REPORT

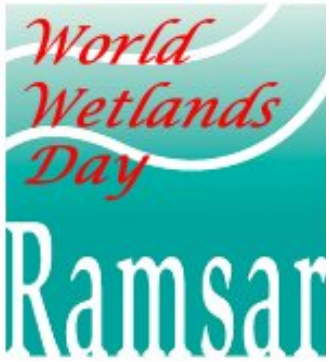
NATIONAL WORKSHOP
ON
CONSERVING NEPALESE WETLANDS:
SHARING EXPERIENCES AND BUILDING PARTNERSHIP

Editor
Dr. Madan Koirala
Tek Jung Mahat
Praveen Chhetri

Organizing Team
Tek Jung Mahat
Achyut Dahal

Table of Contents

Message



Will there be fish for tomorrow?

Fish for Tomorrow, our slogan for World Wetlands Day 2007, is one that touches almost all of us, wherever we live and whatever we do. One billion people rely on fish and shellfish as their main or even sole source of protein, and most of us include fish as part of our regular diet. Yet the current state of the world's fisheries is a matter of great concern. Most of our commercially important marine fisheries and many of our inland stocks are currently being over fished or are being fished at their biological limits, yet the demand for fish will continue to grow as the global population increases. The majority of our fishers are small-scale fishers: their livelihoods depend on making sure that there will be fish for tomorrow.

We hope that this World Wetlands Day will be an opportunity for you to look at local and national fisheries issues, and to make that vital link between healthy, well-managed coastal and inland wetlands and the long-term sustainability of your fisheries.

The potential solutions to the problems facing the world's fisheries are many, as our World Wetlands Day materials illustrate, and while some of them require international cooperation, many depend on national and local commitment. The true success of WWD and its outcome depend on that all important ingredient - the local and national 'flavour' that you can add to this year's focus - so that your WWD targets are well informed of the issues and their role in finding solutions.

We wish you a happy and productive World Wetlands Day 2007. Let's make sure that there will indeed be ***Fish for Tomorrow***.

The Ramsar Convention Secretariat

Foreword

Wetlands cover about 5.05 % of the total area of Nepal and they are the most productive of ecosystems of the world. Wetlands of Nepal are important for migratory waterfowl. Wetlands are important for cultural, religious, socio-economic and environmental point of view but due to heavy dependence and negligence of government for their conservation, wetlands are in verge of extinction. Siltation, over fishing, overgrazing, and human induced pollution is the some of the major problems. In spite of various legislation for conservation of wetland resources, they are degrading day by day. The suggestions for the better conservation include the awareness creation among the people about the importance of wetlands and bringing them in the conservation work.

Nepal River Conservation Trust (NRCT) is such organization which is working in conservation of wetlands of Nepal through awareness campaign since its establishment in 1995 as non-profit organization. The NRCT aims to conserve the natural and cultural heritage of the rivers of Nepal through various conservation, awareness, and community development activities.

This workshop is outcome of NRCT's such commitment and combined effort of like minded organizations working for restoring degrading condition of wetlands of Nepal and their common goal is to raise various conservation related issues of wetlands in Nepal and crate awareness among stockholders.

The publication is intended to raise awareness among planners, policy makers, researchers, students and common people about degrading condition of Nepal. I hope this proceeding will prove useful in raising awareness.

I would like to extend my sincere gratitude to all the resource persons who contributed their papers and the organizations especially MoEST, DNPWC, NTNC, NTB, STN, and ICIMOD etc. which supports and contributions resulted into successful and productive workshops and proceeding.

Megh Ale
Founder President
Nepal River Conservation Trust.

Chapter 1

Presentation

Conserving Nepalese Wetlands: Sharing Experiences and Building Partnership: A Case of the Bagmati River Festival

Tek Jung Mahat, Praveen Chhetri and Megh Ale

Abstracts

Bagmati River is the principal and sacred river of the Kathmandu Valley. However, over the past 20 years, the pressure placed upon Bagmati and other rivers by the ever growing population of the Kathmandu Valley have turned this sacred river into something that is little more than a drain- a convenient disposal system for the solid waste and sewage produced by the people of Kathmandu. In response to the worsening situation of the Bagmati River and in order to alter the biological degradation in it, NRCT had initiated Bagmati river conservation campaign called Bagmati River Festival (BRF) in 2001, in association with some like-minded organisations. The festival comprises of several events including clean-up campaign, public awareness programs, workshops, water sports events etc. In this context we have realized that intensifying the Bagmati River Festival can be the only way to ensure biological, social, religious and political sustainability of the Bagmati River

Keywords- sewage, biological degradation, conservation campaign, water sports, sustainability.

1. Background

The Bagmati River has its origin in Bagdwar from the southern slope of Shivapurilekh, north of Kathmandu basin at an altitude of about 2650m and flows straight to south-west cutting Mahabharat range (Sharma, 1977). Starting from Mahabharat range in the north it flows down to the plains of Nepal in the south and merges into the Ganges in India. The river Bagmati in the Kathmandu valley runs southward and then westwards bordering Kathmandu and Lailitpur districts, then again takes a course towards south after receiving Vishnumati River. Its total length is about 196 km in Nepal and the catchments area of the river is 3610sq. km which is 2.25% of total area of Nepal (Shanker & Kiran, 1976).

The Bagmati is not a snow-fed river and most of its water is contributed by run off. There are 24 main tributaries originating from Mahabharat and Siwalik lekh which fed the river Bagmati (Tuladhar, 1979) and (Pradhan, 1998) listed 20 tributaries Table 1. But in its way within the Kathmandu valley, it receives only 5 main tributaries as Monohara khola, Balkhu khola, Nakkhu khola. The river Bagmati enters in the valley near Sundarijal, travels downward bordering the north-west boundary of Gokarna forest and then flows west wards to Pashupati. There after turning towards south, near Shankhumal, it flows westward south, near Shankhamul, it receives Manohara khola and then again continues to flow westward bordering Lalitpur and Kathmandu districts. It receives tributaries Tukucha khola at Kalmochan Ghat, Vishnumati at Teku dovan and Balkhu khola at Sanepa. Before reaching Khokana Nakhu khola pours water into it near Sundarighat. Water resources from the Bagmati River System are important for hydro-electricity, small-scale irrigation and as drinking water sources. About 82% of water volume is extracted daily from the surface water sources for drinking water supply in the Valley. On the other hand, these rivers are extensively being used as dumping sites for solid wastes, outlets for domestic sewerage and industrial and agricultural effluents. Also, the riverbanks are being encroached upon by slum dwellers without any restrictions from the government. All these negative approaches in addition to uncontrolled and mismanaged growth of urban population are affecting the balance of the riverine ecology. The uncontrolled quarrying of sand has tremendously affected the self-treatment capacity of the rivers.

Following are the researches on Bagmati Rivers which shows its degrading condition.

The physico-chemical parameters and biological indicators of Bagmati river have been studied by many researches e.g. Amattya (1977), Shrestha (1980), Khadka (1983), Upadhaya and Rao (1982), Vaidya and Karmacharaya (1986), Khattri (1986), Pradhangana et. al. (1987), Vaidya et al. (1987), Bajracharya et al (1988), Bottino (1988), Sharma (1988), Shrestha (1990), Stanle et al. (1994), Poudel and Upadhaya (1995), Yadav (2002), Chhetri (2006) etc. which shows water quality of Bagmati river is degrading day by day and pollution level increased as river passes through dense settlements. Their researches have shows that in the river of Kathmandu valley, original communities of aquatic fauna have completely disappeared and two groups of fauna (eg. Tubificids and Chironomids) typically of polluted water have appeared.

***Table 1**: Place of origin, elevation and length of the Bagmati River and its tributaries*

S.no	Name of river	Length (Km)	Elevation (m)	Origin places
1.	Bagmati	35.50	2732	Shivpuri Bagdwar
2.	Bishnumati	17.30	2300	Shivpuri Tarebhir
3.	Bosan	6.10	1800	Pokhari Banjyang
4.	Dhobikhola	18.20	2732	Shivapuri dada
5.	Godavari	14.80	2200	Phulchoki dada
6.	Hanumante	23.50	2000	Mahadevpokhari dada
7.	Indrawati	16.80	1700	Dahachok dada
8.	Indrayani	7.00	2000	Bhangari dada
9.	Kodku	14.90	2000	Tileswor dada
10.	Mahadev	9.20	2000	Aale dada
11.	Manamati	6.10	2000	Bhangari dada
12.	Manohara	23.50	2375	Manichur dada
13.	Matatirtha khola	5.00	2000	Matatirtha dada
14.	Nagmati	7.90	2443	Shivpuri dada
15	Nakhu	17.60	2200	Bhardeu ridge
16.	Samakhusi	6.40	1350	East of Dharampur
17.	Sangla	10.70	2000	Aale dada
18.	Syalmati	4.80	2200	Shivpuri dada
19.	Tribeni	10.70	1700	Bhirkot
20.	Tukucha	6.40	1325	Within ring road (Maharajganj)

Source: *Pradhan (1998)*

2. Drivers of the Degradation of Bagmati River - A problem

Drivers are any natural or human induced factor that directly or indirectly causes a change in the ecosystem. A direct driver influences ecosystem processes and therefore can be identified and measured to some degree of accuracy. Indirect drivers are more complex and operate from a distance, influence direct drivers and can seldom be identified through direct observation of an ecosystem. Following are the drivers which are contributing in degradation condition of Bagmati River.

Population growth- Population is one of the fundamental driving forces shaping the water environment in the Kathmandu valley. Kathmandu, the capital city, is the mean urban centre and dominates in terms of concentration of population and economic activities; it has been growing at a very high annual rate in excess of 7% (Nippon Jogesuide, 2002). This has increased water demand, sewage and disposal to river.

Table 2: *Population increase in Kathmandu valley.*

Census Year	Total	Urban	Rural	Population density (Ind/sq.km.)	Average annual growth of urban population
1920	306,909	-	-	341	-
1952/54	410,995	196,777	214,218	457	-
1961	459,990	218,092	241,898	511	-
1971	618,911	249,563	369,348	688	1.36
1981	766,345	363,507	402,838	852	3.86
1991	1,105,379	598,528	506,851	1229	5.11
2001	1,158,234	995,966	585,268	1759	5.22

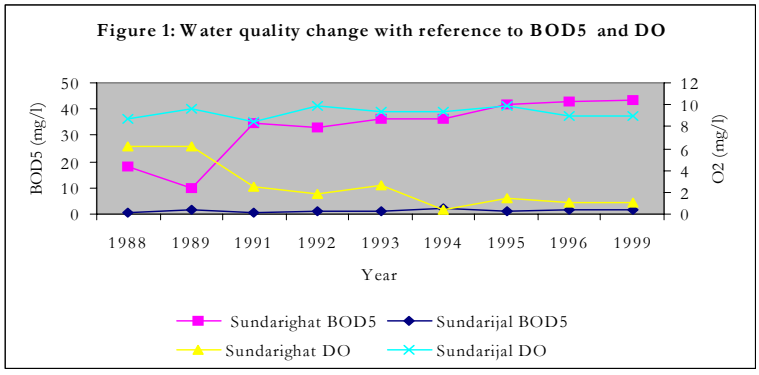
Source - CBS (2002), ICIMOD/UNEP/MoEST (2007)

Urban growth and expansion- Kathmandu valley urban population increased from 47.4% in 1961 to 60% in 2001. The main contribution to the rapid growth of urban population is the valley is migration. For instance, between 1981 and 1991 the valley's urban population increased by over 82%, in which migration accounted for 59%, the largest ever since the 1950s. These rapid urbanization consequences into increase in solid waste generation, level of pollution etc.

Agricultural development- Between 1984 and 1994, the valley's urban area increased from 3,096 to 8,378 ha and 5,282 ha of fertile agriculture land were lost to urbanization (MOPE 1999)

3. Status of the Bagmati River

The amount of dissolved oxygen (DO) and Biological Oxygen Demand (BOD) in water is one of the most commonly used indicators of a river health. Figure 1 shows the quality of water in terms of BOD5 and DO before Sundarijal headwater and after Sundarighat end point, the Kathmandu urban area, analyzed from 1988 to 1999 (UNEP 2001). The water at the latter site, particularly since 1994 is highly polluted, as indicated by the high value of BOD5 and low value of DO, as a result of the high concentration of domestic and industrial effluent. Some 21,000 kg of domestic sewage is discharged daily into the Bagmati River from Kathmandu valleys, cities- 42% of the total BOD load produced. The total industrial BOD load discharged directly into the river is 3,151 kg per day (CEMAT, 2001).



Source - UNEP (2000)

4. Birth of Bagmati river festival - A solution

The Earth Summit held in Rio de Janerio, Brazil, from 3 to 14 June 1992 included a topic entitled "Promoting Education, Public Awareness and Training" in chapter 36 of Agenda 21. It is necessary to increase public awareness about the effects of human activities on the environment. Thus public awareness can be one of the tools to control the degrading condition of the Bagmati River.

For the last six years, one such effort in generating awareness about the Bagmati's plight "Bagmati River Festival" has been put forward by the Nepal River Conservation Trust (NRCT).

NRCT is a non profit organization that was established by a group of concerned river guides who were alarmed by the ecological, social as well as cultural damage that was wreaking havoc on Nepal's river.

The Bagmati river festival was started in 2001 to provide a platform for all interested individuals and organizations to express their concerns and provide solutions to overcome the plight of this holy river.

1st Bagmati River Festival- The Nepal River Conservation Trust (NRCT), in partnership with the Friends of the Bagmati (Friends), organized the 1st Bagmati River Festival, a project that attempted to draw maximum public attention to the critically degraded condition of the Bagmati River, and provide a platform for action.

2nd Bagmati River Festival- Nepal River Conservation Trust (NRCT) and Friends of the Bagmati (FOB) jointly organized the 2nd Bagmati River Festival 2002 in the Bagmati River. The festival was supported by All Nepal River Guide Association, Bagmati Sewa Samittee, and Rotary Club Yala and is promoted by Nepal Tourism Board (NTB). The festival was basically divided into three sessions. 1. Kayak Race from Sundarijal to Gujeshori 2.Rafting from Tilganga to Shankamul 3.Environmental/schools/music programme at Shankamul.

3rd Bagmati River Festival- The NRCT in association with the Forum for Management and Research -Nepal (FERN), the Co-organizer of this festival organized the 3rd Bagmati river festival on August 23, 2003. Over 25 river guide and more than 100 rafting enthusiasts, environmentalists, tourists, journalists and satirists donned face masks and traveled through a section of Bagmati River, following right the heart of Nepal's capital. This excursion aimed to draw attention to the river's sorry state, and urged the community and the government to take necessary actions immediately.

4th Bagmati River Festival- With association of more than 50 co-organizers NRCT took the Bagmati river festival this year to greater heights. From a one-day festival the previous three years to a three-month long 4th Bagmati river festival-2004 was a big leap. Starting from the 5th June- World Environment Day with a Puja and a Clean up campaign at Pashupati and ended with a Kayak race and cultural program on 21st August. Over 50 of river guide and more than rafting enthusiasts, environmentalists, tourists, journalists, school, college, university students, corporate houses and hundreds of local people participated in the festival creating the much needed awareness about the dismal state of the Bagmati.

5th Bagmati River Festival- The World Environment Day was the auspicious occasion chosen to inaugurate 5th BRF. More than 100 participants from several schools, colleges, locals and journalists gave hands to whip up the rubbish from the heavily polluted Bagmati River. The cleanup campaign of the Bagmati was from the Aryaghat-Pashupatinath to the Tilganga Eye Hospital stretch. The series of conservation programs, cleanup programs, river rafting, kayaking were organized throughout the festival.

6th Bagmati River Festival- NRCT and the Sustainable Tourism Network (STN), the main organizers and Nepal Tourism Board (NTB), as a promoter of the festival in association with the various co-organizers, taken the Bagmati River Festival this year also to greater heights. This year NRCT added some new programs like fund raising concerts and started its course from 2nd June 2006. But the inauguration program was on usual day i.e. 5th June; the festival coincided with the World Environment Day with a puja and mantra chanting ceremony.

5. BRF-Diversity in program and stakeholders

	Events	Site	Major co-organizers and participants	Remarks
1	Clean-up campaigns	Pashupati, Tilganga area, Thapathali, Kupondole, Teku, Chovar…	Partner I/NGOs, community organisations, clubs, Aama Samuha, media, corporate houses, schools and universities, student societies…	Since 2001
2	Heritage Walk	Teku-Thapathali…	Locals, Expatriates, students, media, I/NGO representatives…	Since 2004
3	School art, essay and poetry competitions, stage drama, amateur photography,	Schools and the closing venue, usually Thapathali	School children	Since 2001
4	Tree Plantation	Kupondole, Thapathali…	students, media, I/NGO representatives, corporate houses, local clubs, aama samuha…	Since 2001
5	Anti-plastic campaigns	Simultaneously at various sites (SVS)	Partner I/NGOs, youth initiatives, community organisations, clubs, schools and universities, student societies…	Since 2004
6	Waste management training (mainly composting)	Teku, Thapathali…	Locals, clubs, aama samuha and partner NGOs	Since 2004
7	Cycle rallies for women and men	SVS	Partner I/NGOs, clubs, corporate houses, universities…	Since 2004
8	Technical workshop on Bagmati River	NTB hall	Students, media, I/NGO representatives, universities, student societies…	Since 2004
9	Bagmati Kayak Clinic	Taudaha	School children and interested others	Since 2001
10	Dunda Daud School Challenge	Sundarijal-Jorpati, Tilganga-Thapathali… SVS	School students	Still have to part of festival
11	Down River Kayak Race	Sundarijal-Jorpati, Tilganga-Thapathali… SVS	NARA, ANRGA and partner corporate houses	Since 2001
12	Blood Donation	SVS	Youth and Lion clubs, partner I/NGOs	Still have to part of festival
13	Nature Hike	SVS	Different societies and clubs, expatriates, students, media, music professionals, I/NGO, representatives, universities, student societies…	Since 2006
14	Bird Watching	Sundarijal, …SVS	Partner I/NGOs, different societies and clubs, expatriates, students, media, music professionals, representatives, universities, student societies…	Since 2004
15	Eco-Challenge (Marathon, Cycling and Rafting)	Chovar-Balaju-Sundarijal-Jorpati	Partner I/NGOs, different societies and clubs, expatriates, students, media, music professionals, representatives, universities, student societies…	Since 2004
16	Let's Walk with Bagmati	Bank of the Bagmati River	Partner NGOs, clubs, local societies, expatriates, students, media, music professionals, representatives, universities, student societies…	Since 2004

6. Major Achievements

- Established as a convenient and most effective platform to exercise different approaches to promote sustainability of Bagmati (a network of networks).
- A festival of all religions, age groups, professions, communities… (Image of a "common")
- A festival of all I/NGOs, I/GOs, CBOs, clubs, initiatives etc. working in Bagmati.
- Grew conservation awareness at all levels of a society. (an open school)
- An extensive media coverage (Radio, TV, Print & Electronic) (sensitization & Institutionalization of the agenda)
- A place where a wide range of issues can interplay;

-Tourism: Heritage walk, Rafting, Cycling etc.

-Sports: Cycling, Rafting, Kayaking, Marathon etc.

-Capacity Building: Training to the river bank communities and competitions among the school children.

-Conservation activities: Bird watching Clean-up, Tree plantation

-Entertainment: Food festivals, concerts etc.

-Demonstration: Workshops, Exhibitions,

-Religious aspects: Gathered a wide range of people from different religions to a same place and promoting Bagmati River Festival as a festival of 21st century.

-Promoting interactive society: Facilitate to interact among different classes of a society

-Strengthening Social bond: Blood donation

- Common platform to share ideas and to show how one can contribute to "Save the Bagmati"? (Action-hub, experimentation and demonstration site)
- Slow down the rate of degradation of the Bagmati River with respect to other factors influencing in (in parts)
- A big push to conservation and environmental movement in Nepal, particularly in case of rivers.

7. Conclusion

Bagmati River is the principal and sacred river of the Kathmandu Valley.. However, over the past 20 years, the pressure placed upon Bagmati and other rivers by the ever growing population of the Kathmandu Valley have turned this sacred river into something that is little more than a drain- a convenient disposal system for the solid waste and sewage produced by the people of Kathmandu. Thus, it is imperative that we respond to these issues with appropriate measures that are timely and effective.

In response to the worsening situation of the Bagmati River and in order to alter the biological degradation in it, NRCT had initiated Bagmati river conservation campaign called Bagmati River Festival (BRF) in 2001, in association with some like-minded organisations. The festival aimed to provide a platform for all interested individuals and organisations to express their concern and provide solutions to overcome the plight of this holy river. Since then, BRF is being organized on an annual basis and today, the number of active partner organisations has crossed over eighty-four. Also, over four-hundred institutions have participated in this event so far, since its inception in 2001. The partner organisations includes many I/NGOs, I/GOs, academia, research and development organisations, business houses, local clubs, media, actors, singers

and music bands, conservation campaigners and civil society. Government organisations like Nepal Tourism Board, Sustainable Tourism Board, Kathmandu Metropolitan City, different ministries and some I/NGOs along with donor communities, corporate and media houses etc. are providing minimum funding and technical support to organize, the events included in the BRF. The festival has attracted people of all age, groups (School children to university graduates and job holders to retired professionals) and from a variety of professions. The two and half month festival is formally launched every year on June 5th to mark the World Environment Day (WED) and continues till the third or fourth week of August. Depending on Nepali calendar, it ends on Nagpuja, a holy festival of Hindus.

The festival comprises of several events including clean-up campaign, tree plantation program, heritage walk, rafting for public, press/media dunga daud, corporate dunga daud, corporate challenge, poetry, drama, essay and photography competition at school levels, Bagmati eco-challenge, training on waste management to several groups of women living along the bank of the Bishnumati/ Bagmati river, school student's kayak race, professional down river kayak race, Bagmati friendship float, student's theatre program, technical workshop on Bagmati/Bishnumati river, sharing scientific findings about the river, public exhibition on various activities done by the partner organisations, Bagmati conservation campaigns and rallies, anti-plastic campaigns, women for Bagmati cycle rally, exhibition of environmental models prepared by the students of high school, live music concerts etc.

The unique feature of the Bagmati River Festival is that, it is probably the only model in world that gives an equal opportunity to interplay science, sports, conservation education, recreation, music, religion and social activities to produce synergy in conservation and gives a unique opportunity to interact among peoples of different areas and professions. As a result one can easily notice the contribution made by the festival to save the sacredness of the Bagmati River. The volume of waste dumped in the river and riverbank is relatively less in comparison to the population growth and level of awareness among the stakeholders is increasing. The biggest achievement of the Bagmati River Festival is that, it has somehow managed to develop a common and active alliance of over eighty like-minded organizations and has gained an identity as the "Festival of the 21st Century". Since the population in the valley is growing rapidly, the amount of daily waste generation has almost doubled in last one decade and due to the lack of proper waste management system, again Bagmati is becoming the ultimate dumping destination of the majority of these wastes. In this context we have realized that intensifying the Bagmati River Festival can be the only way to ensure biological, social, religious and political sustainability of the Bagmati River.

Reference:

Botlino, A. (1980): Pollution monitoring of the Bagmati River (Preliminary reports) FPAN-DISVI project, Ktm.

Central Bureau of Statistic (CBS) (2002) A Hand book Environmental Statistic, Nepal , Kathmandu.

CEMAT (2000) "Report on surface water quality monitoring works of Kathmandu valley". Urban water supply reforms in the Kathmandu valley project.

Chhetri,P.K (2006) a case study on water pollution of Bagmati River, case study M. Sc 1st year Environmental Science, CDES, T.U.

ICIMOD/UNEP/MoEST (2007) Kathmandu Valley Environmental Outlook. Kathmandu

Khattri, T.B (1986): The study of the water pollution of river Bagmati and Bishnumati of the Ktm, valley, Degree thesis, T.U. Kathmandu.

Khadka, M.S (1983) Study of major ions in Bagmati river near Pashupathinath Temple on the day of Mahashivaratri *J.Nep.Chem. Soc. 3.*

MOPE (1999) Environmental Planning and Management of the Kathmandu Valley, Kathmandu.

Nippon Jogesuido Sekkei Co Ltd Japan et al (2002) 'Urban and environmental Improvement Project Nepal'. Final report : Volume 1 main report. Kathmandu, Asian Development Bank and His Majesty's Government of Nepal, Ministry of Physical Planning and Works, Department of Urban Development and Building Conservation.

Pradhanga T.M (1988): Water quality of the Bagmati river in the Pashupati area, Pub. by RONAST.

Pradhan, B (1998) Water Quality Assessment of the Bagmati River and its Tributaries, Kathmandu Valley, Nepal. Ph.D. Dissertation, Department of Hydrobiology, Institute of Water Provision, Water Ecology and Waste Management , BOKU University, Vienna, Austria.

Shankar and Kiran (1976): Paper on water hydrology in Nepal, Symposium on water and energy recourses under the joint sponsorship of NWREC, CEDA and UNDP Ktm.

Sharma, S (1988), Studies on the effect of some physico-chemical parameters on the distribution and abundance of Zoobenthose in the river Bagmati, Kathmandu, M.Sc. thesis, T.U, Kathmandu

Sharma, C.K. (1977), River System of Nepal, MB Sangeeta Sharma, Bishalnagar 25.

Shrestha, T.K (1980): The Biological indicators of pollution in the river Bagmati, Kathmandu valley, *T.U.J Research of Div. Rector's office.*

Shrestha and Karmacharya (1990): An assessment of pollution in Bagmati river.

Tuladhar, D.R (1979): The rainfall runoff characteristics of Bagmati river, *J .Nat. Hist. Mus., T.U. Inst. of Sci. and Tech.(1-4)*

United Nations Environment Programme, (UNEP) (2001) Nepal: state of Environment 2001.Bangkok: United Nations Environment Programme, Regional resource Centre for Asia Pacific.

Upadhaya, N.P and Roy, N.N (1982): Studies on river pollution in Kathmandu Valley, *Indian J. Environ. HCTH Vol 24. No. 2.*

Vaidya, K. *et al* (1987): Water pollution in Bagmati river of Pashupati development area, Proc. of Seminar on Environmental Issues of Pashupati area: Identification and Control Measures, RONAST, Kathmandu.

Vaidya, S. and Karmacharya, S (1986): Study of ground and surface water of Kathmandu valley NCST Newsletter, Kathmandu.

Yadav, U.K.R (2002), Study on Physico-Chemical environment and biological components of Bagmati River and application of macrophytes to reduce the level of water pollutants, a report submitted to Institute of Science and Technology (TU).

Caring for the Bagmati
Common sense is not very common

Anil Chitrakar

Introduction

In Nepal there is a lot of debate as to where the threat to democracy and lasting peace will come from. While people are finding all kinds of forces to blame, there is a massive force that is working silently to destroy the very fabric of Nepali society - water related diseases. Half the cabinet and most of the support staff at the Prime Ministers residence had jaundice - a very common water borne disease in the Kathmandu valley. It is very difficult to determine what more will need to happen before the government and people decide to do something about the state of affairs. Peace, democracy and nation building are long term processes, disease and lack of clean water can and will affect us in the immediate term. Over the past several thousands of years of human history, many cities have been founded, thrived and then died. They remain as archeological sites to teach us what happens when we do not take care of the rivers and water in the cities. We cannot sit back and continue to 'study' the Bagmati to death. We can undertake many inexpensive and effective steps to reverse the state of the Bagmati. There are mostly from common sense; but the challenge is that common sense is not very common.

1. Extend the success of Shivapuri

It has taken twenty years to prove that watershed management of the northern part of the valley has been one of the best things to happen for the Bagmati River. There is nothing to prevent us from extending this success to the hills and watershed that surround the entire Kathmandu valley. The Nagarkot hills can meet Bhaktapur's water needs; Phulchoki for Patan's, Chadragiri for Kritipur and Jamacho for Kathmandu is addition to Shivapuri. The additional flow into Bagmati from these watersheds could meet our water needs for many more years. The watershed areas are also managed on the lower parts as community forests. The users groups that manage these forests need to be rewarded for how much water flows out of the system after the locals have utilized what they need. Secondly there are stone and gravel mines and these have to be replaced by compensation that once again will make it more profitable to produce water for the city and homes than gravel for ever more homes. It is also important to learn from Shivapuri and promote alternate energy resources so that peoples' demand for firewood is reduced or made redundant.

2. Invest in Municipal capacity to manage garbage

One of the key reasons for the poor state of the Bagmati is the constant dumping of waste which creates a huge demand for oxygen in the water. The river is dead because of this demand. The land fill sites, transfer station, equipment for transport of garbage are all in this place. The investment needed is to improve the capacity of the municipalities to ensure proper management of garbage so that nothing really goes to the river. We also have to provide incentives to segregate waste so that most of it is composted and then re-used and re-cycled. People and companies that have been helping managing waste in Kathmandu should be given support rather than put additional tax burden. Vermicomposting and industrial or commercial scale biogas plants would help reduce waste and also provide new and clean energy sources.

3. Proper use of the household waste water fee

Every household in Kathmandu is charged a monthly fee by the government to treat and manage household waster water. The fact that open drains go into the Bagmati is proof that this huge resource has not been put to good use. So where does this money go? There are today numerous designs for treatment plans for city waste waters. There is a mechanical unit at Guheswari that operates on electric power. There are natural reed bed filter systems. There are designs for septic tanks and sand filters that could help solve the waste water treatment challenge of Kathmandu. The situation of general IMPUNITY is also a real problem. The fact that the country has borrowed so much money and the fact that most plants that do not work is just not a question of corruption but also really discourages the good companies and engineers. This situation where no one gets punished is a general problem in Nepal is all sectors. The water sector is no exception. This goes for everyone who dumps waste and waste water into the Bagmati in general.

5. Federal Nepal - de-invest in Kathmandu

Over the next decade, it is crucial that we invest outside the Kathmandu valley. The limits to growth have been reached with almost all resources in the valley while the rest of Nepal looks and seeks investment. However this will not happen until the incentives are right. As an example even a tax holiday could be announced for those who make large investments in the next five years. We can have special economic zones, new international airport and a new parliament building all outside Kathmandu valley.

Nepal's Wetlands: A Conservation Plan for Action

Sameer Karki and Praveen Chhetri

Abstract
Nepal has several wetland ecosystems of global significance and about 0.731 million ha of land in Nepal is covered by wetlands, including water bodies, of different sizes and characteristics. They are very important in terms of their ecological, economic, cultural and recreational values. Natural and anthropogenic are the two factors which are threatening Nepalese wetlands. The reasons for the loss of wetlands habitat are lack of awareness among people, planners and policy makers, lack of an effective wetland policy, lack of responsible institutions and multiple ownership of wetlands. So properly formulated conservation plan can help in restoration of degrading wetlands of Nepal.

Keywords: wetland, ecosystems, awareness, wetland policy, conservation.

Introduction

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetlands soils. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Indeed, wetlands are found from the tundra to the tropics and on every continent except Antarctica**.** Two general categories of wetlands are recognized: coastal or tidal wetlands and inland or non-tidal wetlands. Many of these wetlands are seasonal (they are dry one or more seasons every year), and, particularly in the arid and semiarid West, may be wet only periodically. The quantity of water present and the timing of its presence in part determine the functions of a wetland and its role in the environment.

Status of Nepal wetlands

Wetlands in Nepali are called simsar-derived from the Persian word "sih", which means low-grade land not suitable for cultivation and the Sanskrit "sar" for water. Nepal has several wetland ecosystems of global significance, including 20 of 27 globally recognized freshwater wetland types. About 0.731 million ha of land in Nepal is covered by wetlands, including water bodies, of different sizes and characteristics (Bhandari, Shrestha and McEachern, 1994). Wetlands are highly fertile and productive ecosystems. Nepal's wetlands can be divided into five categories.

- ☐ The trans-Himalayan wetlands comprising of lakes such as Rara, Tilicho and Phoksundo.
- ☐ The relatively shallow midland-mountain wetlands lakes such as Phewa, Begnas and Mai Pokhari.
- ☐ The lowland-tropical wetlands which are seasonally flooded riverine flood plains, including Koshi Tappu.
- ☐ The human managed wetlands such as ponds, rice fields, ghols, etc.
- ☐ Artificial wetlands such as reservoirs, irrigation canals and sewage ponds.

Altogether Nepal have 2323 high mountain glacial lakes (ICIMOD, 2002), 6000 rivers and rivulets (WECS, 2002), over 80 freshwater lakes/ponds in mid hills, 163 Terai wetlands which includes floods plains, lakes and ponds, marshes, reservoir etc (IUCN 1998).

***Table 1**. Number of Wetland Sites in Nepal*

DEVELOPMENT REGION	NUMBER OF SITES (%)		TOTAL (%)
	Terai	**Hills and Mountains**	
Eastern	18 (7.4)	24 (9.9)	42 (17.4)
Central	37 (15.3)	15 (6.2)	52 (21.5)
Western	34 (14.4)	16 (6.6)	50 (20.7)
Mid-western	12 (5.0)	22 (9.1)	34 (14.0)
Far-western	62 (25.6)	2 (0.8)	64 (26.4)
Total	**163 (67.4)**	**79 (32.6)**	**242 (100.0)**

Source: IUCN-Nepal (1996)

Significance of Wetlands

Wetlands are among the most productive ecosystems in the world. They are very important in terms of their ecological, economic, cultural and recreational values. These ecosystems support a wide variety of plants and animals of economic value, which provide a wide range of goods and services as well as income-generating opportunities. Wetlands are also one of the most threatened habitats because of their vulnerability and attractiveness for development (Hollis *et al.* 1988). Wetlands in Nepal are rich in biological diversity and are known to regularly support more than 20,000 waterfowl during the peak period between December-February. In Nepal, wetlands provide a habitat to over 180 species of fishes and a number of water-dependent birds and other animals. About 190 bird species are considered water-dependent, of which 90 species are migrants, 66 species are residential, while the remaining 34 bird species are uncommon and rare resident species (Manandhar and Shrestha, 1994). Of the 370 species of mammals, birds, reptiles, fish and higher vertebrates dependent on wetland habitats, about 100 species are estimated to be threatened, while the Ganges river dolphins (*Platanista gangetica*) and gharials (*Gavialis gangeticus*) are considered vulnerable (Shrestha, 1995). Wetlands are also rich in aquatic angiosperms. They provide food for human beings, fodder for wild animals and ungulates, and feed for bird species. In Nepal several legislation, policy and plan are exists which protect these valuable wetlands and water resources.

Wetland's related Legislation in Nepal

The Aquatic Life Protection Act 1961 is one of Nepal's oldest pieces of legislation indicating the early recognition of wetlands and aquatic life values. It restricts the introduction of poison and explosive substances in water bodies for any type of use, but this Act remains ineffective as nobody has been prosecuted for violating the Act. It does not specify an agency to administer or enforce the Act.

Much of the legislation concerning protected areas is irrelevant to wetland habitats. **The *National Park and Wildlife Conservation Act 1973*** provides a legal basis for Nepal's conservation program. The national park and wildlife program were initiated in 1974 to control hunting and restrict wild animal trade in accordance with the Convention on International Trade in Endangered Species (CITES) of wild flora and fauna, of which Nepal is a signatory.

Soil and Watershed Conservation Act, 1982 Ensure soil conservation through land use regulation. According to this Act, the government is to construct and maintain dams, embankments, terrace improvements, diversion channels, and retaining walls as well as protect vegetation in landslide-prone areas.

Nepal is signatory to CBD, CITES and the Convention on Wetlands of International Importance (the Ramsar Convention) in 1978.

Water Resources Act, 1992 Promote environment assessment, water quality standard, and avoid significant impacts on local environment in the course of water use. This Act is a public trust doctrine. It strives to prevent environmental damage to wetlands, lakes and rivers through environmental impact assessment studies.

Environment Protection Act, 1996 and Environment Protection Rule 1997 Maintain clean and healthy environment and contribute to sustainable development.

The Water Resources Strategy 2002 sets guidelines for the sustainable use of water, and is a landmark for Nepal by being the first policy document related to water resources that acknowledges environmental conservation and ecosystem maintenance as a priority during water resource planning. In spite of these acts, policies and plans wetlands of Nepal are degrading day by day and some of the major threats to Nepalese wetlands are discussed below.

Threats to Nepalese Wetlands

Natural and anthropogenic are the two factors which are threatening Nepalese wetlands.

Succession- everything in nature is subject to a process of succession. Wetlands are also subject to this succession; as autochthonous organic matter accumulates and fills up the basin, the vegetation changes gradually from one dominated by herbs to that comprising woody species and also in-flowing sediments may alter the water regimes and turn the wetlands slowly into dry uplands. Vegetative succession in the wetlands poses weed infestation. Many wetlands are being invaded by weeds and shrubs such as *Ecihhornia crasspies, Aeschynomene sps, Ipomoea sp* etc.

Pollution is a very common problem in wetlands. The sites area being polluted from domestic sewage, industrial effluents, pesticides and fertilizer. Industrial waste disposal, though a serious problem is being easily ignored. For example Bhrikuti Paper and Pulp industries at Gaindakot, Nawalparasi, directly dispose their chemicals into the Narayani, which is toxic to aquatic life.

Dam construction has also posed serious threats to the biodiversity maintenance. This problem can be observed in dam site at Karnali River. The Gangetic dolphin in Karnali River easily crosses the dam to India in the down stream. But due to dam, the gone dolphins are unable to return to the upstream. Overfishing, overgrazing, over water harvesting and harvesting of plants materials like any other human activities pose threats to the wetlands resources.

Siltation is major threat to the wetlands. Siltation effects result in downstream due to deforestation in upstream and also due to erosion prone cultivation practice.

Lack of awareness among people, planners and policy makers, lack of an effective wetland policy, lack of responsible institutions and multiple ownership of wetlands leads in to degradation of wetlands of Nepal.

The alarming level of groundwater extraction directly affects the health of our wetlands. Kathmandu's deep aquifer has dropped from 9m to 68m below the surface within the past decade. It has been estimated that total sustainable withdrawal of groundwater from the Valley's aquifer is approximately 26.3 MLD while current withdrawals total about 58.6 MLD (ICIMOD/UNEP/MoEST, 2007). More importantly, the discourse over water resources must include their crucial importance to livelihoods, especially the livelihoods of the marginalized wetland dependent communities in Nepal.

Population pressure- wetlands are increasingly threatened by a spreading population most of whom depend on agriculture for livelihood. Wetlands are often drained or reclaimed for agriculture, industrial and urban use, particularly in the more developed central region of the country. The modification of land-use is particularly noticeable in the Terai where migrants have pushed population growth rates up to nearly 4 percent in areas like Kailali. This poses a serious problem because the Terai also has the greatest diversity of wetlands-the Kosi Tappu Wildlife Reserve alone has 17 wetland types. Of 163 Terai wetland sites inventoried by the IUCN in 1998, 43 percent had suffered some degree of drainage.

Inappropriate wetland management often results in increased fragmentation of wetlands and forests, reducing previously extensive populations of mammals and large reptiles into genetically isolated sub-populations, many of which are now at risk.

Climate change and its impacts on wetlands in Nepal currently poorly understood. Climate change has direct impact on water resource and species and indirect impacts due to water demands from people.

So, Nepalese wetlands are in verge of extinction, timely and properly generated conservation plan can save them from being history.

Conservation Plan for Action - guide to sustainable use of Nepalese wetlands

Conservation Plan for Action in Nepal requires-

1. National policy and legal support

Nepal has always recognized the value of protecting its natural resources from the beginning of the 8th plan period (1992-1997) environment issues have been consistency induced in Nepal's socioeconomic development plans. Although the government has accorded a high priority to resolving environment problems and has formulated comprehensive sets of policies, plans and programs, their effectiveness has been below expectations.

Policy like Nepal Biodiversity Strategy 2002, Nepal Wetland Policy 2003 etc exists for wetland conservation but due to resources constrains, they are limited within wetlands of protected area. High mountains 1144 glacial lake, 21 of 163 of Terai wetlands are under protected area. Among them important are Rara lake (Nepal's biggest lake), Koshi Tappu, Beeshazari Tal (Ramsar site) etc. Government and I/NGOs programmes are focused on these few advertised wetlands. There are many important wetlands exists within and outside protected area. They must be identified and categorized under community conservation area/ district conservation area etc.

2. Effective implementation of protected area and buffer zone plans

Implementation of wetland conservation plan of protected area and buffer zone are lacking due to resources constrains. Mismanagement, over extraction of resources, invasive species, pollutions etc of wetlands situated outside protected area are affecting wetlands of protected area and buffer zone as these problems are transboundary. Above listed problems can be solved by suitable financing mechanism of institute and sustainable management of wetlands outside protected area.

3. Conservation of wetlands for biodiversity conservation and livelihoods outside protected area and buffer zone

Many wetlands outside are under various forms of management like Koshi Barrage area (International), fish ponds of Kailali districts (Private lease), wetlands inside community forest (User groups), Indrasarowar (National government managed). But biodiversity conservation is not well integrated by management entities. So awareness and capacity building of such management authorities must be done by focusing on wetland sites of importance. But it should be also realized not all can be managed for primarily biodiversity conservation objective. However, we should have minimum criteria, such as not converting to other land use, pollution prevention, not introduction of invasive species and equitable use of water and other resources.

4. Institutional Arrangement for Wetlands Conservation

National Ramsar Authority, Department of National Park and Wildlife Conservation are the institution working for wetlands inside protected area and buffer zones. They have on authority to work outside protected area and buffer zone. So policy, plan etc must be revived to increases their involvement in wetlands conservation out side protected area. District Development Committee and Village Development Committee must be sensitized for their involvement in wetland conservation. Department of Soil Conservation and Watershed Management may be the one of line agency for management and conservation of wetland outside protected area.

Conclusion

Nepal have highly diverse, ecologically, culturally rich wetlands ecosystem from Terai to high mountain. They are in critical stage because of lack of awareness among stack holders, lack of an effective wetland policy, lack of responsible institutions and multiple ownership of wetlands. Properly and timely formulated conservation plans followed by effective implementation strategy can lead towards sustainable use of our wetland.

Reference:

Bhandari, B. 1992. The Current Status of Wetlands in Nepal. Country report presented at the Asian Wetland Symposium organised by the Ramsar Centre, 14-20 October 1992, Otsu-Kushiro, Japan.

Bhandari, B., Shrestha, T.B. and McEachern (eds). 1994. Safeguarding Wetlands in Nepal: Proceedings of the National Workshop on Wetlands Management in Nepal. IUCN-Nepal, Kathmandu, Nepal.

Bhandari, B., 1998. An inventory of Nepal's Terai Wetlands, IUCN Nepal, Kathmandu.

Hollis, G.E., Holland, M.M. and Larson, J.S. 1988. Wise Use of Wetlands. *Nature and Resources* **24**(1):2-13

ICIMOD/UNEP/MoEST (2007) Kathmandu Valley Environmental Outlook. Kathmandu

IUCN-Nepal. 1996. An Inventory of Nepal's Wetlands. IUCN-Nepal, Kathmandu.

Shrestha, J. J., 1995. Fishes, Fishing Implements and Methods in Nepal. India.

WECS, 1996. *Energy Synopsis Report, Nepal 1994/95*. Ministry of Water Resources. Water and Energy Commission Secretariat. Kathmandu.

Water and Energy Commission Secretariat (WECS). 2002. Water Resources Strategy Nepal, Kathmandu.

Manandhar, L. and K. L. Shrestha, 1994. In *Safeguarding Wetlands in Nepal*, B., Bhandari, Shrestha T.B. and J. McEachern (eds.), Proceedings of the National Workshop on Wetlands Management in Nepal. 3-5 March 1993, Kathmandu.

Degrading and Disappearing Wetlands:
Efforts and Achievements on Conservation of Taudaha

Sudeep Devkota

1. OVERVIEW

Wetlands are neither aquatic nor terrestrial, because they have not been easily assimilated by the well-established scientific disciplines of terrestrial and aquatic ecology; they are among the most productive ecosystem in the world. They are very important in terms of their ecological, economic, cultural and recreational values. The ecosystems support a wide variety of plant and animal restricted to such environment thus, providing a range of goods and services as well as income generating activities for people. Indeed, wetlands are a main component in helping to maintain the water cycle, by capturing and holding rainfall and snowmelt, retaining sediments, and purifying water. Wetlands are important areas of biodiversity, and they also provide immense services to humans, both as water recyclers and as producers of biomass and nutrients for the food chain. (Dugon, P. 1995)

'Wetland denotes a diversity of ecosystems where high water availability, seasonally or perennially, has a significant influence on the flora, fauna and soil conditions. The Ramsar Conventions classifies wetlands into 12 marine and coastal types, 19 inland types and 10 types of human made wetlands. (Ramsar Convention Bureau, 2002) The Convention's Articles 1.1 and 2.1 define wetlands as:

Article 1.1:
"A*reas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including area of marine waters, the depth of which at low tide does not exceed six meters".*
Article 2.1:
"…may include riparian and coastal zones adjacent to the wetlands, or islands or bodies of marine water deeper than six meter at low tide lying within".

1.2 Wetlands in Nepal

Nepal comprises different types of wetlands that include permanent flowing rivers to seasonal streams, lowland oxbow lakes, high altitudes glacial lakes, swamps and marshy lands, paddy fields, reservoir and ponds.

Lakes and ponds, riverine floodplain, water storage areas, swamps, marshes and deepwater agricultural lands are most productive ecosystem and are important natural resources for economic and developmental sustainability in Nepal. People involved in their conservation have always appreciated their significance in terms of biological ecological economic, cultural, recreational and aesthetic values.

The term 'wetland' translates into 'Simsar' in Nepali. 'Sim' is a derivative of the Persian word 'Sih', which means 'low-grade land not suitable for cultivation'. 'Sar' is a word meaning 'water'.

Thus, *Simsar* means different things to different people and there are over twelve terms for Simsar in Nepal. (Bhandari *et. al.*, 1994).

1.3 Wetlands in Kathmandu Valley

The Kathmandu Basin is an inter-montane basin located in the central Himalayas and is filled with the late Pliocene to Pleiostocene thick basin-fill sediments (Yoshida and Igarashi, 19984; Gautam, 1988) on the basis of lithology and sedimentary facet of sediments obtained from drill cores from the basin-fill sediments of Kathmandu valley show various potential groundwater zones.

Legend about the Kathmandu Valley tell that it was once a big lake with full of water, as evidence of very much thick layer of clay deposit or lacustrine deposit in the complete low land of the valley. (Chaudhary, R.P.*et.al*., 2001). But on the pass of time, now, Kathmandu Valley is being the 'Jungle of Concrete'. The permanent as well as temporary wetlands are being exploited day by day due to haphazard urbanization, dumping of solid wastes, with-drawing of under groundwater etc.

The temporary wetlands, the rice fields of Kathmandu are almost covered up with large buildings. Similarly the ponds and lakes are encroached by the settlement and solid waste deposition. There are both artificial and natural lakes and ponds in the Valley. The renowned artificial ponds are Ranipokhari, Nagpokhari, Kamalpokhari, Siddhapokhari and so on. Similarly, natural lakes are like Nagdaha located at Lalitpur District and Taudaha located at Kathmandu District.

1.4 Degradation of Wetlands

Apparently the wetlands are static, inert and unchanging. In reality, they are self-destructive ecosystems, which are in the process of transition from permanently wet to generally dry environment. And the ultimate result, the wetlands are doomed to die. Usually the natural process of changes takes place so slowly over so many years that it may seem that nothing at all is happening. Sometimes, however the process of degeneration of wetlands is accelerated by sudden natural change or human intervention.

Degradation of wetlands is due to expansion of agriculture and subsequent conversion of wetlands through drainage into rice fields, irrigation for enhancement of agricultural productivity; national, local and rural infrastructures. Similarly, overgrazing by livestock, over-fishing and associated disturbances, siltation due to degradation of the watershed areas, which are often transboundary in nature are the causes of depredation of wetlands. Also pollution of water due to industrial, urban agrochemicals and other types of pollutants including from transboundary sources leads to depreciation of water quality of wetlands. (Benthem, W.; Lavieren, L.P.V. 1994)

Concentrating on Kathmandu Valley, the disappearance and degradation of wetlands is in such a rapid rate that temporary and productive wetlands rice fields has been turned to big urban areas. Due to high rate of extraction of underground water, solid waste deposition, encroachment over lakes/ponds area, these are being disappeared and the remaining are also in quite vulnerable state of disappearing. The burning example is Kamalpokhari situated at the heart of the Kathmandu city, which has been turned to small patch of grassland since, 15 years.

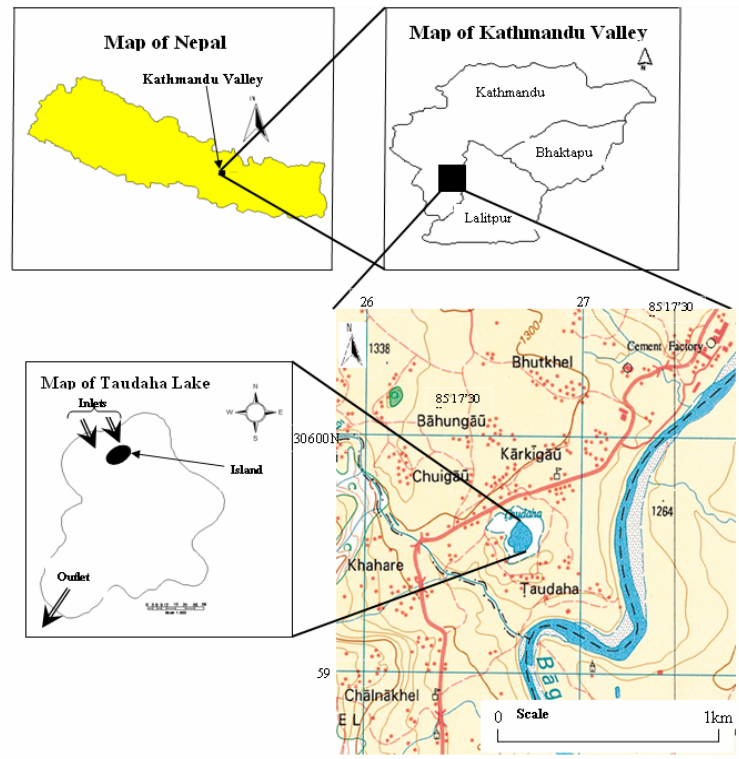
Population growth and an increasingly potent agro-industrial capacity have, however brought continuous change in the forms and functions of the original landscape in most of the world. Since, wetlands are ecologically sensitive areas, which are outstanding in natural values for hydrological, geological, scenic, wildlife or vegetation. Wetlands are open systems influenced by activities well beyond their boundaries. Because of externalities, the protections of ecologically sensitive wetlands are quite necessary. Simultaneously, the wetlands and its ecosystems are perhaps the most vulnerable of habitats through their use by humans as:

- sinks for many products of human activities in their catchments.
- a valuable and essential resource for various purposes.
- to control water borne diseases.
- to establish farmland (but without the knowledge of the consequences of pollution and eutrophication).
- eutophication causing threats of toxic pollution, over-fishing, introduction of exotic species and recreational pressures.

Since, the regulation of wetlands has raised this more forcefully than any other combined action related to environment. Regulation of wetlands is the first major step towards broad protection of landscape features, rather than protection of environmental media.

1.5 Descriptions of the Study Area

Taudaha is one and only natural lake of the Kathmandu district and which lies in the southern west side of the Kathmandu. It covers an area of 5 ha (Bhandari, 1998) having irregular polygonal outline. Taudaha lies at the Kirtipur Municipality, Ward no. 15 of Kathmandu District, formerly at the Bhutkhel Village Development Committee, situated at 27° 39′ N latitude and 85° 17′ E longitude at an altitude of 1350 meter from the sea level.



Taudaha has two major inlets with other several small inlets, while it has only one outlet that overflows from dam, which is constructed at its southern east periphery. The climate of Taudaha is typically subtropical to warm temperate showing three distinct seasons, viz: summer (hot and dry) followed by rainy season and winter (cool and dry). The lake is surrounded by agricultural land; from where massive amounts of sediments and runoff can be entered into the lake. There is no any forests near and adjoining area of Taudaha, except few *Pyrus pashia* trees.

1.6 Objectives of the study

The overall objective of the research is to investigate cause of disappearing and degrading of Lake Taudaha. However, specific objectives of the studies include the following:

- To calculate the soil loss from the Taudaha watershed area by Universal Soil Loss equation (USLE).
- To find out the rate of sedimentation and its contributors to the lake.
- To prepare the bathymetric map of the Lake Taudaha.
- To analyze the qualitative and quantitative composition of aquatic vegetation of the lake.
- To map the vegetation covers over the surface area of Taudaha by macrophytes.
- To assess the water quality of the lakes, to find the degrading quality of the water.

2. MODUS ANALYSIS

Observation techniques were used to collect physical and geographical information. Key informants were used to collect additional information. Geographical information was collected by the help of GPS (Geographical Positioning System). Socioeconomic information was collected by questionnaire survey and all the in formations were triangulated from the multiple sources.

Overall following tools and methods were applied for the whole study: informal survey; field observations; laboratory analysis; statistical analysis; field diary; documentation process; field visit; census data; secondary data; personal interviews etc.

The paraphernalia during the study were GPS, a camera, topographical map, sampling quadrat, and few necessary chemicals, sampling bags including computer programmes like MS-Word; MS-Excel, and computer software Arc view GIS 3.2.

2.1 Approach:

Both laboratory and field studies were planned for each of the objectives, including the evaluation of different tracers for identifying surface condition on sediment transport to the lake, soil loss, aquatic vegetations, and pollutant source areas. Laboratory studies are designed to further the understanding of basic sediment and chemical transport processes. The field study was used to expand the laboratory findings to real-world situations. Based on the research findings, efforts were also taken for designing the conclusions and recommendations.

2.2 Selection of the Sampling Site:

The experiments of water analysis and vegetation were carried out for the three periods: pre-monsoon, monsoon and post monsoon. The sampling site of the Taudaha Lake was selected on the basis of catchment area substrate structure, density of vegetation, and human activities. Appropriate sampling sites were selected to make the data meaningful and reliable. The following four points were selected for the study as in the following figure:

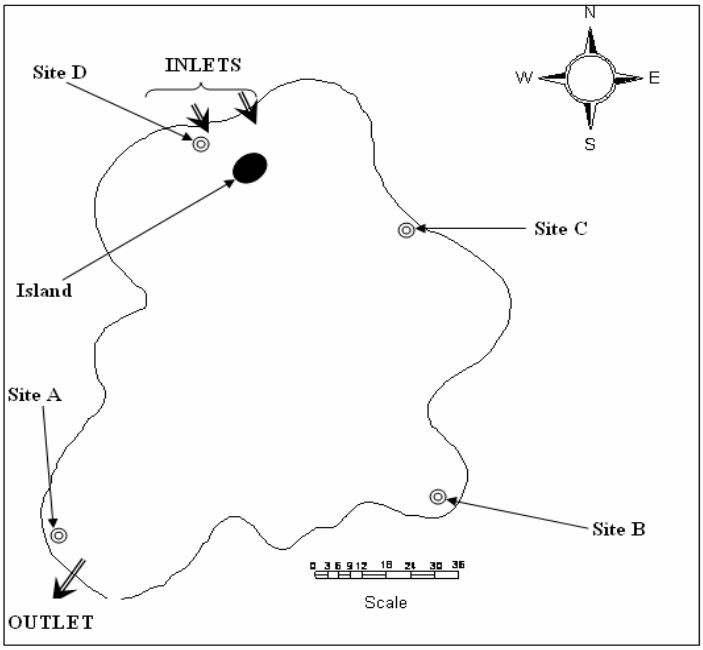


Fig: Location Sampling Site

3. FINDINGS

3.1 Paleo- geo-environment of the Area:

The origin of Taudaha can be hypothesized in the following two ways:

i. Taudaha has alluvial deposits, which are formed by the deposition of debris by the running water. Taudaha area has fluvial sediments, as the sediments can be observed were rounded in structure. Taudaha lies in the second terraces of the Bagmati River, which can be proved by rounded pebbles and stones, which are formed by the Bagmati River. This shows the evidence that Bagmati River used to flow from the existing Taudaha in the past time. So, Taudaha may be an ox-bow lake, which may be formed due to meandering of the Bagmati River. It can be supported by the absence of bed rock around the area of Taudaha.

   Paleo-soil has not developed in the flood plain and also in the terraces. So, it can be said that these flood plain and firs terraces were formed in the Holocene period, less than 10,000 years. Youngest Lake sediments are 10,000 years old, which shows that, the age of Taudaha Lake may ranges from 10,000 years to 30,000 years.

ii. Taudaha seems to be an ox-bow Lake made by the Bosan Khola, which is flowing nearby from the lake. In the past geologic time Bosan Khola used to flow from the present Taudaha, but by the passage of time, the process of upliftment of land occurred in the east side of Taudaha, its route was blocked and then it took the route of present outlet of Taudaha. In this way the Taudaha was formed.

3.2 Final soil loss calculation for Taudaha

Table: Soil loss from the Taudaha Area.

Slope type	R value	K value	LS value	C value	P value	Soil loss (tons/ha/yr)
A1	112.293	0.323	5.161219	0.011	0.5	1.029605801
A2	112.293	0.50388	4.652243	0.011	0.5	1.44779025
A3	112.293	0.50388	4.22892	0.011	0.5	1.316050957
A4	112.293	0.4522	4.048877	0.011	0.5	1.130788422
A5	112.293	0.3876	8.508685	0.011	0.5	2.036865559
A6	112.293	0.52972	6.071842	0.011	0.5	1.986474668
C1	112.293	0.43928	34.68592	0.011	0.9	16.93882663
B1	112.293	0.43928	16.63182	0.011	0.7	6.317212796
B2	112.293	0.43928	20.58304	0.011	0.8	8.934848194
B3	112.293	0.50388	17.07888	0.011	0.8	8.503986344
B4	112.293	0.50388	22.98769	0.011	0.9	12.87689141
C2	112.293	0.50388	28.50202	0.011	0.9	15.96582933
B5	112.293	0.52972	5.302105	0.011	0.5	1.73464588
Total						80.21981624
Average						6.170755095

Soil loss is calculated according to the slope types, which are divided into 13 segments. According to soil loss by the segment wise the highest amount of soil loss occurs in the segment C_2 which is 15.96 tons/ha/year. And the least soil loss occurs in the segment A_1, which is 1.029 tons/ha/year.

The study showed that total soil loss from the whole transect area that is under current study shows 80.22 tons/ha/year of soil loss and the average soil loss from this area is 6.17 tons/ha/year during the year 2003/0 which is a tolerable rate of erosion. Since, in the Taudaha area the lands are well and widely terraced and the slope is also not so steeper. This has resulted the minimum sol loss from the area. This shows that why conservation practices has brought the annual soil loss level under tolerance, and which favor soil conservation and less degradation of land.

3.3 Sedimentation Rate:

Table: Sedimentation rate calculation.

		May	June	July	August	September	Average
Inlet	TSS(gm)	0.72	1.03	0.85	0.78	0.68	0.81
	Discharge (m3/s)	0.01	0.02	0.02	0.02	0.01	0.02
	Sediment.Disc. (kg)	10754.88	48273.15	42844.74	43585.92	12475.98	31586.93
Outlet	TSS(gm)	0.45	0.75	0.65	0.60	0.70	0.63
	Discharge (m3/s)	0.02	0.02	0.02	0.03	0.01	0.02
	Sediment.Disc. (kg)	8888.10	44813.97	37831.85	39784.85	11179.05	28499.56

From table, Total sediment to the Taudaha in a year is 15436.84 kg.

3.4 Sedimentation:

Sediment load to Taudaha

As the Taudaha situated in the lower basin of the watershed, the sediment can easily entered into the lake from all of the surrounding areas. Sedimentation is a natural phenomenon that is impossible to check completely, but we can reduce or minimize the rate of sedimentation by different tools and techniques. (Sthapit, K.M., (1996). Here in the current study the rate of sedimentation at Taudaha is 19.50 m3/yr. This amount of sedimentation is minimal amount comparing to the sedimentation to the Phewa Lake of Pokhara valley. It has been estimated that in Phewa Lake 57,000 m^3 of sediment was added during time of 1994 to 1998 (DSCWM, 1998), which is 14250 m^3/ year. The sedimentation in Taudaha is quite minimum due to that, Taudaha is situated in the gently sloped land where the erosion is quite minimum and in the calculation of soil loss of Taudaha area, is 6.17 tons/ha/year, which is low soil loss and is within the tolerable limit.

3.4.1 Total Sedimentation:

Thus, the grand total sediment to the Taudaha in a year is 15745.58 kg.
Since, the bulk density of the bottom sediment is 807.675 kg/m^3.
So, the sedimentation per year is 19.49495 m^3/ yr.
Hence, the sedimentation rate to the Taudaha is 19.49495 m^3/ yr.

3.4.2 Life Span of Lake:

Since, the sedimentation rate to the Taudaha is 19.49495 m^3/ yr.
Area of the Taudaha is 4081.335 m^2.
Average depth of the lake is 3.003 m.
Thus, the total volume of the lake is 12107.28 m^3.
Hence, the time to fill-up the Taudaha is 621.0471 years.
(*This is the life span of the lake if the current rate of sedimentation continues in future. It is noteworthy that, this life span is only in terms of sedimentation rate only excluding all other contributing factors for sedimentation.)*

3.5 Bathymetric map:

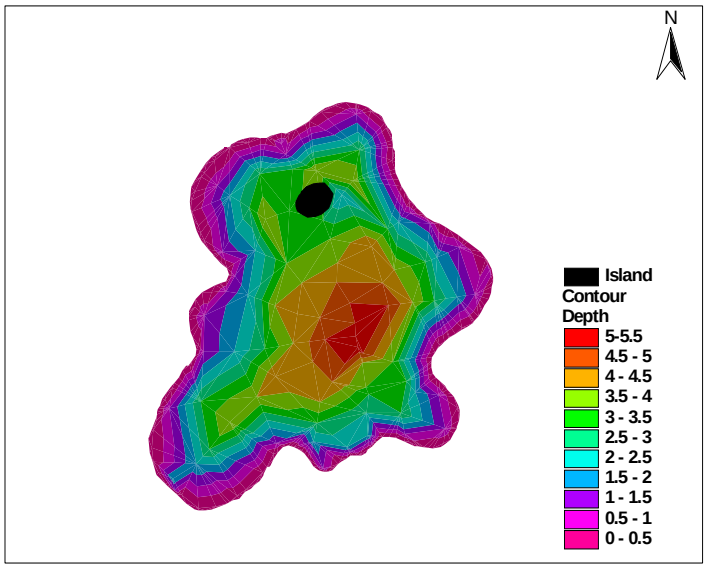


Fig: Bathymetric map of Taudaha

3.6 Vegetation Mapping of Taudaha

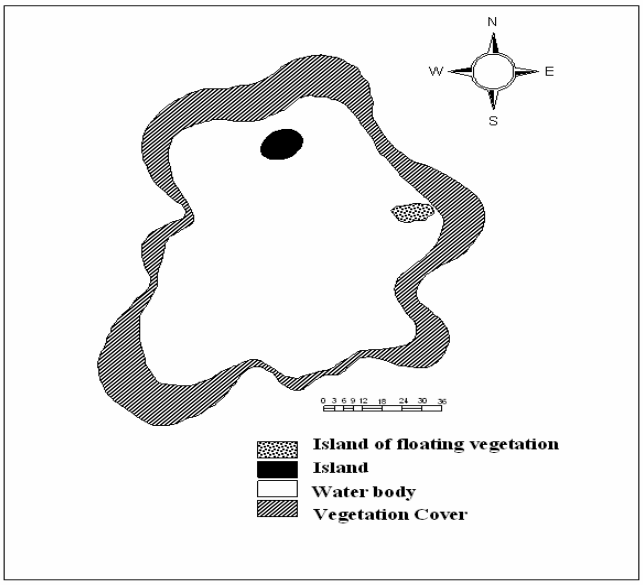


Fig: Vegetation Coverage Map during Post-Monsoon

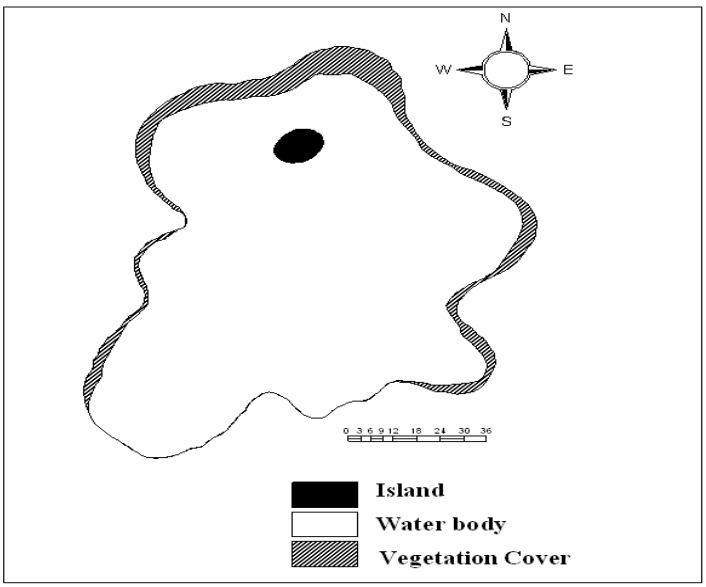


Fig: Vegetation Coverage Map during Pre-Monsoon

3.7 Vegetation Analysis:

In the vegetation study of the Taudaha, it was found that the most dominant plant is *Myriophyllum aquaticum*, in all pre-monsoon, monsoon and post-monsoon season. This *Myriophyllum aquaticum*, occupies the 42% of total density in the pre-monsoon season, 47 % in the monsoon season and 43 % in the post-monsoon season as in the figure no. 4.9; 4.10; and 1.11. This result can be express as *Myriophyllum aquaticum* covers 43.32 % of total area rather than species in the pre-monsoon season, 45.26 % coverage in monsoon season and 50 % coverage in the post-monsoon ason. The second denser species is *Trapa bispinosa* which has relative density of 17.8 % and 16 % during pre-monsoon season, and monsoon season respectively, and in post-monsoon season *Polygonum densiflorum* species second largest dominant species which has relative density is 16.9 %.

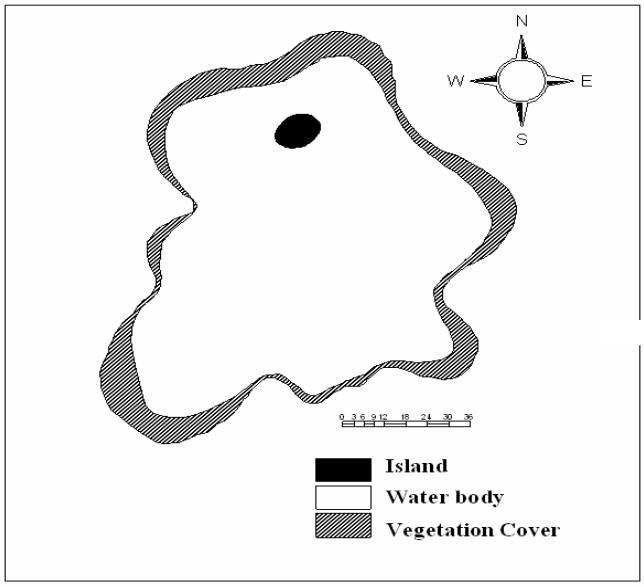


Fig: Vegetation Coverage Map during Monsoon

Conversely, on the vegetation study of the Taudaha, it was found that the least dominant plant is *Hygroryza aristata*, in pre-monsoon. This *Hygroryza aristata,* occupies the 0.4 % of total density in the pre-monsoon season, in the monsoon season *Nympoides indica* is the least dense species which occupies 0.4 % of the total density. But in the post-monsoon season *Utricularia aurea* is the least dense species which occupies 0.8 % of the total density as in the figure no. 4.9; 4.10; and 4.11. This result can express as *Hygroryza aristata* covers an area of 3.74 % in the pre-monsoon season, 3.68 % coverage in monsoon season, but in the post-monsoon season *Utricularia aurea* covers 2.78 % abundant. The second least denser species is *Utricularia aurea* which has relative density during pre-monsoon season, similarly in the monsoon season the second least dense species is *Hygroryza aristata* which covers the 1.5 % of the total density, and in post-monsoon season *Ceratophyllum demersum* and *Hygroryza aristata* species again second least dominant species which has relative density is 1.7 %.

Other species *Ceratophyllum demersum, Hydrilla verticillata, Nympoides indica, Polygonum densiflorum, Potamogeten crispus,*and *Vallisneria spp.* are also found in the significant amount. Among them the *Nympoides indica* is the only species that occur only during the monsoon season.

Similar result in the study of biomass study, the highest biomass produced during the monsoon season which is 773 gm/m^2 and the least biomass production is during post-monsoon season, which is 365 gm/m^2. Similarly in the pre-monsoon season biomass production is 648 gm/m^2. According to figure no.4.12, the *Myriophyllum aquaticum* species gives the higher amount of biomass in all seasons, in which 315 gm/m^2 in pre-monsoon season, 398 gm/m^2 in monsoon season and 155 gm/m^2 in post-monsoon season. The second largest producer of biomass in Taudaha is *Trapa bispinosa* in pre-monsoon season and post-monsoon which gives biomass of 95 gm/m^2 and 61 gm/m^2 respectively, while in the monsoon *Ceratophyllum demersum* has second largest biomass production which is 95 gm/m^2.

Conversely, the least biomass produced according to figure no.4.12; the *Vallisneria spp.* species gives the lesser amount of biomass in all seasons, in which 1 gm/m^2 in pre-monsoon season, 4 gm/m^2 in monsoon season and 1 gm/m^2 in post-monsoon season. The second lesser producer of biomass in Taudaha is *Utricularia aurea* in all seasons which gives only 2 gm/m^2 of biomass in al seasons. One noticeable species *Nympoides indica* is only one species found in the Taudaha, during monsoon season, which has biomass of 25 gm/m^2.

3.8 Conservation Issue:

Ever since, conversion of wetlands to croplands has been the leading cause of depletion. Encroachment and conversion of wetlands into agricultural land is the major problem for the shrinking and disappearance of wetlands in Nepal. They encroach wetland area, cultivate it for a year and then sell it. Alien and invasive species-that grows and infests due to various human activities like the use of chemicals in agricultural fields.

Still no unified approach exists for the sustainable utilization of wetland resources in Nepal. The Nepal Wetland Policy has also underscored the need of controlling of invasive species, raise adequate funds at the level of community, internal and external assistance. The policy has recommended formulation of separate laws for wetlands, management of wetlands in the

mountain region, control of ground water use and water pollution, and monitoring of wetlands conservation on periodic basis among others.

Most wetlands are facing threats due to sedimentation, eutrophication, over exploitation, over fishing, hunting and poaching, overgrazing by livestock, illegal harvesting of wetland resource, encroachment, water pollution, developmental activities in adjoining areas, drainage, introduction of invasive species, and floods. (DAEPA, 1990). Through the ecologically sustainable development and management of lakes in a manner that provides opportunities for a diverse range of water based recreation, sporting and tourism activities, consistent with the conservation of heritage values, flood protection, and maintenance of ecological processes, and by involving the community in the planning, management and conservation of lakes.

Based on the questionnaire survey, it was found that the deterioration and degradation of Taudaha are attributed by easy accessibility to wetlands and shortage of alternative lands around local communities, and they consider this place as free and common goods. On the questions of conserving the Taudaha, people say that it is possible to conserve if the government give the priority and fund for the conservation.

People seem to be quite receptive to external assistance, particularly for the purpose of conservation of the Taudaha. In their opinion any assistance from the government, INGOs, local NGOs would be helpful for the conservation and preservation of Taudaha.

The values search which highlighted how people perceive urban Lake Taudaha and explored ideas for their future management. The communities are generally satisfied with the lakes and value them for the following reasons (from questionnaire survey):

- aesthetic qualities, particularly when water bodies are visible;
- appreciation of the existing natural systems and aquatic life;
- the wide range of available recreational opportunities, including swimming and boating;
- facilities for family and group gatherings including watching of birds in winter season
- Opportunities to interact with the natural environment.

4. FINAL REFLECTIONS

To understand the causes and consequences of wetland degradation it is necessary to see the wetland as an integral part of the whole catchment area. Many processes have to be considered how the deterioration of the catchment results directly in a non-sustainable wetland or lake. The holistic approach attempts to consider all the processes occurring in the landscape and how theses are interrelated in both time and space, which are the functions of wetland within the catchment, and their possible degradation.

Today, more and more freshwater bodies have become polluted by nutrients originating from agricultural, domestic and industrial sources as in the Taudaha. This situation causes these freshwater bodies to become eutrophied. In an effort to prevent this problem, significant financial resources have to be invested in expensive infrastructure and equipment, yet the situation is worsening. Furthermore, there has been a misconception that the only way to prevent the problem is through the use of technology. Technology can assist in this endeavor, but it is not the only answer since, Nepal is a poor country.

Wetlands should be conserved by ensuring their wise use where there is sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

On the basis of the present study following recommendations are forwarded in favour of conservation of Taudaha and its longevity of life span:

- Define area and their buffer zone
- Establishment of lake ownership and determine the institution responsible for Taudaha management
- Determine the restriction zone for the use of chemical fertilizer and pesticides
- Periodic cleaning of lake
- Check the sediment to the Taudaha
- Block the drainage of waste water to lake from house
- Discourage bathing, washing clothes cleaning cooking utensils
- Promotion of ecotourism
- Development of infrastructure
- Stop encroachment
- Regular monitoring of water
- Community awareness

4. REFERENCES

Benthem, W.; Lavieren, L.P.V. (1994), *Wetlands are not wastelands: A manual and Strategy for Conservation and Development of Wetlands*-Srilanka, Wetland Conservation Project, Central Environmental Authority.

Bhandari, B., Shrestha, T. B. and Mc Eachern, P (Eds.), 1994. In *Safeguarding Wetlands in Nepal*. Proceeding of the National Workshop on Wetlands Management in Nepal. 3-5 March, 1993, IUCN Nepal, Kathmandu, pp. 119 – 136.

Bhandari, B., 1998. An inventory of Nepal's Terai Wetlands, IUCN Nepal, Kathmandu. pp.25-29.

Chaudhary, R.P.; Joshi, S.D.; Shrestha, P.R. (2001), *Wetlands of Kathmandu Valley: Inventory and Management Strategy Final Report* – MOPE, Kathmandu, Nepal.

(DAEPA)Department of the Army and the Environmental Protection Agency, 1990. Memorandum of Agreement between The Department of the Army and The Environmental Protection Agency concerning The Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines.
URL: http://www.epa.gov/OWOW/wetlands/regs/mitigate.html

DSCWM (Department of soil Conservation and Watershed Management), 1998. *Sedimentation Survey of Phewa Lake,* Conserve soil and water, promote Greenery.

Dugon, P. (ed.) (1995), *Wetland in Danger: A Mitchell Beazley World Conservation Atlas*- Great Britain.

Sthapit, K.M., 1996. *Sedimentation Monitoring of Kulekhani Reservoir*. Reprint from the Proceedings of the International Conference on Reservoir Sedimentation. Nepal-UK Forest Research Project. Kathmandu.

An investigation on the pollution of inland surface water from industry: A case study of Manohara River

Santosh Kafle

Abstract

This study deals with the investigation of effluents from two industries, one is Beverage Industry (BI) and another is Carpet Dyeing Industry (CI) and their subsequent effect on water quality of neighboring Manohara River. Twenty-one physicochemical parameters were analyzed from nine different sampling points during April, May, August and September of 2004. The study showed that effluents from both the industries degrade the water quality of Manohara River. Effluents contain high amount of BOD and COD. At the same time, it characterizes with high temperature and wide range of pH value. The effluents from CI contain Cr at offensive level. Similarly, cl, alkalinity, for BI was found higher than that of CI. Both industries were found not complying with existing legal standard.

Keywords: water quality, water pollution, effluents, physico-chemical Parameters, legal compliance.

Introduction

Changes in magnitude of physicochemical parameters due to the discharge of untreated industrial wastes and sewage containing varieties of chemical species from relatively harmless dirty water, nutrients to highly toxic chemicals are constantly converting wetlands into bodies of water unable to support aquatic life

In terms of water pollution, industrial effluent are usually liquid, varying considerably in composition and generally contain water, organic solvents, suspended solids and dissolved chemical compounds. Effluent may vary in quality and strength from relatively harmless dirty water to highly toxic metallic and organic sludge (APHA, AWWA, WEF, 20th Ed.)

Forty per cent of Nepal's total industrial units (4,271) in 1992 were related to water pollution. (SOE, Nepal, 2001). Up to fiscal year 2002/2003, the total number of industries registered was 157,458 out of which only 32933 have been renewed. Among manufacturing industries number of CI and soft drink manufacturing industries registered in 1996 to 2003 were 223 & 185 respectively (DCSI 2004).

Report of DHM (1996) on water quality of Rivers concluded that Rivers like Bagmati, Bishnumati, Dhobikhola, Manohara and Hanumante were all highly polluted. Gewali et al., (1994) in his study of industrial effluents showed that effluents with very high temperature were discharged directly from Brewery, CI and Tannery industries.
This study was conducted to clarify the effect of industrial effluent on river water. Furthermore, the industrial effluents were tested for their compliance with the existing legal framework and regulatory requirements of GoN.

Study Site

Manohara River, one of the important tributary of Bagmati River, originates at the Nagarkot ridge at an elevation of about 2000m in the East of the Kathmandu valley. The river has an approximate total length of 24km and drainage area of about 75 km^2. Salinadi, Manamati, and Indrayani, Hanumante, Godavari and the Kodku are its major tributaries. Manohara at Bode and Kodku are Harisiddhi are used as source of drinking water supply. Besides, Manohara River serves as an important source of sand as mineral resource for construction purpose.

Methods

All the experiments were performed according to methods described in "Standard Method for the Examination of Water and Wastewater 1998"[APHA, AWWA, WEF, 20th Ed.] and "Text Book of Quantitative Chemical Analysis"1996[Vogel's, 5th Ed.]

Three sets of samples were collected for four months each during April, May, August and September in the year 2004. Out of three sets, the first set consisted samples obtained from single point of river Manohara at Sankhu (site I), second set consisted samples taken at Sinamangal including effluents from BI (site II) and the third set of samples were taken at Balkumari including CI effluents (site III). For each second and third set, samples were obtained from four points, the first being effluents, the second being sample obtained just after mixing of effluents with river water (MP), third was the sample drawn from 100m downstream from point of mixing (D/S) and the fourth just upstream from point of mixing (U/S). Duplicate grab samples were taken for each time of sampling for each site.

Results and Discussion

All samples except effluents were observed colorless and odorless. The highest recorded temperature during study period was 76^0C in effluent of CI and lowest recorded was 19^0C at Sankhu in September. pH was observed in the range 6.7 in CI effluent in September to 12.3 in effluents of BI in April. Effluent from BI is found to cause significant rise in pH at MP. Highest conductivity recorded was 4666 □∫/cm in effluent of BI in April and lowest recorded was 22□∫/cm at Sankhu in September. The conductivity of effluents of BI (2329□∫/cm to 4666□∫/cm) was found greater than effluents of CI industry (1132□∫/cm to 1808□∫/cm). Both these industries were found to raise the conductivity at respective MP and D/S especially during premonsoon. T.D.S value ranged from 8 mg/L, which occurred in September at site I to 1800 mg/L in effluent sample at site II in May. T.S ranged from 12mg/L in September at site I to 2200 mg/L in April in effluent at site II. T.S.S values were obtained in the range 4 mg/L at site I in September to 800 mg/L in effluent of CI in May. Effluents from both of the industry were found to cause significant rise in solids value at MP and D/S.

Alkalinity was found in the range 41.5 mg/L at site I to 485/686 mg/L in effluent sample at site II in April. The effluent sample at site II contains higher alkalinity, which significantly raises the alkalinity of river at MP and D/S within 100m stretch of river. Chloride concentration was found in the range 5.1 mg/L in September at site I to 179 mg/L in effluent at site II in April. The lowest recorded NO_2^- concentration was 0.1mg/L in August at site I and the highest recorded concentration was 13.7 mg/L in effluent of site II in September. The lowest recorded NO_3^- concentration was 0.1 mg/L at site I in April and the highest recorded concentration was 5.6 mg/L in effluent at site II in April. PO_4^{---} concentration was obtained in the range less than 0.1mg/L at site I to 5mg/L in effluent of site II. NH_3 was obtained in the range less than 0.1mg/L at site I in August to 2.7mg/L at D/S of site III in April.

Ca concentration was obtained in the range 0 mg/L in effluent at site III in September 37.7 mg/L at downstream of site III in May. The lowest observed Mg concentration was 3.1 mg/L in August at site I and highest was 209 mg/L in CI effluent in May. Hardness at site I ranged from 4.1 mg/L at Sankhu to 220 mg/L in effluent. The highest recorded Fe concentration was 8.6 mg/L in BI effluent lowest recorded was 0.1 mg/L in most samples at Sankhu. Highest Cr concentration for 6.1 mg/L was recorded in effluent sample of CI and the lowest recorded concentration was less than 0.1 mg/L at Sankhu. Effluent raises the Cr Concentration at MP and D/S more effectively during premonsoon.

DO at site I was fair ranging 6.0 mg/L in May to 7.1 mg/L in September. In site II, DO was found in the range 3.2 mg/L in effluent in May to 7.3 mg/L at U/S in May. DO at site III ranged from 0 mg/L in effluent to 5.8 mg/L in September at U/S. Effluents from CI significantly lower DO content at MP. BOD was obtained in the range 1.4 mg/L in September at site I to 470 mg/L in effluent samples of CI. Highest COD was found in the effluent of CI which ranged from 592 mg/L to 790 mg/L and lowest COD occurred at site I, which ranged from 11.6 mg/L to 154 mg/L.

The effluents should be free from color and should not possess odor in any form, Effluent should not raise temperature of water beyond 40^0C in any section of the stream within 15m D/S from the effluent outlet. The color of effluent from CI might possibly be due to use of dyes while dyeing which comes out as spent dye. Similarly, color in BI effluent may be due different coloring material used in preparation soft drinks. Dyeing process which is generally done dipping wool in bath and washing of beverage bottle with hot water may be the possible reason for high temperature in effluent of respective industries. Except for effluent from BI p^H was obtained within the range of tolerance for industrial effluents discharged into inland surface water. The p^H was also found within range as recommended for Bagmati river system. Except for effluent samples and MP for both the industries, T.D.S values were well within the standard recommended for Bagmati river system (MoPE 2001). T.S of BI effluents (1600 mg/L - 2200 mg/L) and CI effluent (1200 mg/L - 2000 mg/L) were observed greater than other sampling sites. T.S.S of all samples except for BI effluent were found lower the limit (30 mg/L to 200 mg/L) of tolerance for industrial effluents discharged into inland surface water (MoPE 2001). In similar manner, except Sankhu T.S.S at all the points of measurement at each time were found exceeding the recommended requirement for aquatic life and bathing for Bagmati river system (MoPE 1994).

Effluent from CI contains low alkalinity (23.5 mg/L to 27 mg/L) in comparison to effluents from BI (367.5/458 mg/L to 485/686 mg/L)**.** Chloride concentration in BI effluent (144.5 mg/L to 179 mg/) was found comparatively higher than rest of the samples. Thus chloride concentration was found well within the maximum desirable concentration as recommended for Bagmati river system. Except at Sankhu and effluent samples of CI, NO_2^- concentration exceeded the maximum desirable water quality criteria for Bagmati river system. NO_3^-concentration of all samples was found well within the recommended water quality criteria for Bagmati river system. Except for effluent (1.0 mg/L to 5mg/L) at site II the PO_4^{---} concentration was found below 2.5 mg/L. Thus leaving Sankhu, total PO_4^{---} content at all sampling points was found higher than the recommended maximum desirable water quality criteria of the Bagmati river system. NH_3 concentration was found far less than the limit (50mg/L) for industrial effluent discharged into inland surface water. Except at site I and in site II [in May and September] NH_3 was found beyond recommended water quality criteria (MoPE 1994). The comparatively higher NH_3 at site III might possibly due to high sewage volume coming from the feeding tributaries like Hanumante and Kodku.

Ca concentration at site I ranged from 0.9 to 2.4 mg/L and in site II it ranged from 3.1 to 22.2 mg/L. Mg concentration at site I (3.1 mg/L to 5.6 mg/L) was lesser than site II (8.9 mg/L to 67.5 mg/L). Mg concentration at site III ranged from 42.6 mg/L to 2.9 mg/L. effluent in April. Effluent raises the concentration of Fe at MP (3.4 mg/L to 7.1 mg/L) and D/S (1.1 mg/L to 4.2 mg/L) in comparison to U/S (0.3 mg/L to 2.9 mg/L). Cr concentration of CI effluent was found in the range 2.7 mg/L to 6.1 mg/L which exceed the limit of tolerance for industrial effluent discharged into inland surface water (MoPE 2001). Except at site III Cr Concentration was found within the desirable water quality criteria for Bagmati river system (MoPE 1994) for agriculture (0.1 mg/L). Higher Cr Concentration of CI effluent may be due to use of Cr Containing synthetic dyes.

Except for the effluents, DO at all points in most of the time of measurement were obtained in acceptable range as recommended for aquatic life, bathing and agriculture for Bagmati river system (MoPE 1994). BOD were found beyond the tolerance limit for industrial effluent discharged into inland surface water (MoPE 2001) especially in effluents and MP for both of the industries in premonsoon . Absence in DO content of CI effluents was most possibly due to hot effluents. Except at site I (1.4 mg/L to 2.4 mg/L) BOD of all samples were observed beyond the recommended maximum desirable criteria Bagmati river system (MoPE 1994). Low BOD at site I indicates absence of organic pollution. In similar manner, higher BOD value at other sites implies addition of organic pollutants. COD values of effluents of both the industries were found beyond the tolerance limit of industrial effluent discharged into inland surface water (MoPE

2001). Both the industries were found to raise the COD at mixing point and downstream more effectively in pre-monsoon. At Sankhu, the measured parameters were well within the standard of drinking water (WHO 2002). Further more, they were also found within the acceptable limit of water quality recommended for Bagmati river system (MoPE 2001). Effluents from industries are not complying with existing national standard, which is clearly indicated by the magnitude of parameters like temperature, p^H, T.S.S, BOD, COD, and Cr being found far beyond the generic standard for industrial effluent discharged into inland surface water. The higher magnitude of parameters in beverage industries may be due to the various reason like the use of chemicals in production process, washing of bottles, cleaning of plants and industrial premises, treatment of water for production process, draining of excess or leaked beverage itself etc. For CI, use of various chemicals and dyes for dyeing, discharge of spent dye after the completion of the process, washing of dyed wool, particulate of wool itself etc could be the possible reason for high concentration of measured parameters.

The effluents from these industries have been observed polluting from MP along respective 100m stretch of river especially during low flow months; however, such effects are highly attenuated in monsoon due to high discharge of river. Thus, it can be said that besides industrial effluents, River Manohara is getting progressively polluted with other sources, which might possibly be municipal sewage or agricultural runoff or both. It was further found that 100m stretches of Manohara River was not enough distance to completely disperse the observed concentration of pollutants at acceptable level in low flow season.

Conclusion

Author recommend need of further study, considering more distance separated at decreasing interval to find the exact point of complete dispersion of pollutants. The dyeing industry should detain their effluent for sometime and discharge only when temperature drops below 40^0C, which will also help to settle suspended solid. The dyeing factory should avoid using chromium and other heavy metal containing synthetic dyes.

Acknowledgement:
Prof. Dr. Mohan Bikram Gewali (TU) and Mr. Tek Jung Mahat (ICIMOD)

Reference:

APHA, AWWA, WEF, (1998): *Standard Methods for Examination of Water and Wastewater*. American Public Health Association, Washington DC., 20th edition.

WHO, (2002): *Guidelines for Drinking Water Quality*. World Health Organization, Geneva, AITBs publishers and distributers, Delhi-IInd Ed, vol. (2).

DCSI, (2003): Industrial Promotion Statistics. Department of Cottage and Small Industry/ MOI/HMG, Tripureshwor, Kathmandu, Nepal.

ICIMOD/MOPE, (2001): *State of Environment Nepal*. Ministry of Population and Environment, Kathmandu, Nepal.

DHM, (1996): *Water Quality Data of Rivers of Kathmandu Valley (1992-1995)*. Department of Hydrology and Meteorology, HMG/N, Kathmandu.

Gewali, M. B., Amatya, R., Rai, R. Awale S. and Schaumberg, G. D.,_*Journal of Nepal Chemical Society* (1994). *"Chemical Analysis of Industrial Wastewater from Kathmandu Valley".*

HMG/MoPE, (1994): *The Bagmati Basin Water Management Strategy Investment*. HMG, Ministry of Housing and Physical Planning With Assistance of The World Bank, Final Report, April 1994.

HMG/MoPE, (2001)*: Tolerance Limit for Industrial Effluent Discharged into Inland Surface Water*. Baishakh 17, 2058, section 51, Division 3, notification 3.

HMG/MoPE, (2003): *Generic Standard for Industrial Effluents Discharged into the Public Sewers.* Nepal gazette.

HMG/MoPE, (2003): *Generic Standard for Industrial Effluents Discharged into Inland Surface Water Coming out From Combined Sewage Treatment Plant*. Nepal gazette, 9 Ashad 2060, Section 53, Division - 3, Division -2.

HMG/NBSM, (1997): *Tolerance Limit for Industrial Effluents Discharged into Inland Surface Water*. HMG/N, Nepal Bureau of Standard and Meteorology, Kathmandu.

HMG/NBSM, (1999): *Tolerance Limit For Industrial Effluents Discharged Into Inland Surface Water.* Nepal Bureau of Standards and Meteorology/HMG, Kathmandu, Nepal.

IUCN, (1991): *Sources Of Industrial Pollution in Nepal*. A National Survey, HMG N, NPC/IUCN, Kathmandu, Nepal.

Mendham, J., Denney, R.C., Barnes, J.D., Thomas, M (2000) *Vogel's Textbook of Quantitative Chemicals Analysis*, 6th Edi. Pearson Education Ltd. Indian Branch, Delhi, India.

Chapter 2 Participants of the Workshop

Appendix 1

Participants-"National Workshop on Conserving Nepalese Wetlands: Sharing Experiences and Building Partnership"

Venue: Nepal Tourism Board (Lecturer Hall)

S.N	Name of Participants	Organization	Email/Contact
1.	Sharddha Tuladhar	Nepal Travel Trade Reporter	nttreporter@mail.com.np
2.	Sudeep Kumar Kayastha	College of Applied Sciences Nepal	deepukarna@gmail.com
3.	Padam Bahadur Rokaya	College of Applied Sciences Nepal	prokaya@yahoo.com
4.	Soni Aryal	College of Applied Sciences Nepal	aryalsoni@hotmail.com
5.	Anushiya Shrestha	College of Applied Sciences Nepal	anushiya123@hotmail.com
6.	Bindu Shova Ranjit	College of Applied Sciences Nepal	burmo98@hotmail.com
7.	Laxmi Prasad Timilsina	ECOAN	laxmitm5@yahoo.com
8.	Aananda Raj Joshi	Environmentalists' Association of Nepal	joshi_ananda@yahoo.com
9.	Gaurab Raj K.C	WEPCO	auril_stranger@yahoo.com
10.	Durga Bhakta Pokharel	Patan Multiple Campus	pokharel_db@yahoo.com
11.	Dhruba Babu Subedi	Patan Multiple Campus	volcanism_me@yahoo.com
12.	Mochan Bhattarai	Amrit Science College	mochanbhattarai@hotmail.com
13.	Ashok Raj Wagle	Trichandra College	urfrien_ashok@hotmail.com
14.	Arun Prasad Bhattarai	Trichandra College	urlonelyarun@yahoo.com
15.	Ishwor Raj Bartaula	CDES, TU	irbartaula@hotmail.com
16.	Sanjay Khanal	Kathmandu University	sanjay@ku.edu.np
17.	Kripa Maharjan	Trichandra College	k_ripa@hotmail.com
18.	Sushil Anu	ECCA	ecca@mos.com.np
19.	Shalik Ram Sigdel	SAFE Concern	sr_sigdel@hotmail.com
20.	Rewati Niraula	CDES, TU	brooz_rn@yahoo.com
21.	Nawaraj Tiwari	CDES, TU	nawarajenv@gmail.com
22.	Maneesha Rajbhandari	Environmentalists' Association of Nepal	rmaneesha@wlink.com.np
23.	Aseem Sharma	Living Earth	nature_aseem@yahoo.com
24.	Subodh Adhikari	Amrit Science College	ssubory@yahoo.com
25.	Ramesh Paudyal	CDES, TU	pauramesh@hotmail.com
26.	Bhoj Raj Shrestha	Dolphin Conservation Centre	091-580173, 091-621189
27.	Anju Parajuli	Environment Concern Group Nepal	par_anju@yahoo.com
28.	Sarita Karki	Environment Concern Group Nepal	karki_sarita07@yahoo.com
29.	BP Bhurtel	Khwopa College	bp_sepb2@yahoo.com
30.	Anu Shrestha	ECCA	anistha90@hotmail.com
31.	Madan K. Suwal	Khwopa College	loyinms@hotmail.com
32.	Ghanendra Uprety	Tribhuvan University	-
33.	Bipin Paudel	CDES, TU	poudelbipin@gmail.com
34.	Mitra Raj Dangi	-	-
35.	Neena Karmacharya	Padma Kanya College	karmachy02@yahoo.com
36.	Manoj Rana	KITS	renomdream@hotmail.com
37.	Jyoti Devkota	SAMAX	jdevkota@bhrikuti.com
38.	Kabita Karki	CDES, TU	kabkar1@gmail.com
39.	Bishowamber Khadka	CDES, TU	madhav_khadka@yahoo.com
40.	Bikash Tripathi	Friends of Nature	btripathi@fonnepal.org
41.	Himlal Shrestha	CEMECA	hlshrestha@gmail.com
42.	Devendra Bista	NPU	4232084
43.	Laxmi Thapa	CDES, TU	ltamrakar977@hotmail.com
44.	Bhumika Shrestha	Padma Kanya Campus	2170698
45.	Cheli Gurung	Padma Kanya Campus	2388175
46.	Anju Pandit	CDES, TU	anjupandit16@yahoo.com
47.	Tek J. Mahat	ICIMOD/NRCT/EAN	tmahat@icimod.org
48.	Sameer Karki	Winrock International	skarki@winrock.org.np
49.	Anil Shrestha	SAFE Concern	anilinaus@gmail.com

50.	Karmath Subedi	Amrit Science College	karmath.subedi@gmail.com
51.	Sudeep Devkota	Environmentalists' Association of Nepal	devkotasudeep@gmail.com
52.	Samir Thapa	SMSH	info@silvermountain.edu.np
53.	Keshav Kumar Sharma	Environmentalists' Association of Nepal	keshav91@yahoo.com
54.	Dilli Bhattarai	Water Partnership	dbhattarai2000@yahoo.com
55.	Sailesh Shakya	Trichandra College	saigam709@yahoo.com
56.	Dwarika Aryal	IUCN	dwarika@iucn.org.np
57.	Ngamindra Dahal	National Trust for Nature Conservation	ndahal@ntnc.org.np
58.	Bhupendra Devkota	College of Applied Sciences Nepal	devkotajb@yahoo.com
59.	Ranjit Pandey	CDES, TU	ranjit_pandey@hotmail.com
60.	Pragati Shahi	The Kathmandu Post	ma_pragati@yahoo.com
61.	Krishna Khakurel	Trichandra College	krishna_khakurel@yahoo.com
62.	Laxman Dangol	Trichandra College	dangolax@yahoo.com
63.	Prakash C. Aryal	Khwopa College	aryal_c@yahoo.com
64.	Bishal Rijal	Khwopa College	env_bishal@yahoo.com
65.	MK Dhamala	Khwopa College	dmankumar@yahoo.com
66.	Binod Dawadi	Patan College Environment Department	dawadibinod@yahoo.com
67.	Pabitra Adhikari	Patan College	pabitra_7cc@hotmail.com
68.	Sujita Bhattarai	Amrit Science College	spicy_sujita@hotmail.com
69.	Mamila Pradhan	Amrit Science College	mamilapradhan@yahoo.com
70.	Buddi Sagar Paudel	DNPWC	buddi.paudel@gmail.com
71.	Jhamak Bahadur Karki	DNPWC	dnpwc@wlink.com.np
72.	Tika Ram Adhikari	DNPWC	-
73.	Uba Raj Regmi	DNPWC	-
74.	Shiva Devkota	SAFE Concern	devkotashiva@yahoo.com
75.	Shishir Adhikari	Tribhuvan University	asisir@hotmail.com
76.	Rajeshwor Paudel	Trichandra College	rajeshor_paudel@yahoo.com
77.	Santosh Kafle	Trichandra College	santosh_kafle@hotmail.com
78.	Netra Prasad Osti	NARC	n_osti@yahoo.com
79.	Vimal Thapa	Bird Conservation Nepal	vimal@av.wlink.com.np
80.	Jeeban Panthi	Trichandra College	panthijeeban@hotmail.com
81.	Madan Koirala	CDES, TU	-
82.	Lekh Raj Nirola	Nepal Village Resort	bbc@wlink.com.np
83.	Krishna Pithakoti	Borderland Resort	4361995
84.	Barsha Rupakheti	Rehdon College	-
85.	Sneha Pathak	Rehdon College	sneha_pthk@yahoo.com
86.	Amit Shrestha	KITS College	khandbari_1@hotmail.com
87.	Pragya Paudyal	KITS College	pragyapaudyal@hotmail.com
88.	Shankar Shah	Samaya	4427073
89.	Advocate Mr. Paudel	HUREP Nepal	advocate_mpaudel@hotmail.com
90.	Achyut Dahal	Nepal River Conservation Trust	nrct@wlink.com.np
91.	Anil Chitrakar	ECCA	achitrakar@ashoka.org
92.	Bhairav Risal	Seniro Journalist	-
93.	Naresh Rimal	SEEP Water	-
94.	Tara Giri	Padma Kanya College	taragiri@rediffmail.com
95.	Srijana Bhattarai	Padma Kanya College	shreejsweet@yahoo.com
96.	Sharda KC	College of Applied Sciences Nepal	fren_sha@yahoo.com
97.	Sangita Shakya	College of Applied Sciences Nepal	shakya_sangita20@hotmail.com
98.	Mridaney Paudel	College of Applied Sciences Nepal	mridaney@hotmail.com
99.	Puja Thapa	College of Applied Sciences Nepal	puja100@hotmail.com
100.	Mausam Khanal	Environment Concern Group Nepal	ilamesathi.mausam@gmail.com
101.	Dev Raj Sapkota	Environment Concern Group Nepal	hermit_jogi@yahoo.com
102.	Sanam K. Aksha	Nepal River Conservation Trust	nepaliketo.raj@gmail.com
103.	Bhaskar Kafle	Environment Concern Group Nepal	kaflester@gmail.com

Appendix 2

Co organizers, Supporters, and In Association With

Organizer

Nepal River Conservation Trust (NRCT)

Co organizer

Environmentalist Association of Nepal (EAN)

Supporters

Department of National parks and Wildlife Conservation Nepal (DNPWC)

Nepal Tourism Board (NTB)

Sustainable Tourism Network (STN)

National Trust for Nature Conservation (NTNC)

In association with

Bird Conservation Nepal (BCN)
Borderland Resorts (BL)
Central Department of Environmental Science (TU)
College of Applied Sciences Nepal (CAS)
Department of Environmental and Biological Sciences (KU)
Department of Fisheries
Environment and Sustainable Development Organization (ESDO)
Environmental Camps for Conservation Awareness (ECCA)
Environment Concern Group Nepal (ECGN)
Friends of the Bagmati (FOB)
Himal Media
International Centre for Integrated Mountain Development (ICIMOD)
The World Conservation Union (IUCN) Nepal
Kathmandu Institute of Technical Sciences (KITS College, TU)
Khwopa College
Ministry of Environment, Science and Technology (MoEST)
Nagdaha Sudhar Samiti
Nepal Cycling Club (NCC)
Nepal Forum of Environmental Journalists (NEFEJ)
NGO Forum for Urban Water & Sanitation
ProPublic
Taudaha Youth Club
The Centre for Sustainability, Environment, Equity and Partnership (SEEP)
Ultimate Descents (UD)
Wildlife Conservation Nepal (WCN)
Winrock International
Women Environment Preservation Committee (WEPCO)
World Wildlife Fund (WWF-Nepal)
YATRA

Organizer Profile

Nepal River Conservation Trust

Introduction

The Nepal River Conservation Trust (NRCT*)* is a non-profit organization that was established by a group of concerned river guides who recognized the ecological and cultural damage that was taking place on Nepal's rivers at an alarming rate.

Since its inception in 1995, the NRCT has worked towards conserving Nepal's cultural heritage and developing an environmentally responsible river tourism industry.

Our Himalayan River is an international attraction; however; their existence is under threat from damming and other unfriendly environmental practices.

Our Mission

"To restore, conserve and protect the rivers of Nepal through affirmative action and education, whilst maintaining the cultural integrity of local river side communities."

Objectives

Increasing public awareness through workshops, seminars, and special rafting trips to policy makers, journalists, students and other stakeholders.

- River side community development;
- River-guide training on environmentally sound rafting and camping practices.
- Conducting River restoration projects such as beach clean up and tree plantation;
- Networking with national and international groups and lobbying on the behalf of Nepal's river environment etc.

For our communities

- To identify and develop riverside conservation and community projects.
- To educate village communities about the causes and effects on river due to water pollution and land degradation.
- To raise awareness for conservation and community projects along the rivers.
- To ensure that the community alongside the river benefits directly from income generating activities.

For the natural environment

- To maintain and enhance the natural environment alongside the rivers.
- To promote and implement conservation activities on Nepalese rivers.
- To endeavor to find and ecological balance between human needs and wants and the fragile river ecosystems.

For the Rafting Industry

- To promote sensible and ecologically sustainable rafting kayaking and canyoning practices for Nepalese rivers.
- To work with partner organization of similar interest for the benefit of the rivers, river communities and rafting industry.

Overall, it must be highlighted that NRCT seeks to extend its activities into the international arena, extending its linkages with various environmental bodies to improve and sustain river conservation in Nepal. NRCT seeks to affiliate itself with all of the Nepal Rafting Agency, as it is essential that all agencies must unite for the common goal of protecting our national rivers from complete destruction (which will be the case if immediate action does not take place.)

Ongoing Long Term Efforts of NRCT

- Annual River Festival in Bhotekoshi since last 6 years (2nd February-March Last). This festival includes celebration of World wetland day (Feb-2nd), workshop for river guides, clean-up campaign, friendships floats, workshop for school children and communities, rafting trips, kayaking, and canyoning.
- Bagmati River Festival in Holy river Bagmati since last four years (June 5th – August 4th Week). This festival comprises activities like; celebration of world environment day (June 5th), clean-up campaigns, tree plantation, cycle rallies, heritage walk (promenade), research paper presentation, Competitions among school children (Poetry, Speech, Drawing, Photography, etc), media, corporate, and public rafting trips, kayaking, Bagmati eco-challenge (Mini marathon-Mountain biking, rafting and kayaking competition), music concert, poster and banner display, Anti-Plastic Campaign, Composting Training, food festival, professional kayak race, friendship float, exhibitions etc.
- Seti River Festival in Seti since last 2 years Sept,(27th-30th). This festival includes Clean-up campaign in Seti ricer and Phewa Lake, workshop on river conservation for school children, awareness rallies, rafting trips and down water kayak race etc.

Ongoing Short Term Effort of NRCT

- Workshop for river guides during monsoon, off-season and winter
- Field work such as plantation during monsoon
- Workshop for river community and schools
- Volunteer projects for international school participants
- International event for river conservation
- Kayak Rodeo, White water championship

Developing the course of study for river conservation and for kayaking and rafting in Nepal

- Implementation of Code of Conduct
- Bring awareness on Eco-tourism among all tourism entrepreneurs and let them be informed them that the river is a part of it
- Networking with I/NGOs in general and international river conservation communities in particular
- All river-guides and owners of river companies should be concerned about river conservation issues
- Implement school and college programs pertaining to river conservation
- Conservation and sustainability of the Himalayan rivers for our future generation
- Development and sustain Community Development Projects along Nepal's rivers
- Issuing and publishing River Conservation journal regularly after conducting relevant environmental and social impact assessments. Projects along Nepal's rivers
- Issuing and publishing River Conservation journal regularly after conducting relevant environmental and social impact assessments
- Conduct training program for river guides on First Aid and SRT (Swift Water Rescue Technician)
- Educate river guides on natural history and river conservation issues with the cooperation of NARA (Nepal Association of Rafting Agencies) and ANRGA (All Nepal River Guides Association).

WELCOME TO NRCT AND THANK YOU FOR YOUR CONTRIBUTION

Reg.No.231/051/52
Tel: 2357122, 4700894
E-mail:nrct@wlink.com.np
URL:www.nepalrivers.org.np
P.O.Box.:12346, Kathmandu, Nepal

Contact Person:
MR. ACHYUT DAHAL-COORDINATOR
9841633485