

The Bhopal Disaster and its Aftermath

A Review

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Abstract.

On December 3, 1984, more than 40 tons of methyl isocyanate gas leaked from a pesticide plant in Bhopal, India, immediately killing at least 3,500 people and causing significant morbidity and premature death for many thousands more. The company involved in what became the worst industrial accident in history immediately tried to dissociate itself from legal responsibility. It was eventually found culpable and ordered to compensate in the relatively small amount of \$470 million based on significant underestimations of the long-term health consequences of exposure and the number of people exposed. The disaster indicated a need for enforceable international standards for environmental safety, preventative strategies to avoid similar accidents and industrial disaster preparedness.

Since the disaster, India has experienced rapid industrialization. While some positive changes in government policy and the behavior of a few industries have taken place, major threats to the environment from rapid and poorly regulated industrial growth remain. Widespread environmental degradation with significant adverse human health consequences continues to occur throughout India.

December 2004 marked the twentieth anniversary of the massive toxic gas leak from Union Carbides Corporation's chemical plant in Bhopal in the state of Madhya Pradesh, India that killed more than 3,500 people. This review examines the health effects of exposure to the disaster, the legal response, the lessons learned and whether or not these are put into practice in India in terms of industrial development, environmental management and public health.

History.

In the 1970s, the Indian government initiated policies to encourage foreign companies to invest in local industry. Union Carbide Corporation (UCC) was asked to build a plant for the manufacture of Sevin, a pesticide commonly used throughout Asia. As part of the deal, India's government insisted that a significant percentage of the investment come from local shareholders. The government itself had a 22% stake in the company's subsidiary, Union Carbide India Limited (UCIL)[1]. The company built the plant in Bhopal because of its central location and access to transport infrastructure. Because of budget constraints, the plant was configured differently than initially planned using technology that was unproven and significantly different to Sevin production plants in the United States[1].

In 1984, the plant was manufacturing one quarter of its production capacity due to decreased demand for Sevin caused by widespread crop failures and famine on the subcontinent in the 1980s and led to increased indebtedness and decreased capital for

farmers. Local managers were directed to close the plant and prepare it for sale. When no ready buyer was found, UCIL made plans to dismantle key production units of the facility for shipment to another developing country[1].

At 11.00 PM on December 2, 1984, while most of the one million residents of Bhopal slept, an operator at the plant noticed a small leak of methyl isocyanate (MIC) gas and increasing pressure inside a storage tank. Apparently a faulty valve had allowed one ton of water for cleaning internal pipes to mix with forty tons of MIC[1]. Pressure and heat in the tank continued to build because the gas flare system, a critical component of plant safety, was out of action and had been for three months. At around 1.00 AM, December 3, loud rumbling reverberated around the plant as a safety valve gave way sending a plume of MIC gas into the early morning air[2]. Within hours, the streets of Bhopal were littered with human corpses and the carcasses of buffaloes, cows, dogs and birds. An estimated 3,500 people died immediately, mostly in the poor slum colonies adjacent to the UCC plant[1, 3]. Local hospitals were soon overwhelmed with the injured, a crisis further compounded by a lack of knowledge of exactly what gas was involved and what its effects were[1]. It became one of the worst chemical disasters in history and the name Bhopal became synonymous with industrial catastrophes and the hazards of “development.”[3]

Estimates of the number of people killed in the first few days by the plume from the UCC plant run as high as 10,000, and the Indian government reported that more than half a million people were exposed to the gas[4]. Several epidemiological studies conducted soon after the accident have shown significant morbidity and increased mortality in the exposed population. Table 1. summarizes early and late effects on health. These data are

likely to under-represent the true extent of adverse health effects because many exposed individuals left Bhopal immediately following the disaster and never returned, and were therefore lost to follow-up[5].

Health effects of the Bhopal methyl isocyanate gas leak exposure[5, 6].	
Early effects (0-6 months)	
Ocular	Chemosis, redness, watering, ulcers, photophobia
Respiratory	Distress, pulmonary edema, pneumonitis, pneumothorax
Genetic	Increased chromosomal abnormalities.
Psychological	Neuroses, anxiety states, adjustment reactions
Neurobehavioral	Impaired audio and visual memory, impaired vigilance attention and response time
Late effects (6 months onwards)	
Ocular	Persistent watering, corneal opacities, chronic conjunctivitis
Respiratory	Obstructive and restrictive airway disease, decreased lung function.
Reproductive	Increased pregnancy loss, increased infant mortality, decreased placental/fetal weight
Genetic	Increased chromosomal abnormalities
Neurobehavioral	Impaired associate learning, motor speed, precision
Cancer	Increased relative risk of lung and oropharyngeal cancer

Aftermath

Immediately after the disaster, UCC began attempts to dissociate itself from responsibility for the gas leak. Its principal tactic was to shift culpability to UCIL, stating the plant was wholly built and operated by Indians. It also fabricated scenarios involving sabotage by previously unknown Sikh extremist groups and disgruntled employees but this theory was vigorously impugned by numerous independent sources[1].

The toxic plume had barely cleared when on December 7, the first multi-billion dollar lawsuit was filed by an American attorney in a U.S. court. Two days later, another American lawyer arrived in Bhopal and began signing up clients. This was the beginning of years of legal machinations in which the ethical implications of the tragedy and its affect on Bhopal's people were largely ignored. In March, 1985, the Indian government enacted the Bhopal Gas Leak Disaster Act as a way of ensuring that claims arising from the accident would be dealt with speedily and equitably. The act made the government the sole representative of the victims in legal proceedings both inside and out of India. Eventually, all cases were taken out of the U.S. legal system under the ruling of the presiding American judge and placed entirely under Indian jurisdiction, much to the detriment of the injured parties. The average compensation received by living victims was \$550 while the families of those who died received about \$4000[3]. The total compensation settlement was US\$470 million for the 600,000 claimants, a major underestimation of projected rehabilitation costs[1, 7]. This is significantly less than the US\$ 2.5 billion for 60,000 victims in the Manville Asbestos claim in the U.S. and the US\$5 billion for cleanup following the Exxon Valdez oil spill in which there were no fatalities. The figure was partly based on the government's claim that only 4000 people

suffered permanent disabilities. Independent analyst arrived at figures ten to a hundred times this number for those permanently disabled. Upon announcing this settlement, shares of UCC rose \$2 per share or 7% in value[1].

At every turn, UCC has attempted to withhold finances and manipulate, obfuscate and withhold scientific data to the detriment of victims. An important course of treatment was withheld from MIC victims at UCC's insistence, because it would have been a marker of the nature of the exposure. Even to this date, the company has not stated exactly what was in the toxic cloud that enveloped the city on that December night[5].

As further insult, UCC discontinued operation at its Bhopal plant following the disaster but failed to clean up the industrial site completely. The plant continues to leak several toxic chemicals and heavy metals which have found their way into local aquifers. Dangerously contaminated water has now been added to the legacy left by the company for the people of Bhopal[1, 8].

Lessons learned

Until recently, little was done in India or other developing countries to control, regulate or manage pollution and industrial hazards. Yet Bhopal signaled that the heady rush of industrialization had begun to reveal some inevitable toxic side effects[2]. The disaster demonstrated that seemingly local problems of industrial hazards and toxic contamination are often tied to global dynamics. UCC's Sevin production plant was built in Madhya Pradesh not to avoid environmental regulations in the U.S. but to exploit the large and growing Indian pesticide market. However the manner in which the project was

executed suggests the existence of a double standard for multinational corporations operating in developing countries[1]. From a legal viewpoint, the disaster demonstrated that enforceable international standards are clearly and urgently needed for hazardous industries, particularly multinationals operating in developing countries. Such regulations would at least narrow the gap between standards in the developed countries and those in the Third World. There needs to be some method of accountability to local populations when a company's primary responsibility is increasing profits for shareholders who live elsewhere, often on another continent. Even without enforcement, international standards could provide norms for measuring performance of individual companies engaged in hazardous activities such as the manufacture of pesticides and other toxic chemicals in India[9].

One of the most obvious lessons drawn from Bhopal is the need to prevent future environmental catastrophes. National governments and international agencies should focus on widely applicable techniques for corporate responsibility and accident prevention as much in the developing world context as in advanced industrial nations[10]. Specifically, prevention should include risk reduction in plant design and safety legislation[11].

A key principle for protecting the surrounding population is preparedness. Industry and government need to bring proper financial support to local communities so they can provide medical and other necessary services to reduce morbidity, mortality and material loss. Thorough training is essential. An immediate and appropriate emergency response is also critical and includes deployment of rescue squads of medical teams and professionals to ascertain type and extent of exposure. Follow-up to assess late effects of

exposure and evaluate response measures is important in response to such a disaster[5, 11]. Strong public health infrastructure is a crucial part of the preparedness paradigm. Future management of environmental accidents requires that the same effort thus far devoted to relief measures in Bhopal in the post-impact phase be devoted to advance planning before any disaster occurs[12].

Since 1984

Following the events of December 3, 1984 environmental awareness and activism in India increased significantly. The Environment Protection Act was passed in 1986, creating the Ministry of Environment and Forests (MoEF) and strengthening India's commitment to the environment. Under the new act, the MoEF was given overall responsibility for administering and enforcing environmental laws and policies. It established the importance of integrating environmental strategies into all industrial development plans for the country. However, despite greater government commitment to protect public health, forests, and wildlife, policies geared to developing the country's economy have taken precedence in the last 20 years[13].

India has undergone tremendous economic growth in the two decades since the Bhopal disaster. Gross domestic product (GDP) per capita was around \$1,000 in 1984 while the latest figures are \$2,900 and it continues to grow at a rate of over 8% per year[14]. Rapid industrial development has contributed greatly to economic growth but there has been a significant cost in environmental degradation and increasing public health risks. Since abatement efforts consume a large portion of India's GDP, MoEF faces an uphill battle as it tries to fulfill its mandate of reducing industrial pollution[13].

With the industrial growth since 1984, there has been an increase in small scale industries (SSIs) that are clustered about major urban areas in India. There are generally less stringent rules for the treatment of waste produced by SSIs due to less waste generation within each individual industry. This results in SSIs disposing of their wastewater untreated into drains and subsequently into rivers. New Delhi's Yamuna River is illustrative. Dangerously high levels of heavy metals such as lead, cobalt, cadmium, chrome, nickel and zinc have been detected in this river which is a major supply of potable water to India's capital thus posing a potential health risk to the people living there and areas downstream[15].

Land pollution due to uncontrolled disposal of industrial solid and hazardous waste is also a problem throughout India. With rapid industrialization, the generation of industrial solid and hazardous waste has increased appreciably and the environmental impact is significant[16].

India has relaxed its controls on foreign investment in order to accede to WTO rules and thereby attract a growing flow of capital. In the process, a number of environmental regulations are being rolled back as growing foreign investments continue to roll in. The Indian experience is comparable to that of a number of developing countries that are experiencing the environmental impacts of structural adjustment. The exploitation and export of natural resources has accelerated. Prohibitions against siting industrial facilities in ecologically sensitive zones have been eliminated while conservation zones are being stripped of their status so that pesticide, cement and bauxite mines can be built[17].

In March 2001, residents of Kodaikanal, southern India caught the Anglo-Dutch company, Unilever, redhanded when they discovered a dumpsite with toxic mercury laced waste from a thermometer factory run by the company's Indian subsidiary, Hindustan Lever. The 7.4 ton stockpile of mercury-laden glass was found in torn stacks spilling onto the ground in a scrap metal yard located near a school[18]. Other examples of poor environmental stewardship and economic considerations taking precedence over public health concerns abound. In the fall of 2001, steel from the ruins of the World Trade Center was exported to India apparently without first being tested for contamination from asbestos and heavy metals present in the twin tower debris[18].

The Bhopal disaster could have changed the nature of the chemical industry and caused a reexamination of the necessity to produce such potentially harmful products in the first place. However the lessons of the acute and chronic effects of exposure to pesticides and their precursors in Bhopal have changed little in terms of agricultural practice patterns. It is estimated that 3 million people per year, mostly in the agricultural developing world, suffer the consequences of pesticide poisoning. It is reported to be the cause of at least 22,000 deaths in India each year. In the state of Kerala, significant mortality and morbidity have been reported following exposure to Endosulfan, a toxic pesticide whose use continued for 15 years after the events of Bhopal[19].

UCC has shrunk to one sixth of its size since the Bhopal disaster in an effort to restructure and divest itself. By doing so, the company avoided a hostile takeover, placed a significant portion of UCC's assets out of legal reach of the victims and gave its shareholder and top executives bountiful profits. The company still operates under the

ownership of Dow Chemicals and still states on its website that the Bhopal disaster began with “an act of sabotage”[19].

Not all news from industry is bad. The British Chemical company ICI, whose Indian subsidiary manufactured pesticides, increased attention to health, safety and environmental issues following the events of December, 1984. They now spend 30-40% of their capital expenditures on environmental-related projects. However, they still do not adhere to standards as strict as their parent company in the UK[18].

The US chemical giant DuPont learned its lesson of Bhopal in a different way. The company attempted for a decade to export a nylon plant from Richmond, VA to Goa, India. Apparently haunted by the specter of Bhopal, DuPont, in its early negotiations with the Indian government, had sought and won a remarkable clause in its investment agreement that absolved it from all liabilities in case of an accident. But the people of Goa were not willing to acquiesce while an important ecological site was cleared for a heavy polluting industry. After nearly a decade of protesting by Goa’s residents, DuPont was forced to scuttle plans there. Madras was the next proposed site for the plastics plant. The state government there made significantly greater demand on DuPont for concessions on public health and environmental protection. Eventually, these plans were also aborted due to what the company called “financial concerns”[20].

Conclusion

The tragedy of Bhopal continues to be a warning sign at once ignored and heeded. The accident occurred at precisely the moment of a fundamental shift from Third World

economic nationalism to neoliberal globalization. Bhopal and its aftermath were a warning that this path was fraught with human, environmental and economic perils consisting of more hazardous investment and the loss of economic independence. But the leadership of the Indian government did not want the political fallout from the disaster to undermine its efforts to create a stable and desirable investment climate for transnational corporations.

Some moves by the Indian government, including the formation of the MoEF have served to offer some protection of public health from harmful practices of local and multinational heavy industry but it has mostly been grassroot organizations that have led the charge against the perils of development.

The Indian economy is growing at a tremendous rate but at significant cost in environmental health and public safety as large and small companies throughout the subcontinent continue to pollute. Far more remains to be done for public health in the context of industrialization to show that the lessons of the countless thousands dead in Bhopal have truly been heeded.

Competing Interests

No competing interests.

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