About The Poison Within

The Poison Within got its title from the idea that environmental deterioration and contamination originates from our conscious behaviour and decisions as a society, rather than from external sources. In other words, the title suggests taking responsibility for our actions, irresponsible towards the future generations. The poison, the problem, comes from within.

Our manual informs you about the impact of poor environmental quality on the health of children, with a special focus on India. It examines data related to a range of pollution, from contaminated water to toxic chemicals, to build a case for severe damage to children's health. However, it is not alarmist in tone or intent. Chintan's objective is to build a public understanding of the linkages between environment and health and the impact on children. Reading this manual may require more concentration than a glossy, but we've consciously not dumbed it down, because we believe protecting our Gen Next is serious business and you should have the option to learn about it optimally. We offer straightforward solutions only when these make sense. Often, solutions are not easy and require broad policy shifts, which we indicate in passing. Our aim is not to spoon-feed our readers, but to goad them into thinking harder about the issue and join us in seeking solutions that work.

Hopefully, this is not the only version of the manual we will bring out. With your rich inputs, ideas and experiences, we hope to constantly update the general pool of knowledge and strengthen our collective informed action. Please contact us with your comments.

Contact us

CHINTAN Environmental Research and Action Group
238 Sidhartha Enclave,
New Delhi - 110014 INDIA
Phone : +91-11-46574171/72/73
Fax : +91-11-46574174

Our Email :
info@chintan-india.org

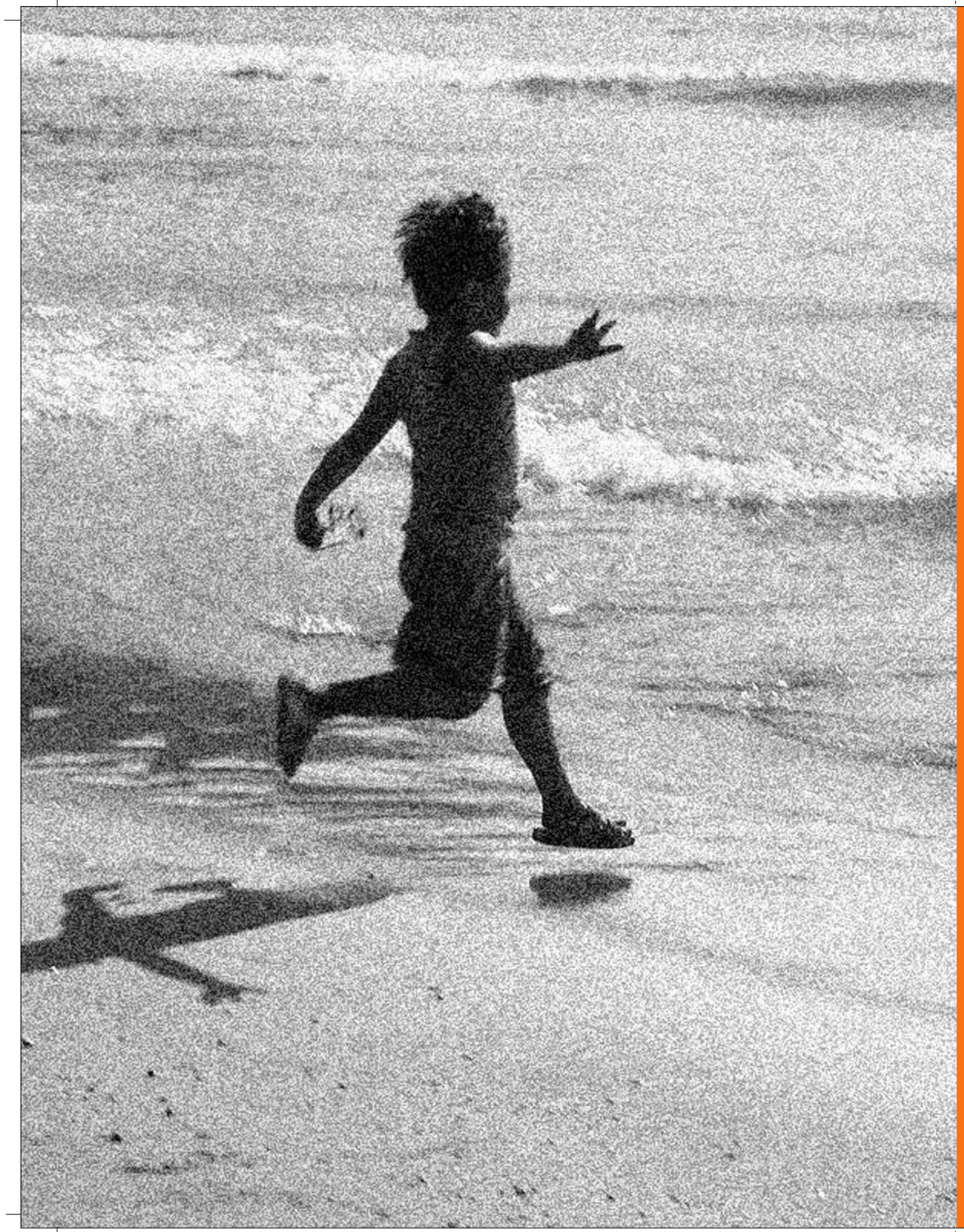
Our Website :
www.chintan-india.org

The Poison Within

How Environmental Contamination is Impacting Our Children's Future

A Manual for Everyone.

CHINTAN
ENVIRONMENTAL RESEARCH AND ACTION GROUP



The responsibilities of the present generations towards future generations in UNESCO's instruments and programmes

The present generations have the responsibility to bequeath to future generations an Earth which will not one day be irreversibly damaged by human activity. Each generation inheriting the Earth temporarily should take care to use natural resources reasonably and ensure that life is not prejudiced by harmful modifications of the ecosystems and that scientific and technological progress in all fields does not harm life on Earth.

In order to ensure that future generations benefit from the richness of the Earth's ecosystems, the present generations should strive for sustainable development and preserve living conditions, particularly the quality and integrity of the environment.

The present generations should ensure that future generations are not exposed to pollution which may endanger their health or their existence itself.

From the Declaration on the Responsibilities of the Present Generations Towards Future Generations, November 12th 1997. UNESCO

Contents

Acknowledgements

The manual was written by Pranay Lal and Bharati Chaturvedi. It was produced with the financial assistance of the Union Ministry of Environment and Forests, Delhi, India.

Acknowledgements:

Dr. Manoranjan Hota of the Ministry of Environment and Forests has supported not only this specific idea, but the need to bring into the public domain the importance of children's environmental health.

Others who have contributed are Vandana Madan, Kiran Kampani, Mansi Shourie and several others from the Chintan team.

Several others have contributed ideas throughout the long time it took to complete the report. These are Randeep Guleria, All India Institute of Medical Sciences, parents Lavanya Marla and Ritu Prasad, Madhu Bhatnagar of the Sri Ram School and Alex Hilderbrand of the World Health Organization, South East Asia Region.

Chintan was lucky to benefit from a rich knowledge pool in the United States, from where we were able to access ideas and knowledge. Many people took time to help us. These are Philip Landrigan, Head of Pediatrics, Mt. Sinai Hospital, New York, Lauri Boni, Mt. Sinai Hospital, Martha Burger, Bob Sonawane, Caroline Hubbard, Ameesha Mehta-Sampath, Maureen O'Neill, all from the USEPA, Karim Ahmed, Children's Environmental Health Fund, Susan West, formerly Physicians for Social Responsibility, John Balbus, Environmental Defense Fund and Nsedu Obot Witherspoon, Children's Environmental Health Network. Many of the pictures used in this manual were downloaded from Stock.Xchng (www.sxc.hu).

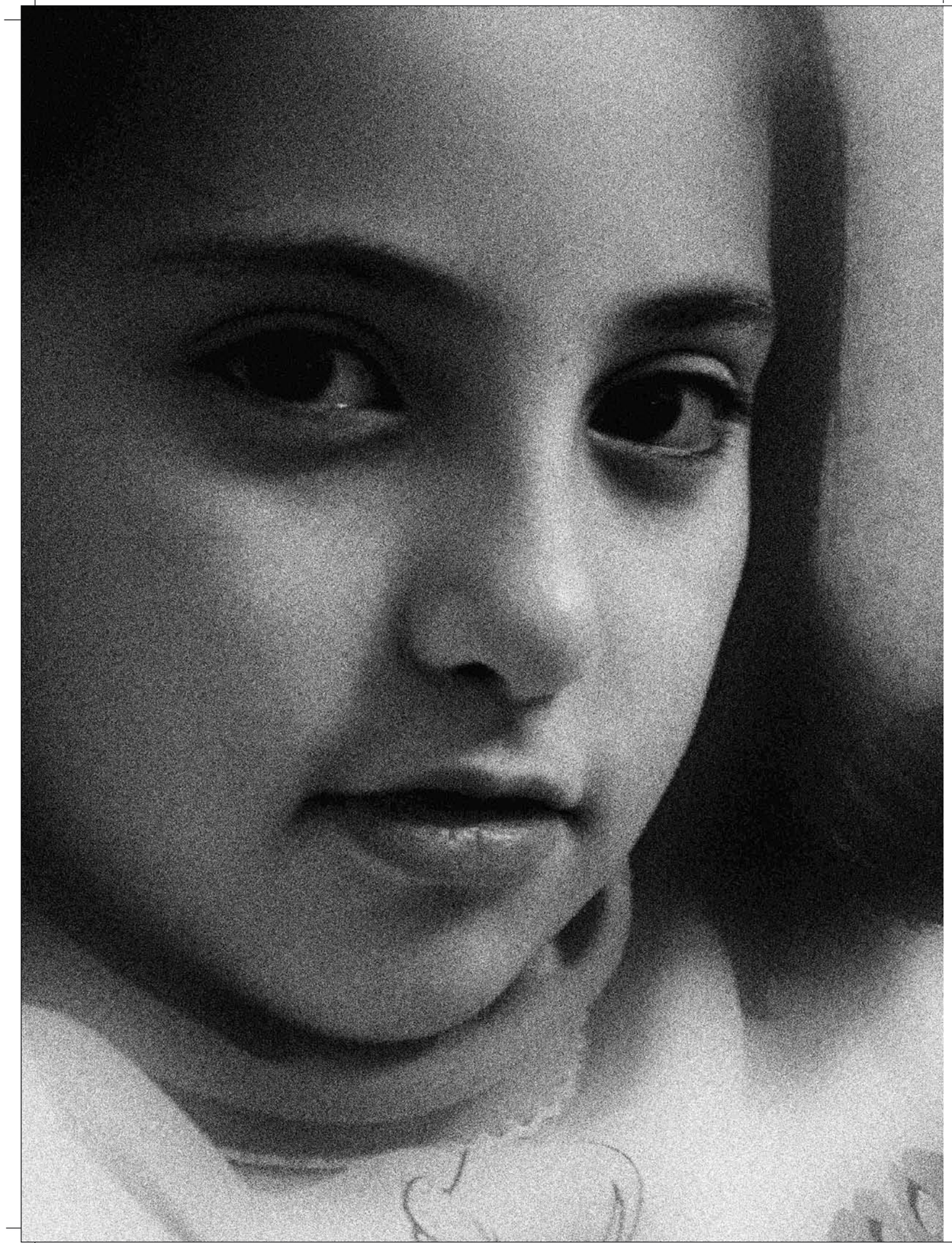
To everyone, thank you.

About Chintan

Chintan envisions a world in which members from all sectors of society develop partnerships that ensure environmental and social justice through sustainable consumption, a dignified existence for the urban poor and a toxic-free environment.

Our mission is to work in partnership with diverse sectors and groups to explore replicable and innovative approaches for urban poverty reduction and environmental justice at the ground level and use these along with research to advocate for policies that lead towards social equity and environmentally sustainable practices.

Contact us at:
CHINTAN Environmental Research and Action Group
238 Sidhartha Enclave,
New Delhi - 110014 INDIA
Phone: +91-11-46574171 / 72 / 73
Fax: +91-11-46574174
Our Email: info@chintan-india.org
Our Website: www.chintan-india.org



Preface

If there is one thing children everywhere have in common today, it's the impact of degraded environment on their health. Poor air quality, dirty water and deadly poisons have a way of creeping into the lives of children wherever they are. Being affluent in India doesn't help. Being poor is infinitely worse. And being in the sole superpower, the United States, is not useful either. Researchers tell us that across the globe, children are under siege. The World Health Organisation reports that environmental hazards kill three million children under five every year globally.

Official India has a healthy glow with 8 percent growth and climbing numbers of millionaires. Official India must surely be a single, no-kids yuppie. Don't let it fool you.

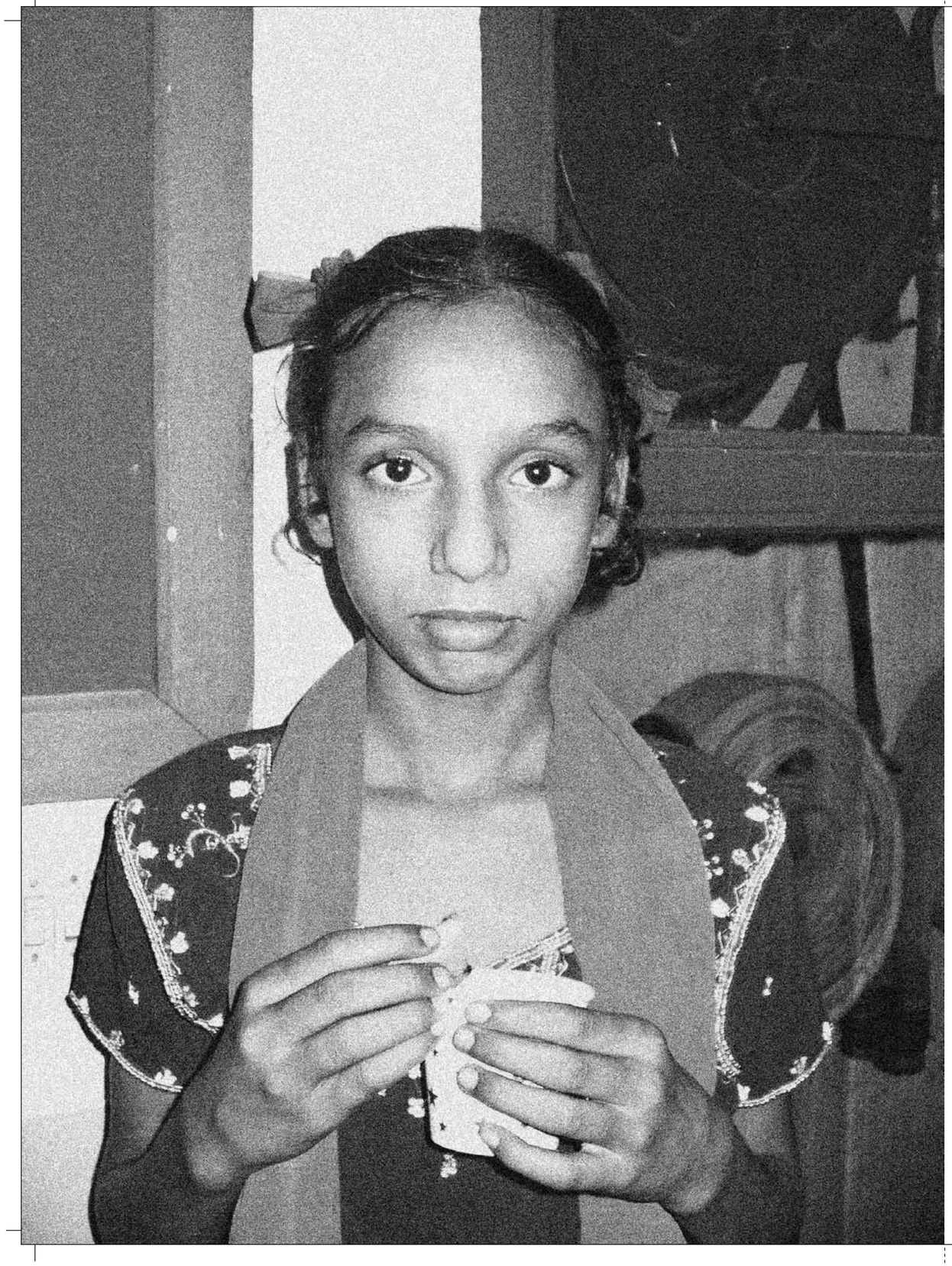
In India, children bear a double burden. On one hand, older illnesses-from contaminated water and air- are still widely prevalent. On the other, new threats, such as those from toxics, are now playing out clearly. The Ministry of Health and Family Welfare reports that almost 45% of illnesses experienced by children today are linked with environmental causes. A landmark study by Kirk Smith of the University of Berkeley, California, in 2000, has linked 20% of all childhood illnesses in India to environmental factors. The World Cancer Report 2002, tells us that childhood cancers are one of the fastest growing cancers. It tells us that India reports many such cancers. Some originate in the womb, or are passed on from a parent, before the child is even born.

None of this is classified information. Awareness about environmental issues in India is increasing. Yet, it has not quite helped to make the terrifying link between children's health and pollution.

The global discourse on inter-generational equity reminds us of our fundamental duties as citizens of this planet, whether or not we are parents. It demands much greater environmental protection coupled with much more sustainable consumption by everyone. Unfortunately, few connect this and a child's future. The Poison Within is a manual that makes these linkages clear. We don't dumb things down, because the issue has layers of complexity that must be dealt with. We have used a range of information to paint what is a hard picture to even sketch. By doing this, we expect to help every informed reader understand the issues with confidence and come to grips with the seriousness of it all. Above all, we hope that this manual spurs more people into action.

There are millions of children in India who breathe, eat, drink and ingest what they have inherited. Their illnesses today indicate India's economic, social and political decline tomorrow. More importantly, unhealthy children point to our fundamental failure as a society. We can't let ourselves off the hook. This manual has been written in the hope that we won't.

Bharati Chaturvedi
Director



Chapter 1:

Why are Indian children so sick?

Introduction

The future of our children depends on our past choices. A frightening thought, but true. Indian children today are not healthy. To a considerable degree this is because of the deteriorating state of their environment.

The World Health Organisation reports that ***environmental hazards kill three million children under five every year globally***. These environmental health threats include dirty water and poor sanitation, air pollution, accidents, injuries and toxic chemicals. Many diseases and syndromes have emerged due to changing and degrading environment, many of which continue to confound modern medicine. Over and above this, many of these diseases occur suddenly, often overwhelming the public health system because the nature of disease is confusing and therefore treatment becomes difficult.

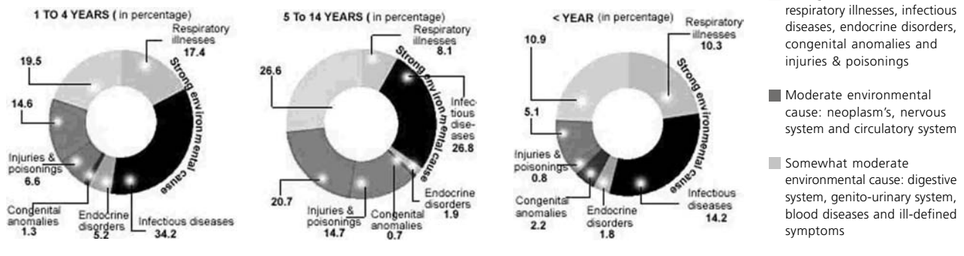
According to the Government of India's National Commission on Macroeconomics and Health, on an average, ***the Indian child suffers from four episodes of illness every year***, a shameful figure comparable to many least developed African countries. And even this is a best-case scenario. Many children live too far away from a healthcare centre for us to even learn of their illness. A few succumb to the first serious illness they encounter. Besides, the documentation systems in India are poor and fail to cover the entire population. As a result we find many children are left out of the documenting process—those on streets; those working; or those who access private or local practitioners.

The Ministry of Health and Family Welfare's report, The Health Information of India shows that environmental reasons are increasingly responsible for increased mortality in women and children (See graphs below: What kills India's children). According to the report, 55 per cent of child mortality in India is due to conditions originating in the perinatal period. A significant proportion of the other 45 percent, as shown in the table, are strongly related to environmental causes. But this data only accounts for recorded deaths. The World Health Report (1999) of the WHO shows that 429,000 children in India die every year due to childhood diseases such as polio, diphtheria, measles and tetanus. This estimate is about three times the figure given in the Health Information of India report.[i]

The chart below categorises the estimated distribution of diseases from environmental origin for infants, babies and children.

What kills India's Children

Environmental reasons are increasingly responsible for increased mortality in children (excluding 55 per cent of perinatal conditions)



Source: Anon 2000, Health Information of India 1997 and 1998, Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, Government of India.

It's hard to come to terms with these disparate figures .It is however clear that one of the reasons for this discrepancy is that estimates in surveys done by the Government of India do not address critical issues from the environmental health perspective. For example, the cause of a disease, its inception and categorisation are not recorded. Consequently we fail to understand the cause and cannot prevent the illness. Take for example, blindness in India. Blindness occurs due to several reasons - poor diets that lack in Vitamin A, constant exposure to indoor air smoke, and infectious diseases. Even the WHO categorises blindness into simple clinical manifestation, thereby making it difficult to attribute the cause of blindness. Some experts believe that as much as 85% of blindness in India can be prevented. Much of this blindness has its origins in childhood. A child exposed to smoke from wood, cigarettes and other types of smoke is vulnerable to early onset of blindness. If only the data available could help us make some of these linkages with histories of exposure, health care would be more positive.

So, how much ill-health can be attributed to the environment?

In 2000, a research done by scientists at the University of California, Berkley, led by Kirk Smith, found that at least 20 per cent of all mortality in India is attributable to environmental factors. Of this, foul indoor air and dirty water alone cause about 80 percent of deaths. (See chapter on air pollution and traditional diseases) This research study found that another 12 to 15 per cent of all disease can indirectly be triggered by environment but the causal link may not evident. Kirk Smith's analyses suggests that globally about 43% of the total burden of disease due to environmental risks fall on children under the age of 5 years, even though they make up only 12% of the population.[ii] A more recent study, presented In June 2006. The World Health Organization, Geneva reported that 24 per cent of the global health burden arises from environmental causes.[iii]

At home in India, another estimate made by the Ministry of Environment and Forests, of the Government of India found that 18.5% of all disease burden in India is caused by environment and its degradation.[iv]

Think of it: almost every disease has an environmental cause or reason for its emergence. Environmental degradation of the past impacts the very air that the children breathe, the water that they drink and the food that they eat. Almost every new infectious disease that has emerged since 1972 has an environmental origin.[v]

Even traditional diseases like malaria, diarrhoeas, and malnutrition are deeply rooted in degradation of the environment. Vector borne diseases and fevers like malaria for example emerge when vectors (like mosquitoes) find favourable conditions to breed and find vulnerable people to infect. Often, they increase when the local ecology is disturbed. Waterborne diseases like diarrhoeas and worm infections occur when leaky sanitation systems infiltrate the water systems, or poor hygiene practices ad behaviour bring pathogens in direct contact with children (See chapter 4).

Malnutrition is a more complex and multifaceted problem. Malnutrition most obviously occurs because there is very little food and widespread hunger, which can result from crop failure caused by severe environmental or climatic events. Together with fevers and infections, especially intestinal worms and blood parasites, malnutrition is widely prevalent in India.[vi]

For example, early rains or extended warm periods can spur the rapid proliferation of pests like locusts, which overwhelm the natural checks and balances, like predators to respond to them, which in turn devastate crops and cause famines. Also soils that have poor micronutrients like selenium, boron and iron, can lead to micronutrient deficiency in children. This deficiency prevents the body's ability to fight diseases by weakening the immune system. It affects children's growth and retards mental development. (Chapter 4 describes in detail the role of the environment in traditional diseases.)

Another important class of diseases are modern diseases such as cancers, asthma and systemic disorders. Many of these are more closely attributed to environmental reasons such as pollution and chemicals in food. Given that the onslaught of chemicals is relatively recent in human development, we are rendered completely defenceless against these.

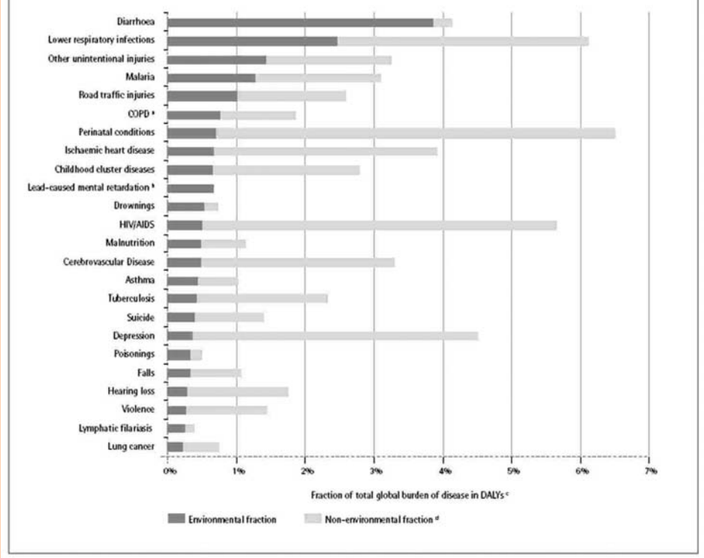
These chemicals affect the genetic material (especially the DNA) and cause impairment of functions and growth, and in some conditions lead from gradual to rapid mutations. Children are particularly susceptible to environmental hazards because they consume more food and fluids (volume by volume), inhale more air and constantly explore their environment. This means that more pollutants accumulate in their bodies, which may create a 'double burden' of disease in this generation. In urban India, an emerging challenge is posed from the increase in lifestyle-related diseases such as diabetes, attention deficit disorders (ADD) and obesity. Health statistics proves that these illnesses are also on the rise as urban children are increasingly getting addicted to "junk" food with little or no nutritive value and are leading more sedentary lives.

There is increasing evidence that foetal growth is the most important aspect of life for any child. Most exposures that occur in a mother and young children are accidental. Foetal lung growth studies indicate that abuses such as smoking and hazards such as ambient air pollution can result in reduced lung function. Plastics and plasticizers, dioxins, pesticides, and other chemicals invade the body through every possible portal of entry. The growing evidence of invasive chemicals that impair or retard growth of children is overwhelming. Often these substances work in bewildering new combinations that are difficult to analyse.

Consequently, there is an upsurge of paediatric cancers, neurological impairments, mental retardation, low birth weight and chronic anaemia and still births. According to the National Commission on Macroeconomic and Health's report on Burden of Disease in India, childhood cancers in India have increased from 3 cases per 100,000 in 1970 to 18 cases per 100,000 in 1998.[vii] The World Cancer Report 2002, produced by the WHO says that childhood cancers are fastest growing as a class of cancers, and India reports many new forms of these cancers.[viii]

The Burden of Disease from the Environment:

FIGURE 5 DISEASES WITH THE LARGEST ENVIRONMENTAL CONTRIBUTION



[a] Abbreviations: COPD = Chronic obstructive pulmonary disease.
[b] Lead-caused mental retardation is defined in the WHO list of diseases for 2002, accessed at: www.who.int/evidence.
[c] DALYs represent a weighted measure of death, illness and disability.
[d] For each disease the fraction attributable to environmental risks is shown in dark green. Light green + dark green represents the total burden of disease.

Source: WHO, 2006, Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease, Geneva

Table 1: Environmental Factors in the Burden of Disease in India-2001

Environmental Factor	% Contribution to the Total Burden of Disease
Access to Water and Sanitation	9
Vector Diseases (Malaria)	0.5
Indoor Air Pollution	6
Urban Air Pollution	2
Agro Industrial Pollution	1
All Environmental Factors	18.5

Source: Delhi Urban Environment and Infrastructure Improvement Project, Ministry of Environment and Forests, Govt. of India and Govt. of NCT of Delhi.

In India, children have to bear the double burden of diseases that have persisted for generations as well as of new diseases caused by various environmental factors. In rural India, a mother is most likely to be anaemic or malnourished. She works for long hours in smoke-filled kitchens and in the field. The constant assaults of both traditional diseases such as diarrhoea, malaria and other infectious diseases etc., and modern diseases caused by poisoning and contamination by pesticides and fertilisers in dusts, air, water and food, plastic wastes, agricultural or industrial effluents etc., make her specially vulnerable to a range of infections. This affects the unborn foetus as well. In urban India, another emerging challenge are the lifestyle-related diseases such as diabetes, attention-deficient disorders and obesity that are also on the rise, as urban children are getting addicted to "junk" food with little or no nutritive value and are leading an increasingly sedentary life.

There is little doubt that modern development has occurred due to rapid growth in the discovery and use of new chemicals. But many of these chemicals are neurotoxic in nature, affect the brain and interfere with the workings of the nervous system. These substances have the ability to affect intelligence, language ability, and attention span. Children are especially vulnerable to the effects of these neurotoxic substances. They may cause behavioural and social adjustment problems as well as affect mood. At very high doses, neurotoxins may produce such effects as coma, convulsions, respiratory paralysis, and death.

While definitive numbers do not exist, estimates are that in the order of 100,000 chemicals are used in commerce worldwide; of these, 75,000 are registered in the United States. Worldwide, more than one new chemical (including industrial chemicals, pesticides, pharmaceuticals and food additives) is introduced into the environment every day. Only a fraction of the new compounds are completely tested for their safety. Little is known about carcinogenicity or other, often fatal, health effects for the majority of chemicals in use today. In developed countries, chemical substances are loosely regulated by technical and enforcement agencies. For example, as of 1984, 10 per cent of the pesticides in common use in the United States had been assessed for hazards, while for 38 per cent virtually nothing was known. As of 1997, between 1.5 and 3.0 per cent of the approximately 75,000 industrial chemicals in US commerce had been tested for carcinogenicity. The problem in assessing chemical toxicity is that different age groups and sexes respond differently to the varying levels of chemicals, and most of these outcomes manifest several years later. Often, combinations of chemicals act overtly and insidiously to produce confounding results. Despite being a serious threat, chemical and toxins are least studied by the medical fraternity. Even basic investigation protocols and therapeutic interventions are not developed.[ix]

What are environmental diseases?

A typical characteristic of environmental disease is that it seamlessly pervades environmental settings. Water, air, food and soil can transport toxic chemicals or pathogens from one place to another and can cause disease, and most often there are few barriers, safeguards and checks that prevent these from invading the bodies of the vulnerable. Environmental disease, especially those caused by chemicals do not elicit immunity. What's worse, manifestation from exposures of chemicals, in different age groups and sexes show different symptoms! Doctors and physicians treat the illness uniformly, and are therefore often unable to pinpoint what is causing these illnesses. Even infectious diseases, like the many unknown viral fevers that people encounter during change of season, manifest differently in different age groups. Every environmental threat poses a multitude of risks. Depending on the development stage (foetus, childhood, teenage, adulthood, old age), gender and the intensity and duration of exposure (chemical or pathogens), the disease presents itself differently. Environmental diseases have another characteristic namely, they show a succession of diseases for the same person, as the individual ages or as the intensity of exposure changes.

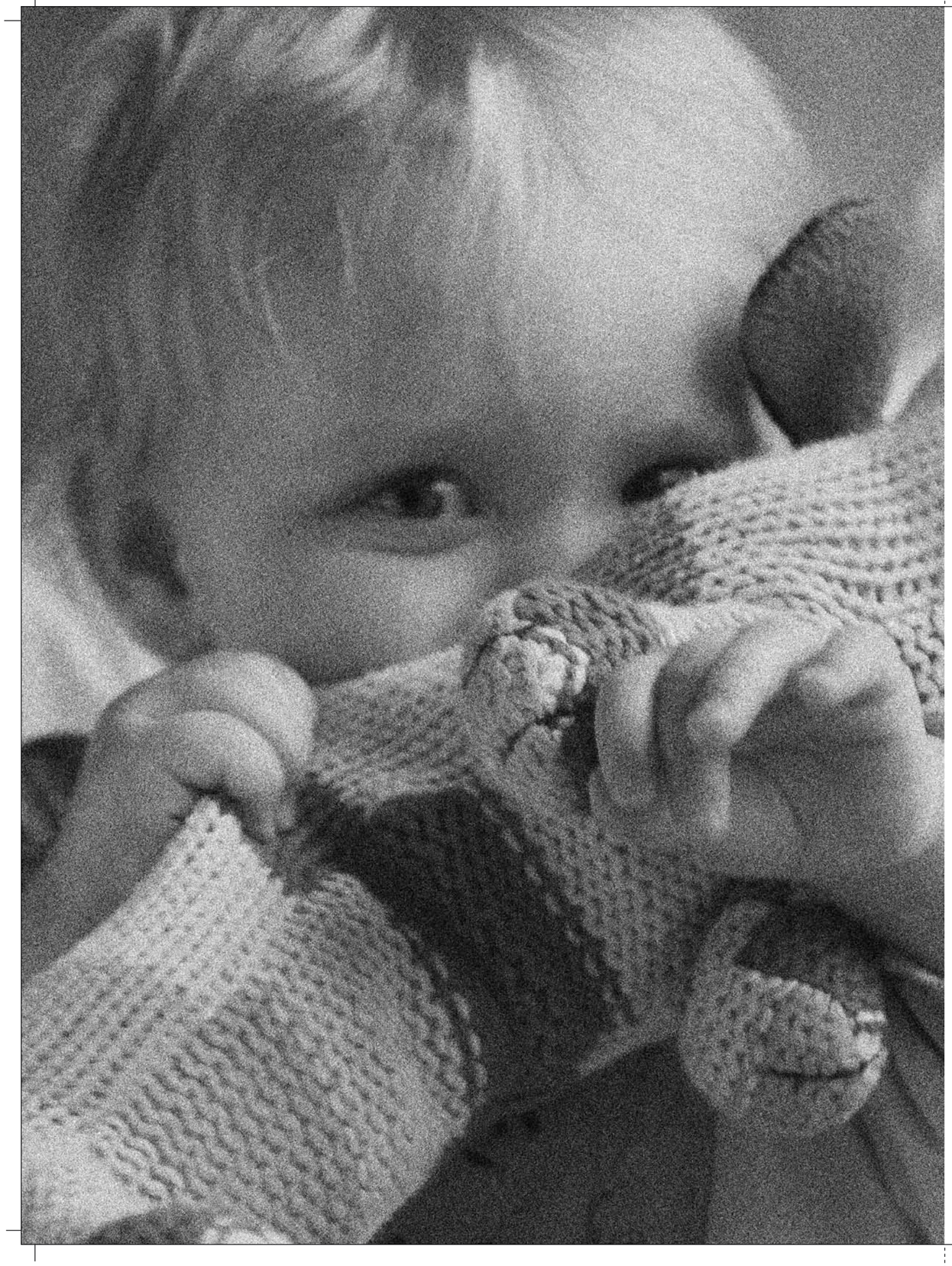
Kirk Smith form the University of California, Berkley used the WHO classification of diseases and attributed risks for various diseases based on regions, age groups, and sexes and found that Sub-Saharan Africa and India were most affected by environmental degradation. For particular diseases (See chart below) his study found that acute respiratory infection (ARI), diarrhoea and perinatal conditions reflected severe to moderate impact of bad environment.

What's in Store for Indian Children?

Look around you and you will have the worse case answer. The burden of both communicable and communicable diseases will continue to bother children. The environment will have a significant impact on both of these.

The concept of environmental health has emerged only in the past 30 years or so and is yet to receive recognition from medical fraternity. The warning given in Rachel Carson's *Silent Spring* (1962) that pesticides were creating greater problems than they were intended to solve-started off a controversy still raging today between environmentalists and the pesticide industry. More evident and large-scale disasters like Bhopal, endosulfan poisoning in Kerala, Soveso dioxin poisoning, the Minamata mercury poisoning have moved governments globally to create effective policy measures and regulatory bodies, yet it does not seem to have deterred industries from producing chemicals or at least conduct studies on their safety and long term implications. Therefore educating people on the impact of chemicals and toxics in their daily life is more important and more effective in bringing about this change.

Modern diseases are the driving force of environmental health as a discipline in the developed countries. But India suffers from a double burden of diseases which pose more questions and reveals few answers on how they will interact and impact children. The need is an approach that integrates health and environment, both in the research agenda, policy domain and in clinical diagnosis and treatment by medical practitioners. So far, environmental causes to diseases are not considered in the "radar" of diagnosis. But there is hope that with increase in awareness, this mindset will change and there will be more holistic approach to diseases. Indian children will continue to be sick unless we can leverage policy and practice to protect the environment and foster sustainable development practices with urgency.



Chapter 2 :

Killer No 1 : Traditional disease

Introduction:

Overview of traditional diseases

Traditional diseases are diseases that have persisted since historical times. Modern epidemiologists also call them primitive diseases, largely neglecting the fact that many of these are still the largest killers in the world and that several of these, especially vector borne diseases, pose an immense threat to children in the developing world.

Many of us think that these are illnesses of the past, and rarely ever link them to the environment. But in fact, the environment directly results in many illnesses that all of us have had. Traditional diseases are dominated by three types of diseases: waterborne diseases that occur due to pathogens in drinking water; foul indoor air caused by burning biomass for cooking; and diseases like malaria and dengue caused by biting insects.

The impact of traditional diseases on children

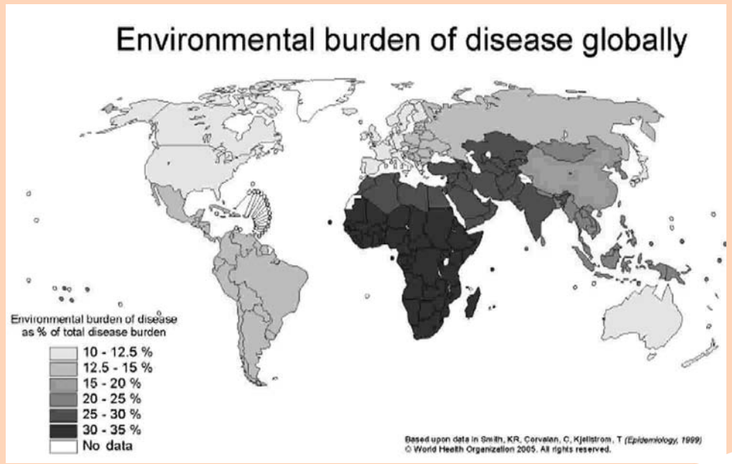
Contaminated air and water are the major environment-related killers in children under five. For example, diarrhoea kills 1.8 million people globally of which 1.6 million are children.[x]

Stagnant and poorly managed water bodies also promote the proliferation of biting insects like mosquitoes (called vectors) which spread disease. Malaria kills an estimated eight thousand children under five in India every year. Most of these incidents take place in Central India, in the states of Madhya Pradesh and Orissa, but increasingly cities now have large numbers of cases. A child can get malaria before or during the monsoon season. This is also the time when fields are cleared; forests are burnt so that crops can be planted. This disturbs the mosquitoes natural habitat, and forces them to seek refuge in villages and towns situated on the fringes of forests and grasslands. Here they find ample exposed water and vulnerable people—especially children who have never been exposed to disease agents like the malarial parasite (Plasmodium) and pregnant women. Children are particularly susceptible to Japanese encephalitis and dengue. In June 2005, more than 800 children died from Japanese encephalitis in India. Dengue is largely an urban disease where clean water stored in overhead tanks breeds the mosquito that transmits the disease.[xi]

Indoor air pollution too is a persistent killer in the developing world. Because children live indoors and stay close to their mothers who cook and heat food in unventilated kitchens, toxic wood smoke causes their lungs to become prone to sickness and infections. According to recent estimates in India, indoor exposures to particulates appears to be responsible for more than 7% of the national burden of disease. This is substantially greater than the percentage attributed to urban air pollution. A similar magnitude of health damages is observed in China. An estimated 2 billion people burn firewood, dung, and crop residues for heating and cooking using simple stoves and open fires, often without chimneys, flues or appropriate ventilation devices.

The magnitude of the problem is demonstrated in India, where 75% of all households (a total population of approximately 700 million) depend on traditional bio-fuels. Biomass smoke in homes is estimated to cause one-half million premature deaths each year. The majority of these deaths are of women and young children who have been exposed to high concentrations of toxic pollutants for many hours each day.

Global risk map of environmental burden of disease from traditional diseases (indoor air pollution, water and vector borne diseases)



You will notice in the map that India is only marginally better in terms of morbidity than some African countries – many of which are in crisis following wars and famines. In fact, it is comparable with some countries in sub-Saharan Africa, which are reeling from drought, civil wars and mass migrations. Even within India, certain districts in states like Orissa, Bihar and Rajasthan are worse off.

More children die in India from traditional diseases than the entire population of Austria, every year.

Waterborne diseases

Consider the huge amount of clean water that is used to carry a small quantity of human excreta! While the majority of the country, and most urban dwellers do not get chlorinated or safe treated water. While in homes that are privileged enough to receive chlorinated water, it is used both for flushing and for drinking!

In early summer in India, just before the school examination season, jaundice is most prevalent. During peak summer when there is widespread water scarcity, bacterial waterborne diseases like cholera, dysentery and other gastroenteritis affect children. The most persistent waterborne infection is amoebic diarrhoea which occurs year round. This is caused by waterborne protozoan like amoebas and giardias. Water also carries cysts and eggs of worms like hookworms and tapeworms. This too affects children the most. With such a diverse variety of infectious diseases, every year children succumb to one illness or the other.

In developing countries, treatment of water and wastes is often non-existent or grossly inadequate and until sanitation is improved it will be impossible to impact the level of waterborne disease.[xii] Less than 5 per cent of wastewater from India's cities is treated before disposal. The rest flows into rivers, lakes, and groundwater.

In developed countries, deficiencies in treatment and delivery systems, anthropogenic impacts on source water, and the emergence of resistant and more virulent micro-organisms pose serious threats to human health. Newly recognised agents (Cryptosporidium, Giardia, Cyclospora) that have a high resistance to chemicals used in water treatment have arisen just as the development of antibiotic resistant strains of pathogens.

Approximately 4 billion episode of diarrhoea cases occur each year in India, which cause 2.2 million deaths, mostly among children under five; this is equivalent to approximately 6,000 children dying every day, or one child dying every 15 seconds. In statistical terms, these figures represent the population of India's iron capital- Jamshedpur or the total number of children born in New Zealand and Australia in ten years. This is shameful considering that treatment does not require state-of-the-art medication or sophisticated technological solutions. All that is required is "safe drinking water", by keeping water from mixing with dirt and sewage. The most basic disinfectants, like chlorine kill pathogens that cause diarrhoeas, dysentery and jaundice. In most cases medicines, if any, are required only at the advanced stages of infection. For example, cholera is one of the most dreaded diseases in India. Yet, people who die from cholera die not from lack of medicines but from dehydration due to a lack of available clean drinking water and simple understanding of how to use rehydrating salts.

Some diseases like viral hepatitis occur silently and occasionally flare up into epidemics, while others are violent and cause severe morbidity to the community. The unending suffering from these recurrent set of diseases exacts a heavy toll on local economies.

Environmental causes of Waterborne diseases

Waterborne diseases are simply diseases that proliferate in water due to unhygienic conditions or contamination. Unlike some other infectious diseases, what stands out about waterborne diseases is their terrifying simplicity. They are caused by some of the commonest organisms known to human beings, and treatment, control and containment are simple. The most basic of disinfectants kill waterborne disease pathogens that cause diarrhoeas, dysentery and jaundice. These infections serve as the most clear-cut example of the relationship between health, disease, development and environmental pollution.

Waterborne diseases present problems of access to clean water not medicines. The relationship between health, development and environmental pollution is fore grounded by three simple facts:

- Human beings require 40 litres per capita per day (lpcd) of safe drinking water. A further amount is needed for basic hygiene.[xiii]

- Since these diseases are caused as a result of pollution of water by faecal matter or urine, through sewage, water supply and sanitation are intimately connected in terms of health and environment.

- For every one gramme of faeces that an healthy adult excretes, an average of 100,00,000 viruses, 1,000,000 bacteria 1,000 parasitic cysts and 100 parasitic eggs are released every day.[xiv] These are ready to infect the next person who comes into contact with them. Dilution in water, rivers or seawater does nothing to kill them. However, there is an infective dose for each pathogen—the number of organisms required to cause infection. While viruses and protozoa have low infective doses—several hundred or thousand bacteria are needed to form an infective doses, sometimes just one protozoan cyst could cause infection.

Numbing Numbers

Globally a child dies of a water related disease every eight seconds.[xv] Twenty-eight percent of the world's population, or 1.7 billion people, are without access to clean water. As a result, more than 5 million people, mostly children, die each year from preventable waterborne diseases.[xvi] Another assessment by the World Bank and the World Health Organization (WHO) has estimated that each year, 3-4 million people die from water-borne diseases.[xvii] The WHO has identified that diarrhoeal disease is one of the six diseases that contribute towards about 90% of all infectious disease deaths. It lies third after acute respiratory infection and AIDS.

More than 70 percent of India's billion people live in half a million rural villages where water-borne diseases are a major health problem[xviii]. In comparison, the 1999 Gujarat earthquake, which received widespread international and national coverage, killed only 20,000. But the number of deaths from waterborne diseases is a yearly, not a one-time event. The government of India's figures are far lower since civic authorities only register deaths by symptom and not cause.

Killer No 1 : Traditional disease

So why do traditional diseases persist in India and other developing countries?

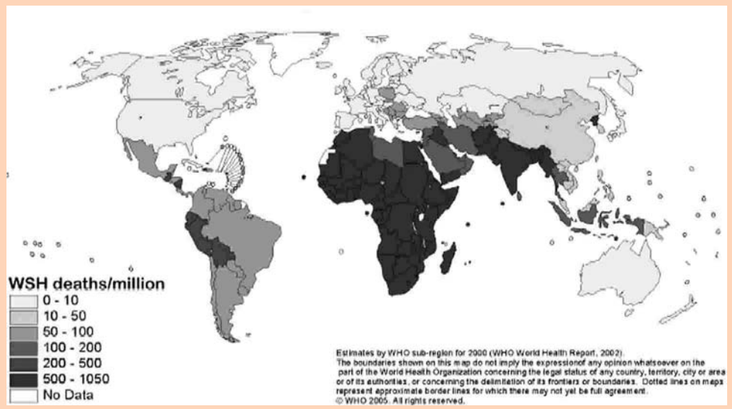
Government neglect: Because health is managed by states and disease control programmes are sponsored by the central government, there is lack of coordination between agencies. Corruption plays a role too.

Lack of options: Agencies have run out of options and exhausted their resources because every successive programme has failed. Programmes failed because of narrow focus and lack of cooperation between departments, and people's participation in management of resources and maintenance of assets is ignored!

Lack of understanding: That environment, health, development, water and energy needs are linked and that they need to be addressed collectively.

More than half the hospital beds in the world are filled with people suffering from water-related diseases. In China, India, and Indonesia – three of the world's most populous nations – twice as many people die from diarrhoeal diseases than from HIV/AIDS each year . Intestinal worms infect about ten percent of the population of developing countries; intestinal parasitic infections can lead to malnutrition, anaemia and retarded growth as much of the caloric intake of people suffering from worms is captured by the parasites.

Global Deaths from Unsafe water



Waterborne diseases in India

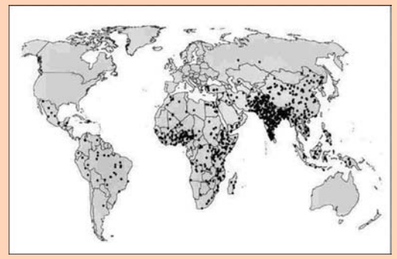
While the west saw the last of epidemics like cholera in the early 1900s, India continues to grapple with such diseases. In India alone, more than 700,000 children under five years old die annually from diarrhoea every year.[xx] At least one in two children would suffer from an acute episode of diarrhoea or manifestation of contaminated water and one in five children will need hospitalisation. Nearly every water body—river, lake or pond in India has unacceptable levels of pathogenic micro-organisms. The Central Pollution Control Board for example, has found that the sewage pollution (measured in the form of faecal bacteria called E.coli or coli forms) has increased every year in major rivers across the country, despite the general idea that India is progressing at a rapid rate. At least 2000 million working days are lost annually due to diseases caused by dirty water, costing India approximately Rs 36000 crore.[xxi] The actual costs may be even higher since a large number of cases are under-reported.[xxii]

The pathogen cycle – How waterborne disease spread

It is important to realise that as far as these diseases are concerned, we are not battling alien organisms that arise out of unfamiliar matrices. The logic is simple: people contaminate the environment and in turn are contaminated by it in a "pathogen cycle". Breaking this cycle of transmission between humans and infective agents is the function of sanitation in the simplest sense. Preventive control strategies too are based on a simple imperative: that the pathogen cycle be understood by those most at risk from waterborne diseases. The problem begins with the disposal of human excreta. The 'natural' way, as followed by animals, and still by many human settlements, is to defecate in the open, and away from the living area, to avoid contamination of the zone that surrounds dwellings. This is acceptable when the population is sparse, as natural processes degrade the excreta and kill pathogens. As populations increase, areas demarcated for defecation purposes are encroached upon. If there is no corresponding space demarcated for safe disposal of excreta, waterborne disease pathogens increase dramatically and find their way into drinking water supply. Almost everyone in India is prone to contracting any waterborne disease at any given time.

Waterborne viral diseases : A rapidly emerging threat

Perhaps the most far-reaching virus in recent times is the rotavirus family, which gained global reach in a short time. Rotaviruses cause mild to severe diarrhoea and were discovered only in 1973 in South and South-east Asia. Rotavirus diarrhoea is endemic and has been observed throughout the year in tropical India and Bangladesh.[xxiii] Between 1986 and 2000, rotavirus had caused approximately 111 million episodes of gastroenteritis and about 352,000-592,000 deaths in children less than five years of age. Children in the poor countries account for 82 percent of rotavirus deaths and India contributes about 80 per cent to this (see map below).[xxiv] If rotavirus infection is any indicator on the overall number of diarrhoea and other cases, India may well have more cases than all developed and developing countries combined!



Source: www.cdc.gov/ncidod/ EID/vol4no4/parasharG.htm

Various levels of action are required to change the current scenario

At School:

- Educate teachers, parents and children alike on water, hygiene and sanitation issues and the interconnectedness of the water cycle and how the mismanagement of any one of these leads to disease
- Schools administration must ensure that water bodies and ponds near school must not breed larvae and mosquitoes. If they do, they must introduce fish to exterminate larvae.
- Do not pile up of old furniture, as they provide spaces for vectors to rest and if water accumulates

Killer No 1 : Traditional disease

in hollow spaces, then mosquitoes can breed. Similarly, canteens and other stores must monitor old tins and should see that they do not become breeding grounds for mosquitoes

• Encourage water harvesting to increase water availability. Much waterborne disease occurs because there is too little water and people rely on unsafe water source for daily use!

• Educate on preventive measures like Oral Rehydration Salts (ORS, a simple formulation of a teaspoon of sugar and a pinch of salt in a 200 ml tumbler of clean drinking water) when epidemic or bouts of waterborne illnesses occur.

• Every child to be taught about washing hands.

• Teachers to encourage students to take the message of mosquito nets home, and reduce the poor and unfashionable image of such nets.

At home

• Make sure that your municipality treats its sewage and water, and does not introduce sewage into natural water bodies. Residents to teach themselves how to monitor this.

• Promote the use of mosquito nets

• Demand safe water. Piped water that is chlorinated is a basic human right that needs to be provided to every one.

• Adopt simple technologies like SODIS (see box) and observe simple hygiene practices which reduce chances of infections like: Washing your hands; Washing fruits and vegetables before use; and boiling water for drinking

In 1993, the World Bank found that 30% of the burden of disease could be averted by improvements in the household environment and of these, 20% are just modest interventions like improving sanitation, through better garbage disposal, improving indoor air pollution and removing vector-breeding grounds.

SODIS (solar disinfection) and other technologies where hi-end chlorination is not possible. SODIS is a simple technique of using glass bottles which along with the use of sunlight can disinfect water. with convex mirrors at their base. Water from which soil and other particles are removed through straining is exposed to direct sunlight for an entire day. The convex mirror concentrates suns' rays into the bottle, heating the water to high temperatures and killing all microbes. In late evening, pour out the water, after the water has cooled down and make ensure that muddy particles settle down in the bottom. (see http://www.sodis.ch/ for some interesting models to use)

At macro and policy level

• Sanitation and toilet connections are given to every home; ensure that sewage that leaves a home is treated and water is recycled for agricultural use or safe domestic use (like watering the garden or washing the car), while freshwater for drinking purpose is treated and is safely delivered to homes.

• Make safe water a right for all and a reality at the ground – do this through piped water or closed water-supply systems that are adequately treated for microbial and chemical threats

• Ensure that water filtration and purification take place, and ensure their sustainability, through modern management regimes and protect water from contamination from sewage and wastes

• Integrated water resource management: Different users within a watershed are interdependent; therefore, integrated water resource management is essential. Upstream uses of water impact the potential of downstream users to meet their needs. Land use, agricultural patterns, and industrial development all affect water resources. A wide range of sectors, e.g., agriculture, energy, industry, fisheries, tourism, local government all must plan and coordinate strategies for the full range of developments that affect ecosystems, natural hydrology, and water consumption – with reference to expert advice and guidance of health and environment sectors.

• Promote safe chlorination at community and household levels

Vector borne diseases

There are some insects that spread diseases and fevers. These diseases are termed vector borne diseases (VBDs) and the insects that help in spreading them are called vectors. There are several VBDs caused by viruses (like Japanese encephalitis, dengue), bacteria (as in plague), protozoans (malaria, kala azar) or worms (filaria), spread by their specific vector (see table below).The most versatile and prolific vector among all is the mosquito. Other vectors of importance include the sand fly, which spreads kala azar and fleas which cause plague.

Vector borne diseases are staging a comeback in India. The most recent epidemic was in June 2005, when 12 districts of eastern Uttar Pradesh had a sudden epidemic of Japanese encephalitis, killing 1360 children. Public health experts and scientists believed in the 1960s that malaria had been eliminated and that eventually all VBDs would be conquered. By the mid-1970s, malaria had re-emerged strongly. Other VBDs too have spread, but remained neglected. Filaria and JE that were localised in coastal and parts of south India, have spread northwards.

Worldwide more than 28 "new" or previously unrecognised disease-causing microbes have been identified since 1973, many of these in India. Plague re-emerged in Surat and Beed in 1994, which caused widespread panic within India and across the world. The Indian economy suffered a loss of Rs 2,730 crore in exports and livelihood. Today, Dengue afflicts Delhi and industrial cities with increasing ferocity, largely because of water storage methods that create an environment for

Vectors	Diseases spread
Mosquitos (Culicidae)	
Anopheles spp.	Malaria, filarial
Culex spp.	Filaria, Japanese encephalitis, other viral diseases
Aedes spp.	Yellow fever, dengue, dengue hemorrhagic fever, other viral diseases, lymphatic filarial
Other vectors	
Plague flea (Xenopsylla cheopis)	Plague
Sandflies (Phlebotomus)	Leishmaniasis (kala azar)

Each disease pathogen has a unique vector for a given ecology. Depending on the region and ecology, VBDs can occur across the globe (like malaria). A few often exist in only two continents, like yellow fever occurs in Africa and South America, or restricted to pockets like filaria within India.

Many of these are seasonal but often there is a virtual succession of VBDs that haunt communities. In the case of India, almost the entire country is prone to one or the other VBD. India's burden of disease due to VBDs like malaria, kala azar, dengue, and Japanese encephalitis (JE) among others, is almost three times that of China.

the dengue mosquito to proliferate. In addition, deadly fevers continue to remain unidentified and undiagnosed. Many diseases are, often misdiagnosed, leaving a susceptible population vulnerable.[xxv]

Vector borne disease occur when rapid changes in local ecology occurs, like heavy rains, mass migration of people and cattle who carry the microbe and bring it to new populations, deforestation, floods, dam-building, change and expansion of agriculture especially rice and sugarcane.[xxvi] In India, malaria was largely restricted in patches and along riverine areas. With increasing industrialisation, deforestation and rapid

expansion in agriculture, malaria spread to the entire country. Filaria which was restricted to small pockets has increased its spread, as has JE. Kala azar which was more widespread has got restricted because the ecology of the sand fly favours only sandy river plains, which are now only seen in parts of South Bihar.[xxvii]

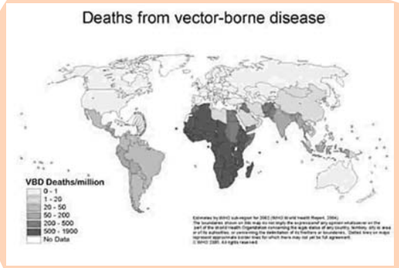
VBD and Children

Children are particularly prone to vector borne diseases. Poor, malnourished children and those that have an already compromised immune system – like children in slums who are heavily infected with intestinal worms – are more prone to waterborne and vector bone fevers. Poor diets and constant exposure to disease agents mean that most energy is used in repair of the constantly threatened immune system leading to life long susceptibility.

Kala azar affects the poorest of poor children, although adults and children are at equal risk. The bite of the sand fly is painful and festers as an open wound (or ulcer) on the skin. Children occasionally get prolonged fever and lose weight as their body needs to continuously fight the fever. Children are more vulnerable to infectious disease because their bodies may not have developed immunity to fight infectious diseases. To add to this, in far-flung rural areas, access to health care and services are poor, as a result of which children are the ones who suffer the most.

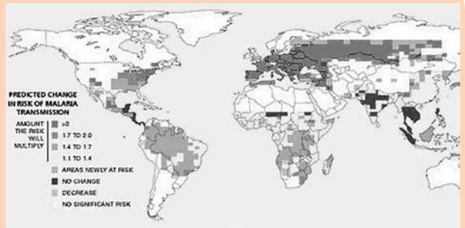
Japanese encephalitis exclusively affect young children. It is widespread and epidemics occur sporadically in Andhra Pradesh, Karnataka, Uttar Pradesh and West Bengal. These states have certain farming and animal care practices in common. Here farmers cultivate rice along with breeding pigs, this can perpetuate the fever year after year. In 2003, JE caused over 300 deaths in Andhra Pradesh alone. Earlier, in the year 2000, there were 2,313 cases of JE in India, with 535 deaths. JE epidemics occur before the onset of winters in north Indian towns.

Young children and infants are the first to contract malaria and dengue. And children under the age of seven almost exclusively die from Japanese encephalitis. 1145 cases of Japanese encephalitis were reported from 14 districts of Uttar Pradesh, in June - July 2005. The WHO claims that only about one-fourth of these (or 296) died, whereas, local newspapers stated that more than 800 died. More than 90 cases from the adjoining districts of Bihar also suffered from the infection.



Source: (http://www.searo.who.int/EN/Section10/Section392_10243.htm).

Climate change and vector borne diseases



Global warming is destined to have an impact on the incidence and prevalence of VBDs. Changes in the concentration of greenhouse gases (water vapour, carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons), which trap infra red radiation from the Earth's surface, resulting in the greenhouse effect, is a natural phenomenon, which helps maintain a stable temperature and climate on earth. Human activities, such as burning fossil fuel like wood, coal or using petroleum products and some industrial processes are supposed to increase the concentration of greenhouse gases, thereby leading to global warming. This causes changes in the air temperature, rainfall, rise in sea levels, and melting of glaciers. Climate change and global warming over the years have expanded the range and incidences of VBDs. An increase of 3-5 degrees centigrade in the temperature

Contd. >

Contd. >

translates to about an extra 50-80 million cases of malaria every year. As global warming continues, the transmission of some tropical diseases is likely to increase and spread into temperate regions. This could be more so in the case of malaria, since temperature determines the rate at which mosquitoes develop into adults, the frequency of their blood feeding, and the rate with which pathogens are acquired and the incubation time of the pathogen within the mosquito. This has to be compared with the opposing effects that high temperatures exert, in reducing adult mosquito survival.

Studies suggest that by the year 2100, temperatures will have increased 2-3 degrees centigrade with accompanying indirect effects: a 0.9-0.88 metres (mts) rise in sea level, an increase in water extremes and enhanced evaporation. A direct impact of this would include deaths and injury caused by intense flooding and a rise in VBDs due to flooding. Some argue that a rise in sea levels could also result in a net increase in salinisation that may actually reduce the transmission of malaria, since the malaria vector breeds only in freshwater. Diseases like plague spread by rodents and other mammals, may be affected by climate change as well.

Stopping Vectors from attacking us

An important question before us is of how we tackle VBD

1: Chemical Control

One of the biggest drawbacks of the vector control programme is dependence on the use of chemical insecticides (DDT), lindane and malathion (See chapter on Toxics)[xxviii]. Virtually the entire vector population is resistant to DDT and there is growing resistance to malathion and other insecticides). The government and municipalities continue to rely on chemicals and often use them on ad-hoc basis. This needs to change, because despite wide application of chemical pesticides vector borne fevers have not decreased. They have only become intermittent and unpredictable and often return with a vengeance[xxix]. The Government and Ministry of Health and Family Welfare have proposed that to counter the Japanese encephalitis epidemic in Uttar Pradesh after the 2005 epidemic where 1360 children died, helicopters will be used to fog villages and fields with high doses of malathion. This is a most impractical solution for preventing future epidemics. It is not only expensive to sustain but also does not consider vector resistance.

2: Environmental Control

Bio-environmental vector control (BVC), a preventive measure that employs the use of local environmental conditions to reduce vectors, has shown that it can reduce vectors by 50 to 85 %. Naturally this means the fewer the vectors, the less the disease. Unfortunately, chemical insecticides are pushed because they are an easy option for the public health department. This also means that people remain ignorant and do not manage their resources – forests, water bodies, sewage and wastes etc.. and neglect them. Effective containment of VBDs is possible only when both preventive and curative measures are simultaneously deployed. For this, the interplay between environment and the population growth of insects that become vectors, needs to be clearly understood.[xxx]

If vector borne diseases emerge largely due to changing environment, manipulating the environment can restrict their numbers. Most of southern Europe and the southern states of the US eradicated malaria not with the use of DDT and other chemicals but by doing away with environment that promoted vector growth. Drainage of swamps, destruction of mosquito breeding sites and clearing of vegetation are effective methods to reduce mosquitoes and other vectors. Even the British could go further into jungles and wetlands and conquer far flung areas by "managing the environment", especially around cantonments.

The sanitary and public health engineering department played a crucial role in vector control through draining and de-clogging sewers and canals. Quinine was used to cure and prevent fevers but was always in short supply. One of the early experiments (1902-1909) in mosquito control was conducted at the military cantonment of Mian

Mir, near Lahore, in Pakistan, which has a large canal system from the Indus river. The project failed because of the scale of operations. Elsewhere cantonments and municipalities were successful in reducing malaria incidence through draining and ensuring that accumulation of water did not occur nearby.

Two methods have proved very effective in controlling mosquito breeding. Firstly, growing rice in ankle deep water is unnecessary according to researchers at Cornell University, USA. According to them by using practices like alternatively wet and dry irrigation (called AWDI) for rice, we can drain and flush accumulated water, thereby not only reducing numbers of mosquitoes, but also increasing the productivity of rice.

Secondly, the use of environmentally friendly organic fertilisers like blue-green algae (BGA) has controlled the proliferation of the Japanese encephalitis vector.[xxxi] Martin Birley at the Liverpool School of Tropical Medicine, UK, says that "It would contribute to a change away from inorganic fertilisers".

Use of natural predators of vectors is also effective. Viet Nam and Thailand have used a natural predator for mosquito larvae—the copepods—a minute crustacean to reduce malaria and dengue in villages.

Simple hygiene programmes are effective too. Recycling of discarded containers like plastic bags and bottles reduces the number of potential breeding sites for mosquitoes, especially in the case of dengue. In Cuba, Hawaii, Puerto Rico, islands of the Caribbean and central America, dengue incidence has dropped by as much as 40-76 per cent where these basic hygiene practices have been stringently administered.

3: Non-chemical methods and their control in India

Bio-vector control in India has been tried successfully in urban areas (Goa, Chennai), industrial sites (Bharat Heavy Electrical Limited, Hardwar, Indian Oil Corporation, Mathura and National Thermal Power Corporation, Sonebhadra, Uttar Pradesh) and rural settings (Kheda, Gujarat).[xxxii] [xxxiii] The thrust of BVC projects was vector reduction largely through anti- larval measures. Draining and simple hygiene measures proved effective in eliminating resting and breeding sites for mosquitoes. By introducing larvae-eating fish and bio larvicides, like Bacillus thuringiensis (Bt), the growth of mosquito larvae was prevented. Limited use of synthetic insecticides was advised only as a precaution, in case an outbreak took place in neighbouring areas.

In all these interventions, community participation was crucial. Another community success model for control of VBD can be seen in Cherthala taluk in Allappuzha district, Kerala. This was the hotbed for filaria. In 1955-1956, more than one fourth of the population was afflicted by the disease. In 1987 fish, water weed extraction and drug administration in high-risk areas reduced the parasite load. Health education was enabled through a Students Filariasis Control Club (SFCC) in schools. Student volunteers took active part in de-weeding various localities. According to Sabesan Shanmugan, deputy director, vector biology and entomology department, VCRC, Pondicherry, "The human infection level at Cherthala is maintained at below one per cent. And no new infection, especially among children has been recorded in the last five years."

BVC is a common sense approach that lacks the appeal of the biochemical science but has mesmerized public health officials with its effectiveness. With environmental measures, the local community is responsible and has the choice to manage their local resources and health outcomes. Compared to chemical insecticides, BVC methods are cheaper, sustainable and have positive economic spin offs that enhance efficacy. The cost of bioenvironmental interventions was worked out to be as low and may be around Re 1 per capita per year (in 1991) as against Rs. 10 to 45 per person for chemical pesticides.

Recommended strategies to control vector borne diseases

• Use a combination of strategies – do not focus on pesticides as a means to control mosquitoes because most mosquitoes are resistant to older pesticides like DDT and malathion and are developing resistance to new pesticide at an increasingly pace

• Environmental sanitation should be made an important feature of control. In this, unused stagnant water especially that which does not support much aquatic life like fish and frogs, must be drained.

• Bed nets also are effective if used by all within households.

• Introduce of larvivorous fish in water bodies. Eliminate breeding sites like filling tree holes or draining and removing tyres and leftover cans and containers

• Close surveillance of mosquitoes and rising mosquito population.

• Use bio-larvicides that are neem-based or micro-organisms like Bt and avoid using chemical insecticides unless vector population build up is rapid

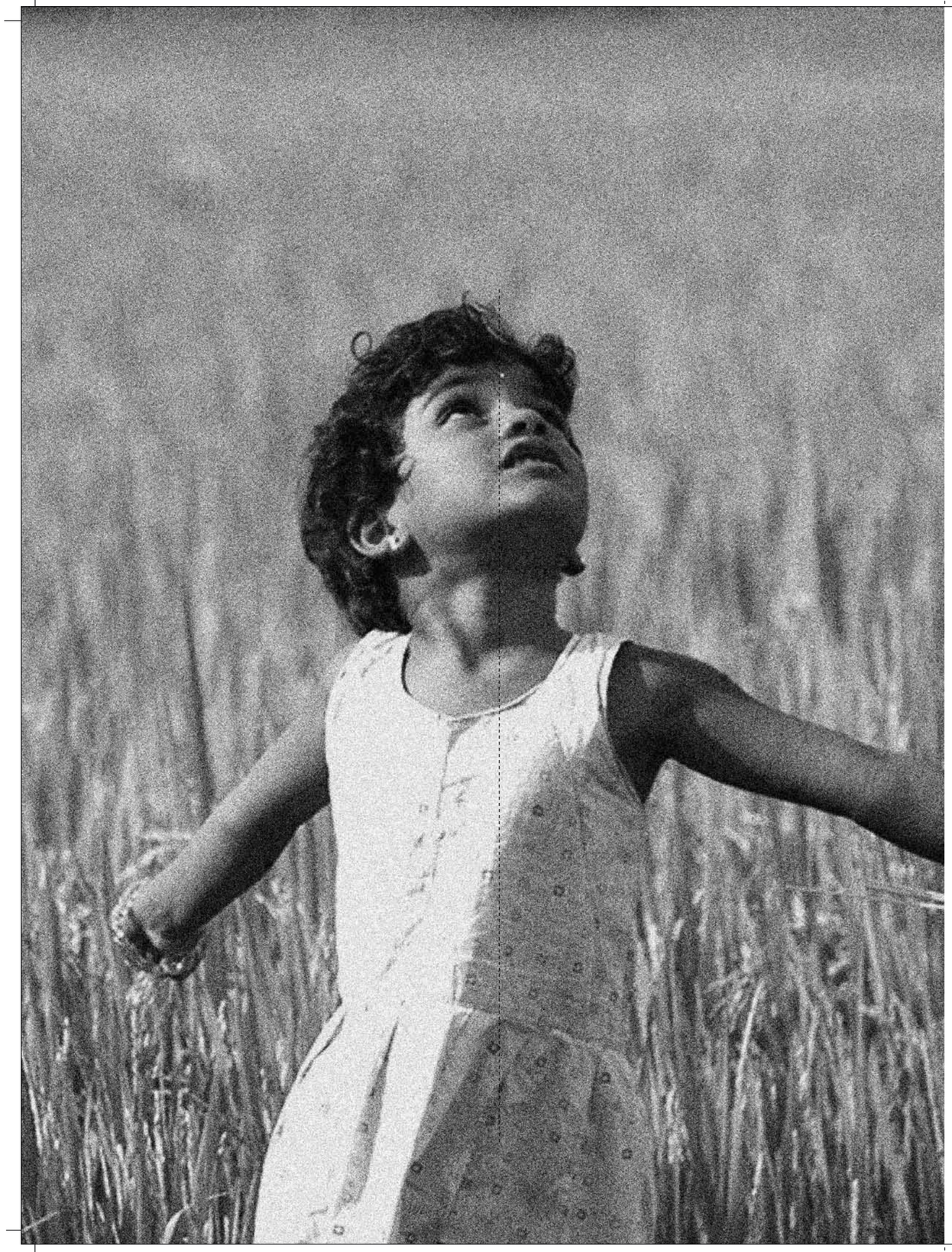
• Use chemicals as a last option. Malathion or DDT will work only if the vector is still susceptible to it. Use small but sufficient doses to reduce vector population.

Conclusion and summary

This is the 21st century. Ironically, India has the Nuclear Bomb and is a software superpower. Yet, even now, despite progress, and the fact that more facilities and greater funds are available for safe water, ***more children in India die of traditional diseases than any other***. Today, 65% of India has unsafe water, and no government or municipality can assure its citizens that sewage does not mix with their drinking water. The figures of the World Health Organisation and ground realities in severely affected states are testimony to how little the government knows and does anything about epidemics. Much of this is due to poor planning and the failure of adequate and equitably distributed infrastructure -piped water schemes, toilets that the poor want to use which are safe for women, and proper sewage treatment. Besides this the government does little to reduce unplanned growth and large scale activities that change the environment which suits mosquitoes and because of there are recurrent fevers. The government has also failed to provide for clean energy options at the household level, which means that women and children continue to suffer silently. This must change. This does not require high-end science but sheer commitment to break the bureaucratic lethargy of not doing anything about it.

We have listed a range of options, both here and in the more general sense, in the chapter on advocacy. No matter which school your children goes to, no matter where you live, remember that disease seeps in everywhere-through the food and water we drink and use in our daily lives. Deteriorating environmental conditions also spur growth of mosquitoes and sand fly populations which can breed well outside your area and attack you. You are not immune.

Besides, traditional diseases are such that the solution lies not in protecting children individually, but protecting society as a whole. We urge you to consider these facts, their impact on your child and to act upon these, both as a parent and a concerned citizen .



Chapter 3 :

Air Pollution and Illness

What Is Air Pollution?

Air pollution is the contamination of air when harmful substances are discharged into it. These substances do not come only from cars or factories, but could also be emitted from smoke inside your home when you cook or when someone smokes. In the outside environment, air pollution is simply called ambient or "outdoor pollution". Based on the sources – vehicular, industrial, municipal waste etc., Pollution is further categorized to make it more specific. Indoor air pollution occurs in closed home, office or school environments. In the context of India and other developing countries, indoor air pollution is largely caused by burning of wood and agro-waste that are used for cooking and heating. This definition of indoor air pollution in terms of toxics needs to change because several chemicals and products emanate harmful chemicals (like mosquito coils, degrading plastics, perfumes, incense etc.) and contribute to indoor air pollution, as well.

Air pollution consists of toxic gases and particles that are harmful to health. Broadly speaking there are two ways in which indoor air pollution affects health: Either substances in the smoke can themselves be responsible for a health impact, as is the case with carcinogens or toxins or these substances can also pave the way for infection by bacteria or viruses by damaging the respiratory system's mechanical and immune defenses. Usually the former causes the body's immune systems to devote energy in removing toxins and particles in the air thereby giving opportunity for viruses and bacteria to cause infections in lungs and the throat.

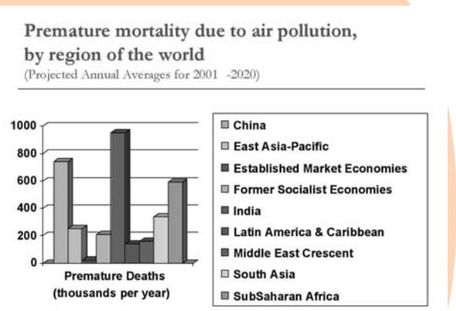
Although air pollution in general occurs through natural processes like burning of forests or volcanic eruptions, the real cause for concern is human-induced pollution, which is more toxic and sustained. Besides, very often natural causes cannot be controlled, while human induced burning can be reduced. Many man-made (or anthropogenic) pollutants are synthetic which do not break down easily. These persist for long and cause injury to all life forms, as naturally they have now mechanism to detoxify them. The build up of these is extremely dangerous. (See chapter on Toxics)

According to the World Resources Institute, while industrial and domestic pollution is increasing at a slower rate (about 2 per cent annual growth per decade), vehicular air pollution is growing at 4 to 7 per cent in large cities.

Air pollution can cause serious health problems. Most of these are breathing problems, such as respiratory infections and asthma. Sometimes air pollution leads to lung and tracheal cancer and some chemicals found in polluted air can also cause birth defects, brain and nerve damage, and long-term injury to the lungs and breathing passages. Above certain concentrations and durations, certain air pollutants are extremely dangerous and can cause severe injury or death.

About 25 per cent of estimated indoor air pollution (IAP) related deaths worldwide among women and children take place in India. According to indoor air pollution expert, Kirk Smith, about five hundred thousand adult women and children under age five die prematurely due to polluted indoor air in India. We need to protect our children from unclean air (see graph on the right).

The effect of air pollution can be cleaned, but only for some pollutants. However complex organic pollutants that persist in soil, water and air are more difficult and very expensive to clean up.



Source: World bank, Health and Environment, Strategy Series Number 1, October 2001

Major Air Pollutants and their health impacts.

Major Air Pollutants

Pollutant	Description	Sources	Effects	Release
Carbon Monoxide (CO)	CO is an odorless, colorless, and poisonous gas produced by the incomplete burning of fossil fuels (gasoline, oil, natural gas).	Cars, trucks, buses, small engines, and some industrial processes are major sources. Wood stoves, cigarette smoke, and forest fires are also sources of CO.	CO interferes with the blood's ability to carry oxygen, slowing reflexes and causing drowsiness. In high concentrations, CO can cause death. Headaches and stress on the heart can result from exposure to CO.	Direct
Nitrogen Oxides (NO_x)	Nitrogen and oxygen combine during combustion (burning) to form nitrogen oxides. Many nitrogen oxides are colorless and odorless gases.	NO_x come from burning fuels in motor vehicles, power plants, industrial boilers and other industrial, commercial, and residential sources that burn fuels.	NO_x can make the body vulnerable to respiratory infections, lung disease, and possibly cancer. NO_x contributes to the brownish haze seen over congested areas and to acid rain. NO_x easily dissolves in water and forms acids which can cause metal corrosion and fading/deterioration of fabrics.	Direct
Sulfur Dioxide (SO_2)	SO_2 is a gas produced by chemical interactions between sulfur and oxygen.	SO_2 comes largely from burning fossil fuels (gasoline, oil, natural gas). It is released from petroleum refineries, paper mills, chemical and coal-burning power plants.	SO_2 easily dissolves in water and forms an acid which contributes to acid rain. Lakes, forests, metals, and stone can be damaged by acid rain.	Direct
Volatile Organic Compounds (VOCs)	VOCs are organic (contain carbon) compounds that vaporize easily. Gasoline, benzene, toluene, and xylene are examples of VOCs.	VOCs are emitted as gases (fumes). Sources of VOCs include burning fuels, solvents, cleaning supplies, paints, and glues. Cars are a major source of VOCs.	VOCs contribute to smog formation and can cause serious health problems such as cancer. They may also harm plants.	Direct
Particulate Matter (PM) also known as **Particle Pollution**	Particulate matter is a term used to describe very small solids. Smoke, ash, soot, dust, lead, and other particles from burning fuels are examples of some of the compounds that make up particulate matter.	Some particles are directly emitted from cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, and burning wood. Other particles are indirectly formed when gases from burning fuels react with sunlight and water vapor.	Particulate matter can reduce visibility and cause a variety of respiratory problems. Particulate matter has also been linked to cancer. It can also corrode metal; erode building and sculptures, and soil fabrics.	Direct and formed in the air
Lead	Lead is a metal found naturally in the environment as well as in manufactured products. Small solid particles of lead can become suspended in the air. Lead can then be deposited on soil and in water.	The major source of lead is metal processing with the highest levels of lead generally found near land smelters. Other sources include waste incinerators, utilities, and lead-acid battery manufacturers.	Exposure to lead can cause blood, organ and neurological damage in humans and animals. Lead can also slow down the growth rate in plants.	Direct
Ozone (O_3)	Ozone (O_3) is a gas not usually emitted directly into the air. Ground level ozone is created by a chemical reaction between NO_x and VOCs in the presence of heat and sunlight.	Motor vehicle exhaust, industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOCs.	Ozone can irritate lung airways and cause wheezing and coughing. Repeated exposure can cause permanent lung damage. Ozone damages leaves of trees and other plants. It decreases the ability of plants to produce and store food, and reduces crop yield.	Formed in the air

Major Air Pollutants and their health impacts.

INDOOR AIR POLLUTION:

Indoor air gets polluted when biomass is burnt in poorly ventilated homes. This smoke lingers and is a complex mixture of toxic gases. In small concentrations this builds up gradually in the lungs and the respiratory system, and gets carried through the blood instead of oxygen. The brain and other vital organs need oxygen, rather than these toxic gases to function normally. In children the impact is far greater as their organs especially lungs, heart, brain and eyes develop gradually. Indoor air pollution is prevalent in villages and cities alike. Many daily activities can severely contaminate the indoor air.

Here are some of the worst culprits:

Biomass Fuel

In almost all of rural India, most household energy needs are met through burning biomass like wood, agricultural waste and dung. Homes are typically one room, at best two. When food is cooked inside homes or wood burned to keep families warm, smoke is emitted. Usually, it lingers on and we sense it as foul or stale air. This is actually a mixture of deadly gases, which cause chronic diseases. Biomass burns inefficiently. It produces little heat, burns too slowly, produces ash and releases noxious gases and tiny particulate matter.

At the receiving end of this everyday assault of fumes are women who bend over on earthen stoves to cook food or heat embers to keep the family warm, and children, especially infants, who spend time with their mothers inside these closed unventilated spaces The functioning and development of specific organs like the brain, lungs and heart can decrease greatly, if children live in such polluted environments. Children's lungs are only fully developed in their late teens and their breathing is faster, thus they absorb pollutants more readily than adults and retain them in their systems for longer.

In terms of chemical composition, indoor air pollution from biomass is a major attributable factor for ill health in rural India. It is estimated that 82 per cent of SO_2, 38 per cent of NO_2, 88 per cent of volatile organic compound (VOC) and 96 per cent of particulate matter emission in India come from the household sector.[xxxiv] These pollutants can rapidly build up indoors and to levels much higher than that found outdoors. A study by Majid Ezzati, Professor, International Health at the Harvard School of Public Health and Research Fellow at the Resources for the Future, Washington, found charcoal to be a cleaner fuel than biomass or wood because it produces 34 to 52 per cent less particulates than wood.[xxxv]

Right from the chore of 'collecting' biomass – an extremely exhausting routine, to 'burning' biomass to cook and heat, women and children face the greatest brunt of not having access or the choice to cleaner fuels. According to the Census of 2001, 101 million (100,842,651) homes in India depend on firewood, and about 38 million depend on crop residue and other biomass alone. About 90 percent of this is rural population (88 million depend on firewood and 35 million on crop residue and other biomass).[xxxvi] Children in all these homes are therefore exposed to indoor air pollution to a lesser or greater degree. Although it's overwhelmingly a rural problem, it happens in poor homes in cities too, because LPG is neither easily available nor is it cheap. Look around and you will find someone around you who is burning bio-mass to cook. It is not only causing a health crisis but more importantly the question is, what is it doing to future generations?

Incense and Perfume

Incense burning and volatile perfumes are commonly found in homes. Incense or agarbattis are made of wood and wood products to which aromatic oils and synthetic chemicals are added. When burnt in slow fire to produce aromatic fumes, these chemicals produce fine particles that line the lungs. What appears to be pleasant to the senses is actually a cocktail of lethal chemicals. Other sources of IAP include deodorants, perfumes, hair sprays and other cosmetics. These enter the lungs and cause damage to it. Like wise the eyes, nasal linings and skin too can get damaged with repeated exposure. Other common household chemicals that emit a strong aroma like furniture polish, glues, air fresheners, moth repellents, wood preservatives, and many other products used in the house affect the lungs and can trigger wheezing, asthma bouts or induce persistent cough and irritation.

The main health effect is the irritation of the eye, nose and throat. In more severe cases there may be headaches, nausea and loss of coordination. In the long term, some of the pollutants are suspected to damage the liver and other parts of the body. Children are particularly prone to these chemicals as their lungs may not be able to breath out the chemicals quickly. This reduces their immunity and makes them prone to infections. Further, poor ventilation ensures that these chemicals linger for long and affect more and more people.

Outgas of plastics and PVC floors

Despite its many alternatives, polyvinyl chloride (PVC) is one of the most widely used plastics.

Global phthalate ester production has increased from very low levels at the end of World War II to approximately 3.5 million metric tons/year. A collaborative study done by Swedish and Danish scientists researched the associations between persistent allergic symptoms in children, which have increased markedly in developed countries over the past three decades, and the concentration of phthalates in dust collected from their homes. 10,852 children were studied and this study found that higher concentrations of butyl benzyl phthalate (BBzP) in dust was associated with higher levels of wheezing (an indicator of asthma), and eczema. In particular this study showed that phthalate (DEHP) was strongly associated with asthma .The study concluded that the three major phthalates—BBzP, DEHP, and di-n-butyl phthalate—can combine to cause even deadlier toxic damage in children.[xxxvii]

Those most affected: Poor children

Indoor air pollution is more prevalent in poor communities, but this does not mean that homes of the rich may be immune from this problem. Because the poor rely both on lower-grade fuels and have least access to clean technologies for cooking and heating, there homes are constantly filled with smoke. Young children (especially infants under five years) are also greatly exposed as they are placed close to where the mother is working – in some countries strapped to the mother's back as she cooks. They are thus exposed to long periods in the polluted environment. Infants and young children are also physiologically more susceptible to the health impacts. Susceptibility is exacerbated by malnutrition, poor living standards, overcrowding and exposure to disease through poor sanitation, as well as a low standard of medical care. Domestic indoor air pollution from cooking smoke is therefore mainly a poverty related issue.

Children, especially those who live in slums or around factories face high levels of both outdoor and indoor pollution. Take the case of Delhi. A study shows that young children living in areas of high air pollution are in danger of developing rickets. It found that there are growing concerns that increasing air pollution from industry and motor vehicles blocks out ultraviolet (B) radiation and children's ability to make vitamin D naturally, leading to rickets. It found that children that lived in a central location in Delhi had higher rates of rickets than those who lived in the outskirts of the city, where air pollution is much lower.[xxxviii]

Table 1: Bad air and its impact on children

Number of children affected by unclean air in India is unacceptably high

Health	Statistic	Comment
Annual no. of births (thousands),2003	25052	The total population of Nepal
Annual no. of under-5 deaths (thousands), 2003	2180	More than the population of Kuwait
% of under-fives with acute respiratory infection (ARI) (1998-2003)	19	3 times the population of Fiji
% of under-fives with ARI taken to a health care provider (1998-2003)	64	

Source UNICEF (http://www.unicef.org/infobycountry/india_statistics.html)

Table 2 : How Bad Air is Killing India's Children:

Disease	Impact
Acute respiratory infections (ARI) is one of the three major causes of infant mortality in India (the other two being diarrhoea and malnutrition). Long-term inhalation of these respirable particulates impairs the clearing ability of lungs and makes them more susceptible to infections.	Acute respiratory infections kill 4.3 million children per year, or 30 per cent more than are killed by diarrhea.[xxxix, xl] In India, 81 per cent of the ARI is due to dirty indoor air. [xli]60 per cent of these are children less than 5 years.[xlii]
Tuberculosis	39 million people in the urban areas and 60 million in the rural areas are tuberculosis infected. About eight per cent of the deaths in India occur from TB. Many of these infections are latent and may infect those who have not taken the BCG vaccine.
Asthma	It accounts for 0.2 per cent of the deaths in India.[xliii] The higher asthma incidence in rural India may be due to the greater use of fuelwood and cow dung as cooking fuel.[xliv]
Chronic obstructive lung disease (COLD) – caused by organic volatile compounds and particulates blocking airways and fine structures of lungs. It is a disorder of the lungs characterised by shortness of breath and cough and may result in premature death. Like TB, children are pre-disposed to COLD.	WHO estimates, that 22 per cent of the chronic respiratory diseases occur due to exposure to indoor smoke.[xlv] COPDs account for 1.5 per cent of deaths in India and chronic bronchitis accounts for about 1.5 per cent of the deaths among the women in India.[xlvi]
Blindness: Emissions from biomass combustion like, formaldehyde and naphthalene have been found associated with eye irritation and cataract development. Cataract (or opacity of the lens) also occurs from constant exposure to dirty air.	Stove smoke can also aggravate factors that cause blindness. For instance, eye irritation from smoke may cause persons to rub their eyes, which in unsanitary conditions can spread infection.[xlvii] Leads to premature blindness in children.
Lung cancer	In India, 0.4 per cent of the deaths occur due to lung cancer in women.[xlviii] Cooking for three hours per day exposes women to similar amounts of benzopyrene (a carcinogen) as smoking two packets of cigarette daily. Think of what it does to infants who stay next to their mothers all day?

OUTDOOR AIR POLLUTION

Outdoor air pollution occurs when a large volume of pollution is produced from burning of waste, incinerating waste, even medical waste and emissions from vehicles like cars, trucks, buses and bikes, and industries. Because industries and vehicles are concentrated in cities, urban air pollution is most rampant here. But it would be a folly to think that it occurs only in cities. Large thermal power stations, steel plants, sugar industries, distilleries and many large and small scale industries are often located in rural areas which produce noxious gases. The health consequences of exposure to dirty air are considerable:

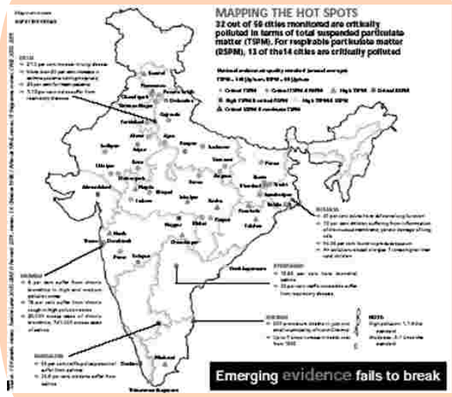
• On a global basis, estimates of mortality due to outdoor air pollution run from around 200,000 to 570,000, representing about 0.4 to 1.1 percent of total annual deaths. As the range of these estimates indicates, it is difficult to quantify the toll of outdoor air pollution. The health impacts of urban air pollution seem likely to be greater in some of the rapidly developing countries where pollution levels are higher.

• The World Bank has estimated that exposure to particulate levels exceeding the WHO health standard accounts for roughly 2 to 5 percent of all deaths in urban areas in the developing world.

• Several studies on air pollution effects in Europe and the United States documented an increase in the death rate of those chronically exposed to dirty air. These increased risks translate roughly to a 1- to 2-year shorter life span for residents of the most polluted cities. Higher infant mortality rates have also been associated with high particulate levels.

Outdoor air pollution in India

Air pollution has been aggravated by developments that typically occur as countries become industrialised: growing cities; increasing traffic; rapid economic development and industrialization; and higher levels of energy consumption. The high influx of population into urban areas, increase in consumption patterns, urban planning without the poor kept in the framework and industrial development have led to the problem of air pollution.



Major Air Pollutants and their health impacts

Carbon Monoxide (CO) is an odourless, colourless gas. After being inhaled, CO molecules can enter the bloodstream, where they inhibit the delivery of oxygen throughout the body. Low concentrations can cause dizziness, headaches, and fatigue; high concentrations can be fatal.

CO is produced by the incomplete burning of carbon-based fuels, including gasoline, oil, and wood. It is also produced from incomplete combustion of natural and synthetic products, such as cigarette smoke. It can build up in high concentrations in enclosed areas such as garages, poorly ventilated tunnels, and even along roadsides in heavy traffic.

Carbon Dioxide (CO2) is the principal greenhouse gas emitted as a result of human activity (e.g., burning of coal, oil, and natural gas). CO2 can cause burns, frostbite, and blindness if an area is exposed to it in solid or liquid form. If inhaled, it can be toxic in high concentrations, causing an increase in the breathing rate, unconsciousness, and death.

Chlorofluorocarbons (CFCs) are chemicals used in great quantities in industry, for refrigeration and air conditioning, and in consumer products. CFCs, when released into the air, rise into the stratosphere (a layer of atmosphere high above the Earth). In the stratosphere, CFCs take part in chemical reactions that result in reduction of the stratospheric ozone layer, which protects the Earth's surface from the sun. Reducing the release of CFC emissions and eliminating the production and use of ozone-destroying chemicals is very important to the Earth's stratosphere.

Ozone: Ozone decreases a child's breathing ability. Ozone exposure also leads to shortness of breath, chest pain when inhaling deeply and wheezing and coughing. Ozone levels typically rise between April and October when higher temperatures and the increased amount of sunlight combine with the stagnant atmospheric conditions that are associated with ozone air pollution episodes.

Particles are of varied sizes - some that are visible to the eyes and others that are too small - called nano particles. The smaller the particle, the deeper it penetrates in the cells of the lungs. Often these particles are laced with metals which cause cell injury and death. Not only do particles (mostly from diesel cars, trucks, buses and generators) go deep into the lungs, they are coated with toxics like polycyclic aromatic hydrocarbons (PAH), which are highly carcinogenic. In 1995 a study done by the Centre for Science and Environment, a leading Delhi based environmental NGO, showed that the number of deaths had increased to 9,859 in just three years, which means a death rate of one per hour due to air pollution, and this too only because of one pollutant – particulates from diesel.[xlix]

Lead is a highly toxic metal that produces a range of adverse health effects particularly in young children. Lead can cause nervous system damage and digestive problems, and some lead-containing chemicals cause cancer. Lead can also harm wildlife. Lead has been phased out of diesel and petrol, which has considerably reduced the contamination of air by lead. However, lead can still be inhaled or ingested from other sources. (See chapter on Toxics).

What Causes Outdoor Air Pollution?

We have all experienced air pollution outside our homes?
Here are some reasons for it:

Vehicular Pollution

In urban areas, vehicles are the major contributors, along with some industries and thermal power plants. Many people can also afford vehicles now: the number of motor vehicles has increased from 0.3 million in 1951 to 48.2 million in 2005. Out of these, 37% are concentrated in 23 metropolitan cities. Delhi itself accounts for about 11% of the total registered vehicles and has more registered vehicles than those in the other three metros (Mumbai, Calcutta, and Chennai) taken together. That explains one reason for urban air pollution. Rural areas too have a growing vehicular air pollution related crisis. Tractors, irrigation pumps and generator sets use diesel which emit more noxious fumes and particles than fuels. Also, adulteration of fuel is higher in rural areas because poor farmers end up mixing diesel with inferior chemicals to run their engines. Also highways and roads have increased traffic in may rural areas. This too contributes greatly to local air quality. Vehicular emissions are of particular concern since these are ground level sources and thus have the maximum impact on the general population. Because school and homes are situated close to highways, bus depots and car parks, vehicular emission is a greater threat for children in cities. Children who work are often engaged in occupations that require them to be near or on roads, increasing their vulnerability.

A World Bank study concluded that air pollution in Mumbai, India causes 2,800 cases of premature mortality, 60 million respiratory symptom days, and 19 million restricted activity days, all of which are valued at a total cost of 18 billion Indian rupees per year.

Industrialization

India has made rapid strides in industrialization. But progress, has brought with it unwanted and unanticipated consequences such as unplanned urbanization, pollution and the risk of accidents.

The Central Pollution Control Board (CPCB) has identified seventeen categories of industries (large and medium scale) as significantly polluting and the list includes highly air polluting industries such as integrated iron and steel, thermal power plants, copper/zinc/ aluminum smelters, cement, oil refineries, petrochemicals, pesticides and fertilizer units. The state-wise distribution of these pre-1991 industries indicates that the states of Maharashtra, Uttar Pradesh, Gujarat, Andhra Pradesh and Tamil Nadu have a large number of industries in these sectors.

Small scale industries are a special feature of the Indian economy and play a significant role in pollution. India has over 3 million small scale units accounting for over 40 percent of the total industrial output in the country. In general, Indian small scale industries and industries in the informal sector lack pollution control mechanisms. Given the insecurity within which they are forced to operate, they are unable to invest in these. Since many of these are within cities and near homes, the impact of pollution from small scale units can be severe. When all these forms of pollution combine, it makes a deadly cocktail of toxins.

So while industries and cities propel economic growth, environment takes a backseat. In the name of development (in terms of gross development produce or GDP), various forms of pollution has grown dramatically. We pay for this with our health.

Incineration

Burning garbage has been a common means of disposal and as volumes increase and open land get more expensive, municipalities resort to open burning. Now, there is a move towards waste to energy projects that involve incineration. But incineration has been shown to have severe environmental impacts. It is known to release dioxins, one of the most toxic chemicals known to humankind. (See toxics chapter) Incinerators are know to cause birth defects in children born to parents who live or work close to incinerators.

Delhi: India's Asthma Capital

Delhi is also India's asthma capital. Because of high pollution levels in Delhi, asthma especially among children continues to be on the rise. "Earlier, about 5-10 per cent of the children would show its symptoms. Now the number has risen to around 15-20 per cent. In fact, one-fourth of the children in the pre-school age are recurrent wheezers," says Dr Sanjiv Bagai, senior consultant pediatrician at Batra Hospital.

The worse time for children to get asthama is just after Diwali and up to February. While pollution levels may have fallen over the past few years thanks to the switchover to CNG in the capital, doctors say that this has had no bearing on asthma among children. "It is still much above the critical level. Also, pollution has only now gone down while some of these children may have had their first attack about three to four years back when the levels were still high," said Dr Anoop Misra of FORTIS Hospital, Gurgaon . "Smoking certainly hasn't decreased and that is something that affects passive smokers as well," added Dr Sibal. While some children do grow out of the problem, in others, it is important to let them lead as normal a life as possible. "Quality of life should not be compromised. Having asthma shouldn't mean that the child is not able to participate in sports. If he has to be put on inhalers for that, the step must be taken," said Dr Sibal. In fact, the number of children dependent on inhalers has also gone up significantly in the past few years."

Indoor or Outdoor: Which one is the bigger evil?

Both indoor and outdoor air comprises of different types of gases. When wood or organic wastes like dung burn it produces carbon dioxide but also a large variety of organic compounds. If more types of wood and wastes are mixed, many different combinations of gases can be made. Outdoor gases are largely produced from combustion of engines of cars and other vehicles, and machines in industries. The fuel used here is a hydrocarbon – either diesel or petrol. In many industries, coal is used. These when used properly produce carbon dioxide, carbon monoxide, and oxides of nitrogen and sulphur. By and large, good machines and engines can reduce the release of noxious gases like nitrogen and sulphur oxides and particulate matter. But this is seldom done neither by car owners or industries. Adulteration of fuels is a major menace, because fuels burn inefficiently producing more noxious fumes.

Smoking and Children

Don't smoke and don't let anyone else smoke around your children either. Here's why.

Environmental tobacco smoke (ETS) is a mixture of particles that are emitted from the burning end of a cigarette, pipe, or cigar, and smoke exhaled by the smoker. Smoke can contain any of more than 4,000 compounds, including carbon monoxide and formaldehyde. More than 40 of the compounds are known to cause cancer in humans or animals, and many of them are strong irritants. ETS is often referred to as "second hand smoke" and exposure to ETS is often called "passive smoking."

Second hand smoke has been classified as a Group A carcinogen by the U.S. Environmental Protection Agency (EPA), a rating used only for substances proven to cause cancer in humans.

Infants and young children whose parents smoke in their presence are at increased risk of lower respiratory tract infections (pneumonia and bronchitis) and are more likely to have symptoms of respiratory irritation like coughing, wheezing, and excess phlegm.

In American children under 18 months of age, for example, passive smoking causes between 150,000 and 300,000 lower respiratory tract infections, resulting in 7,500 to 15,000 hospitalizations each year, according to EPA estimates. These children may also have a build-up of fluid in the middle ear, which can lead to ear infections. Slightly reduced lung function may occur in older children who have been exposed to second hand smoke. Children with asthma are especially at risk from ETS. This ETS increases the number of asthma episodes and the severity of symptoms in 200,000 to 1 million children annually in the US. Second hand smoke may also cause thousands of non-asthmatic children to develop the disease each year.

Dry Cleaning : Watch out, and not for your clothes

Despite its name, dry cleaning is not totally dry. It involves the use of liquid chemicals called solvents that remove most stains from a variety of fabrics. Most drycleaners use Perchloroethylene, or PERC, as their primary solvent. Because the clothes are cleaned in a liquid solution that is mostly PERC or some other solvent, with very little water if any, the term "dry cleaning" is used to describe the process. Perchloroethylene, or PERC is the dominant chemical solvent used in dry cleaning. It is a clear, colourless liquid that has a sharp, sweet odour and evaporates quickly. It is an effective cleaning solvent and is used by most professional drycleaners because it removes stains and dirt from all common types of fabrics. PERC usually does not cause clothes to shrink, nor dyes to bleed. Since PERC can be reused, it is a cost-effective and efficient solvent for cleaning clothes. It is also a toxic chemical with both human health and environmental concerns.

The extent of any health effects from PERC exposure depends on the amount used and how long the exposure lasts. People exposed to high levels of PERC even for brief periods, may experience serious symptoms. Those include dizziness, fatigue, headaches, confusion, nausea, and skin, lung, eye and mucous membrane irritation. Repeated exposure to high levels can also irritate the skin, eyes, nose and mouth, and can cause liver damage and respiratory failure. It might cause effects at lower levels as well.

While there have been studies of people who are exposed to high levels of PERC, the studies are limited and inconclusive. Scientists have not yet determined whether PERC exposures can cause such adverse effects in pregnant women as increased incidence of miscarriage or reproductive effects, affect women's fertility, or affect children born to parents exposed to high levels of PERC.

PERC has been shown to cause cancer when swallowed or inhaled. There is also evidence, from several studies of workers (and their children) in the laundry and dry cleaning industry, suggesting a causal association between PERC exposure and elevated risks of certain types of cancer i.

PERC can get into the air, water and ground during the cleaning, purification, and waste disposal phases of dry cleaning. Through recent improvements in equipment and more careful operating practices, PERC consumption and losses to the environment are being reduced.

Most of the PERC used by the dry cleaning industry escapes into the outdoor air through open windows, vents, and air-conditioning systems . In older dry cleaning systems, PERC may still be vented directly to the outdoors as part of the dry cleaning process. Fortunately, many drycleaners now use new machines that control or eliminate the amount of PERC that escapes during the cleaning process. Once outdoors, PERC can remain in the atmosphere for several weeks, and although small amounts are always in the air, PERC itself does not deplete the ozone layer of the atmosphere. After a few weeks, PERC breaks down into other chemicals. Some of which are toxic, and some of which are suspected to deplete the ozone layer.

Driven by concerns about PERC and other dry cleaning solvents, recent advances in both technology and garment care have resulted in a sophisticated machine-based process called "wet cleaning" which uses water as the solvent. Cleaning is done in specially-designed machines that have to be operated by garment care professionals. While professional cleaners have always employed some form of water-based cleaning methods, often by hand, these historic methods bear little resemblance to the new machine-based wet cleaning process. Wet cleaning is appealing from an environmental point of view because the cleaning process is done in a solution of water with a few percent of additives.

Toxic Air contaminants that disproportionately impact infants and children

Toxic Air Contaminant	Source	Major Reasons Why Chosen
Acrolein	Burning and incineration	Exacerbation of asthma
Chlorinated dioxins and dibenzofurans (dioxins)	Burning and incineration	Endocrine disruption, thyroid and immunotoxicity at low body burden; young animals more susceptible than older animals
Environmental Tobacco Smoke	Cigarette smoke	numerous adverse health effects; several known effects are specific to children, and other known effects to which infants and children may be more susceptible.
Lead and compounds	Chemicals, paints, unleaded fuel, batteries etc.	Children the most susceptible subpopulation due to developmental neurotoxicity.
Particulates	Emissions from Diesel-fuelled Engines (Diesel exhaust particulate matter)	Allergic response and induction of asthma; PAH can cause genetic mutation
Polycyclic Organic Matter (POM)	Mix of wastes	Affects growing foetus

Source: http://www.oehha.ca.gov/public_info/public/kids/kidtactable.html

Asthma in Children

Asthma is a chronic respiratory disease. It is characterized by shortness of breath, coughing, inability to perform strenuous jobs and may also lead to death. It also has social stigma attached to it. Asthma is a global epidemic; between 100 and 150 million people around the globe—roughly the equivalent of the population of the Russian Federation— suffer from asthma and this number is rising. World-wide, deaths from this condition have reached over 180,000 annually. Asthma is widely distributed globally. In rich and developed countries Switzerland and Germany, about 6 to 8 per cent population has asthma. Some 25-30 years ago, this level was less than 2%. According to the UCB Institute of Allergy in Belgium, in Western Europe as a whole, asthma has doubled in ten years. In the United States, the number of asthmatics has leapt by over 60% since the early 1980s and deaths have doubled to 5,000 a year.

In Australia, one child in six under the age of 16 is affected. In developed countries, asthma is the third leading cause of hospitalization among children under the age of 15. To reduce the impact of an attack, cumbersome drugs called anti-inflammatory agents and bronchodilators are prescribed by doctors. But globally it has been seen that where ever the air has been cleaned and warnings are issued before pollen season, there have been fewer episode of asthma in children.

The important thing, point out doctors, is to recognize the trigger that sets off an asthma attack in your child. "If a child is having repeated attacks of wheezing, one needs to find out what it is in the environment at home that is triggering it off. It could be heavy curtains or pets or maybe some plants," said Dr Anupam Sibal, director, medical services at Indraprastha Apollo Hospital, India.

Asthma occurs when a chemical causes an allergy in the lungs cells. These cells trigger constriction of the airway muscles, making it difficult to breathe. Asthma is the most common chronic disorder in childhood. Triggers range from viral infections to allergies, to irritating gases and particles in the air. Each child reacts differently to the factors that may trigger asthma, including: respiratory infections, colds, allergic reactions to pollen, mold, animal dander, feathers, dust, food, and cockroaches; vigorous exercise; exposure to cold air or sudden temperature change; cigarette smoke, and many air toxic chemicals released by burning. Recent evidence also shows that obese children are predisposed to asthma. Also some studies have shown that fast foods can make children prone to asthma. Children should also avoid aerated drinks, tinned food items like baked beans and ketchup, potato chips, chewing gum and Chinese food which has ajinomoto. Strong perfumes, and certain medications like aspirin can also trigger attacks.

In India, according to National Family Health Survey (NFHS-II), 1997, asthma prevalence rates were much higher in rural India than in urban India. The Northeastern states had a higher incidence of asthma compared to the rest of the country in general. The WHO estimates that in India here are 20 million asthmatics, of which 25 to 30% are children. In India, rough estimates indicate a prevalence of between 10 to 15% in 5-11 year old children.

According to another clinical survey, the asthma scenario may be even more grim. Pediatric pulmonologist at the Lakeside Medical Center and Hospital, Bangalore, Dr. H Paramesh reviewed 20,000 children under the age of 18 years between 1979 and 1999 in Bangalore. He found that prevalence increased from 9% to 29.5% - a jump of more than 12 per cent every year. Dr. Parmesh believes that the increase in the numbers is largely because of rapid urbanisation and more traffic in cities. Another startling fact that Dr. Paramesh found was that the prevalence of asthma increased in children who traveled further to school. Children who were poor, and lived and studied in areas which had more dirty air, had 2.5 times greater chance of having asthma than those who studied or lived in places with cleaner air. Even though genetic predisposition is one of the factors in children, others factors are equally important - urbanization, air pollution and environmental tobacco smoke contribute more significantly.

ACT NOW!

Strategies to reduce air pollution:

At Home:

- Ventilation is critical. Ensure fresh air can come in.
- If possible, install an exhaust fan in the kitchen
- Open door or windows when cooking will result in pungent fumes
- Avoid cooking with coal or barbequing unless there is adequate ventilation.
- Minimize carpets and rugs
- Minimize cushions
- Do not allow any smoking indoors, ever
- Avoid dry cleaning clothes, wash whatever you can. Pay special attention to children's clothes. Avoid moth balls too.
- Light up incense only when essential
- Use air sprays and air fresheners only if you cannot resist it.
- Try placing charcoal in a box to absorb odours
- If someone you know uses a chula, convince them to cook outdoors to the extent possible. And do not object when they do
- Ask yourself if you always want to keep your furniture polished or if you can let it be.
- Paint your home when it needs to be painted, not just to look perpetually new. Try touch-ups as well
- Avoid vinyl tiles and flooring. Instead, work with coloured cement

Look at how you travel:

• Can you walk to the market? Or anywhere else?

• Can you take a bus if your destination is just next door?

• Do you have a diesel car?

• Are you driving to optimize petrol consumption?

• Do you have to go far away to shop?

• Avoid high speeds, drive smoothly and avoid lengthy idling.

• Keep your car well maintained, especially the emissions control system.

• Keep tires properly inflated.

• Maintain your vehicle's air conditioning system — do not allow it to leak.

• Make fewer trips in your vehicle — plan routes to avoid traffic.

• Reduce fuel use as often as possible — a vehicle's shape and design features can affect its fuel use.

What a school can do:

For everything you do, help parents to understand the logic

• Make sure no waste or leaves are burned within the premises or nearby

• No smoking anywhere, even by the teachers

• If parents use cars for their children, encourage CNG, followed by petroleum vehicles by reserving parking for them.

• Encourage children to use the school bus, not be ashamed of it

• Organize a campaign for children to walk to the bus stop if it is under 600 m from their home.

• Change the colour of the uniform to minimize dry-cleaning

• Help children to understand how festivals do not have to be environmentally destructive by creating smoke and pollution

• Help teachers learn about asthma and its management

• Place restrictions on the canteen contractor: sell food that is healthy, because many children may react to food with ajino-moto, surplus salt, sugar and preservatives

• If many children eat food cooked on chulas at home, encourage parents to cook outdoors, when possible. Encourage them also to ask children to sit nearby when they cook.

• Reduce use of PVC floorings, plastic coated wallpapers and plastic doors that leach out noxious fumes

As a community:

• Celebrate festivals like burning Holika etc. in one group, if at all.

• Ensure leaves are not burned

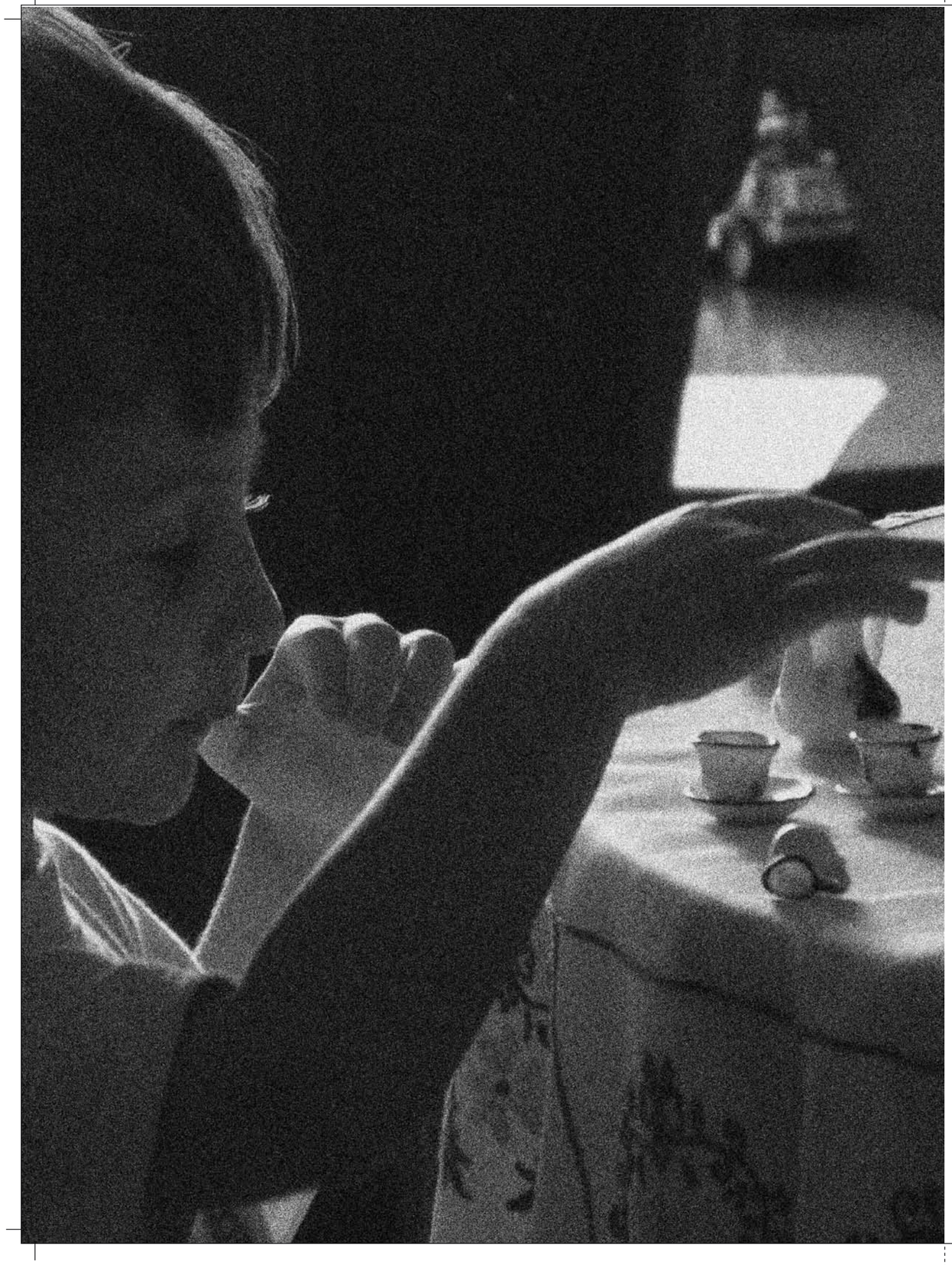
• Ensure waste is not set on fire

• If there is a hospital or nursing home nearby, find out if there is an incinerator installed. If so, remember, legally, only body parts and pathological waste can be incinerated. No plastic or paper etc. should be found in the incineration stream. Get in touch with your local State Pollution Control Board to find out it the incinerator has been inspected and found to be operating according to the standards of the Bio-Medical Waste Rules. Use the Right to Information Act to get information, if necessary. Remember, there are many alternatives to burning which the law allows.

• If you live near a main road, use plants with broad leaves and thick foliage to reduce some of the pollution that enters the premises

• Do not allow any dumping of fly ash near or around your colony

• Support cleaner air, particularly indoor air, for those who live nearby, particularly in sub-standard housing. Do this by allowing people to cook outside their homes, and by supporting piped-gas supplies to them first.



Chapter 4 :

Toxics

What are toxics?

A toxic agent, according to the US-governments' Agency for Toxic Substances and Disease Registry (US-ATSDR) is a chemical that, under certain circumstances of exposure, can cause harm to living organisms. The term “chemicals” includes dusts, mixtures, and common materials such as paints, fuels, and solvents.

Millions of chemicals, many of which are toxics, are ingested by us through air, food and drinking water everyday. These chemicals assault us everyday, in small doses that constantly attack our bodies and lower immunity levels, causing ailments. These particularly pose a serious risk to children's' health. These chemicals are of diverse varieties, very many with strange long chemical names, and others that are abbreviated and sound suspicious and sinister. These chemicals include, but are not restricted to pesticides, dioxins, PCBs, and heavy metals such as lead and mercury.

The sheer number of toxic substances present in the environment is alarming. According to the American Chemical Association in the last 50 years at least 80,000 chemicals have been developed and introduced into the environment. Only 3,200 or so have been tested to some degree for safety. Even among these at least 800 show varying levels of toxicity to humans, There is no global estimate of how much quantity of chemical is produced because many new industries are coming up across the world, many of which are illegal and many surreptitiously trade in restricted and banned chemicals. Although there are laws at every stage - from production, export, use, environmental and food safety standards, violating these is very easy. Chemicals cause a very large burden of chronic diseases like cancers, birth defects, asthma and many new diseases that till a few decades ago were extremely rare. They are now increasingly common the world over.

Special vulnerability of children

Children are at higher risk than adults of being exposed to hazardous substances and of suffering adverse health effects as a result of their exposure. Their activities expose them more to hazardous substances that might be in water or soil as their height puts them at a level where they are more likely to breathe dust and vapours close to the ground. Also, small children often put their hands in their mouths, which can allow contaminants into their bodies orally.

Children's smaller body size and developing systems also place them at greater health risk than adults. Because they are smaller, children receive higher doses of toxicants per pound of body weight. Pound for pound, children drink more water, eat more food, and breathe more air than adults do. Many organ systems in young children, such as the nervous system and the lungs, undergo rapid growth and development in the first years of life. During these periods of development, their organ systems are especially vulnerable to injury. Of special concern is exposure of the foetus, whose organ and body systems are still developing. Environmental toxicants are thus a growing cause of preventable illness in children globally.

In the case of children, research reveals that early exposure to the following toxicants can cause a variety of health and learning disorders.

Benzene the most common organic solvent and a common constituent of diesel, causes leukemia and possibly other cancers.

Environmental tobacco smoke can raise children's risk of ear infections and breathing problems and trigger asthma attacks.

Lead, commonly used in batteries, medicines, paints, and cosmetics, causes learning and behavioural problems.

Mercury, commonly used in thermometers, dental fillings and paints can lead to cerebral palsy, severe mental retardation, neuro-developmental delays, and seizures.

Nitrates and nitrites cause methemoglobinemia (the decreasing capacity of the blood to transport oxygen).

Household and agricultural pesticides can cause cancer, birth defects, and nerve damage.

Contact with **Polychlorinated biphenyls** (PCBs) used in electrical transformers and in machines and contact can lead to lower intelligence quotients (IQs) in children.

Trichloroethylene (TCE), commonly used in dry cleaning of clothes, is associated with hearing loss and delays in speech development.

Table: So how many chemicals affect children's health
There has been a dramatic growth in the number of chemicals that impact children's health.
An increasing numbers of chemicals (from 1993 and 2005) are causing havoc to children's health

	Numbers of chemicals proven to affect children	
	2005	1993
Possible and suspected		
Endocrine Disrupting Compounds (EDCs)	312	7
Suspected Neurotoxicants =	584	32
Recognized Reproductive Toxicants =	107	4
Suspected Reproductive Toxicants=	248	18

Source: US-ATSDR and IRIS online databases, as viewed on March 11, 2006

History of chemicals

Historically, metallurgy alchemy and fermentation of bread and wines were important areas of study, but the preparation of chemical mixtures were few and far apart. It was recognized in ancient times that basic elements produced during mining and metallurgy had a detrimental impact on the human body. In ancient Rome for example, lead poisoning was very common, as metal for arms and utensils were made in backyards of homes.

Following the Industrial Revolution, advances in chemistry and chemicals synthesis started on a large scale. The discovery of oil, new sources of ores and energy and new scientific methods of separating constituents and mixing what naturally did not occur, to create new molecules, spurred chemists to make new chemical compositions. Chemicals were the industrial revolutions "double edged sword". This was because while being the biggest and most important engines of growth, and spurring every sphere of development, they reached inside homes in small but toxic doses, and invaded the human body.

Two important classes of chemicals to have been discovered in modern times were "plastics" (or polymers) and "halogenated organic compounds" that were used as medicine and pesticides. In 1862, Alexander Parkes, a chemist in London, unveiled an organic material derived from cellulose that once heated could be moulded, and retained its shape when cooled. Parkes claimed that this new material could do anything rubber was capable of, but at a lower price. Chemists globally realized that common organic chemicals like hydrocarbons were a great source for making raw materials for everyday life. With the discovery of large hydrocarbon reserves in the form of oil fields and progress made in organic chemistry, new polymers began to be synthesized.

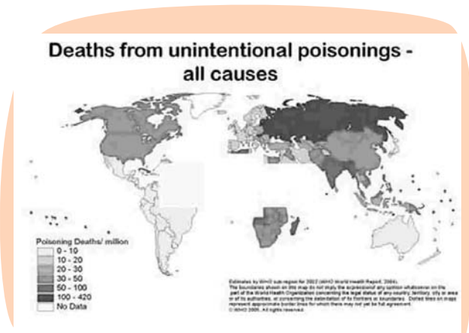
In 1900, viscose sheets—marketed as Cellophane—the first fully flexible, water-proof wrap, were invented. The 1920s witnessed a "plastics craze", as the use of cellophane spread throughout the world. DuPont, one of the industry leaders, became a hotbed for discovering new plastics. In the 1940s, the world saw the use of such materials as nylon, acrylic, neoprene, SBR, polyethylene, and many more polymers to replace of natural material. The development of polyvinyl chloride (PVC), or vinyl –brought an inexpensive, durable, fire-resistant material which was easily moulded into different shapes and sizes. Since the mid-1960s, many new types and varieties of plastics have been produced. To make plastics colourful and durable, pigments and additives are added. All plastics cause serious health threats, especially phthalates (See chapter 4 for more discussion) which are of critical importance with regard to children's health.

While synthetic chemistry was developing materials for industrial and domestic use, many other chemicals were being developed as by-products. Among these were organic chemicals whose effect on pests was profound, especially organo-chemicals like halogenated compounds. The first synthetic organic pesticides for example were the organochlorines (OCs), such as DDT (dichlorodiphenyltrichloroethane) which were discovered just before World War II. German scientists first synthesized DDT, and used it strategically to protect their soldiers from malaria and scrub typhus during the wars. The Allies discovered this white powder and soon employed it also. For two decades, developed countries in Europe and the Americas used it to conquer malaria and other vector borne fevers. By the early 1960s, the first signs of side effects of these synthetic chemicals were seen in birds and animals. DDT and other chemicals were found responsible for limiting survival of fragile eggs of birds, especially raptors that were showing rapid decline in population.

Over decades in the environment, these OCs became known as "persistent organic pollutants" (POPs). DDT, HCH (hexachlorocyclohexane), chlordane, aldrin, endrin and dieldrin are among the infamous POP's, "dirty dozen". Being organic, these compounds dissolve in fat tissue and(bio)accumulate in living organisms and undergo a build up in the food chain .This is called "bio-magnification" at successive levels of the food chain with the species at the top, humans for instance, accumulating the largest quantities. Once in the environment, OCs (and to a less extent other classes of pesticides) rapidly spread via a cycle of evaporation-condensation allowing them to travel thousands of kilometers, to otherwise unexposed regions such as the Arctic, leading to widespread exposure.iii (See grasshopper effect below)

Human breast milk is an important indicator of pesticide exposure - particularly DDT and HCH. Many developing countries now have very low average concentrations of DDT and other organochlorine pesticides in breast milk, but some developed countries that had banned these pesticides much earlier, still have higher concentrations. This is because of the high amounts of pesticides in their environment. Although India banned DDT for agricultural purposes in 1989, public health programmes still use it for mosquito control. As a result, DDT levels in breast milk of Indian women remain very high. It is estimated that in the past two decades, an average Indian infant has consumed 0.170-0.300 mg/day of DDT via breast milk which exceeds the safe limits by 1.4 to 2.5 times.

DDT is now making a comeback because the US and other G-8 countries have found that it is the best strategy to combat malaria in Africa. The very rationale for banning DDT three decades ago has been foregone. Indian industries which still produce and export large quantities of DDT are delighted with this prospect. Sadly, it is estimated that at least three million reported cases of pesticide-associated acute poisoning occur annually resulting in 20,000 deaths almost entirely in the developing world. The long-term effects of exposure to these chemicals may be less obvious but equally insidious. For example, during the past decade, a spate of birth defects and chronic health problems of villagers in Kerala has refocused national concern on the link between pesticide toxicity and health.



Many pesticides are capable of mimicking natural hormones. In doing so, they disrupt normal cellular process inducing a wide range of chronic health problems ranging from known and rare new forms of cancers especially childhood cancers, suppression of the immune system, reproductive and birth defects to neurological deficits. Occupational and environmental exposure to these poisons pose serious acute and chronic health risks to the Indian public that need serious attention.

Today, many chemicals are added to foods, medicines, toys, cosmetics and everything that is considered safe. Also, increasingly research organizations are finding out that what was once considered safe is no longer that safe.

Chemical action and reactions

Many chemicals persist in the environment and do not breakdown naturally. If toxic, these chemicals are the ones that pose a challenge to human and animal health. If chemicals persist longer in natural environments, then they can get transported by wind and water and deposited far from the source. For example, researchers have found that mobile compounds like DDT, which is still used in India to fight mosquito borne disease is being re-introduced in Africa in a large way to fight malaria there, but gets deposited as far away as the in the Arctic. The transportation of chemicals like DDT to the Arctic is called the "grasshopper effect" (See figure on the facing page).

POPs kill 5 million children a year: Lead causes neurological damage to millions of others

Toxic pollutants kill at least five million children each year around the world and another 18 million suffer neurological damage because of lead poisoning, according to a top official with the World Health Organisation. "An estimated 40% of the diseases in the world linked to environmental problems affect children below the age of five. Some five million young victims are felled each year. The WHO's Deputy Director of Health and Environment Roberto Bertollini told Italy's Panda magazine published by the World Wide Fund for Nature that children are most vulnerable to dangerous pollutants. He also told the magazine, that "lead is the deadliest pollutant, and between 15 to 18 million children in developing countries suffer permanent neurological damage because of it."

Bertollini said the issue was one of the WHO's top priorities, urging European legislators to devote greater attention to the problem. Earlier this year, the Italian cabinet approved the ratification of an international accord, bringing the country one step closer to outlawing several of the world's most dangerous pollutants.

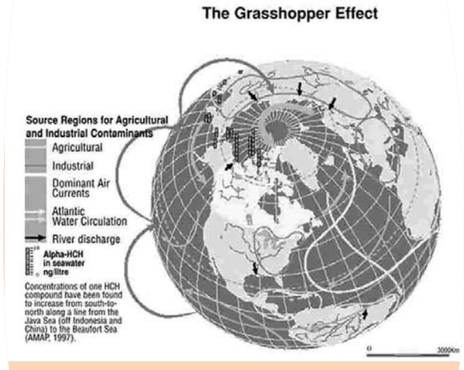
POPs are a group of highly toxic chemicals which are extremely resistant to the natural breakdown process. Once released into the environment, they often persist for years, even decades. One particular problem with POPs is that they accumulate in the fatty tissues of animals and humans, so even low environmental levels of POPs can lead to high levels in animals and humans. They are transported by air, water and migratory species, making them a cross-border problem requiring coordinated international action, experts say. A new treaty signed by 22 nations called the Aarhus protocol in 1998 called for an immediate ban on nine substances of the so-called "dirty dozen" list: aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene. A number of POPs have already been outlawed under the Stockholm Convention, which over 90 nations signed in May 2001, but according to the international environmental group Greenpeace, others have risen up to take their place.

(Source: (ANSA) - Rome, October 20, 2005)

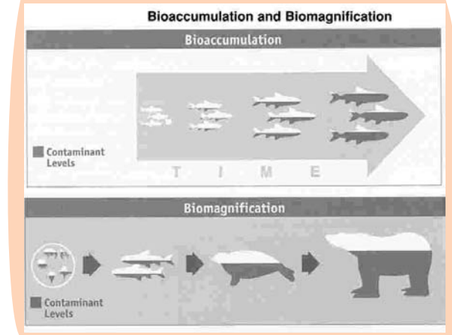
The grasshopper effect is a combination of methods by which chemicals can get transported over long distances from diverse toxic hotspots from North America, Russia, Northern Europe, Asia and even Africa. One important pollutant is elemental mercury. It originates from industrial countries and rapidly industrializing countries like India and China, but is carried away by wind and deposited in northern Europe and the North Pole region. Here both mercury and DDT invade the food chain and enter the fatty tissues of whales, fish and eventually into the native Inuit population. What appears pristine and natural in the Arctic region is actually heavily contaminated by mercury and DDT.

The most common action of chemicals is to accumulate within soft tissues of animals. Chemicals enter from one small organism and deposit in greater amounts in higher plants and animals till they reach human beings in large doses. This deposition in the food web is called "bioaccumulation" (see figure: What is bio-accumulation). Because of the tendency of these chemicals to accumulate in fatty tissue, many (such as DDT and dioxin) can potentially breach every human cell and affect life-giving activities like breathing, movement and digestion of food. Think of it, we therefore end up breathing, eating and drinking chemicals in trace amounts everyday.

The Grasshopper Effect



Bioaccumulation and Biomagnification



First signs

When toxic chemicals are released (from production of chemicals, to manufacture of products for our daily use and their eventually disposal), they are released in small doses and affect animal populations. The most noticeably affected are amphibians (such as frogs and toads). In the 1970s and 1980s in many parts of the world, frogs, toads and other amphibians showed catastrophic declines. The cause is unknown, but was suspected to be acid rain or ultraviolet radiation. More recently deformed frogs have been showing up at very high rates in the beautiful countryside of northern U.S. Bizarre extra legs, missing legs, and missing eyes have been seen. They were first found by a class of 6-8 grade students on a field trip in Minnesota in 1995, but have since been found in six species, at rates of up to 60%, across the US. These deformities in frogs are known to have been caused by exposure to toxic herbicides. But all cases of chemical contamination do not affect the same species.

For instance in India, the population of vultures has become almost extinct because of exposure to Diclofenac, medication used to treat inflammation in cattle, which the vulture scavenged upon . Some bird experts estimate that the vulture in India is near extinction. Similarly, DDT was known to have caused tremendous decline in eagle, osprey and great condor populations in the US in the mid 1960s. It is extremely tragic when such "first signs" of decline are ignored. Communities may lack awareness and knowledge, but the greed of industry and negligence of government agencies plays a major role in causing environmental catastrophes.

Often in developing countries, such first signs of vanishing animals and birds are disregarded or ignored. The build up eventually reaches humans, and children are often the first targets. This has been seen in the case of mercury poisoning in Minamata Bay, Japan and closer home in Kerala, where cashew plantations sprayed aerially with endosulfan has impacted upon workers health

Chemicals and Chronic diseases

Chemicals in small doses build up in the body and show symptoms similar to chronic diseases like cancers and organ failure. Because several chemicals can act together and in diverse manner, these symptoms take several years to show up.

There is no biological explanation for why chronic diseases like cancers, birth defects and systemic disorders like liver failure should be growing globally. Cancer is possibly widely prevalent in every society and every region. Childhood cancer, which was till a few decades ago only a subject of curiosity, is now a full-fledged discipline. (Cancer and other disorders are discussed later in this chapter.) It is however important to understand how cancer causing compounds (or carcinogens) are ranked (See box below)

Ranking the worst carcinogens

It is difficult to define toxicity. One way to do this, is to compare with a universally acknowledge toxic chemical. Benzene is a well studied and documented chemical. Every chemical is compared to Benzene to see how toxic it is!

The table on the facing page shows releases of carcinogens into pounds of benzene-equivalents. Benzene-equivalents provide a common denominator for comparing carcinogenic releases, taking into account variations in toxicity and exposure potential across chemicals. The units indicate the number of pounds of benzene that would have to be released into the air to pose the same approximate level of health risk as the reported release of chemical X. Benzene-equivalents are calculated by multiplying the reported releases of chemical X to air or water by its media-specific toxic equivalency potential. Because chemicals undergo different environmental fates if they are released to air or water (with subsequent differences in human exposure opportunities), this scoring system assigns them different air and water toxic equivalency potentials. To obtain a single common denominator of benzene-equivalents, water TEPs are normalized to air TEPs. Benzene was selected as a reference chemical for cancer TEPs because it has a potency value in the middle of the observed range of carcinogenic chemicals and it is a familiar chemical name to the general public. Benzene-equivalents are also used as a common denominator for assessing the health—risks of air toxics in a toxicity-weighting system developed by the international chemical manufacturer ICI—also a major paint manufacturer in India.

Carcinogenic chemicals vary widely in both their toxicity (the added cancer risk associated with exposure to a unit dose) and exposure potential (the total human dose associated with a one pound release). A chemical like benzoic trichloride is extremely toxic in terms of its carcinogenic potency, but it quickly degrades when released into water, limiting human exposure opportunities. In contrast, a chemical like hexachloroethane has a relatively low potency, but a very high exposure potential when released to water. A one pound release of each of these chemicals poses significantly different human health risks. If all chemicals are treated the same (a pound of one is no better or worse than a pound of another), we will miss important opportunities for risk reduction. Toxic equivalency potentials (TEPs) are designed to address this problem. If the TEP of chemical A is 10 times the TEP of chemical B, the emissions of 1 pound of chemical A is considered to be as harmful to human health as that of 10 pounds of chemical B.

Contd. >

Contd. >

Table Cancer Risk Score

1	Arsenic (Organic Or Inorganic Compounds)	3,300,000,000
2.	Cadmium Compounds	460,000,000
3.	Carbon Tetrachloride	120,000,000
4.	Chromium Compounds	74,000,000
5.	Arsenic	43,000,000
6.	Chromium	37,000,000
7.	Lead Compounds	33,000,000
8.	Cadmium	15,000,000
9.	1,2,3-Trichloropropane	12,000,000
10.	Methyl Iodide	8,300,000
11.	Lead	7,900,000
12.	Beryllium Compounds	7,200,000
13.	Benzene	6,000,000
14.	Ethylene Oxide	4,300,000
15.	Hexachlorobenzene	3,900,000
16.	Nickel Compounds	2,600,000
17.	Acrylonitrile	2,600,000
18.	Tetrachloroethylene	2,300,000
19.	Dichloromethane	2,200,000
20.	Chloroform	2,000,000
21.	Beryllium	1,700,000
22.	Acrylamide	1,600,000
23.	Dimethyl Sulfate	1,500,000
24.	Vinyl Chloride	1,300,000
25.	1,2-Dichloroethane	1,200,000
26.	Aldrin	1,200,000

Source: http://www.scorecard.org/env-releases/def/tep_cancer.html

In the following sections of the chapter discusses three broad classes of chemicals: **pesticides**, **heavy metals**, and e**ndocrine disruptors**. Their character supported by examples is discussed here briefly. The sections that follow will broadly introduce these toxics and their commonly used forms .Under pesticides, DDT, malathion, endosulfan and lindane are discussed; under heavy metals, the three most important toxic metals - arsenic, lead and mercury are described; and lastly endocrine disruptors are discussed in general, with dioxins and phthalates as crucial examples.

PESTICIDES

In the mid -1950s, large-scale industrial production of pesticides and fertilisers happened globally. Fertilisers promoted growth of crops while pesticides prevented crop failure from pest attacks. The use of both was driven by the anxiety of the 20th century to feed millions of hungry mouths and growing millions in poor and developing countries.

Fertilisers and their health impacts

From a single crop in a growing season, fertilisers and pesticides enabled farmers to produce more crops. Till the early 1960s, organic fertilisers like animal and plant waste were used as fertilisers. But with subsidised chemicals and fertilisers being made easily available to every farmer, there was large scale use which disturbed the natural chemical balance of soils, and gradually these agricultural soils were depleted of nutrients. Fertilisers and pesticides replaced or killed the natural organisms that created natural fertilisers and organic matter for plants. Farmers were urged to put more and new fertilisers, expediting the collapse of an already fragile soil ecosystem. Fertilisers also leached into water systems causing water-bodies to turn toxic, and killing all life within them . Excessive nitrogen in water bodies also impacts human beings. From across the world there are confirmed reports that excessive nitrogen causes oral cancer, cancer of the colon, rectum or other gastrointestinal cancers, and Alzheimer's disease. In the US nitrates have shown to cause neural tube defects, Hodgkin's lymphoma (a kind of cancer in children) and growth retardation in children. Blue-baby syndrome is increasingly being reported from Jaipur and other districts of Rajasthan.[lvii]

Sale of pesticides is a multi-billion dollar business. In all, 1.5 million tons of pesticides are sold annually and sales are worth an estimated US$30 billion[5]. According to the UN's Food and Agriculture Organisation, in 1961 India produced $ 1253,000 worth of pesticides (and exported $70,000 worth), by 2004 exports and imports had increased to $1,140,440,000 - or 106 times![lviii] New chemicals types not used previously - like herbicides and fungicides are being produced, stored, and used in the backyard! The most profitable sector is the growth in domestic use of household pesticides. Because government and municipalities maintain hygiene and cannot control proliferation of mosquitoes, there is a market for these chemicals. The tragedy is that

Household insecticides could double child leukemia risk

Children frequently exposed to household insecticides used on plants, lawns and in head lice shampoos appear to run double the risk of developing childhood leukemia, research suggests. A study by French doctors, published in the journal Occupational and Environmental Medicine, supports concerns raised in recent years about the use of toxic insecticides around the home and garden - including plant sprays, medicated shampoos and mosquito repellents - and a possible correlation with increased rates of acute leukemia in children.

A study done by INSERM in 2005, France's national institute for medical research, was based on 280 children who had acute leukemia, newly diagnosed and 288 children matched for sex and age but disease free. Detailed interviews were carried out with each mother. These included questions about the employment history of both parents, the use of insecticides in the home and garden and the use of insecticidal shampoos against head lice. It showed that the risk of developing acute leukemia was almost twice as likely in children whose mothers said that they had used insecticides in the home while pregnant and long after the birth.

In the same study, exposure to garden insecticides and fungicides as a child was associated with a more than doubling of disease occurrence. The use of insecticidal shampoos for head lice, using Lindane, was associated with almost twice the risk. Describing the links as significant, the authors said that preventive action should be considered to ensure that the health risks to children were as small as possible.

A group of pesticides known as carbamates, which are present in plant treatments, lice shampoos and insect sprays, are most commonly linked to cases of leukemia. There are three main carbamates used in the UK - carbaryl, carbofuran and carbosulfan. Head lice products containing carbaryl are now restricted to prescription after a report by a government committee that gave warning of potential carcinogenic properties.

Although products sold for use in homes and gardens are tested, mixtures of pesticides are not generally tested because of the number of permutations involved.

Source: Sam Lister, Health Correspondent, The Times London, available at http://www.timesonline.co.uk/article/0,,13509-1988878,00.html, as viewed on January 17, 2006

many of these formulations are not safe to use at home. Baygon (Proxopur, produced by Bayer) has been found to be extremely dangerous and even African countries are limiting its use. According to The US-Centers for Disease Control and Prevention (CDC), it must be strictly kept away from children. So an important question to ask is why is it so easily available and widely used in Indian homes?

This is largely because disclosure of such chemical safety data is not required in India and regulations in India remain very lax as does consumer awareness.

Chemical trespass

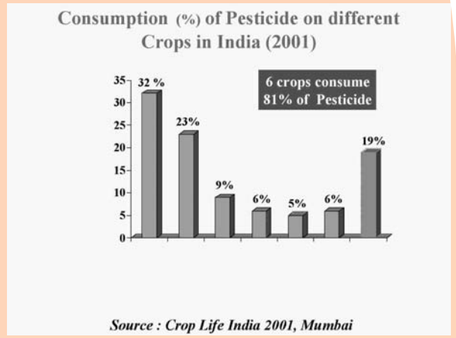
According to a report produced by Pesticide Action Network North America (PANNA) and partner groups, **Chemical Trespass: Pesticides In Our Bodies And Corporate Accountability**, in more than 20 cities many U.S. residents carry toxic pesticides in their bodies above government assessed “acceptable” levels. Analyzing pesticide residue data collected by the US Centers for Disease Control and Prevention (CDC) on levels of chemicals in 9,282 people nationwide revealed that government and industry have failed to safeguard public health from pesticide exposures. CDC found that among the people who had their blood and urine tested, 100 per cent showed pesticide residues. The average person carried a toxic cocktail of 13 of 23 pesticides analyzed. Two insecticides—chlorpyrifos and methyl parathion—were found at levels up to 4.5 times higher than what U.S government deems acceptable. Children, the population most vulnerable to pesticides are exposed to a higher level of nerve damaging organo phosphorus pesticides.lxi

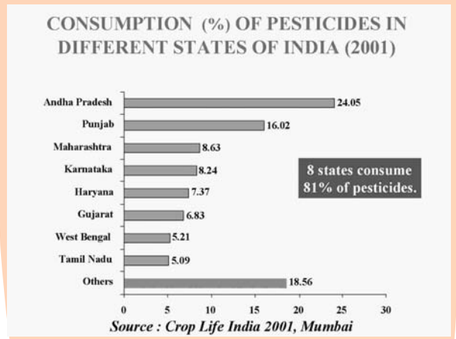
In 2004,The World Wide Fund for Nature (WWF) produced a report titled: Bad Blood, which analysed blood samples of 14 European ministers from 13 European countries, for 103 different man made chemicals from 7 different chemical families--- organo chlorine pesticides, polychlorinated biphenyls, synthetic musks, per fluorinated chemicals, brominated flame retardants, phthalates and anti bacterial. The study found that 55 of the 103 chemicals analyzed were detected and every volunteer tested had six of the 7 chemical groups. The chemical found in highest concentration in whole blood was Diethyl hexyl phthalate (endocrine disrupter) and BDE, a neurotoxic chemical used as flame retardant.[lxii]

Pesticide Use in India

After the success of the Green Revolution in India, the agriculture industry's use of pesticides increased manifold from 154 MT in 1954 to 88,000 MT in 2000-2001. According to industry estimates, pesticide use has high growth potential in India, as the use of agricultural pesticides is markedly low at 0.54 kg/ha as against 3.7 kg/ha in USA and 2.7 kg/ha in Europe. Notwithstanding the fact that overall consumption of pesticides in India as a whole is lower than that used in the developed countries of the world, there is still a widespread contamination of water, soil and air with pesticide residues. In India, among different states maximum consumption of pesticides-1999-2000 was in Uttar Pradesh(7459 MT) followed by Punjab (6972 MT), Haryana (5025 MT), Andhra Pradesh, Gujarat. Leading pesticides used in India include monocrotophos (10700 MT- globally highest consumer), acephate, endosulfan and chlorpyrifos (5000 MT - fourth highest consumer in the world).[lxiii]

About 54% of the total pesticides used in Indian agriculture are consumed on cotton alone, though it accounts for only 5% of the total cultivated area. During the 1970s, developed countries began to ban and phase-out the use of organo chlorines and adopt less persistent alternatives such as the organophosphate (OP) and carbamate pesticides. Nevertheless, in India, OCs are still the most used pesticides followed by the OPs. Three pesticides alone —DDT and HCH (OCs) and malathion (OP)—account for nearly 70% of total pesticide consumption in terms of volume in India.





According to the Ministry of Agriculture, 683 pesticides, chemicals and mixtures are registered for use with them as per the checklist prepared by them in October 2005. Of these 465 have known health impacts, 22 are organisms and plant derivatives, 196 are chemicals for which there is little or no health and safety data.

The graph (below) shows the 465 commonly used pesticides in India. If analyzed, virtually every pesticide causes one or more serious health problems. Pesticides are toxic in large or small doses; can cause cancer (1 in 4 does!); affect the nervous system (called cholinesterase inhibition, an enzyme that is first disrupted); and cause reproductive or growth limitations, especially in children.

Pesticide and health

A. How does pesticides enter our bodies?

While many of cases of poisoning occur at sites (pesticide factories, warehouses, farmers stores), most acute cases occur in developing countries, where users are often illiterate, ill trained and get exposed to these toxics. Occasionally, during spraying of fields, rural homes or villages will be inadvertently sprayed as well. This contaminates food and water and reaches infants during pregnancy and breast-feeding from residues in the mother's blood and milk. Keeping track of how much pesticide enters the environment is notoriously difficult because it is applied across thousands of fields by thousands of farmers.

Water and food samples throughout India have consistently been found to have high levels of pesticide residues, in excess of those theoretically permitted by the Indian Government. Disturbingly, there is no indication of improvement. Over the past twenty years, there has been little evidence of an observable decrease in pesticide residues in either water or food residues - in contrast to developed as well as other developing countries. Virtually, all freshwater in India has high trace amounts of pesticides and fertilisers. In 1998 the Indian Central Pollution Control Board (CPCB) found 250 groundwater samples from Delhi alone to have high levels of several organo chlorine pesticides (DDT, BHC, dieldrin, and aldrin). Many states including Madhya Pradesh, Uttar Pradesh, Tamil Nadu and Gujarat have reported this type of contamination. In addition to groundwater contamination, pesticides contaminate many of India's rivers.

Even what is considered clean and produced by multinational corporations contain toxic chemicals. (See box: CSE Coke story-*Ganda matlab Coca Cola*). Food in general,and even baby foods have unacceptable amounts of pesticides. A study done by the Centre for Science and Environment found high levels of pesticides in bottled water and soft drinks in 2003 and 2004. The study showed that even sophisticated plants and equipment cannot ensure that all toxics are removed from food and water!

Ganda matlab Coca Cola

In 2003 and 2004, Centre for Science and Environment, in New Delhi, found that bottled water and soft drinks had excessive amounts of pesticides in them. Two multi national companies—PepsiCo and Coke brands sold in Delhi and around were found to contain a deadly cocktail of pesticide residues. According to the tests conducted by the Pollution Monitoring Laboratory of CSE, all samples contained residues of four extremely toxic pesticides and insecticides: lindane, DDT, malathion and chlorpyrifos. Three samples each of the 12 brands purchased from markets across the city, analysed in April-August and found to contain pesticides residues are Pepsi, Mountain Dew, Diet Pepsi, Mirinda Orange, Mirinda Lemon, Blue Pepsi, 7-Up, Coca Cola, Fanta, Limca, Sprite and Thumbs Up.

Sunita Narain, Director, CSE, pointed out that in all the samples, levels of pesticide residues far exceeded the maximum residue limit for pesticides in water used as "food", set down by the European Economic Commission. In all PepsiCo brands, total pesticides on an average were 0.0180 mg/litre, 36 times higher than the EEC limit of total pesticides at 0.0005 mg/l. In Coca Cola brands they averaged at 0.0150 mg/l, 30 times higher than the EEC limit. The soft drink Mirinda Lemon topped the chart among all the tested brand samples with a total pesticide concentration of 0.0352 mg/l. Unfortunately, it is not easy to regulate pesticide in foods, simply because governments are too weak to implement the already lax standards and the chemical and food industry (which will have to clean the food before they sell) are too strong to manipulate standards. While globally the developed world is adopting new and safer pesticides, India continues to use old pesticides and chemicals that are proven toxic.

B.Pesticides in India's blood, breast milk and serum

Not only are adults at risk of getting cancers, but they also transfer this risk during pregnancy and breast feeding. A study in Jaipur found women with breast cancer had higher amount of DDT, HCH and eldrin in their breast tissue.

B. Cancer and Children

Look at what the map tell us about children at risk. Can you compare it with the cancer map of India?

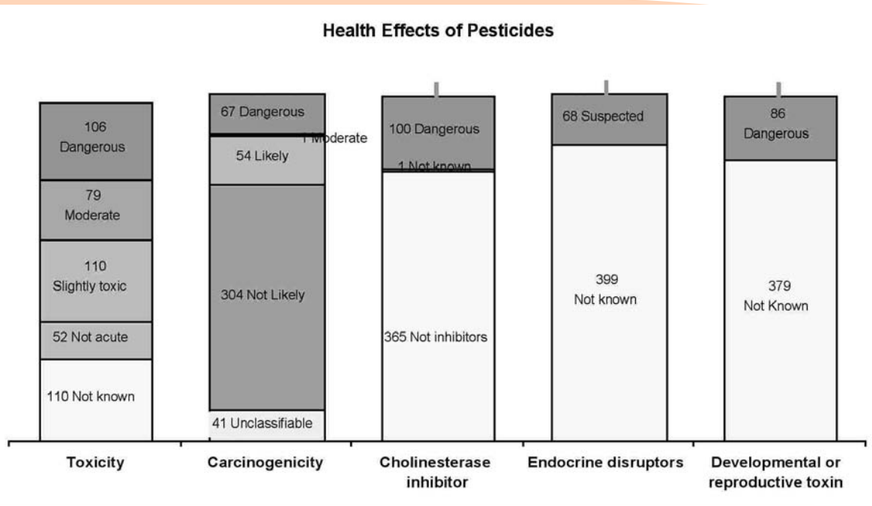
Black: More than 1.5 ppm
Dark Grey: 1.5 to 0.75 ppm
Grey: 0.75 to 0.01 ppm
Light Grey: 0.01 to 0.001 ppm
White: Not surveyed in studies
Safe level for DDT and other organochlorines: 0.001 pm

Sources: Indian Council of Medical Research (ICMR), National Institute of Occupational Health (NIOH) and Industrial Toxicology Research Centre (ITRC) reports and 62 journal articles on DDT, HCH and other pesticides found in tissue samples in India. Sample studies extrapolated to actual use of DDT, BHC and HCH in each district, based on data from IARI and Malaria Research Centre...

C. The health impact of pesticides

Short-term exposure to high pesticide concentrations cause acute poisoning often leading to death. Symptoms develop relatively soon after exposure and depend on the toxicity of the poison and on the quantity absorbed. Other symptoms of organophosphate poisoning include headache, nausea, respiratory depression and slowed heartbeat, while very high doses may result in

unconsciousness, convulsions or death. Although the number of cases of acute poisoning due to pesticides is difficult to estimate since the majority are thought to go unreported, they are thought to be responsible for at least 10% of all Indian poisonings. According to the Poison Information Centre of the National Institute of Occupational Health (NIOH), Ahmedabad, organophosphates are responsible for approximately 70% of India's pesticide poisonings. India, according to the WHO has the highest suicides and deliberate poisonings from pesticides and other chemicals (See graph below)



When pesticides enter a child's body in small but regular doses (called chronic exposure), it causes chronic ailments like cancers. Below is brief summary of what diseases can occur from such exposure. Each pesticide can cause many different types of diseases, and when two or more pesticides are exposed, the cocktails can cause even more confounding diseases.

Cancer and Pesticides

Pesticides increase the risk of cancers through a variety of mechanisms. They can mutate the DNA and stop normal production of proteins through a process called genotoxicity. They can reduce the effects of a normal immune system and cause cancerous tumours. Some pesticides have both these effects. Farmers and those who work in chemical factories that produce pesticides (or similar chemicals) have high risks of cancer rates. Even their children are not spared, as pesticide fumes and dusts are carried with them back home! Common occupational cancers include Non-Hodgkin's lymphoma (NHL), leukemia, prostate cancer and soft-tissue sarcoma (STS).

Cancer and Children

It can be especially difficult to understand and accept when a child develops cancer. The most common cancers in children are leukemia, brain tumours, and lymphomas. Nearly 1 in 450 children will be diagnosed with cancer before the age of 15. Many pediatric cancers occur very early in life and many parents want to know why. The cause of most childhood cancers is not known; although some of these cancers are the result of genetic predisposition (cancer runs in the family). Radiation exposure also contributes to certain types of childhood cancers. Other factors that have been implicated in childhood cancers include infectious diseases, prenatal conditions, environmental pollutants, electromagnetic fields, and use of medications. Unlike most cancers in adults, childhood cancers are not significantly related to lifestyle risk factors such as tobacco or alcohol use, poor diet, or not enough physical activity.

Many organ systems in children are undergoing rapid growth and development in the first years of life. These systems are especially vulnerable to injury during these periods of development. The types of cancer that occur in children vary greatly from those seen in adults.

Most Common Cancers in Children:
- Leukemias: acute lymphocytic (lymphoblastic)
- Brain and Other nervous system tumor: neuroblastoma
- Lymph-node cancers (lymphomas)
- Bone (osteosarcoma)
- Soft-tissue sarcomas: rhabdomyosarcoma
- Kidney: Wilms tumor
- Eye: retinoblastoma
- Adrenal gland (adrenocortical carcinoma)

Acute lymphocytic leukemia (ALL) is the most common childhood malignancy. ALL accounts for almost one-third of all childhood cancers. Brain and spinal cord cancers are the second most common cancers in children. Most brain cancers of children involve the cerebellum or brain stem. Adults are more likely to develop cancers in different parts of the brain—usually the cerebral hemispheres. Spinal cord tumours are less common than brain tumours in both children and adults.

Detecting Cancer in Children

Cancers in children are often difficult to recognize. Parents should take their children to regular medical checkups and should be alert to any unusual signs or symptoms that persist. It is important to report unusual signs or symptoms to a health care provider

Unusual signs or symptoms include:
- unusual mass or swelling
- unexplained paleness
- loss of energy
- sudden tendency to bruise
- persistent, localized pain or limping
- prolonged, unexplained fever or illness
- frequent headaches, often with vomiting
- sudden eye or vision changes
- excessive, rapid weight loss

Source: http://www.atsdr.cdc.gov/hanford/docs/whatisc.pdf

Don't Paint Your Children

Children are at greater risk of cancers and fertility problems in later life because of the growing use of their cosmetics and toiletries, health experts are warning.

Adolescents and the parents of young children are buying more beauty products made for adults and toiletries such as baby wipes and bubble baths than ever before. Fertility experts, cancer specialists and environmentalists are becoming alarmed by evidence that most of these products use potentially dangerous chemicals linked to breast cancer, falling sperm counts and hormonal damage. A report by Friends of the Earth accused the UK's largest retailers of failing to take effective action to cut down on these chemicals in their products. The ingredients of greatest concern include chemicals called “parabens”, which can affect the hormone estrogen and were recently found in breast cancer tissues. Even leading MNC brands have chemicals that are dangerous and often carcinogenic to children. In March 2005, the Food and Drug Administration in Mumbai found that Johnson Baby Oil contained paraffin - a compound that can cause allergy, trigger asthma attacks and in the long term also cause cancer.[lxx]

Suppressed Immunity:

- **Suppressed Immunity:** As mentioned above, low immunity can promote tumours, but there can be other diseases also. In India, toxicologists (experts who study toxic chemicals) found that pesticides rendered people more prone to new or existing diseases by suppressing their immunity.[lxxii] Many studies in India have shown that farmers, spray men and workers in chemical companies have strained immune systems. lxxiii, lxxiv, lxxv, lxxvi

• Reproductive and developmental disruption: From conception to birth to middle age, hormones and enzyme play a large role in development, reproduction and determination of the sex of a child. Pesticides have similar chemical structures to these hormones and mimic their action. Once they replace hormones, they cause a variety of reproductive and developmental abnormalities. For many years researchers have linked potential disruption of male hormones due to pesticide exposure with the decreasing sperm counts in developed countries.[lxxvii] Similarly, a study by the Institute for Research in Reproduction, Mumbai, has found a definitive decline in Indian semen quality and quantity,[lxxiii] and this especially seen in farmers like cotton field workers.[lxxix]

• Still births and birth defects: Pesticides are a major contributor to genetic abnormalities and birth defects in foetuses and children.[lxxx, lxxxi] Pesticides also cause miscarriages or still births.[lxxxii,lxxxiii, lxxxiv] High levels of DDT and DDE in maternal and foetal tissues causes spontaneous abortions and foetal deaths than for normal pregnancies.[lxxxv, lxxxvi] Two studies in India, showed that women who worked in farms had greater abortions, stillbirths, and deaths of new born than others within the same community.[lxxxvii, lxxxviii] In Kerala, a toxic pesticide called endosulfan has been held responsible for high rates of birth defects in exposed villages.[lxxxvix]

• Neurological consequences: Nerve disorders result when chemicals interfere with normal electrical transmission between nerves.[xc] Many recent studies have implicated pesticides with Parkinson's disease a profound motor disorder.[xci, xcii, xciii] Disorders of the nerves and sensory organs are often associated with long-term exposure to organochlorine, organophosphate or carbamate pesticides. In India, spray operators who visit colonies and homes during or before malaria seasons have been found have neurological symptoms, such as anxiety, sleep disturbance and depression, caused by malathion and DDT.[xciv]

'Pesticide cocktail' in blood of Punjab farmers

Punjab may be the food grain provider of the country in India but its people could have paid a heavy price for this, according to a Centre for Science and Environment (CSE) study revealing alarming pesticide levels in the blood of farmers in two districts. The CSE study of villages in Bathinda and Ropar districts found pesticide levels in the blood of Punjab farmers was 16 to 605 times higher than their counterparts in the US. It stated that higher levels of pesticides could be the cause of higher incidence of cancer among families of farmers. "We do not have any set parameters on what pesticide levels should be there. Our study was based on pesticide levels found in the blood of farmers in US and findings revealed that our farmers had much higher pesticide content," CSE director Sunita Narain told reporters.

She said pesticide manufacturers were pushing pesticides into the market with the government and its agencies doing little to regulate them. This was resulting in unsuspecting farmers getting them inside their bodies by using them in the fields. According to Narain, the study was not aimed at seeking a ban on pesticides but to give a wake-up call to the government to monitor and regulate the manufacture and use of pesticides countrywide. She said though the study had been done in Punjab, the presence of pesticides in blood of farmers could be a countrywide phenomenon. The CSE study found that farmers had in their blood veins a "cocktail" of six to 13 different types of pesticides. These included DDT, Lindane and other organophosphorous pesticides.

DDT alone was present in 95 percent of the samples taken in the study. Though manufacturers were now pushing "safer" pesticides, but studies had proved that the new pesticides like monocrotophos and chlorpyrifos were several times deadlier than DDT and Lindane.

Says Dr. Salil Dheer, leading endocrinologist based in Chandigarh says: "There is sufficient anecdotal evidence that girls in Punjab are reaching puberty earlier than before. We also have hotspots of breast cancer in Punjab, and we are also seeing that many of these women are in their mid-thirties. This is a result of several including genetic predisposition, diet and changing lifestyles and possibly heavy chemical use in the region". According to Ludhiana based oncologist, Dr. VK Khurana, "Leukemia rates in children are extremely high and also new forms of cancers especially in soft organs are being noticed".

Summary of pesticides types and their health impacts

Class of Chemical Pesticides	First Used	Examples	Current Status	Effects on children
Organochlorines	1942	aldrin; chlordane; dieldrin; endrin; heptachlor; lindane; methoxychlor; toxaphene; hexachlorobenzene (HCB); pentachlorophenol (PCP); DDT	Restricted use in the west, extensively used in India and being re-introduced in Africa (DDT to control malaria)	Persistent, bioaccumulative, affect the ability to reproduce, develop, and to withstand environmental stress by depressing the nervous, endocrine and immune systems. Potential cause of cancers
Organophosphates	Very early 1940s	schradan; parathion; malathion	Discontinued in 1970s in the west, extensively used in developing countries especially malathion, and parathion	Non-persistent, systemic (cholinesterase-inhibiting), not very selective, toxic to human. Possible carcinogens
Carbamates	First appeared in 1930 but large-scale use in mid-1950s	carbaryl; methomyl; propoxur (Baygon); aldicarb	Aldicarb discontinued in 1970s in the west, increasingly used in India for new exotic crops	Mode of action with the organophosphates, their effects are reversible, affects the nervous systems especially in children
Phenoxy	Large-scale marketing and distribution began in 1946	2,4-D 2,4,5-T	2,4-D is widely used 2,4,5-T banned in Canada, later banned in USA and many European countries	Potential to cause cancer in laboratory animals. 2,4,5-T: is the source of a toxic contaminant dioxin

4: Pests and pesticides

Overuse and abuse of pesticides has triggered rapid mutation in pests, and has made them resistant to future pesticide treatments. Resistance to insecticides is so common that more than 700 species have acquired resistance, not only to individual chemicals, but also groups of chemicals and currently nobody is really keeping score. In India, the number of serious pests has also gone up in the decades of pesticide use - in rice from 10 to 17 serious pests and in sugarcane from 2 to 43 serious pests .

Broad recommendations for reducing impact of pesticides:

At personal and home setting

- Reduce use of home and garden pesticides
- Wash raw foods, fruits and vegetables and cook fatty foods
- Survey use of pesticides in neighbourhood, especially broadcast and spraying of powders for vector control
- Identify industries, farms and incinerators where pesticides can be used or deployed

At policy and regulation level:

At production and use-level:

• Ask regulators to compare national and global standards of pesticides - see how many are banned or restricted for use. Seek deadlines for monitoring, surveillance of use, and phase-out

• Ask regulators and producers to train farmers on careful storage and use of pesticides

At food standards and regulatory level:

• Insist for composite standards - that develop a basket of pesticides option which restrict numbers of pesticides and total amount of pesticides

• Insist on public disclosure of company and regulatory methods used to assess safety from pesticide

• Insist that food standards need to be made keeping in mind the foetus and children as target and not adults

• Insist that foodstuff that have high probability of pesticide content to be labelled with pesticide use

• Ask government to support organic foods

• Monitor registration of new pesticides - globally and locally

Pesticides in detail

DDT (dichlorodiphenyltrichloroethane) is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria. DDT is a white, crystalline solid with no odour or taste. Its use in the U.S. was banned in 1972 because of damage to wildlife, but is still used in some countries. DDT breaks down into DDE and DDD oth of which are chemicals. DDT enters the environment when used as a pesticide. DDE enters the environment as a contaminant or breakdown product of DDT; DDD also enters the environment as a breakdown product of DDT. In air, DDT is rapidly broken down by sunlight, almost all within 2 days. All three stick strongly to soil and their decomposition is slow. It takes 2-15 years, depending on the type of soil. DDT, and especially DDE, build up in plants and in fatty tissues of fish, birds, and other animals. By eating contaminated foods, such as these root and leafy vegetables, fatty meat, fish, and poultry, leads to a build up of toxics in the human body.

Incidentally, countries like the US which were first to ban DDT in the 1970s, have recently promoted its use to fight malaria in Africa

Health impacts of DDT

Different agencies like the WHO's International Agency for Research on Cancer (IARC) and USEPA have determined that DDT may possibly cause cancer in humans.

Infants fed on breast milk from mothers who have been exposed have one of the highest DDT levels (in the form of DDD, and DDE) in their blood. DDT affects the nervous system. People who accidentally swallowed large amounts of DDT became excitable and had tremors and seizures. These effects went away after the exposure stopped. Several global studies have shown that women who had high amounts of DDE had an increased chance of having premature babies. These women also were unable to breast feed their babies for as long as women who had little DDE in the breast milk. DDT has in some cases been linked to the early onset of puberty[xcvi].

Dolphins and DDT

Studies by K Senthil Kumar show that the elusive dolphin and other fish in the Ganges have extremely high concentrations of DDT and other pesticides. The presence of polychlorinated biphenyls (PCBs), DDT and its metabolites and other organo chlorine pesticides has been found in dolphins of the Ganges. The World Conservation Union regards dolphin as a vulnerable species. The decline in their numbers is a cause for concern for environmentalists and scientists. Senthil Kumar and his colleagues of the department of environment conservation, Ehime University, Japan, during 1993 to 1996, found pesticide in dolphins blubber (fat) and the fishes that they ate. Since river dolphins are top predators in the riverine food chain, they are good indicators of contamination. The presence of various DDT manufacturing industries around the holy river and the disposal of their waste in it has also resulted in high concentrations of DDT in the river. DDT concentrations in the Ganga were found to range between 0.07 and 143 mg/l, with levels often exceeding 1mg/l, a safe limit proposed by the World Health Organization. The study reports high levels of DDTs in the blubber of river dolphins —in the range of 30 to 120 mg/g.

DDT use in India

Although banned for use in agriculture, DDT is still used for vector (malaria) control. It is also used surreptitiously in the spurious markets for agricultural crops and is called the Kanpur powder. VP Sharma, former director of the Malaria Research Centre, New Delhi found that three main factors have contributed to the ineffectiveness of DDT in India in controlling malaria. First, the widespread phenomenon of resistance that developed because of irrational use within and outside government agencies; two, the failure of the national programme to deliver the correct dosage of DDT and three social and cultural factors that allowed only a few homes to be sprayed while others resisted spraying in their homes, caused the mosquitoes to develop resistance easily. (V. P. Sharma, DDT: The fallen angel, CURRENT SCIENCE, VOL. 85, NO. 11, 10 DECEMBER 2003).

Holy Flying Cats!!

In the 1980s, in Malaysia, huts were sprayed with DDT to kill mosquitoes. DDT not only killed mosquitoes but also other insects, including wasps, which normally ate moth larvae living in these thatched roofs. Cockroaches that were found in the treated huts were fairly resistant to the DDT. Geckos that lived in the huts ate the cockroaches and died of DDT poisoning. Cats that ate the geckos with DDT in their bodies also died of DDT poisoning. Due to sudden scarcity of cats in the village following the DDT treatment, rats multiplied, which ushered the scare of bubonic plague. WHO arranged for cats to be dropped by parachutes to the remote village to replace those that had died and to eliminate the rats to prevent plague!

Source: J Duffs and H Worth 1998, www.iupac.org/publications/cd/essential_toxicology/IUPACDDTcase.pdf

Global revival in use of DDT

Irrational use of DDT in the past has led to resistance, especially in South and southeast Asia (see box : Flying cats). President Bush's administration was increasingly pressurised by US health advocates like Harvard's Amir Attaran who believe that it is important to save Africa from malaria now than to see the longterm and "uncertain" toxic impacts of DDT globally . President Bush as a result has given a go ahead for the use of DDT in Africa.[lcviii]

Consisering the fact that it was the US that initiated the Stockholm process on the ban on the use of POPs like DDT,this volte-face is intriguing. Instead of seeking safer alternatives, the US government is again pushing for toxic chemicals. But success of DDT in Africa will be short-lived. Conflicts, famines, mass migration of people and cattle, weak public health infrastructure, and conflicting priorities in health and development, will mean that DDT spraying will be sporadic and this is - the ideal recipe of rapid resistance development in mosquitoes. As a prescription, DDT should be used only when environmentally safe alternatives like draining, use of mosquito-eating fish, bio-pesticides, bed nets, and effective surveillance etc have failed. (See chapter on traditional diseases where we have discussed bio-environmental control measures for mosquito borne diseases and suggest caution in overuse and abuse of pesticides like DDT)

Lindane

Lindane is an organo chlorine pesticide that has been used to control many types of insects since the early 1950s. It is known to be a relatively volatile and persistent pesticide that accumulates in the body fat of humans and other animals. It can migrate over long distances through air, water and sediment. Because of these properties and also its use world wide for more than 50 years, lindane is now found throughout the global environment and has even been detected in areas of non-use like the Arctic, indicating global atmospheric transport. Studies of chemical body burden in various countries document that lindane exists worldwide in human tissues as well. Lindane has been banned in many countries, and where it is still in use it often faces pressure for additional restrictions or phase-out.[lcix]

Lindane is used both for agricultural pest control and for public health use. It is also used to control insect infestation in materials like wood, leather, wool and cotton as well as livestock applications for control of parasites.

Lindane affects the nervous system in many ways. It can start with trembling, loss of coordination, paralysis, and eventually death. Surprisingly many lotions and medicated shampoos have lindane to control head lice and scabies and it is a common household pesticide in India. Many studies from across the globe have found that excessive use of lindane in children caused them to suffer from chronic anaemia, lacking in attention-span, which led to long-term brain damage and even caused cancers. Also companies that made these concoctions, increasingly found that head lice have become resistant to current combination of pesticides like lindane, permethrin and malathion. As a result, they started adding highly concentrated mixtures of pesticides to be effective, causing more harm to children's health. Lindane-based pharmaceutical products should no longer be on the market because this growing resistance renders the products ineffective.[c]

Lindane is known to have both acute and chronic health effects. Acute exposure mainly affects the central nervous system with symptoms including vomiting and diarrhoea followed by convulsions. International Agency for Research in Cancer (IARC) reports that digestive tract inflammation, bleeding, coma and death have been reported after lindane poisoning. Workers who were heavily exposed to lindane, DDT or both for periods ranging from 5-13 years showed higher rates of cirrhosis and chronic hepatitis of the liver.[ci]

Globally, agencies have concluded that lindane is a possible human carcinogen and an endocrine disruptor capable of imitating certain hormones in humans and thereby disrupting the physiological functions. Like DDT, lindane too has been found in areas where it is not used, from Tokyo's rainwater, New Zealand's sewers and even in the pristine Arctic region. Indigenous people in the Arctic region are at special risk from organo chlorines such as lindane. The Arctic is considered a "sink" for persistent organic pollutants, because they become less volatile and are deposited in colder regions. Once in the Arctic, lindane accumulates rapidly in micro-organisms, invertebrates, fish, birds and mammals, especially in fatty tissue. This puts indigenous people of the Arctic region at greater risk, since they often rely heavily on game for their primary food source. Monitoring studies from around the world have found residues of lindane in human breastmilk. In several countries lindane has also been identified in human blood serum, fat and adipose tissue. Lindane is also linked with rare types of anaemia and occurrence of breast cancer.[cii]

Chocolate and lindane

Breast cancer incidence rates have increased exponentially over the last 50 years. Rising 1% annually over the last 30 years in the industrialized countries and now expected to kill more than 370,000 women worldwide. In the UK a woman's lifetime's risk of developing the disease has risen from one in 12 in 1995 to one in nine in 2004. Yet more than 50% of all cases still remain unexplained.

Established risk factors such as ageing, early menarche and late menopause, late childbirth, hereditary factors, and exposure to ionising radiation can only explain about 25-50% of breast cancer cases, which leaves the other 50-75% of cases with no known cause.

Many chemicals and pesticides build up in our fat tissue and breast milk. Pesticides especially can be both carcinogenic and hormonally disruptive. Breast cancer should be regarded a major and yet unsolved public health crisis.

UK based Women's Environmental Network(WEN) has been advocating a phase out for lindane in agriculture since July 2002. Not because of 100% evidence of harm but because of suspicion of harm. Still used on cocoa crops in Africa and South America, it enters developed countries like the UK through chocolate laden with lindane. Lindane has been linked with breast cancer and is a hormone disruptor. It was used extensively on the sugar beet crops in Lincolnshire. Lincolnshire has one of the highest rates of breast cancer in the UK, and also consumes high amounts of chocolates and dairy products.

Both dairy products and cocoa products need rigorous food standards especially with respect to lindane. The Pesticide Action Network (PAN), UK is advocating that since children also consume large amount of chocolates, lindane needs to be monitored closely in developing countries and its safety standards be re-valuated.

Source: Memorandum submitted by the Women's Environmental Network (Z35),20 December 2004,
www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/258/258we26.htm
http://www.pan-uk.org/banlindane/

New lice lotion

Now a California based has found a simple solution - called Nuvo lotion, to remove lice. This lotion is massaged into wet hair and scalp and then blown dry to form a shrink-wrapped, airtight invisible film that completely covers hair shafts and lice. The lice then suffocate. "Lice have portholes on the side of their bodies, which they breathe through. If you plug up all those portholes, they die," Dr. Dale Lawrence Pearlman, has developed such a lotion, according to Reuters Health. The lotion is left on for at least eight hours and then is shampooed out. The process is repeated at one-week intervals for a total of three treatments. In the medical journal Pediatrics, Pearlman notes that all of the ingredients in the lotion are "generally recognized as safe".

Malathion

Malathion is the most popular and widely used organophosphate insecticide used to kill insects on farm crops and for vector (mosquito) control. It rose to prominence when DDT was found to be hazardous and DDT resistance was growing in mosquitoes. Although marginally more expensive than DDT, malathion is used extensively in India and other developing countries. As in DDT, in India, almost all pests and mosquitoes have become resistant to malathion. Yet, it is used by the government and farmers alike to fight pestilence.

Malathion enters the environment primarily through spraying on farm crops. Malathion does not stick to soil and is broken down rapidly by bacteria in the soil, so it does not usually move from the soil to groundwater. But during rains if high concentration of malathion is applied then it can poison drinking water sources. Malathion is easily broken down by the action of the water and bacteria in the water and sunlight. Unlike DDT it does not accumulate in the food chain due to rapid break down in aquatic organisms. . Farm workers, chemical sprayers, and people who work in factories that make malathion are most likely to be exposed. The action of malathion is through regular exposure in the air they breathe or on things they touch, unless they live next to areas being sprayed. Children who play in fields and farms, or are close to the spraying during malaria seasons get exposed often to malathion.

How Malathion affects children

Malathion interferes with the normal way that the nerves and brain function. Exposure to very high levels of malathion for a short period in air, water, or food may cause difficulty breathing, chest tightness, vomiting, cramps, headaches, dizziness, loss of consciousness, and even death.

It is likely that health effects seen in children exposed to high levels of malathion will be similar to the effects seen in adults. There are reports of deaths in children of rapid death due to long exposure to malathion. Possibly the most important health impact of malathion is nerve damage. In a comprehensive review of published research on children, two scientists from the University of Plymouth (UK) wrote, "Over the last 20 years experimental evidence has accumulated that OPs [organophosphate insecticides] can interfere with the immune system in children."

Malathion exposure may cause wheezing, a respiratory symptom of that often triggers violent bouts of asthma. Lab animals are good models to test effects of chemicals. One study exposed young rats to small quantities of malathion and found that rats rapidly developed cancers like the Non-Hodgkins Lymphoma (NHL) .If rats can develop cancers, think of how growing foetuses and children would responds to sustained exposure to malathion!.

Globally, according to the World Cancer Report 2003, children have shown a rise of non Hodgkins Lymphoma (NHL). by as much as 40 per cent.

Endosulfan

Endosulfan, like DDT, has been found in some food products such as oils and fats and fruit and vegetable products. Farmers and workers can breathe in the chemical when spraying the insecticide on crops. Endosulfan enters the body through lungs by breathing or food or water contaminated by it. There are few studies on humans but it is confirmed that they can cause convulsions or other nervous system effects on short and long term exposures. In children it can cause

retardation, brain damage and even death. Because the brain controls the activity of the lungs and heart, lethal or near lethal exposures (in animals) have also resulted in failure of these organs.

But increasingly evidence has shown that children are greatly impacted by this once-safe pesticide (see box below). In India, a study by Dr. HN Saiyed of National Institute of Occupational Health, Ahmedabad, India found endosulfan exposure in male children may delay sexual maturity and interfere with sex hormone syntheses. If global evidence is taken , such children may not have children of their own as their sexual organs and their sperm are defective, and they also develop high rates of testicular cancer as they approach adulthood.ciii

In Turkey, S Kutluhan and his colleagues from the Suleyman Demirel University, School of Medicine, Department of Neurology, Isparta, Turkey found that young children who were exposed to small amount of endosulfan developed recurrent epileptic seizures.[civ]

Children of endosulfan

In Kerala, India, endosulfan has been linked to hundreds of deaths and disorders among cashew nut plantation workers and villagers. In Kasaragod district, where aerial spraying of endosulfan occurred for at least 15 years, alarmingly high levels of endosulfan residues have been detected in the blood and breast milk of villagers and cancers and disorders of the reproductive and central nervous systems are very common.

A survey of a few representative households (123) found 49 cancer cases, 43 psychiatric cases, 23 epileptics, 9 with congenital abnormalities and 23 with mental retardation. A case-controlled study comparing 170 children exposed to endosulfan with 92 unexposed children found, among the former, significantly poorer academic performance, elevated prevalence of congenital abnormalities and learning difficulties, delayed puberty in boys, and very high levels of menstrual disorders (see table below).

Romeo Quijano, Professor of Pharmacology and Toxicology (University of Philippines), recently led an investigation of health defects in Kasaragod District and stated that, “no other reasonable cause can explain the illnesses experienced by the people, except endosulfan.”

Incidence of symptoms linked to endosulfan exposure to children

Symptom	Likelihood of greater morbidity (than unexposed population)
Learning disability	More than 4.5 times the average
Retained in same class	More than 1.8 times the average
Congenital abnormalities	More than 5 times the average
Menstrual disorders	More than 4.5 times the average
Retained in same class	More than 1.5 times the average
Congenital abnormalities	More than 5 times the average
Menstrual disorders	More than 5 times the average

Source: Yadav, K. & Jeevan, S. Endosulfan Conspiracy. Down to Earth [15 July 2002] www.cseindia.org/html/endosulfan/endosulfan_index.htm.

HEAVY METALS

"Heavy metals" are elements that are five times more heavy than water (specific gravity of water is 1 at 4°C). Some well-known toxic metals are arsenic, lead, mercury, cadmium and chromium. In small quantities, certain heavy metals are nutritionally essential for a healthy life (called trace elements) and are commonly found naturally in foodstuffs, in fruits and vegetables, and in commercially available multivitamin products. Heavy metals are also common in industrial applications such as in the manufacture of pesticides, batteries, alloys, electroplated metal parts, textile dyes, paints etc. Metals are commonly present in food and water in India. It is also a deliberate adulterant in Ayurvedic medicines - so avoid all such medicines unless they are certified to be free of metals.[cv]

Heavy metals become toxic when they reach our digestive and other organs in large doses and cannot be metabolized by the body. These then start accumulating in the soft tissues. Like all toxins, heavy metals may enter the human body through food, water, and air. Industrial exposure accounts for a common route of exposure for adults. There are two broad types of toxicity - short (acute) and long (chronic) poisoning .None of the chronic diseases caused by chemicals have a cure. Even clinical understanding for many of these is poor.

Poisoning from metals are of two types. First, acute toxicity, which occurs when large doses of metals are ingested. This causes severe, rapid onset of cramping, nausea, and vomiting; pain; sweating; headaches; difficulty breathing; convulsions, and even death.

The second is chronic heavy metal toxicity which shows the following signs - anaemia's; lower energy levels; irreversible damage to blood composition (especially copper); damaged or reduced mental and cognitive ability (especially lead and mercury) and central nervous function, damaged lungs (all metals in vapour form), kidneys, liver, and other vital organs; muscular degenerative processes (multiple sclerosis and similar diseases);early onset of Alzheimer's disease; Parkinson's disease; and diverse forms of cancers are also found.

Children may develop toxic levels from normal hand-to-mouth activity when small children come in contact with contaminated soil or by actually eating objects that are not food, but dirt or paint chips. If inhaled as dust, fumes or vapours, they cause acute poisoning. Commonly toxic heavy metals discussed below are arsenic, lead, and mercury. The metals below, are ranked based on the ATSDR scale (Agency for Toxic Substances and Disease Registry). This is a US-based research agency on toxic chemicals, (http://www.atsdr.cdc.gov/) with well researched data on toxics globally and is an important scientific body on decisions made on toxic chemicals in the US.

A daily source of metals in India is the from the vegetables we consume. A study in Delhi found that vegetables are contaminated by heavy metals and are openly sold in Delhi markets. The vegetables were studied for their presence of lead, zinc and cadmium include spinach (palak), cauliflower (gobhi) and okra (bhindi). More than 70% of the 135 palak samples exceed safe limits for lead. The study also exposes the risk of vegetables and crops that grow close to cities, as these are more heavily contaminated than those that come from more rural areas.[cvi]

Heavy metals in detail

Arsenic

Arsenic is the most common cause of acute heavy metal poisoning in adults and is number 1 on the ATSDR's "Top 20 List." Arsenic is released into the environment by the smelting process of copper, zinc, and lead, as well as by the manufacturing of chemicals and glasses. Arsine gas is a common by-product produced by the manufacturing of pesticides that contain arsenic. Arsenic may be also be found in water supplies worldwide, leading to exposure through fish and through cereals and irrigated crops. Other sources are paints, rat poisoning, fungicides, and wood preservatives. Target organs are the blood, kidneys, and central nervous, digestive, and skin systems. The ailment caused by chronic exposure of arsenic is called arsenicosis, which involves dark patches with lesions on palms and soles and a gradual build up of breathing problems.

Arsenic occurs naturally in the Earth's crust. Scientists are of the view that arsenic originates in the Himalayan headwaters of the Ganga and Brahmaputra rivers. For the past many centuries, these rivers have been depositing arsenic-laden sediments across the Gangetic plains and the Padma-Meghna-Brahmaputra basin. It is human intervention in the form of groundwater abuse that has accelerated the leaching of arsenic into our drinking water sources. Two theories have been put forth explaining this contamination - that of oxidation and reduction of salts that release arsenic in water sources. Paints, varnishes, dyes, and pesticide and fungicide dusts have high concentration of arsenic.

In the Indian context arsenic is a mass poison. Arsenic is found in soils and water of the Indo-Gangetic plains, starting from central Uttar Pradesh to West Bengal, and Bangladesh. Steady reports of contamination are coming from previously unaffected states like Assam, Uttar Pradesh, Chattisgarh and Jharkhand and some of the neighbouring countries like Nepal (see table: chronology of arsenic). The natural arsenic contamination of water in this region is the single largest epidemiological disaster. About 8.7 million people residing in nine districts of West Bengal are exposed to arsenic levels above the permissible limit. But arsenic is no longer restricted to just these areas. It is feared that about 150,000 square kilometres (km) of West Bengal and Bangladesh are arsenic contaminated and a population of 66 million people residing in this area is continually exposed to the risk of arsenic poisoning. Dipankar Chakraborti, professor of environmental sciences at Jadavpur University, estimates that by 2010, about 450 million people living in the Ganga-Meghna- Brahmaputra basin—encompassing the states of Uttar Pradesh, Bihar, West Bengal, Jharkhand, Assam and Bangladesh—will be at risk of contracting arsenic-related diseases.

A large study done in children of Bangladesh found that high arsenic concentrations from drinking water was associated with reduced intellectual function and children living in areas that were increasingly getting contaminated by arsenic were losing several IQ points.[cvii] Arsenic debilitates children severely. Regular consumption of arsenic in water and food causes stunting, severe anaemia, low immunity and poor intellectual capability. A child may be born with low weight and may have breathing problems.

Chronology of arsenic detection in groundwater

1976 Punjab
1983 West Bengal
1991 Bangladesh
1999 Pakistan
2001 Nepal
2002 Bihar
2003 Uttar Pradesh and Jharkhand
2004 Assam

Source: Dipankar Chakraborti undated, http://www.soesju.org/arsenic/arsenicContents.htm?f=facilities.htm, School of Environmental Studies, Jadavpur University, Kolkata, accessed on November 19, 2004.

Many environmentalists allege that the excessive use of hand pumps in districts like Nadia and other eastern districts of West Bengal, when adequate surface water was available for drinking, is the cause of the problem. Others have pointed out that excessive irrigation, and especially the building of the Farraka barrage, that prevents water from the mighty rivers to enter Bangladesh, as a cause leaching out of arsenic into water. Whichever theory is considered, it is clear that by ignoring careful environmental planning in projects, a bigger health concern has emerged, to which there is no easy solution yet.

Strategies to combat arsenic in water

We must recognise that managing arsenic is more about effective water management strategies and less about technologies to remove the toxin. The problem of arsenic poisoning abounds because people residing in regions blessed with abundant surface water increasingly depend on groundwater, especially for drinking purposes. There is no specific medical treatment currently available to cure arsenic related diseases.

Arsenic mitigation strategy is more about prevention than cure. Identifying arsenic-affected areas and using low-cost options for treating arsenic-laden water, coupled with judicious use of groundwater for both drinking and irrigating purposes, can go a long way in checking the spread of arsenic. But there is very little rigorous research to provide a breakthrough to remedy arsenic in groundwater.[cviii]

Strategies to combat arsenic from other sources

Paints, treated wood and varnishes: This is a major concern in developed countries, but remains ignored in India. There is very little research on arsenic in commonly used and consumed commodities.

As a precaution, look for BIS certified or internationally recognised certifications.

Also keep children away from painted walls and varnished products for a week or more, so that there is considerable reduction in volatile arsenic exposure.

Lead

Lead is placed second on the ATSDR's "Top 20 List." Lead accounts for most of the cases of paediatric heavy metal poisoning (Roberts 1999). It is a very soft metal and has been used in pipes, drains, and soldering materials for many years. Most of this lead is used for batteries. Lead compounds used in paint taste sweet, encouraging small children to lick or chew paint chips or chalky paint residue. ***A single chip of paint of the size of a thumbnail contains 1 gram of lead and a few such chips can raise the intake of lead to 1,000 times the acceptable limit.***

Lead poisoning is a major environmental disease affecting over 100 million people in India, especially children, pregnant women and occupational workers. When an expectant mother has a poor diet, the problem is compounded since she will start breaking down bone to release calcium and other minerals, thereby releasing lead stored in the bones which passes to the developing baby.

In a study conducted by The George Foundation in 1998-99 in seven major Indian cities (Mumbai, Delhi, Calcutta, Chennai, Bangalore, Hyderabad and Vellore), it was seen that over 50% of the children below the age of 12 are experiencing elevated levels of lead in their blood, well above the "acceptable" limit. The study found an alarming number of children, especially in densely populated urban areas, to have high levels of lead. Another study corroborated these findings. Dr. Veena Kalra of AIIMS, New Delhi found a high prevalence of lead toxicity (as measured by the mean blood lead levels (BLL)) in schoolchildren and children residing in an urban slum of Delhi. Her study found that at least 18.4 per cent children had blood lead that was 10 times greater than permissible amount. The study also found that children whose homes and schools were away from large traffic zones and roads had lower levels of lead their blood. Vehicular pollution it was found is the major source in major cities.[cix]

Poor battery recycling for both domestically used cells, and batteries used in cars, heavy vehicles (electric) inverters are major sources of lead pollution. Because these are used in cities, they are often stored and recycled in makeshift factories and backyard units, which bring the risks of poisoning closer to children. Even people who handle these- rag pickers, scrap dealers, and those who eventually buy lead for making new batteries or other products are at risk of getting contaminated. Lead recycling is an informal clandestine industry. Since recycling is done in small units, pollution control departments do not consider these to be important sources of pollution. Lead released into the environment can impact children who live, play or study around these illegal industries.

Other source of lead are from cable coverings, plumbing, ammunition, and fuel additives. Six sources appear to account for most lead exposure: petrol and diesel additives; food can soldering; lead-based paints (see box below); ceramic glazes.

Children pick up lead dust from the floor, from their toys, and wall and furniture paint. They ingest lead when they put their hands in their mouths, when they eat with their hands, when they suck their thumbs, when they ingest soil.

Worldwide experiences have proven the economic and technical feasibility of phasing out leaded petrol. The cost of phasing out leaded gasoline, including investment costs and the incremental costs, has been estimated in the range of US$0.01-0.02 per litre of gasoline. Therefore, the removal of lead from gasoline is a highly cost effective measure. In the United States for example, the benefits of phasing out lead were estimated to outweigh the costs more than ten times.[cx] Unfortunately, India has not measured its economic gains from phasing out lead from fuels.

In India, despite phasing out lead from auto fuels, there has been a marginal decline in ambient lead levels. Possibly the rise in the numbers of cars and increasing traffic is also contributing to the rapid increase in lead levels. No agency monitors lead (or any metals) in the air or environment. Lead in paint in India is one of the highest in the world. Despite simple and cheap alternatives to lead in paint (zirconium and other benign elements can replace the use of lead), industry and government do little to offer consumers this choice.

Health impacts of Lead

No level of lead in blood is safe or normal. The disturbing fact is that exposure to extremely small amounts can have long-term and measurable effects in children while at the same time causing no distinctive symptoms. Once lead is absorbed into the bloodstream, some of it is filtered out and excreted, but the rest gets distributed to the liver, brain, kidneys and bones. Lead causes anaemia in both children and adults by impairing

the formation of oxygen-carrying molecules in the red blood cells. Progressive elevation of blood lead levels in a child's system can cause a potential genius to drop to an average achievement level and an average child to become learning disabled. Studies have shown as much as a 5.8 decline in IQ (on a scale where 100 is average) for every 10 micrograms increase of lead in blood levels. Long-term consumption of low levels of lead can be more dangerous than a single ingestion of concentrated lead.

How lead acts

High blood lead levels in children prevent normal physical and mental growth in children and limits intellectual functioning and academic achievement. These persist into adulthood and may be irreversible. Children are particularly sensitive to lead (absorbing as much as 50% of the ingested dose) and are prone to ingesting lead because they chew on painted surfaces and eat products not intended for human consumption (e.g., hobby paints, cosmetics, and even playground dirt). In addition to the symptoms found in acute lead exposure, symptoms of chronic lead exposure could be allergies, arthritis, autism, colic, hyperactivity, mood swings, nausea, numbness, lack of concentration, seizures, and weight loss. Foetuses of pregnant women are gravely affected by lead exposure since lead can pass through the placenta directly into the baby. High lead exposure probably results in foetal death. Deficiency of iron, calcium and zinc increase absorption and effects of lead. This is because the lack of one essential metal leads to the substitution by another leading to ill-health.

Mercury

Number 3 on ATSDR's "Top 20 List" is mercury. Mercury is generated naturally in the environment from the degassing of the earth's crust, from volcanic emissions. It exists in three forms: elemental mercury; organic mercury and inorganic mercury. Mercury as a metal can exist inertly (as in thermometers) and is extremely toxic. Specific compounds comprising mercury can be toxic too. Methyl-mercury, is the most common form of mercury found in the environment. It can pass into the air, soil and the food chain, mostly through aquatic animals and can become a considerable health risk. Presently, India is the largest user of mercury in the world (207-531 tonnes annually). For this reason, we need to make special efforts to protect children from this exposure.

Chlor-alkali plants and paper industries are significant producers of mercury. Other contributors are coal-fired plants viz. thermal power plants, steel industries and cement plants. Plastic industry (mercury is used as a catalyst), pulp and paper industry, medical instruments and electrical appliances, certain pharmaceutical and agricultural product account for additional consumption of mercury.

Mercury is a highly mobile element and cannot be broken down into harmless components. Mercury continuously escapes in traces, even from sludge buried deep within "secure" landfills, and companies have no facilities to monitor this escape. According to the Centre for Science and Environment, more than 90 per cent of the mercury used in industrial processes literally vanishes into thin air. Though elemental mercury is less hazardous, its other forms, especially organic mercury compounds (when it combines with carbon) such as methyl-mercury are more toxic.

Mercury is highly volatile and is converted into vapour form at relatively low temperatures. Given how much Mercury we use in India, it poses a huge risk and public health problem.

India - a mercury hotspot

It is clear that India is the world's largest producer of this terrible toxic chemical. While the developed world has an effective retrieval system and strict norms, India hardly has any regulation worth speaking of. In India, there are no norms for controlling the use of mercury in various products.

Mercury pollution is widespread in rivers and lakes of India. The main reason for groundwater contamination in places like Gujarat (Vatva, Ankleshwar and Vapi) and Andhra Pradesh (Patancheru, Medak) is the practice by rogue industries of discharging untreated effluents into the ground through bore wells. Even contaminated effluent flowing through rivers and streams or rainwater percolating through contaminated soil (at sites where toxic wastes are dumped or land-filled) can leach into the groundwater. India is one of the world's mercury hotspots, with mercury being released into the air uniformly at a rate of 0.1-0.5 tonnes per year, with coastal areas having an even higher emission rate ranging between 0.5 to two tonnes per year.

Children's Vinyl Lunch Boxes Can Contain Dangerous Levels of Lead

The Center for Environmental Health (CEH), based in Oakland, California, found that leading brands of soft vinyl lunch boxes that can expose children to harmful levels of lead. Companies included Toys "R" Us, Warner Brothers, DC Comics, Time Warner, and others involve many lunch boxes featuring beloved children's characters including Superman, Tweety Bird, Powerpuff Girls, and Hamtaro. The level of lead in one lunch box, was tested at 56,400 parts per million (ppm) of lead, more than 90 times the 600 ppm legal limit for lead in paint in children's products.

"Lead exposure should not be on the lunch menu when kids' go back to school this fall," said Michael Green, CEH Executive Director. "There is no reason to expose children to any lead from lunch boxes. We are calling on these companies to recall these products and take action to eliminate lead from their products in the future." Other lunch boxes showed levels of lead between two and twenty-five times the legal limit for lead paint in children's products. In most cases, the highest lead levels were found in the lining of lunch boxes, where lead could come into direct contact with food. Lead is known to be harmful to children even in minute amounts, as it can impair brain development and cause other behavioural and developmental problems. Children may be exposed to lead from lunch boxes when they eat food that has been stored in them. Handling the lunchboxes just before eating could also be an exposure risk.

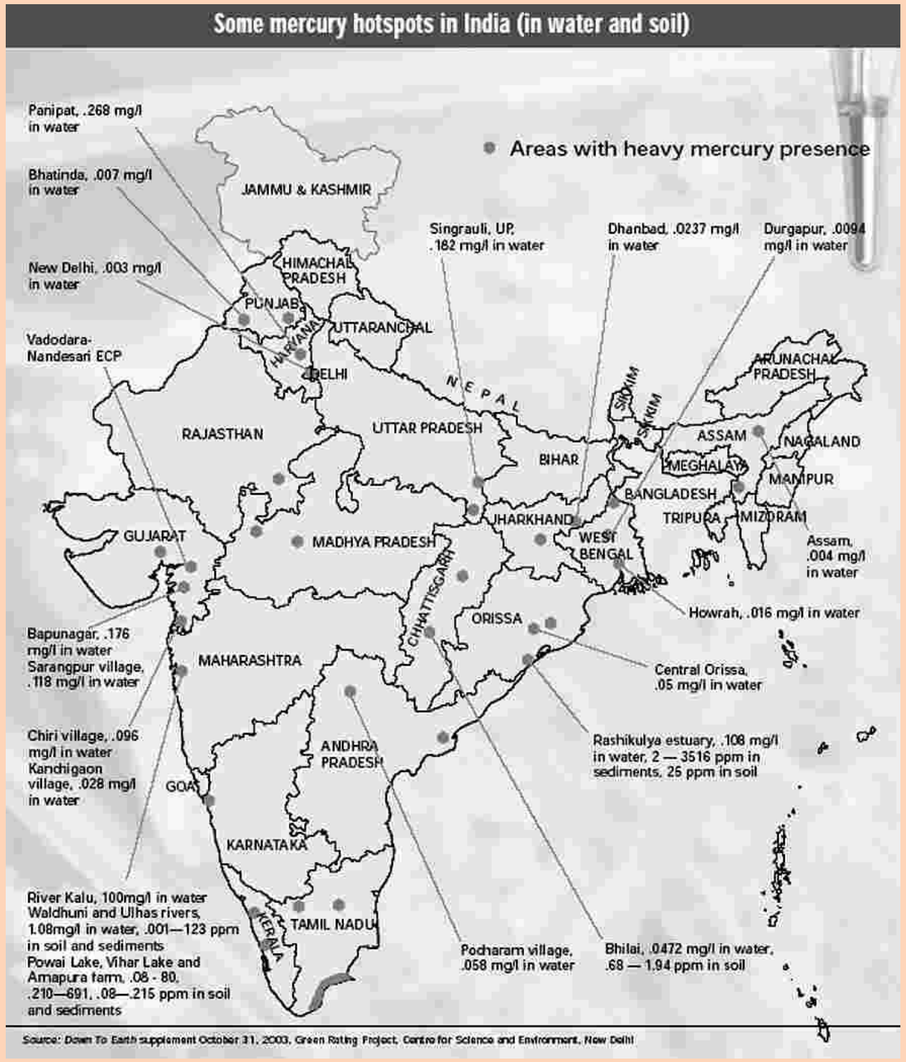
It is not possible to tell by appearance whether a vinyl lunch box may contain lead, so CEH is advising parents to avoid vinyl lunch boxes altogether. "Parents may need to seek out alternatives, since many mass produced lunch boxes are vinyl or vinyl-lined," said Green. "A reusable cloth bag would be a good alternative." Parents can find information on how to test for lead in their children's lunch boxes at home at www.cehca.org/lunchboxes.htm

Source: www.cehca.org/lunchboxes.htm .

Minamata: a lesson forgotten

During the 1960s and 70s, the Minamata Bay in southern Japan, received global media attention for a mercury pollution disaster and its negative health effects. Between 1932 and 1968, the Chisso Corporation discharged about 27 tonnes of methyl mercury with its wastewater into the bay. The pollution caused severe damage to the central nervous system of the people who ate large quantities of mercury contaminated fish from the bay. Congenital Minamata disease occurred in many infants which resembled cerebral palsy. The disease was officially recognised on 1 May 1956, caused many people to suffer from physical deformities. After the cause of the disease was finally confirmed, a number of measures were implemented, ranging from regulation of the factory effluent, ban on harvesting of fish and shellfish, and dredging of mercury-containing sediments. It was only in October 1997 that the Minamata Bay was reopened for fishing. Till 1992, 2,252 people had been diagnosed with "Minamata Disease", with 1,043 deaths reported.

India - a mercury hotspot



Practical measures to prevent mercury in daily life

It is obvious that these industries especially in India still use mercury compounds even though most developed countries have stopped using them. The government should immediately ban or restrict the use of this technology.

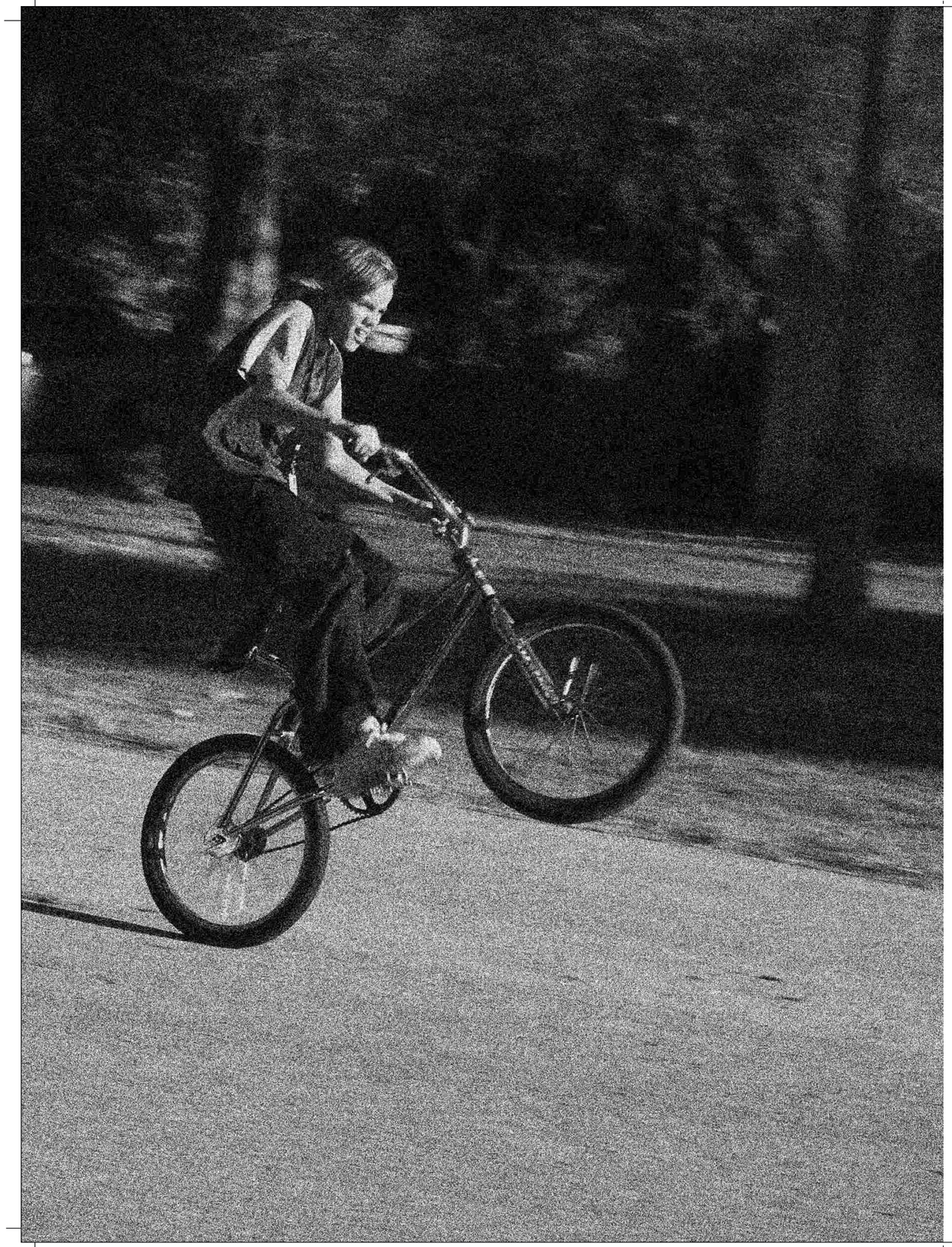
In daily life the following products must be avoided or carefully used:

• **Mercury used in dental amalgam**: instead seek the use of ceramic, porcelain or polymer fillings. Many of these fillings are more expensive but they help you stay healthier.

• **Mercury based batteries**: seek zero mercury and lead batteries, and ask for rechargeable Ni-Cad or Lithium batteries which exist in the markets. Though marginally expensive, once demand for these batteries increase, mercury and lead batteries can be phased out

• **Laboratory use**: It is possible to restrict mercury use in school.

• **Mercury thermometers**: Ask for alcohol, electric and electronic thermometer, because it is difficult to collect and safely dispose mercury from broken thermometers.



Chapter 5 :

Modern Chemicals

Modern chemicals have arisen because of the tremendous progress made in chemistry, specially after the First World War. Most of these are introduced in markets even before they are tested for their impact on human and environmental health.

Since the 1940splastics and other polymers have overwhelmed consumers. As each of these products were used on a large scale, replacing natural products like paper, metal and wood. Soon it became very cheap to make products from these and eventually they became disposable. These "wastes" were burnt, dumped or buried. Their toxic nature surfaced many years later.

Five main types of modern chemicals have become serious health concerns. These are PCBs, PVC, PBDE, dioxins and phthalates. Don't let these names scare you away, we will introduce their full forms and dangers to you one-by-one. All these cause diverse diseases ranging from birth defects to cancers to chronic unexplained syndromes. People who live near incinerators, landfills and municipal dumps globally have shown to have many of these diseases.

One of the most important health problems caused by modern chemicals is endocrine disruption (ED). This is when chemicals mimic human hormones or disrupt their functioning and are therefore called Endocrine disruptors (ED). Endocrine disruptors can cause an effect using more than one mechanism. Chemicals that cause this damage can also impair the growth of the foetus or poison the womb permanently. At least 250 confirmed hormone-mimicking chemicals are still being pumped into the environment in large quantities each year. The most important evidence of ED was seen when a prescription drug - synthetic estrogen diethylstilbestrol (DES), was given to pregnant women (between 1945 to 1970) to prevent miscarriage. Daughters born to mothers who took DES during their pregnancy had congenital malformations of the genitalia and cervical cancer. In their sons, DES caused reproductive cancers.

Since the 1930s, plasticizers(chemicals that give plastics their specific properties) have been used to impart flexibility to an otherwise rigid polyvinylchloride (PVC). Di-(2-ethylhexyl)-phthalate (DEHP) is the most commonly used plasticizer in PVC formulations. Like all ***plasticizers***, DEHP leaks out from plastic items, PVC in this case, with time. DEHP exposure can occur directly from surfaces made of PVC or through the diet of children if foods and fluids have been kept in contact with PVC. Plasticizers adversely affect male reproductive tract development and in girls reduce breast size and delay or speed up puberty. (Latini, G., De Felice, C., Verrotti, A., 2004. Plasticizers, infant nutrition and reproductive health. Reproductive Toxicology 19: 27-33.)

Workers in chemical factories, petrol pumps, plastic units, dyeing industries, mining and smelting are at the greatest risk. Possibly the biggest perpetrators are a class of compounds called dioxins.

A review presented in the esteemed journal, Environmental Health Perspectives, found that timing, frequency, and duration of exposure of single or multiple compounds can complement action of chemicals.[cxi]

Damage caused by environmental toxins during critical periods of growth have been found to be

Dioxin

Dioxin is a family of chemicals containing carbon, hydrogen and chlorine. There are seventy-five different forms of dioxin, with the most toxic being 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD. TCDD is more commonly recognized as the toxic contaminant found in Agent Orange and at Love Canal, N.Y. and Times Beach, Missouri. The top three sources of dioxin are municipal waste and hospital incinerators and backyard burn barrels. Additional sources include chemical processing facilities that use chlorine to make products such as polyvinyl chloride (PVC) plastic and pesticides and pulp mills that use chlorine to bleach wood pulp to make paper white.

90% of dioxin comes from the food we regularly eat, such as meat, dairy, and fish products. Dairy cows and cattle absorb dioxin by eating grass or feed that has become contaminated by airborne dioxins that settled onto soil and plants. The animals absorb and accumulate dioxin in their bodies, which we consume and accumulate in our bodies when we eat food high in fat content such as meat, fish and dairy products.

Dioxin can lead to a wide array of adverse health effects including cancer, birth defects, diabetes, learning and developmental delays, endometriosis, and immune system abnormalities. Dioxin is a known carcinogen. IARC, the International Agency for Research on Cancer, which is part of the World Health Organization, classified it as a known human carcinogen in 1997. Dioxin also causes a wide range of non-cancer effects including reproductive, developmental, immunological, and endocrine effects in both animals and humans. In children, dioxin exposure has been associated with IQ deficits, delays in psychomotor and neurodevelopment, and altered behaviour including hyperactivity.

How shampoos may be scrambling your hormones

Ingredients in shampoos, dyes and detergents may be mixing up your hormonal signals. No one knows for sure, but the EPA is stepping up research, according to consumer research organisations in the US and Europe. The concern grew largely out of a study published in 2002 of 17,000 U.S. girls showed that 48 percent of black girls and 15 percent of white girls showed signs of puberty by age 8. Doctors offer several explanations, some benign. One is that "normal" development ages may be based on flawed data, or that better nutrition in recent decades has had an impact. But some researchers worry that ingredients in some shampoos, dyes and detergents are absorbed through the skin and then scramble hormonal signals.

Other studies in reputed journals have proven that chemicals are playing havoc with hormones that control reproduction and development. Two possible signs of trouble: Lower sperm counts in men and earlier puberty in girls.

"Hormone disruption has emerged as one of our top research priorities over the past couple of years," says Lawrence Reiter at the U.S. Environmental Protection Agency. After reviewing nearly 300 studies, the EPA concluded in 1997 that hormone-disrupting chemicals "can lead to disturbing health effects in animals, including cancer, sterility and developmental problems."

The agency said the jury is still out on whether these chemicals—many originating in pesticides, plastics and industrial pollutants—are causing similar problems in humans. But it called for stepped-up research because of potential risks, especially for children.

irreversible. Young boys and girls globally have been reaching puberty earlier than the previous generations. The most important study done so far has been a survey of 145 girls in Belgium during a 9-year period for treatment of precocious puberty. The study found that exposure to endocrine disruptors like DDT, had caused this change. It was found that girls of foreign origin had higher levels of DDE, a derivative of DDT. Native Belgian girls did not show any large variation from previous generations. Because DDT continues to be used in high amounts in developing countries, it contaminates food and is absorbed in the body.

The Risk for Children of Both Sexes

The stakes are high because hormones play such a crucial role in body functions. Produced by the endocrine glands, hormones act as chemical messengers that tell cells in organs and tissues what to do. Hormones like estrogen and testosterone, for example, help determine how sex organs develop and function. Scientists want to know if man-made chemicals that can interfere with the hormonal system are responsible for plummeting sperm counts in men in many parts of the world and for other problems such as the dramatic increase in a defect of the penis in U.S. newborns.

Industry can't ignore it

A number of people believe there's already ample evidence to indict several chemicals. "At what point do you say there are enough red flags?" asks University of Missouri biology professor Frederick vom Saal, one of several experts working with the National Academy of Sciences on the issue. Vom Saal says his research shows a chemical in the lining of cans leaches into food in amounts capable of disrupting hormones in humans. The chemical industry sees things differently. Hormone disruption "is a plausible hypothesis; you can't walk away and ignore it," says Jon Holtzman of the Chemical Manufacturers Association. But so far, he says, "the replicated, peer-reviewed research has not turned up significant problems." His group is spending $4 million in the next two years to research the issue.

Dr. Roya Rozati, of Mahavir Hospital and Research Center, Hyderabad produced a seminal research study to show that how much EDC have invaded the bodies of a common Indian. Her study evaluated the role of the environmental estrogens polychlorinated biphenyls (PCBs) and phthalate esters (PEs) in the deterioration of semen parameters in infertile men. Her study found high levels of PCBs and PEs were in the plasma of infertile men but not in healthy (controls) people. It was found that PCB and PE concentrations were found in urban fish eaters, followed by rural fish

Evidence from India

In India too, girls and boys are reaching puberty earlier than before. Research by Dr. H N Saiyed, director of National Institute of Occupational Health (NIOH), Ahmedabad, and his associates have found that schoolgirls whose school is situated close to a lead smelter in Kolkata matured sexually quicker than other girls in other parts of the city where lead concentrations were lower. Says Saiyeed, "Lead is mostly accumulated in the bones but also targets soft organs causing particular damage to the brain and nervous system, kidneys, liver, reproductive system and the cardiovascular system Apart from reducing intellectual performance and cause severe anaemia in children (lead displaces iron in red blood cells), our study has shown that it is a serious endocrine disrupter."

eaters, urban vegetarians, and rural vegetarians. This study proves that PCBs and PEs are making the young and maturing Indians in infertile. (Source: Roya Rozati,, Role of environmental estrogens in the deterioration of male factor fertility Fertility and Sterility Vol. 78, NO. 6, December 2002 American Society for Reproductive Medicine, Elsevier Science Inc.) There is therefore increasing rates where children who achieve puberty do not have functional reproductive organs (the testes). How else can one explain the rise in infertility clinics in cities of India? In Delhi, according to the Health Directory of India, published by the Ministry of Health and Family Welfare, in 2004 there were 286 registered conception assistance and andrology centres addressing this problem as against, only three such centres in 1986!

Polychlorinated biphenyls (PCBs)

PCBs are found commonly in fats of fish or animal flesh and cannot be removed by washing or cooking. The dietary intake of PCBs is expected to account for 89%-99% of human exposure to these compounds. Studies have found that exposure to phthalates is highest via food (baby milk formula, milk products and potato chips), drinks directly contaminated by plastic wraps containing phthalates, or polluted drinking water. Rozatti's research attributes to declining sperm

levels in young males to rapid industrialization and environmental degradation around Hyderabad. Her study states: "industrial effluents from major industries such as cement and cement products, synthetic drugs and pharmaceuticals, petrochemicals, plastic industries, heavy electrical, fertilizers, tobacco, and coal" may account for observations of higher concentrations (of chemicals) in urban dwellers compared with rural dwellers.

Data shows that in the last 25 years, the incidence of cancers, especially in children, is rising. Testicular cancer is affecting even younger males, and their average age is declining.

Polybrominated diphenylether (PBDE) is another major endocrine disruptor which has got little attention. The following products usually contain PBDEs: computers, television sets, mobile phones, electronics and electrical items, automotive equipment, construction materials, polyurethane foam mattresses, cushions, carpets, upholstered furniture, and draperies, among others. PBDEs typically constitute between 5 and 30 percent of the product's net weight.
Despite the fact that human PBDE concentrations are significantly lower than those of PCBs or DDT in mothers' milk, over the past 25 years, PBDE levels in breast milk have climbed much higher. In developing countries like Malaysia and Thailand, both DDT and PBDE levels are very high in breast tissue and milk, This means that PBDE does not replace DDT, rather accommodates to add to the toxic burden!

Despite little scientific research in India, scientists elsewhere have found that the blubber of cetaceans (mammals that belong to the family of whales) in India have much lower level of PBDE than other industrialised Asian countries like Japan and South Korea. But the researchers warn that across Indian coast the levels vary and these are increasing rapidly.[cxii]

Polyvinyl Chloride (PVC)

PVC is also known as the poison plastic because of its toxic emissions and their impact on health. At every stage - from production, to use to its destruction - PVC is a leading toxin contributor.. The UN-led Stockholm Convention on Persistent Organic Pollutants (POPs) identifies PVC combustion as a significant source of dioxins. A study on PVC toys has shown that PVC toys have unacceptably high content of phthalates, and as much 10-40% of the toys' weight.

PVC is environmentally hazardous throughout its lifecycle (production, use, and disposal). Dioxin, a known human carcinogen, is created during the production of PVC, as well as when PVC is burned. Among other things, dioxin has been linked to endocrine disruption, reproductive abnormalities, neurological problems, and infertility in humans and animals. In addition, large amounts of chemicals called “phthalates” are used tomanufacture PVC products. A commonly used phthalate plasticizer called diethylhexyl- phthalate (DEHP) is a probably reproductive toxicant, as well as a toxicant of the liver and kidneys. PVCs is extensively used in building materials such as furniture and floor coverings.

A 2003 Finnish study investigated a high incidence of adult-onset asthma among employees working in an office building. Rates of asthma in this workplace were nine times higher than that among Finnish workers similarly employed. Researchers discovered that degraded vinyl floor covering had released volatile organic chemicals such as 3-ethyl-1-hexanol and 1-butanol, into indoor air, which triggers breathlessness or asthmatic attacks on those who are sensitive. A study of more than 10,000 Swedish children found that the combination of floor moisture and PVC flooring significantly increased asthmatic symptoms.[cxiii]

Chemicals cling on to food
Plastic food packaging film or cling film, has made protecting and preserving of foods. But recent studies indicate that commonly used plasticizer in these films - di-2-ethylhexyl adipate, DEHA - is dangerous, especially to children's health.

A study published in the US-Consumer Report endocrine disrupters in cheeses that is wrapped in several kinds of plastic, found very high levels of DEHA. DEHA leaches from the PVC film into an acidic cheese thereby making children susceptible to endocrine disruption. Other plasticizers, in particular dibutylphthalate (DBP) and di(2-ethylhexyl)phthalate (DEHP) are also present in varying amounts in cheese.

Source: CONSUMER REPORTS, June 1998, page 52

Phthalate

Phthalates are the most common endocrine disrupting compounds (EDCs) that humans encounter. Phthalates are a class of chemicals that are widely used in consumer products to soften plastics, and as carriers for fragrances. Many soft vinyl products may contain more than 40% phthalates by weight. Humans are widely exposed to phthalates because vinyl is a ubiquitous plastic used to make anything from home furnishings (for example, flooring, wallpaper), medical devices (for example, catheters, IV- and blood bags), children's items (for example, infant feeding bottles, squeeze toys, changing mats, teethers) to packaging (for example, disposable bottles, food wrap).

Beyond vinyl, humans are further exposed to phthalates in cosmetics and scented products such as perfumes, soaps, lotions and shampoos. Phthalates are also added to insecticides, adhesives, sealants and car-care products. The human health effects of phthalates are not yet well understood, but emerging scientific evidence is raising serious concerns. The developing foetus and infant appear to be particularly sensitive to the effects of phthalates. Certain phthalates have been shown to cause a wide range of adverse effects in lab animals, including reproductive and developmental harm, organ damage, immune suppression, and inducing early puberty in children and cancers.

India produces 135, 000 metric tonnes of phthalate plasticizers, as reported in a government committee report in 2000. The plastics sector will grow at about 11 per cent, and phthalate production is anticipated to double in 8-9 years.[cxiv]

A study released by the Center for Disease Control and Prevention (CDC) in 2001 confirmed that humans have certain phthalates in their bodies. Eating is probably the main route by which humans are contaminated with diethylhexyl phthalate (DEHP), the most widely used phthalate plasticizer. DEHP migrates into food from certain food wraps during storage. Children may take in higher than average amounts because many chew toys made of highly phthalate-softened vinyl (for example, teethers). Indeed, the highest levels released from teethers and toys exceeded the acceptable daily intake level. According to studies conducted in the Netherlands and Denmark, that simulated children's mouthing behaviour. Furthermore, a Dutch study confirmed what most of us have observed—children suck or chew their fingers and other things that are not intended to go into their mouths. This instinctive chewing undoubtedly adds to their overall intake of phthalates.

The CDC's National Toxicology Program (NTP) expressed concern over the adverse development of babies born to pregnant women who take in DEHP at the normal levels estimated for an adult. They also expressed concern that male infants and toddlers who substantially exceed adult DEHP intake estimates could suffer problems in their reproductive system development. DEHP has been classified as a "probable human carcinogen" by the EPA.

In 1999, prompted by the potential of babies to intake dangerous amounts of phthalates and the serious, negative health effects found in animal studies, the European Union placed an emergency ban on the use of certain phthalates in toys made for children under the age of three. This emergency ban was recently renewed. In the United States, the Consumer Product Safety Commission (CPSC) and the Toy Manufacturers of America (TMA) agreed upon a voluntary limit of DEHP at 3% in pacifiers and teethers in 1986. There are no recommendations for phthalates in India.

Globally, developed countries in Europe and the US are aiming to improve the safety of numerous toys and baby-care products that contain toxic chemicals. The European Union already recognizes that phthalates (such as DBP and DEHP) simply don't belong in baby bottles, rubber duckies or teething rings. The EU is also re-evaluating the use of bisphenol-A in children's products. There is acceptance that children and adults are regularly and unknowingly exposed to phthalates. Bisphenol-A, a hormone disrupter, is also used in dental sealants and in the resins that line food cans, in addition to hard, clear plastic products, such as baby bottles. Children under age 3 are thus one of the most vulnerable populations by far. But children are also highly vulnerable long before they are even born. Shanna H. Swan , professor of obstetrics and gynecology at the University of Rochester School of Medicine and Dentistry, conducted a study which found that even before birth boys are susceptible to the effects of plastics - which she calls the phthalate syndrome. "We found that the higher the level of phthalates in the mother, the more likely to have incomplete testicular descent and smaller penises" says Swan. The changes occurred at phthalate levels that have been measured in about one-quarter of women in the United States according to the study.[cxv]

Some broad protection measures from chemical toxins:

In the home, the basic rule of thumb is raising your awareness of possible sources of exposure and reducing the threat of exposure to chemical toxins

Think carefully about the necessity of having products containing toxic metals around the house or in the store, such as domestic pesticide, paints, refinishing chemicals, household cleaning agents, batteries, varnishes, other chemicals etc.

When these products are necessary, store them carefully. Make sure the lids are tightly placed and the containers are placed out of the reach of children.

• Use kitchen-based alternatives when possible.

• Emphasize safety rules with children. If your work involves chemical use directly or indirectly, avoid bringing toxic materials into your house on your clothing and shoes.

• Read labels. Know the potential hazards of what you are buying.

• Store products in their original container. Read the label every time you use a product. Refer to the label in case of an accidental spill or ingestion. Never store household chemicals in a food container, even if the container has been re-labeled.

• Become familiar with the symptoms of poisioning and first aid procedures for ingestion of substances containing toxic chemicals.

Ask if you are a higher risk group

Higher risk groups are:

• Those who work in or live around industries that manufacture batteries, pesticides, and fertilizers or who are members of their households and residents around landfills (industrial and municipal) - find these out through land use plans of your town or city.

• Those who live in homes that contain lead pipes and lead-based paint or in areas having high environmental levels of elemental mercury, iron, or aluminum

• Those who work in industries that are involved in chemicals and metal finishing

• Those who handle chemicals or radiation in scientific or laboratory settings

• Exposure to heavy metals can be considered acute from an accident or chronic from long-term exposure. Unrecognized or untreated toxicity is likely to result in illness and reduced quality of life. Testing is essential if you suspect someone in your household might have heavy metal toxicity. If test results are positive, initiation of appropriate conventional and natural medical procedures might be required.

Solutions against chemical toxics

At home and schools:

• Eliminate use of dangerous chemicals

• As a consumer and citizen, demand complete information on safety and health aspects of all chemicals including pesticides and make these available publicly

• Change your diet. Limit your intake of meat and dairy products, or switch to leaner or lower-fat versions. This reduces your exposure to industrial pollutants, such as dioxin, that concentrate in the fat of animals.

• Buy organic food whenever possible.

• Avoid vinyl. Don't give children pacifiers or teething rings made from vinyl. Change plastic flooring and doors!

• Go natural with pests. Use herbal or scent-based, not pesticide-based, insect repellents.

• Read shampoo labels. Choose hair-care products without "octoxynol" or "nonoxynol" among their ingredients.

• Avoid polystyrene foam. Don't use plastic foam containers for fatty foods, alcohol, or hot foods or beverages.

• Carefully monitor waste disposal. There are rules and standards in India for this, educate yourself to act. Learn about the MSW rules 2000, Bio Medical rules 1998.

• Watch out for incinerators in industries and hospitals that emit loads of dioxins.

• Ask your municipality to stop all waste burning.

Inform yourself about the Legislation. Read about these ones first:

• The Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003

• The Air (Prevention and Control of Pollution) Act 1981, amended 1987

• The Environment (Protection) Act, 1986, amended 1991

• The Municipal Solid Waste (Management and Handling) Rules, 2000

• The Bio-Medical Waste (Management and Handling) Rules, 1998

• Hazardous Wastes (Management and Handling) Amendment Rules, 2003

• The Batteries (Management and Handling) Rules, 2001

• The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996

• The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000

• The Public Liability Insurance Rules, 1991, amended 1993

All of these are available on http://envfor.nic.in/legis/legis.html#J

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) is the European Union's new chemical policy. Most simply explained, it puts the onus of proving that a chemical is safe on the manufacturer, who will provide information on a chemical's safety till the EU is satisfied. This information will be publicly available. Initially, just the most commonly used chemicals by weight are being targeted, followed by others. REACH also has several incentives to switch over from more toxics to less toxic chemicals. By doing this, the EU is regulating chemicals for protection of public health. Hopefully, as toxic are cast aside in the EU, policy makers in India will also want to safeguard our health and use their learning to leapfrog. Read more at http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

General conclusion

Future of insidious chemicals

Though the science of making new chemicals is not new, their impacts on humans and the environment is seldom studied by those who make them. Once the efficacy of a chemical is proved in the lab, the regulatory process to its clearance is simple. Many countries simply follow what has been accepted in other countries and accept them in their own country. As understanding of chemicals and disease is emerging, new challenges are arising. For example, scientists and health experts are now debating how two or more chemical can combine to cause similar or diverse impacts on human health. In growing children this is particularly a serious issue. We feel that certain issues need to be considered for policy making and research.

These include:

1. Research for safer alternatives and promote use of safer alternative instead of what is cheap and benefits an interest group (like industries!)

2. Ask governments and regulators to develop rigorous study methods. Also demand that the Government should tax chemicals that are hazardous – both from the producer and consumers – so that it offsets excessive production and use.

3. Initiate bio-vector control for malaria and dengue control and Integrated Pest

In other words, what is needed is a national protocol that is driven not by economics, but by health concerns. Regulators must be influenced more by law and public issues rather than supporting commercial and vested interests.

References

1 World Health Organization (WHO) (2000) World Health Report (1999), Geneva

ii KR Smith, Corvalan CF, Kjellstrom T (1999) How much global ill health is attributable to environmental factors? Epidemiology 10(5):573-84.

iii WHO, 2006, Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease, Geneva

v Delhi Urban Environment and Infrastructure Improvement Project, Ministry of Environment and Forests, Govt. of India and Govt. of NCT of Delhi.

iv Pranay Lal, Fevers of Unknown Origins, Down TO Earth, November 15, 2000, Centre for Science and Environment, New Delhi

v Food and Agriculture Organisation (FAO , World Hunger Report 2003

vii http://www.mohfw.nic.in/reports_on_ncmh.htm

viii www.iarc.fr/WCR/

ix National Toxicology Program Studies available at www.ntp-server.niehs.nih.gov (as on March 31, 2006)

x WHO website: http://www.who.int/ceh/publications/atlas/en/index.html

xi World Health Organization (WHO) website http://www.who.int/whr/1999/en/index.html and The Global Fund for AIDS, TB and malaria website : www.theglobalfund.org/en/files/ about/replenishment/disease_report_malaria_en.pdf

xii T Ford et al 1996, A global decline in microbiological safety of water: A call for action, in American Academy of Microbiology, Washington DC, USA, pp 5-35.

xiii World Bank 2001, Rapid Assessment of Government Subsidy To Rural Water Supply In India, Infrastructure Forum, World Bank, New Delhi, pp 1-7

xiv Water Supply and Sanitation Collaborative Council undated, WASH facts and figures, available at www.wsscc.org, as viewed on July 5, 2003.

xv World Health Organization 1996, Water and Sanitation, Fact Sheet No 12, WHO, Geneva, http://www.who.int/inf-fs/en/fact112.html as viewed on October 15.

xvi VJ Mathan 1998, Diarroheal diseases, British Medical Journal, 54 (2): 407-419.

xvii World Health Organization (WHO) 2001, Action against Infection Newsletter, WHO, Geneva, http://www.who.int/infectious-disease-news/newsletter/vol2-7November-December2001/vol2-7-eng.pdf as viewed on March 1.

xviii The World Bank 1998, India - Comparative Review of Rural Water Systems Experience: The Rajasthan Water Supply and Sewerage Project, and the Rural Water Supply and Environmental Sanitation Projects for Maharashtra and Karnataka, Impact Evaluation Report, No 18114, New Delhi, p 23.

xix Millennium Challenge Report, 2005,

xx UNDP-World Bank, 2002, Water for India's Poor - Who Pays the Price for Broken Promises? UNDP-World Bank Water and Sanitation program report, , South Asia Region Report

xxi World Health Organization (WHO) 2000, Polio Eradication Initiative: Strategic Plan 2001-2005, WHO, Geneva, www.who.int/vaccines-polio/all/news/ les/pdf/The_nal_FRR_3.pdf as viewed on June 5.

xxii W Edmundson et al 2002, Worm Infestation In India and Indonesia, Macmillan International, Australia, available at http://www.midcoast.com.au/~wedmunds/c12-worm.htm as viewed on February 20.

xxiii A Kapikian et al 1990, Rotaviruses. In: elds BN, Knipe DM, Channock RM, (eds), Virology, Raven Press, London, UK, pp 1353-1404.

xxiv U Parashar et al 2003, Global Illness and Deaths Caused by Rotavirus Disease in Children, in Emerging Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, USA, Vol 9, No 5, p 565.

xxv P Lal et al 2001, Hollow men and ailing systems, in Down To Earth, Society for Environmental Communications, New Delhi, Vol 11, No 12, November 15, pp.

xxvi V P Sharma 1996, Re-emergence of malaria in India, in Indian Journal of Medical Research, Indian Council of Medical Research, New Delhi, Vol 103, pp 26-45.

xxvii Y K Jain 1999, Changing ecology of malaria, in Resonance, Indian Academy of Sciences, Bangalore, pp 33 – 37.

Andrew Speilman and Michael D'Antonio Mosquito : A Natural history of our most persistent and deadly foe, Hyperion, 1st. ed., 2001 page 215 - 216

xxviii S Pattanayak 1994, Malaria paradigms in India and control strategies, in Indian Journal of Malariology, Imalaria Research Centre, New Delhi, pg. 148.

xxix National Anti Malaria Programme (NAMP) 1999, Malaria and its control in India- Country Scenario, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, New Delhi, pp 49-56

xxx Jürg Utzinger et al, 2001, Efficacy and cost-effectiveness of environmental management for malaria control, Princeton University, Princeton, New Jersey, USA draft submitted to Submitted to: Tropical Medicine and International Health – 11/05/2001

xxxi J Victor and R Reuben 2000, Effects of organic and inorganic fertilisers on mosquito populations in rice fields of southern India, in Medical and Veterinary Entomology, Vol 14, No 4, pp 361-368.

xxxii R Sharma 1991, The Kheda malaria project: the case for environmental control, in Health Policy and Planning, Oxford University Press, New Delhi, Vol 6, No 3, pp 262-270.

xxxiii V Sharma and V Dua 1997, Industrial malaria control: a bioenvironmental approach, in Journal of Parasitic Diseases, Vol 21, No 1, June, pp 89-94.

xxxiv Gayathri Ramachandran 2003, Integration of rural energy issues in rural development planning in India, Ex-officio principal secretary, Environment Department, Government of Andhra Pradesh, mimeo.

xxxv Jessica Budds et al 2001, What's cooking?, Water and environmental health at London and Loughborough, UK.

xxxvi Census of India 2001, Tables of Household, household amenities and assets, H Series, Registrar General and Census Commissioner, India, page 51

References

xxxvii Carl-Gustaf Bornehag, et al , The Association between Asthma and Allergic Symptoms in Children and Phthalates in House Dust: A Nested Case-Control Study, Environmental Health Perspectives Volume 112, Number 14, October 2004.

xxxvii Science notes: Archives of Disease in Childhood 2002;87:111–113.

xxxix Kirk Smith, Annual Review of Energy and Environment, 18, 529, 1993.

xl M R Pandey 1996-97, Women, Wood Energy and Health, in Wood Energy News, Regional Wood Energy Development Programme, Bangkok, Thailand, Vol.12, No 1, December / April, pp 3-5..

xli Anon 2000, Addressing the link between indoor air pollution, household energy and human health, Report on the WHO-USAID Global consultation on health impact of indoor air pollution and household energy in developing countries, Washington DC, May 3 to 4.

xlii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xliii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xliv Vinay Tandon and Mamta Chander 2004, LPG a key to empowerment of hill women, Winrock, New Delhi, mimeo

xlv Xavier Bosch 2003, Ominous start to US influenza season, in The Lancet, The Lancet Publishing House, UK, Vol 362, p 1902.

xlvi Kirk Smith 2002, Indoor air pollution in developing countries: recommendations for research, in IndoorAir, Blackwell Munksgaard, Denmark, Vol 12, pp 198-207.

xlvii Zodpey SP, Ughade SN (1999) Exposure to cheaper cooking fuels and risk of age-related cataract in women. Indian Journal of Occupational and Environmental Medicine, 3(4):159-161

xliii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xlix Priti Kumar et al 1997, Death is in the Air in Down To Earth, Society for Environment Communication, New Delhi, Vol 6, No 12, p29-43.

l www.epa.gov/chemfact/f_perchl.txt

li H Paramesh, Epidemiology of asthma in India. (Year : 2002 l Volume : 69 l Issue : 4 l Page : 309-12, Indian Journal of Pediatrics

lii F Wania et al 1993, Global fractionation and cold condensation of low volatility organochlorine compounds in polar regions, in Ambio, Vol 22, No 1, pp 10-18.

liii Daniel Smith 1999, Worldwide trends in DDT levels in human breast milk, in International Journal of Epidemiology, Vol 28, pp 179-188.

liv WHO/UNEP Working Group. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO, Geneva, Switzerland

lv Sandra Postel , Dividing the waters: Food security, ecosystem health, and the new politics of scarcity, Worldwatch Paper 132, p5-64, Sep. 1996))

lvi E. V. S. Prakasa Rao and K. Puttanna, Nitrates, agriculture and environment, CURRENT SCIENCE, VOL. 79, NO. 9, 10 NOVEMBER 2000. pg- 1163-66

lvii Deepanjan Majumdar, The Blue Baby Syndrome -Nitrate Poisoning in Humans, Resonance, Indian Academy of Science, October 2003, http://ns1.ias.ac.in/resonance/Oct2003/pdf/Oct2003p20-30.pdf

lviii FAO :http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0

lix See : www.pic.int/incs/icrc3/Z1)/English/ICRC.3.17.add1.PDF

lx http://www.cdc.gov/niosh/ipcsneng/neng0191.html

lxi KS Schafer, Reeves M, Spitzer S, Kegley S (2004) In Chemical trespass: Pesticides in our bodies and corporate accountability, Pesticide Action Network North America. Available athttp://www.panna.org.)

lxii WWF, 2004, Bad Blood A Survey of Chemicals in the Blood of European Ministers, WWF DetoX Campaign http://www.wwf.fi/wwf/www/uploads/pdf/baqdblood.pdf

lxiii Pesticide Information, Volume XXVIII, No. 3, October- December 2002)

lxiv http://cibrc.nic.in/list_sched.htm

lxv Damandeep Singh 1998, Capitals Groundwater is a Health Hazard, in The Indian Express, Indian Express Newspapers Limited, February 10.

lxvi P S Datta 1998, National Overview of the Chemical Contamination of Groundwater in India, Paper presented at the National Conference on Health and Environment organised by Centre for Science and Environment, New Delhi, July 7-9, mimeo.

lxvii National Poisoning Information Centre 2001, Annual Report, New Delhi, p 2.

lxviii A Dewan et al 1998, Acute poisonings due to agricultural pesticides reported to the NIOH Poison Information Centre, In Proceedings of the WHO Workshop on Occupational Health Problems in Agriculture Sector. Eds. JR Parikh, VN Gokani, PB Doctor, DN Gandhi and HN Saiyed, National Institute of Occupational Health, Ahmedabad, p 136.

lxix HH McDuffie 1994, Women at work: agriculture and pesticides, In J Occup Med, Vol 36 No 11 pp 1240-6; DL Davis et al 1993, Agricultural exposures and cancer trends in developed countries, in Environ Health Perspect, Vol 100, pp 39-44.; SH Zahm et al 1998, Pesticides and cancer, in Occup Med, Vol 12, No 2, pp 269-89; JG Vos et al 1994, Animal Models for Assessment, in JH Dean, MI Luster, AE Munson and I Kimber (Eds), Immunotoxicology and Immunopharmacology, Second Edition, New York, Raven Press Ltd, pp 19-30.; A Bhatia and J Kaur 1993, Recent advances in immunomodulatory effects of some chemical pollutants: a review, in International Journal of Environmental Studies, Vol 45, pp 61-70.

xxxiv Gayathri Ramachandran 2003, Integration of rural energy issues in rural development planning in India, Ex-officio principal secretary, Environment Department, Government of Andhra Pradesh, mimeo.

xxxv Jessica Budds et al 2001, What's cooking?, Water and environmental health at London and Loughborough, UK.

xxxvi Census of India 2001, Tables of Household, household amenities and assets, H Series, Registrar General and Census Commissioner, India, page 51

xxxvii Carl-Gustaf Bornehag, et al , The Association between Asthma and Allergic Symptoms in Children and Phthalates in House Dust: A Nested Case-Control Study, Environmental Health Perspectives Volume 112, Number 14, October 2004.

xxxvii Science notes: Archives of Disease in Childhood 2002;87:111–113.

xxxix Kirk Smith, Annual Review of Energy and Environment, 18, 529, 1993.

xl M R Pandey 1996-97, Women, Wood Energy and Health, in Wood Energy News, Regional Wood Energy Development Programme, Bangkok, Thailand, Vol.12, No 1, December / April, pp 3-5..

xli Anon 2000, Addressing the link between indoor air pollution, household energy and human health, Report on the WHO-USAID Global consultation on health impact of indoor air pollution and household energy in developing countries, Washington DC, May 3 to 4.

xlii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xliii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xliv Vinay Tandon and Mamta Chander 2004, LPG a key to empowerment of hill women, Winrock, New Delhi, mimeo

xlv Xavier Bosch 2003, Ominous start to US influenza season, in The Lancet, The Lancet Publishing House, UK, Vol 362, p 1902.

xlvi Kirk Smith 2002, Indoor air pollution in developing countries: recommendations for research, in IndoorAir, Blackwell Munksgaard, Denmark, Vol 12, pp 198-207.

xlvii Zodpey SP, Ughade SN (1999) Exposure to cheaper cooking fuels and risk of age-related cataract in women. Indian Journal of Occupational and Environmental Medicine, 3(4):159-161

xliii Kirk Smith and Sumi Mehta 2003, National burden of disease in India from indoor air pollution, in Proceedings of the National Academy of Sciences, National Academy of Sciences, Vol 97, No 24, pp 13286-13293.

xlix Priti Kumar et al 1997, Death is in the Air in Down To Earth, Society for Environment Communication, New Delhi, Vol 6, No 12, p29-43.

l www.epa.gov/chemfact/f_perchl.txt

li H Paramesh, Epidemiology of asthma in India. (Year : 2002 l Volume : 69 l Issue : 4 l Page : 309-12, Indian Journal of Pediatrics

lx Severin Carrell, Children at risk from cosmetics, 30 May 2004, The Independent, London, www. news.independent.co.uk

lxi JG Vos et al 1994, Animal Models for Assessment, in JH Dean, MI Luster, AE Munson and I Kimber (Eds), Immunotoxicology and Immunopharmacology, Second Edition, New York, Raven Press Ltd, pp 19-30.

lxii A Bhatia and J Kaur 1993, Recent advances in immunomodulatory effects of some chemical pollutants: a review, in International Journal of Environmental Studies, Vol 45, pp 61-70.

lxiii SK Nigam et al 1993, Clinical and biochemical investigations to evolve early diagnosis in workers involved in the manufacture of hexachlorocyclohexane, in Int Arch Occup Environ Health, Vol 65 S193.

lxiv VK Bhatnagar et al 2002, Biological indices in formulators exposed to combination of pesticides, in Bull Environ Contam Toxicol, Vol 68, pp 22-28.

lxv AB Karnik et al 1993, Immunological profile in workers exposed to pesticides, in Indian J Ind Med, Vol 39, p 110.

lxvi SK Kashyap et al, Scope and need of toxicological evaluation of pesticides under field conditions – Medical surveillance of malaria spraymen exposed to HCH (Hexachlorocyclohexane). In Field Worker Exposure during Pesticide Application, Eds WF Tordoir and EAH van Heemstra-Lequin, Elsevier Scientific Publishing Company, Amsterdam, p 53.

lxvii S Swan et al 2000, The question of declining sperm density revisited: An analysis of 101studies published 1934 – 1996, in Environmental Health Perspectives, Vol 108, 961-966.

lxviii K Gopalkrishnan 1997, Decreasing Sperm Counts – Fact or Fiction, in ICMR Bull, Vol 27, No 8, pp 77-82.

lxxix DS Rupa et al 1991, Reproductive performance in population exposed to pesticides in cotton fields in India, in Environ Res, Vol 55, No 2, pp123-8.

lxxx R Recio et al 2001, Organophosphorous pesticide exposure increases the frequency of sperm sex null aneuploidy, in Environ Health Perspect, Vol 109, No 12, pp 1237-40.

lxxxi Anon 1998, Vicious Dimension of Pesticide Poisoning, in The Observer of Business and Politics, Observer (India) Ltd, New Delhi, February 2.

lxxxii T Arbuckle et al 2001, An exploratory analysis of the effect of pesticide exposure on the risk of spontaneous abortion in an Ontario farm population, in Environmental Health Perspectives, Vol 109, pp 851-857.

lxxxiii T Taha et al 1993, Agricultural pesticide exposure and perinatal mortality in central Sudan, in Bulletin of the World Health Organization, Vol 71, pp 317-21.

lxxxiv L Pastore et al 1995, A case-control study of stillbirths in relation to residential and occupational exposures, in American Journal of Epidemiology, Vol 14 p S73.

lxxxv S Korrick et al 2001, Association of DDT with spontaneous abortion

lxxxvi L Sever et al 1997, Reproductive and developmental effects of occupational and pesticide exposure: the epidemiologic evidence. In ed. MC Keifer, Human Health Effects of Pesticides, Occupational Medicine: State of the Art Reviews,
Vol 12, No 2.

lxxxvii DS Rupa et al 1991, Reproductive performance in population exposed to pesticides in cotton fields in India, in Environ Res, Vol 55, No 2, pp123-8.

lxxxviii M Marconi and A Fait 1993, Toxicology in Health Effects in Man from Long-term Exposure to Pesticides, Elsevier Science Publishers, Ireland, Vol 78, p 120

lxxxix S Joshi 2001, Children of Endosulfan. Down to Earth, Vol 19, 28 February 2001, p 28.

xc T Sherer et al 2002, Environment, mitochondria, and Parkinson's disease, Neuroscientist, Vol 8, pp 192-197.

xci F Tuchsen et al 2000, Agricultural work and the risk of Parkinson's disease in Denmark, 1981-1993. Scandinavian Journal of Work Environment and Health, Vol 26, pp 359-362.

xcii A Priyadarshi et al 2001, Environmental risk factors and Parkinson's disease: A meta-analysis, in Environmental Research, Vol 86, pp 122-127.

xciii K Semchuk et al 1992, Parkinson's disease and exposure to agricultural work and pesticide chemicals, in Neurology,Vol 42, pp 1328-1335.

xciv B Dinham 1993, The Pesticide Hazard: A Global Health and Environmental Audit. Zed Books, London.

xcv (USDA, Handbook of Agriculture, vol III, USDA, Charlotte, NC USA)

xcvi (J P Bourguignon 2001, Sexual precocity after immigration from developing countries to Belgium: evidence of previous exposure to organochlorine pesticides, Human Reproduction, Oxford University Press, Vol. 16, No. 5, 1020-1026.)

xcvii http://www.ksg.harvard.edu/news/experts/2000/attaran_malaria_qa.htm

xcviii USAID isn't against using DDT in worldwide malaria battle,
http://www.hillnews.com/thehill/export/TheHill/Comment/LetterstotheEditor/111505.html

xcix International Programme on Chemical Safety, The WHO recommended classification of pesticides by hazard and guidelines to classification 1994-1995, UNEP/ILO/WHO, 1994.

c Health and Safety Executive Pesticides Registration Section, Evaluation on Gamma HCH (Lindane II), Ministry of Agriculture Fisheries and Food Pesticides Safety Division, December 1992 in «Lindane: A chemical of the past persists in the future.» A PAN UK fact sheet on Lindane. Available at http://www.pan-uk.org/pestnews/Actives/Lindane.htm

ci Rotterdam Convention on the Prior Informed Consent Procedure For Certain Hazardous Chemicals And Pesticides In International Trade (PIC) May 28, 2001. http://www.pic.int/index.html, section 3.4.4

cii (United State Environmental Protection Agency (USEPA), Re-registration Eligibility Decision (RED), Case 315, September 25, 2002 http://www.epa.gov/pesticides/reregistration/lindane.).

ciii HN Saiyed et al Environmental Health Perspectives Volume 111, Number 16, December 2003 Effect of Endosulfan on Male Reproductive Development.

civ S Kutluhan et al Three cases of recurrent epileptic seizures caused by Endosulfan, Neurlogy India, Year : 2003, Volume : 51, Issue : 1 , Page : 102--103)

cv Pulok K. Mukherjee, and Atul Wahile, Integrated approaches towards drug development from Ayurveda and other Indian system of medicines, Perspective paper, Journal of Ethnopharmacology ,Volume 103, Issue 1 , 3 January 2006, Pages 25-35

cvi (http://www.toxicslink.org/publicationsdet.php?id=32)

cvii Gail A. Wasserman et al Water Arsenic Exposure and Children's Intellectual Function in Araihazar, Bangladesh, Environ Health Perspect 112:1329-1333 (2004).

cviii WHO, http://www.who.int/mediacentre/factsheets/fs210/en/index.html)

cix Veena Kalra et al, Blood Lead Levels and Risk Factors for Lead Toxicity in Children from Schools and an Urban Slum in Delhi, Journal of Tropical Pediatrics 2003 49(2):121-123; Oxford University Press

cx http://www.eng-consult.com/BEN/papers/Paper-mahbub.PDF

cxi Carol Rice et al, Exposure Assessment for Endocrine Disruptors: Some Considerations in the Design of Studies, Environmental Health Perspectives, Mini-Monograph, Volume 111, Number 13, October 2003

cxii Natsuko Kajiwara,, Geographical Distribution and Temporal Trends of Polybrominated Diphenyl Ethers (PBDEs) in Cetaceans from Asian
Waters.http://www.bfr2004.com/Individual%20Papers/BFR2004%20Abstract%20041%20Kajiwara.pdf

cxiii Sandra Steingraber, Update on the Environmental Health Impacts of Polyvinyl Chloride (PVC) as a Building Material: Evidence from 2000-2004 a commentary for the U.S. Green Building Council on behalf of Healthy Building Network April 2, 2004

cxiv Working Group constituted by Dept. of Chemicals & Petrochemicals, available at: http://chemicals.nic.in/

cxv Op-ed from OB-Gyn professor finding genital changes in boys to women with higher phthalate levels, San Francisco Chronicle, January 9, 2006, http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2006/01/09/EDGMKGJGL61
.