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Practical Report
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The contamination of groundwater and soil in the vicinity of the UCIL plant in Bhopal

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A survey on the response of officials and experts

Proposed by
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Photo on the title page by Maude Dorr, 2003

1. Abstract

Severe problems remain in Bhopal 21 years after the gas tragedy at the Union Carbide India Ltd. pesticide plant. In the vicinity of the plant, soil and groundwater are contaminated with pesticides and heavy metals. Residents of the communities in this area are suffering from health problems caused by the contamination of drinking water. This report is part of Matthias Stucki's compulsory practical work in the Environmental Sciences course at the Swiss Federal Institute and it shall give an overview on the positions of key players connected to the issue of groundwater and soil contamination in Bhopal. Gaining insight in the attitudes of experts and officials could help in understanding why to date no remediation of the contaminated site has been implemented and why local residents have had to drink contaminated water over such a long period without access to clean drinking water. Thirteen interviews were conducted with people from state and central government, companies, scientific institutes and other agencies. The results show a general acknowledgement of the necessity of remediation and the 'polluter-pays' principle. Union Carbide and Dow Chemical are responsible for financing the remediation and for compensating affected people. The state government is responsible for supplying clean drinking water to all its residents and organising the remediation in a proper way. The central government of India has to support the state government of Madhya Pradesh. The tendency of officials to refer to other agencies instead of admitting their own responsibility might be one of the reasons why the contamination has not been cleaned up yet. A wide range of statements were given to the question about the number of affected people and the expertise and technology for remediation. It is important that governmental laboratories set up long-term studies on the contamination and its effects. The Government of Madhya Pradesh wants to burn certain portions of the contaminated materials in an incinerator and dispose of the rest in a landfill, whereas NGOs are concerned about safety and demand a remediation adhering to international standards. If the responsible agencies do not implement a radical turnaround in their policy, the contamination of groundwater and soil will remain for many more years to come. The possibility of such wide scale damage to environment and human health is unacceptable.

2. Index

3. Introduction

3.1 The Union Carbide Ltd. Factory in Bhopal

On the night of December 2nd/3rd, 1984, the largest industrial disasters in history happened in Bhopal, India. A gas leak at the Union Carbide India Ltd.(UCIL) pesticide plant on the north side of the city caused the death of about 8'000 in the first week and at least 8'000 later on (Eckermann 2005).

The UCIL pesticide plant was closed down in 1984. Part of the pipes, drums, and tanks were cleaned with water and a chemical decontaminant and then sold off ("Environment of the Ground" 1998). The MIC plant, the Sevin plant, and the tanks, however, are still there and contain a variety of residues.

The area around the plant was used as a dumping ground area for hazardous chemicals. Between 1969 and 1977, all effluents were were dumped in an open pit area (Srishti 2002). From then on neutralisation with hydrochloric acid was undertaken before the effluents were dumped in two evaporation ponds outside the factory (Eckermann 2005).

3.2 Contamination and remediation

A report of UCIL's own laboratory (1989) noted that 21 sites inside the the plant were highly polluted.

In samples from the vicinity of the UCIL plant mercury, chromium, copper, nickel and lead were found at elevated levels as well as toxic organochlorines. Volatile organic chlorines (VOCs) such as chloroform, carbon tetrachloride and chlorinated benzenes were also found in the groundwater of several wells outside the UCIL site at levels above the limits established by the World Health Organisation (Labunska et al. 1999).

The National Environmental Engineering Institute classified the soil of several areas at the UCIL factory site as contaminated sites (Chakrabarti 1997)

In 1991 and 1996, the State Research Laboratory of the Public Health Engineering Department reported serious chemical contamination in tubewells in the area. The municipal authorities declared the water of over 100 tubewells to be unfit for drinking (Sambhavna 1998)

21 years after the gas disaster, the UCIL pesticide plant site remains heavily contaminated with a range of organic and inorganic persistent pollutants. There are chemical stockpiles in several buildings of the abandoned factory complex. The area surrounding the solar evaporation pond outside the factory site, into which Union Carbide discharged process waste water, is now contaminated, too (Stringer et al. 2002).

A recent study done by Greenpeace International revealed the urgency for more detailed and extensive studies and for steps to reduce and eliminate the further exposure of the communities in Bhopal (Labunska et al. 1999).

Recommendations by an international expert team on the remediation show that clean-up of the site can be done in a secure manner and in a way that meets international standards. The clean-up of soil would take four years. The cost of remediation of groundwater and soil would be about 115 – 135 crore rupees or USD $26-31 million (Burmeier et al.). Greenpeace International says the costs might be much higher.

Stringer et al.(2002) has elaborated technical guidelines for a clean-up of the site. As the polluter Union Carbide became a wholly owned subsidiary of Dow Chemical Company in 2001 with regard to the polluter pays principle the financial liability for remediation passes to Dow (Stringer et al. 2002).

3.3 Human rights

Because no agency accepts the responsibility for the contamination, the contaminants continue to threaten the people living near the factory site. “As legal processes continue to try to establish liability and compensation, responsibility for the contamination which remains in and around the site remains unaddressed. Given the nature of the processes at the plant and the chemicals handled there, it is possible that residents of the communities surrounding the former UCIL site may still be exposed to hazardous chemicals on a daily basis.” (Labunska et al. 1999).

Since India’s accession to the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social, and Cultural Rights (ICESCR), the government of India and the state government of Madhya Pradesh have been legally bound to respect, protect, and fulfill these human rights. This includes

- the right to highest attainable health (article 12 of the ICESCR)

- the right to an adequate standard of living (article 11 of the ICESCR)
- the right to a safe environment

State parties have to take steps necessary for the improvement of all aspects of environmental and industrial hygiene and for the prevention and reduction of the population's exposure to harmful substances such as harmful chemicals. State parties are obliged to ensure that natural water resources are protected from contamination by harmful substances (Amnesty International 2004).

3.5 Objective

This survey shall give an overview about the response of different officials and experts on unsolved questions in Bhopal. State and central government authorities as well as scientific experts were asked to show their position in the issue of the groundwater and soil contamination in the vicinity of the UCIL plant. Hopefully these interviews may help to understand why no remediation has been done and groundwater and soil remain contaminated more than 21 years after the gas disaster.

4. Material and method

4.1 List of officials and experts

First a list of competent officials and experts to be interviewed was put together. Among the main actors in the issue of groundwater and soil contamination around UCIL in Bhopal are the state government, the central government, courts, scientific institutes, and Dow Chemical. This lead to the following list of people, who were contacted for interviews.

Bhopal Municipal Corporation:

- Mr. Manish Singh, Commissioner of Bhopal Municipal Corporation

State government:

- Mr. Shivraj Singh Chauhan, Chief Minister of Madhya Pradesh
- Mr. Babulal Gaur, Minister of Bhopal Gas Tragedy Relief and Rehabilitation, Madhya Pradesh and former Chief Minister
- Mr. Manoj Goyal, Director of Bhopal Gas Tragedy Relief and Rehabilitation
- Mr. M. M. Upadhayay, Principal Secretary of Bhopal Gas Tragedy Relief and Rehabilitation
- Mr. P. S. Dubey, Chariman of Madhya Pradesh Pollution Control Board
- Mr. Uma Shankar Gupta, former Gas Relief Minister

Central government:

- Mr. Yashvir Singh, Director, Bhopal Cell, Ministry of Chemicals and Fertilizer
- Dr. Raja Gopalan, Central Pollution Control Board
- Dr. N. K. Verma, Central Pollution Control Board
- Ms. Satwant Reddy, Bhopal Cell
- Mr. Mukesh Kacker, Joint Secretary of Bhopal Cell
- Mr. Ram Vilas Paswan, Minister of Chemicals and Fertilizer

Courts:

- Mr. Satish Tiwari, Chairman Local Area Environment Committee. Supreme Court Monitoring. Committee on Hazardous Waste
- Dr. G. Thyagarajan, Chariman of Supreme Court Monitoring Committee (Chennai)
- Dr. Claude Alvares, Member of SCMC

Scientific institutes:

- Dr. Bela Shah, Senior Deputy Director General, Indian Council of Medical Research
- Dr. D.K. Shukla, Indian Council of Medical Research
- Dr. S. Sriramachari, Indian Council of Medical Research, retired
- Mr. N.K. Ganguly, Director General of Indian Council of Medical Research
- Mr. J.S. Yadav, Director of Indian Institute of Chemical Technology
- Dr. H.N. Saiyed, National Institute of Occupational Health
- Dr. Tapan Chakrabarti, National Environmental Engineering Research Institute.
- Director and Secretary of Regional Research Laboratory

Companies:

- Mr. Anil Gain, Engineers India Limited
- Mr. R. B. Singh, Engineers India Limited
- DOW Chemical International Private Limited, Managing Director, Chembur, Mumbai
- DOW Chemical Company, CEO, Switzerland

Others:

- Dr. D.P. Aggarwal, Chief Medical Officer of Gas Relief Hospitals
- Dr. M.A. Qaiser, Physician, Sambhavna Trust Clinic

4. 2 Questionnaire

A questionnaire drafted to include the following questions:

1. What is your opinion regarding the official and non-official reports on the contamination of groundwater and soil in the vicinity of the Union Carbide factory in Bhopal?

2. According to you, which agency is responsible for this contamination and why?

3. According to you, what are the responsibilities of the state and central government with regard to this contamination?

4. What steps need to be taken for remediation of groundwater and soil?

5. What is the size of the population whose health is potentially impacted due to groundwater contamination?

6. Are any of the health consequences of drinking contaminated water manifest among the residents of the communities affected by groundwater contamination?

7. According to you, are the residents of the communities affected by groundwater contamination entitled to compensation? If yes, who should pay them compensation?

8. What steps have been taken by the government to ensure that people affected by groundwater contamination are adequately compensated?

9. According to you, does the expertise and technology for remediation of groundwater and soil exist in India?

10. What, according to you, has been the role of NGOs with regard to the issue of groundwater and soil contamination?

The actors were contacted by email, phone call, or fax and asked for an interview appointment. Interviews typically lasted 20 to 40 minutes and were conducted in the offices of the subjects. A supporting letter from the advisor at the Swiss Federal Institute of Technology certified the survey.

4.3. Visiting the area

To understand the source of the contamination, the UCIL factory site was visited with permission from the local collectorate.

On the 21st anniversary of the gas tragedy, a protest demonstration by its victims was observed and their demand for justice and clean drinking water remarked. Deepening the observation and understanding of the range of the contamination and its effects was a residence of three months duration at the Sambhavna Trust Clinic, where people are treated for health problems caused by consumption of contaminated water.

5. Results

5.1 Interviewed people

After contacting all the people from the interview list, thirteen personal interviews were arranged. All the other people were either physically too distant to meet or were unable or unwilling to talk to the interviewer. Most of the requested interviews, however, could not be arranged simply because of excessive bureaucracy. When contacted, the people were not available or not competent or interview requests went unanswered.

Interviews were conducted with at least one person from every category. The following is a list of those who were interviewed:

Bhopal Municipal Corporation:

- Mr. Manish Singh, Commissioner of Bhopal Municipal Corporation

State Government:

- Mr. Babulal Gaur, Minister of Gas Tragedy Relief and Rehabilitation, Madhya Pradesh and former Chief Minister
- Mr. Manoj Goyal, Director of Bhopal Gas Tragedy Relief and Rehabilitation
- Mr. P.S. Dubey, Chairman of Madhya Pradesh Pollution Control Board

Central Government:

- Mr. Yashvir Singh, Director, Bhopal Cell, Ministry of Chemicals and Fertilizer

Courts:

- Mr. Satish Tiwari, Chairman, Local Area Environment Committee. Supreme Court Monitoring. Committee on Hazardous Waste.

Scientific Institutes:

- Dr. Bela Shah, Senior Deputy Director General, Indian Council of Medical Research
- Dr. D.K. Shukla, Indian Council of Medical Research
- Dr. S. Sriramachari, Indian Council of Medical Research, retired

- Dr. Tapan Chakrabarti, National Environmental Engineering Research Institute.

Companies:

- Mr. Anil Gain, Engineers India Limited

Others:

- Dr. D.P.Aggarwal, Chief Medical Officer of Gas Relief Hospital
- Dr. M.A. Qaiser, Physician, Sambhavna Trust Clinic

It should be mentioned that the interview with Mr. Goyal was conducted in writing, while all of the others were conducted in person. It should also be noted that Mr. Chakrabarti chose to speak in the interview on the condition that he not be quoted as a representative official from the National Environmental Engineering Research Institute, but as a private person.

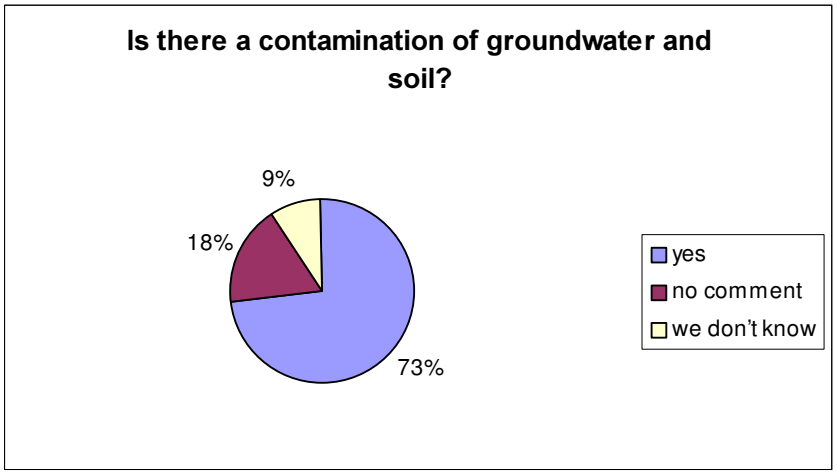
5.2 Responses

The full interviews are posted to the annex of this report. A summary of the most important statements is presented in this chapter. The responses are ordered by the different question topics.

5.2.1 Opinion regarding the contamination

What is your opinion regarding the official and non-official reports on the contamination of groundwater and soil in the vicinity of the Union Carbide factory in Bhopal?

The contamination of groundwater and soil in Bhopal is generally accepted as fact by most agencies. But while Mr. Dubey said: ”The contamination consists only of pesticides and nothing else.”, Dr. Qaiser pointed out that heavy metals have been reported. The threat to the local population by contaminated groundwater is the main concern of most interviewd people. Mr. Chakrabarti explained how NEERI found contamination of soil and predicted contamination of water.

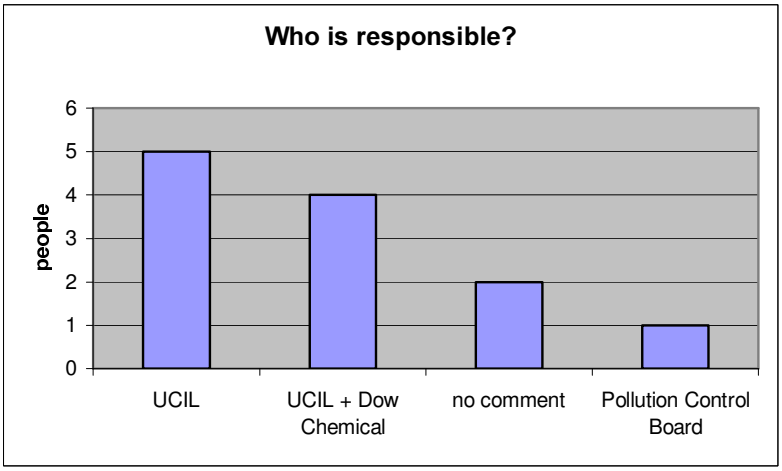


5.2.2 Responsible agency

According to you, which agency is responsible for this contamination and why?

Nine out of twelve people agreed that Union Carbide Ltd is responsible, and four people mentioned Dow Chemical, too.

The polluter-pays principle should be implemented, according to Mr. Tiwari: "Definitely Union Carbide, the polluter has to pay and clean up the area." Mr. Goyal agrees: "Union Carbide Limited India may be responsible because of improper water management at the time of operation."



5.2.3 Governmental responsibility

According to you, what are the responsibilities of the state and central government with regard to this contamination?

According to most interviewed people the main governmental responsibility belongs to the State Government of Madhya Pradesh, which is supposed to organise the supply of clean drinking water and the remediation of the contaminated area. For example, Dr. Sriramachari stated: "The state government should be blamed for not doing the remediation. The central government and the courts are responsible for charging Union Carbide for additional damages and starting a fresh case against them, so they have to pay for the remediation."
Mr. Gaur from the state government, on the other hand, said: "The central government is responsible for compensating all people in the affected area, whether they are ill or not."

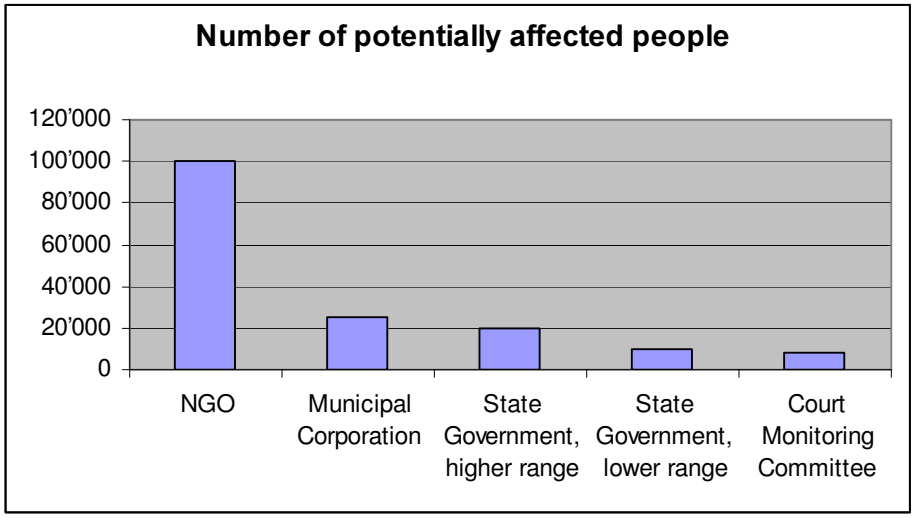
5.2.4 Remediation

What steps need to be taken for remediation of groundwater and soil?

Most of the interviewed people mention the urgent need for several key things including the supply of clean drinking water, more scientific studies about the contamination, and source remediation of the hazardous waste as a first step. How the remediation should continue after that is debatable. What should happen with the contaminated material?
Dr. Sriramachari said: "dump it far away in the Indian Ocean, incinerate it, or dump it in several dumps." Mr. Singh from central government agreed that incineration and landfill disposal would be appropriate: "There are two types of waste -- one which can be treated and then dumped in secure landfills and everything else, which needs to be taken for incineration." But Mr. Tiwari said: "No secure landfill is safe and incineration is an obsolete technology. The contaminated waste could also be shipped back to the United States."

5.2.5 Affected population

What is the size of the population whose health is potentially impacted due to groundwater contamination?



5.2.6 Health impact

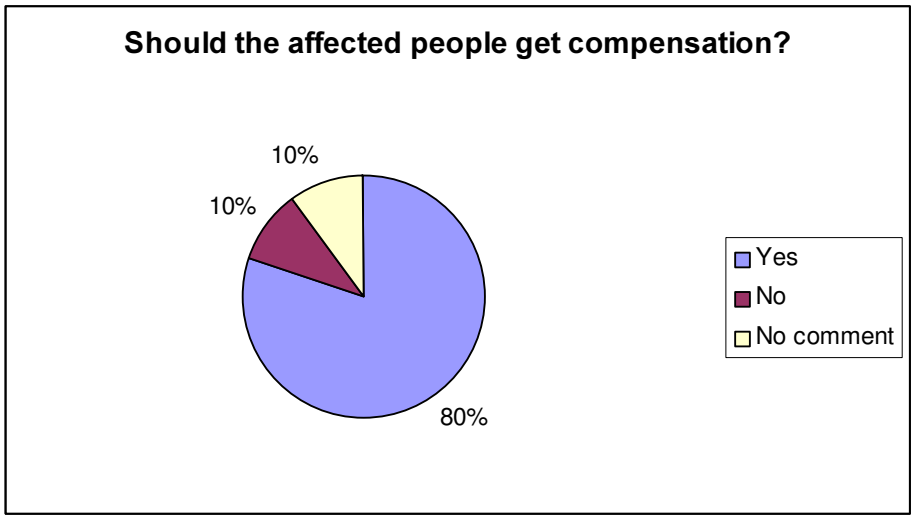
Are any of the health consequences of drinking contaminated water manifest among the residents of the communities affected by groundwater contamination?

Within the interviewed people, there was not much knowledge about specific health effects, but most of them have heard of the complaints or know that the contaminants can be harmful. Only Dr. Qaiser, as a practicing medical doctor, could name symptoms: "The complaints in the area with the groundwater contamination are different from the complaints of the gas victims and those from other parts of the population. There are complaints such as abdominal pain, diarrhea, vomiting, skin diseases, dizziness, etc." Mr. Chakrabarti mentioned a study done by NEERI about the "genotoxicity of Sevin and alphanapthanol".

5.2.7 Compensation

Are the residents of the communities affected by groundwater contamination entitled to compensation? If yes, who should pay them compensation?

A majority of the interviewed people, including those from state and central governmental agencies, are convinced that people whose health is affected due to ground water contamination should get compensation payment. Of the people who stated that compensation payment would be appropriate, all call upon Union Carbide or Dow Chemical as the party responsible for the payment. Mr. Tiwari said: "If people have suffered, then they are definitely entitled for compensation and it is 100% the liability of Union Carbide/Dow Chemical." Other people made similar statements.



5.2.8 Government and compensation

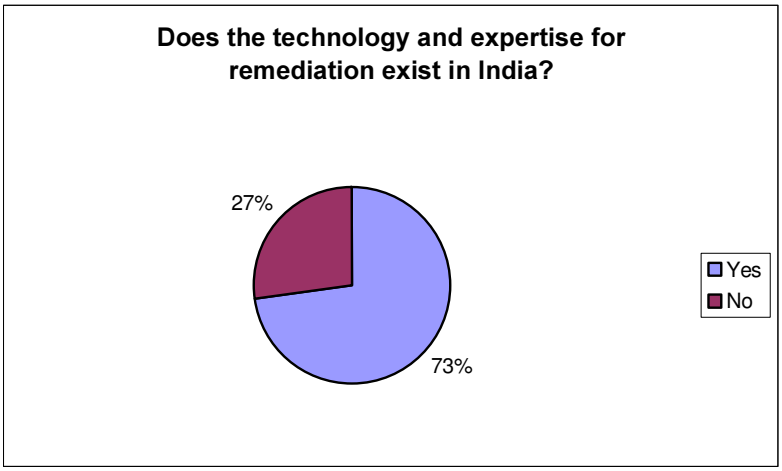
What steps have been taken by the government to ensure that people affected by groundwater contamination are adequately compensated?

The government hasn't done anything to ensure that people affected by the groundwater contamination get compensation. This fact was only stated by two people, but the others showed no evidence that the government did anything for the affected people. When asked about the contamination they usually drifted away from the issue and spoke about other governmental activities. Dr Qaiser said: "The government hasn't done anything, so far."

5.2.9 Expertise and technology

According to you, does the expertise and technology for remediation of groundwater and soil exist in India?

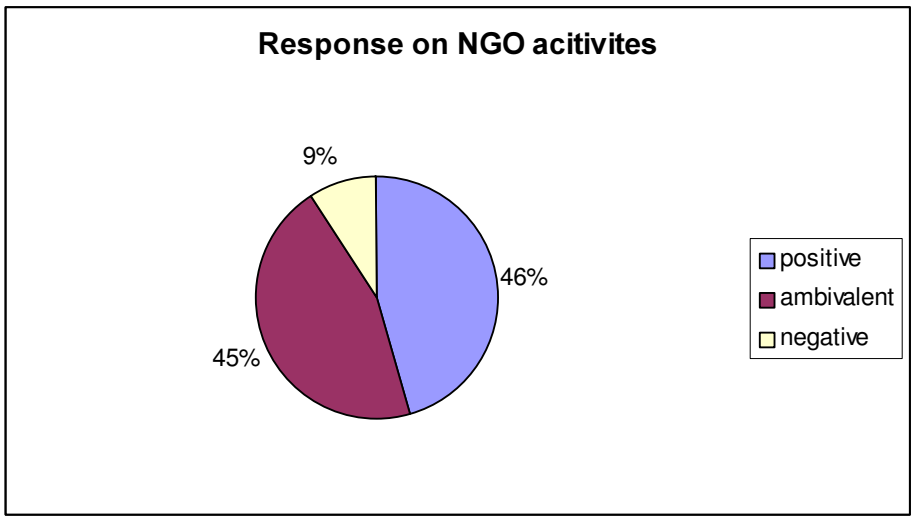
Eight people said that it does indeed exist in India, while three people said it did not. The positions were well settled. Mr. Chakrabarti, for example, as a member of a scientific institution said: "Absolutely, we have all the methods to do the decontamination, including groundwater." Dr. Qaiser, however, as a member of an NGO, said: "It does not exist in India, therefore Greenpeace should do the remediation."



5.2.10 Non-governmental organisations

What, according to you, has been the role of NGOs with regard to the issue of groundwater and soil contaminaton?

About half the interviewed people gave an ambivalent response to this question and the same number of people said only positive things about the NGOs. Only one person, Mr. Dubey from Pollution Control Board, offered solidly negative criticism for the NGOs by saying that "the NGOs are only shouting, making demonstrations, and not helping in a concrete way." Mr. Y. Singh from the central government had only positive words: "I must give credit to the NGOs for the role they are playing." Others, like Mr. Gaur from the state government, had both positive and negative thoughts: "Some are doing well, but others are agents of the American capitalists or enemies of Union Carbide."



5.3 Visiting the area

A visit to the area in January 2006 revealed that the factory is in a miserable state (picture 1). Parts of the plant are lying around and various chemicals in bottles (picture 2.) and piles of pesticide powder remain in several buildings. The security guards didn't grant access to all areas of the site, so the state of the all parts of the site cannot be described. Even though the security guards keep foreigners from seeing all of the site, they cannot keep away the local people from using the contaminated factory site as a shortcut, from grazing their cattle there, or from letting their children play there. Many people do not know about the danger of these activities. The communities around the factory site are poor and most people cannot afford to move away to an uncontaminated area.

picture 1. UCIL plant

picture 2. Chemicals laying around

picture 3. Slogan on a factory door

6. Discussion

Many officials might be afraid of negative publicity about their role in the contamination. So they didn't find time for an interview, they referred the interviewer to other agencies, or they found other reasons to avoid an interview. For example Dr. Chakrabarti refers to the ICMR for the number of affected people, but the interviewed people at ICMR say, that the ICMR has nothing to to with the issue of contamination and refer inquiries to the Pollution Control Board. Dr. Aggarwal and Mr. Chakrabarti even said that they are not allowed to talk about the issue of contamination.

It is generally accepted as fact that the waste at the Union Carbide site and the contamination of groundwater and soil threatens to destroy the health of communities settling around the factory site. Most of the interview subjects agree that remediation of the site is necessary and possible. Concerning the liability, it is in general accepted, that Union Carbide has to pay for the remediation and potential compensation payment of by the contamination the affected people. The polluter-pays principle has to be implemented. As Union Carbide became a fully owned subsidiary of Dow Chemical, Dow Chemical is now responsible for the remediation in Bhopal.

The governmental officials have to ensure that the Indian environmental and health laws are implemented. As land, environment, and health are state subjects, it is the state government's responsibility to provide clean drinking water for its residents, to organise the remediation, and deal with the compensation demands. As the state government didn't do all this properly in the past, several interviewed agencies request that the central government support the state financially, with expertise, and in dealing with UCIL.

One of the reasons the site and its surrounding remains contaminated 21 years after the gas disaster is the fact that each agency denies its responsibility and refers to other agencies. As contamination is a state subject, the central government is not willing to do more than monitor the process. The state government on the other hand is not able to organise the remediation on its own and needs help.

How the remediation should be carried out is a very debatable issue. The governments are planning to bring the contaminated materials and wastes for incineration or landfill. This solution is rejected by the NGOs, who demand instead a remediation that meets international standards, using the latest technology, or even sending the material back to the United States.

In general it seems to be a problem that the contamination and its negative impacts on human health have not yet been proven by governmental studies. As nobody supervises the range of the contamination, the statements on the number of potentially affected people goes from 8'000 (Mr. Tiwari) to 100'000 (Dr. Qaiser). Contamination studies done by NGOs like Greenpeace are not accepted by all agencies. It is important that a long term study in Bhopal be initiated and regular measurements be made to track the trend of groundwater contamination. Analysis of the compounds present must be included in this effort.

The idea that the people, whose health is affected by the groundwater contamination might be entitled for compensation seemed to be new to most of the officials interviewed. But after thinking about it most of them agreed that these people should get compensation from Union Carbide. So far, the state and central government have not done anything to ensure that these people get compensation. But more urgent than the compensation payment is that all the people get clean drinking water.

The question that got the widest range of responses was the question about the presence of necessary expertise and technology in India. Mr. Dubey, Chairman of Madhya Pradesh Pollution Control Board (the agency that might organise the remediation), and Mr. Chakrabarti from NEERI, the agency that is interested in carrying out the remediations and most other interviewed people are convinced that the expertise and technology for this exists in India, a conviction that might have more to do with national pride than with solid evidence. Mr. Gain thinks that NEERI lacks the experience necessary to do the job. Other critical people like Mr. Tiwari and Mr. Qaiser are concerned about the health of the people in Bhopal and stress that to Bhopal needs a remediation employing international expertise and technologies for a results that match international standards.

Most of the interview subjects have a positive attitude towards the NGOs, as they are raising the issues of the contamination to the public. Only Mr. Dubey from the Pollution Control Board, who has been criticised by the NGOs many times, says that NGOs are not helpful. Even Mr Y. Singh, whose agency, the Ministry of Chemicals and Fertilizer has also been criticised by the NGOs, gives them credit for their role. The NGOs remind the officials of their responsibilities, critically supervise the process, and keep the issue present in the world's media. Dr. Qaiser even thinks that the environmental NGOs should be the ones to directly carry out the remediations themselves.

The contamination of groundwater and soil is a severe threat to the environment and human health. The urgency of the issue demands a radical turn-around of the official policy. Otherwise the toxic materials will remain as an unacceptable and unnecessary danger to the residents of Bhopal for many more years to come.

7. Annex

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B) Pictures

Picture on the title page by Maude Dorr, 2004
Picture 1.-3. by Matthias Stucki, 2006.

C) Interviews