

# Challenges in Regulating Water Pollution in India

## Standards, Monitoring, Enforcement and Accountability

SHARACHCHANDRA LELE, PRIYANKA JAMWAL, MAHESH MENON

With rapid industrialisation and urbanisation, the problem of water pollution in India has escalated dramatically over the last few decades. The regulatory apparatus, has, however, lagged behind. Major gaps in standard setting, including lack of standards for ambient water quality, poor monitoring and weak enforcement by the pollution control boards are the major proximate causes. Controlling water pollution will require a concerted effort to address these regulatory failures.

While air pollution attracts public attention every winter across northern India as visibility drops and respiratory difficulties rise, attention to water pollution is perhaps more episodic and localised with events like Bellandur lake in Bengaluru catching fire (Nath 2015) or fish deaths in the Ganga (Anonymous 2018). Nevertheless, such episodes have served to attract the attention of regulators (mainly the Central Pollution Control Board or CPCB), the judiciary (especially the National Green Tribunal or NGT) and sometimes political attention. Yet the situation on the ground (or in the water) seems to change little, with (for instance) more river stretches being reported as critically polluted than ever before (Koshy 2018).

India passed its first water pollution regulation law, known as the Water (Prevention and Control of Pollution) Act, back in 1974 and supplemented it with the Environment (Protection) Act in 1986. Since then, the context has changed dramatically: not only has the population more than doubled (now approximately 138 crore), but the urban population has more than tripled (now approximately 35%), the gross domestic product (GDP) has quadrupled, and the industrial sector has grown more than proportionately. Even as the quantity of pollutants generated has increased dramatically, the nature of pollutants has also changed or diversified. In addition to domestic sewage and conventional industrial pollutants (such as salts), heavy metals, pesticides from agriculture and micro-pollutants from expanding household chemicals are a matter of concern (Riva et al 2019).

The response from the state and central regulatory set-up, which includes the pollution control boards (PCBs) on the one hand and an active judiciary on the other, has been somewhat haphazard. They have inter alia expanded water quality monitoring geographically—from 18 sites in 1978 to 4,111 in 2020 (CPCB 2018), (repeatedly) launched major “clean-up” programmes (such as the Namami Gange in 2014), imposed common or individual effluent treatment plants (CETP/IETP) requirements on industries and in some cases set zero-liquid-discharge constraints on them, and more recently imposed treatment and reuse requirements on apartment complexes. There is talk of passing a new act to unify the water, air, and environmental pollution acts.

This paper seeks to look beyond these individual responses to identify some of the fundamental issues plaguing our water pollution regulatory mechanisms. Our analysis focuses on standard-setting, monitoring, and enforcement, which are primarily the tasks of the PCBs and have secondarily become the realms of intervention by the judiciary (courts or NGT).

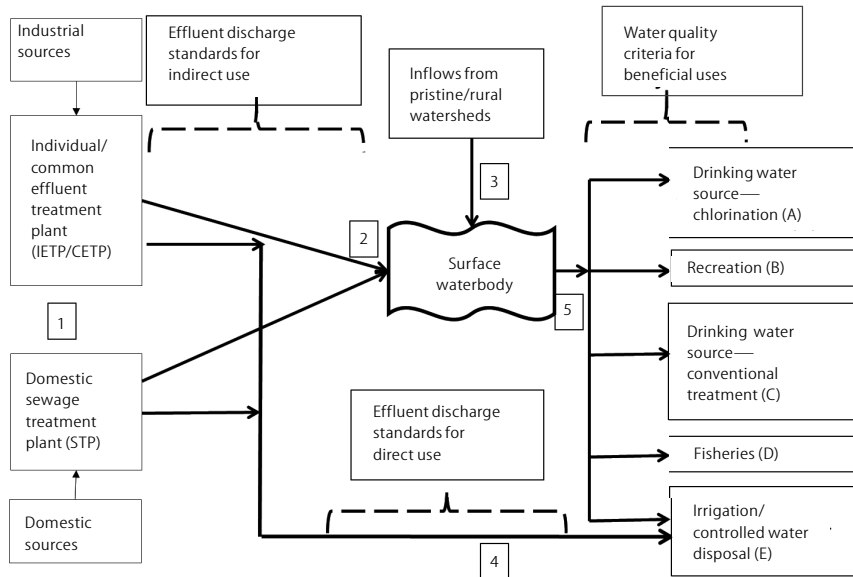
Sharachchandra Lele ([slele@atree.org](mailto:slele@atree.org)) is a distinguished fellow at the Centre for Environment and Development, ATREE and adjunct faculty at the Indian Institute of Science Education and Research Pune. Priyanka Jamwal ([priyanka.jamwal@atree.org](mailto:priyanka.jamwal@atree.org)) is a fellow at the Centre for Environment and Development, ATREE. Mahesh Menon ([menonm86@gmail.com](mailto:menonm86@gmail.com)) is assistant professor of Law at the School of Law, Sai University, Chennai.

This leads us to the questions of the governing structure of the boards and the functioning of the NGT. Perforce, we do not look at the other actors in the water pollution control space: the industry that has to meet standards, the municipal authorities or parastatals that are charged with domestic waste water treatment, the elected representatives that are supposed to initiate legislative action, or the citizens' movements that have emerged to draw attention to the water pollution problem. We draw from the literature and substantially our own analyses of these aspects in Karnataka and find gaps and structural shortcomings at all these levels.

**Standard-setting**

Water quality is regulated to ensure human and environmental health. Defining acceptable water quality is enormously complicated because of two factors: the diversity of pollutants (point 1 in Figure 1) and the variety of uses to which the water is being put (point 5). A third complication is that when polluted water is discharged, it may not get used directly (point 4). Typically, it is released into a surface waterbody (point 2) where it gets diluted by other "natural" flows (point 3) before being used.

**Figure 1: Schematic Diagram of the Discharge, Flow and Use of Polluted Water and the Points at Which Standards Are Set**



Source: Authors' own compilation.

Water pollution standards in India (set under the Environment (Protection) Rules, 1986, Schedule VI, read with Section 3 (3-A) primarily focus on the quality of discharge, either into surface waterbodies (indirect use: 5 above) or for direct use (4). The quality parameters or pollutants specified and their permitted limits vary depending on where the effluents are being discharged: inland waterbodies, coastal areas or direct use in (say) irrigation. Several assumptions appear to have gone into setting these standards; assumptions that may not hold today (for more details, see Jamwal et al 2016):

(i) The discharge standards for indirect use appear to assume that the receiving waterbodies (such as streams, rivers, ponds, and lakes) have inflows from pristine or rural watersheds, diluting the discharged pollutants' concentration. But this would not

be true for seasonal rivers and may no longer be true even for perennial ones, as upstream catchments or stretches of the river get urbanised and industrialised. The Ganga going through Kanpur and proceeding further downstream is an example of the latter. Vrishabawathi river, a seasonal river originating in Bengaluru, which carries only domestic sewage during the lean season (Jamwal and Lele 2017), illustrates the former situation.

(ii) The standards vary inexplicably: effluent discharge into any surface waterbody is regulated by 35 parameters, including heavy metals, whereas waste water for "land application" (that is, used directly in irrigation) is regulated by only 10 parameters with no parameters that cover heavy metals. The assumption may have been that reuse happens only with domestic sewage, but that does not hold in mixed catchments.

(iii) Certain sources are entirely unregulated. For example, limits for persistent organic pollutants (POPs) are specified only for industrial discharges, ignoring that farming is a significant source of POPs.

(iv) The standards are almost always concentration-based, not load-based, and therefore, the total amount of pollutants entering the receiving waterbody is not being regulated.

The standard-setting for water use is even more patchy and peculiar. Standards are set for marine water when put to specific uses (item 86 in Schedule I, Rule 3 of the EP Rules) using five to eight parameters. A standard for bathing water (but nothing else) has been defined in item 93 (Schedule I) with four parameters. But no standards are defined for irrigation water use (which is the biggest user of water where human contact occurs) or even drinking water (only the standard for the sale of packaged drinking water is specified in FSSAI standards) (FSSAI 2011). (As mentioned above, the irrigation use standard is for direct use of effluents.)

The most significant gap is that no standards have been set for the ambient water quality of a surface waterbody, whether in general or corresponding to different uses that it might be put to. So unlike air quality (where national standards were set fairly recently), there is no "attainment objective," and no goal for the regulator to strive towards. All that exist are "water quality criteria" (WQC) that were identified by the CPCB for the following use categories: drinking (that only requires disinfection), outdoor bathing, drinking water that needs treatment and disinfection, fishing and propagation of wildlife, and finally irrigation/industrial cooling/controlled waste disposal. These criteria have no legal standing; they are simply used to tag a particular waterbody as classes of A/B/C/D/E or below E. Moreover, the parameters specified in these criteria are minimal, and in particular, no industrial contaminants such as heavy metals are mentioned at all. The inconsistency between discharge standards and these (albeit unenforceable) WQC is

staggering. It is as if water originates in pristine or rural catchments, and the only sources of contamination are domestic sewage (hence standards for biochemical oxygen demand [BOD]) and geogenic contaminants like boron or salts.

Furthermore, the lax to non-existent water use standards, including irrigation water use, means neither state agencies supplying water for domestic use nor those building dams and irrigation canals can be held responsible when farmers, fisherfolk, or villagers use river water downstream. As India urbanises and more waste water is generated, irrigation is the biggest form of reuse (Schellenberg et al 2020), and evidence of the presence of industrial contaminants despite the notified discharge standards (Suthar et al 2009; Aktar et al 2010) of the enormous amount of untreated domestic sewage and consequent biological contamination (Jamwal 2009; Jamwal et al 2011), and the public health impacts of polluted reuse is mounting (Srinivasan and Reddy 2009; Ramesh and Moorthy 2012). Domestic sewage now also contains an increasing number of chemicals, including phosphates in detergents.

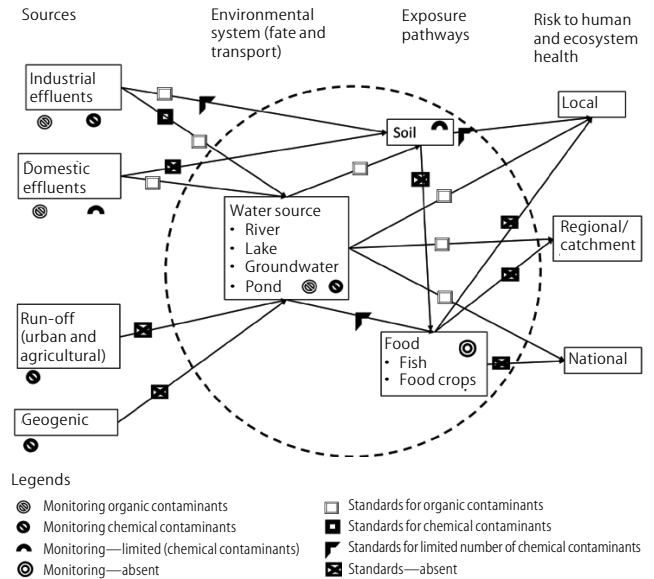
The flowing water in channels, streams and rivers, including that which enters lakes and links upstream polluters to downstream users—both humans and aquatic species. Therefore, ensuring ambient water quality serves both as a cross-check on discharge regulation upstream and as the means of ensuring public and ecosystem health downstream. Thus, the absence of an ambient water quality goal or goals and procedures to ensure them is a significant lacuna in Indian water pollution regulation. The approach adopted in countries like the United States is to set detailed standards for different uses, and then through a public process, decide what a particular waterbody is meant for or should be used for: irrigation, fishing, swimming, or supply for domestic use (what is its “designated best use,” to use their terminology). The goal would then be to ensure that the waterbody met the standards for that use. Accordingly, keeping in mind the catchment’s hydrology (what kinds of inflows are received from where), the regulator would have to set discharge standards, possibly load-based ones, for industries and other polluters in the catchment. Section 3 of the Water Act empowers the PCBs to do all this, and the CPCB has paid lip service to the idea of designated best use. But there is apparent reluctance on the part of the PCBs to move in this direction because it forces them away from their simple focus on end-of-pipe monitoring. It also requires changes in their staffing and operating methods, which we shall discuss later.

**Monitoring**

Needless to say, adequately defined standards have to be matched by rigorous monitoring to identify situations where pollution levels are unacceptable, to trace them back to causes or sources on the one hand, and to estimate impacts on the other. Monitoring, therefore, needs to happen at multiple points (Figure 2): sources, in-stream/in aquifers, soil and food pathways, and the final recipient human populations and ecosystems.

The monitoring effort in India is no doubt deployed at these multiple points. The primary focus, however, is on industrial sources. Monitoring of these sources takes place under routine

**Figure 2: Framework Showing Gaps in the Water Quality Monitoring Framework in India**



or surprise inspections by pollution inspectors of the regulated industries and can include “compliance evaluation” inspections (where pollution control facilities are checked) and “compliance sampling” inspections (where air/water samples are taken on-site) (Gupta et al 2019). But limited data are available, or research has been done on the intensities of compliance sampling, and the results of this sampling are certainly not in the public domain. Gupta et al’s study in Punjab showed that overall inspection levels are low, with 75% of the firms inspected less frequently than once in five years. PCB staff confess to having limited time for actual sampling (Lele et al 2016).

When it comes to domestic sewage, the monitoring is focused on the effluents from sewage treatment plants. Not only is this monitoring of STPs done poorly (Jamwal et al 2015), but it ignores the fact that a significant fraction of domestic sewage in Indian cities never enters STPs. The PCBs have made no effort to track this fraction, let alone bring about any reductions. Similarly, there is no effort to monitor agricultural runoff for POPs.

Second, monitoring effort has no doubt increased when it comes to monitoring pollutants in transit: under the Global Environmental Monitoring System (GEMS) and the Monitoring of Indian National Aquatic Resources System (MINARS) schemes. For instance, in Karnataka, the state PCB monitors 63 locations: five under GEMS and 61 under MINARS (CPCB 2015). The number of parameters monitored has also increased. But there seems to be a peculiar disconnect between monitoring and its use. As already mentioned, there are no ambient water quality standards, so the monitoring and tagging of the waterbodies into classes A–E or below E as per the WQC does not translate into any action as there is no legal requirement to abate pollution. Moreover, although many parameters seem to be monitored, the CPCB reports on river pollution (for example, CPCB 2015) classify river stretches into “priority classes” only based on BOD levels (CPCB 2011). Finally, the monitoring is often carried out at locations far downstream from the sources or only on major rivers where pollutants may get diluted or after the polluted

water has already been reused. For instance, Vrishabawathi river is not monitored under these programmes at all, while monitoring takes place on the Arkavathy 20 km downstream of where the Vrishabawathi meets it, while most of the reuse happens in the Vrishabawathi upstream of the confluence.

A third and major deficiency in the monitoring strategy used for in-stream water quality is the sampling regime. Usually, the samples are collected in the form of “grab samples” (one-time samples) at a fixed (day) time once in three–four months. This often does not capture the true picture regarding the pollution levels: round-the-clock monitoring on the Vrishabawathi river in Bengaluru showed much higher peaks at night and early morning than during the day (Jamwal et al 2021).

Fourth, monitoring water quality at a location is not the end of the matter. Unacceptable levels of pollution are a pointer to the existence of a problem. In some cases, the sources may be obvious (the industry from which the sampled effluent is being discharged), while in others (when a stream is sampled), the sources have to be traced. In extreme events or unconventional crises, such as a lake catching fire or producing masses of foam at its outlet, as in the infamous Bellandur lake (Pickard et al 2021), the regulator needs to invest in research or collaborate with research groups to diagnose the problem. But such initiatives are almost non-existent. Research institutes are only brought into the picture by the courts or the NGT, typically for short-term fact-finding that cannot substitute for long-term research into processes, causes and their relative contribution. Similarly, there is no strategy for monitoring industrial contamination of groundwater, even though anecdotal evidence suggests industries often discharge effluents into abandoned borewells.

Finally, in a diverse country like India with limited state capacity, citizen involvement in monitoring can make a big difference (Rajaram and Das 2007). The idea of citizen science is gaining popularity in other countries. In the Indian context, however, there is an enormous reluctance on the part of the regulatory agencies to engage with citizens. In the context of pollution measurements, too much is set store through tests by “authorised” agencies and little attempt is made to incorporate local knowledge (Karpouzoglou and Zimmer 2012). This may be related to the legal framework focused on criminal prosecution, which requires higher levels of reliability and sanctity. But it also reflects the lack of “locus standi” given to citizens in the law, which has carried over into the mindset of the PCBs.<sup>1</sup>

### Enforcement

Given a set of water quality standards and the detection of their violations and identification of polluters, the next stage in regulation is law enforcement. The powers given for enforcement include the ability to revoke or not renew consent, direct shutting down of operations, direct state utilities to shut off electricity and water supply to errant polluters, and finally, initiate criminal prosecution. The data on enforcement are hard to come by, and independent authentication of compliance is nearly impossible (since the researcher is never “authorised” to collect samples from industries and even conduct in-stream sampling requires permission). Where some data has become available, there is

evidence that just the act of repeated inspection improves compliance (Gupta et al 2019). In the absence of powers to impose fines on its own, the PCBs will have to launch a criminal prosecution when there are repeated instances of violations. However, the record on criminal prosecution is abysmal: for example, Lele et al (2016) show that the vast majority of cases prosecuted by the Karnataka PCB have failed in court, and the result is a combination of poor legal representation, scientific rigour, and excessive attention to legalities by the court, possibly because the violations are crimes under the law. This poor record of prosecution success prevails across all states (OECD 2006). There is also a reluctance on the part of the courts to impose harsh sentences for environmental violations, and disposal of these cases take a long time as the regular civil and criminal matters pending before courts receive more priority (Planning Commission 2000).

While there are suggestions that the existing powers of the boards are not fully used (for example, Agarwal 2005), many analysts contend that giving the boards the power to fine and compound offences (by downgrading some of the offences to civil ones) would help (Ghosh 2015; Prasad 2006). Others remain wary about whether, in the absence of structural reforms, this would become another avenue for corruption by the PCB officials (Abraham and Rosencranz 1986). While the criminal prosecution option is indeed challenging given the delays in and vagaries of the lower courts, we believe that the lack of effort on enforcement and the widespread accusations of corruption need to be addressed before adding other means of enforcement.

### Accountability

Why do the above lacunae in standard-setting, monitoring and enforcement continue even 35 years after the environmental protection agency was passed? This leads us to the question of how PCBs are governed. Several studies have debunked the supposed scarcity of funds and pointed instead to the shortage of human resources even when funding is available, poor or narrow training of staff and the lack of investment in monitoring equipment and technology upgradation (Planning Commission 2000; CSE 2009, 2014; Sahu 2013). But this only begs the question of why such a state of affairs prevails.

The problem originates in the structure of the governing body (the “board”) of the PCBs: issues partly caused by the act and rules and substantially aggravated by practices followed by the state and central governments. Legally, the potential polluters are very well represented on the state boards: three persons representing agriculture, horticulture and industry, three representatives of urban local bodies, representatives of industrial development boards, as well as state parastatal, such as sewerage boards. There is, however, no representation of the affected public (the potential pollutees). Nor is there any place for independent experts/scientists. Thus, the boards are hardly accountable to the public they are supposed to serve, nor are they really “autonomous” or “independent” of the state government as envisaged in the Water Act.

The problem is greatly aggravated by how the chairpersons and “member secretaries” (effectively the CEOs) are appointed. Chairpersons often have poor qualifications, or may even come

from industry, or are bureaucrats (Indian Administrative Service [IAS] or Indian Forest Service [IFS] officers) simultaneously holding other positions (while also not having any environmental qualifications) (Sahu 2013). Matters have come to such a pass that courts have, on instances, struck down appointments to these posts (Madras High Court 2015; NGT 2016), and the Supreme Court has issued orders directing the state governments to frame guidelines for appointments to ensure that only people of adequate qualifications are appointed (Supreme Court 2017). The Karnataka High Court has recently asked the state government to reconsider its appointment procedure (TNN 2021). It remains to be seen whether any significant changes occur.

The issue is not just about qualification but also about independence (which means chairpersons must be allowed to complete terms and renewed based on a proper performance review) and accountability. The latter requires that member secretaries be full-time professionals hired and fired by the governing body. Unfortunately, here, the tendency is to fill this position on deputation—almost always by IFS officers. Apart from their actual experience in pollution regulation, the fact that they are on deputation means they have no real commitment to or accountability towards the board they serve. Conversely, the rare competent and committed officer cannot be retained by the board beyond three years.

### Adjudication

When the regulators fail or fall short, the most common recourse in India has been for the public to approach the judiciary. The judiciary, therefore, willy-nilly becomes part of the regulatory process. A closer look at its performance is therefore necessary. We focus here specifically on the performance of the NGT in water pollution cases.

Before the NGT was established, cases relating to pollution were either filed before the high court or the Supreme Court as writ petitions, and a handful of cases were filed before civil courts seeking injunctive reliefs (Subramanian and Vakil 2018). The NGT was specifically established at the behest of the Supreme Court to be a specialised forum to hear only environmental cases, with a panel consisting of judges and technical members who had experience in environmental sciences or regulation. Thus, the NGT was expected to provide an impetus to science-driven environmental adjudication in India (Gill 2016) and promote better access to justice (Shrotria 2015). The tribunal has developed several substantive and procedural innovations that enable fact-finding, go beyond merely adjudicating the disputes presented before it and actively inquire into the situation and draw on science and scientific expertise in its decision-making (Gill 2019)—expansive powers that have been endorsed by the the Supreme Court (2021). These innovations enable the NGT to initiate proceedings suo motu, facilitate fact-finding on its own (which could otherwise be burdensome on the complainant) and tap into expertise available across multiple institutions evolve responses to violations.

Nevertheless, the NGT's handling of water pollution cases leaves much to be desired. Our analysis of 15 cases of pollution-related litigation and compensation decided in 2020 (Annexure 1, p 52),

and the high-profile case of Bellandur lake in Bengaluru reveals the following patterns. First, the fact-finding process it deploys is ridden with conflict of interests. In 15 cases of pollution-related litigation and compensation that we examined, the NGT's fact-finding committees included representatives of the PCB (and in four cases consisted solely of the PCB representative) precisely when the matter had arisen because of the negligence of the PCBs.

Second, when compensation was awarded, the orders did not explicitly mention the basis on which compensation is awarded or how its quantum has been set (either in law or in facts). Moreover, only in one of these cases was the compensation directed to be paid to the actual victims of pollution (subject to the district administration identifying who these were). In four cases, the compensation was asked to be paid to the PCB, and in the other cases, the orders did not make it clear as to who it was to be paid to.

Finally, the poor use of existing knowledge or reasoned analysis and a certain degree of capriciousness is epitomised by the Bellandur lake pollution case. To begin with, the NGT initiated suo motu proceedings based on popular media reports that the lake had "caught fire" in February 2017 (NGT 2017). Over the next four years, the tribunal practically administered a major operation to clean the lake, which included directions for setting up of STPs, desilting and de-weeding, removing illegal encroachments and diversion of sewage inflows (NGT 2017–21). Thus, instead of fixing any accountability on the existing regulators, the tribunal became a "super regulator," taking on the responsibility of prodding the regulators and functionaries to perform their duties. This in itself is a problem: an adjudicatory body sitting in Delhi can never perform a continuous regulatory function on the ground over a long period of time.

Specifically, from a water-pollution perspective, the NGT's use of scientific knowledge, evidence and reasoning was particularly weak. To begin with, the NGT completely ignored a comprehensive report submitted a few months before by an expert committee set up by the state government (Department of Urban Development, Government of Karnataka 2016) and the monitoring committee formed to oversee the implementation of the recommendations. Instead, the NGT set up its fact-finding committee, which consisted entirely of lawyers that made a cursory visit in May 2017 and submitted a brief report. Then, the tribunal ordered the closure of all industries located within the lake's catchment area, even though no evidence had been offered of the presence of any major industrial contaminants. The major source of pollution of Bellandur lake has always been untreated domestic sewage coming from all parts of the catchment, partly from unsewered areas in the centre (old) part of the city and partly raw sewage transported by the Bangalore Water Supply and Sewerage Board (BWSSB) itself in its sewer lines but let out due to the absence of STPs, as explained in the expert committee report of 2016. Instead of focusing on these problems and holding the BWSSB liable to discharge its statutory duties, the NGT targeted apartment complexes in the entire catchment which constituted a tiny fraction of the population. Most of these apartments were connected to sewer lines and were paying sewerage charges to install their own STPs. They wanted to

reuse 100% of their treated water, an impossible and unfair demand (Chatterjee 2018). Finally, the NGT's order to divert the inflows and desilt the lake lack a scientific basis, to say the least (Chatterjee 2020). Similarly, the NGT's orders on sewage treatment by towns and cities (NGT 2019) suggest that stringent conditions of compliance: the NGT overruled the relaxation of discharge standards for sewage treatment plants and set a uniform standard across the country, ignoring the suggestion of graduated standards by its own expert committee (Kapil 2019).

**Summing Up**

A rapidly urbanising and industrialising country with a dense population is bound to throw up significant water pollution challenges. While water pollution may be somewhat easier to deal with because it travels within known and observable channels (except for ground-water contamination), it is also less palpable than air pollution and easily overlooked or solved in a limited way through individual purification devices. Our review suggests that neither has the law in India regarding water pollution/quality standards kept up with the times, nor have the regulatory authorities, primarily the PCBs, come close to discharging their duties with the scientific and administrative rigour that would be required to address this problem. The structural weaknesses in the governance of the PCBs result in extremely poor accountability

to the affected public, and the judiciary is not able to consistently and credibly strengthen this accountability. We have illustrated these problems mainly from a somewhat narrower canvas of examples of individual smaller rivers such as Vrishabawathi or individual cities such as Bengaluru. The problem is even more pressing yet intractable when it comes to Ganga river—repeated grand clean-up missions have ended up making hardly any dent (Alley 2016). The literature on water pollution has generally been divided on disciplinary lines between the plethora of studies by environmental scientists showing the existence of the problem and analyses of the legal dimensions by environmental lawyers. But the questions of monitoring practice, enforcement effort and mechanisms and the structure and functioning of the regulators and the adjudicators could bear with more interdisciplinary investigation.

There is, of course, the larger question of whether one can even expect genuine public accountability institutions and rigorous enforcement in an era of single-minded promotion of economic growth and “ease of doing business” by the state. On the other hand, citizen activism and engagement with water-pollution issues is increasing, as in the case of Bengaluru's lakes. It remains to be seen whether these concerns gain enough traction in the political space to force some long-term shifts in the regulation of water pollution in the country.

**NOTE**

1 The personal experience of the first author in NGT fact-finding committees has been that persons filing complaints in the public interest are treated as trouble-makers or worse by PCB officials, while they have a cosy relationship with the regulated entities, frequently accepting their hospitality.

**REFERENCES**

Abraham, C N and A Rosencranz (1986): “An Evaluation of Pollution Control Legislation in India,” *Columbia Journal of Environmental Law*, Vol 11, pp 101–18.

Agarwal, V K (2005): “Environmental Laws in India: Challenges for Enforcement,” *Bulletin of the National Institute of Ecology*, Vol 15, pp 227–38.

Alley, Kelly D (2016): “Rejuvenating Ganga: Challenges in Institutions, Technologies and Governance,” *TEKTON*, Vol 3, No 1, p 16.

Aktar, MdWasim, M Paramasivam, M Ganguly, S Purkait and Daipayan Sengupta (2010): “Assessment and Occurrence of Various Heavy Metals in Surface Water of Ganga River around Kolkata: A Study for Toxicity and Ecological Impact,” *Environmental Monitoring and Assessment*, Vol 160, No 1, pp 207–13.

Anonymous (2018): “Thousands of Dead Fish Found Floating in Ganga, Experts Blame Toxic Effluents,” *Hindustan Times*, 15 May, <https://www.hindustantimes.com/lucknow/thousands-of-dead-fish-found-floating-in-ganga-experts-blame-toxic-effluents/story-ujQ4HnvtMVXULPY-Ra2XENP.html>.

Chatterjee, Soumya (2018): “Bellandur Lake Fire: Green Court Orders Apartments in Catchment Area to Build STPs,” *News Minute*, 30 January, <https://www.thenewsminute.com/article/bellandur-lake-fire-green-court-orders-apartments-catchment-area-build-stps-75612>.

— (2020): “Bellandur Lake Cleaning: Experts Divided over Desilting, Diverting Polluted Water,” *News Minute*, 13 February, <https://www.the->

[newsminute.com/article/bellandur-lake-cleaning-experts-divided-over-desilting-diverting-polluted-water-118097](https://www.thenewsminute.com/article/bellandur-lake-cleaning-experts-divided-over-desilting-diverting-polluted-water-118097).

CPCB (2011): “Polluted River Stretches in India: Criteria and Status,” Central Pollution Control Board, New Delhi, [http://cpcb.nic.in/upload/NewItems/NewItem\\_172\\_FinalPollutedStretches.pdf](http://cpcb.nic.in/upload/NewItems/NewItem_172_FinalPollutedStretches.pdf).

— (2015): “River Stretches for Restoration of Water Quality,” MINARS/37/2014–15, Central Pollution Control Board, New Delhi, [http://cpcb.nic.in/upload/Publications/Publication\\_528\\_RESTORATION-OF-POLLUTED-RIVER-STRETCHES.pdf](http://cpcb.nic.in/upload/Publications/Publication_528_RESTORATION-OF-POLLUTED-RIVER-STRETCHES.pdf).

— (2018): “River Stretches for Restoration of Water Quality,” Central Pollution Control Board, New Delhi.

CSE (2009): “Turnaround—Reform Agendas for India's Environmental Regulators,” Centre for Science and Environment, New Delhi.

— (2014): “Strengthen Institutions, Reform Laws and Streamline Processes: Agenda for Improving Environmental Governance in India,” Centre for Science and Environment, New Delhi.

Department of Urban Development, Government of Karnataka (2015): “Expert Committee Report Rejuvenation of Bellandur Lake,” <https://opencity.in/documents/expert-committee-report-on-rejuvenation-of-bellandur-lake-november-2016>.

FSSAI (2011): Food Safety and Standards (Food Products Standards and Food Additives) Regulation, and Food Safety and Standards (Packaging and Labelling) Regulation.

Ghosh, S (2015): “Reforming the Liability Regime for Air Pollution in India,” *Environmental Law and Practice Review*, Vol 4, pp 100–04.

Gill, Gitanjali Nain (2016): “Environmental Justice in India: The National Green Tribunal and Expert Members,” *Transnational Environmental Law*, Vol 5, No 1, pp 175–205, <https://doi.org/10.1017/S2047102515000278>.

— (2019): “The National Green Tribunal: Evolving Adjudicatory Dimensions,” *Environmental Policy and Law*, p 10.

Gupta, Shreekant, Shalini Saksena and Omer F Baris (2019): “Environmental Enforcement and Compliance in Developing Countries: Evidence from India,” *World Development*, Vol 117, pp 313–27, <https://doi.org/10.1016/j.worlddev.2019.02.001>.

Jamwal, Priyanka (2009): “Efficiency Evaluation of Sewage Treatment Plants with Different Technologies in Delhi (India),” *Environmental Monitoring and Assessment*, Vol 153, Nos 1–4, pp 293–305.

Jamwal, P, T M Zuhail, P R Urs, V Srinivasan and S Lele (2015): “Contribution of Sewage Treatment to Pollution Abatement of Urban Streams,” *Current Science*, Vol 108, No 4, pp 677–85.

Jamwal, Priyanka, S Lele and M Menon (2016): “Rethinking Water Quality Standards in the Context of Urban Rivers,” paper presented in Urbanization and the Environment: Eighth Biennial Conference of the Indian Society for Ecological Economics, organised by INSEE in Bengaluru, 4–6 January.

Jamwal, Priyanka and Sharachandra Lele (2017): “Addressing Pollution in Urban Rivers: What We Learnt from the Vrishabhavathi River in Bengaluru,” *Transcending Boundaries: Reflecting on Twenty Years of Action and Research at ATREE*, Ankila J Hiremath, Nitin Rai and Ananda Siddhartha (eds), pp 104–13, Bengaluru: ATREE.

Jamwal, Priyanka, Atul K Mittal and Jean-Marie Mouchel (2011): “Point and Non-point Microbial Source Pollution: A Case Study of Delhi,” *Physics and Chemistry of the Earth, Parts A/B/C*, Vol 36, No 12, pp 490–99.

Jamwal, P, D Nayak, P R Urs, M Zuhail, M Gopinath, M Idris and S Lele (2021): “A Multi-pronged Approach to Source Attribution and Apportionment of Industrial Contaminants in Urban Rivers: Implications for Standards, Monitoring and Enforcement,” *Ambio* (under revision).

Kapil, Shagun (2019): “After NGT Asks for Stringent Norms for STPs—A New Dilemma,” *Down to Earth*, 8 May, <https://www.downtoearth.org.in/news/waste/after-ngt-asks-for-stringent-norms-for-stps-a-new-dilemma-64412>.

Karpouzoglou, Tim and Anna Zimmer (2012): "Closing the Gap between 'Expert' and 'Lay' Knowledge in the Governance of Wastewater: Lessons and Reflections from New Delhi," *IDS Bulletin*, Vol 43, No 2, pp 59–68, <https://doi.org/10.1111/j.1759-5436.2012.00308.x>.

Koshy, Jacob (2018): "More River Stretches Are Critically Polluted: Central Pollution Control Board," *Hindu*, 17 September (sec National), <https://www.thehindu.com/news/national/more-river-stretches-critically-polluted-cpcb/article24962440.ece>.

Lele, Sharachandra, NakulHeble, Bejoy K Thomas and Priyanka Jamwal (2016): "Regulation and Compliance in Industrial Water Pollution: The Case of the Vrishabhavathy River, Bangalore," paper presented at national workshop on "Managing Surface Water Quality in Urbanising Watersheds," organised by ATREE in Bengaluru, 5 August.

Madras High Court (2015): *Dr K Karthikeyan v V Anbazhagan*, WA No 112 of 2015, Judgment dated 24 April 2015.

Namami Gange (2014): Namami Gange Programme, National Mission for Clean Ganga, <https://nmcg.nic.in/NamamiGanga.aspx>.

Nath, Sanchayan (2015): "In Pictures: Bellandur Lake's Fire and Snow," *Citizen Matters*, 20 May, <http://bangalore.citizenmatters.in/articles/in-pictures-bellandur-snow>.

NGT (2016): *Rajendra Singh Bhandari v State of Uttarakhand & Ords*, OA, No 318/2013, Judgment dated 24 August 2016.

— (2017): *Court on Its Own Motion v State of Karnataka*, OA No 125/2017, Order dated 20 February 2017.

— (2017–21): *Court on Its Own Motion v State of Karnataka*, OA No 125/2017, Orders dated 20 February 2017, 20 March 2017, 19 April 2017, 11 April 2018, 6 December 2018, 22 August 2019, 24 January 2018, 21 October 2019, 4 August 2020, and 12 March 2021.

— (2019): *Nitin Shankar Deshpande v Union of India & Others*, OA No 1069/2018, Order dated 30 April 2019.

OECD (2006): "Environmental Compliance and Enforcement in India: Rapid Assessment," <https://www.oecd.org/env/outreach/37838061.pdf>.

Prasad, P M (2006): "Environment Protection: Role of Regulatory System in India," *Economic & Political Weekly*, Vol 41, No 13, pp 1278–88.

Pickard, Amy, Stella White, Sumita Bhattacharyya, Laurence Carvalho, Anne Dobel, Julia Drewer, Priyanka Jamwal and Carole Helfter (2021): "Greenhouse Gas Budgets of Severely Polluted Urban Lakes in India," *Science of the Total Environment*, Vol 798, p 149019.

Planning Commission (2000): "Evaluation Study on the Functioning of State Pollution Control Boards," New Delhi, <https://niti.gov.in/planningcommission.gov.in/docs/reports/peoreport/peoevalu/index.php?repts=peopoll.htm>.

Rajaram, T and Ashutosh Das (2007): "Water Pollution by Industrial Effluents in India: Discharge Scenarios and Case for Participatory and System Specific Local Regulation," *Futures*, Vol 40, No 1, pp 56–69.

Ramesh, H L and V N Yogananda Moorthy (2012): "Assessment of Heavy Metal Contamination in Green Leafy Vegetables Grown in Bangalore Urban District of Karnataka," *Advances in Life Science and Technology*, p 6.

Riva, Francesco, Ettore Zuccato, Enrico Davoli, Elena Fattore and Sara Castiglioni (2019): "Risk Assessment of a Mixture of Emerging Contaminants in Surface Water in a Highly Urbanized Area in Italy," *Journal of Hazardous Materials*, Vol 361, January, pp 103–10, <https://doi.org/10.1016/j.jhazmat.2018.07.099>.

Sahu, Geetanjoy (2013): "Environmental Regulatory Authorities in India: An Assessment of State Pollution Control Boards," Centre for Science, Technology and Society, School of Habitat Studies, Tata Institute of Social Sciences, Mumbai.

Schellenberg, Tatjana, Vrishali Subramanian, Ganapathy Ganeshan, David Tompkins and Rohini Pradeep (2020): "Wastewater Discharge Standards in the Evolving Context of Urban Sustainability—The Case of India," *Frontiers in Environmental Science*, 8 April, p 30, <https://doi.org/10.3389/fenvs.2020.00030>.

Shrotria, Sudha (2015): "Environmental Justice: Is the National Green Tribunal of India Effective?" *Environmental Law Review*, Vol 17, No 3, pp 169–88.

Srinivasan, Jeena T and V Ratna Reddy (2009): "Impact of Irrigation Water Quality on Human Health: A Case Study in India," *Ecological Economics*, Vol 68, No 11, pp 2800–07, <https://doi.org/10.1016/j.ecolecon.2009.04.019>.

Subramanian, T N and Rubin Vakil (2018): "The Mechanisms of the National Green Tribunal," *National Law School of India Review*, Vol 30, No 1, pp 74–85.

Supreme Court (2017): *TechiTagi Tara v Rajendra Singh Bhandari*, Civil Appeal No 1359 of 2017, Judgment dated 22 September 2017, Judgment Dated 7 October 2021.

— (2021): *Municipal Corporation of Greater Mumbai v Ankita Sinha*, Civil Appeal No 12122.

Suthar, Surindra, Arvind K Nema, Mayuri Chabukdhara and Sanjay K Gupta (2009): "Assessment of Metals in Water and Sediments of Hindon River, India: Impact of Industrial and Urban Discharges," *Journal of Hazardous Materials*, Vol 171, Nos 1–3, pp 1088–95, <https://doi.org/10.1016/j.jhazmat.2009.06.109>.

TNN (2021): "HC Suggests Fresh Exercise to Appoint KSPCB Chairman," *Times of India*, 1 March, <https://timesofindia.indiatimes.com/city/bengaluru/hc-suggests-fresh-exercise-to-appoint-kspcb-chairman/articleshow/81266935.cms>.

**Annexure I: Cases of Water Pollution and Compensation during 2020–21 by the NGT**

Between 2020 and 2021 July, the NGT passed orders or finally disposed of about 100 cases relating to pollution. Fifteen of those cases involved compensation awarded for pollution. They are listed below.

Sl No	Case Number	Case Name	Cause of Action/Issue Involved
1	OA No 917/2019	<i>Ramesh Chand v state of Haryana</i>	Pollution caused by industrial units that contaminated groundwater
2	OA No 738/2018	<i>Satpal Singh Sarpanch v Indian Oil Tateathan Ltd Panipat Refinery</i>	Discharge of industrial effluents in violation of discharge norms
3	OA No 18/2021	<i>Tateathan Ramodass v District Collector</i>	Operating an auditorium/wedding hall without consent and water pollution caused by discharge of municipal solid waste and other pollutants in to waterbodies.
4	OA No 70/2016	<i>Tribunal on Its Own Motion v the State of West Bengal and Others</i>	Disposal of Municipal Solid Waste in violation of the law and resultant pollution of surface water
5	OA No 915/2019	<i>Ravi Sharma, MLA, Jhansi v State of UP</i>	Illegal disposal of biomedical waste and resultant pollution of water sources
6	OA No 186/2019	<i>Jagriti Sansthan v State of Uttar Pradesh and Others</i>	Illegal extraction of groundwater and pollution
7	OA No 125/2020	<i>Kulwant Singh and Others v Union of India and Others</i>	Violation of environmental norms by a power company and resultant pollution to waterbodies
8	OA No 63/2020	<i>Radheshyam v Union of India and Others</i>	Illegal mining and pollution of waterbodies.
9	OA No 41/2019	<i>Saveamruta Aradya v Sta te of Karnataka</i>	Illegal constructions in the buffer zone of Kudluchikkakere lake in Bangalore South, Karnataka
10	OA No 70/2016/EZ	<i>Tribunal on its own motion (Regarding Dumping of Garbage at Rajiv Nagar, North 24 Parganas) v State of WB and Others</i>	Improper and illegal disposal of municipal solid waste, resulting in pollution to water
11	OA No 43/2020(EZ)	<i>Bonani Kakkav v Oil India Limited and Others</i>	Remedial steps for restoration of the environment and compensation to the victims on account of damage resulting from the incident of oil blowout and resultant pollution, including water pollution
12	OA No 1002/2018	<i>Abhisht Kusum Gupta v State of Uttar Pradesh and Others</i>	Seeking remedial action for preventing untreated sewage being released to the "irrigation canal"
13	OA No 107/2017	<i>Sree Kottam Tulasi Reddy Memorial Educational Society v M/s S N S Starch Limited and Others</i>	Industrial pollution of air and water
14	OA No 140/2019	<i>Mahendra Saini, President, Moda Pahad Sangharsh Samiti v State of Rajasthan</i>	Illegal operation of stone crushing units and resultant environmental pollution, including water pollution
15	OA No 603/2019	<i>Rajiv Verma v State of Himachal Pradesh and Others</i>	Dumping of debris of road construction on riverbeds and the resultant pollution