

**The Stockholm Convention** is one of the many International Environmental Conventions that we have given ourselves as a global society, in hope of reversing our environmental wrongdoings. The Convention aims to phase out some of the most toxic and dangerous chemicals we know. These are the Persistent Organic Pollutants, or POPs. And for good reason : POPs have severe health effects on both human and animal health. Besides, they often enter our bodies stealthily, intruding rudely and aggressively upon its healthy functioning. This first-of-a-kind manual discusses POPs in the context of their health impacts, particularly for women in India. Although there is little contextual information available, the Stealthy Intruders team of doctors, environmental and public health specialists, environmental advocates, social scientists and writers applied available information to India, where over a billion residents deserve to protect themselves from the widely present POPs.

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## Stealthy Intruders

How Persistent Organic Pollutants are  
harming the health of women  
**A GUIDE FOR WOMEN IN INDIA**



**CHINTAN**  
Environmental Research  
and Action Group

**We are a registered, non-profit organization working on the issue of sustainable, equitable consumption and environmental justice.**

### **Our mission is**

to work towards social and environmental justice as well as a dignified existence for wastepicker communities, particularly of women and children, to help them move towards better education and livelihood opportunities.

To advocate for sustainable consumption and safer toxics free materials as a means to safe and environmentally sustainable products which do not affect the health of any as also of the wastepicker communities or impact the common environment of all.

## **Stealthy Intruders**

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### **About IPEN**

The International POPs Elimination Network is a global network of public interest non-governmental organisations united in support of a common POPs elimination goal. The mission of IPEN, achieved through its participating organisations, is to work for the global elimination of persistent organic pollutants, on an expedited yet socially equitable basis.

Founded in early 1998 by a small number of NGOs, IPEN was formally launched with a public forum at the first session of the UNEP Intergovernmental Negotiating Committee (INC1) in Montreal in June 1998, convened by UNEP to start negotiations to develop a global, legal instrument to control and/or eliminate persistent organic pollutants (POPs). Throughout the course of the five negotiating sessions, the Network grew to include more than 400 public health, environmental, consumer, and other non-governmental organisations in 65 countries. For more details, see [www.ipen.org](http://www.ipen.org)

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## CHAPTER 1 Apologies for the Bad News...

**Scientists** have discovered a group of distinct organic compounds which persist in the environment and in living creatures for long durations and exhibit their toxic nature in various forms. These synthetic chemicals are industrially produced for varied uses. Known as **Persistent Organic Pollutants** or 'POPs', these are a group of organic chemical compounds that are highly toxic and persist in the environment. Having a longer half life, they travel long distances in air and water, tend to migrate from warmer to colder regions of the world and bio-accumulate in fatty tissues of living organisms. Most POPs have similar characteristics and toxicity behavior and are usually halogenated (containing fluorine, chlorine, bromine, and to a lesser extent, iodine) organic compounds with similar chemical structures.

Due to their very nature and ecotoxicological properties, POPs are considered a major threat to ecology and human existence. Several studies conducted by individual researchers,

### Box 1 Persistent Organic Pollutants - The 'Dirty Dozen'

- Aldrin
- Dieldrin
- Chlordane
- Toxaphene
- Mirex
- Endrin
- Heptachlor
- Hexachlorbenzene
- Polychlorinated Biphenyls
- Dichloro Diphenyl Trichloroethane (DDT)
- Dioxins
- Furans

international agencies and civil society organizations have exposed serious environmental health impacts of POPs. Apart from the toxicological impact on the exposed population, trans-generational transmission and long shelf life have increased the long term implications of these pollutants. POPs disrupt normal physiological activities of humans and eventually result in many illnesses.

Their multiple sources have made the control measures more challenging. POPs are used as essential chemicals in our modern life, in agriculture, various industries, household products and cosmetics. Hence, in order to prevent their further entry into the environment, a simple banning of the products at one point of time is not feasible. In addition to that, economic interests of manufactures further make a difficult situation more challenging. Several attempts have been made to curb further production of POPs, as well as seeking alternatives at various levels. But there has been little impact so far. This is a reflection of the fact that abatement strategies and programs that may have proven useful for controlling conventional pollution are often of little use as solutions to POPs based contamination. It is also clear that no government, acting alone, has the power to enable measures that will protect the health of its population or its national environment from POPs. A remedy to the POPs problem requires enactment of global and intergovernmental measures for it to have an impact.

### Here's what's new about this bad news...

As compared to other pollutants, POPs are different in all respects right from their chemical nature and life cycle, toxic properties, mode of exposure, toxicity and outcomes.

**Omnipresence of POPs:** Other pollutants tend to remain close to their sources, and often can be effectively controlled through measures that reduce inputs to levels that then dilute and are assimilated without harm. POPs, on the other hand, tend to travel long distances and survive longer in the environment. The twelve POPs are semi-volatile and evaporate relatively slowly. This means that any release of POPs into the environment represents a potential global threat. Even some countries that have worked diligently to restrict and eliminate some of their domestic POPs sources continue to endure health and environmental injury caused by POPs that originate far away.

**Colder regions – sinks of POPs:** POPs get condensed in the atmosphere above colder regions and come down on earth with down flow of wind and also with snowfall and rain. That is the reason POPs are detected in colder arctic regions and also in high mountainous regions, for example in the Himalayas.

High levels of POPs have been discovered in polar bears,



caribou, mink, and terrestrial birds in the Arctic. A 1988 study found metabolites of the man-made insecticide chlordane in penguins in Antarctica, thousands of miles from the chemical's sources. The Arctic and sub-Arctic regions have some of the lowest population densities of the world, and have therefore been considered pristine because of their remoteness. However, the region has become a sink for persistent organic contaminants, which have been detected in Arctic air, surface seawater, suspended sediments, snow, fish, marine mammals, sea birds, and terrestrial plants and animals.

**Tropical regions – not spared:** Tropical regions are not spared from POPs as a result of precipitation and wind flow. There is evidence of POPs in poultry, located near incinerators in some cities in India. These animals

have deadly dioxin and furan contamination predictably from polluted air.

**Long half life:** Every chemical has its own shelf life, which depends upon its chemical properties. After certain period the chemicals disintegrate into simpler structures or combine with other chemicals. POPs are in this regard stronger and so they have a long half life (from months to decades). It is an important aspect of POPs because long half life indicates prolonged toxic effects in the environment.

**Bioaccumulation and Bio-magnification:** Unlike other toxic chemicals, POPs resist breakdown in water but readily dissolve and accumulate in fatty tissue. So, upon entering the ecosystems, they tend not to dilute but rather to build up through the food chain. This process is called bioaccumulation. POPs not only bio-accumulate; they also increase in intensity as they move up the food chain. This process is called bio-magnification. Therefore bigger animals, or to be precise, predatory animals that have consumed contaminated animals lower down in the chain, accumulate more POPs mostly in their fatty tissues. These animals can absorb concentrations of POPs at levels many times higher than those found in the environment. For example, concentrations of some POPs in fatty tissue of fish have been observed at levels up to 70,000 times those found in the water column. As human beings belong to the highest level of the food chain, they tend to be the highest storehouse of POPs.

**Difficulty in estimation:** Estimation of POPs in environment and animals is a very difficult task due to the the complex chemical properties of POPs and responses. Hence bio-availability of each chemical needs detailed study right from production sites. But unfortunately, in developing countries either inventories of POPs production are absent or poorly maintained. Particularly, import of hazardous waste and clandestine manufacture and use of POPs in various consumer products have made the assessment extremely complex. Measurement of POPs requires appropriate technology, which is not always available. Hence the estimation of POPs is not an easy task.

### It doesn't end at the dirty dozen, go on counting...

Apart from the twelve POPs, many chemicals with similar characteristics have been included in the category of POPs. Some are already scheduled for elimination through a countries' national action or regional treaties like the UNECE Convention on Long-Range Trans-boundary Air Pollution (LRTAP) on POPs and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR). Several researchers from across the globe have identified a range of persistent toxic substances that they wish to be considered for

inclusion in the Stockholm Convention. Once added to the Stockholm Convention, their production and use can be eliminated in many more countries.

The discovery of newer POPs render the situation even more challenging to manage. It shows that the problem is much deeper than perceived in the initial period. A majority of the new POPs are found in pesticides and related products, flame retardants, computers, preservatives, cosmetics, toys, electrical gadgets and home appliances, automobile products and car interiors, industrial solvents, food wrappers, paints, fabrics, papers, home decorative, wood preservatives -used in doors, windows and furniture, and so on. This round-the-clock exposure points to a new dimension.

The new list of POPs satisfy the majority of criteria for them to be banned. But unfortunately several countries still continue to produce them. For instance, Lindane (hexachlorocyclohexane) a much debated insecticide, listed in the Rotterdam Convention on Prior Informed Consent for Trade Control and severely restricted under the International Protocol on Long-Range Trans boundary Air Pollution, is manufactured in India and Romania. Lax environmental laws and almost non-existent enforcement of environmental protection and occupational safety regulations, is leading to the generation of

dangerous stockpiles of highly persistent toxic wastes that are lying scattered and illegally disposed in the country sides, water bodies, agricultural fields and most likely in the bodies of people and cattle living around the waste dumps located close to lindane producing facilities. Don't forget, in order to manufacture to manufacture one ton of lindane, nine tons of waste is generated.<sup>1</sup>

<sup>1</sup> Gamma-hexachlorocyclohexane (γ-HCH) is an effective chemical configuration of HCH as this chemical structure is responsible for killing of insects. But during the production of gamma-HCH, alpha, beta and delta HCH are also produced, which are not effective insecticides. As there are no safe methods to store, these are dumped behind the factories as waste, specially beta and delta HCH and severely affect the ecology. It affects human health by direct contact, inhalation of dust and contaminating agriculture products.

### Fortunately, the world realizes the severity...

Realizing that toxic pesticides and other hazardous chemicals affect human and animal health and contaminate the natural environment, and forced by public pressure and the media, governments globally started addressing this problem in the 1980s by establishing a voluntary Prior Informed Consent (PIC) procedure. PIC requires exporters trading in a list of hazardous substances to obtain the PIC of importers before proceeding with the trade. The **Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal** was adopted in

Basel, Switzerland in 1989. The Convention was initiated in response to numerous international scandals regarding hazardous waste trafficking that began to occur in the late 1980s. The Convention entered into force on 1992 and today has its Secretariat in Geneva, Switzerland. In 1995, in response to criticism that the Convention failed to adequately pr the dumping of hazardous wastes, the **Basel Ban** was created. The Ban Amendment prohibits all forms of hazardous waste exports from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries. Although the Basel Convention was not directed at POPs containing chemicals, it included in its lists some chemicals that were emitters of POPs or produced POPs when recycled or disposed off.

However, a much more important international convention that came into force later was the Stockholm Convention (See Box 2 overleaf). Initially, based on research; twelve POPs (also known as the 'dirty dozen') were listed here. The majority of the twelve POPs were pesticides and rodenticides, suggested for elimination by banning further production and clearing stockpiles and some POPs, such as dioxins and furans, which were by-products of various processes. Only PCBs, (Poly Chlorinated Bi-Phenyles) were used as lubricants in electric transformers.

**Box 2:****Chronology of initiatives to stop POPs**

A number of regional/international agreements on POPs have been negotiated in order to address the global risks posed by the long range transport of POPs.

1. On a global level, the United Nations Environmental Program (UNEP) began a process in the early 1990s of examining the risks posed by POPs, as well as strategies to phase out the most hazardous of these.
2. In June 1996, the Intergovernmental Forum on Chemical Safety (IFCS) submitted a final report to UNEP and the World Health Assembly (WHA), the governing body of the World Health Organization. The final report recommended immediate international action to protect human health and the environment from POPs.
3. A series of efforts have taken place to establish global negotiations and legally binding agreement to reduce or eliminate the health and environmental threats posed by POPs.
4. Under the auspices of the UN Economic Commission for Europe (UN/ECE), thirty-two European and North American countries signed the Aarhus Protocol (1998) to the ECE's Convention on Long-Range Trans-boundary Air Pollution (LRTAP). The objective of the Aarhus Protocol is to control, reduce, or eliminate discharges, emissions and losses of persistent organic pollutants.
5. The international community responded to the POPs threat by adopting the Stockholm Convention in May 2001. The Stockholm Convention is intended to protect human health and the environment by reducing and eliminating POPs, starting with an initial list of twelve of the most notorious, the "dirty dozen."
6. India signed the Convention on 14th May 2002. The Convention entered into force in May 2004 and the first Conference of the Parties (COP1) took place on 2 May 2005 in Uruguay. The Rottardam convention (which was adopted on 10 September 1998) entered into force on 24 February 2004

**CHAPTER 2****India is overflowing with POPs and POP-like chemicals**

**India is a signatory** to the Stockholm Convention. But that hardly helps tackle the layers and decades of contamination. The problem of POPs in India is more precarious than in many other developing countries, because of:

**Pesticide Use and Abuse**

It is well known that India uses pesticides extensively. The main pesticide chemicals used have been DDT, Aldrin, Dieldrin, Heptachlor and Endrin. Of these, DDT has been the most widely used to control malaria, and continues to be the main POPs chemical being used to date in the region. Of the 10 intentionally produced POPs listed in the Stockholm Convention, Toxaphene and Mirex have never been manufactured or used in India.

There are also several stockpiles in India that require urgent handling. Currently, while there is an acknowledgement of these, there is

no inventory or action plan in the public realm to eliminate these.

Despite public pressure and compelling studies from civil society organizations, poor food safety standards continue to endanger public health and policy shifts have not yet taken place.

Despite bans, India continues to import several chemical pesticides

**Lindane as Indicator**

It is clear that POPs are widespread and that India is a large user and producer of POPs. Unfortunately there is no comprehensive data on POPs. Many scientists consider HCH (lindane) a good indicator of the widespread use of POPs. Lindane emissions are highest from India, signifying the level of POPs contamination here. Some Eastern European countries and Southeast Asian countries also produce high quantities.

### Poor Waste Handling

India is mis-managing the waste it produces. Not only does poor collection of waste result in mass burning in waste dumps, but even municipal agencies are seen to burn excess waste to stop it from spilling over. These are sources of dioxins and can result in dioxin factories randomly scattered all over the country. Besides, poor disposal of medical waste and incineration also results in dioxin releases. The new shift towards waste-to-energy also promotes incineration, although it is an important source of dioxin and furan release. The extraction of precious metals from various wastes, such as electronic wastes, also result in dioxins as many chlorinated plastics, such as PVC are burned by the informal recyclers. In fact, PVC handling by scrap dealers, who are not given the space or legitimacy to



store PVC coated copper wires for manual stripping, is another source of dioxins. The dealers are forced to burn the wires and the release of dioxins is inevitable.

### Toxic Wastes Mismanagement

India is also a dumping ground for imported toxic wastes. Industrialized countries choose developing countries to dump their wastes in the name of promoting their indigenous recycling industry. There is import of plastics, used electrical gadgets and computers mostly from many parts of the world. Burning these to extract small quantities of precious metals are a source of POPs. The ship breaking industry is another example of potential source of POPs.

Although it is not possible to compute the amount of POPs being generated through this, the problem

is serious. Official import data of the GOI (Government of India) indicates that India has been a favoured dumping ground for plastic wastes, from industrialized countries like Canada, Denmark, Germany, UK, the Netherlands, Japan, France and the United States. There are also reports of import of banned pesticides in India. According to the Government of India import data, more than 120,000 tons of plastic wastes have found their way into India in the years 1999 and 2000. The imports included wastes of highly toxic plastics such as PVC (poly vinyl chloride), exported primarily from United States, Taiwan, the Netherlands, Japan, France, UK and Belgium.

Every year around 1.38 million personal computers get obsolete. If the above figure is taken as baseline data, India is producing 8600 tons of plastics, 2300 tons of PVC and 700 tons brominated flame retardants respectively from e-waste every year. Current estimation says India generates 0.14 million tons of e-waste from computers, televisions, refrigerators and washing machines and in 2012 this will increase up to 1.6 million tons. Many electrical goods are manufactured in Europe and South East Asian countries and imported to India for various uses.

### Clean Production not Upto the Mark

Many industrial processes that result in the release of POPs require help to transition to a cleaner way of

doing things. However, investment in these shifts is too expensive and too much of a risk to be undertaken by medium or small industrialists. Hence, a proactive policy of developing and piloting cleaner technologies is critical, though currently missing.

### The Signs on the Wall

Besides these reasons, it is also said that where animals come to harm, the fate of human beings is writing on the wall. Alarm bells in India should be ringing, given the many studies confirming the presence of POPs in Indian animals.

Dioxins and other POPs were detected and measured in tissues of humans, fish, chicken, lamb, goat, predatory birds, and Ganges River dolphins collected from various locations in India. Fish samples were collected from various locations (Bhavani Sagar Dam and Chennai, in the southern part of India, Patna and Farakka on the River Ganges in northern part of India) during March 1994, February 1997, and 2000. Animal fat samples (goat, lamb and country chicken) were collected from local markets in Coimbatore-district, southern India in March 2000. Liver and blubber of Ganges River dolphins collected from Chappra and Patna in 1994 and 1996. Bird samples were obtained in March 2000 from nomadic tribes in Coimbatore.

It was found that concentrations of pesticides and pollutants in animals and fish from India varied:

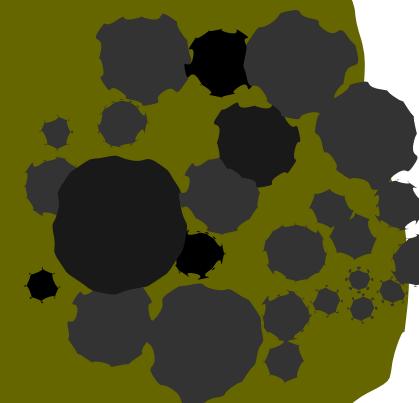
- From 9.5 to 82 and from 2.9 to 48 Pico gram (pg)/g, on a fat weight basis, respectively.
- The sum of concentrations of twelve dioxin congeners in fish ranged from 2200 to 33000 pg/g, fat wt.
- Further concentrations of chemicals in animal origin foods (country chicken, lamb and goat) ranged from 11 to 19 and 3.2 to 5.4 pg/g, fat wt, respectively.
- The sum of concentrations of 12 dioxins in meat products ranged from 110 to 270 pg/g, fat wt.



- Concentrations of total pollutants in liver and blubber of dolphins were 74-420 and 26-54 pg/g, fat wt, respectively.
- Concentrations in the muscle of the spotted owl were the highest (430 pg/g fat wt) followed in decreasing order by prairie kite (370 pg/g fat wt), osprey (350 pg/g fat wt), black-winged kite (160 pg/g fat wt) and eagle (43 pg/g fat wt).

Based on the observed pattern of contamination in these animals, experts suggest sources like chlorine bleaching, paper and pulp mills, generic sources derived from atmospheric deposition, incineration, and sewage disposal as the main culprits in the production of POPs and their by-products.

## CHAPTER 3 POPs and the Human Body



### How human beings are being exposed to POPs all the time!

Human exposure to POPs is more complex as compared to animals, as a lot of behavioral and occupational issues are associated with it. Broadly, human beings are exposed to POPs through inhalation, direct skin contact, food and water and trans-placental transfer. Various forms of sickness amongst animals due to POPs indicates the possibility of similar nature of human suffering, as physiologically human beings are very close to animals, particularly mammals.

### Our food is contaminated...

Humans are generally exposed to POPs through their food intake. Foods rich in animal fat, such as meat, fish, and dairy products are the most important means of exposure. Moreover, human beings are on top of the food chain and hence expected to bio-accumulate

the highest amount of POPs. Humans consume a variety of sea food and meat. Apart from that, consumption of vegetables and eggs can also lead to ingesting POPs. The kind of POPs present in food depends upon the type of food, sources, and nature of cooking.

Concentration of POPs also depends on source of food, status in food chain and indeed duration and magnitude of contamination. Similarly in animal products, concentration of POPs will be more in large animals and predatory animals due to bioaccumulation of POPs from animals or plants found at a lower level in the food pyramid. Also, the age of the animal matters in deciding the concentration of POPs. Young animals and fish contain less POPs than older species. The longer the life of an animal, the more it leads to cumulative accumulation of POPs in the body.

If food is grown around industries or incinerators producing POPs, it

would contain contaminants in various concentrations. There is evidence for instance of DDT in crops cultivated around the DDT factory in Kerala.

Dioxins and Furans are found in poultry products situated near incinerators, as recent tests on eggs produced near incinerators indicated. If food is cooked by burning wood, they might contain PAHs. There is evidence of POPs contamination of food cooked in non-stick utensils (Teflon). In fact, the Indian dietary intake of DDT was found to be the highest in the world. Practices like the dermal application of DDT on cattle probably leads to its high levels in milk and dairy products.

That the food we eat is not safe is not just sensationalism. It's a fact, as these studies have shown:

- In 1993-1996, a study was made to investigate the magnitude of contamination of bovine milk with organo chlorine pesticide (OCP) residues from Jaipur City, Rajasthan, India. The results indicate that all the milk samples were contaminated with DDT and its metabolites, isomers of hexachlorocyclohexane (HCH) heptachlor and aldrin. Seasonal variations of these pesticide residue levels were also observed in all the milk samples. Samples collected during winter season were found to contain higher residue levels as compared to other seasons.

- In another study, where 63 butter samples were collected from 23 countries and analyzed for regional and global scale distribution of PCBs and selected organo chlorine pesticides/ metabolites in air, concentrations of DDT were highest in butter samples from areas of current use like India.

- New evidence reports that chicken eggs in India carry high levels of dioxins and polychlorinated biphenyls (PCBs). The dioxin levels were found to be 5.5 times higher than the European Union safe dioxin limit for eggs and the samples collected exceed the limit for PCBs by 4.7 times. Test results revealed the presence of the most toxic of dioxins, which form a family of 210 compounds. Other reports show contaminant levels exceeding the EU limit for dioxins in eggs by more than 4-fold. The study is particularly relevant to India as there are no standard guidelines to breed and feed poultry in the country.

- Studies conducted in India found high levels of POPs in fish, animal fats, meat, poultry and diary products.

- Soft drinks from Multinational Companies were also found laced with several pesticides including POPs.

- Recent studies showing the presence of multiple POPs pesticides in blood samples of Punjabi farmers strongly correlates the food chain contamination and human exposure of POPs.

## ...and so are our bodies

Several studies have been conducted in various parts of India to measure the specific pesticides in human biological samples. Despite many shortcomings in these studies, they present us with a grim picture, as the table below elucidates.

**Table 1 : Our Contaminated Bodies**

Study area	Pesticides identified	Brief findings
Delhi, 1976	DDT and its metabolites	Blood samples taken from 182 people were examined for DDT residues and showed that all except 8 contained DDT and its metabolites. The average total DDT concentration in the whole blood ranged from 0.177 to 0.683 mg/l in males and from 0.166 to 0.329 mg/l in females. The DDT metabolites detected were pp'- DDE, pp'-DDD and op'-DDT. DDE accounted for most of the total DDT
Lucknow, 1983	DDT and BHC residues	DDT and BHC residues were detected in all the 99 samples of blood and adipose tissue of normal and exposed persons from urban area of Lucknow. Total HCH concentration in normal population was 0.038 ppm (children), 0.034 ppm (females), 0.075 ppm (males) and in exposed persons was 0.295 ppm. Total DDT concentration in normal population was 0.023 ppm (children), 0.023 ppm (females), 0.028 ppm (males) and in exposed person was 0.200 ppm
Delhi, 1984	DDT, HCH	A total of 340 biopsies of body fat and blood samples from 162 males and 178 females collected from 3 government hospitals in Delhi showed (CONTD...)

(Table 1 CONTD...)

Study area	Pesticides identified	Brief findings
		a mean DDT concentration of body fat of 22.25 + 1.66 mg/kg and for blood 0.71 + 0.05 mg/l. The mean total HCH of body fat was 16.85 + 0.94 mg/kg and for blood 0.49+ 0.05 mg/l
Delhi, 1987	DDT	A survey of blood samples of general population of occupationally unexposed population from Delhi showed levels of DDT several times higher than that from other countries. Total DDT ranged from 0.053- 0.663 ppm with a mean value of 0.301 ppm. Mean total DDT in males (0.344 ppm) was higher than of females (0.229 ppm)
Ahemdabad (rural area) 1992	DDT, HCH, heptachlor, heptachlor epoxide, aldrin, oxychlorane, HCB and dieldrin in serum	In a study from Ahemdabad (rural area) blood samples collected from 31 healthy males during 1989-90 were analysed for DDT, HCH, heptachlor, heptachlor epoxide, aldrin, oxychlorane, HCB and dieldrin in serum. Mean serum levels of pp'-DDE, op'-DDT, pp'-DDD, pp'-DDT and t-DDT were 37.25, 0.335, 1.33, 8.828 and 47.745 mg/l. pp'-DDE was the major metabolite and it alone contributed about 78% of total DDT. All serum samples were contaminated by HCH with an average of 147.335 mg/l with equivalent amounts of a, b and g- HCH). Heptachlor, oxychlorane, aldrin and dieldrin were detected at an average concentration of 0.819mg/l, 1.465 mg/l, 0.200 mg/l, 2.152 mg/l. Heptachlor epoxide and hexachlorbenzene were not detected in any sample

(Table 1 CONTD...)

Study area	Pesticides identified	Brief findings
Hardwar, 1996	HCH and DDT	Mean HCH and DDT contents in whole blood of general population of 37 males not involved in spraying from district Hardwar, UP were 21.50 mg/l and 20.79 mg/l respectively. 47 samples from the occupationally exposed persons, involved in spraying operation of HCH and DDT during Ardh Kumbh Congregation at Hardwar in April, 1992 for the control of mosquitoes and flies, analyzed for HCH and DDT contamination in whole blood was 68.0 mg/l and DDT was 58.43 mg/l i.e. 3.1 times and 2.8 times more as compared to general population
Delhi, 1996	DDT, HCH	In a study conducted in Delhi, samples of maternal blood, breast milk and cord blood from 25 mothers (23.4+ 1.085 years of age with a range of 18-40 years) and their new born from Irwin Hospital, Delhi showed the presence of t-DDT at an average level of 1.27, 0.27 and 0.14 mg/l respectively. Breast milk contained four and a half times more DDT than the maternal serum. Levels of different metabolites of DDT in maternal serum were more than those in cord serum. HCH isomers were present in smaller amounts than those of DDT residues. Average value of t-HCH in maternal blood, breast milk and cord blood was 0.327, 0.050 and 0.033 mg/l. b-isomer was the predominant isomer accounting for more than 60 percent of the various isomers (CONTD...)

(Table 1 CONTD...)

Study area	Pesticides identified	Brief findings
Ahmedabad (urban) area 2004	DDT, HCH	Human blood samples from 18 male healthy volunteers of Ahmedabad (urban) area showed the presence of pp' DDE, op'- DDT, pp' DDD, pp' DDT and t-DDT at an average value of 20.85, 1.15, 2.03 9.28 and 32.61 mg/l in serum samples respectively. The concentration of a, b and g- and t-HCH in serum samples was 4.49, 35.06, 1.69 mg/l and 41.23mg/l respectively. Hexachlorobenzene was present in 7 samples at an average concentration of 0.2 mg/l
Punjab, 2005	DDT, HCH, Endosulfan,, Heptachlor, aldrin and chlordane Monocrotophos, chlorpyrifos, malathion and phosphamidon	Twenty blood samples randomly selected from 4 different villages of Punjab - Mahi Nangal, Jajjal and Balloh in Bhatinda district and Dher in Ropar district - were analyzed for 14 organochlorines and 14 organophosphorus pesticides. Total content of HCH (sum of a, b, g and d HCH) in whole blood samples from villages of Punjab was 0.057 mg/l. g isomer of HCH (lindane) was detected at a level of 0.0227 mg/l in blood samples and ranged from 0.0136 to 0.0569 mg/l. Total content of DDT (sum of DDD, DDE and DDT) in blood samples from villages of Punjab was 0.0652 mg/l. Mean levels of pp'- DDE in whole blood samples from Punjab was 0. 0450 mg/l. Total-endosulfan (a, b and endosulfan sulfate) in whole blood samples from Punjab was 0.0046 mg/l however isomers of endosulfan. Heptachlor, aldrin and chlordane were detected in 1, 16 and 14 out of 20 blood samples analyzed (CONTD...)

(Table 1 CONTD...)

Study area	Pesticides identified	Brief findings
		from Punjab. Monocrotophos, chlorpyrifos, malathion and phosphamidon were detected at mean levels of 0.0948, 0.0662, 0.0301 and 0.0366 __mg/l respectively in Punjab blood samples. Mean levels of total organochlorines in whole blood samples from Punjab were 0.1424, total organophosphorus was 0.2278 and total pesticides were 0.3701 mg/l respectively.

### It's Possible to Touch Poisons...

Direct transmission of POPs is also evidenced from various studies. This mostly occurs while handling pesticides or toxic products and working in some kinds of recycling units. Application of cosmetics containing POPs is as already mentioned above directly absorbed through skin. (Box 6)

Children are particularly vulnerable, as now a days toys are made up of soft PVC (added with Phthalates) to make them more attractive. Often children are found biting the toys and thus get contaminated with POPs. Modern vinyl flooring is another source of POPs Apart from that, PBDEs, PCPs, chlorinated paraffin's are widely used in modern electronic gadgets, paints, toys, carpets,

furniture, building materials and their direct contact can lead to contamination of POPs.

### ...and breathe them too

Inhalation of toxic fumes is another source of POPs, particularly for people working in hazardous industries without adequate protection and communities living near by. There is also evidence of higher concentration of POPs among the people living nearby incinerations as compared to people living further away.

### You can give them to your baby, before it's even born...

According to WHO's estimation, POPs kill at least five million children each year around the world. This death can

be the cumulative impact of trans-placental transmission from mother to fetus along with breast milk contamination and direct contamination through skin, environment and food. Therefore, exposure to POPs in early human developmental stages is a very serious issue due to higher probability of permanent damage to immunological and endocrine system. A study by the Environmental Working Group detected 287 commercial chemicals, pesticides, and pollutants in the umbilical cord blood from 10 newborn infants, randomly selected by the Red Cross from U.S. hospitals.

Out of 287 chemicals detected in cord blood, 180 cause cancers in humans or animals, 217 are toxic to the brain and nervous system, and 208 cause birth defects or abnormal development in animal tests. The dangers of pre- or post-natal exposure to this complex mixture of carcinogens, developmental toxins and neurotoxins have never been studied before.

The finding of these chemicals in the bloodstreams of the youngest and most vulnerable members of our society raises issues of sheer importance to public health. The study reveals that even before birth, a child is exposed to hundreds of chemical compounds, many of which could harm his/her health and further development. The immature blood brain barrier may allow greater chemical exposures to the

developing brain. A diminished ability to excrete and detoxify many chemicals can produce higher levels of chemicals circulating in the blood of the child than the mother.

Because POPs accumulate in fatty tissues, the first exposure in humans occurs in the fetus, when a percentage of the maternal "burden" or mother's "lifetime" accumulation of POPs is transported across the placenta. Evidence suggests that exposure of the fetus to even minute concentrations of some POPs (one tenth of one part per trillion) can cause adverse effects at critical junctures in development that persist later in the individual's life. As well, a significant POPs loading occurs during breast feeding, wherein more of the accumulated POPs in the maternal body fat are passed on to the offspring.

### ....and actually spend your money buying POPs and other toxins

Human skin is extremely permeable. That's why cosmetic ingredients are absorbed through the skin.

The problem is when some of the ingredients are POPs or even, toxic in other ways:

- A study showed that 13 percent of the cosmetic preservative butylate



hydroxytoluene (BHT) and 49 percent of the carcinogenic pesticide DDT (which is found in some cosmetics containing lanolin) is absorbed through the skin. Lanolin is very common ingredient of cosmetics. But cosmetic grade Lanolin can be contaminated with carcinogenic pesticides such as DDT, dieldrin and lindane.

- Natural animal musks have long been used as fragrances in beauty products, but because they are expensive to produce, scientists have developed synthetic chemicals to replace them. These toxic synthetic compounds and have been shown to accumulate in fat and have been found in surface and wastewater, freshwater fish, shellfish and in human fat, blood and breast

milk. No studies have determined nitro musks' toxicity to humans, but musk compounds have been shown to cause cancer in laboratory rodents.

- A wide range of personal care products including shampoos, hair conditioners, cleansers, lotions, and creams, besides household products such as soaps and cleaning products, contain surfactants or detergents. Epidemiological studies on one such compound - dioxane-exposed furniture makers have reported suggestive evidence of excess nasal passage cancers. On the basis of such evidence, the Consumer Product Safety Commission concluded that "the presence of 1,4 - dioxane, even as a trace contaminant, is a cause of concern. Hair spray, hair mousse, anti-perspirant, perfumes, nail polish, body lotion contain toxic chemicals called phthalates which have been shown to damage the lung, liver and kidneys, the developing testes of male offspring, and affect the fetus. Almost every skin care product on the market today describes itself as 'natural' or 'pure'. It's the marketing buzzword of today and it sells. Applied to skin care products it is also the most misused word in the English language. 'Natural' skincare products only need 1% of natural ingredients to be called 'natural'. Each year over 100,000 tons of man-made chemicals are dumped into so called 'natural' cosmetics! Around 60% of any substance applied to skin is absorbed, women can absorb up to 2 kg (4.4 lb.) of chemicals through their skin every year.

### It's a potent public health problem...

Without precise information concerning exposures, the relationship between exposure and effect is often difficult to characterize. This creates a significant barrier not only in the diagnosis of health outcomes related to POPs exposures, but significantly contributes to the medical invisibility of this potent public health problem.

After entering in to the human body, POPs keep on accumulating and exhibit toxic manifestation in a gradual manner. The incubation period of any manifestation is very complex and it depends upon:

- the nature of the chemical
- exposure rate
- duration and frequency of exposure
- immune status of the person
- body burden of the toxic chemicals
- nutritional status

Not only can there be many years between exposure and outcome in the exposed individual, but in some cases there is a trans-generational leap from exposure to outcome; that is, exposure in the parent is observed by effects in the offspring.

It is also agreed that POPs have the potential to injure human health and the environment at very low concentrations.

Damage caused to humans and other species by POPs is well documented, as you would have read above, and includes:

- the pathologies of cancer and tumours at multiple sites;
- reproductive disorders;
- neurobehavioral impairment including learning disorders;
- immune system dysfunction;
- lack of development in various body system such as the reproductive system, endocrine system, immune system and neurological system;
- adverse effects to the adrenal glands, the liver and the kidneys;
- heart diseases;
- cerebro-vascular diseases; still births

### So, why haven't we all fallen down dead?

Chemicals, even the most severe ones, don't have to kill you in order to be extremely harmful. Science now tells us that to remove old fashioned images of deadly poisons that killed in a swift swig. Instead, the new breeds are the real life Dementors we read about in Harry Potter. They suck out your life and mind, almost the juice out of a person. They change the quality of your life and the transform how even the smallest cells work. Here's how :

- Certain POPs have the capability to affect enzymes that are involved in the biosynthesis of heme (the iron compound) in the blood This may lead

to a disease called porphyria, which may cause seizures and other complications in the neuromuscular system – or the system that cause the movement of muscles.

- Exposure to POPs has also been known to affect vitamin A metabolism. This lack of activity may cause an inclination towards infection and cancer. Another result may be reproductive disorders, skin lesions and disturbance in growth and development.

- Specific POPs, mainly chlorinated hydrocarbons, can also negatively impact the adrenal gland. The adrenal gland secretes epinephrine, the "fight or flight" hormone necessary to many organisms' survival. If the creatures no longer had this capability, they would be at an extreme disadvantage in their ability to survive.

- Cancer causing POPs tend to promote cancers rather than induce them. Some studies in fact show that most POPs are regarded as cancer promoters.

- The International Agency for Research on Cancer (IARC) has recently classified the deadly dioxin as a known human carcinogen. Dioxins and furans are known to reduce the level of testosterone in males. Fetuses exposed to dioxins through the placenta and babies through breast milk exhibit dysfunctional muscle reflexes and

hypothalamic/pituitary/thyroid system failure. Infants similarly exposed to Dioxin exposure has been reported to be associated with endometriosis (described later), cardiovascular disease, cancer, diabetes, decreased testosterone, altered thyroid hormone status, altered immune status, and following developmental exposures, neurobehavioral differences, cognitive deficits, and altered sex ratios. Dioxins are reputed to be one of the most dangerous chemicals known to mankind.

- Many POPs can cause drastic inhibiting affects to the immune system. In some cases, the pollutants have the capability to disrupt the body's ability to produce such helpful entities as antibodies and T-cells, both of which fight against tumors and viruses. Since POPs are immunosuppressive, AIDS and cancer patients who are taking immunosuppressive drugs are severely at risk. Dioxins suppress both the immune responses of the immune system. PCBs that enter the body cause infection rate to increase, as exposure to PCBs impairs immune response to infection.

- POPs have the capability to harm the nervous system through several different avenues. Acute exposure to aldrin and dieldrin can create symptoms such as severe seizures, headaches, nausea, anorexia, muscle twitching and psychological illnesses. They are

suspected to induce peripheral neuropathy and can result in Parkinson's disease. Exposure to endrin shows similar symptoms, with the addition of possible death. Abnormal balance, reduction in reaction time and verbal recall, and slowing of motor speeds are results of chlordane poisoning. DDT can also cause nausea and headaches, plus irritation of mucous membranes, tremors, and other nervous system abnormalities. The POP heptachlor often causes hyperexcitation of the central nervous system, plus cerebrovascular disease, consequentially leading to death. When exposed to PCBs, fetuses undergo neural and developmental changes, resulting in lower psychomotor scores and reduction in short-term memory and special learning.



- POPs may affect reproductive development through several different avenues. Chemicals such as DDT, specific dioxins and PCBs have the capability to diminish the survival of offspring, decrease fertility and disrupt reproductive function and reproductive cycles. If unborn embryos are exposed to POPs, then the embryo or fetus mortality rates increase exponentially. Sex hormone levels are abnormal, sperm production is reduced, and total reproductive failure is often imminent. There has also been evidence that gene expression can be altered, which may indicate that POPs have the ability to detrimentally affect liver function, impede fetal ovarian development, and disrupt carbohydrate, protein and lipid metabolism.

- The health effects of POPs are generally subtle, and can be triggered at extraordinarily low concentrations. A majority of the POPs work as Endocrine Disrupting Chemicals (EDCs) as these substances that can cause adverse effects by interfering in some way with the body's hormones or chemical messengers. These substances are therefore called hormone disruptors or endocrine disruptors, as it is the endocrine glands that secrete hormones.<sup>2</sup> These are exogenous chemicals, which either "mimic" or "antagonize" the action of endogenous hormones in the human body. Xeno estrogens or

'environmental hormones' are endocrine disruptors, that interfere with the normal functioning of the endocrine system—cells and glands in the body that secrete hormones, the chemical messengers that regulate bodily processes.<sup>3</sup>

Some of the 100,000 registered chemicals for use in the world have hormonal effects in addition to toxic and carcinogenic effects. Also the synergistic effects are known to occur but also are largely exactly unknown. The field of xeno hormones is new and only been in existence since about 1991. A Dartmouth University Study showed that plastic wrap heated in a microwave oven with vegetable oil had 500,000 times the minimum amount of xeno estrogens needed to stimulate breast cancer cells to grow in the test tube.

Hormones play a crucial role in guiding normal cell differentiation in early life forms, and so exposure to endocrine disrupting substances in the egg or in the womb can alter the normal process of development. This is also a double burden on women, as they would not only have high concentrations of these chemicals inside them, but have to care for more vulnerable children. Mature animals can also be affected, but it is the developing organism that is especially vulnerable. Exposure at this sensitive time may cause effects that are not

evident until later in life, such as effects on learning ability, behaviour, reproduction and increased susceptibility to cancer and other diseases.

The effects that can be seen in an organism exposed to an endocrine disrupting chemical (EDC) depend on which hormone system is targeted. For example, if an organism is exposed to sex hormone disrupting pesticides in the womb, then the sort of effects that may be evident include effects on sexual behaviour, structural deformities of the reproductive tract, including inter-sex type conditions and undescended testes, deficits in sperm counts, and effects on sex ratios. However, if the primary action is on the thyroid hormones, then as these hormones are responsible for

<sup>2</sup> The Endocrine system consists of glands, which secrete complex biochemical substances (hormones), which control the physiological activities of animal bodies and every aspect of body function, such as growth, immune response, metabolism, reproductive function (menstruation, pregnancy, fetal growth, sperm genesis), lactation, normal cellular growth. Disruption of endocrine system may lead to depressed immune function, sterility, pregnancy failure, and cancer.

<sup>3</sup> Most of the POPs are known as xeno estrogen, as they generally mimic estrogen hormone. Estrogen hormones maintain menstrual cycle, development of reproductive organs, pregnancy and also bone development, development of breast tissue. More production of estrogen or addition of exogenous estrogen like chemicals can disrupt the normal but delicate hormonal system.

metabolism and normal brain development, exposure in the womb may cause effects on intelligence and growth.

Some endocrine disruptors may exert their action by interfering with the brain's release of hormones, which in turn regulate the production of other hormones that control the growth and the activity of many other endocrine glands. Indeed, the pituitary has been termed the conductor of the endocrinal orchestra, and pollutants that cause the pituitary region in the brain to malfunction may therefore have ripple effects.

The liver breaks down estrogen into either a weak estrogen, which is safe, or into a strong one capable of damaging deoxyribonucleic acid (DNA) and initiating precancerous changes. DDT, DDE, atrazine, and other pesticides depress the liver's mechanism that weakens estrogen while promoting production of the stronger, more dangerous estrogen. This further damages human body.

- POPs also have an effect on the cerebrovascular system. Environmental exposure to persistent organic pollutants (POPs) may lead to elevation of serum lipids, increasing risk of atherosclerosis with thrombo-embolism, a recognized cause of stroke. A study conducted of the population of New York City shows that people living near a source of POPs contamination constitutes a risk of exposure and an increased risk of

acquiring cerebrovascular disease.<sup>4</sup> However further research with better control of individual risk factors and direct measurement of exposure is necessary for providing additional support for this hypothesis.

All this makes it clear that POPs are redistributed upon entry into the human body, including liver, kidneys, reproductive organs, endocrine glands, nervous system and fat (also known as adipose) tissues. A study conducted at the Kovai Medical Center and K.G. Hospital in Coimbatore, showed concentrations in various fat tissue (breast, thigh and shoulder fat) which ranged from 170 to 1300 pg/g, fat wt (mean: 540 pg/g, fat wt). It shows that we should pay more attention to POPs and their impacts on the woman's body. There are no safety limits of dioxins and furans. But some attempts are made to reach a consensus regarding safe level.

<sup>4</sup> A study was conducted in New York where the rates of stroke hospital discharges were compared among residents of zip codes containing hazardous waste sites with POPs, other pollutants or without any waste sites using information for 1993–2000 from the New York Statewide Planning and Research Cooperative System (SPARCS) database, containing the records of all discharge diagnoses for patients admitted to state-regulated hospitals. After adjustment for age and race, the hospitalization rate for stroke in zip codes with POPs-contaminated sites was 15% higher than in zip codes without any documented hazardous waste sites. These results suggest that living near a source of POPs contamination constitutes a risk of exposure and an increased risk of acquiring cerebrovascular disease.

## CHAPTER 4

# Women of the World, Unite!

**Having established** that POPs are an universal threat to healthy living in an equally healthy environment consider the following facts, however general they may seem :

- More than 100,000 chemicals have entered into the market since 1945, and it is estimated that 75,000 of them are still in commercial use. Most of these chemicals remain untested for their safety in humans and other species
- 44% of the 50 countries surveyed by WEDO (Women's Environment & Development Organization) all over the world (1999) report that reproductive health disorders as a result of chemical exposure in the work place and other occupational hazards have increased manifold
- The health effects of water pollution are especially severe on women and children. In the Ukraine, 13 % of the illnesses affecting women and children have been linked to water pollution, and 21% to air pollution

- In Russia, pollution has led to doubling of bladder and kidneys disorders in pregnant women. In the Ural region, the synergistic impact of a cocktail of chemicals is causing birth defects, tumours, malignant blood diseases and diabetes

- In Uzbekistan, prolonged use of water polluted by pesticides and industry has led to increases in pregnancy complications and birth defects, and a higher incidence of anaemia, and kidney and liver diseases in women

- In the UK, government experts found that 12,000 to 24,000 people might die prematurely as a result of exposure to air pollution. The incidence of breast cancer here has risen massively, and is now one of the highest in the world .Every 1 in 12 women risk contracting breast cancer in their lifetime, and there is evidence that this rate increases to 1 in 11 in certain regions of the country. Also, women in certain occupations are at higher risk of contracting the disease

## Women are POPs biggest victims

It's not an exaggeration to make this statement. Read on to make up your mind....

### POPs are linked to Breast Cancer

A series of studies have analyzed the linkages between several POPs and breast cancer. POPs are detectable in almost all samples of adipose tissue or the fat of human breast milk. Eleven studies have analyzed various organochlorine compounds including DDE, PCBs and other pesticides and breast cancer. These include studies by Frank Falck, Mary Wolff and others who compared blood samples of women with breast cancer and found that DDE (a metabolite of DDT) levels were 35% higher in women with cancer.



Significantly higher levels of HCB were found in Germany, Canada and Sweden in women with breast cancer compared with patients without breast cancer.

### Breast Cancer and the Environmental Connection

There is growing body of scientific evidence suggesting a link between increase in breast cancer and avoidable environmental contaminants: Scientists believe a ban on three carcinogenic pesticides may be responsible for 30% drop in breast cancer rates in Israel in 1976-1986, despite a worsening of known factors. Levels of PCBs and DDT were reported to be 50-60% higher in the breast tissues of women with breast cancer than in women without breast cancer in a study in Connecticut.

Breast cancer is rising very fast in developing countries (about 4% per

year), while in developed countries it increases by 1% per year. Has this got anything to do with the developing world's desire for competing for comparable life-styles with the developed world, without frog-leaping the learning curve?

### POPs stop women from Protecting and Nursing their own Children

Studies show how contaminated even breast milk has become. The problem of breast milk contamination and breastfeeding has been a major subject of debate. Since the early 1980s, when high levels of PCBs were detected in breast milk in a number of European countries, the question was raised whether it was still advisable to feed new-born babies on breast milk, especially when formula milk was available.

Twenty two percent (22%) of 50 countries surveyed by WEDO world-wide, report breast milk contamination from chemical exposure.

The research of Dutch scientists (1989, 1993) showed that even when plasma sampled from breast-fed 42-month-olds contained 4,5 times as much PCBs as plasma obtained from children who had been formula-fed as babies, exposure to PCBs and dioxins via breast milk was unrelated to brain development at 42 months of age. All in all, despite the presence of PCBs

and dioxins in human milk, breast-feeding has a small advantageous effect on long-term neurological development.

Lactation and the breastfeeding problem studies carried out by Walter Organ, Caren Lanting and others show that the presence of DDT and PCBs in breast milk can reduce the ability to breast feed, with a 40% decrease in lactation time reported among women with the highest levels of DDT and PCBs in their breast milk.

***Isn't it tragic that chemicals now come in between a mother and her infant, reducing the quality and ability to feed the child its most critical food?***

However, the main conclusion of numerous researches is that: Despite the fact that breast milk can be a major source of PCBs and dioxins, it also provides essential elements for optimal child development, for activating of the immune system, which are not present in formula milk (for example, antibodies against some infective diseases).

Despite the presence of PCBs and dioxins in human milk, breast-feeding should be advocated. However, all possible measures should be taken to reduce the level of dangerous chemicals (and further - to eliminate them) in breast-milk, (see recommendations).

## POPs are a pain, even when disguised as Endometriosis

Endometriosis is one of the most common causes of pelvic pain and infertility in women. Endometriosis is a puzzling disease affecting girls and women in their productive years. The name comes from the word "endometrium", which is the tissue that lines the inside of the uterus and builds up and sheds each month in the menstrual cycle. In endometriosis, tissue like the endometrium are found outside of the uterus, in other areas of the body. In these locations outside of the uterus, the endometrial tissue develops into what are called "nodules", "tumors", "lesions", "implants", or "growths". These growths can cause pain, infertility, and other problems.

Endometriosis typically affects women during their menstruating years. Symptoms can start with or after the first menstruation and, for most women, the disease is rarely found after menopause. It is estimated that 30-40% of women with endometriosis may have difficulties in becoming pregnant (but this means that 60-70% will have no problems!).

The cause of endometriosis is not known, but a number of theories have been advanced. One of them is the retrograde menstruation or transtubal migration theory. Another theory suggests that the endometrial tissue is distributed from the uterus to other parts of the body through the lymph



or blood. A genetic theory suggests that certain families may have predisposing factors to endometriosis

Recent research spearheaded by the Association of Endometriosis has shown that environmental toxins such as dioxins and PCBs, which act like hormones in the body and damage the immune system, cause endometriosis in animals (Endometriosis Association, 1999)

New data from the world's largest research registry on endometriosis shows that women with endometriosis and their families have a heightened risk of breast cancer, melanoma, and ovarian cancer. There is also a greater risk of non-Hodgkin's lymphoma in the families. These findings parallel other work, including a study of 20,686 endometriosis cases in the Swedish cancer registry which also

found an increased risk of breast cancer, ovarian cancer, and non-Hodgkin's lymphoma in women with endometriosis.

Researchers at Harvard Medical School have found an association between melanoma and endometriosis.

A number of the cancers and autoimmune problems seen in women with endometriosis and their families have been linked to environmental toxins.

Research conducted by the Association beginning in 1992 and the US-National Institute of Environmental Health Sciences, the Environmental Protection Agency, and others since then, has pointed to dioxins as a possible trigger.

As the authors of the study utilizing the Swedish cancer registry mentioned above wrote, "Recent observations that dioxin, a well-recognized immunosuppressive agent, is associated with both non-Hodgkin's lymphoma and endometriosis may indicate that shared environmental factors may be responsible for our observation, an issue that deserves investigation in future studies."

### The puzzle of endometriosis

Statistics on the incidence of this disease world wide is still lacking. But endometriosis appears to be on the rise in the US, where it afflicts 10-20% of women of childbearing age. Prior to 1921, there were only 20

reports of the disease in world wide medical literature, German researchers report that women with endometriosis have higher levels of PCBs in their blood than women who do not suffer from this disease. Animal studies indicate that endometriosis is closely linked with exposure to dioxin.

## Having Healthy Children : Are POPs coming in the way?

Reproductive health is now part of official language and government policies and programs. When we say 'reproductive health', we mean the ability of healthy women to bear healthy children with healthy men. Reproductive health also refers to the ability of these healthy children to develop into healthy adults and then to bear healthy children themselves.

Females are born with all their ova. Exposure to toxicants during the formation of fetal ovaries and ova will impact on future generations. Similarly males produce sperm continuously. Past, recent, or ongoing occupational/environmental exposures may alter spermatogenesis (the process of sperm production), with the possibility of "recovery". For example lead and some pesticides have been detected in follicular fluid and semen.

The biological process of reproduction involves:

- Production of healthy germ cells
- Receptive reproductive organs
- Conception

- Viable embryo
- Growth & development of fetus in favorable maternal environment
- Lactation
- Successful delivery of baby
- Growth and development

Any environmental factor that affects one or more of these key stages can result in reproductive failure. POPs have been associated with particular impacts on women which affect their ability to bear healthy children, capable of developing into healthy adults.

The following pathologies have to be taken into account relating foetal contamination and women's ability to bear healthy children:

#### Miscarriage

Animal studies indicate that exposure to certain synthetic chemicals, such as PCBs, increase the risk of miscarriage. Similar studies implicate chemical exposure to increased spontaneous abortions in women in contaminated sites (eg: Soveso in Italy, landfills in France, UK and the US).

#### Spontaneous Abortions

Commonly used pesticides like DDT, aldrin and endrin can cause spontaneous abortion – both in early and later stages of pregnancy.

#### Intellectual Development

Studies done by Sarah and Joseph Jacobson on the intellectual impairment of children exposed intrauterine to PCBs indicate that

these children suffer from lower full-scale and verbal IQ scores, with strongest effects being reported on memory and attention. What is of concern is that these effects are seen in children exposed to PCB concentration only slightly higher than those found in the general population.

#### Immune System Dysfunction and Immunodeficiency Syndrome

Several studies indicate that women and adolescent girls, especially in the high Arctic do not have a fully developed immune system. Also, babies in the Arctic do not produce the necessary antibodies when they receive vaccination for smallpox, measles, polio and other diseases. Similar trends are being seen in Europe on background exposure signs of immunotoxicity are detected.



#### Temperament Change

During pregnancy often the foetus is contaminated with toxic chemicals. Children born to mothers who ate contaminated fish (contaminated with a wide range of POPs like PCBs, dioxin, dieldrin, chlordane and mirex) appear to be over-reactive to stimulation, demonstrate a greater number of abnormal reflexes, and do not smile or seem to experience joy as much as do children whose mothers did not eat contaminated fish.

#### POPs scramble fetal signals

The hormones estrogen and testosterone are the body's sexual messengers ordering embryo's how to grow. Without these testosterone signals, reproductive development is affected. Even a minuscule dose of hormone during the onset of an embryo's sexual development, can trigger abnormalities in sexual behaviour, and may cause malformed genitalia, lowered sperm count etc. Because hormones also regulate the embryo's immune system and brain development the offspring might be prone to disease and behavioural disorders.

The failure of enzymes and hormones are far from the whole story on endocrine disruption. Man-made chemicals scramble all sorts of hormone messages, and they can disrupt this communication system without ever binding with a receptor.

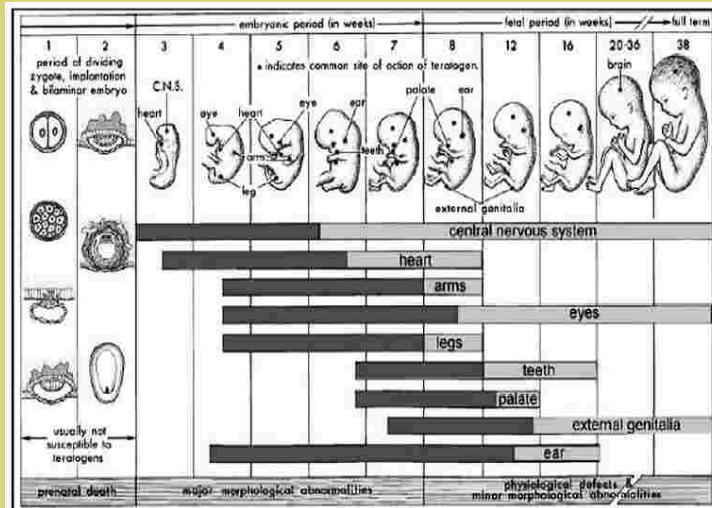
Theo Colborn's example from "Our Stolen Future" is apt to explain how this may happen. If cellular phone messages aren't getting through, the problem isn't necessarily with your phone. There may be trouble somewhere else in the system, such as in the satellite that relays the message from continent to continent or the transmitter that sends the message into space. The same holds true for the endocrine system.

*"Endocrine disrupting chemicals have been reported in semen, the ovarian follicle, the womb environment, and in breast milk at especially elevated concentrations of actions and unique target sites".*

Certain chemicals can pass through the placenta from mother to developing foetus. Since the foetus is exquisitely sensitive to even minute quantities of HDCs, it has been suggested that the chemicals we are exposed to in the womb may have an effect years later. For example a synthetic oestrogen, Diethylstilbestrol (DES) was given to over five million women from 1948-1971 and is regarded today as a "model for the problems that other oestrogen-like substances may cause". Originally prescribed to prevent miscarriage, DES was also used for menopausal symptoms, as a "morning after" contraceptive, for girls who were growing "too tall" and most bizarre of all, by farmers to fatten chickens, cows and other livestock. Years later daughters and sons of women who took the drug developed various cancers and genital abnormalities.

The greatest damage can occur during pregnancy, when some POPs mimic or block the miraculously delicate signals that the mother's and fetus' hormonal system sends to the developing fetus to guide its development. According to studies, as the child develops, endocrine disruption in the womb and through breast milk may result in cancer, endometriosis, learning disorders, immune and neurological disorders and a wide range of other problematic conditions such as low sperm count and sperm volume decline, miscarriages, low IQ, genital malformations and infertility.

### Windows of Development



### Men Aren't Spared Either

POPs don't leave men alone, although most research has been on women. There are shocking findings in the last two decades with regard to infertility of men. A literature review revealed that there has been a serious decline in both volume of semen and the number of sperm between 1949 and 1990. A research project which reviewed 61 papers from 61 countries showed that semen volume declined from 3,40 to 2,75 ml and the number of sperm from 113,000,000 to 66,000,000 per ml. Accumulating evidence suggest that 'estrogens' could be responsible for disturbing

maturation of males that may seriously affect male fertility. Conversely, even in healthy sperms the binding of the ovary and sperm may be difficult in women who have high dioxin and furan contamination in their bodies. Based on observations in animals, there is increasing evidence that a number of persistent organochlorine pollutants can alter the endocrine homeostasis, this resulting in toxic effects in particular in the developing organism.

However, the role of these chemicals in determining endocrine-related diseases in humans, and possibly a decrease of fertility, is still controversial. A paper by Elena De Felip and her colleagues from University of Rome found that POPs

invade the reproductive tract and has a strong potential disrupt normal binding of the sperm and the egg.

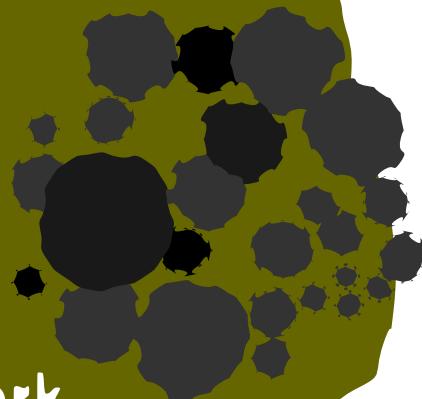
### Conclusion

There is growing body of literature – from independent and publicly funded research institutions – to show that chemicals especially POPs are causing adverse health impacts. Currently there is no safe limit on POPs. While it is common knowledge that POPs are harmful, a safe level hasn't been established before major problems begin to occur.



## CHAPTER 5

# POPs Shouldn't be the Only Ones at Work



**Chemicals** are particularly hard to act against in the conditions of everyday contamination. They are so dispersed, simultaneously all-encompassing yet hard to see that it's not possible to even understand what one can do. Here are some guiding ideas that can help to plan how not to remain a spectator and demand our Right to Life, a fundamental Right given to every Indian under Articles 14 and 21 of the Indian Constitution.

### What we can expect of Government

- India should learn from the European Union's REACH policy, as well as from concepts of Extended Producer Responsibility. These should be mainstreamed into transactions with larger players with an iron hand.
- The Government of India (GOI) has to undertake a paradigm shift.

Industry or their associations should not be seen purely as a means to growth. Human capital, the reason for our software super-power status today, is equally important. It must be protected by protecting future generations.

- The GOI should stop being scared of punishing offenders, for fear of offending them.
- The GOI must give the highest priority to elimination of POPs because of the dangers these substances pose to the most vulnerable aspects of human health: the reproductive system and the mental and physical development of children from prenatal phase through puberty. The Right to Life is, after all, a Fundamental Right of every Indian.
- A transparent phase out of the production and the use of POPs in the public realm should be undertaken.

- New POPs should not be allowed to take over. There must be developed criteria and procedures based on environment health protection to identify new POPs for elimination

- Apply the precautionary principle: no chemical should be allowed on the market before sufficient scientific proof exists that the chemical is not dangerous to human health, not only in short-term but also in long-term use

- Promote more research to identify POPs in human tissues and to analyze the links between human health and POPs in environment in India.

- Work towards making breast milk toxin free.

- Develop labeling schemes for products and goods containing POPs, so that consumers can take informed decisions

- Provide governmental support for the monitoring and mapping of the environmental health situation - particularly the impact of chemical pollution - by women's organizations and other NGOs and local groups in co-operation with scientists and experts. The results should be taken into account in national policymaking

- Stop subsidizing and encouraging incineration

- Monitor incinerator functioning

### What we can do ourselves:

- Stop trash from being burned

- Discuss the issue of DDT in malaria control with the local agencies of your district to avoid it

- Control and avoid pesticides applied in our gardens and on our lawns

- Learn about using plants, herbs and harmless kitchen products to control insects

- Use traditional remedies to handle lice, not Lindane-laced shampoos

- Ensure no nursing home or hospital is burning its waste. If they have a license, please ask for all their compliance records under the Right to Information . It is unlikely that they are non-polluting. In any case, there is no operational dioxin-facility in India as yet

- Read about cosmetics and cosmetic brands before purchasing them. Major International brands are discussed at [www.safecosmetics.org](http://www.safecosmetics.org), but for local Indian brands, there is no information available

- Use your Right to Information to learn about what is being done about toxics in your State and neighbourhood

- Get regular check ups for breast cancer



## Glossary

1. **Autoimmune:** An illness that occurs when the body tissues are attacked by its own immune system. The immune system is a complex organization within the body that is designed normally to "seek and destroy" invaders of the body, including infectious agents. Patients with autoimmune diseases frequently have unusual antibodies circulating in their blood that target their own body tissues. Autoimmune diseases are more frequent in women than in men. It is felt that the estrogen of females may influence the immune system to predispose some women to autoimmune diseases. Furthermore, the presence of one autoimmune disease increases the chance for developing another simultaneous autoimmune disease.

2. **Ecotoxicity:** Ecotoxicology is the study of how chemicals affect the environment and the organisms living in it. Scientists who study the

environment tell us that all organisms are connected in the web of life. Therefore, if a chemical affects some of the organisms, other organisms in the ecosystem may suffer since all organisms depend on one another. Ecotoxicity as a discipline is to understand the concentration of chemicals at which organisms in the environment will be affected. This concentration should be avoided in order to protect the environment.

3. **Epoxide:** It is an organic chemical, a cyclic ether with only three ring atoms. This ring approximately is an equilateral triangle, i.e. its bond angles are about  $60^\circ$ , which makes it highly strained. The strained ring makes epoxides more reactive than other ethers, especially towards nucleophiles. Simple epoxides are named from the parent compound ethylene oxide or oxirane, such as in chloromethyloxirane. A polymer made of epoxide units is called a polyepoxide

or an epoxy. Epoxy resins are used as adhesives and structural materials.

4. **Food chain:** A succession of organisms in an ecological community that constitutes a continuation of food energy from one organism to another as each consumes a lower member and in turn is preyed upon by a higher member. In other words, a group of organisms interrelated by the fact that each member of the group feeds upon on the one below it and is in turn eaten by the organism above it in the chain.

5. **Hormones:** chemical substances having a specific regulatory effect on the activity of a certain organ or organs. The term was originally applied to substances secreted by various endocrine glands and transported in the bloodstream to the target organs. It is sometimes extended to include those substances that are not produced by the endocrine glands but that have similar effects.

6. **Inuit:** A member of a group of Eskimoan peoples inhabiting the Arctic from northern Alaska eastward to eastern Greenland, particularly those of Canada. Their diet includes local meats. Hence they are more vulnerable to exposure of toxic chemicals bioaccumulated in these.

7. **Isomer:** In chemistry, one of two or more compounds having the same

molecular formula but different structures (arrangements of atoms in the molecule) is known as isomer. Isomerism is the occurrence of such compounds. Isomerism was first recognized by J. J. Berzelius in 1827. The common example of isomer can be glucose and fructose with same molecular formula  $C_6H_{12}O_6$  but different molecular structure. The molecular structure is often deciding factor of certain chemical properties of the compounds.

8. **Oligozoospermia:** It is abnormally low total number of spermatozoa in an ejaculate. Also known as oligospermia, is a medical symptom affecting men. It is defined as having less than 20 million spermatozoa per ml of ejaculate. Oligospermia has many different causes, as many different medical conditions can reduce sperm concentration. The most effect of oligozoospermia is sterility.

9. **Organic chemical:** Molecules that contain carbon and hydrogen atoms are classified as organic chemicals. This is known as organic because hydro-carbons are building blocks of all living organisms.

10. **Perinatal:** Of, relating to, or being the period around childbirth, especially the five months before and one month after birth. Pertaining to the period immediately before and after birth. The perinatal period is defined in diverse ways. Depending on the definition, it starts at the 20th to 28th week of gestation and ends 1 to 4

weeks after birth. The word "perinatal" is a hybrid of the Greek "peri-" meaning "around or about" and "natal" from the Latin "natus" meaning "born."

11. **Physiology:** The biological study of the functions of living organisms and their parts. Physiology (in Greek physis = nature and logos = word) is the study of the mechanical, physical, and biochemical functions of living organisms.

12. **Prenatal:** Occurring or existing before birth. Prenatal care is the regular health care women should receive during pregnancy from an obstetrician or midwife. Prenatal development is the growth and development of a single-celled zygote formed by the combination of a sperm and an egg into a baby. The word "prenatal" comes from the Latin "pre-," before + "(g)natus," birth = before birth. "Antenatal" is often used in lieu of "prenatal" in the UK, Australia, etc.

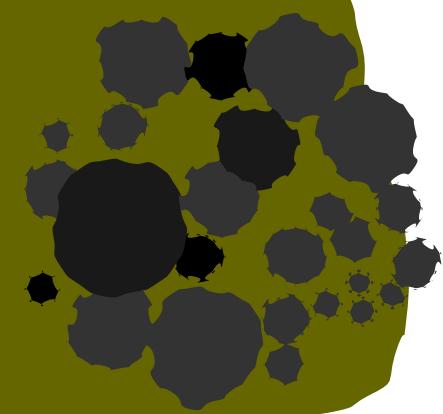
13. **Ship breaking industry:** Literally, the process of dismantling old ships and revering materials from them. Alang in Gujarat is one of the major hubs of ship breaking. It is considered a highly hazardous industry.

14. **Stockpiles:** Leftover or outdated supplies from the past. Several environmental health researches have shown local pollution due to leaking from weathered storing chambers. Disposal of Stockpiles is now a major concern.

15. **Synergism:** It means that exposure to more than one chemical can result in health effects greater than expected when the effects of exposure to each chemical are added together. Very simply, it is like saying, most simply, that  $1 + 1 = 3$ . When chemicals are synergistic, the potential hazards of the chemicals should be re-evaluated, taking their synergistic properties into consideration.

16. **Teflon:** It is the brand name of a polymer compound discovered by Roy J. Plunkett (1910–1994) of DuPont in 1938 and introduced as a commercial product in 1946. It is a thermoplastic fluoropolymer. Teflon has the lowest coefficient of friction of any known solid material. It is used as a non-stick coating for pans and other cookware. It is found that prolong use of Teflon coated utensils gradually erode the coat and contaminate the food.

17. **Vinyl flooring:** A relatively inexpensive flooring product made from polyvinyl chloride and sold in large sheets or small tiles. This is mostly popular in using in office, hospitals, institutions, factories. At domestic level, vinyl floor is also used to cover the floor as it is very convenient to clean. While playing over the vinyl floor children get exposed to toxic PVC, or Poly Vinyl Chloride. The burning of a building containing vinyl flooring causes sudden release of a high quantity of POPs and is a known health hazard.



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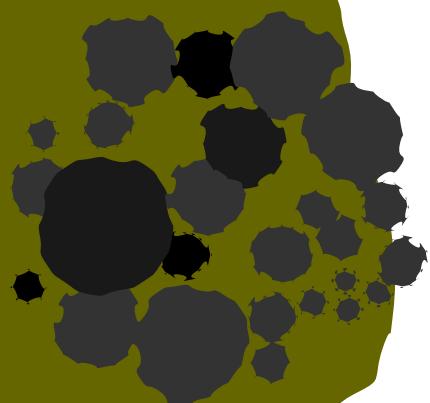
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# Appendix



## Appendix A: Using The Manual

This manual has been structured to allow the user to get a good grasp of the problem of POPs. After that, the knowledge is what you make of it and how effectively you use it.

One of the most effective ways to use it is likely to be by further mainstreaming the information within existing programmes. In a reproductive health programme, for example, this information can be shared and locally relevant work plans and ideas developed. The last section, which details what can be done, offers ideas about how some of these plans can be actualized through campaigning and advocacy. If anything, our studies show us that women's reproductive rights are amongst the most severely impacted by POPs.

Another good way to use this information is to take up the issue as a campaign based on any of the ideas

that you have read about. Your local club, perhaps even combined with other similar clubs and associations, could simply campaign to stop any one activity. Or simply campaign the government to take more urgent action. All this work will be a positive contributory factor towards women's (and children's) health.

Using the Right to Information Act, you could even track the government's progress of its commitments on the treaty. Get on to the website and learn what the treaty demands. Ask if the government is really doing it? For example, if you live near any POPs pesticide plants, you could play an important role in alerting the communities and garnering wide support to phase out the plant. Your interest alone will force action.

If you work with any groups of people—clinics, schools, libraries, offices—share the information with your colleagues to see if there is the interest in taking collective action.

## Carrying out a POPs audit

It's not easy to undertake a POPs audit and it's unlikely anyone, anywhere can ever do a thorough job. However, don't let that scare you off. Do whatever you can and act on it

- Re-read this manual carefully to understand the source of the dirty dozen
- Make a list of the possible sources of POPs in your neighbourhood
- This could be by burning PVC coated copper wires, an incinerator in a hospital nearby, open burning, use of DDT by the malaria control department, lindane based shampoos, specially if they have been bought in the United States, or any agricultural activity, however small. Expand your list later, based on the new POPs that we've mentioned in the manual
- Try to see if these POPs are present
- Make a rough map of the neighbourhood and plot these on it
- If you have any idea of quantities, (how much waste burned etc), put those there too
- You don't have to even think of measuring POPs. It's hard, expensive and not needed. Besides, India is only just developing its capacity to test dioxins.
- Your final map, with your qualitative and quantities comments, is your audit result.

## Appendix B: What if You are a Home-maker and Want to Make a Difference?

In all probability, the movement against toxics will really only take off in India if homemakers begin to take up the issue, given the impact of their decisions and ability to create a shift in mind-set at the community level. If you want to do something, here are some ways to start:

- Learn about the issue to speak with confidence. Read this manual again
- Audit your home for POPs: do you burn your waste? Do you use a Lindane based anti-lice shampoo? If you do, phase it out
- Talk to your neighbours and bring up the issue at the next Residents Welfare Association Meetings. Share this manual. If you need more, let Chintan know
- Collectively audit your neighbourhood. Don't try to be perfect—identify whatever you can
- Meet the local municipality and malaria control department to determine if they use DDT for malaria control
- Work out alternatives for mosquito control. Begin with your own neighbourhood first
- Make a collective action plan, based upon your audit results
- Stop any POPs emitting activities in your neighborhood
- As you know, POPs travel far and wide. Spread your movement to other

neighbourhoods. Don't be shy to speak about the issue at other people's meetings

- Attend as many meetings as possible and share your experience, including the things you couldn't do
- Don't forget to write to us at Chintan, so that we can let others know about your work and learn from it ourselves

### Appendix C : How Chintan Can Help you in Your Work

Although we have tried to put in all our resources and information in this manual, there are many other ways we can help you to take the issue forward. We can:

- Help you link up with international experts
- Help you link up with doctors who know
- Help you to access more information on the issue
- Help you to link with any other groups who are working on these issues
- Help arrange a specialist to come and speak at your event
- Help you plan your campaign or have a specialist help you in your awareness materials
- Put you in touch with active NGOs in your part of the country
- Help disseminate your work or campaign to several hundred people
- Help you gather support for your campaign from people you may not know

### Appendix D : Teach Yourself More

Chintan published 'Stealthy Intruders' to be an information rich manual, which would need no supplements for an elementary understanding of a complex issue. However, there is a wealth of information that will help you to learn much more about this fascinating subject. Some of our favourites sources:

To read about the process by which this treaty came into being, the full text of the Stockholm Convention and related technical information:

**[www.pops.int](http://www.pops.int)**  
**[www.unido.org/doc/29721](http://www.unido.org/doc/29721)**

To learn more about civil society activities related to POPs :

**[www.ipen.org](http://www.ipen.org)**

To understand more about chemicals related legislation and similar legislation in the United States :

**[www.ciel.org](http://www.ciel.org)**

To understand what's happening in the world of pesticides:

**[www.panna.org](http://www.panna.org)**

To understand more about toxics and environmental justice:

**[www.rachel.org](http://www.rachel.org)**

To learn more about pesticides and toxics in India:

**[www.cseindia.org](http://www.cseindia.org)**  
**[www.thanal.org](http://www.thanal.org)**

To learn more about POPs in East Asia:  
**<http://www.env.go.jp/chemi/pops/3rd/mat02.pdf>**

