HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT

Fighting Pollution with Data: Environmental Audits and the Gujarat Pollution Control Board

Rohini Pande and Anjani Datla

Harvard Kennedy School Case 2054

2016

Fighting Pollution with Data:
Environmental Audits and the Gujarat Pollution Control Board

By Rohini Pande and Anjani Datla

Abstract: In 2010, the overwhelmed Pollution Control Board in the Indian state of Gujarat faced a difficult path ahead. The agency charged with monitoring and enforcing pollution regulations in the heavily industrialized state had a problematic environment audit system on its hands. For more than a decade, industrial plants were required to submit an annual environmental audit, which was conducted by a third-party auditor, and paid for by the plant. But from the pollution control board's point of view, many of the audit reports were perfunctory, without useful recommendations, and gave officials little basis for enforcement action.

Yet, many plant owners found the annual audits to be a bureaucratic waste of time and money. In 2005, a group of industrialists filed suit to end the audit program. They complained that the program was useless, especially since the GPCB had never done anything with the reports. But in 2010, the Gujarat High Court ruled against the manufacturers. The audit program would stay, and the pollution board was required to take "all necessary follow up steps on the basis of the audit reports to control environmental pollution." The agency had to ensure that "data collected through [audit] reports does not collect dust in the archives of the office but is put to meaningful use."

Could the pollution control board find a way to turn the environmental audit program around? And could the agency use the evidence to craft more effective environmental policy?

Learning Objective: This case examines the conflict of interest that arises when auditors are hired and paid by the organizations whose operations depend on positive audit reports. Participants will explore the role of accurate information in good policy. By closely analyzing the competing incentives at play for regulators, firms, and auditors, students will gain a deeper understanding of how regulations in a wide range of sectors, including the environment and finance, can be made more effective.

Citation: Pande, Rohini, and Anjani Datla. 2016. Fighting Pollution with Data: Environmental Audits and the Gujarat Pollution Control Board. HKS Case 2054.0. Cambridge, MA: Harvard Kennedy School Case Program.

A teaching plan and "B" case will be available in 2016 at: http://case.hks.harvard.edu/fighting-pollution-with-data-environmental-audits-and-the-gujarat-pollution-control-board/

Sponsors: Support for the case study was provided by the Sustainability Science Program and the Evidence for Policy Design, both at Harvard's Kennedy School of Government and Italy's Ministry for Environment, Land and Sea.

HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT
KS1159

Case Number 2054.0

Fighting Pollution with Data: Environmental Audits and the Gujarat Pollution Control Board

Introduction

In the summer of 2010, Hardik Shah, the functional head of the Gujarat Pollution Control Board (GPCB), found himself in a fierce tug of war over environmental audits.

The environmental audit program had been created in 1996 to help an overwhelmed GPCB, the agency charged with monitoring and enforcing pollution regulations in the heavily industrialized state of Gujarat, India. In the early 1990s, industrial development in Gujarat had begun to expand at a rapid rate. By the mid-1990s the GPCB faced an untenable workload—fewer than 150 technical officers were responsible for monitoring more than 10,000 industrial plants.[1] With industrial pollution spilling onto agricultural land, several aggrieved farmers brought a public interest lawsuit to compel action from the court.

In December 1996, the Gujarat High Court came up with a novel idea to control industrial pollution: a third-party audit program for firms thought to be among the highest polluting in the state.[2] Under the plan, the GPCB required industrial plants to submit an annual environmental audit, which was conducted by a third-party auditor and paid for by the plant. The court hoped that by capturing annual information on plant level pollution, the audit program would boost the GPCB's capacity to regulate industrial pollution.

But a decade later, the program had not lived up to expectations. From the GPCB's point of view, many of the audit reports were perfunctory, without useful recommendations, and gave officials little basis for enforcement action. “We expected that with the scheme the overall environmental scenario would improve,” Shah explained. “This wasn’t happening to satisfaction. We had the gut feeling that some auditors were not coming out with expected recommendations, but we had no proof.”[3]

From the point of view of many plant owners, the reports were a bureaucratic waste of time and money. In 2005, a group of plant owners filed suit to end the audit program. The industrialists complained that the program was useless, since the GPCB had never done anything with the reports.

This case was written by Rohini Pande, Mohammad Kamal Professor of Public Policy at the John F. Kennedy School of Government (HKS) and Anjani Datla, Senior Case Writer at HKS. *Support for this case was provided by the Harvard Kennedy School’s Sustainability Science Program and The Italian Ministry for the Environment, Land and Sea.* *HKS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.*

In early 2010, the Gujarat High Court ruled against the manufacturers. The audit program would stay, but the court also directed the GPCB to take "all necessary follow up steps on the basis of the audit reports to control environmental pollution," and admonished the agency to ensure that "data collected through such audit reports does not collect dust in the archives of the office but is put to meaningful use for understanding the environmental impact."[4]

With all eyes trained on the GPCB, could Shah and his colleagues find a way to turn the problematic environmental audit program around? Could they convert gut instinct into hard evidence, and could the GPCB use the evidence to craft more effective environmental policy?

Hardik Shah

Hardik Shah graduated from Gujarat University in 1994 with a bachelor in environmental engineering. Instead of following the well-trodden path of joining the family business, Shah followed his passion. Keen to build a career in the relatively new area of environmental management, Shah received prescient advice. “I wanted to do something for the environment, especially for nature, for people, for the communities,” Shah said. “My professor suggested that to make a strong career in the environment, I would need a law degree.”

During his second year in law school, in 1996, Shah landed his first job: Engineer in the Gujarat Forests and Environment Department (the state’s environmental planning and regulatory authority).[A] At the Department, from the beginning, Shah was assigned complex projects that drew on his mix of technical and legal training.

Over time, Shah became familiar with all facets of Gujarat’s environment. He began by conducting studies of coastal zone management and later became adept at conducting environmental impact assessments, used to determine the effects of new projects. In the early 2000s, Shah was promoted to Undersecretary in the Department and tasked with rescuing Gujarat’s largest city, Ahmedabad, which had just been ranked the most polluted in the country. Shah was instrumental in creating and implementing Ahmedabad’s road map to reduce the city’s air pollution, and in a few years he helped make significant improvements.

As Senior Technical Officer (equivalent to Deputy Secretary), Shah became familiar with the units that worked under the Environment Department, particularly the Gujarat Pollution Control Board. In 2008 and 2009, he worked closely with the GPCB’s Member Secretary on various projects, including the environmental audit program. Shah learned about the nature of industrial pollution in Gujarat and the complex interaction between industries—the source of Gujarat’s economic growth—and the pollution regulator.

In many ways, Shah’s professional trajectory coincided with Gujarat’s manufacturing boom. By the time Shah took over as the Member Secretary (functional head) of the GPCB in 2010, though, the environmental costs of Gujarat’s manufacturing miracle were evident, and Shah was about to face his greatest challenge yet.

[A] Shah went on to finish his law degree at Gujarat University by attending evening classes. And in 2003, Shah received a master in environmental engineering.

"Vibrant Gujarat"

With the longest coastline in India, the western state of Gujarat was always well-suited for manufacturing and trade. Starting in 2001, spurred by a pro-business administration, Gujarat's cities and quiet countryside were transformed by rapid industrialization. A bevy of policies designed to attract and retain manufacturing industries turned Gujarat into one of India's most industrialized states. Between 2001 and 2007, Gujarat's economy grew by more than 10 percent every year, consistently outperforming the rest of India.[5] Although home to just 5 percent of the nation's more than 1 billion people, by 2010, Gujarat accounted for nearly 10 percent of India's manufacturing employment, 19 percent of manufacturing output, and 22 percent of exports.[6]

Over time, Gujarat, home to three of the nation's largest industrialized districts, boasted both large-scale industries such as refineries and automobiles and a critical mass of small and medium-scale manufacturing firms ranging from textiles to chemicals. Ahmedabad, the commercial capital of Gujarat, became the nerve center of the state's industrial sector. Thousands of textile plants burgeoned in Surat, the second-largest city in the state. More than 15 industrial clusters cropped up along the "Golden Corridor"—a 400-kilometer-long strip in the middle of the state that stretches from Vapi in the south to Ahmedabad in the north. Each of these industrial clusters contained 300 to 1,000 small and medium-scale plants, manufacturing a range of products including petrochemicals, pesticides, dyes, paints and fertilizers. Gujarat's industrial awakening was so swift that many saw Vibrant Gujarat's formula as a way forward for an India eager to stake its claim in the global economy.

This growth was not without significant costs. By 2010, it was difficult to ignore the toll Gujarat's economic growth was taking on the environment. All large cities in Gujarat violated air pollution standards.[7] While pollution in the big cities was often a potent mix of vehicular and industrial emissions, many of Gujarat's rivers and waterways were often unfit for drinking or irrigation, mainly as a result of industrial processes. In 2007, the federal government identified five of the most polluted rivers in the country: three were in Gujarat.[8] And in 2009, the federal government labeled several of Gujarat's industrial clusters, including Vapi, "critically polluted."[9]

"As elsewhere in the developing world, this impressive industrial growth has been accompanied by pollution on a large and increasing scale," wrote Gautam Appa, Professor Emeritus at the London School of Economics. "Air and water pollution, accumulation of solid hazardous waste and land contamination have been a concomitant part. From coal dust and fly ash spewing from Ahmedabad's cotton textile mills to the dumping of waste products in rivers, woods, ravines and valleys along the Golden Corridor, the environmental degradation has gone largely unchecked."[10]

In the shadow of hulking industrial facilities, residents of small farming communities near the Golden Corridor often accused industries of dumping effluents without first treating them. In some parts of the state, because of polluted air and water bodies contaminated by industrial waste, citizens and environmental groups took to filing public interest lawsuits against alleged industry offenders.

Mitigating Pollution in the Developing World

Gujarat was not alone in its struggle with environmental decline. "The rapid industrialization and urbanization in India's booming metropolises are straining the limits of municipal services and causing serious environmental problems," warned a 2006 report by the Organization of Economic Cooperation and Development, while "deforestation, soil erosion, water pollution and land degradation continue to worsen and are hindering economic development in rural India."[11]

By 2010, the situation had worsened. The air in Delhi, to the surprise of many, was worse than in Beijing, long the city most emblematic of unmanageably high levels of pollution (see Exhibit A). All big cities had dangerously high levels of particulate matter produced primarily by power plants, industries and vehicles. Deadly particulates were choking the nation, causing respiratory problems such as strokes and cancer, and affecting the health of children. Pollution challenges were not limited to cities and other environmental concerns related to water and land were no less daunting. The World Bank estimated that environmental degradation in India cost roughly $80 billion annually and accounted for 23 percent of the nation's child mortality.[12]

Climate experts predicted that, in the coming decades, most of the global increase in greenhouse gas emissions would come from developing countries like India, as they continued to industrialize. Scientists also predicted that the mortality costs of climate change were likely to be highest in the developing world. But with international climate negotiations stalled, the world appeared to be moving toward a model where countries were going to have to set and enforce their own targets.

Local authorities like the Gujarat Pollution Control Board were at the forefront of mitigating pollution in India, but their record in successfully enforcing environmental standards was mixed.

The Regulatory Framework

Three significant laws enacted in the 1970s and 80s, comprised the core of India's stringent pollution regulation framework. The first two: the Water Act of 1974 and the Air Act of 1981 gave birth to federal and state pollution control authorities, the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCB), and ushered in an era of "command and control" environmental regulation in the country.

The third came about in 1986, in the wake of the worst environmental disaster in India (a 1984 toxic gas leak from a pesticide plant that killed more than 8,000 people, and injured half a million in Bhopal). Seeking to strengthen environmental oversight, the Indian government passed the 1986 Environment Protection Act. The umbrella legislation bound together disparate environmental policies, including the Water Act and Air Act, to create an overarching mechanism for environmental protection.

By the late-1980s, three key institutions were responsible for enforcing India's environmental laws, the Ministry of Environment and Forests (MoEF) and the Central Pollution Control Board at the federal level, and the State Pollution Control Boards at the state level. The MoEF set environmental policies, including those controlling and preventing pollution, while the Central and State Pollution Control Boards were given the authority to enforce the policies. The Central Pollution Control Board, located under the MoEF, was mandated to advise the federal gov-

ernment on pollution standards, coordinate the activities of State Pollution Control Boards, and provide technical support and guidance to states. At the state level, the SPCBs were affiliated with the Departments of Environment (or in some instances, Forests and Wildlife), and, under the supervision of the CPCB, were assigned the primary role of enforcing pollution standards (See Exhibit B).

State pollution boards were given broad powers to monitor and control industrial pollution. They enforced pollution standards known as the "minimum national standards," formulated by the CPCB and approved by the MoEF, but had the freedom to impose more stringent guidelines based on local needs. They had the authority to issue (and revoke) permits to establish for polluting industries planning to build new plants, as well as the authority to issue (and revoke) permits to operate for existing factories. State boards had at their disposal a menu of tools to ensure compliance. The boards could mandate monitoring and reporting from polluting industries, conduct random inspection of facilities, collect sampling of effluents, impose corrective measures, and dictate compliance actions like installing abatement equipment. State boards could also penalize non-complying firms by shutting down plants by ordering their vital electricity or water supplies disconnected.

In theory, state pollution boards possessed a great degree of authority to enforce environmental standards. Experts, however, argued that, in practice, the pollution boards were overstretched and underfunded, and could only manage haphazard enforcement of environment policies. Under the Water, Air and Environment Acts, violation of pollution regulations was a criminal offense. Pollution boards had to file and win a criminal case, but in India's beleaguered justice system, it could take several years for such a case to be heard. Aside from shutting down industrial plants, pollution boards could do little else to swiftly penalize pollution violators. This measure too had drawbacks. During the mandatory fifteen-day shutdown period, companies were required to present the pollution board with an abatement plan. In most instances, the plan was approved and the company restarted operations after the two-week hiatus. But it could be months, if not years, before pollution boards could follow up on whether the abatement plan was implemented effectively.

Starting in the 1990s, however, India's Supreme Court and several state High Courts began to play a crucial role in protecting the environment through citizen-led public interest lawsuits. In many instances, the courts issued orders with detailed implementation guidelines, with broad implications for regulators and industries alike. Gujarat's environmental audit program was one such example of a court-mandated environmental policy.

The Environmental Audit Program

In December 1996, after a series of public interest lawsuits drew widespread attention to rampant industrial pollution, the Gujarat High Court called on the GPCB to implement an environmental audit program, the first of its kind in India. The audit program was designed to complement the GPCB's existing framework, which until then relied entirely on regulatory inspections conducted by the GPCB's own technical and scientific staff, working in branch offices across the state. If Gujarat was to strengthen its environmental monitoring infrastructure, the High Court said, it would have to boost the GPCB's ability to inspect thousands of industries scattered across the state. The GPCB, which consistently faced shortfalls in personnel and infrastructure to deliver its mandate, welcomed the audit proposal.

A committee of technical experts from academia, the Gujarat government, and federal agencies, developed the audit program's standards. The program was rolled out with three overarching goals: "enforce discipline amongst industries, arm the GPCB and the industries with required data, and conduct regular monitoring of various industries from a different angle," said Hardik Shah Member Secretary of the GPCB. The program allowed for qualified technical professionals to become "an extended arm of the GPCB in collecting important performance information."

The audit program applied to an important group of the most polluting industries in Gujarat. These plants were classified into two categories according to their pollution potential. Schedule I industries had greater pollution potential than Schedule II industries, either because of the type of product manufactured or because they discharged higher quantities of effluents than similar industries in Schedule II.[B] Schedule I industries included thermal power plants, oil refineries, cement plants, integrated iron and steel mills, and manufacturers of dyes and dyes-intermediates, pigments, fertilizers, petrochemicals and common infrastructure facilities. Schedule II industries included manufacturers of dyes, pigments, fertilizers, and petrochemicals, in addition to textile processing facilities and steel rolling mills.[13]

Under the program, Schedule I industries had to be audited by reputed engineering colleges or technical institutes, as chosen by the GPCB. And Schedule II industries had to be audited by private firms certified by the GPCB.

In order to be certified by the GPCB, auditors needed a full-fledged laboratory and at least one team of four technical professionals: two engineers and two scientists, all with specialized knowledge of environmental management. In addition to the long list of technical requirements, the audit scheme built in important safeguards. While auditing firms could have more than one technical team, each team could do no more than 15 audits a year and each auditing team had to be recertified every two years. Auditing firms could not consult for the industries they audited. And, starting in 2010, industries could not hire the same auditing firm for more than three consecutive years.

Industries were required to hire and pay auditing firms and submit an annual environmental audit report conducted by the auditors. Auditors visited each plant at least three times in the year (once for each season) to collect samples of emissions and observe environmental management processes. After each visit, auditors tested the samples in their lab. The final audit report, submitted at the end of the audit year in a format set by the GPCB, provided information on the production process, the physical state of the plant, measures the plant had taken to control pollution, as well as the pollution readings. Auditors also included recommendations for follow-up steps plants could take to better control pollution. If an industrial plant did not submit its audit report in accordance with the compliance schedule, or violated pollution standards, the GPCB employed its powers to close down the plant. Similarly, the GPCB reserved the right to de-certify auditors found to be reporting inaccurate pollution readings.

[B] The classification was based on three criteria: what the plant manufactured, where it discharged effluents (such as wastewater), and the volume of the effluent.

Garbage In Garbage Out

In some ways, by 2010, the audit program could have been labeled successful. The GPCB had certified 24 Schedule I auditors and 45 Schedule II auditors. Roughly 10 percent of the 20,000 plants the GPCB monitored in Gujarat were covered under the audit scheme and the GPCB had access to regular pollution readings from these crucial industries. In several instances, starting in 2007, the GPCB had demonstrated regulatory muscle by cutting off power and water to industrial plants based on information in the audit reports.

But all parties to the audit program were increasingly dissatisfied. The 2005 lawsuit filed by dye manufacturers to scrap the audit scheme was indicative of industry frustration at having to hire and pay for environmental audits. For its part, the GPCB found it difficult to work with the largely boilerplate audits they received. "Many of the audit reports were stereotypical, without solid recommendations for pollution control and pollution prevention, which were the objectives of the scheme," said Hardik Shah.

According to veteran environmental auditor, Rakesh Shah (no relation to Hardik Shah), the audit scheme had, over time, devolved into an annual ritual with little meaning. "For most of the industries this has become a formality. And because this has become a formality the companies are not really interested in finding the lacuna or the shortcomings," he said.[14]

Rakesh Shah cited intense bidding wars among auditors as a major driver in the low quality of audit reports. As business practice, Rakesh Shah's Schedule II auditing firm, Anand Consultants, did not bid on industries' requests for audit proposals. Anand Consultants fees, on average, ranged between Rs. 80,000 and 150,000 (approximately 1,100 to 2,200 US Dollars) per audit report, which Rakesh Shah said barely covered the total cost of the year-long audit process. But Rakesh Shah was aware that other auditing firms sometimes charged as little as Rs. 20,000 (approximately 300 US Dollars) for an audit report. That, he said, was how they drummed up business. "If I compete [for an audit job] then I have to be the lowest bidder to get the assignment," he explained. "When competing with 45 other consultants, I obviously have to keep my fees low. When I have to keep my fees low, I have to cut corners and therefore the quality of work is not appropriate."

Hardik Shah at the GPCB concurred. "If you are the least paid you are not expected to perform your job well," Shah said, and the audit process in such cases turns into "something like garbage in and garbage out."

Yet, presumably, if industries were serious about following environment policies, the quality of audit reports would matter. In this regard, Rakesh Shah believed there was wide variation in how industries reacted to the long arm of the pollution board. "The industries we work for select us only," Rakesh Shah confirmed. "They don't get any other proposals because they want a good piece of work done and they know the lowest proposal would probably not be the right one." When his audit team made pollution control recommendations, he found that the industries tried to implement them. "We put recommendations in our report and, after one or two or maybe three cycles, it does happen that the industries take the necessary steps," Rakesh Shah noted. "Initially they may not have the finances, the wherewithal, or the technical capabilities to do it, but over a period of time they do take positive steps on those particular aspects."

Among other industries, though, Rakesh Shah observed that the pollution board instilled fear rather than inspire compliance. “The regulators are doing their job perfectly. But in trying to do the perfect job they are creating a fear psychosis among industries so that the industries try to give the regulator whatever it wants,” he argued. “If there’s a CEO who is absolutely pro-environment he will not mind the report going to the authorities because he knows that he is going to take action in any case. But the CEO who does not want to take action will force the auditor to say something in the report which will not harm his company.”

Priyam Mehta, CEO and owner of Maize Products, manufacturer of corn products including for food and chemicals, counted his company among the ones that cared for the environment. Mehta believed the GPCB’s power to close down his company for non-compliance was incentive enough to ensure that the annual environmental audit was well done and the recommendations taken seriously. Mehta, however, echoed Rakesh Shah’s argument that not all industries operated under the same premise. “I know some companies have been shutdown [by the GPCB] at least once or twice a year,” Mehta said. “But Maize Products is a continuous process plant. We run 365 days, 24 hours, so if we have to close down because of a pollution notice, the loss for us in 15 days would be much more money than what we would spend implementing the pollution control board’s regulations.”[15]

Mehta found that some industries opted to follow the rules, while others overlooked them, largely because pollution control equipment was expensive. “Meeting pollution norms is tricky,” said Mehta. “Let’s be frank, treating effluents is an expensive affair, but at the end of the day, it is for the betterment of the environment, and well-being of our future generations.”

Hardik Shah believed that the audit program was open to manipulation because industries selected and hired their auditors. “If the auditors are selected and paid by the industry then their loyalty is more to the industry than to the environment,” Shah said. According to Rakesh Shah, the audit program was structured in a way that allowed wrong information to flow through the system. The incentive for industries to report on actual pollution levels, he said, was “frankly zero.”

“If the audit fee is paid by a fourth party,” Rakesh Shah argued, “not the industry, not the pollution control board, not the auditor, of course, but a fourth party, then even the auditors who worry about their survival would give out perfect reports because they are not depending on the industry to pay them.”

The Experiment

Amee Yajnik was one of the GPCB’s lawyers. She had led the court battle against the dye manufacturers to retain the environmental audit scheme. In 2008, Yajnik met Rohini Pande, development economist and Director of Evidence for Policy Design at Harvard University. Pande recommended a policy-research engagement on the audit program, to help identify and test reforms that were rooted in economic principles, and were backed by rigorous evidence. Yajnik orchestrated a meeting between Pande and the GPCB and helped launch a “smart policy design” partnership. “The profile of the researchers gave us a lot of confidence that we could have something useful come out of experiment,” said Shah. Soon after, the GPCB and the researchers approached the Abdul Latif Jameel Poverty Action Lab’s (J-PAL) South Asia unit, which conducts on-the-ground implementation of policy-research partnerships in India.

First, the researchers and GPCB officials examined potential reasons for why the interests of the auditors and the regulator could be misaligned. Both the GPCB and the researchers believed a conflict of interest lay at the heart of the environmental audit program: auditors were hired and paid by the industries. Next, to test this hypothesis, the researchers varied financial incentives for a sub-sample of industrial plants. "Working with the GPCB, we changed the auditing rules for a randomly selected set of firms, but not for a control group," said Pande and Michael Greenstone (economist at the Massachusetts Institute of Technology), another member of the research team. "The randomized selection is important because it ensures that the firms required to comply with the new auditing rules are initially no different from the control firms."[16]

With the experiment, the GPCB and researchers were seeking answers to two big questions: does it matter who pays the auditor, and would the behavior of the auditors change if they were monitored for accuracy? From a sample of 473 Schedule II industrial plants in Ahmedabad and Surat, 233 were randomly assigned to receive a modified environmental audit scheme meant to ensure absolute independence for auditors. Nothing changed for the remaining 240 firms, which served as the control group. The modified environmental audit program ran for two years and had four components:[17]

1. The industrial plants in the treatment group were randomly assigned an auditor whom they were required to use.
2. In the first year, auditors were paid a flat, fixed fee of Rs. 45,000 from a central pool of money rather than by the industrial plant. The fee was set in advance and covered the costs of pollution measurement and offered a modest profit.
3. A random sample of auditor pollution readings were verified through follow-up visits by an independent technical agency (Schedule I auditors, usually engineering colleges) which collected pollution readings for the same pollutants from the same places as the auditor, usually within a few weeks. The auditors knew that there was a possibility their reports would be verified by an independent agency but the verification visits were unannounced.
4. At the start of the second year of the experiment, treatment auditors were informed that their pay would be tied to the accuracy of their reports as measured by the verification checks made by independent technical agencies.

The researchers worked with the GPCB to find areas of common ground where economic insights could help the Board's work. Nicholas Ryan, an economist at Yale University, and one of the members of the research team, described the partnership with the GPCB as a coincidence of circumstances. "The problem with the environmental audit program related to a conflict of interest, which is within the scope of what economists know something about," Ryan said. "Because of the pressure from the court case on the audit program, the GPCB was in a position to make changes and do an evaluation as part of those changes. If we approached the GPCB on a subject unrelated to what they immediately had a problem with, it would perhaps not have been possible to do such an ambitious project. That coincidence of something that is useful for research and yet urgent and important to policy partners, independent of the evaluation, is as close to ideal as it gets."[18]

The Wait

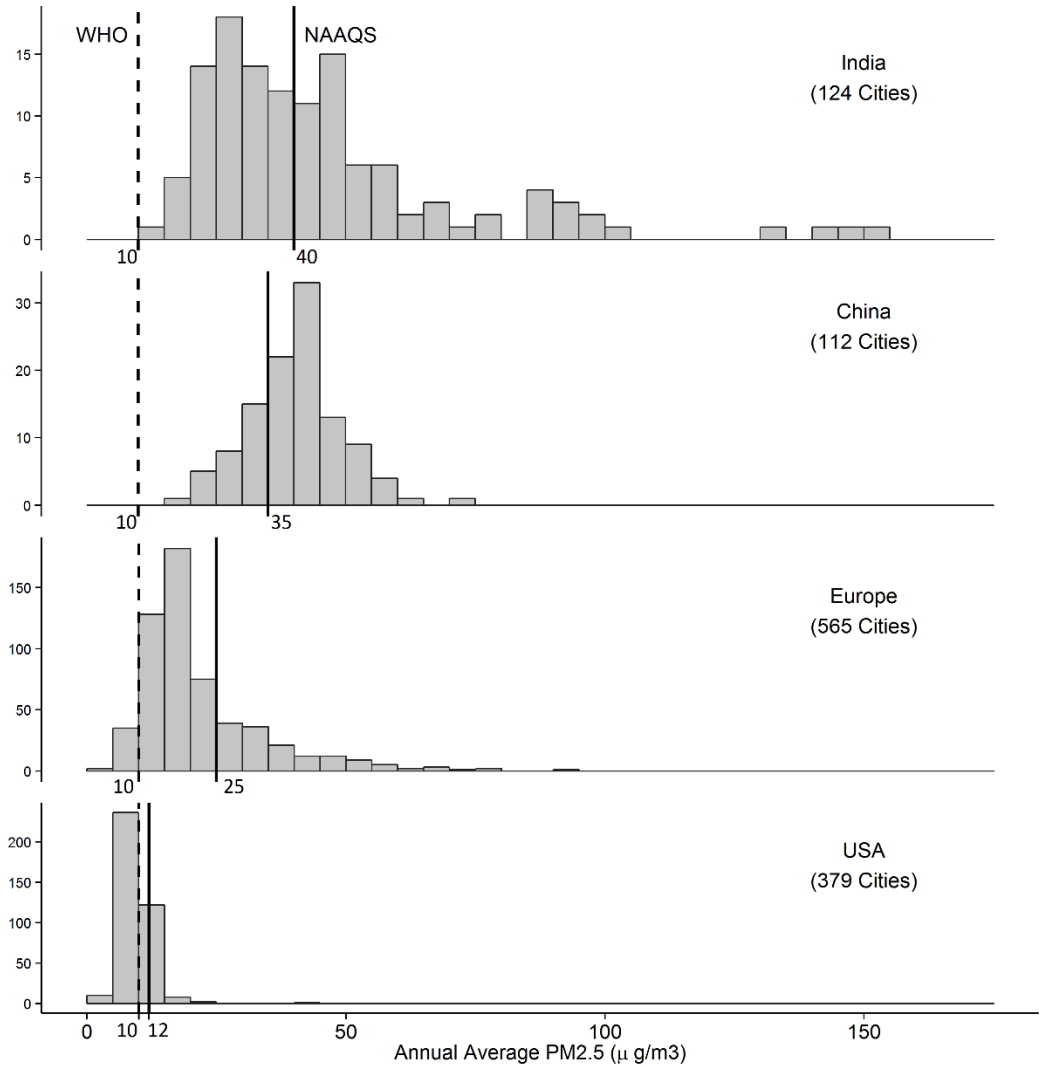
In 2010 and 2011, while the experiment was underway, Hardik Shah was focused on large-scale pollution cleanup efforts across the state. The GPCB stepped up awareness and training programs to help industries recognize the dangers of unabated pollution. The state government introduced more tax breaks for companies that purchased pollution control equipment. Shah attributed these efforts to the state's "visionary leadership, which was always a great source of inspiration and motivation and set the goals for sustainable development."

While waiting for the experiment's results, Shah was hopeful that the renewed focus on data would help fundamentally change interactions between industries and the GPCB. "I've always asked industries to not treat us as cops, but as doctors," Shah said. "If we go to the doctor, we don't hide our symptoms. We don't say 'I have a headache,' when our stomach has a problem. So I tell the industries not to hide their pollution. At the GPCB, our motto is that we will not allow industries to die. We might take some strict steps to control their pollution, but this is how they can become more sustainable and this is how they can have better balance sheets in time to come."

Exhibit A

Air Pollution Levels: A Comparison of India, China, Europe and the United States

(Annual Average Concentration Levels vs. Prescribed WHO, National Standards for Particulate Matter 2.5)

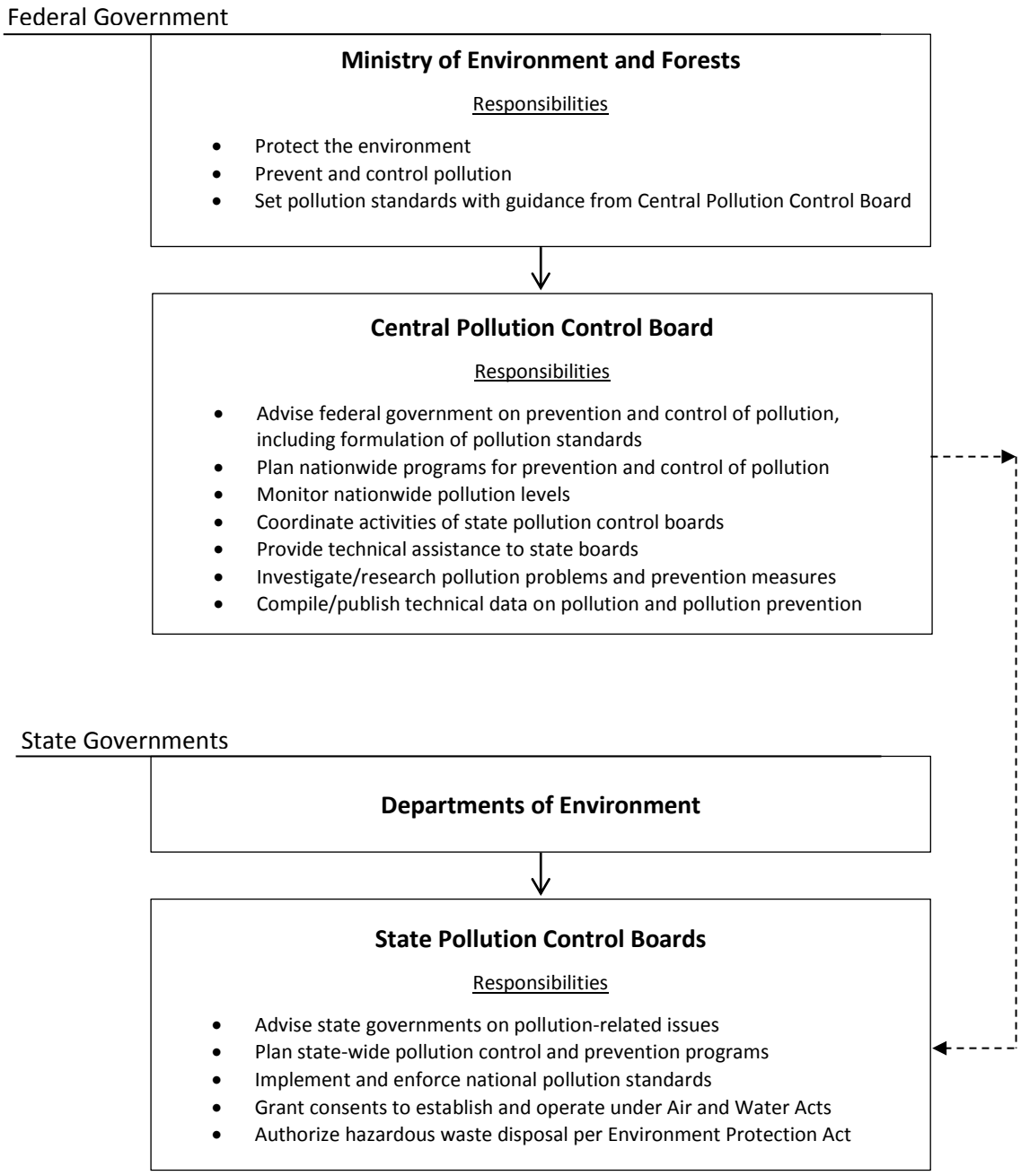


Note: Particulate matter (PM) is a type of air pollution, consisting of numerous tiny particles suspended in air. Particulate matter air pollution is called by different names, depending on the size of the particles. Globally, ambient air quality standards are set in terms of prescribed levels of annual and daily average concentrations of PM10 and PM2.5. The prevailing Indian National Ambient Air Quality Standard NAAQS-2009 adopts PM10 and PM2.5 based standards.

Source: Michael Greenstone, Janhavi Nilekani, Rohini Pande, Nicholas Ryan, Anant Sudarshan, and Anish Sugathan, "Lower Pollution, Longer Lives: Life Expectancy Gains if India Reduced Particulate Matter to Air-Quality Standards," Mimeo, 2014.

Exhibit B

India's Pollution Control Board System



Note: Lists of responsibilities highlight salient parts of government units' work, but are not comprehensive.

Source: Depicted graphically based on Organization of Economic Cooperation and Development Programme of Environmental Co-operation, "Environmental Compliance and Enforcement in India: Rapid Assessment," 2006.

Endnotes

[1] Estimated from Center for Science and Environment, "Turnaround: Reform Agenda for India's Environmental Regulators," 2009, available at http://www.cseindia.org/userfiles/regulators_report.pdf and Gujarat Pollution Control Board Manual Part IV, 2008, available at http://www.gpcb.gov.in/payroll/ACCOUNTS_MANUAL.PDF.
[2] Gujarat High Court, Environmental audit scheme for industries manufacturing specified products, Special Civil Application, 770/1995, 1996.
[3] All quotations attributed to Hardik Shah were drawn from interviews conducted with the author on May 21, 2014, May 31 2014, and June 12, 2014.
[4] Gujarat Dyestuff Manufacturers Association vs. State of Gujarat, Special Civil Application, 22609/2005, 2010.
[5] *The Economist*, "India's Guangdong," July 7, 2011.
[6] ASI, Annual Survey of Industries, Ministry of Statistics and Programme Implementation, Government of India, 2005.
[7] Central Pollution Control Board, "Annual Report: Technical Report," 2009.
[8] Central Pollution Control Board, "Annual Report: Technical Report," 2007.
[9] Central Pollution Control Board, "Annual Report: Technical Report," 2009.
[10] Gautam Appa, "Gujarat's Troubling Environmental Record," London School of Economics, India at LSE Blog, available at: http://blogs.lse.ac.uk/indiaatlse/2014/04/04/gujarats-troubling-environmental-record/, accessed on July 2, 2014.
[11] Organization of Economic Cooperation and Development Programme of Environmental Co-operation, "Environmental Compliance and Enforcement in India: Rapid Assessment," 2006.
[12] World Bank, "Diagnostic Assessment of Select Environmental Challenges in India," 2013.
[13]Gujarat Pollution Control Board, "Environmental Audit Scheme and Guidelines for Environmental Auditors," 2006.
[14] All quotations attributed to Rakesh Shah were drawn from an interview conducted with the author on June 4, 2014.
[15] All quotations attributed to Priyam Mehta were drawn from an interview conducted with the author on June 18, 2014.
[16] Michael Greenstone and Rohini Pande, "India's Particulate Problem," Op-Ed, *The New York Times*, February 9, 2014.
[17] Esther Duflo, Michael Greenstone, Rohini Pande and Nicholas Ryan, "Truth-Telling by Third-Party Auditors and the Response of Polluting Firms: Experimental Evidence from India," *Quarterly Journal of Economics*, 2013, pp. 1-47.
[18] All quotations attributed to Nicholas Ryan were drawn from an interview conducted with the author on July 2, 2014.