

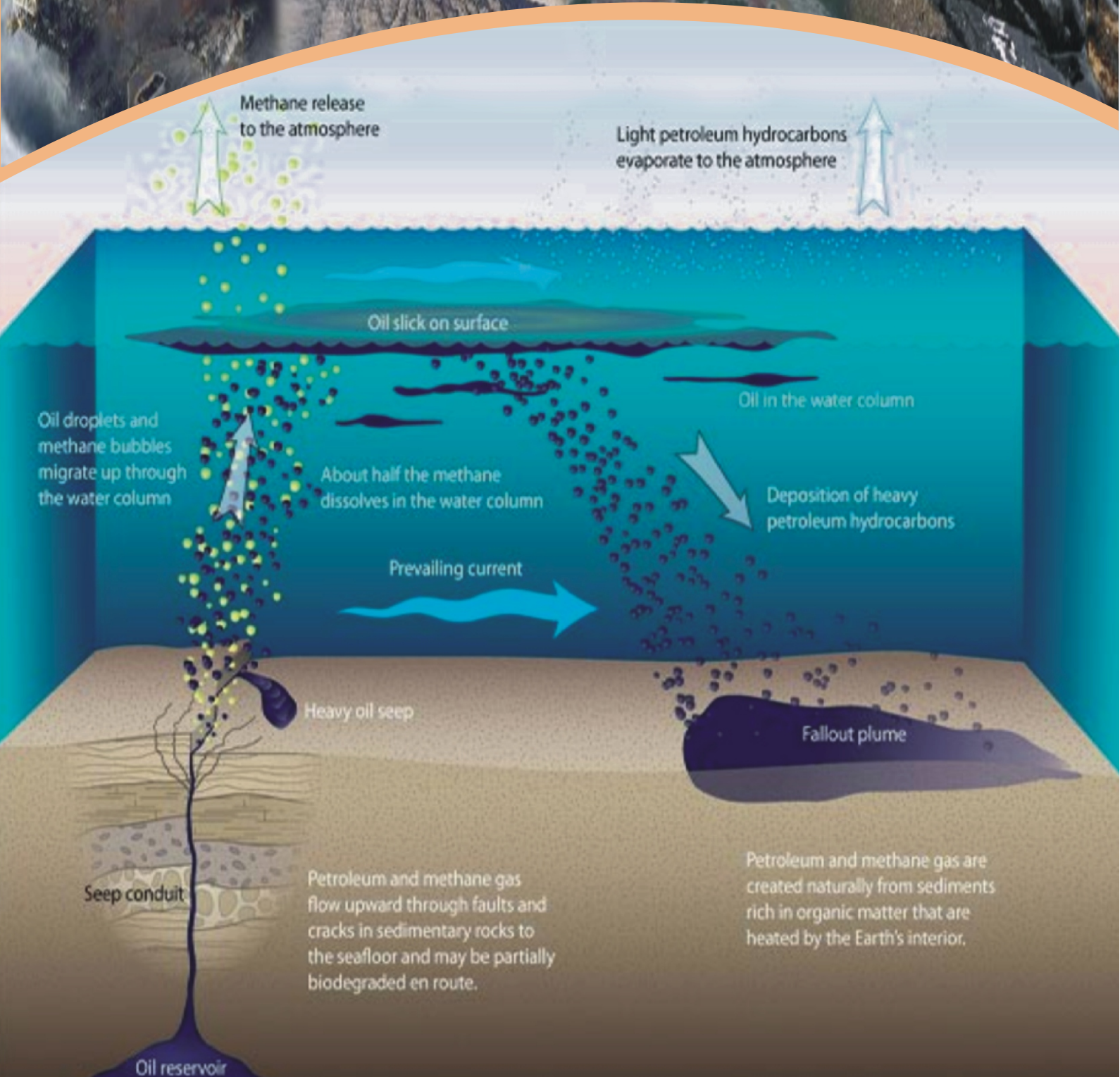


# Newsletter

ENVIS CENTRE ON ENVIRONMENTAL ECONOMICS

# ENVISAGE

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तहाँ है स्वस्थली ॥  
Ministry of Environment and Forests

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## **Contents**

- ❖ Bhopal Gas Tragedy:  
The Disaster Exported to India
- ❖ Liability and Environmental  
Damage:  
The Indian Experience
- ❖ Top-10 Manmade Disasters
- ❖ Forthcoming Conferences on  
Manmade Disaster Management
- ❖ Web Sources on Manmade  
Disaster Management

## **Editorial**

Manmade disasters occur when human actions lead to severe threats to safety and health, property, and the environment. Examples of inadvertent activities include, clearing mangrove swamps removes natural protection from cyclones and flooding; excessive deforestation or cultivation, combined with heavy rain, leaves settlements vulnerable to landslides, soil erosion, water pollution and ultimately desertification. Accidental manmade disasters include fire, industrial accidents, oil spills, transport disasters, and the spread of contagious diseases. Deliberate manmade disasters include acts of war or large-scale violence, terrorism, arson and destruction of property, and environmental pollution. War and violence can lead to societal collapse resulting in widespread hunger, disease, and suffering. The Bhopal Gas Tragedy in 1984, perhaps is the prime example of how human negligence and poor safety standards can lead to devastating impact of the societies. Leakage of methyl isocyanide gas and other chemicals from the pesticide plant of Union Carbide India Limited in Bhopal on 3<sup>rd</sup> December, 1984 exposed several thousands of people to devastating effect of the deadly poisonous gases. This resulted in an enormous death toll and human suffering. While estimates of dead vary across several estimates, one of the striking aspects of the Bhopal Gas Tragedy is its after effects. A government affidavit in 2006 stated that the leak caused 558,125 injuries including 38,478 temporary partial and 3900 severely and permanently disabling injuries. Chemicals abandoned at the plant continue to leak and pollute the groundwater. This is the magnitude of the disasters that are often caused by human activities which are collectively termed as 'Man-made Disaster'. Given the scenario, in this issue of ENVISAGE newsletter we focus on the theme of 'Man-made Disasters'. In the lead articles, Dr. I. Zareena Begum elaborates the unending sufferings of Bhopal Gas Tragedy and the forgotten obligations of the multi-national firm. In a follow-up article, Dr. Zareena summarizes the experience on the liability issues due to industrial disasters in the Indian context.

# BHOPAL GAS TRAGEDY: THE DISASTER

## Exported to India

Twenty-five years have passed since the country's worst industrial disaster in Bhopal which saw a cloud of deadly gases explode out of a faulty tank in a pesticide factory and silently spread into the homes of people. Over 20,000 people were killed within days, and the horrific effects of the gas continue to this day. The multinationals, which entered the 'developing world' as harbingers of profit and gain were in fact, brought the death demon, the Union Carbide which authored the tragedy thought it could wash off its hands by selling the abandoned Bhopal plant to Dow Chemicals, even as it emanate the poisonous gases and continue to cause enormous damage to the environment. It is not known with great certainty the figure of casualties and injured persons it is not possible to measure up the real damage to the environment which appear as on today as eternal.

It is shocking that the Dow Chemicals claimed the remainder of the Relief Fund carved out of the settlement between the Government of India and Union Carbide for cleaning up the environmentally hazardous pollution emanating from the abandoned unit of the factory at Bhopal. The balance of the hitherto undistributed compensation has accumulated interest and grown to Rs. 1,505 crores. (some \$327 million).

Very appropriately, the Supreme Court on 19 July, 2004 ordered the Government of India to distribute the balance of compensation remaining from Union Carbide's settlement among the 566,876 Bhopal survivors whose claims have been successfully settled.

Survivors whose claims may have been wrongly dismissed or who were underpaid were directed by the court to file a separate application, and seek compensation from the Government of India. The average payout will still only amount to \$570 per person which, despite Dow-Carbide's now famous dictum that "\$500 is plenty good for an Indian", comes nowhere near meeting the costs of medical treatment that survivors have already had to fund for themselves, much less compensating for two

decades of illness, loss of livelihood and fear for what new horrors may emerge in their bodies.

It is a further setback for the Dow-Carbide corporation and its political accomplices in India, who are on record as demanding that this money, meant for the relief of the survivors, should be used to clean up the company's abandoned and polluted factory in Bhopal. Last month, the Government of India threw its weight behind a court action to force Dow-Carbide to bear the full costs of cleaning the plant.

The Government of India has decided to convey the "No Objection" to the US Court of Appeals to consider environmental contamination claims unrelated to the Bhopal Gas Leak Disaster as defined in section 2(a) of the Bhopal Gas Leak Disaster (Processing of Claims) Act 1985.

While third world countries expected that foreign investments would bring them avenues of employment, they brought unending misery and pollution. Veiled threats reached the government, the media and the legal institutions that imposing severe penalties on the MNC would deter other multinational players from entering the Indian Market, a possibility that was projected as dire. If the transferring MNC was to be let off lightly, it would send out signals that life was cheap in the developing world, and that profits could be essayed at the risk of death and disaster. UCC tried to shift blame saying it was local negligence and not design defect.

There can be no other live example of death demon than one created by MNCs of developed nations is the Bhopal massacre caused by UCC. The death, disaster and dreadful conspiracy to exploit human labour in India and to unhesitatingly pollute the environment can be seen from the pathetic tragedy in Bhopal.

The Bhopal gas tragedy was described in different terms such as: accident, disaster, catastrophe, and crisis and also as sabotage, conspiracy, massacre, and experiment, whichever best suited the arguments that would help to pin the 'blame' on somebody.

## Unending Sufferings

A series of studies made five years later showed that many of the survivors were still suffering from one or several of the following ailments: partial or complete blindness, gastrointestinal disorders, impaired immune systems, post traumatic stress disorders, and menstrual problems in women. A rise in spontaneous abortions, stillbirths, and offspring with genetic defects was also noted.

About 300,000 more would suffer agonising injuries from the disastrous effects of the massive poisoning while none could say if future generations would be affected. Forty tons of toxic gases were released from Carbide's Bhopal plant and spread throughout the city. The cause was the contamination of Methyl Isocyanate (MIC) storage tank No. 610 with water carrying catalytic material. The result was a nightmare that still has no end. Residents awoke to clouds of suffocating gas and began a desperate flight through the dark streets. No alarm ever sounded a warning and no evacuation plan was prepared. When victims arrived at hospitals breathless and blind, the doctors did not know how to treat them since Carbide had not provided emergency information. But it was only when the sun rose the next morning that the magnitude of the devastation was clear. Dead bodies of humans and animals blocked the streets, leaves turned black, the smell of burning chilli peppers lingered in the air. Responsible estimates suggest that as many as 10,000 may have died immediately. The precise number of deaths still remains a mystery. 2,000,00 were injured and 30,000 to 50,000 were too ill to ever return to their jobs. This is the Hiroshima of chemical industry [1, 2].

## Forgotten Obligations

The present generation has an obligation to protect their future generations. A man has no right to exploit the ecology to the detriment of to be born. The International Community recognized this

responsibility and drafted several instruments reminding the mankind to be kind to the natural world. After the loss of millions of human beings the UN Charter expressed a deep concern for the people yet to be born.

The Stockholm conference in 1972 explained the imperative goal for mankind as to defend and improve the human environment for present and future generations. Besides war, peace and Development the International Law made a beginning in regulating the environmental issues. Man has both a right to healthy world around and a solemn responsibility to protect and improve the environs for the next generation.

The United Nations General Assembly adopted World Charter for Nature in 1982, which explicitly states that the Governments have a duty to pass on their natural heritage to future generations.

The World Commission on Environment and Development WCED headed by Giro Harlen Bruntland proposed a set of legal principles for sustainable development and suggested for a global convention for this purpose. (World Commission on Environment and Development, Our Common Future, 1987) For this purpose and for arresting further degradation of the environment and to repair damage already done, the Rio Earth Summit was convened by the UNGA. Maintenance of ecological balance, prevention and control of environmental pollution, preservation of our natural resources, disaster mitigation and sustainable development are the basic factors of the "Earth Charter", which is also called the "Rio Declaration".

## Regulation of MNCs

Union Carbide's operations in India go back to the beginning of this century when it began marketing its products there. In 1924, an assembly plant for batteries was opened in Calcutta. By 1983 Carbide had 14 plants in India manufacturing chemicals

pesticides, batteries and other products. Union Carbide's operations in India were conducted through a subsidiary, Union Carbide India, Ltd. (UCIL). The parent US Company (UCC) held 50.9 % of UCIL stock. The balance of 49.1% was owned by various Indian investors. Normally foreign investors are limited to 40% ownership of equity in Indian companies, but the Indian government waived this requirement in the case of Union Carbide because of the sophistication of its technology and the company's potential for export.

The multinationals operating in frivolous areas should be given second priority as compared to the much needed technology for key sectors of Indian industry. What is vital is that the multinational should not be allowed to function except under a strict regime of environmental controls and health and safety regulations.

The Bhopal plant was licensed to manufacture 5250 tons of MIC based pesticides per year. However, peak production was only 2704 tons in 1981, falling to 1657 tons in 1983. Thus the quantity of pesticides manufactured in 1983 was only 31.37% of its licensed capacity. Was the Bhopal plant used for experiments in processes for which the UCIL was not authorized? Or was the capacity of the plant being under-utilised to maintain a monopolistic hold over prices?

In the first ten months of 1984, losses amounted to Rs. 5,03,39,000. Union Carbide India Limited (UCIL), was thus deducted by Union Carbide Corporation (UCC) to close the plant and prepare it for sale. When no buyer was available in India, plans were made to dismantle the factory and ship it to another country. Negotiations toward this shutdown were completed by the end of November 1984. Financial losses and plans to dismantle the plant exacerbated Carbide's already negligent management practices leading to executive decisions that directly caused the contamination of the MIC storage tank that leaked its contents over Bhopal. While saving money for both

Union Carbide Corporation (UCC) and UCIL, negligent maintenance and substantial reductions of trained personnel culminated in the horrors of December 3, 1984.

### **International Code for Trans National Companies**

Bhopal gas tragedy and consequent litigation has also revealed the need for evolving over all controls over the activities of MNCs especially when they are engaged in hazardous operations. Such a need was felt all over the world and the Secretary-General has rightly responded to it by evolving some methods in his report. The first step he suggested was risk assessment and involvement of factory employees and the community in the development of methods to identify the hazards and second step was about evolving strategies to plan and reduce the consequences of accidents and to settle the claims of liability. But the question as to the extent of liability of the parent company for the environmental harm caused by its affiliate was left open for further discussion. Had Bhopal tragedy was covered by industrial insurance, the victims would have received the necessary relief without much delay. It took four years to reach settlement and the distribution of relief is still going on in Bhopal. Speedy trial and early disposition of claims is as important as the fundamental right to life. All the theories of liability- the effect theory and enterprise theory pinpoint the liability on the parent American company UCC which controlled the Indian Company UCIL in its establishment and functioning besides playing a significant role in decision making. UCC not only owes a duty of care towards Indians but people in general. It is the basis of human rights jurisprudence and MNCs are subjected to the international human rights obligation. Similarly the Government of Madhya Pradesh and Government of India also are liable when the MNCs permitted by them are violating the international human and environment rights.

## International Codes

Since then various codes of conduct were developed. United Nations General Assembly, the International Labour Organisation ILO, The Food and Agricultural Organisation FAO and the Organisation for Economic Cooperation and Development OECD have incorporated the environmental aspects and the relations between the MNC and the host country.

## The UN Code of Conduct

The UN Draft Code for Transnational Corporations (TNCs) contains several specific obligations addressed directly to the MNCs. They include:

1. The obligation to respect the national sovereignty of the countries in which they operate and the right of each state to exercise its full sovereignty over its natural resources within its territory.
2. The obligation to be subject to the laws of the host country and the explicit duty to carry on their activities in conformity with the developmental policies, objectives and priorities of the respective governments.
3. In the light of the new interpretation given to development including the safeguarding of the environment, it should implicitly mean an obligation not to unreasonably alter the ecological balance of the host country through their activities.

Whenever an enterprise starts a hazardous activity in the territory of a state, there is an inherent duty in the nature of the agreement itself, an understanding that it will not cause any serious adverse effects on the health of the people or environment of the country. If an accident like Bhopal tragedy results from the activity of the MNC it might amount to delinquent conduct or a wrongful breach of duty.

The code also imposes an obligation on the MNCs to respect the human rights and fundamental freedoms in the host countries. Right to clean environment is a significant aspect of new human rights jurisprudence. It is a duty of MNC to protect and preserve that environment. However strong the code may be, its binding nature is a questionable aspect. The states have to enforce the code, which is addressed to the MNCs. Developed nations may not agree to enforce the code.

## OECD Guidelines

Organisation for Economic Cooperation and Development issued a Declaration on International Investment and MNEs in the Annex of which guidelines are embodied. The MNEs are accordingly under an obligation to give due consideration to the host countries aims and priorities with regard to economic and social progress, including industrial and regional development and the protection of environment. These guidelines are only advisory and not mandatory. They are not legally enforceable. But it reflects the agreement of international community to the aspect of duty of MNCs to abide by the laws, controls and regulations of the state in which the MNC operates like any other domestic corporation.

MNCs and their activities brought very complex legal problems to the fore. The principles of tortious liability, Human rights jurisprudence, Environmental law and International relations are intertwined and with rights of the nations and persons as victims. Environmental Law and International Corporate law is yet to develop into a full-fledged law. Till then it is difficult for developing nations to control the hazardous activities of MNCs. The MNCs are not primary subjects of International Law. They are neither states nor public international organizations. It is the duty and obligation of the states to exercise their sovereignty and impose liabilities over the multinational enterprises without minding their

international character and affiliations. Life and environment are the primary concerns of any state or organization. It is everybody's responsibility to protect the natural rights and the nature, so that the major tragedies like Bhoposhima are not recurred [3].

## **Is there any conclusion to this endless trauma?**

### **Shocking Aftermath**

Around twenty years after the world's worst disaster the story has not yet ended, Thousands who survived are today suffering multiple health complications and those living closest to the plant continue to be poisoned. Thousands drink water poisoned by the chemicals that remain in the abandoned Union Carbide plant. Neither the Government nor the Dow Chemicals, which bought Union Carbide is willing to take responsibility for cleaning up. The victims are still running from court to court seeking justice, while the rest of the country does not know anything about their plight. It is rightly described as the tragic story of Bhopal of how corporate indifference, government's apathy and uninformed people's disinterest made the life of victims miserable for decades. It is an unending continuation of perpetuation of the tragedy.

It is reported that the company dug the bottom soil from three large solar evaporation ponds in Atal Ayub Nagar adjoining UCIL's factory in Bhopal, spread over more than 20 acres, which were used to dump waste by UCIL. It was dug to bury the sludge under three meters of farm soil. People bathe, swim and even drink this water. Cattle die after drinking water from these ponds. The adjoining tube wells give water unfit for drinking. The yield from crops from nearby fields was drastically reduced. At least one person a day still dies from gas exposure related diseases and 1.5 lakh

are in urgent need of medical attention. Breathlessness, loss of appetite, pain, menstrual irregularities, recurrent fever persistent cough, neurological disorders, fatigue weakness, anxiety and depression are among the most common symptoms. Research findings on chromosomal aberrations suggest that the future generations of the survivors will possibly carry the leftovers of the industrial toxins [4].

The land around the factory is now occupied and every inch of it has been built upon. The abandoned factory is being used as a public toilet by adjacent slums. Two large cylindrical tanks, which contained MIC including the one responsible for the gas leak on that fateful night are still lying there in the factory emanating the poisonous fumes. Sacks of decaying chemicals, blackened chemical bags, pools of stagnant water, rusted metal boxes labeled Sevin and Nitrate residues are still pose a danger to the vicinity. As the groundwater is totally contaminated, the people living in that area were promised to be supplied with the alternative piped water. The amount of Rs 3 crore sanctioned for this purpose was spent elsewhere.

Who is legally responsible for this toxic wastes left behind by UCIL? In the absence of industrial activity the lease of the land to factory was cancelled by the Government of Madhya Pradesh. The land measuring 87.62 acres has been transferred to the Gas Relief and Rehabilitation department of the Madhya Pradesh Government. But as polluter, the UCIL must be fully responsible for wastes. It agreed to surrender the land in usable and habitable condition, as per lease terms. The Madhya Pradesh Pollution Control Board had directed UCIL to carry out environment investigation of dumpsite and remediation thereafter. Yet site was surrendered without complying with

those directions in the same conditions not fit for habitation. All those provisions in Environment (Protection) Act 1986 and the Water (Prevention and control of Pollution) Act 1974, which contain heavy penalties are yet to be used against them. It is continuation of crime of pollution, the MPPCB does not use its power to prosecute the culprit company.

Cost of clean up was estimated to be Rs 2.5 Crores sometime back. Now the estimates have gone up to even Rs. 100 crores while Greenpeace activists put it at Rs 500 crores. Who will pay? It remains a moot question even today. Bhopal is the symbol of a disastrous 'side' effect of so called Globalization and stands out as a living, say dying, example of inadequacy of domestic law to regulate, prevent or penalize the pollute TNCs and their agents.

As the environment problems are going to be there for all generations to come, it is the duty of every person and every nation to evolve a equitable principle of making Trans National Companies liable for its transfer of hazardous technology to developing countries if that resulted in damage to human life or environment, without leaving any scope for escape after passing the buck on to the subsidiary or agent in different mask.

International law based on conventions and protocols read with UN documents and reports of the UN Commissions, a new law to tackle the TNC hazards and imposing absolute liability should emerge. The environment protection is a universal and inter-generational equitable obligation of entire humanity irrespective of being developed, developing or underdeveloped nations in the international comity of nations. If not, the environment and human life will never be safe. Environmental safety cannot be achieved by creating new fundamental rights in

favour of citizens, when they are not effectively enforced. Disaster may not be frequently repeated. But after experiencing the trauma of disaster, disastrous litigation and corrupt consequences without imposing any criminal liability on the culprits, nothing tangible is left as a system with which we could prevent such disasters. As mentioned even now the abandoned Union Carbide factory is spreading the poisonous gas, and the State did not prevent the spread of residential colonies around the deserted place of disaster, containing the contaminating chemicals. What system do the third world countries have to tackle the present and continuous disaster and to prevent some more?

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## Liability and Environmental Damage: The Indian Experience

The Union Carbide Gas Disaster was the first experience of a major industrial disaster in India. In its aftermath, the vastness of the death and suffering placed the focus predominantly on questions of compensation to the victims and survivors of the disaster. This was resolved by a settlement in 1989 which is widely regarded as inexplicably low in its quantum (475 million US\$ for an indeterminate number of victims, and claims totaling over 5,00,000, with over 2800 having died in the night and day of the disaster, and over 20,000 having died over the years due to causes arising out of the lethal gas leak), and which, in its original statement closed all the criminal proceedings which had been initiated against the corporation and its managers. This was later revised, the criminal cases re-opened, and the trials are currently underway. Warren Anderson, its CEO at the time of the disaster, and the UCC, remain absconders, refusing to present themselves to be tried.

It was not till 1999, when Greenpeace conducted tests in and around the Bhopal plant, that the environmental damage, which continued to affect the population around the plant, acquired a centrality. The toxicity seeping out of the plant, and into the soil, has contaminated the water sources around the plant. Also, there is a reckless disregard, which is in evidence in the absence of a clean-up programme on the site of the factory and its storage depots. In the meantime, Dow chemicals has taken over Union Carbide, but is denying any responsibility for cleaning up the premises. The Union Carbide-Bhopal Gas Disaster is, so far, a saga of impunity.

Environmental law has, in the meantime, developed essentially in the PIL jurisdiction. Public Interest Litigation (PIL) allows any bona fide person to take a matter of public interest to the higher judiciary, even where the person who is espousing the cause is not personally or directly affected by the interest that is being agitated in the court. It is a dilution of the principle of locus standi - a significant departure from traditional rules of procedure - which has given the judiciary enormous scope for intervening in environmental matters.

Indian courts have been categorical in their adoption of the values of sustainable development and of the pre-cautionary principle.

The kinds of environmental issues that have been brought to the court include-

- Riverine pollution – by tanneries, industrial effluents, untreated sewage, for instance.
- Soil and groundwater damage, e.g., in the Bicchri industrial pollution case
- Indiscriminate mining
- Protection of forests
- Fencing in of parks and sanctuaries
- The preservation of monuments of archaeological and historical significance, and their protection from vandalism, and industrial pollution
- Automobile pollution

Indian courts have moulded remedies that were intended to have the effect of

- Amelioration
- Reparation
- Redress
- Penalty

The judicial prescription has included

- The remedial measures that clean-up technology may offer
- Application of the polluter pays principle
- The imposition of a pollution fine
- Revision of environmental standards applicable in Indian conditions, for instance where automobiles were ordered to conform to Euro standards, or in the conversion of commercial vehicles to CNG, a less polluting fuel.

When the source of pollution has been certain, as in the Bicchri Case (1996) where the polluting

industries were clearly identified, the court has ordered that the owners go deep pocket in paying for environmental clean-up, and for compensating those who had suffered losses as a result of the toxicity let loose on the soil and water in that area of Rajasthan. Where a multiplicity of establishments has been found to be polluting a resource, the response has ranged from closing down the enterprise, to getting them to set up ETPs or CETPs, and levying a penal fine on the enterprise.

When Oleum Gas leaked from a factory in Delhi in December 1985, the Supreme Court advanced into law the principle of

- 'Absolute liability' (where act of good and sabotage constitute the only exceptions), and
- Enterprise liability by which the paying capacity of the enterprise would determine the sum of compensation to be paid.

This was intended to serve the cause of deterrence and, consequently enhance safety. In an interim arrangement, the Managing Director of the enterprise was required to give an undertaking that he would be personally liable in the event that another episode led to further damage.

In 1991, the Public Liability Insurance Act was enacted particularly to provide for a scheme of insurance where an activity involving hazardous substances or processes is carried on. This would be drawn upon to pay interim compensation to victims of an 'accident'. In 1992, by an amendment which placed a ceiling on the amounts that an insurance company would have to pay, a provision was made for the setting up of an Environmental Relief Fund. The National Environment Tribunal Act enacted in 1995 has a schedule which, following the Bhopal Claims Act 1985, details the expected losses and the heads of damages following an 'accident' involving hazardous substances or processes.

There is a category of offences termed 'absolute offences' which the court recognizes. 'Absolute

offences', the Supreme Court has said, 'are not criminal offences in any real sense but acts which are prohibited in the interest of welfare of the public and the prohibition is backed by sanction of penalty'. Breach of the prescription under the Factories Act 1948 would, then, constitute an absolute offence.

There is a significant departure from criminal law in cases of absolute offences. In criminal law, the issue to be decided is confined to questions of guilt of persons charged with an offence. In contrast, in the Factories Act 1948, for instance, the occupier or manager of a factory is answerable in the first instance for breach of any provision of the law; but where they claim due diligence or absence of knowledge, consent or connivance in relation to a breach of the law and ask to be discharged, that can be done only when 'any other person whom he charges as the actual offender (is) brought before the court at the time appointed for hearing the charge'. The occupier or manager has to prove too due diligence, and that 'the said other person committed the offence in question without his knowledge, consent or connivance'. And that other person shall be convicted of the offence. This rests on the logic of accountability, and on an understanding that there is, or has to be, a person(s) responsible for the conduct of the plant at all times; and that what happens within the plant is within the near exclusive knowledge of those in authority in the plant.

In 1987, following on the Bhopal Gas Disaster, the term 'occupier' was re-defined to mean, inter alia, 'in the case of a company, any one of the directors shall be deemed to be the occupier'. This was in recognition of the systematic nature of matters of safety, and was intended to foster a greater priority for safety than had been demonstrated so far.

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## Top-10 Man Made Disasters

- 1. Bhopal (Union Carbide):** In 1969, a subsidiary of chemical powerhouse Union Carbide Corporation built a pesticides plant in the middle of Bhopal, India. On December 3, 1984, a tank holding more than 40 tons of toxic methyl isocyanate overheated and released the heavier-than-air gas. It rolled along the ground like a poisonous foggy avalanche. To date, as many as 20,000 people have died.
- 2. Exxon Valdez:** The oil tanker Exxon Valdez left Valdez, Alaska, on March 23, 1989, loaded with 53 million barrels of crude oil for delivery. At 11 p.m. or so, ship captain Joseph Hazelwood left the ship to an officer who was not certified to pilot through notoriously difficult Prince William Sound. Just after midnight on March 24th, the officer ran aground onto a well-charted reef. The stranded tanker spilled 11 million gallons of crude oil contaminated the water, hundreds of miles of coastline beaches and every individual ecosystem within a massive area.
- 3. Chernobyl:** Workers at the Chernobyl nuclear power plant in Northern Ukraine were in the process of running some tests when things began to go wrong in disastrous succession. It all culminated in a steam explosion in the No. 4 reactor, which was powerful enough to blow the roof off. Nuclear meltdown followed in the form of added explosions and a terrible fire. Soviet secrecy prevents an accurate death toll, but an estimated 6.6 million people were exposed to ghastly levels of radioactive contaminate and untold thousands continue to suffer the effects, from birth defects to cancer.
- 4. Castle Bravo:** In March 1954, the United States detonated a thermonuclear weapon in the Pacific code-named Castle Bravo. They expected it would yield no more than eight megatons of energy. It unleashed a three-mile wide fireball and its enormous mushroom. The excessive yield, coupled with high winds, dispersed nuclear fallout over inhabited islands and fishing boats.
- 5. Minamata disease:** In 1932, the Chisso Corporation in Minamata city on Japan's Kyushu Island began releasing nasty toxic compound called methyl mercury into the waters of Minamata Bay. By the end of 1956, an investigation uncovered 40 more cases, 14 of them already dead. To date, the death toll stands at almost 1,800 people.
- 6. St. Francis dam:** America's worst civil engineering failure began as a solution to the need to supply the residents of Los Angeles with water. A self-taught civil engineer named William Mulholland built the dam for the Los Angeles Department of Water and Power. Just before midnight on March 12, 1928, and 12 hours after Mulholland had finished an inspection and declared it safe, the dam failed, unleashing 12 billion gallons of water onto the San Francisquito Canyon below. The death toll is estimated at around 600.
- 7. Yellowstone fires:** In the time leading up to the summer of 1988, authorities for Yellowstone neglected a number of indicators suggesting that the upcoming dry season could be disastrous, and that's exactly what it was: When autumn snowfall finally arrived to effectively extinguish the fires, they burned almost 800,000 acres - or about one-third - of the entire park.
- 8. Jilin explosions:** The No.101 Petrochemical Plant in Jilin City, China, produced a significant amount of aniline, a chemical compound used to make dyes, polyurethane and even acetaminophen (Tylenol). In November 2005, a series of huge explosions rocked the plant, killing six people at the outset. Water contamination reached the Sea of Japan and forced city governments to shut off water supplies, inciting panic in a number of cities.
- 9. Al-Mishraq fire:** On June 24, 2003, NASA satellites picked up a massive plume of smoke rising near the northern Iraqi city of Mosul. The fire, which burned for about a month, became responsible for releasing the most man-made sulfur dioxide into the atmosphere in history: More than 1.3 billion tons, a little more than half the total sulfur dioxide released in the 1980 eruption of Mount St. Helens in Washington State.
- 10. London's killer fog:** The winter of 1952 was a typically cold one for Londoners and many responded in typical fashion, burning coal in their furnaces. This killer fog, laden with sulfur dioxide, nitrogen oxides and soot soon muffled London under near total darkness. Just four days later it vanished, but the damage was done: Throughout the following months, the fog killed more than 12,000 people.

## Forthcoming Conferences on Manmade Disaster Management

1. First International Conference of Disaster Prevention Technology and Management (DPTM-2010)  
October 23, 2010  
Chongqing, China  
(<http://www.managein.org>)
2. ICMDHS 2011 : "International Conference on Migration, Development and Human Security"  
March 29-31, 2011  
Manila, Philippines  
(<http://www.waset.org/conferences/2011/manila/icmdhs/index.php>)
3. 2nd International Conference on Disaster Management and Human Health: Reducing Risk, Improving Outcomes-  
11 - 13 May 2011  
Orlando, USA  
(<http://www.wessex.ac.uk/11-conferences/disastermanagement-2011.html>)
4. 4th International Conference on Safety and Security Engineering  
4 - 6 July 2011  
Antwerp, Belgium  
(<http://www.wessex.ac.uk/11-conferences/safe-2011/page-2.html>)

## Web Sources on Manmade Disaster Management

1. Disaster Mitigation Institute, Ahmedabad, Gujarat- (<http://www.southasiadisasters.net/>)
2. World Institute of Disaster Risk Management- (<http://www.drmonline.net/>)
3. World Vision- (<http://www.worldvision.org.uk/>)
4. Pacific Disaster Center- (<http://www.pdc.org/iweb/pdchome.html>)
5. Disaster Research Institute, Canada- ([http://www.umanitoba.ca/institutes/disaster\\_research/research.html](http://www.umanitoba.ca/institutes/disaster_research/research.html))
6. Centre for Research on the Epidemiology of Disasters(CRED)- (<http://www.cred.be/>)
7. Asian Disaster Reduction Center(ADRC)- (<http://www.adrc.asia/>)
8. Disaster Prevention and Management-An International Journal- (<http://www.emeraldinsight.com/products/journals/journals.htm?id=dpm>)
9. Environmental Disasters Research Institute, Indore

For further information please contact

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