



Environment

Water Community



Solution Exchange for the Water Community Consolidated Reply

Query: *Water Quality Monitoring of Lakes - Experiences;
Advice*

Compiled by Ramya Gopalan, Research Associate

Issue Date: 31 December 2007

From [Latha Bhaskar](#), Community Environmental Resource Centre (CERC), Ashoka Trust for Research in Ecology and Environment (ATREE), Alapuzha, Kerala

Posted 15 November 2007

Like any other water body, Lakes are common property resources whose appropriation was guided by well-defined social norms and customs. However, growing population pressure, emergence of new stakeholders, private dominance of resource allocation and use and the granting of rights by the Government to use the water body without evaluating its cumulative impact on backwaters and biota, has led to largely uncontrolled resource use. Additionally the lakes serve as a sink for effluents of several industrial and manufacturing units, agricultural run offs, and domestic sewage which deteriorates the water quality of the lakes and causes water borne diseases thus affecting the well being of the people and habitat needs of other life forms.

Constant monitoring of the water quality provides better understanding about the condition of the lakes and provides a base for developing effective management practices. Existing official monitoring systems is not extensive enough to understand the real situation of the lakes and existing regulations are insufficient to address the problems. Given, the large number of stakeholders official monitoring efforts alone cannot halt this deterioration.

In this context, I request members of the Solution Exchange Water Community for their experiences and expert opinion on the following aspects:

1. Based on experiences, suggest the most essential parameters to be used for screening the water quality of the lake.
 - a. Simple parameters that can be tested through community participation using simple field test kits/simple machines available on market.
 - b. Essential parameters that need to be tested in lab situations.
2. Details of the Agencies supplying field screening test kits with cost range etc.
3. Frequency of these monitoring activities
4. Details of Research studies on Lake water Monitoring done by various institutions ,available for cross reference.

The ATREE (Ashoka Trust for Research in Ecology and Environment) is initiating a study in Vembanad region (Ramsar site) and one of the objective of this effort is "To develop a scientific and pragmatic methodology for participatory monitoring of the water quality involving local community, stakeholders and other interested agencies /groups". In the link below is the preliminary brief of the project proposal i.e. Vembanad Water Watch Partnership Programme (VWWPP) for background reference.

<http://www.solutionexchange-un.net.in/environment/cr/res15110701.pdf> (Size: 101 KB)

Members may kindly note that this is a draft, which is to be modified further in the light of, cross consultations. The link for our site is <http://www.vembanad.org/> (to be updated shortly)

We therefore look forward to the reactions of members which will be helpful to finalise the parameters for the water quality monitoring programme (Vembanad Water Watch Partnership Programme), scheduled to be implemented shortly.

Awaiting your solutions.

Responses were received, with thanks, from

1. [Shrikant D Limaye](#), Ground Water Institute, Pune
2. [Arunabha Majumder](#), School of Water Resources Engineering, Jadavpur University, Kolkata
3. [R.Srikanth](#), WaterAid, New Delhi
4. [Yusuf Kabir](#), UNICEF, Kolkata
5. [M. Manoj Kumar](#), Development Alternatives, New Delhi
6. [Vijay Krishna](#), India Water Portal, New Delhi
7. [A.A.Kazmi](#), Department of Civil Engineering, IIT Roorkee, Roorkee
8. [T.N.Anuradha](#), United Nations, New Delhi
9. [Lizette Burgers](#), UNICEF, New Delhi
10. [Ashok Ghosh](#), Department of Environment and Water Management, A.N. College, Patna
11. [Shailja Kishore](#), Consultant, Ahmedabad
12. [Amitangshu Acharya](#), Arghyam, Bangalore
13. [Srinivas Moorthy](#), Department of Earth Sciences, Annamalai University
14. [Mrinalinee Vanarase](#), IORA for Environmental Solutions, Pune
15. [Abhay Kumar](#), Toxics Link, New Delhi
16. [B.C.Choudhury](#), Wildlife Institute of India (WII), Dehradun
17. [Deepa Prabhu](#), ICICI Bank, Mumbai
18. [Manish Kumar](#), Technology Information Forecasting and Assessment Council (TIFAC), New Delhi
19. [Usha Srinivasan](#), Development Alternatives, New Delhi*

**Offline Contribution*

Further contributions are welcome!

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Summary of Responses

Discussing water quality monitoring in lakes, members shared insights on the context, monitoring, testing, and frequency parameters, outlined conditions, and listed steps to ensure effective monitoring.

Respondents explained Limnology as the **study of fresh water aquatic systems**, and noted that lake management is a long-term process with many issues, particularly relating to water quality in lakes. Lakes are a special water entity, surrounded by land without any significant inflow, thus if pollutants enter through local run-off or industrial discharge, it can affect the productivity and health of the lake. Members highlighted the belief that high volume lakes can dilute any amount of pollutants; however, they pointed out that greater dry season use, lowers lake water volume increasing concentration of pollutants to critical levels causing algal bloom, fish die offs, and water borne diseases.

The best way to monitor lake water, discussants explained is to examine them seasonally, because lakes are characterized by thermal stratification, which normally breaks down in winter due to temperature phenomenon, leading to nutrient circulation, and changes the measurement parameters. Thus, taking samples from different zones and using different samplers surface, represent better the water quality.

Members noted a set of basic fixed **parameters** (i.e. BOD and COD and pH, and sometimes heavy metals) used for assessing water quality; most requiring laboratory testing. There are also a few indicators, like vegetation and aquatic fauna, which depend on the site and degree of disturbance. Members mentioned a number of [essential parameters](#), physical and chemical in assessing the water quality. After conducting a geographical appraisal of a lake, in relation to its position, water quality can be measured on the basis of existing life forms, biological indicators, entry points for pollution, and eutrophication. Members also suggested [simple parameters](#) that communities can use, employing simple field test kits/machines available on market, including pH; temperature and turbidity; dissolved oxygen and lake depth. One such kit is the [Jal-TARA kit](#), which an NGO used to train students from the [Yamuna Yatra](#) to use to do water quality monitoring. Additionally respondents advised measuring the dissolved oxygen level at various depths weekly using a DO meter pH and recording daily temperatures, which can be used to help derive some basic information on lake water quality conditions.

Members further recommended simple biological indicators, which can be used to assess whether a lake is polluted or not. Along with physical and chemical parameters, the presence or absence of certain aquatic life (Bio monitoring) is another important indicator. Bio monitoring is a qualitative tool; communities can use to monitor the health of local water bodies, primarily surface water. It is a user-friendly, cost-effective, and efficient water quality-monitoring tool, and discussants recommended training communities to use this tool instead of chemical parameters, which are usually complex. Respondents through a [table](#) also highlighted the Central Pollution Control Board's [Biological Water Quality Criteria](#) developed based on the taxonomic presence of water species.

Members also cited studies from [Karnataka](#) and [Rajasthan](#) looking at bird diversity, and suggested using this as a parameter. The studies shared indicated physical and chemical contamination of river bodies directly affect the survival and existence of birds, often reducing the migratory bird population, which can be used a sort of a "Litmus paper of the environment."

Members re-emphasized that as far as ecologists and biologists are concerned very often even without monitoring; they can provide views about the water quality looking at indicator species as well as resident and migratory waterfowl abundance. Thus, the presence or absence of a particular bird, its physical appearance, behaviour, etc. can help in assessing water quality.

Discussants noted that despite the **numerous water quality analysers** available, the choice between using a water monitoring kit or a well-equipped lab depends on the degree of accuracy required and purpose. If monitoring is for record keeping and study, then accuracy and reliability of the data is significant, and can only be gathered with sophisticated instruments. [Water quality monitoring kits](#) are only best when data is collected regularly, because the percentage variant may be up to (+/-) 15-20 from the actual. Therefore, organizations and communities must choose between the various testing kits ranging from single to multi-parameters, those based on volumetric and others use colorimetric methods. Another option is to use field-based water testing kits for screening certain parameters and if the parameters cross desirable/permissible limits, the results must be brought to a lab for validation. Members felt these kits are playing a vital role in the monitoring of water quality. However, they cautioned that field-testing kits can only be used to monitor some parameters and often provides semi-quantitative results. Members also mentioned the "The Standard Methods: APHA Manual," which provides information regarding methodology and comprehending test results

Drawing from the experience of a project on the [Bhoj Wetland](#), members reiterated that selection of wetland water quality parameters and monitoring is contingent on the objectives and that it is essential to consider the test results for all parameters before reaching conclusions about the lake. Given the complexity of the issue, they stressed the need for laboratory facilities, with technicians trained in biological and chemical analysis.

Regarding the **frequency of testing**, discussants noted physical and chemical parameters undergo severe fluctuations- diurnal and seasonal. They thus suggested testing on a regular basis to identify variations and recommended doing meticulous DO testing at the site and hourly DO testing for 24-hours. Labs can also use analytical techniques to monitor the total Phosphorus and Chlorophyll on a monthly basis. They recommended several [organizations](#) developing field test kits, particularly those communities can utilize.

Discussants noted two major concerns with relation to lakes, one the "Eutrophication" process due to nutrient loading derived from detergents and nitrates from industrial sources. Two is the sampling procedure, which requires collecting seasonally and at different depths to assess the nutrient loading of the lake. Members therefore emphasised the **importance of lake water quality monitoring** to understand periodic changes in characteristics and comprehend how it is transforming, from Oligotrophic to Mesotrophic to Eurotrophic. A lake's changing productivity reflects its impact on the ecosystem, enabling appropriate action. Additionally, it is necessary to note if a lake recharges an aquifer, a polluted lake can pollute groundwater. The quality of lake water varies within the lake, laterally and vertically. Therefore, if possible, at least one sampling point per km of lakeshore is required. Vertical sampling in the lake centre may be done twice a year, after Monsoon rains (October) and end of summer (May).

Citing the examples of Mumbai, [Gujarat](#) and **Wisconsin, USA**, Members noted that water quality and clean up initiatives are undertaken with greater interest and efficiency when lakes serve as a key source of drinking water and are well integrated into the village systems. Respondents also highlighted the need for transparency in the water quality monitoring process and suggested involving local academic institutions and communities in citizen watchdog programmes on water quality, to help ensure transparency. They thus stressed **community participation and management** as essential to maintain lake water quality, but as most tests demand laboratory facilities, communities cannot do it independently. Moreover, it is necessary

to make water resource managers understand the concepts of critical minimum water levels and build these management regimes in their annual calendar of monitoring process.

Finally, discussants concluded by emphasising that given the significant characteristics and benefits lakes provide, there is an urgent need for holistic water management of lakes with plans developed for normal water quantity years as well as for years when there are extreme high and low water availability issues.

Additional Material

Simple Parameters for Water Quality Testing include:

1. P^H (by P^H paper strip, P^H Pen meter)
2. Temperature (by thermometer)
3. Turbidity (portable water analyzer kits)
4. Dissolved Oxygen (by Digital D.O. Meter) and v. Depth of Lake.

Essential Parameters that need to be tested in lab situations include:

- Total Dissolved Solids & Total Suspended Solids (BOD, COD, TDS/EC)
 - Productivity of the Lake
 - Total Phosphate
 - Nitrate
 - Potassium
 - Chlorophyll-a
 - Total Coliform & Fecal Coliform
 - Calcium
 - Magnesium
 - Some heavy metals
 - Hardness
 - Sulphates
 - Ammonia
 - Chloride
 - Total Nitrogen
 - Dissolved Oxygen
 - Benthos-benthic diversity
 - Metals depending on Industrial Waste discharges
 - Phosphorous and Orthophosphate
 - Algal Count
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Comparative Experiences

From [T.N.Anuradha](#), *United Nations, New Delhi*

Karnataka

Bird Diversity in Wetland Habitats, Malnad, Western Ghats

In wetlands streams, riverbeds, estuaries, ponds, lakes, waterbeds, marsh are interlinked forming a network, constituting a complex interdependent ecosystem. Excessive vegetation, reduced water clarity, enrichment of waters, siltation and high microbial activity are key environmental concerns. 22 species of aquatic birds were recorded which have now disappeared due to reduced water levels thus disturbing the food chain. Read [more](#).

Rajasthan

Endangered Bird Species in Wetlands, Keoladeo Ghana National Park, Bharatpur

This site is famous for endangered cranes, the Siberian crane (*Crus lucogenanus*), visiting India every year during winter. Keoladeo Ghana was the only place in the country where the exotic population of migratory birds regularly used to visit. However, over the last three decades, the cranes have reduced in number from around 200 Nos. in 1964-65 to just four in 1991-92. Their duration of stay also decreased due to change in habitat conditions. Read [more](#).

Gujarat

Indigenous Practices of Water Scarce Villages, Kutch (from [Shailja Kishore](#), Consultant, Ahmedabad)

Ponds are integrated into the lives of the water scarce villages in the region. In village Dhorado, a wire mesh filter was used to drink pond water. [WASMO](#) helped prepare a proper filter bed and installed a solar pump. In village Khari of Pascham Vistar, Khawada, regulations were followed for protecting and maintaining the pond. Potable testing kits are also used and a monitoring committee formed recorded findings at regular intervals and adopted remedial measures.

Madhya Pradesh

Payment for Environmental Services Project, Bhoj Wetland, Bhopal (from [Amitangshu Acharya](#), Arghyam, Bangalore)

[WII's project](#) on the wetland aimed at urban-rural trade off for improved lake water quality. [LCA](#) undertook data collection and monitoring processes based on select parameters. The lake was divided into rural and urban influenced zones and off 15 sample sites 2 urban and 5 rural were chosen and monthly data acquired was averaged into four quarters. Based on parameters Surface and Bottom, Seasonal Fluctuations and Averaging comparisons were conducted.

New Delhi, Vrindavan and Agra

Yamuna Yatra (from [Usha Srinivasan](#), Development Alternatives, New Delhi)*

High school students trained by [DA](#) undertook water quality monitoring using [Jal-TARA kit](#) at Delhi, upstream and downstream at Vrindavan and Agra, interacting with all local stakeholders. Samples collected revealed alarming DO levels varied at upstream, midstream and downstream. The program made aware the importance of involving youth/students and trained teachers and students to use the kit and monitor Municipal drinking water supply, surface and groundwater.

* *Offline Contribution*

Related Resources

Recommended Documentation

Biological Water Quality Criteria (BWQC) (from [Yusuf Kabir](#), UNICEF, Kolkata)

Monitoring Index; Central Pollution Control Board (CPCB); Chapter V, Annual Report, 1999 - 2000 Available at http://www.cpcb.nic.in/oldwebsite/annual_report1999-2000-14.htm

Based on taxonomic presence of water species, enumerating how presence/absence of specific biotic communities in the aquatic environment is influenced by the water quality

National Rural Water Quality Monitoring & Surveillance Programme (from [M. Manoj Kumar](#), Development Alternatives, New Delhi)

Guidelines; Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water Supply; Ministry of Rural Development; Government of India; New Delhi; January 2006

Available at <http://megphed.gov.in/knowledge/standards/WOMSguide.pdf> (PDF Size: 336 KB)

Presents the guidelines of the program which monitors water quality through field test kits allowing for a personal approach in recording results

Evaluation of Water Quality Field Test Kits (from [M. Manoj Kumar](#), *Development Alternatives*, New Delhi and [Vijay Krishna](#), *India Water Portal*, New Delhi)

Study; UNICEF; June 2005

Available

at

http://www.indiawaterportal.org/data/kits/Field%20Test%20Kits_2nd%20Feb%2006_PRINT.PDF

(PDF Size: 516 KB)

Documents the performance evaluation of different field kits and recommends that prior to choosing a test kit a check for its efficacy must be undertaken

From [T.N. Anuradha](#), *United Nations*, New Delhi

Status and Conservation of Bird Diversity in Western Ghats of Karnataka, South India

Paper; by A.K.Chakravarthy; Chapter 12, *Conservation of Rainforests in India*; ENVIS India, Wildlife Institute of India (WII); Dehra Doon

Available at http://www.wii.gov.in/envis/rain_forest/chapter12.htm

Details the biodiversity of the wetlands and the changing patterns of the various bird species as an indicator of the water and environmental quality of the wetlands

Bio-Monitoring of Wetlands in Wild Life Habitats of Birds Sanctuaries in India - Case Studies

Article; Newsletter Archives; Central Pollution Control Board (CPCB)

Available at <http://www.cpcb.nic.in/News%20Letters/Archives/Bio-monitoring/ch3-bio.html>

Illustrates through the example of Keoladeo Ghana wetlands, how the presence and pattern of bird species in a wetlands is a bio-indicator of the water quality in the region

Fair Deals for Watershed Services in India (from [Amitangshu Acharya](#), *Arghyam*, Bangalore)

Report; by A. Acharya; IIED; October 2007; Permission Required: Yes. Paid Publication

Available

at

<http://www.iied.org/pubs/display.php?o=13538IIED&n=1&l=1&a=A%20Acharya&x=Y>

Shares field experience/lessons to develop incentive-based mechanisms for watershed protection services and improve livelihoods and also reports on the Bhoj Wetland efforts

From [Deepa Prabhu](#), *ICICI Bank*, Mumbai

Assessing a Lake's Water Quality Status

Fact Sheet; US EPA and Lake Management Society; Pennsylvania

Available at http://www.palakes.org/publications/lake_assessments.pdf (PDF Size: 20 KB)

Brief on the Citizens Volunteer Monitoring Program, providing information on the parameters to monitor and area and frequency of monitoring processes

Blame Game Over Lake Cleanliness Continues

Article; by Jayadev Calamur; News, Thane Plus; Times Group; Mumbai; Saturday, 17 November 2007

Available

at

http://www.mumbaipluses.com/thaneplus/index.aspx?page=article§id=1&contentid=2007111720071116151901359244ef9_dd§xslt=&comments=true

Discusses how the TMC maintains that they are regularly cleaning the lakes in the city while residents claim that the TMC is apathetic to the poor condition of the lake

Biosanitizer - A Resource for Ecosanitation

Article; by Uday S. Bhawalkar, Director and Sarita U. Bhawalkar; Bhawalkar Ecological Research Institute (BERI); Waste to Health; Pune

Available at http://www.wastetohealth.com/biosanitizer_ecosanitation_resource.html

Details the naturally produced catalyst that continues to produce need-based amount of active oxygen and drives eco-logical reactions that cleans polluted water

From [Ramya Gopalan](#), Research Associate

Pollution, Assessment, Monitoring & Survey

Status Report; Central Pollution Control Board (CPCB); New Delhi

Available at <http://www.cpcb.nic.in/about%20us/Division%20at%20Head%20office/PAMS/PollutedRiverStretches.html>

Presents data from National Water Monitoring Programme (NWMP) and River Basin Studies indicating water quality deterioration in riverine segments and other water bodies

Wetlands Restoration and Conservation – What, How and Why

Case Study; Centre for Ecological Sciences; Indian Institute of Science; Bangalore

Available at <http://www.ces.iisc.ernet.in/energy/monograph1/Casepage2.html>

Indicates significance of wetland in performing manifold functions, maintaining ecological balance, and discusses the need for a suitable restoration plan to improve water quality

Recommended Organizations and Programmes

International Lake Environment Committee (ILEC), Japan (from [Shrikant D Limaye](#), Ground Water Institute, Pune)

1091 Oroshimo-cho Kusatsu-shi, Shiga 525-0001; Tel: +81-77-568-4567; Fax: +81-77-568-4568; info@ilec.or.jp; <http://www.ilec.or.jp/eg/index.html>

Aims at promoting the sustainable management of the world's lakes and reservoirs

Environmental Quality Monitoring Group, People's Science Institute (PSI), Uttarakhand (from [Yusuf Kabir](#), UNICEF, Kolkata)

252/I, Vasant Vihar, Dehra Doon - 248006; psiddoon@gmail.com; http://www.peoplesscienceinstitute.com/activities/eqmg/eqmg_intro.html

For further information, training and booklet on bio monitoring of water and environmental quality

Development Alternatives (DA), New Delhi (from [M. Manoj Kumar](#))

111/9-Z, Kishangarh, Vasant Kunj, New Delhi - 110070; Tel: +91-11-26134103/26890380; Fax: +91-11-26130817; tara@devalt.org; <http://www.devalt.org/TEMF.htm>

Conducts water quality monitoring across the country using field based kits Jal TARA; if parameters are found to exceed safe limits, they are then validated in the laboratory

From [Amitangshu Acharya](#), Arghyam, Bangalore

Lake Conservation Authority (LCA), Madhya Pradesh

Paryavaran Parishar, E-5, Arera Colony, Bhopal; mplca@sancharnet.in; <http://mphed.nic.in/Organization.htm#lca>; Contact Dr. Sanjeev Sachdev; Senior Research Officer

Its primary objective is to manage, maintain and conserve lakes, ponds, reservoirs, tanks and other surface & sub surface water resources and play an advisory role to the State

Winrock International India (WII), New Delhi

S-212, IInd Floor, Panchsheel Park, New Delhi - 110017; Tel: +91-11-26013869;
<http://www.winrockindia.org/index.htm>

For details on the payment for environment services project (PES) on the Bhoj Wetland in Bhopal, M.P., a Ramsar site, aimed towards improving its lake water quality

Paryavarn Dakshata Manch, Mumbai (from [Deepa Prabhu](#), ICICI Bank, Mumbai)

Contact Vidyadhar Walawalkar; Tel: +91-22-24559652

NGO involved with environment vigilance in Thane and supported several lake-cleaning initiatives

Tamil Nadu Water Supply and Drainage Board (TWAD), Chennai (from [Srinivas Moorthy](#), Department of Earth Sciences, Annamalai University)

31, Kamaraj Salai, Chepauk, Chennai - 600005; Tel: +91-44-28416420/28412341; Fax: +91-44-28548623 twadboard@dataone.in; http://twadboard.gov.in/main_public_quality.html

Recommended for its efforts on water quality, development of water quality monitoring kits and safety tips

UNICEF, New Delhi (from [Abhay Kumar](#), Toxics Link, New Delhi)

73 Lodi Estate, New Delhi - 110003; Tel: +91-11-24690401/2469.1410; Fax: +91-11-24627521/24691410 newdelhi@unicef.org; <http://www.unicef.org/india/wes.html>

Undertaken activities on preventing contamination of water sources, protection of drinking water sources and development of field monitoring kits for water quality

Water and Sanitation Mangement Organisation (WASMO), Gujarat (from [Shailja Kishore](#), Consultant, Ahmedabad)

3rd Floor, Jalsewa Bhavan, Sector 10-A, Gandhinagar - 382 010; Tel: +91-079-23247170/23247171/23237075; Fax: +91-079-23247485 wasmo@wasmo.org;
<http://www.wasmo.org/eng/programmes-watqual.shtm>

Works on community-based water quality surveillance enabling people to demand safe drinking water and get access to regular, adequate and safe drinking water

Global Environmental Monitoring Stations/ Monitoring of Indian National Aquatic Resource, Central Pollution Control Board, New Delhi (from [Ramya Gopalan](#), Research Associate)

Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032; Tel: +91-11-22305792/22303717; cpcb@nic.in; <http://www.cpcb.nic.in/Water/Water.html>

National network of water quality monitoring with 1019 stations in 27 States and 6 UTs, conducts monthly/quarterly monitoring in surface waters and half yearly in groundwater

Recommended Portals and Information Bases

Water Quality Testing Kits for Field Use, India Water Portal, Bangalore (from [M. Manoj Kumar](#), Development Alternatives, New Delhi and [Vijay Krishna](#), India Water Portal, New Delhi)

<http://www.indiawaterportal.org/data/kits/>; Contact Vijay Krishna; Product Manager; Tel: +91-80-41698941; vijay@arghyam.org

Provides details on various testing kits for water quality that can help establish the presence of any parameter and the extent to which it is present in a particular water

From [Deepa Prabhu](#), ICICI Bank, Mumbai

Citizen Lake Monitoring, Wisconsin State Lake Monitoring Network, Wisconsin, USA

<http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/equipment.htm>

Provides detailed information on sampling devices and the necessary parameters that citizen lake monitors may utilise, useful for volunteers engaged in sample collection

World Water Monitoring Day, Water Environmental Federation (WEF), Virginia, USA

<http://www.worldwatermonitoringday.us/>

International outreach program to build public awareness and involvement in protecting water resources, provides useful information, safety tips, kits and fact sheets

Taal 2007 - 12th World Lake Conference, National Institute of Ecology, New Delhi

<http://www.taal2007.org/>

Contains a number of papers and presentations focussing on lakes and improvement of their water quality

OpenWater Wiki, UNEP GEMS/Water Programme, Ontario, Canada (from [Thomas Bjelkeman-Pettersson](#), Stockholm University, Stockholm)*

<http://www.ungiwg.org/openwater/>

Platform for water quality scientists, researchers and practitioners to discuss analytical methods to facilitate improvement and development for water quality parameters

Water Quality Monitoring, Michigan Department of Environmental Quality, Michigan, USA (from [Ramya Gopalan](#), Research Associate)

http://www.michigan.gov/deq/0,1607,7-135-3313_3686---,00.html; Tel: +1-800-292-4706

Contains several water quality monitoring programs that assist in keeping all of Michigan's water clean such as the beaches, lakes, public swimming pool etc.

Recommended Tools and Technologies

World Water Monitoring Day (WWMD) Kits (from [Amitangshu Acharya](#), Arghyam, Bangalore)

Testing Kits; Owned by World Water Monitoring Day, Water Environmental Federation (WEF), Virginia, USA. Permission Required: Yes, Ordering details available at <http://www.worldwatermonitoringday.us/orderkits/kits.php>

Includes an instruction booklet, material safety datasheet, one hardware set, enough pH and dissolved oxygen reagent tablets to perform 50 tests using four parameters

Jal TARA Kit (from [Usha Srinivasan](#), Development Alternatives, New Delhi)*

Water Quality Monitoring Kit; Owned by CLEAN India Campaign, Development Alternatives, New Delhi. Permission Required: Yes, more details available at <http://www.cleanindia.org/jaltarakit.htm> Contact Tel: 91-11-26134103/26890380; temf@devalt.org

Cost effective, portable, compact and easy to operate water testing kit for water potability, designed for concerned citizens, NGOs, students and public authorities

**Offline Contributions*

Recommended Training Courses

Drinking Water Quality Monitoring and Management, Development Alternatives, Madhya Pradesh (from [Ramya Gopalan](#), Research Associate)

29 January to 31 January 2008. Information available at <http://www.devalt.org/TrainingOnDrinking.htm>. For details contact Juhi Nigam; Tel: +91 9839820689; trainings@devalt.org

Aimed at imparting technical skills and enabling organizations to understand the importance of Water Quality Monitoring and promoting surveillance of drinking water

Related Consolidated Replies

Community-Based Water Quality Monitoring and Surveillance, from Ross Nickson, UNICEF, Kolkata (Experiences). Water Community

Issued 12 October 2006. Available at <http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-12100601.htm>

Presents examples/learnings from initiatives in water quality monitoring (WQM) on whether community based WQM improves drinking water quality via community action

Responses in Full

Shrikant D Limaye, Ground Water Institute, Pune

Please visit the homepage of ILEC (International Lake Environment Committee, Japan): <http://www.ilec.or.jp/eg/index.html>.

I was a Recipient, Ibaraki Kasumigaura Lake Prize, Ibaraki Prefecture, Japan and I found that the site has many useful publications, world lake database, a journal and conference information.

In your studies:

1. See if the lake receives discharge from ground water or it recharges the aquifer. In the later case, a polluted lake can pollute ground water.
2. The quality of lake water varies within the lake, laterally and vertically. If possible, have at least one sampling point per Km of lakeshore. Vertical sampling in the lake centre may be done twice a year, after Monsoon rains (October) and end of summer (May).
3. Initially, just concentrate on basic parameters like Temperature, TDS, Ph, E Coli, Heavy metals, Nitrates, Nitrites, BOD, COD, DOC and Trihalomethanes.

Arunabha Majumder, School of Water Resources Engineering, Jadavpur University, Kolkata

Following Parameters are essential to be monitored to assess the water quality of Lakes:

pH
Turbidity(NTU)
Suspended solids
BOD
COD
TDS/EC
Hardness
Chloride
Nitrate
Total Nitrogen
Dissolved Oxygen
Total and Faecal Coliform

Metals depending on Industrial Waste discharges
Phosphorous and Orthophosphate
Chlorophyll
Temp.

Field-testing kits can be used to monitor certain parameters. It gives semi-quantitative results. Results are good to have some idea. Bacteriological testing can not be done by field kit. H₂S strip test used in field kit is not applicable here. A good lab is needed for W.Q. monitoring. D.O. testing is to be done at site meticulously. Monthly analysis is good to find if any variation; if not feasible, it can be quarterly to have seasonal variation.

Hourly D.O. testing for 24hrs can be done for the lake. You can try CPCB developed field kit. AIHPH has developed field test kit for drinking water. There are others also in the market.

R.Srikanth, WaterAid, New Delhi

Study of lake and lake management is a long-term process unlike study of groundwater and other surface water. The lake study is called "Limnology". This has both academic aspects and applied aspects to be taken into consideration. Lake studies have assumed lot of prominence in western countries notably in Canada and other places where lake water is used for human consumption.

The major concern in relation to lake is the "Eutrophication" process due to nutrient loading notable phosphates derived from detergents and nitrates from industrial source. To start with you can be introduced to the study of limnology by "Goldman," which will give you very good insights into which parameters to concentrate on. This book has both academic and applied aspects. In India, lake study is undertaken by various universities.

1. The major constraint is sampling procedure, which requires to be taken in different depth at different seasons and points to assess the nutrient loading of the lake.
 2. There are many simple biological indicators, which can used to assess whether lake is polluted or not by using simple microscope by community instead of getting into complex chemical parameters.
 3. I recommend that the community needs to be trained in biomonitoring tools instead of chemical parameters since this may prove expensive because of sampling and storage process, which unlike surface water is bound to change with time. People Science Institute, Dehradun can train the community in biomonitoring, which can be used for an index of pollution.
-

Yusuf Kabir, UNICEF, Kolkata

Beside the physical and chemical parameters, presence and absence of certain aquatic lifes, that is Bio-Monitoring is very important indicator for health of any surface water. Bio-monitoring is such a qualitative tool where you can empower local community, especially school children to monitor health of any water body, primarily the surface water. This is one of the most user-friendly, cost-effective, but at the same time effective water quality monitoring tool. The presence or absence of specific biotic communities in the aquatic environment is directly influenced by the water quality. Central Pollution Control Board has developed a **Biological Water Quality Criteria (BWQC)** based on the taxonomic presence of water species. And there is a saprobic score or BMWP (Biological-Monitoring working party). The table will something look like this:

No.	Taxonomic groups	Range of saprobic score (BMWP)	Range of diversity score	Water quality characteristics	Water quality class	Indicator colour
1.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Diptera	7 and more	0.2 - 1	Clean	A	Blue
2.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Odonata, Diptera	6 - 7	0.5 - 1	Slight Pollution	B	Light blue
3.	Ephemeroptera, Plecoptera, Trichoptera, Hemiptera, Odonata, Crustacea, Mollusca, Polychaeta, Coleoptera, Diptera, Hirudinea, Oligochaeta	3 - 6	0.3 - 0.9	Moderate Pollution	C	Green
4.	Mollusca, Hemiptera, Coleoptera, Diptera, Oligochaeta	2 - 5	0.4 & less	Heavy Pollution	D	Orange
5.	Diptera, Oligochaeta or No macro-invertebrates	0 - 2	0 - 0.2	Severe Pollution	E	Red

There is an entire guideline developed by CPCB. This bio-monitoring is a well established monitoring tool in many countries.

For further information, training and booklet you can contact a research NGO:

People's Science Institute (PSI)
Environmental Quality Monitoring Group
252/I, Vasant Vihar, Dehra Doon-248006,
psidoon@gmail.com

M. Manoj Kumar, Development Alternatives, New Delhi

The essential parameters, which are to be taken into consideration for water quality monitoring of Lakes:

- pH
- Colour
- Temperature
- Turbidity(NTU)
- Suspended solids
- BOD
- COD
- TDS/EC
- Hardness
- Sulphates
- Ammonia
- Chloride
- Nitrate
- Total Nitrogen
- Dissolved Oxygen
- Total and Faecal Coliform
- benthos-benthic diversity
- Chlorophyll
- Metals depending on Industrial Waste discharges
- Phosphorous and Orthophosphate

There are various types of water testing kits ranging from single parameter to multiparameters available in the market for testing water quality parameters(may not be all the parameters mentioned above). Some of the tests are based on volumetric and some of them are colorometric methods. By using these field-based water testing kits one can go for the screening of the parameters and if found that the parameters are crossing the desirable/permisible limits, same can be brought back to the laboratory and validated. According to me, these kits are playing a vital role in the water quality monitoring of the different sources be it ground water or surface water. We at Development Alternatives are conducting water quality monitoring in various places of the country by using these field based kits only and if found parameters are exceeding the safe limits, same are validated in the laboratory.

Further to this, **Community based water quality monitoring in a participatory mode** is proving to be a good approach to reach out a large number of water sources.

Under **National Rural Water quality Monitoring & Surveillance Programme -Ministry of Rural Development, GoI** all the water sources are being monitored in the rural areas of the country by using these kits only. So one can really approach and find out the results where the monitoring is already carried out.

One should check for the efficacy of the kits before choosing one of them really. In 2005 UNICEF has published a document on the performance evaluation of different field kits. Refer this link: http://www.indiawaterportal.org/data/kits/Field%20Test%20Kits_2nd%20Feb%2006_PRINT.PDF (Size: 516 KB)

For more information on the kits, one can see the **India Water Portal website** - <http://www.indiawaterportal.org/data/kits/>

I will be very happy to share more on this topic.

Vijay Krishna, India Water Portal, New Delhi

India Water Portal has a compilation of field testing kits on the market including price and contact information: <http://www.indiawaterportal.org/data/kits/>

The section also has a UNICEF-sponsored evaluation report of several of the kits.

Evaluation of Water Quality Field Test Kits

UNICEF, 2005

http://www.indiawaterportal.org/data/kits/Field%20Test%20Kits_2nd%20Feb%2006_PRINT.PDF

(Size: 516 KB)

I request members of the community to contact me separately (vijay@arghyam.org) if they are aware of other products on the market so we can make the listing more comprehensive.

A.A. Kazmi, Department of Civil Engineering, IIT Roorkee, Roorkee

At present, I am not involved with any lake project. However, I would like to provide some basic information on lake water quality condition, which can be derived from measuring:

1. Dissolved Oxygen at various depths weekly by DO meter can be available with any HACH or WTW agent in your city. The price is Rs 70,000
2. pH & Temperature daily by pH meter can be available with any supplier. The cost is more than Rs 20,000.

Please remember that the cord for these online measuring instruments should not be less than maximum the depth of the lake.

In addition, they can monitor Total Phosphorus and Chlorophyll by laboratory analytical techniques. The frequency can be monthly.

T.N.Anuradha, United Nations, New Delhi

An important parameter that could be considered for surface water monitoring is studying the bird diversity. Various studies have indicated that physical and chemical contamination of river bodies have directly affected the survival and existence of birds in many cases reduced the migratory bird population. Birds are also called the Litmus paper of the environment. The presence or absence of a particular bird, its physical appearance, behaviour etc can help in assessing the health of the environment. Like presence of Black Winged Stilts in a water body, it is an indication that the water is polluted.

The wetland habitats in Malnad (the Western Ghats area of Karnataka in Southern India) - streams, river beds, estuaries, ponds, lakes, water beds, marsh are interlinked forming a network which constitutes a complex ecosystem, where plants, animals and people are interdependent. The main environmental issue concerning wetlands in Malnad are excessive growth of vegetation and weeds, reduction in water clarity, enrichment of waters, siltation and high microbial activity. Large numbers of Sarus cranes were observed in the winter months of 2003. Egrets were the dominant species of birds found inside the lakes. As many as 22 species of aquatic birds were recorded at the sites. The aquatic birds like coot, jacana and cormorants disappeared from the lakes with reduction in the water level thus disturbing the food chain.

Status and Conservation of Bird Diversity in Western Ghats of Karnataka, South India

A.K.Chakravarthy, Chapter 12, Conservation of Rainforests in India, ENVIS India, Wildlife Institute of India (WII), Dehradun

http://www.wii.gov.in/envis/rain_forest/chapter12.htm

Wetlands of Keoladeo Ghana National Park at Bharatpur in Rajasthan State is famous for endangered cranes, the Siberian crane (*Crus lucogenanus*). The Western population of the Siberian Crane, breeds in the environments of the River Ob (Siberia) and visit to India every year during winter. Keoladeo is named after Keoladeo Shiva temple located inside the bird sanctuary and Ghana means dense forest. Thus, Keoladeo Ghana was the only place in the country where the exotic population of migratory birds regularly used to visit. However, over the last three decades, the cranes visiting Bharatpur have reduced in number from around 200 Nos. in 1964-65 to just four in 1991-92. The duration of these endangered variety of birds to stay in the park has also decreased due to change in habitat conditions.

Also refer to:

Bio-Monitoring of Wetlands in Wild Life Habitats of Birds Sanctuaries in India - Case Studies

<http://cpcbenviis.nic.in/main/newsletter/birdsanctury/ch30703.htm>

Lizette Burgers, UNICEF, New Delhi

The study of fresh water aquatic systems is referred to as Limnology. At the onset, I would like to inform you that community participation and management is essential to maintain the lake but as most tests demand laboratory facilities, communities cannot do it on their own. However, they can support technical staff in testing and remediation.

Water Quality Parameters to assess lake systems are classified into Physical and Chemical. After geographical assessment of the lake with context to its position, existing life forms, biological indicators, points of entry of pollution, eutrophication etc, the water quality of the lake is assessed by conducting physical and chemical testing. One needs to look into test results for all parameters before coming into any sort of conclusion about the lake. The "Standard Methods" - APHA manual would provide all information regarding methodology and comprehending the test results. Nevertheless, I am providing information which I hope may be useful for you to understand how complex the issue is and the need for a laboratory facility is a must. Further, a trained technician on both biological and chemical analysis is required to test the water quality.

Water - Physical and Chemical parameters

The physical parameters include:

- Light penetration----can be used by the community using the Secchi disk (easy to construct)
- Temperature profile –
- Conductivity - by meter
- Turbidity - by tubes – NTU
- Algal count

For all the three above meters are available that community can be trained to handle

The Chemical parameters include:

- Dissolved Oxygen (DO) --meter available and Biochemical Oxygen Demand (BOD) - need to be done in the laboratory and titration is required
- Total phosphorous
- Organic Nitrogen
- Nitrate Nitrogen
- Ammonia Nitrogen
- Calcium - Electrode/Titration
- Heavy metals- AAS/Titration

For point 4 in the Query, the physical and chemical parameters undergo severe fluctuations - diurnal as well as seasonal. So useful to start do testing on regular basis (diurnal and seasonal). Any Pisciculture and prawn culture/Hydroponics institute would monitor water quality and would also have Standard Methods with them. 'Ecology' by Clarke and PT Odum would be useful in understanding Limnology to a great extent.

[Vijay](#) – In response to your specific question - Any Post-Graduate Life Science Department in Bangalore that works on fish biology would test water and would have local addresses for test kits/equipment.

[Ashok Ghosh](#), Department of Environment and Water Management, A.N. College, Patna

1. Based on experiences, suggest the most essential parameters to be used for screening the water quality of the lake.
 - a. Simple parameters that can be tested through community participation using simple field test kits/simple machines available on market.
 - i. P^H (by P^H paper strip, P^H Pen meter)
 - ii. Temperature (by thermometer)
 - iii. Turbidity (portable water analyzer kits)
 - iv. Dissolved Oxygen (by Digital D.O. Meter)
 - v. Depth of Lake
 - b. Essential parameters that need to be tested in lab situations.
 - i. Total Dissolved Solids & Total Suspended Solids
 - ii. BOD
 - iii. COD
 - iv. Turbidity (portable water analyzer kits)
 - v. Dissolved Oxygen (by Digital D.O. Meter)
 - vi. Productivity of the Lake
 - vii. Total Phosphate
 - viii. Nitrate
 - ix. Potassium
 - x. Chlorophyll-a
 - xi. Total Coliform & Fecal Coliform
 - xii. Calcium
 - xiii. Magnesium
 - xiv. Some heavy metals
2. Details of the Agencies supplying field screening test kits with cost range etc.
 - National Chemical Laboratory/Chem-In Corporation, Pune (India) and the cost range for field test kit is in between 5000.00 (Three thousand) to 50,000.00(Five thousand) Indian Rupees

3. Frequency of these monitoring activities
 - Monitoring should be monthly basis
 4. Details of Research studies on Lake water Monitoring done by various institutions, available for cross reference.
 - Department of Environment and Water Management, A. N. College, Patna
 - Department of Natural Resources Management, Texas Tech University, Lubbock, TX, USA
-

Shailja Kishore, Consultant, Ahmedabad

Lakes act as a drinking water source in most of the environmentally challenged villages. They have been and are drinking the water.

The language of Water Quality Monitoring that we are talking about are unheard of by many of the villagers. The tests, the equipments, it's cost & O & M cost is out of reach of many good organizations... Forget the poor villagers.

They are aware of the quality aspects and they had their traditional viewpoint. Villagers used to keep turtles in their village ponds so that it eats the organisms and keep the water clean.

In various water scare villages of Kuchchh, The importance to pond is integrated into their lives. When it overflows during monsoon, there is a special puja / function and that day is a holiday & people enjoy at the site.

Villages like Jakkhao in Abdasa Taluka have more than 23 ponds in there villages.

In village Dhorado in the banny area of Kuchchh, they had developed a wire mesh filter and used to drink pond water. With the help of WASMO a proper filter bed was prepared and a solar pump has been installed. The filtered pond water is used for drinking.

In village Khari of Pascham Vistar, Khawada, The protection & maintenance of the pond and the regulations regarding maintenance is worth mentioning. (Similar situation can be seen in most of the village here regarding protection of the source.)

Today potable-testing kits provided by WASMO has come in handy with the villagers. There is a monitoring committee formed in most of the villages. It is recorded at regular intervals and alternate remedial measures are being adopted.

The best and effective low cost quality monitoring can be seen in the area. With better resources & systems / kits, the situation would be much better & logical in the area, where potable water is a scarce commodity.

Amitangshu Acharya, Arghyam, Bangalore

Apologies for a late response.

Earlier while working with the Natural Resource Management Division of Winrock International India, I was working in a payment for environment services (PES) project on the Bhoj wetland (Bhopal, M.P) which is also a Ramsar site. The project aimed at an urban-rural trade off resulting

in improved lake water quality. It was a part of a larger international initiative and the final report can be referred to at:

Fair Deals for Watershed Services in India

Report by A. Acharya; IIED; Oct 2007; Publication Details available at:

<http://www.iied.org/pubs/display.php?o=13538IIED&n=1&l=1&a=A%20Acharya&x=Y>

Shares field experience/lessons to develop incentive-based mechanisms for watershed protection services and improve livelihoods at micro/macro scales in Himachal Pradesh and Madhya Pradesh.

Lake Conservation Authority (LCA), Bhopal our collaborating partner carried out all data collection and monitoring processes based on selected parameters, which included:

- Nitrate, Phosphate, MPN
- Potassium
- Total Phosphorus (Ortho Phosphate)
- COD
- BOD
- MPN
- Turbidity
- Transparency (Secchi Dish)
- Total/Faecal Coliform

Here I must say that selecting wetland water quality parameters and monitoring them is contingent on the objective of the project itself. Since our project wanted to measure the impact of agrarian pollution in the catchment, the decision was to use a manageable set of parameters, which would provide clear-cut evidence. Otherwise, LCA had been monitoring lake water quality on 120 parameters. You can get in touch with Dr. Sachdev of LCA for greater detail.

Dr. Sanjeev Sachdev
Senior Research Officer
Lake Conservation Authority of M.P.
Paryavaran Parishar, E-5, Arera Colony,
Bhopal (M.P.)-India
Email: mplca@sancharnet.in

Keeping in mind the objective, the lake was divided into rural and urban influenced zones. LCA has monthly water quality data of about 120 parameters at 15 sample sites. Out of this 15, WII and LCA chose 2 in the urban side and 5 on the rural. The monthly data was averaged into four quarters per year (winter, summer, monsoon and post-monsoon). The comparison was then carried out between Surface and Bottom, Seasonal Fluctuations and Averaging based on the list of parameters provided earlier.

I would strongly urge you to contact MPLCA as they have been working on this issue for a long time and have gathered voluminous quantity of data. They have also done a lot in reviving the Bhoj Wetland.

As for participatory monitoring, I can personally suggest the use of monitoring kits distributed by during World Water Monitoring Day by WEF. Please see:
<http://www.worldwatermonitoringday.org>

I personally found the kit to be very useful and it helps in measuring basic parameters such as Ph, Dissolved Oxygen, Turbidity, etc. This can be easily carried out by communities as

instructions (in English) when translated are quite easy to follow and record. I got 3 sets free hence won't be able to provide costs.

I hope that helps. Wetlands are very critical ecosystems. All the best to the ATREE project and would love to hear more on its progress.

[Srinivas Moorthy](#), Department of Earth Sciences, Annamalai University

This is an interesting Query. At first being a lake environment BOD and COD (biological oxygen demand and Carbondioxide demand) has to monitored along with pH, EC and TDS immediately in the field.

There are numerous water quality analysers in the market to analyse this parameters in the field. To determine the extent of pollution then usual major and minor captions and anions like (ca,mg,na,k,cl,so4,no3 Po4 can be determined).

There are water quality monitoring kits developed by Tamil Nadu Drainage and Water Supply Board (TWAD) to measure the above said paramters. You can contact the regional centre one located at Chennai for this kit or go for internet you can find it.

Regarding literature there are numerous studies in lake geochemistry which can be downloaded from net.

I have attempted for lake geochemistry in Tamil Nadu and you can be in touch regarding any help from me.

[Mrinalinee Vanarase](#), IORA for Environmental Solutions, Pune

As far as water quality assessment is concerned, there are fixed parameters like BOD and COD and Ph, and in certain cases other parameters like heavy metals. These are generally known parameters. Most of this is actually a laboratory work. There are few other indicators like vegetation and aquatic fauna. But that depends upon that particular site and degree of disturbance.

However, water quality monitoring is not the only activity communities can take part in, there are other things like habitat creation and development, monitoring of other eco processes, where local people can play a significant role, as they are more familiar with the ecosystem.

If we could pay any visit, we might come up with concrete suggestions.

[Abhay Kumar](#), Toxics Link, New Delhi

I have been following the various responses posted by members of the Solution Exchange Water Community on the Query posed by Latha Bhaskar. I think most of the points raised by Latha Bhaskar have been addressed. Nonetheless, I have the following to say on it:

1. For a comprehensive understanding of physical, chemical and biological characteristics of lakes, it's advisable to collect samples of water, sediments (may be only bed sediments),

phytoplanktons and zooplanktons at various significant locations and depth. Determining physical conditions of lakes are also important.

2. Physical data from surface to bottom at 1 m increments through the thermocline and thereafter, at 5 m depth increments to the bottom for water temperature, dissolved oxygen; specific conductance, pH and Secchi depth transparency measurements should be determined.
3. Sampling locations should include at least inflow, outflow and the midlake sites. Monthly monitoring for common parameters and heavy metals monitoring during pre-monsoon, monsoon and post-monsoon is desirable.
4. Water samples may also be tested for total phosphorous, orthophosphorous, dissolved nitrate-nitrite nitrogen, ammonia nitrogen, total Kjeldahl nitrogen, total organic carbon, dissolved organic carbon, total nutrients and dissolved nutrients. Standard reference materials may be found in literature for all such analysis.
5. A mix of field monitoring kits and lab-based techniques should be used for the analyzing these parameters. Field monitoring kits may do physical parameters.
6. CPCB, UNICEF, NEERI, DA are some of the agencies which have developed field monitoring kits. Commercial firms like Merck may also be contacted.
7. Enough literature is available on it. Prof. Brij Gopal, School of Environmental Sciences, JNU, New Delhi-110067 may be contacted for some of the research papers on related topics.

B.C.Choudhury, Wildlife Institute of India (WII), Dehradun

The problem of water management, particularly water quality in natural lakes and manmade lakes are immense. The general belief is that the volume of most of the lakes is so high that they can dilute any amount of pollutants. In fact the dry season use of the water from the lakes , other than the brackish water lakes, are so high for a host of purposes that the volume of water decreases to critical minimum and causes algal bloom, fish die offs and increased concentration of pollutants resulting in water borne diseases etc.

Since the State Pollution Control Boards are responsible to certify water quality, often they give a clean chit and pollutants keep on mounting. There needs to be transparency in the water quality monitoring process. Perhaps involvement of local academic institutions (universities) and local communities (lakeside schools and colleges with simple water quality monitoring kits) will bring in the transparency that is required. Involvement of local communities and school and colleges will act as a citizen's watchdog programme on water quality and they will bring pressure on the local politicians to act.

As far as water quantity is concerned, very often the purpose and need of water users is projected as far more important than the legitimate need of the aquatic biodiversity and as the thought and concept of critical minimum water level maintenance is not thought of a certain amount of legitimacy is provided for such seasonal water use. In future years, they are used as a status-quo and this ecologically unsound practice continues. Only now the concept of maintenance of critical minimum water level, ecological flow etc are being talked about. However, there is a need to make the water resource managers (irrigation, fisheries and such other departments) understand these concepts and build in such management regimes in their annual calendar of monitoring process.

As far as ecologists and biologists are concerned very often even without monitoring, they can provide views about the water quality looking at indicator species (benthos for example) as well as resident and migratory waterfowl abundance. What is required is a holistic water management

approach for lakes with plans developed for normal water quantity years and for extremes of high and low water availability.

Deepa Prabhu, ICICI Bank, Mumbai

Sorry for late response. I was under the impression, wrongly that I had posted this.

Mumbai City water supply is supplied by lakes and its neighboring Thane District too is populated by many lakes that have seen much clean-up activity in the past few years. IIT Mumbai has been involved as well as citizen groups and Bombay Environmental Action Group (BEAG).

I understand that monitoring activities can range from something as simple as keeping a diary or as sophisticated as a regular detailed scientific study. More details are available at the site of the Wisconsin State Lake Monitoring Network. I also like the simple page developed for creating a network for volunteers, sample collection etc. It may be viewed at:

<http://dnr.wi.gov/org/water/fhp/lakes/selfhelp/equipment.htm>

There are also some useful tips and material on the site of the **World Water Monitoring Day**. How nice if CERC/ATREE could make a start by having one in India too. Their web site is here:

<http://www.worldwatermonitoringday.org/>

If there, is anyone from Chandigarh here in the Network they may also know about the Shramdaan or local involvement in cleaning that they do in Chandigarh.

Lastly, I also have this simple fact sheet on the topic. I am not sure if it is copyright hence I am only providing the link to same and not the document.

Assessing a Lake's Water Quality Status

US EPA and Lake Management Society, Pennsylvania

http://www.palakes.org/publications/lake_assessments.pdf (Size: 20 KB)

A few other additional leads I have to share with the team here are as follows;

1. Some news coverage of the initiatives in Mumbai/Thane:

<http://web.mid-day.com/metro/thane/2004/may/83171.htm>

Blame Game Over Lake Cleanliness Continues

Jayadev Calamur; News; Thane Plus; Times Group; Saturday, 17 November 2007

http://www.mumbaipluses.com/thaneplus/index.aspx?page=article§id=1&contentid=2007111720071116151901359244ef9_dd§xslt=&comments=true

2. A resource contact of an NGO in Thane,

Paryavarn Dakshata Manch

Mumbai

Vidyadhar Walawalkar

Tel: 24559652

Description as given by them: NGO involved with environment vigilance in Thane and have supported many lake-cleaning initiatives.

3. A reference to a Bio- Sanitizer. This is not applicable to monitoring but I thought I would include it in any case, as it is specific to Indian situations and conditions.

A novel eco-friendly eco-sanitation product, BIOSANITIZER, has been developed by the Bhawalkar Ecological Research Institute (BERI – formerly Bhawalkar Earthworm Research Institute), Pune(India). BIOSANITIZER is a naturally produced catalyst that continues to produce need-based amount of active oxygen and drives eco-logical reactions that clean polluted water(surface water, groundwater and wastewater). This oxygen-rich water also becomes a resource for ecosanitation. It can be sprayed to sanitize soil, garbage heaps, medical waste, and animal carcasses. The spraying also controls odor, pathogens, and pests such as mosquitoes, flies, cockroaches, and rats. This paper describes some successful applications of BIOSANITIZER and the authors' model about its action.

(http://www.wastetohealth.com/biosanitizer_ecosanitation_resource.html)

4. The Web site of TAAL at: <http://www.taal2007.org/>

I do not have any personal experience of the above or do not recommend them in any way, but please see if these are of any use.

I am a huge fan of the work both CERC and ATREE are doing- what little I know, and I hope you find some of the above, if not all useful.

In the meantime, I have not read the project proposal in detail. If I have any further inputs or questions, Latha - I will mail you.

Manish Kumar, Technology Information Forecasting and Assessment Council (TIFAC), New Delhi

This is with reference to the query raised on water quality monitoring.

Lake is a special kind of water entity, which is surrounded by land area without any significant flow or mostly stagnant water and receives contaminations/pollutions either through local run-off or industrial discharge. Due to stagnant water, local contamination can affect the productivity and health of lake. For the best approach to monitor Lake Water, it is necessary to divide it in three parts: summer, winter & rainy season. Lake is characterized by thermal stratification, which normally breaks down in winter season due to temperature phenomenon. This breakdown leads to nutrient circulation in lake, which usually changes the parameters on seasonal basis. Samples may be taken from different zones (Epilimnion, Thermocline and Hypolimnion) for better representation of the lake water quality. Different samplers (surface, depth etc) may be used for the purpose. The major parameters to be analyzed for lake monitoring with frequency may be considered as below:

1. Nutrients: Sulphate, Phosphate, Nitrate: (fortnightly basis)
2. TKN, pH & Temperature (strictly at field condition), Turbidity, Conductivity, Chloride(fortnightly basis)
3. Dissolve Oxygen (fortnightly basis)
4. BOD (Monthly Basis)
5. COD (only if lake highly contaminated in terms of organic components)
6. Trace metals (once in 4 months): trace metals may be decided on the local conditions and if any specific effluent is discharged in lake from industry or another source.

The choice of analysis either by water monitoring kit or by well-equipped instrumental lab depends on the degree of accuracy and the purpose of the monitoring initiated by the concerned

agency. If it is done for well record keeping and future study then accuracy and reliability of data gathering is utmost important which can be achieved by only sophisticated environmental instruments. Water monitoring kit is recommended only when data gathering is on general basis, because percentage variant may be upto (+/-)15-20 from the actual in this case.

Here I would like to mention that there are so many players in the market, which are supplying water-monitoring kits, it is an easy job to get their addresses on the site.

Overall, it is necessary to monitor the lake quality to know the changing characteristics of it over a period of time and also to know how lake is transforming from Oligotrophic-Mesotrophic to Eurotrophic. The changing productivity of lake tells the impact of it on Lake Ecosystem and necessary action to be taken if situation gets worse.

[Usha Srinivasan](#), Development Alternatives, New Delhi

I will share with you our "*Yamuna Yatra*" Experience and also how we involve the community specially students and teachers in monitoring the surface water quality.

Yamuna Yatra:

We undertook the Yamuna Yatra from Delhi to Etawah monitoring the water quality at Delhi (Wazirabad, ITO and Okhla), upstream and downstream at Vrindavan and Agra, interacting with the local people including the local NGOs, school students, Government officials, religious leaders at Vrindavan and the media (some of whom accompanied us on the Yatra).

The monitoring was done by high school students trained by Development Alternatives using the jaal-TARA field monitoring kit.

The tests conducted included:

pH, temperature, colour, turbidity
Dissolved Oxygen, Chloride, Nitrate, Fluoride, Ammonia, Phosphate, Iron, hardness
Faecal coliform, Benthic diversity

Samples were collected from midstream (from the barrage). Benthic diversity tests were conducted nearer the banks.

At the three sites in Delhi, the tests (6 sets of tests at each site) were conducted fortnightly (for a period of three months - Feb. to April)), at the same time of the day at each site and once at the other sites outside Delhi.

The results were worse that expected. For e.g. The DO levels at wazirabad varied between 2mg/l and 4.5mg./l , between 0 and 1.2 at ITO and always Zero at Okhla.

Due to natural regeneration, the DO increased to around 4 to 5 upstream of Vrindavan but downstream, it fell to 1.5. At Agra, the upstream Do level of around 1 fell to zero downstream.

The yatra and the findings were widely covered by many national and regional dailies. This experience has given ample evidence to show that students and community can be and should be involved in such activities.

Training of teachers:

A batch of the trainee teachers under Delhi SCERT have been trained on using this kit and they have been using it to monitor drinking water supply as well as the quality of water in some of the water bodies in Delhi.

Involvement of students:

Thousands of teachers and lakhs of students from schools and communities across the country have been trained on using the *Ja-TARA* kit* and Municipal supply water, surface water and ground water sources have been monitored by them seasonally (thrice in a year) under the CLEAN-India (Community Led Environment Action Network) Programme of Development Alternatives. This data has been projected on interactive digital maps. Some local actions have been taken up by the community for water quality and quantity management including conservation.

Our experience has shown that it is important to involve the community, the students and youth in the "understanding" and management of water.

*The results have been validated in the laboratory and the kit has been evaluated by Shri Ram Institute for Industrial Research and was supported by UNICEF.

Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-watr] Query: Water Quality Monitoring of Lakes - Experiences; Advice. Additional Reply."

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