-area encroachment, accelerated eutrophication, invasive species, toxic contamination, over fishing, water diversion, acidification, and climate change. Institutions and institutional arrangements for addressing these issues and for implementing a watershed approach is just beginning to emerge on lakes around the world (Borre et al., 2001). In this context, major environmental threats of Lake Phewa of Nepal, a least developed country, indicated as follows indicate some similarity and differences:

Conflicting Legal Issues: By nature, lakes are interfaces of land, water and forests that represent complex ecosystem, but management of these lakes in Nepal remains seriously divided as it falls within the jurisdiction of different government authorities. Lake subject is narrowly organized along defined sectoral lines under existing legal provisions like Aquatic Animal Protection Act 1961 (amended first in 1999); Forest Act 1993 (amended in 2001); National Park and Wildlife Conservation Act; Forest Act 1993 (amended in 2001); Soil and Watershed Conservation Act 1982; Water Resources Act 1992; Electricity Act 1992; Environment Protection Act 1996. Further, Local Self Governance Act (1999) empowers local government like District Development Committees (DDCs), Village Development Committees (VDCs), Municipal Authorities, and Metropolitan Authorities towards conservation and sustainable development. Under this Act, promoting socio-economic development, natural resources management and conservation become sole responsibility of these local bodies at their levels (Oli 1997).

Municipality Act (1991) empowers Pokhara Sub-Metropolis for managing garbage collection and disposal, and pollution control from the lake shore, and building norms, rules, regulations and taking punitive actions against defaulters. Town Development Act (1988) empowers the Town Development Committee to enforce land use and building regulations, and implements physical development plans and programs, and also has the authority to take punitive action against those who ignore the regulations, and violate the norms and standards set by the committee. Since six VDCs apart from the Pokhara Municipality touches the boundary of the lake, Phewa lake is subjected to the Committees authority derived from Act of 1991. Since DDC is the main coordinating agency for all VDCs in the district, Kaski DDC also has authority over Phewa lake deriving from the Act of 1991. Phewa watershed is subjected to the Forest Act, Soil and Water Conservation Act, Water Resources Act, and both the DDC/VDC Acts,

Municipality Act, Town Development Act, Aquatic Life Act, 1961, thus each agency operating under their own legal mandate and do caring a little of others. This situation is continuous and is one of the major causes for environmental noncompliance and poor legal enforcement in the watershed. This has resulted in the development of uncontrolled urbanization and inconsistent land use in the Phewa lakeshore area resulting it as ‘a tragedy of commons’.

Reclamation & Encroachment: With an extent of growing urbanization multiplied with undefined and officially non-demarcated shoreline, there has been a significant reduction in lake morphometry. Within a short period of 1981-2001, 5.8 km² of lake area of 1981 now has been reduced to 4.4 km² by 2001. Such illustration is seen distinct in lake-head, once completely submerged now surfaced as alluvial plain, due to heavy sediment load carried by Harpan Khola. Initially, such areas were illegally encroached for agriculture and settlements subsequently legalized by cadastral survey of 1975. Further, roads and poorly constructed small houses along shoreline east of dam in Baidam are intense, and areas along Phirke Khola that also drains water in the lake, has been extensively used for building construction including government buildings, such as Municipal Guest House, Armed Police Office and their Quarters, as well as squatter settlements.

In the past, certain efforts to define shoreline were made that prescribed sets of government standards to regulate urban development along shoreline, but a physical



collapse of Phewa dam occurred in 1974 that drained out much of lake water causing lake area shrinking to a smaller area. Such collapse exposed out the land due to receding of shoreline, later illegally encroached by adjoining landowners. This problem was further cropped up after the advent of Democracy Movement-1989. Already set government's norms were either not respected or neglected that subsequently resulted into irregular and uneven erection of numerous sub-standard buildings and hotels

along lake shoreline particularly in the southwestern part of lake (except Raniban), in Anadu and the area to Simle and even beyond. Adverse impacts of such phenomenon has been noticed on shortage of drinking water, roads, drainage system, depletion of wildlife habitats, spoilt amenities as well as trickled down tourism around Phewa by noise and water pollution, narrow trails and pathways and sewage disposals. Unsightliness has also been augmented.

Sedimentation: Physical shape and size of Phewa is degrading because of sedimentation and land encroachment along lakeshore. Sediment comprising silt, sand and gravel are

transported in the lake by Harpan Khola, and sediments in the form of urban garbage are also being transported in the lake by Seti Canal, Bulanudi and Phirke Khola. Seti Canal, Bulaundi and Phirke Khola also transport silt and sand in small quantities whose annual



cumulative effect is huge. It is estimated that during the period of 1990-'94, annual siltation rate has a range of about 175,000-225,000 m³. At this rate the terminal silt trap portion will be separated from the main lake by next 20-25 years and the lake proper will be "dead" by next 135-175 years, assuming loss of 80% water volume (DSC, 1994). A time series map analysis indicate a decrease in

area from 10 km² (1956/57), to 5.5 km² ('76) and 4.4 km² ('98). There has been more than 50% reduction in area within a time frame of 5 decades (JICA/SILT, 2002). Lake Phewa is polluted due to high internal loading of sediments (SAIC, 1992).

Lake Water Pollution: Despite having picturesque outlook, Phewa has been experiencing marked changes in its environmental quality over the past years, due to extreme water pollution caused by sewerage, solid wastes, clothes washing, agricultural run-off and sediments. Table 2 briefly presents the physical and chemical features of Phewa lake. Cultural eutrophication is considered major parameter for water quality management in Phewa. Since management intervention against pollution control are not in effect, density of E-coli (39-123 units/100 ml), regular disposal of solid waste (125 mt) and of soaps and detergents (> 100 kg) per day seems continue to cultivate in lake.

Table 2. Physico-chemical features of Phewa (June 2003)

Parameter	Unit	Surface	3m	5m	10m
Temperature	0 ⁰ C	27.4	27.0	25.5	24.0
p ^H		9.3	8.9	8.4	7.8
Dissolve oxygen	mg/l	5.28	3.25	2.03	4.06
Phenolphthalein alkalinity	mg/l	A	A	A	A
Total hardness	mg/l	77.2	88.4	77.4	77.2
Free CO ₂	mg/l	A	1.956	1.672	0.88
Chloride	mg/l	12.19	29.21	26.00	31.48
Secchi disc transparency	cm	177			
Clast size and pebbles		Oblate and platy			

Further, incidence of algal bloom by early 1990s, as a result of destruction of ecotone or buffer zone area resulted in anoxic condition and mass fish kills combined with adverse health impacts such as skin rash, itching and

conjunctivitis to swimmers in murky water of Phewa implies sharp decline in water quality. This directly posed negative impacts on attraction of the local tourism based economy of Pokhara. Virtually irreversible accelerated eutrophication of a lake is similar to "diabetes" in humans (Nakamura, 1997).

Threats to Biodiversity: Phewa is well recognized as an imperative wetlands habitat of nationally and internationally significant aquatic biodiversity. Peripheral areas of this lake in Rani Ban and Pumdi Bhumdi forests areas are gifts for bird lovers and researchers. The Panchase hill represents biodiversity hotspots of wildlife and rare plants of mid-

mountain region of Nepal. However, existing threats posed by human activities and invaders such as water hyacinth, and exotic carp fish species have caused loss of aquatic biodiversity especially of wild rice and native fish species. It indicates laxity in management such as control through utilization of invasive species, and this in turn poses an adverse impact on the ecosystem health of the lake.

Promotion of Ecotourism: Lake Phewa environ, famed as one of the most beautiful place on earth is touristically significant. It represents a hotspot for ecotourism promotion. However, development of tourism has been unplanned and spontaneous. Growing urbanization and unplanned tourism development activities around the lake in absence of inadequate infrastructural facilities have depressingly affected the lake's recreational values (Banskota and Sharma, 1998).

Eco-zoning of Lake Shoreline: The effects of non-point sources such as agricultural run off are found to be greater than those of point sources of pollution such as laundry areas in Lake Phewa (Rana, 1990). As per conservation guideline, 10-30m strip of land along the lake shoreline and next 90m is recommended for buffer zone and controlled development zone with horticultural/agro forestry activities respectively (IUCN, 1995b). In practice, it needs full implementation. Restructuring of the littoral zone provides a balanced approach to lake restoration and multiple uses of the lake, thereby integrating management practices with planning (Engel, 1987).

Inadequate Institutional Capability: Institutional inefficiency in terms of inadequate cooperation and coordination among stakeholders has hindered effort on sustainable management of the lake resources. There is no specific authority responsible for the conservation and management of Lake Phewa (Banskota and Sharma, 1998) implying "tragedy of commons".

STRATEGIES AND ACTIONS UNDERTAKEN

Policy and Legal Provisions

Strategies and Policies Development: In Nepal, government has made efforts to address lake conservation through policy integration in the development process. These include - the National Conservation Strategy (NCS), 1987; the Nepal Environment Policy and Action Plan (NEPAP) 1993; the Nepal Biodiversity Strategy (NBS), 2002; and Water Resource Strategy (WRS) 2002. Under NBS, wetlands has place as a distinct ecosystem and recommends for wetlands policy. Consequently, National Wetlands Policy emerged out in 2003 with aims to put the conservation and management aspects of wetlands conservation within the framework of broader environmental management. This is the only one policy arrangement responding direct to wetlands and lakes.

Legal Provisions: No specific legal instruments that address lake issues are in place in Nepal. However, there exist some legal instruments that protect some of the wetlands *flora* and *fauna* across the country (inside and outside protected areas). Some major legal instruments are the National Parks and Wildlife Protection Act (NPWPA) - 1973

(amended 4 times) for *fauna*, the Forest Act - 1993 for *flora*, and the Aquatic Animals Protection Act - 1961 for some specific aquatic species. Under NPWCA, 39 species of *fauna* (i.e., 27 species of mammals, 9 species of birds and 3 species of reptiles) are nationally protected.

Conservation Action Plans and Guidelines: Recognizing the values of Phewa, many efforts have been made after 1995 for its conservation and management. Potential causes that degraded the Phewa lake water quality were identified. As an implementation of the National Conservation Strategy Plan, IUCN Nepal with HMG/NPC developed Guidelines for Phewa Lake Conservation in 1995, and also prepared Phewa Lake Conservation Action Plan (1997). This plan has prescribed action areas under 10 strategic directions. They are: defining lake area and its management responsibility; reviewing and preparing uniform legal framework for lake and watershed management; reviewing existing land use plan of Pokhara (revise, amend and update land use strategy for the Pokhara valley); reviewing municipal infrastructure status and realigning Pame road where necessary; controlling lake pollution (development of an effective solid waste collection and disposal system); designing and executing landscaping and beautification schemes at strategic locations; formulating and executing tourism development strategy; encouraging conservation of biodiversity; encouraging horticulture, silviculture, aquaculture and improved animal husbandry; and encouraging watershed management to reduce soil erosion and sedimentation.

Pokhara Town Development Plan: For the regulated growth of Pokhara, in 1973 Physical Development Plan was prepared. This was adopted by His Majesty's Government of Nepal. Consequently, Pokhara Town Development Committee was established under Town Plan Implementation Act 1972 for implementing the plan. There has been a significant impact after the implementation of development plan particularly in the construction of buildings, roads and other infrastructures, however the major issues of Phewa conservation still remained not addressed to this date.

Institutions

The National Planning Commission (NPC) has been established to facilitate inter-sectoral coordination particularly in developing nation's five year development plan. In such planning, lakes/wetlands component often emerge out as one of the cross-sectoral priorities particularly in demonstrating Nepal's commitment towards implementation of international conventions like the CBD, Ramsar and CITES. The MoFSC is responsible for lake conservation under its 4 constituent departments like Environment Division; the DNPWC; DoF; and DSCWM. Environment Protection Council (EPC) established in 1992 under the Ministry of Population and Environment (MoPE) now the Ministry of Environment, Science and Technology (MoEST) works on issues of pollution control, enforcement and monitoring of environmental standards, and environmental impact assessments. The Ministry of Agriculture and Cooperatives (MoAC) considers promotion of aquaculture one of its main activities. The ministry has a unit on agro-biodiversity, which is promoting conservation of wild varieties and wild relatives of rice plant.

The Ministry of Local Development has various DDCs, VDCs, Municipalities and Metropolitan Authorities empowered to manage natural heritage that covers forest, rivers, wetlands etc. Similarly, section 93 and 96 of the Self Governance Act empower municipalities for the conservation of environment, forests, natural heritage, ancient monument, irrigation, soil conservation, wetland management etc. Many of these institutions are also engaged in managing several village ponds and lakes either in isolation or through community participation.

Boat Club is a professional organization run by boat operator. This club has contributed Nrs. 50,000 into the Phewa Endowment Trust Fund with an objective of taking stake to restore lake environment of the Phewa. The club members are also involved in manual removal of weeds from the lake.

NLCDC has been established in 2007. This committee aims to coordinate the national and international bodies, and implement wetlands restoration programs that maximize incentives to target beneficiaries since, the committee has a short development history, and conservation of Phewa remains its lead concern by nature.

Pokhara Environment Improvement Project: A major step taken towards conserving Phewa was under the Second Tourism Infrastructure Development Project (STIDP) assisted by the Asian Development Bank (ADB). Under this project, ADB had provided project preparation technical assistance in 1995. Following to the recommendations of this study, the ADB provided grant and loan assistance in the name of Pokhara Environment Improvement Project under the STIDP for sanitation awareness education, improvement of sanitation facilities, improvement of urban roads, improvement of urban drainage and construction of sanitary landfill site of Pokhara city. Pokhara Sub-Metropolis executed this project and accomplished works in July 2003.

Environmental Conservation of Phewa Lake: In July 2001 an understanding was reached between GOJ/JICA Nepal and HMG/MoPE for implementing the Development Study on the Environmental Conservation of Phewa Lake. Following to this study, on its recommendation, the Phewa Lake Environmental Awareness and Capacity Building Project was launched by JICA Nepal and Pokhara Sub-Metropolis was an executing agency. This project has completed in March 2007.

Lake Phewa Endowment Trust: As recommendation made by IUCN under Phewa Lake Conservation Action Plan (1997), Pokhara Sub-Metropolis successfully mobilized Pokhara based institutions and individuals for the formation of Phewa Lake Conservation Endowment Trust in 1998. As a result, 11-member Phewa Lake Conservation Committee¹ was established to restore the bio-physical environmental quality of Phewa with adoption of sustainable financing mechanism. As a contributor, IUCN Nepal initially provided US \$ 10,000 and other ten institution including Kaski DDC and

¹ This committee has following composition: Chair role - Pokhara Sub-Metropolis, member secretary - Pokhara Valley Town Development Committee, and members - DDC Kaski, Phewa Boat Club, Ward-6 of Pokhara Sub-Metropolis, Lake Line City, Lake Club, FNCC Kaski, Ratna Darabar, Hima Griha and Rani Mandir.

Pokhara Sub-Metropolis each contributed NRs 50,000 to this endowment trust now reached to NRs 1.3 million. Such collaborative fund-sharing practice was the first started after several environmental studies of Phewa lake conservation, but its momentum busted down due to widespread Democracy Movement of 1989 shortly followed by a long period of political strife i.e., the Maoist movement.

Phewa Lake Beach Establishment Initiative: A volunteer organization called the Phewa Beach and Environment Conservation Committee (PBECC) had initiate a NRs 3 million project to establish 300 feet long and 60 feet wide Phewa beach along shoreline on the western bank beside Basundhara Park. PBECC had functional dialogue with Pokhara Valley Town Development Committee and hotel owners, and had started some excavation work. Further, attempts to piles up tons of sand and edge wall construction to avoid sand spilling along shoreline were made to facilitate beach lovers for sunbathing, playing and walking. Though appreciable, the PBECC's plan could not be fully materialized.

OUTCOMES OF THE ACTIONS

Improvement in Physical Infrastructure Development: JICA Nepal has helped Pokhara Sub-Metropolis for the successful construction of sanitary landfill site with leachate and septage treatment facility, equipped sub-metropolis and trained its manpower for septage and solid waste management and prepared local people for sanitation through awareness education. No impacts study has been carried out after such JICA assistance; hence change in water quality requires further exploration.

Enhanced Knowledge: A key outcome of the previous work has a milestone result on the development of information and knowledge about lake conservation in Nepal including the over 20 environmental studies of Phewa lake environment conservation. Development of Phewa Lake Conservation Action Plan (1997) has become a strong integrated framework for the overall development of the Pokhara and conservation of Phewa is center for this.

Strengthened Capacities: JICA Nepal entrusted project has helped generating government personnel and local communities for the cause of lake conservation of the Pokhara valley including Phewa lake one of them. As a result, community and local institution including media have been upraising community voices for the integrated conservation of Phewa lake in Nepal.

Recently, the National Lake Conservation Committee has been providing support for the conduct of few interim activities for Phewa lake conservation like manual subtraction of water hyacinths; park establishment; foot-trail promotion; and diversion of Phirke Khola. The long-term initiatives are yet to be launched with the review of its existing conservation action plan followed by actions in the present context of upcoming governing structure - federalism. The committee is also involved in the preparation of designating it under the Ramsar List.

LESSONS LEARNT AND WAYS AHEAD

- Phewa lake is the most priority conservation wetlands outside PAs in Nepal. IUCN prepared Phewa Lake Conservation Action Plans has identified 10 action areas. Implementation of this plan may yield positive results but this requires building consensus among stakeholders including GOs, INGOs, academic institution, local clubs and academic institution. NLCDC has been emerged as sole a government institution for the cause of sustainable conservation of lakes in Nepal, this committee should prepare itself as a consortium for all where people and institution could discuss, breed ideas and come up with actions agenda for conserving lakes including Phewa in Nepal. For this, this, committee should equip its strength in terms of financial, technical and managerial roles.
- Major problems of the Phewa are shoreline encroachment, water pollution and sedimentation. Hence, basic strategy for conservation of Phewa includes: extend its life span, maintain its cleanliness and promote it as an attractive tourist destination. To achieve this target, from current polluted status, there exists a need of an integrated and holistic approach along with sharing of responsibilities and benefits among the stakeholders.
- Any focus given to the conservation of the Phewa lake needs great efforts to integrate “hard ware” and “soft ware” components exemplified by construction of diversion canal to mitigate problem of water pollution, constructed wetlands to check sediment load, conservation of threatened species and habitats e.g. wild rice and fish spawn site and institutional strengthening. For this, basics for management of lakes includes: watershed approach, intersectional coordination, stakeholders’ involvement and effective institutional arrangement for implementation/ monitoring (Borre et al., 2001). Sustenance of economic development projects is not meaningful in absence of active involvement of people (Banskota and Sharma, 1998).
- Lakes are environmentally sensitive and integrated part of a watershed lying at lowest level is vulnerable to sedimentation and pollution. This implies conservation of lake need coverage in watershed and ecosystem basis. This emphasize on systemic approach (Jorgensen and Vollenweider, 1989). On account of high sensitivity and importance of the lake area, it has been proposed to declare “Phewa Lake watershed conservation area” (IUCN, 1995b), however, it has not been implemented yet.
- Local community can be motivated to integrate income generation and nature conservation such as through tea, coffee plantation in erosion prone hilly areas which is demonstrated in the conservation of the Rupa lake. As economic development governs environmental conservation, promotion of income generating activities holds substantial importance in relation to effectively implementing environmental plans into action (Shrestha, 1999). Current cage fish culture, boating, hotel ad restaurants business could provide more incentives to local communities and business society with proper an integration of sustainable income generation scheme with the conservation of Phewa.

- Pokhara valley is enriched with many lakes in addition to Phewa. Other lakes are Begnas, Rupa, Mairi, Khaste, Dipang, Neureni, and Kamal Pokhari lying within a couple hours of traveling distance. Hence, wisdom interlinking conservation of Phewa with other these lakes is important that require setting a strategic direction envisioning Phewa lake conservation not in isolation.
- A long period time has been passed after the development of Phewa Lake Conservation Plans (1997) and, Phewa Lake Conservation Guidelines (1995). A new federalism structure also has recently been emerged in Nepal. Hence, there is a great need of improvement in the Plans and Guidelines under new governance – federalism. Further, current silent state of endowment trust mechanism of Phewa conservation should be revived as well as be operational.
- Criss-crossed and rugged hills of the Nepalese geography are very specific to nature and function of lakes with densely populated demography background around them elsewhere in Nepal. It implies on the sustenance of lakes that depends on complex dynamics posed by watersheds, rivers and lake basins. In this context, Integrated Lake Basin Management (ILBM) a recent management prescription guided under ‘World Lake Vision’ could be an appropriate for the sustainable conservation of the Phewa lake. For this, wisdom is to establish functional linkages with the International Lake Environment Committee, which is an innovator and architecture of ILBM development. Such functional linkage would help Nepal building its technical and managerial capacities towards sustainable functioning of lakes in Nepal.

CONCLUSION

The Phewa probably is the most important lake that has high gravity in terms of lake tourism. Phewa does not provide the first hand opportunity to attract tourists, but has 2nd option to promote tourism by having an advantage of transit venue for tourists trekking other parts of the country making Pokhar a transit. However, lake encroachment and sedimentation followed by water pollution would remain vibrant threats that need immediate strategy to address. Conservation of Phewa should not be seen in isolation since the Pokhara valley has other eight lakes of diverse nature and values. Conservation of Phewa has been discussed in different *fora* though successful implementation of outcomes of such discussion never resulted into affirmative results. Such case also happened in a support of JICA which pulled out its project to improve environment condition of the Pokhara town including improvement of the Phewa lake. What had happened before are a part of history, now sole management responsibility of the Phewa ultimately goes to action agenda of the NLCDC. Phewa lake needs to integrate some of the issues related to urban and others of rural setting. Hence, a comprehensive effort should be asserted so tourism value of Phewa be always placed at top followed by other conservation incentives directly paying to local livelihoods provided that stake of all partners are well respected in the management of Phewa lake. NLCDC is aiming to initiate a study towards designating all lakes of the Pokhara valley in the Ramsar list. If this initiative materializes well may help opening a new avenue for management, though

one should be careful of not curtailing the access of beneficiaries over the best use of lake resources.

REFERENCES

- Adhikari, Kaushal R (200). Environmental Study of Phewa Watershed Area. A Report Prepared for the Partial Fulfillment of Master Degree in Environmental Science. Central Department of Environmental Science, TU, Nepal.
- Banskota, K., Sharma, B., 1998. Mountain tourism for local community development in Nepal. A case study of Phewa lake side, Pokhara. Discussion paper 98/2, ICIMOD, Kathmandu
- Bista, J.D., Dhakal, R.P., Gurung, T.B., 2002. Changing environmental status and its impact on flora and fauna of Pokhara valley, Nepal. Proceedings of International seminar on Mountains, March 6-8, Kathmandu, Royal Nepal Academy of Science & Technology, Kathmandu, Nepal. p.447-456.
- Borre, L., Barker, D.R., Duker, L.E., 2001. Institutional arrangements for managing the great lakes of the world: Results of a workshop on implementing the watershed approach. *Lakes and Reservoirs: Research and Management* 6, 199-209.
- CBS (Central Bureau of Statistics), 1991. Statistical year book of Nepal. Kathmandu.
- CBS (Central Bureau of Statistics), 1995. Statistical year book of Nepal. Kathmandu.
- DSC (Department of Soil Conservation), 1994. Sedimentation survey of Phewa Lake., Kathmandu.
- Engel, S., 1987. The restructuring of littoral zones. *Lake and Reservoir management*. 3, 235-242
- IUCN, 1995a. Phewa Lake conservation Action plan. National Planning Commission in collaboration with IUCN-The World Conservation Union, Kathmandu.
- IUCN, 1995b. Guidelines for Phewa Lake Conservation. National Planning Commission in collaboration with IUCN-The World Conservation Union, Kathmandu.
- JICA/SILT, 2002. Conservation Development study on the environmental conservation of Phewa Lake in Pokhara, Nepal. Final report submitted by SILT Consultants to JICA/ Nepal, Kathmandu.
- Jorgensen, S.E., Volleweider, R.A., (Eds.), 1989. Guidelines of lake management. Vol.1. International Lake Environment Committee (ILEC), Shiga, Japan.
- Nakamura, M., 1997. Preserving the health of the World's lakes. *Environment*. p.16-40.
- Oli, K.P. (1997) ed. Environmental Study of Nepal's Begnas and Rupa Lakes. National Conservation Strategy Implementation Project, 1996. Kathmandu. xxi+156
- Rana, K., 1990. Water pollution assessment of Phewa Lake, Pokhara, Nepal. M.S. thesis. Submitted to the Asian Institute of Technology (AIT), Bangkok, Thailand
- Rai, A.K, Shrestha, B.C., Joshi, P.L., Gurung, T. B., Nakanishi, M., 1995. Bathymetric maps of Lakes of Phewa, Begnas and Rupa in Pokhara valley, Nepal. *Memoirs of the Faculty of Science. Kyoto University (Series of Biology)* 16, 49-54.
- SAIC (Science Applications International Corporations), 1992. Environmental protection study of Phewa Lake, Pokhara project. Asian Development Bank, Manila, Philippines.
- Shrestha, P., 1999. Management of waterbodies and wetlands in an urban area: a case study of Lekhnath municipality of Nepal. *Environment* 4(5), 39-46.

Shrestha, P., Janauer, G.A., 2001. Management of aquatic macrophyte resource: A case of Phewa Lake, Nepal. In: P.K. Jha, S.R.Baral, S.B. Karmacharya, H.D. Lekhak, P. Lacoul (Eds.), Environment and Agriculture: Biodiversity, Agriculture and Pollution in South Asia. p.99-107. Ecological Society (ECOS) Nepal.

