Chapter 6: Results of programmes for control of pollution in India

Assessment of results is an important step in reaching a conclusion about efficacy of any programme. It is undertaken to ensure that projects, programmes and policies are economically viable, socially equitable and environmentally stable and delivering the intended results.

6.1 Change in water quality of rivers as a result of implementation of NRCP

Ganga Action Plan (GAP) was introduced in 1985 and was subsequently extended to other rivers under NRCP in 1996. As such programmes for preventing and cleaning up of major rivers in India have been in operation for more than 20 years now. Hence, it is important to assess whether NRCP has achieved its major aim of improvement in the water quality of the major rivers. Issues relating to impact of NRCP/NLCP on our rivers and lakes at the central and State level are discussed in the succeeding paragraphs:

When queried about improvement in water quality of rivers included under NRCP, MoEF stated that it monitored water quality of rivers which was analysed for Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, suspended solids (SS) and coliform etc., which were indicators of pollution and that river water quality reflected the impact of project in the vicinity. It stated that Ganga river water quality data from 1986 to 2009 indicated improvement in water quality between Kannauj and Varanasi.

CPCB stated that the natural flow in rivers and streams has reduced drastically due to diversion of water for irrigation from all the reservoirs in the country and there is little fresh water flow or flow generated due to discharge of sewage and industrial effluents. It also stated that the improvement in various environmental components could not be quantified.

6.1.1 How did the cities fare?

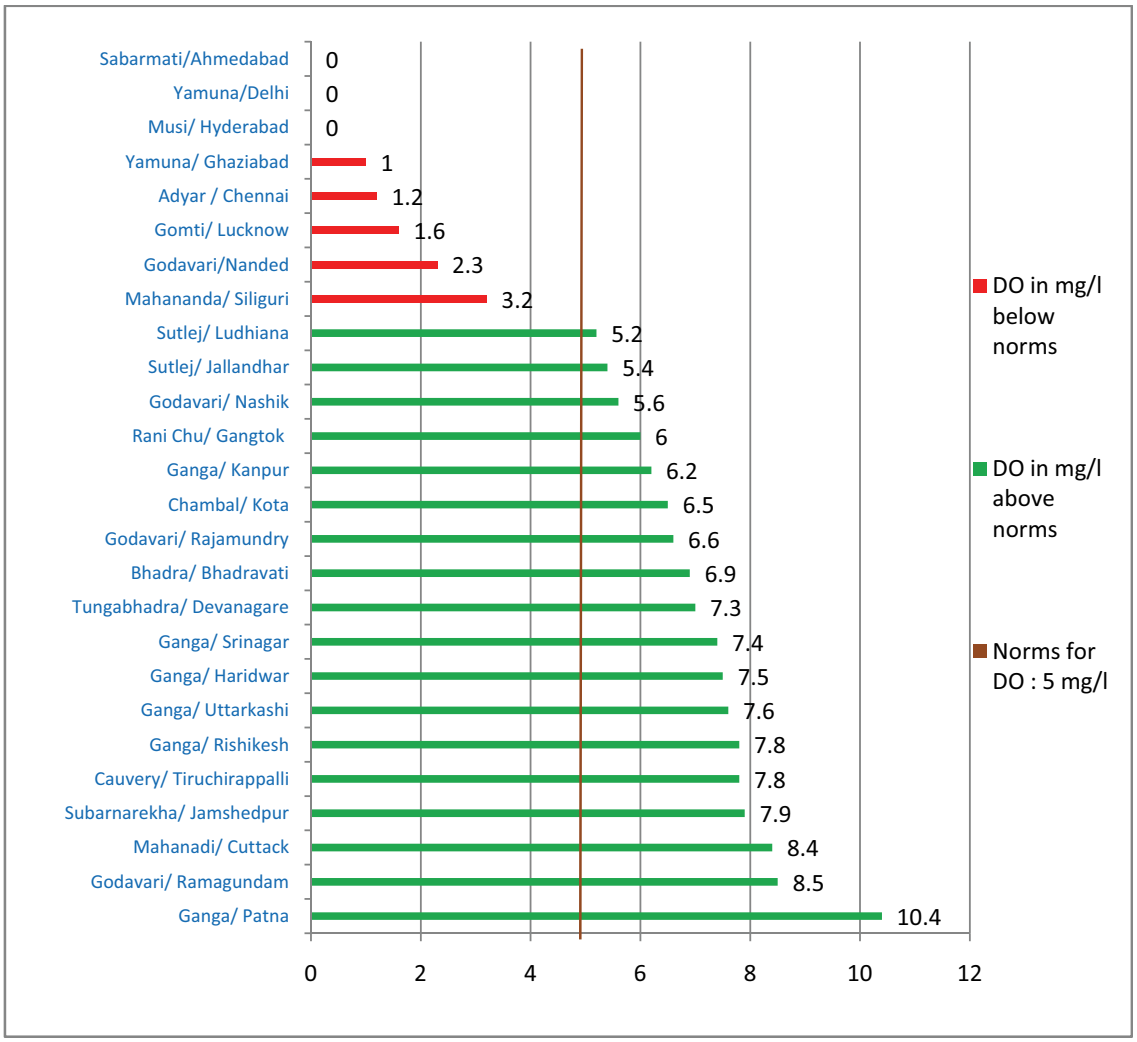
In the course of audit, we looked at the quality of water in test checked rivers in terms of BOD, Dissolved Oxygen (DO) and Total Coliform (TC). These are indicators of organic pollution, of whether the water can sustain aquatic life and presence of harmful, faecal-related bacteria, viruses and protozoa which cause illnesses respectively.

These reports assessed quality of water in the river after it leaves the city where interventions like STPs have taken place. As such, if the interventions are effective, the quality of water in these rivers after they leave the cities should meet the class B criteria (Bathing standards) of CPCB (which is TC-500 MPN/100 ml or less, DO-5 mg/l or more and BOD- 5 days 20^0 C 3 mg/l or less).

DO is a relative measure of the amount of oxygen that is dissolved or carried in the water body. Adequate dissolved oxygen is needed and necessary for good water quality. This is important to the sustainability of a particular ecosystem. Insufficient oxygen in lakes and rivers, tends to suppress the presence of aerobic organisms such as fish. Deoxygenation

increases the relative population of anaerobic organisms such as plants and some bacteria, resulting in fish kills and other adverse events. If water is too warm, there may not be enough oxygen in it. When there are too many bacteria or aquatic animal in the area, they may overpopulate, using DO in great amounts. Oxygen levels also can get reduced through overfertilization of water plants by run-off from farm fields containing phosphates and nitrates (the ingredients in fertilizers). Under these conditions, the numbers and size of water plants increase. Then, if the weather becomes cloudy for several days, respiring plants will use much of the available DO. When these plants die, they become food for bacteria, which in turn multiply and use large amounts of oxygen. As evident from the chart below the level of Dissolved Oxygen was precariously low in the Sabarmati at Ahmedabad, Yamuna at Delhi, Musi at Hyderabad, Yamuna at Ghaziabad, Adyar at Chennai and Gomti at Lucknow.

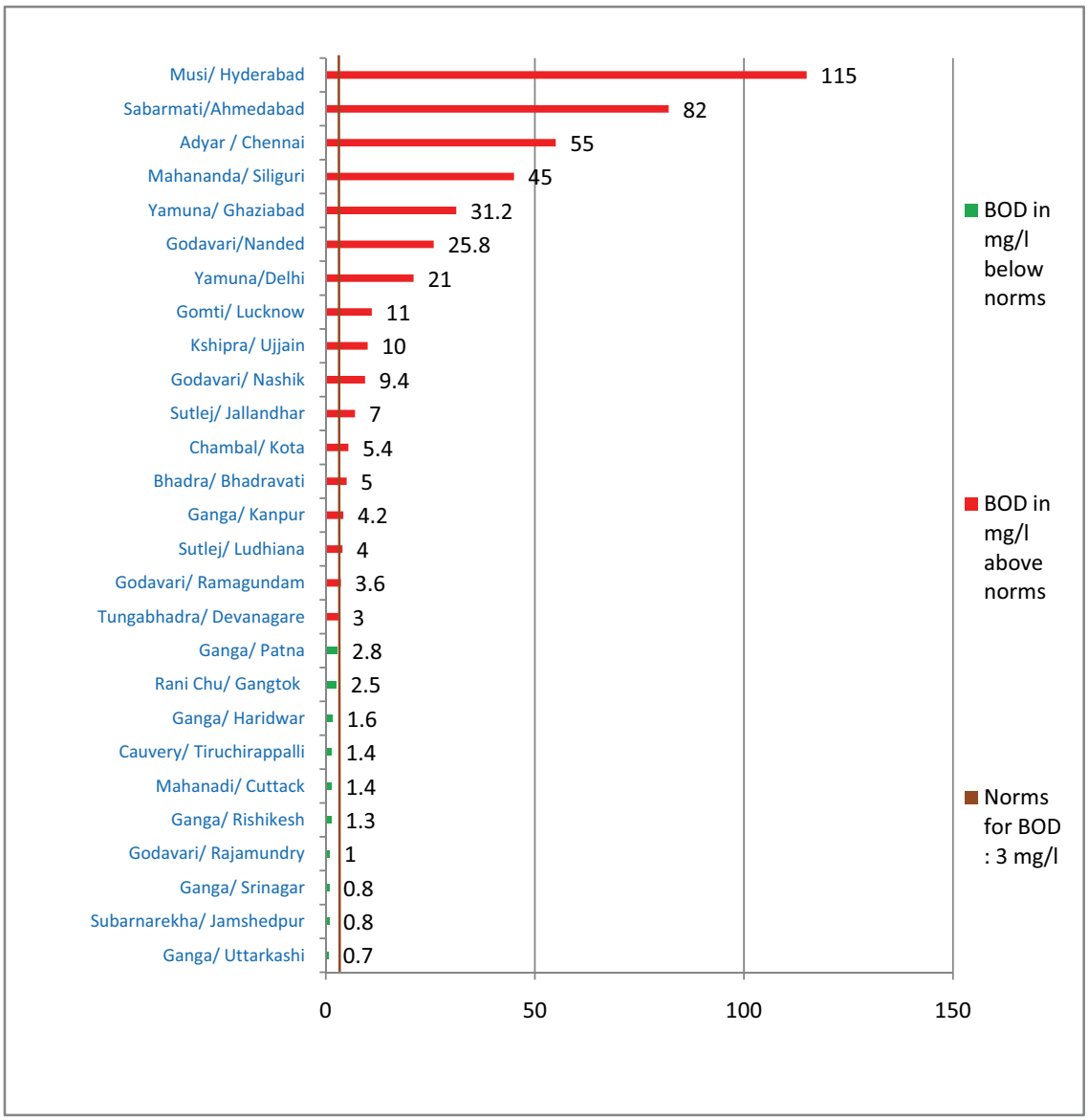
Chart Showing Actual DO in mg/l Against Norms



BOD is a chemical procedure for determining the uptake rate of dissolved oxygen by the biological organisms in a body of water and is widely used as an indication of the quality of

water. It can be used as an indicator of the efficiency of sewage treatment plants. As can be seen from the chart below, the levels of BOD in some major towns was at alarming levels. Thermal discharges, such as water used to cool machinery in a manufacturing plant or a power plant, raise the temperature of water and lower its oxygen content. Fish kills and an invasion and growth of certain types of weeds can cause dramatic changes in a stream or other body of water. Natural sources of organic matter include plant decay and leaf fall. However, plant growth and decay may be unnaturally accelerated when nutrients and sunlight are overly abundant due to human influence. Urban runoff carries pet wastes from streets and sidewalks; nutrients from lawn fertilizers; leaves, grass clippings, and paper from residential areas, which increase oxygen demand.

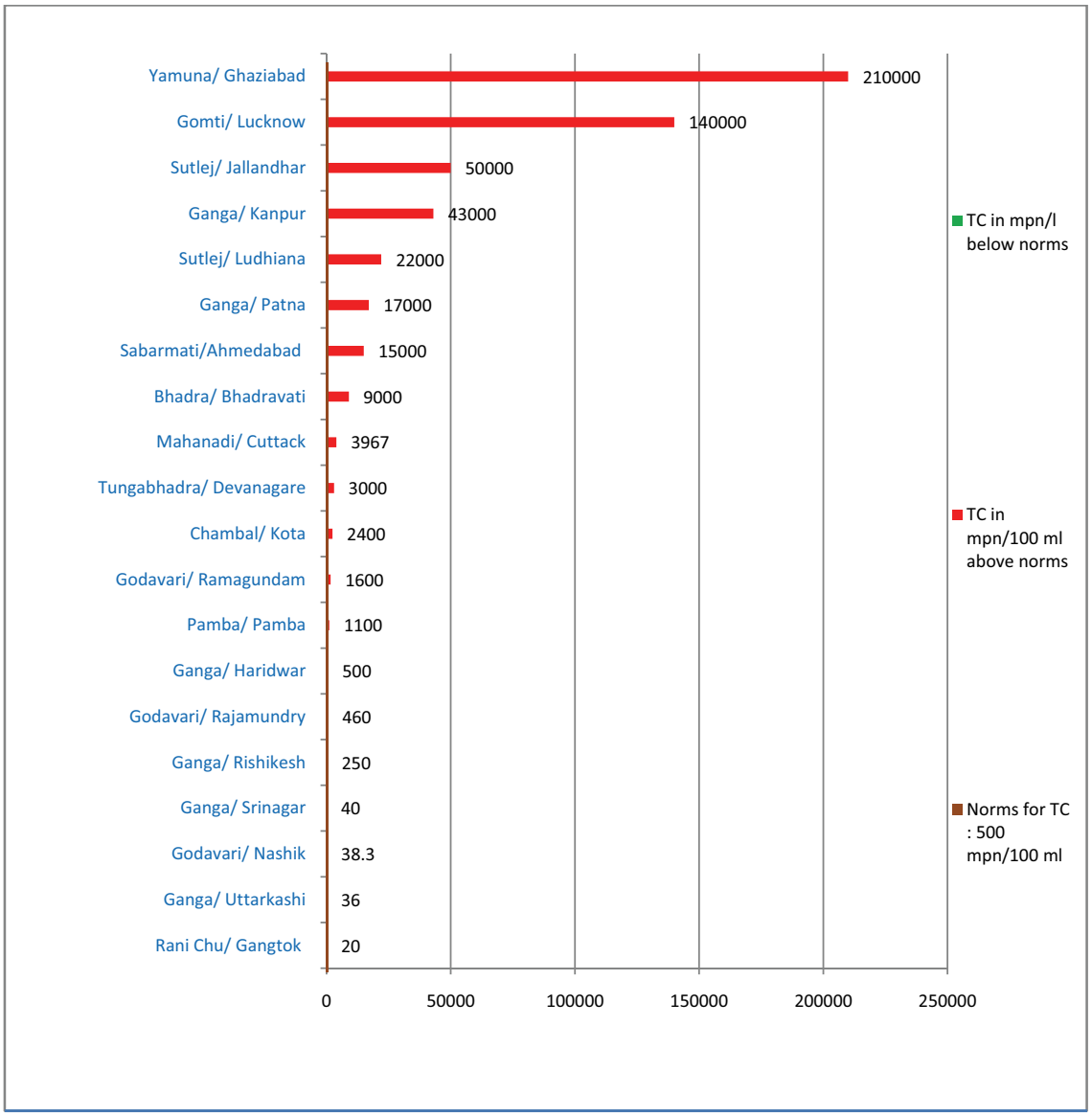
Chart Showing Actual BOD in mg/l Against Norms



TC: Coliforms organisms like fecal bacteria are an indicator of water quality. Coliform bacteria may not cause disease, but can be indicators of pathogenic organisms that cause diseases. The latter could cause intestinal infections, dysentery, hepatitis, typhoid fever,

cholera and other illnesses. Coliform bacteria are organisms that are present in the environment and in the feces of all warm-blooded animals and humans. Coliform bacteria will not likely cause illness. However, their presence in drinking water indicates that disease-causing organisms (pathogens) could be in the water system. These can also occur due to soil, vegetation, sediment, insects entering the water, and their presence indicates that the source is, or recently has been compromised by surface water.

Chart Showing Actual TC in MPN/100 ml Against Norms



The charts above show a particularly dismal position with regard to breach of norms in terms of the three criteria- BOD, DO and TC in the case of Yamuna at Ghaziabad/Delhi, Gomti at Lucknow and Sabarmati at Ahmedabad. In the case of Musi at Hyderabad, for which data on BOD and DO was available, the pollution levels was far beyond the norms.

Table 14: Quality of Water in test checked river stretches

State	River/Town	Quality of water
Andhra Pradesh	Godavari/ Ramagundam	BOD is on the slightly higher side but TC is more than 3.2 times the criteria, indicating the water of Godavari after leaving Ramagundam city is contaminated by harmful, faecal-related bacteria, viruses and protozoa which cause illness.
	Musi/ Hyderabad	Data regarding TC was not available. DO was 0 which indicated inability of Musi to support any aquatic life. Further, BOD was more than 38 times the criteria, indicating high levels of organic pollution of Musi river after it leaves Hyderabad.
	Godavari/ Rajamundry	River quality met desired criteria.
Bihar	Ganga/ Patna	TC was 34 times the criteria in Ganga after it leaves Patna, indicating the presence of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
Delhi	Yamuna/ Delhi	Data regarding TC were not available. DO was 0 which indicated inability of Yamuna to support any aquatic life. BOD was more than seven times the criteria, indicating high levels of organic pollution of Yamuna river after it leaves Delhi.
Gujarat	Ahmedabad/ Sabarmati	BOD and TC were more than 27 times and 30 times the criteria indicating high levels of organic pollution as well as the presence of disease causing, faecal-related bacteria, viruses and protozoa which cause illness in Sabarmati as it leaves Ahmedabad city. Further, DO levels in Sabarmati were 0, indicating its inability to support aquatic life.
Haryana	Yamuna/ Faridabad	No data was available.
	Yamuna/ Panipat	No data was available.
Jharkhand	Subarnarekha/ Ranchi	No data was available
	Subarnarekha/ Jamshedpur	While levels of TC were not measured, it was observed that levels of BOD met the criteria.
Karnataka	Bhadra/ Bhadravati	TC was 18 times the criteria, indicating the presence of disease causing faecal-related bacteria, viruses and protozoa which cause illness as the Bhadra river leaves Bhadravati.
	Tungabhadra/ Devanagare	TC in Tungabhadra river after it leaves Devanagare town is six times the criteria, indicating the presence of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
	Pennar/ Bangalore	No data was available.
Kerala	Pamba/ Pamba	While BOD and DO were not measured, TC in Pamba was 2.2 times the criteria as it leaves Pamba town indicating the presence of disease causing faecal-related bacteria, viruses and protozoa which cause illness.
Madhya Pradesh	Betwa/ Vidisha	No information was available.
Maharashtra	Krishna/ Karad	BOD and DO were not measured while TC levels met the criteria in Krishna river as it left Karad city.
	Godavari/ Nashik	While DO and TC met the criteria, BOD was more than 3 times the criteria, indicating high levels of organic pollution in Godavari river after it left Nashik.

	Krishna/ Sangli	No information was available
	Nanded/Godavari	Levels of TC in the river Godavari after it left Nanded city were not available. Levels of BOD were more than eight times the criteria. Further, DO was less than criteria indicating availability of insufficient amount of oxygen for survival of aquatic life indicating loss of ability of river Godavari to support aquatic life after it left Nanded.
Odisha	Mahanadi/ Cuttack	TC was almost eight times the criteria in Mahanadi after it left Cuttack city, indicating the presence of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
	Coastal area/ Puri	No information was available.
Punjab	Sutlej/ Jalandhar	While BOD was 2.3 times the criteria, TC was 100 times the criteria in Sutlej as it left Jalandhar. This indicated organic pollution as well as presence of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
	Sutlej/ Ludhiana	While BOD exceeded the criteria and DO did not exceed the criteria, TC was 44 times the criteria in Sutlej river as it left Ludhiana city, indicating the presence of a large number disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
Rajasthan	Chambal/ Kota	While BOD did not meet the criteria and DO met the criteria, TC was almost five times the criteria in Chambal river as it left Kota city indicating the presence of a large number disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
Sikkim	Rani Chu/ Gangtok	BOD and TC met the criteria while DO is less than the required criteria, indicating organic pollution in river Rani Chu as it left Gangtok town.
Tamil Nadu	Adyar & Cooum/ Chennai	BOD was 18 times & seven times the criteria in Adyar & Cooum river respectively, indicating high levels of organic pollution. Further, the DO was less than the criteria indicating insufficient oxygen being available for survival of aquatic life. Further, the TC was much higher than the criteria, indicating that Adyar & Cooum were full of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
	Cauvery/ Tiruchirapalli	BOD is 1.37 which is less than the criteria indicating that Cauvery was full of disease causing, faecal related bacteria, viruses & protozoa which cause illness.
	Vaigai/ Madurai	No information was available.
Uttar Pradesh	Yamuna/ Ghaziabad	BOD was more than 10 times the criteria in Yamuna river, indicating high levels of organic pollution. Further, the DO was less than the criteria indicating insufficient oxygen being available for survival of aquatic life. Further, the TC was 420 times the criteria, indicating that Yamuna, after leaving Ghaziabad, was full of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
	Ganga/ Kanpur	BOD was almost 1.4 times the criteria in Ganga river after Kanpur, indicating high levels of organic pollution. Further, the TC was 86 times the criteria, indicating that Ganga, after leaving Kanpur, was full of disease causing, faecal-related

		bacteria, viruses and protozoa which cause illness.
	Gomti/ Lucknow	BOD was more than 3.6 times the criteria in Gomti river, after Lucknow, indicating high levels of organic pollution. Further, the DO was less than the criteria indicating insufficient oxygen being available for survival of aquatic life. Further, the TC was 280 times the criteria, indicating that Ganga, after leaving Lucknow, was full of disease causing, faecal-related bacteria, viruses and protozoa which cause illness.
Uttarakhand	Ganga/ Rishikesh	River quality met the desired criteria.
	Ganga/ Haridwar	River quality met the desired criteria.
	Ganga/ Srinagar	River quality met the desired criteria.
	Ganga/ Uttarkashi	River quality met the desired criteria.
West Bengal	Ganga/ Barrakpore	Not measured.
	Ganga/ Gayeshpur, Halilshar & Kancharapara	No information was available.
	Mahananda/Siliguri	The level of BOD was 15 times in Mahananda river after Siliguri, indicating high levels of organic pollution. Further DO was less than the criteria indicating insufficient oxygen being available for survival of aquatic life.

The table is indicator of the fact that despite more than 26 years of implementation of programme to control pollution in our rivers, water in our rivers remains critically polluted. The levels of BOD, DO and TC are indicators of high levels of organic pollution in our rivers, the inability of our rivers to sustain aquatic life due to presence of pollutants and high levels of disease causing, faecal-related bacteria, viruses and protozoa which cause illness; all of which point to failure of the efforts of the government to control pollution in our rivers through NRCP.

In its reply of June 2011, MoEF stated that:

- In respect of water quality of the river Ganga, the BOD in the year 2010 ranged between 1.48 to 5.51 mg/litre in major monitoring locations as compared to BOD values ranging between 1.7 to 15.5 mg/litre in 1986.
- Levels of bacterial contamination in terms of faecal coliform are reported to be exceeding the maximum permissible limit at a number of locations along the river Ganga. MoEF also stated while water quality in the stretch of the river Yamuna from Tajewala to Palla in Haryana is found to be within the prescribed limits, Yamuna river in the vicinity of Delhi and in parts of Uttar Pradesh does not meet the standards in terms of BOD.
- Water quality of Yamuna had not shown the desired improvement owing to large gap between the demand and availability of sewage treatment capacity and lack of fresh water in the river.
- Pollution load on rivers had increased over the years due to rapid urbanisation and industrialization and abstraction of water for irrigation, drinking, industrial use, power and other purposes compounds the challenge. Also, MoEF was silent about impact of NRCP on water quality of other rivers.

- Conservation of rivers was a collective effort of Central and State Governments and the central Government was supplementing efforts of the State Governments in river conservation through the centrally sponsored NRCP. It also stated that creation of infrastructure for sewage management and disposal was also being undertaken through other central schemes, such as JNNURM and UIDSSMT, as well as under State schemes.

The reply of MoEF corroborated our observation that improvement of water quality had not taken place in all the rivers covered in the sample, barring Ganga in some stretches. Water quality challenges have been exacerbated by abstraction of water for different uses and these reinforce the fact that MoEF needs to move towards basin approach for management of water quality problems as a result of water abstraction for different uses.

Further, the Outcome Budget of MoEF for 2010-11 reflects MoEF's efforts towards building STPs, CETPs, water quality monitoring stations etc., without clear exposition of outcomes achieved. With respect to MoEF's statement that conservation of rivers was a collective effort of the Central and State government, as the primary funding agency for this programmes as well as its mandate as the nodal agency for pollution issues, MoEF cannot avoid its responsibility in ensuring that the programme for conservation and pollution control meets its desired outcomes.

6.2 Change in water quality of lakes as a result of implementation of NLCP

NLCP which aimed to restore and conserve the polluted and degraded lakes of the country was initiated in 2001. It has been in operation for more than 10 years now and it is now imperative to take stock of whether the aim of restoring and conserving the polluted and degraded lakes of the country has been achieved.

MoEF/CPCB had not assessed whether there was measurable improvement in chemical parameters of lakes during implementation/completion of the project. Audit analysed the testing reports of CPCB regarding quality of water in test checked lakes in terms of Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO) and Total Coliform (TC). These are indicators of organic pollution, of whether the water can sustain aquatic life and presence of harmful, faecal-related bacteria, viruses and protozoa which cause illnesses respectively. The results are depicted in the table below:

Table 15: quality of water in test checked lakes

State	Lake	Quality of water
Andhra Pradesh	Banjara	Project still in progress
Jammu and Kashmir	Dal Lake	Quality of water deteriorated even during implementation of project.
Karnataka	Bellandur	Project abandoned
	Kotekere	Met 'B' class water criteria
	Sharanabasaveshwara	Met 'B' class water criteria
Kerala	Veli Akkulum	Project still in progress
Madhya Pradesh	Shivpuri lake	Project still in progress
Maharashtra	Powai	Not being monitored
	Rankala	Project still in progress
Nagaland	Twin lakes	Project still in progress

Odisha	Bindusagar lake	Project still in progress
Rajasthan	Mansagar	Levels of BOD had come down after implementation of project
	Pushkar	Project still in progress
	Pichola	Project still in progress
Tamil Nadu	Kodaikanal	Project still in progress
Tripura	Dimsagar (Agartala)	Project still in progress
	Laxminarayanbari (Agartala)	Project still in progress
	Durgabari (Agartala)	Project still in progress
Uttar Pradesh	Mansi Ganga	Project still in progress
Uttarakhand	Nainital lake	Levels of BOD had come down, D.O increased
West Bengal	Rabindra Sarovar	Project still in progress
	Mirik	Project still in progress

The quality of water in Kotekere & Sharanabasaveshwara in Karnataka, Mansagar in Rajasthan & Nainital lake in Uttarakhand had improved as per indicators of organic pollution laid down by CPCB.

In its reply in June 2011, MoEF stated that water is a State subject and pollution prevention and conservation of water bodies including lakes remains the domain of State Governments. National River Conservation Directorate (NRCD) in MoEF is supplementing efforts of the State Governments in conservation of lakes through centrally sponsored scheme of NLCP for conservation and management of polluted and degraded lakes in urban and semi-urban areas of the country.

MoEF also stated that evaluation of NLCP together with NRCP, is presently being carried out by independent agencies engaged by MoEF. This reply needs to be viewed in light of the fact that MoEF being the primary funding agency as well as being mandated for prevention of pollution needs to take greater responsibility for the projects funded by it. Further, MoEF did not provide any evaluation reports of NLCP carried out by independent agencies. The Ministry in its reply was silent about the impact of NLCP in improving the quality of water in the lakes across India.

6.3 Change in water quality as a result of implementation of programmes for control of pollution of ground water

Despite increasing pollution of ground water sources and the presence of contaminants like arsenic, nitrate, fluoride, salinity etc., no programmes at the Central level and the State level were being implemented for control of pollution and restoration of ground water. Hence, no impact assessment was possible in the absence of programmes.

In West Bengal we observed that the State Government was monitoring groundwater pollution in six blocks but ground water quality monitoring was not taking place regularly in five blocks. It was also found that water quality monitoring laboratories were established in five blocks but the groundwater sources were not being tested more than once in a year by these laboratories in five out of six blocks.

It was observed that the Tamilnadu government had initiated Fluorisis Mitigation Project in June 2010 in Dharmapuri and Krishnagiri districts which were endemic with respect to excess fluoride content in the ground water. The scheduled date of completion was May 2013. The programme, being implemented with assistance from Japan International Cooperation Agency, was being executed by Tamilnadu Water Supply and Drainage Board. The sanctioned cost of the project was ₹ 28.44 crore. The technology for fluoride mitigation was adopted by the implementing agency after appropriate study which proved its efficacy. Regular inspection of the facilities set up was taking place by the implementing agency and follow-up was taking place as and when required.

There is no nation-wide impact assessment relating to the pollution of ground water.

Conclusion

It is important to continuously monitor programmes to confirm whether programmes are achieving the objectives set out for them. River cleaning and control of pollution programmes for polluted rivers are being implemented since 1985.

The thrust of these programmes has been to stop sewage from polluting our rivers. The programmes have also tried to stop non-point sources of pollution through construction of low cost sanitation, electric crematoria etc., however, the data on the success of these programmes are not very encouraging.

With the Exception of Ganga in certain stretches, all the other rivers test checked by us i.e., Yamuna, Gomti, Godavari, Musi, Cauvery, Cooum, Mahananda, Khan, Kshipra, Vaigai, Chambal, Rani Chu, Mandovi, Sabarmati, Subarnarekha, Bhadra/Tungabhadra, Pennar, Pamba, Betwa, Krishna, Sutlej etc., continue to be plagued by high levels of organic pollution, low level of oxygen availability for aquatic organisms and bacteria, protozoa and viruses which have faecal-origin and which cause illnesses. These rivers are the lifeline of India and its States and people depend on them not just for water but also for livelihood.

With respect to lakes across India, many of them have disappeared due to drying up of their catchment areas which have been reclaimed for uses like urbanisation. Most lakes in India are under threat from nutrient overloading which is causing their eutrophication and their eventual choking up from the weeds proliferating in the nutrient-rich water.

Implementation of NLCP in conserving these lakes has had no discernible effect. Lakes support not only humans for livelihood like tourism and fishing but also support very diverse biodiversity which is disappearing from the levels of pollution entering our lakes.

All the lakes test checked by us i.e., Pichola, Pushkar, Dimsagar, Banjara, Kotekere, Bellandur, Veli Akkulam, Shivpuri, Powai, Rankala, Twin lakes, Bindusagar, Mansagar, Mansiganga, Rabindra Sarovar, Mirik, Kodaikanal lake, Dal lake, Laxminarayanbari Lake, Durgabari Lakei, Nainital lake etc., not only support livelihood but are unique eco-systems supporting a wealth of biodiversity.

Recommendation 24

MoEF/CPCB, in conjunction with the States, should conduct a city-wise assessment of the levels of pollution in our rivers. They should also evaluate the success of projects undertaken under NRCP in terms of pre-defined indicators developed by MoEF/CPCB. Such impact assessment should be done in a continuous manner so that data is generated to judge whether the programme is meeting its stated objectives.

Recommendation 25

MoEF/CPCB along with the States should carry out a comprehensive assessment of levels of pollution in the lakes across the country and also assess the impact NLCP has had in improving the water quality of those lakes on the basis of key indicators laid down by MoEF. Impact assessment should be a regular exercise so that data is generated to judge whether the programme is meeting its stated objectives.