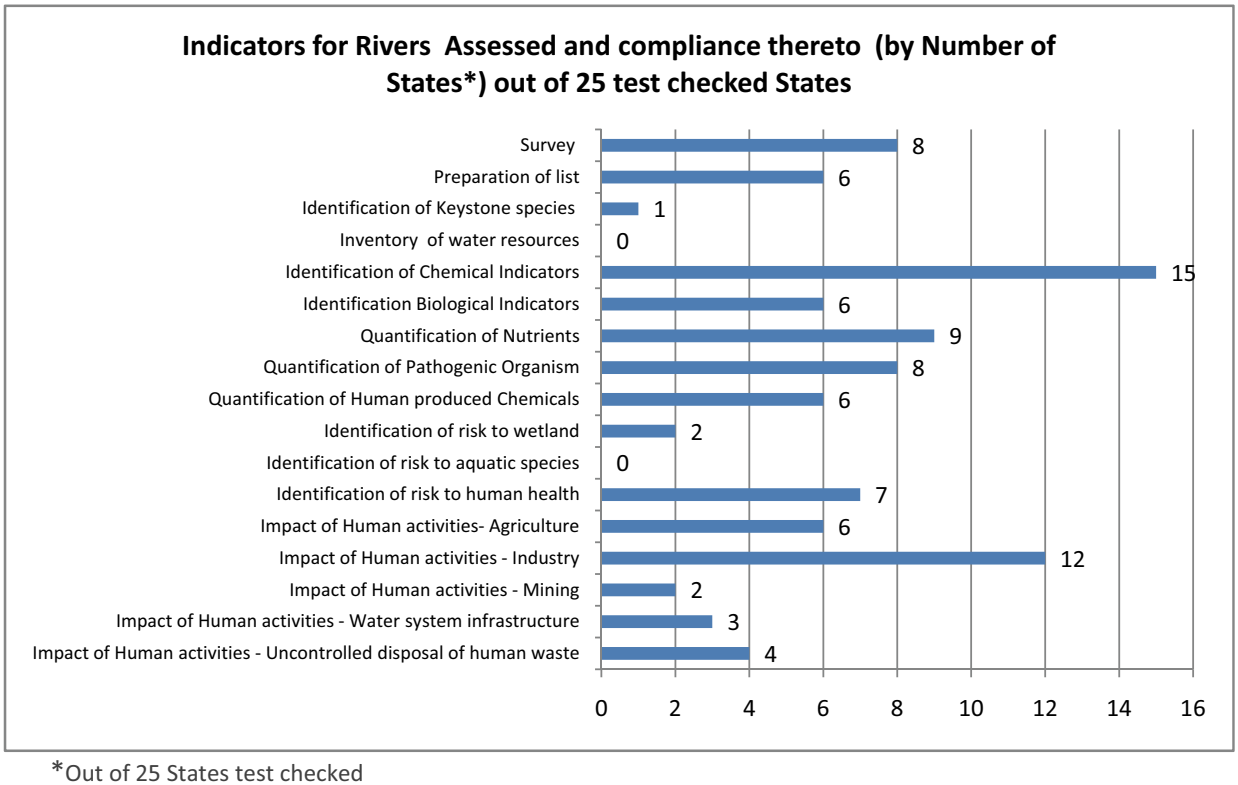
Chapter 3: Planning for control of pollution of rivers, lakes and ground water

A prerequisite of efficient protection of water resources against pollution is the preparation of a comprehensive and detailed plan of protection which takes into consideration all point and diffuse sources of pollution, pollution processes and movements, consequences and all possible structural and administrative measures of protection against pollution.

Assessment of the quantity and quality of water resources includes identification of potential sources of freshwater supply and determination of sources, extent, dependability and quality of water resources and of the human activities that affect those resources. However, for assessing surface water and ground water resources, governments require adequate and comparable information. This data on water resources, both quantitative and qualitative, becomes the basis of sound decisions.

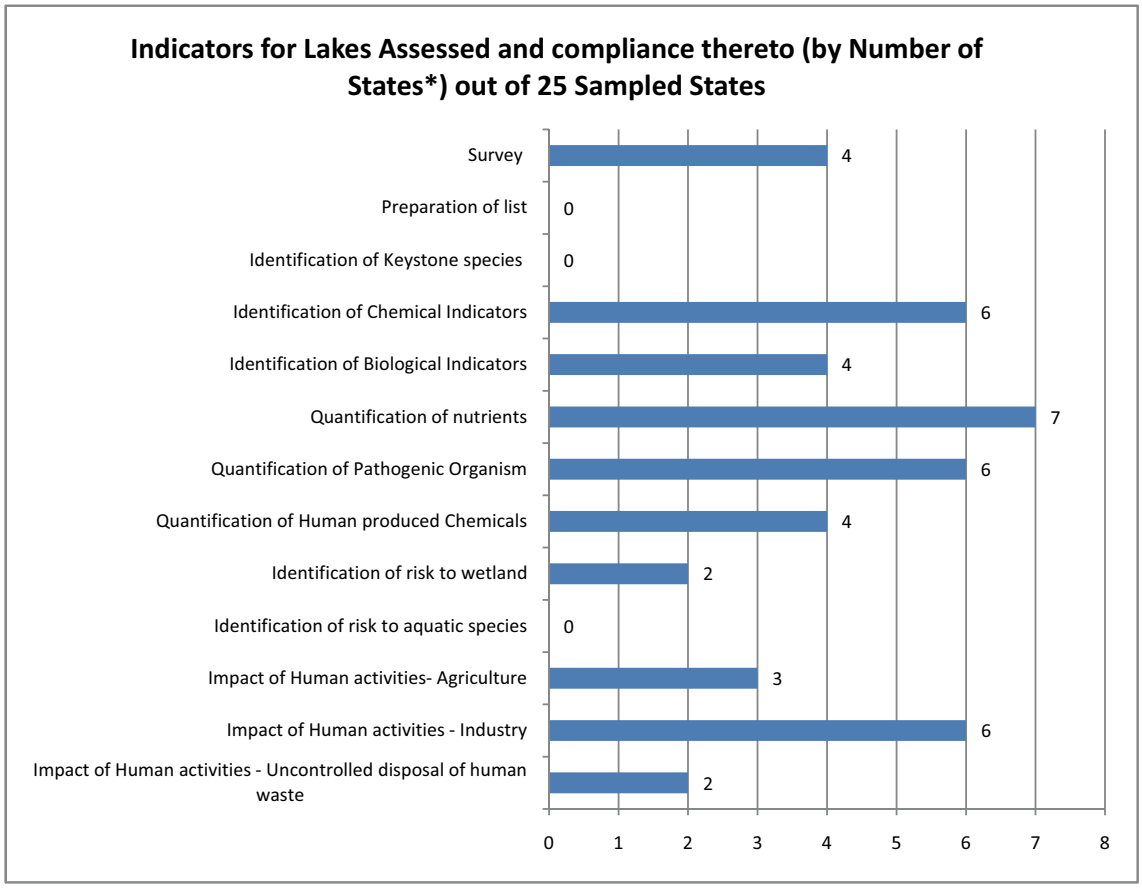
Polluted water in rivers, lakes and ground water poses risks to environment as well as health of people exposed to the polluted water. The basin approach is being recognised as a comprehensive basis for managing water resources more sustainably and will lead to social, economic and environmental benefits. Water quality goals are the minimum acceptable standard of quality of surface water and ground water. These goals, in the nature of standards, are minimum acceptable standards which are enforceable by water pollution control agencies.

The identification of various indicators of water pollution for rivers and lakes were examined in audit and a summary position of the compliance for 25 States test checked is shown in the chart below:



*Out of 25 States test checked

In the case of the chart pertaining to rivers, shows that out of 25 States test checked, the compliance to relevant indicators in terms of enumeration/identification/quantification etc. has been very dismal. At the best, in the case of one indicator namely identification of chemical indicators, there was compliance by 60 per cent of the States test checked. In the case of two indicators namely inventory of water resources and identification of risk to aquatic species, not a single State in the country had been able to comply with the standard.



*Out of 25 States test checked

In the case of the chart pertaining to lakes, shows an even more dismal position with regard to enumeration/identification/quantification of the relevant indicators. In the case of quantification of nutrients in the lakes, the compliance was by 28 percent of the States, in the case of three out of 13 indicators namely preparation of list, identification of Keystone species and identification of risk to aquatic species there was no compliance by any of the States.

The succeeding paragraph brings out the position in terms of individual States and the position obtaining at the Centre.

3.1 Inventory of rivers/lakes and keystone species associated with them

3.1.1 Preparation of inventory of rivers, lakes and ground water

In order to make comprehensive and workable plans to tackle water pollution, it is necessary to establish databases on the availability of all types of hydrologic data at the national level and to identify surface and ground water resources and potential sources of water supply and prepare national profiles. In this regard, we observed that

At the Centre

Detailed inventory of **rivers** and **lakes** had not been made by MoEF. MoEF stated that no survey to identify all rivers and lakes was done and no identification and classification of rivers and lakes as major/minor rivers and lakes had been done by it.

It also stated that since assessment of ground water resources in the country was not in the mandate of MoEF the same has not been done. Audit observed however that the Ministry of Water Resources operates a Ground Water Information System which maps, among other things, hydrological boundaries, land use, drainage and water level.

In the States

With respect to inventory of **rivers, lakes and ground water** resources and identification of keystone species audit scrutiny showed that:

- Only eight States, Punjab, Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra and West Bengal, had carried out a survey to identify rivers in their States and six States, Goa, Gujarat, Karnataka, Kerala, Maharashtra and Orissa had prepared an exhaustive list of rivers running in their States.
- Only four States, J&K, Kerala, Tamil Nadu and West Bengal had carried out a survey to identify the lakes in their States.
- 14 States, Punjab, Haryana, Andhra Pradesh, Bihar, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal, Delhi and Rajasthan had carried out district-wise assessment of ground water resources.

In the absence of an inventory for rivers and lakes, MoEF, which is the nodal ministry for pollution related issues in India, would not have adequate knowledge and information on the water resources which is the key part of the platform for setting objectives for water pollution prevention and control and implementing responses to it.

The absence of such an inventory will also hamper the water pollution management by the States.

3.1.2 Preparation of inventory of keystone species

A keystone species is a species so critical to an ecosystem that its removal could potentially destroy the entire system. The concept of keystone species has become an important issue in conservation today as the loss or decline of keystone species may have far-reaching consequences for the structure and functioning of the eco-systems in which they live.

At the Centre

MoEF has not identified keystone species associated with each **river** and **lake** for major river systems and lakes in India. This has been done only in the case of Ganga River where river dolphin was identified as a keystone species. Such identification is imperative as it would not only act as indicator of the health of the eco-system but would also help MoEF to design programmes to protect species threatened by water pollution.

In the States

- Only Himachal Pradesh had identified keystone species associated with some of the rivers running in their States.
- No State had identified keystone species associated with lakes in their States. Himachal Pradesh had identified some species of flies like Perlidae, Taenioperygidae, Ephemerellidae, Heptageneiidae and Hydropsychidae which live in streams. However, these were not keystone species.

In June 2011, MoEF stated that identification of keystone species was location-specific and need-based. Further, MoEF stated that it had notified the Gangetic River Dolphin as the national aquatic animal. However, the reply was silent about preparation of inventory of keystone species for other major river systems and lakes in India.

Absence of inventory of water bodies and keystone species associated with them leads to an incomplete understanding of water quantity and quality. The absence of such a database weakens the process of planning comprehensive and effective pollution control programmes.

3.2 Identification of existing pollution levels in terms of chemical and biological indicators

Chemical indicators like BOD, COD, faecal coliform and total coliform are traditional methods of water quality which provide an indication of organic pollution. However, due to complexity of effluents now entering the water bodies and the inability to develop analytical methods for each and every pollutant, use of biological indicators[6] is now assuming importance. Biological monitoring goes beyond the conventional measures of water quality to address questions of ecosystem function and integrity.

3.2.1 At the Centre

- Identification of chemical indicators of water pollution like faecal coliform, total coliform, dissolved oxygen and biochemical oxygen demand in **rivers** and **lakes** was

[6] It involves the measurement of species or a group of species like invertebrates whose population is used to determine environmental integrity

done by MoEF under the National River Conservation Programme and by CPCB under the Monitoring of Indian National Aquatic Resources (MINARs) programme.

- CPCB had also identified chemical indicators of pollution of **ground water** in the country like arsenic, nitrate, iron, fluoride and salinity. Identification of indicators of pollution by industries which emit contaminants had been done by CPCB by means of indicators like anions, other inorganic ions and micro pollutants. However, these were tested only once a year.
- This assumes significance in terms of the high levels of industrial pollutants which are being discharged into rivers, lakes and ground water in India as discussed later in this report.
- It was observed that CPCB has identified biological indicators (benthic macro-invertebrates) for some **rivers** in India such as Yamuna, Narmada, Krishna, Cauvery, Tungabhadra, Gomti, Kosi, Mahanadi and Brahmani. However such identification was not done for each river in India due to insufficient infrastructure facilities.

Biological indicators had not been identified for any lake in India by MoEF/CPCB.

MoEF stated in its reply of June 2011 that it had carried out studies relating to biological indicators and identified some limitations of such indicators. It also stated that biological indicators can supplement but not replace the chemical indicators. Also, agreeing with audit conclusions, MoEF stated that biological indicators reflect the effect of pollution on the water bodies.

The reply of MoEF has to be seen in light of the fact that biological indicators go beyond the conventional measures of water quality to address questions of ecosystem function and integrity and give a complete picture of the extent of pollution of rivers, lakes and ground water in India.

3.2.2 In the States

Audit scrutiny revealed that:

- 15 States, Punjab, Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, J&K, Jharkhand, Tamil Nadu, Odisha, Uttarakhand, West Bengal, Delhi and Kerala had identified some chemical indicators of pollution of rivers while only six States, Himachal Pradesh, J&K, Odisha, Tamil Nadu, Uttarakhand and West Bengal had done so for lakes.
- Biological indicators of pollution for some rivers had been developed by six States: Punjab, Andhra Pradesh, Bihar (for only two rivers), Himachal Pradesh, Tamil Nadu and West Bengal while only four States, Andhra Pradesh, Himachal Pradesh, Tamil Nadu and Uttarakhand had done for some of the lakes in the State.
- With respect to ground water, 17 States, Punjab, Haryana, Andhra Pradesh, Bihar, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Maharashtra, Uttarakhand, West Bengal, Delhi and Rajasthan had identified existing pollution levels in terms of arsenic, nitrate, salinity etc.

The scenario of identification of chemical and biological indicators of pollution in rivers and lakes in the States reveals a particularly dismal position in respect of biological indicators.

This also indicates that the planning process cannot be symmetrical as no comprehensive data is available to give a holistic picture of the nature and quantum of pollution in India's surface water bodies.

3.3 Identification and quantification of contaminants

A wide range of human and natural processes affect the biological, chemical, and physical characteristics of water and thus impact water quality. Contaminants[7] can harm aquatic ecosystems and make water unsuitable for human use.

3.3.1 At the Centre

Identification and quantification of contaminants like nutrients, erosion and sedimentation, water temperature, acidification, salinity, pathogenic organisms (bacteria, protozoa and viruses), human produced chemicals and other toxins, introduced species and other biological disruptions etc., had not been done in respect of any **river** or **lake** in India by MoEF, CPCB or by MoWR.

Identification and quantification of pollution levels in **ground water** in terms of arsenic, nitrate, iron, fluoride and salinity in ground water for each of the States in India has been done by CGWB. However, no identification and quantification has been done regarding presence of nutrients, human produced chemicals and other toxins in ground water.

3.3.2 In the States

With respect to identification and quantification of contaminants, audit scrutiny revealed:

- Nine States, Andhra Pradesh, Goa, Gujarat, Himachal Pradesh, Kerala, Maharashtra, Odisha, Tamil Nadu and West Bengal had identified and quantified nutrients in some rivers.
- Six States, Andhra Pradesh, Bihar, Karnataka, Odisha, Tamil Nadu and West Bengal had identified and quantified human produced chemicals in some rivers.
- Eight States, Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Uttarakhand and West Bengal had identified and quantified pathogenic organisms affecting quality of water in some of the rivers.
- Seven States, Andhra Pradesh, Himachal Pradesh, J&K, Kerala, Odisha, Tamil Nadu and West Bengal had identified and quantified nutrients in respect of lakes.
- Four States, Andhra Pradesh, Karnataka, Tamil Nadu and West Bengal had identified and quantified human-produced chemicals in some lakes and

[7] Contaminants like nutrients, erosion and sedimentation, acidification, salinity, pathogenic organisms (bacteria, protozoa and viruses), human produced chemicals and other toxins, introduced species and other biological disruptions etc

- Six States, Andhra Pradesh, Gujarat, Karnataka, Kerala, Uttarakhand and West Bengal had identified pathogenic organism affecting quality of water in some of the lakes in their respective States.

In June 2011, MoEF stated that CPCB had undertaken comprehensive studies/inventories of pollution sources and their effect in river basins like Ganga, Brahmaputra, Brahmini, Sabarmati etc., and published a document on assessment of industrial pollution which provided the pollution load from major industries.

MoEF also stated that control of agricultural pollution was difficult and Ministry of Agriculture needs to devise suitable policy in this regard.

CPCB had conducted studies on pollution sources and their effects. However, these studies took place between 1980 to 1995 and did not cover all rivers and all sources of pollutants.

As such, these studies have not taken into account the impact of the rapid pace of industrial development which has added complexity to the quantity and type of pollutants.

3.4 Identification and quantification of human activities that impact water quality

Numerous human activities including agriculture, industry, mining, disposal of human waste, population growth, urbanisation, climate change etc. impact water quality. Agriculture can cause nutrient and pesticide contamination and increased salinity and nutrient enrichment has become one of the most widespread water quality problems of the planet.

3.4.1 At the Centre

MoEF/CPCB/MoWR have not carried out assessment and quantification of the effect of activities which affect the quality of water in **rivers** and **lakes** from an activity-based perspective such as mining or agriculture, or industrial sector. The water quality monitoring is presently carried out by CPCB's 1700 monitoring stations including 490 locations for ground water on the basis of 28 parameters consisting of physio-chemical and bacteriological parameters.

Further, CGWB had carried out only a few special studies regarding the effect of human activities on **ground water** like agriculture and uncontrolled disposal of human waste on the quality of ground water.

No studies have been carried out by MoEF/CPCB to probe the effects of industrial activities like paper mills, pharmaceutical industry, chemical plants, distilleries, tanneries, oil refineries, sugar factories and mining.

3.4.2 In the States

With respect to assessment and quantification of the effect of activities which affect the quality of water in rivers and lakes, audit scrutiny revealed that with regard to

Quality of water in rivers:

- Effect of *agriculture* had been assessed only by six States: Andhra Pradesh, Assam, Goa, Odisha, Tamil Nadu and West Bengal;
- Effects of *industrial activities* had been assessed only by 12 States: Delhi, Haryana, Andhra Pradesh, Assam, Gujarat, Himachal Pradesh, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, Uttarakhand and West Bengal;
- Effects of *mining* had been analysed by only two States: Goa and Odisha;
- Effects on the *water system infrastructure* has been assessed only by three States: Andhra Pradesh, Himachal Pradesh and Tamil Nadu;
- Effects of *uncontrolled disposal of human waste* had been assessed by only four States: Himachal Pradesh, Maharashtra, Odisha and West Bengal.

Quality of water in lakes:

- Effect of *agriculture* had been assessed by three States: Andhra Pradesh, Tamil Nadu and West Bengal;
- Effects of *industrial activities* had been assessed by six States: Andhra Pradesh, Gujarat, Himachal Pradesh, Kerala, Tamil Nadu and West Bengal; and
- Effects of *uncontrolled disposal of human waste* had been assessed only by two States: Himachal Pradesh and West Bengal.

Quality of ground water:

- Effects of *agriculture* had been assessed only by seven States: Punjab, Haryana, Andhra Pradesh, Goa, Kerala, Tamil Nadu and West Bengal;
- Effects of *industrial activities* had been assessed only by nine States: Haryana, Andhra Pradesh, Assam, Goa, Gujarat, Himachal Pradesh, Tamil Nadu, West Bengal and Delhi;
- Effects of *uncontrolled disposal* of human waste on quality of water in the ground water had been assessed only by four States: Haryana, Himachal Pradesh, Kerala and West Bengal.
- Effect of *mining* on the quality of ground water had not been assessed by any State.

In June 2011, MoEF stated that the entire impact of human activities had been assessed by CPCB and for sewage generation, collection, treatment and disposal, separate documents had been produced.

The reply of MoEF needs to be viewed in light of the fact that the CPCB reports have essentially focussed on only one of the human activities, i.e., uncontrolled disposal of human waste which affect the quality of river water. Further, the reports do not address the impact of other human activities such as agriculture, mining etc., which impact the quality of water. Further these studies are more than two decades old and have not been done with respect to all the rivers, lakes and ground water sources in India.

3.5 Assessment of risks of polluted water to environment and health

Polluted water in rivers, lakes and ground water poses risks to environment as well as health of people exposed to the polluted water. With respect to assessment of risks, audit scrutiny revealed the following:

3.5.1 At the Centre

MoEF had not identified wetlands associated with each **river/lake** and no identifications of risks to these wetlands due to pollution of river water/lake water had been carried out by MoEF/CPCB. Further, MoEF/CPCB had not identified the major aquatic species, birds, plants and animals facing risks due to pollution of rivers and lakes. As such, MoEF/CPCB was unaware of the risks being faced by the environment as a result of pollution of rivers and lakes.

We observed in audit that risks to human health from water borne diseases and water based diseases as a result of pollution of **rivers and lakes** has not been assessed by MoEF/CPCB.

In 2009, Ministry of Health and Family Welfare reported that 1.14 crore cases of acute diarrheal diseases occurred in India.

With respect to assessment of risks to human health from pollution of **ground water,** MoEF/CPCB stated that it had not been done while CGWB stated that such risk assessment was outside its purview. Thus, MoEF/CPCB/CGWB were unaware of the risks to human health being posed by polluted rivers, lakes and ground water.

3.5.2 In the States

- Risks to wetlands from pollution of rivers and lakes have been assessed by only two States: Punjab and Tamil Nadu.
- None of the States in India have identified the major aquatic species, birds, plants and animals facing risks due to pollution of rivers.
- Risks to human health from water-borne diseases and water-based diseases as a result of pollution of rivers had been assessed by only seven States: Goa, Haryana, Jharkhand, Kerala, Madhya Pradesh, Himachal Pradesh and Odisha.
- Risks to human health from arsenic, zinc, iron, mercury, copper, chromium, cadmium, lead, persistent organic pollutants like dioxins, furans and polychlorinated biphenyls as a result of pollution of ground water had been assessed by only two States: Assam and Karnataka.

In June 2011, MoEF stated that risk assessment was taken into account while developing the water quality objectives, criteria and standards. It also stated that diseases caused as a result of contamination of water are well known and such incidents are also well documented.

Both Union and State governments have failed to conduct comprehensive assessment of risks to environment and health. Such studies on risk assessment would have enabled them to put in place preventive measures to lessen the deleterious impacts of water pollution on human health as well as the fragile freshwater ecosystem.

3.6 Basin level approach for control of pollution

The basin approach[8] is recognized as a comprehensive basis for managing water resources more sustainably and will lead to social, economic and environmental benefits.

With respect to planning for control of pollution at the basin level, we observed that MoEF established a long-term vision for only Ganga river basin as against the 24 major river basins existing in India.

For the river Ganga, the National Ganga River Basin Authority (NGRBA) was constituted in February 2009. We, however, observed that only government level stakeholders namely, Ministers of Urban Development, Water Resources, Deputy Chairman, Planning Commission and Minister of State for Environment were involved in consultations while setting up NGRBA. MoEF had taken very limited action on integration of policies, decisions and costs across sectoral interests relating to pollution such as industry, agriculture, urban development, navigation, fisheries management and conservation, including through poverty reduction strategies.

Further, it did not engage in strategic decision-making at the river basin scale which guided actions at sub-basin or local levels. No involvement of private sector/civil society in investment decisions in the planning process was found. With respect to **lakes**, no planning was found to have been done according to the basin approach.

In June 2011, MoEF stated that the need for a river basin approach for conservation had been already recognised by the Central Government and National Ganga River Basin Authority (NGRBA) had been set up as an empowered planning, financing, monitoring and coordinating authority for the Ganga River with new institutional structures. It further stated that the objective was to have the river basin as the unit of planning, to shift from town-centric to river-basin approach and to have a comprehensive response covering water quality and flow, sustainable access, environment management, prevention and control of pollution in the form of a national mission.

Audit acknowledges the fact that the basin approach has been adopted for conservation of river Ganga and MoEF must now start planning similar basin approaches for all the river basins in India, starting with the ones which are the most polluted like River Yamuna.

3.7 Development of water quality goals, corresponding parameters for each river/lake and their enforcement

Water quality goals are the minimum acceptable standard of quality of surface water and ground water. These goals, in the nature of standards, are minimum acceptable standards which are enforceable by water pollution control agencies. Action should be taken against agencies that violate such standards.

[8] Basin approach promotes the coordinated development and management of water, land and related resources of the whole river basin to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

In this regard, it was observed that MoEF had failed in development of water quality goals and corresponding parameters for each **river and lake**. MoEF also had not established enforceable water quality standards that protect human and ecosystem health. It had only developed water quality criteria for five activities and general standards under Environment Protection Act, 1986 for wastewater discharge to a water body, land and sea.

The Environment (Protection) Act (EPA) introduced in 1986 sought to take steps for the protection of environment and prevention of hazards to human beings, other living creatures, plants and property.

Section 15 the act laid down that "*whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued there under shall in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees, or both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.*"

MoEF/CPCB have set no water quality goals for the country. They have also not set any standards for agricultural practices and runoff pollutant levels for rivers and lakes.

With respect to **ground water**, it was observed that standards for agricultural practices and runoff pollutant levels for ground water had not been set by either MoEF or CGWB. CGWB stated that it was outside its purview. No monitoring of pollution caused by agricultural practices and runoff pollutant levels were being done by MoEF/CPCB/CGWB. While MoEF stated that information was available with Ministry of Agriculture and Departments like Indian Council of Agricultural Research, CGWB stated it was outside its purview. Enforceable water quality standards that protect human and ecosystem health have not been set by MoEF. CGWB stated that it was outside its purview.

Conclusions

The compliance in terms of enumeration/identification/quantification of indicators have been very dismal by the States. The absence of a comprehensive inventory of rivers/lakes and keystone species associated with them, which form a key step in planning the control of pollution in aquatic resources, reflects deficiencies in the planning process.

The Ministry failed to adopt a wide-ranging approach towards identifying pollution levels in different water bodies. This was so because of its focus on chemical indicators and its lack of attention to biological indicators.

The risk assessment procedures of MoEF/CPCB and the States were deficient as they failed to carry out comprehensive identification and quantification of human activities which impact water quality and the different sources which affect water quality. No agency in the country has assessed the risks of polluted water in rivers/lakes/ground water to health and environment.

The enforcement of standards of water quality are bound to meet with limited success given that MoEF has not adopted the basin-level approach for control of pollution of rivers and lakes. It has also not developed water quality goals and corresponding parameters for each river/lake.

As such, overall planning for the control of pollution on part of MoEF and the States was inadequate which would have concomitant repercussions on implementation of programmes for control of pollution and their outcomes as discussed in the succeeding chapters.

Recommendation 3

MoEF/CPCB should initiate steps, along with other client ministries like Ministry of Water Resources and all the States to draw up a comprehensive inventory of all rivers, lakes and ground water sources in India. It should also undertake a survey to list all the keystone species associated with each river and lake in India. This inventory should also be placed in the public domain.

Recommendation 4

MoEF/CPCB and most States need to intensify their efforts in developing biological indicators to ensure that the functional integrity of aquatic ecosystems are safeguarded.

Recommendation 5

MoEF/CPCB and most States need to undertake a comprehensive assessment to identify and quantify the contaminants present in each river and lake in India. This would not only help MoEF and States in designing regulations for their control but also help in safeguarding health of humans as well as the ecosystem. Identification and quantification of nutrients, pesticides etc., need greater priority due to immense damage they cause to health of ecosystems as well as human health. This process of identification and quantification should also be taken up on priority basis as a high proportion of ground water is used for potable supply.

Recommendation 6

MoEF and most of the States need to also take steps to identify and quantify the effect that human activities like industries, agriculture, mining, urbanisation etc., have on water quality of rivers, lakes and ground water. This will enable MoEF and States to design targeted programmes which would seek to regulate those human activities which are causing the most pollution.

Recommendation 7

MoEF and CPCB, along with most States need to undertake assessment of risks posed to health and environment due to pollution of rivers, lakes and ground water in India. MoEF can also coordinate with Ministry of Health and Family Welfare in assessment of risks to health posed by polluted water and get diseases caused by water pollution included in the Health Status Indicators published by the Ministry of Health and Family Welfare.

Recommendation 8

MoEF should take into account the basin approach while planning for reduction of pollution of all rivers and lakes in the country. The basin approach will allow it to address the

pollution of rivers and lakes holistically and integrate policies and plans with other ministries and civil society/research organisation which will be more effective in tackling pollution issues in the long run.

Recommendation 9

With respect to lakes, all three attributes of the lake, i.e., the basin, the water body and the command area need to be conserved instead of the present focus of NLCP on the water body only.

Recommendation 10

MoEF/ States needs to develop water quality goals and corresponding parameters for each river and lake which is essential for regulating ecosystem health and integrity.

Recommendation 11

MoEF also needs to establish enforceable water quality standards for rivers, lakes and ground water that would help protect human and ecosystem health. Penalties need to be levied for violations of water quality standards. Further, MoEF, in conjunction with Ministry of Agriculture, needs to develop standards for pollutants like nitrogen, phosphorus etc., which arise from agricultural practices, use of pesticides and fertilisers as pollution from agricultural sources is one of the biggest non-point source of pollution.