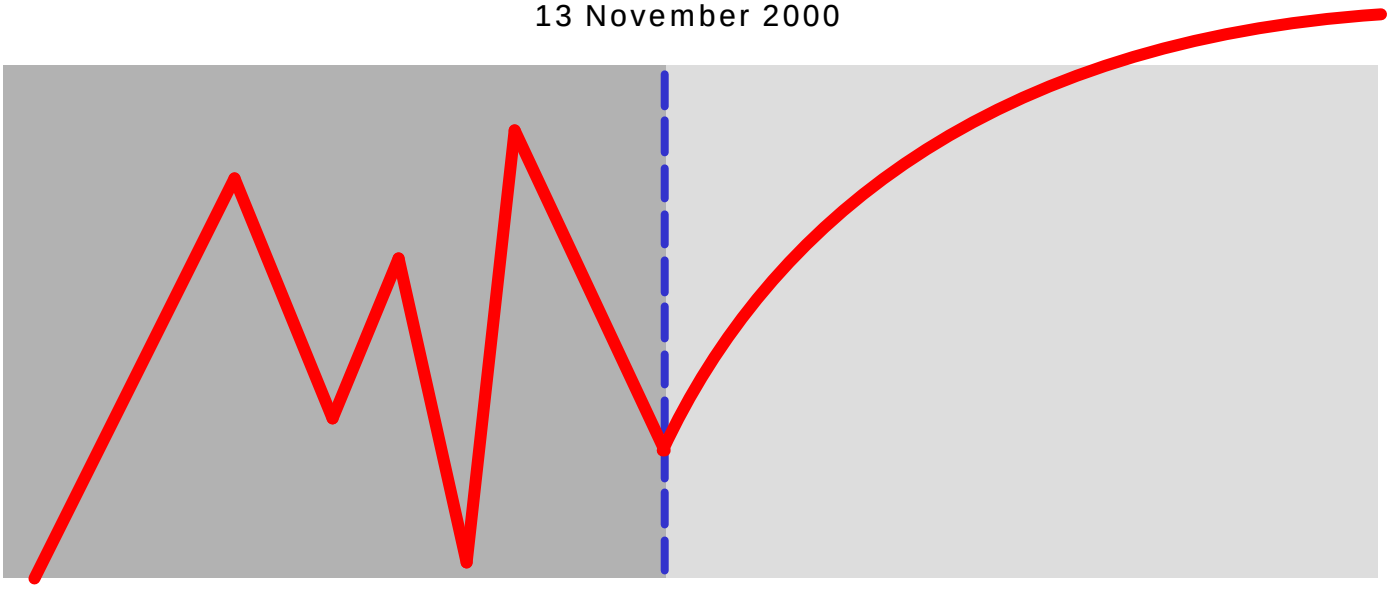
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO ROUND TABLE - MARGINALIZATION VERSUS PROSPERITY

13 November 2000



Panel 2:
UNIDO's efforts towards the Implementation of the Persistent Organic Pollutants (POPs) Convention

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I. Introduction:

Persistent Organic Pollutants (POPs) raise concern at all geographical scales – local, national, regional and global. At numerous locations throughout the world, large quantities of POPs – obsolete chemical pesticides, obsolete industrial chemicals and unwanted chemical by-products – can be found in storehouses, in wastes, in water bodies, in soils and sediments.

POPs, synthetic chemicals with unique and dangerous characteristics, pose a serious threat to wildlife and humans and merit global action. POPs have four common properties: persistence, bioaccumulation, global transport, and toxicity. As a consequence of the persistency to natural breakdowns, the tendency to accumulate in fatty tissues and to biomagnify within food-chains, long-term exposure to relatively small concentrations of these compounds leads to the accumulation of considerable deposits in animal and human tissues. Scientific research has revealed the alarming effects of these chemicals, which are still being used in several parts of the world and are present in all.

POPs routinely escape from the storage sites and from contaminated locations into the wider environment by volatilization, or by ground and surface water run-off (see Figure 2). A number of POPs have been shown to cause, at low concentrations, neurological defects, and serious immune and metabolic damage. As a result, POPs have been placed by national and international agencies in the category of hazardous materials. UNEP has listed certain POPs for elimination through the implementation of a global treaty, which is presently being negotiated by over 100 governments. This treaty lists 12 organochlorines – commonly known as "the dirty dozen" (see Table 1) – that are known to be toxic contaminants.

Transport of POPs in the environment takes place either by movement of fresh and marine waters or, in the case of semi-volatile compounds, by movement in the atmosphere. This propensity of POPs to be transported long distances, across all political boundaries, linked to their large-scale production and usage, results in a widespread distribution of these compounds, even in regions where they have never been used. As a result, many POPs have become global contaminants and are found ubiquitously in both the terrestrial and the aquatic environment.

In recent decades huge amounts of POPs have been produced and used worldwide and many are still in production and in use in everyday products. Thus, humans and other organisms are exposed to POPs, in many cases for extended periods of time. In view of their hazardous nature, usage and discharge of POPs must be reduced, through the adoption of clean production technologies and/or their substitution by more environmentally friendly alternatives.

I.A. General chemical properties and global transportation:

POPs have similar physicochemical properties, and as a consequence of these are persistent in the environment. They become stored in fatty tissues of animals and continue to build up as the chemical is taken in. The levels of some of these chemicals increase as animals feed on others, so that the highest levels are found in animals at the

top of the food chain, including humans. Excretion of organic contaminants is normally facilitated through their metabolic conversion to more polar forms. However, because of their resistance to metabolic breakdown POPs are not easily excreted. As mentioned earlier, because they are soluble in fat and are able to bioaccumulate, the highest levels are found in meat, fish and dairy products. Therefore, since most are present in food, human exposure to many POPs is unavoidable.

The US Environmental Protection Agency (EPA) and the US Agency for Toxic Substances and Diseases (ATSDR) have determined that POPs can injure human health and ecosystems at locations nearby the site from which they escape into the environment but also at locations very distant from that site. For example, it is well established that the marine food chain in the Arctic and near-Arctic regions is significantly contaminated with synthetic pesticides that originally escaped from sites in temperate and in tropical regions.
Recent studies of contaminants under the Canadian Northern Contaminants Program (NCP) have substantially enhanced understanding of the routes by which contaminants enter Canada's Arctic and move through terrestrial and marine ecosystems. They provide an account of how POPs are transported over long distances on air currents from warmer regions of the globe and condense at colder, higher latitudes onto vegetation, soil, and water bodies. This process known as the *global distillation effect* (or *global fractionation*) is the cause of the high concentrations of some pollutants found, for example, in the Earth's arctic regions.

The atmosphere is recognized as an important contributor for the dispersal of synthetic organic compounds to oceanic and freshwater ecosystems. Organic contaminants are removed from the atmosphere and deposited on water by wet deposition (rain, snow, fog), dry particle deposition, and gas exchange at the air-water interface. Oceans are especially sensitive to atmospheric deposition because of their high surface area, which leads to a major fraction of the hydrologic input being by direct precipitation on the surface. For several pesticides the oceans have become the major reservoir and transport agent. Human activities have polluted marine ecosystems, but the magnitude of the problem and the full consequences of it have yet to be fully recognized. Contamination from land-based sources is responsible for at least 80% of marine pollution worldwide.

I.B. Impacts of POPs on human health and the environment:

Over the past several years, the risks posed by POPs have become of increasing concern in many countries due to their inherent toxicity; they can impact adversely on wildlife, marine life, and domestic animals. Effects may arise directly from exposure during manufacture/formulation and indirectly from their chronic accumulation in human bodies through inhalation, diffusion through the skin and intake of food crops and others. POPs are also implicated in reproductive anomalies and cancer in both humans and wildlife. There is mounting evidence that organochlorine compounds especially can act as hormones. There are profound interconnections between the hormone (endocrine) system and many body systems, including the nervous, reproductive and immune systems. Endocrine-disrupting chemicals may upset the hormonal balance in the body and thereby disturb the regulation of body functions. POPs may be partly responsible for the decrease in the quality of semen, reduction in

male fertility (lower sperm count and sperm deformities), increase in testicular and prostate cancer, increase in defects in male sex organs; and increased incidence of breast cancer that has been observed over the last fifty years.

In addition, due to injudicious use of chemical pesticides, many pests have developed resistance to them, resulting in pest resurgence. Resistance in e.g. vegetable pests has led in the South to an over-dosing of pesticides by up to eight times the recommended rate.

Furthermore, POPs residues in soil, in addition to eliminating or reducing parasitic microbes, are also toxic to the non-parasitic and ecologically useful soil microbial and vertebrate population. POPs may reduce certain microorganism populations while they stimulate the growth of others, especially the saphrophytic and spore forming types. Soil chemical properties may also be altered by the accumulation of residual POPs and their metabolites. These processes may disrupt the ecological balance in soil micro-environments, by simplifying the microbial population, and possibly by reducing soil fertility and its ability to support life.

I.C. POPs an issue of concern in developing countries:

POPs pose a major threat to human health and the environment particularly in the developing world. There, the problems caused by POPs are surrounded by a number of unique situations, viz., economic priorities, high burden of infectious diseases, poverty, and absence of a regulatory framework for the disposal of toxic chemicals. In countries where governments have enacted relevant regulations, their implementation has been problematic partly because of the ignorance of the manufacturer, the local formulator or the distributor and partly because of the low level of education of the public.
The limited amount of additional land that can be brought under cultivation is forcing developing countries to wage a perpetual, uphill battle to produce sufficient food for their growing populations and, at the same time, to gain economic independence. The anticipated trend is, therefore, large-scale, capital intensive, monocropping with high inputs of synthetic pesticides. Unfortunately, the rate of increase in crop productivity in many countries is barely keeping pace with the rate of population increase. Therefore future increases in agricultural production must come from increased crop yields per hectare, which implies additional chemical inputs in the form of pesticides. Thus, recent estimates suggest that pesticides account for more than 20,000 fatalities yearly, most of which occur in developing countries, making agriculture one of the world's most hazardous industries. Women and men working in the agricultural sector make up around 60% of the total work force. Pesticide use accounts for 14% of all known occupational injuries and 10% of all known fatalities.

Most countries with developing economies and economies in transition lack the technical infrastructure as well as the financial and appropriate capacity to properly manage and destroy obsolete stocks of POPs and/or to remediate POPs-contaminated environmental reservoirs.

II. Key issues and UNIDO's response

If they act alone, many developing countries do not have the power or the technical capabilities to protect their environment and their human populations from the severe threats and impacts caused by POPs. The nature and magnitude of contamination by POPs is such that it calls for collective action in the form of an internationally legally binding instrument to ban certain persistent organic pollutants. There is a high demand for sustainable solutions covering the release of POPs into the environment, the invention of destruction technologies for POPs, and the presentation of eco-friendly alternative forms to support environmentally sustainable economic development and consequently to achieve global environmental benefits.

Most countries with developing economies and economies in transition lack adequate and appropriate know-how and technical capacity to overcome the hurdles they face in their efforts to fulfill the requirements of a future global treaty to ban certain POPs once it comes into force. Therefore, because of the persistence of POPs, action has to be taken already in the interim to reduce and eliminate the release of POPs into the environment.

UNIDO, as the specialized agency of the United Nations in industrial development in developing countries and countries with economies in transition, has accumulated significant knowledge in the pesticide sector as well as in its Cleaner Production Programme. UNIDO's response is based on a solid foundation of expertise that the Organization has gained from more than 30 years of service. Issues related to industrial chemicals and unintentionally generated by-products such as dioxins and furans have also been addressed specifically, most importantly in the Pulp and Paper sector. Furthermore, through its International Centre of Science and High Technology (ICS), in Trieste, Italy, UNIDO has been involved jointly with UNECE (United Nations Economic Commission for Europe) in the preparation of a Compendium of Soil Clean-up Technologies and Soil Remediation Companies (2nd edition, 2000). This compendium covers technologies for the elimination of POPs.

Furthermore, UNIDO has supported the UNDP Sub-programmes *Pesticide Development Programme India* and *Strengthening of Pesticide Development Centre*, aiming at the improvement of pesticide formulation techniques by replacing carriers/ingredients that were toxic persistent organics with water-based user and eco-friendly formulations.

Over the past two decades, India has received assistance through UNDP, UNIDO and FAO to strengthen its national capabilities in pesticide development and in safer and effective application of crop protection agents through Integrated Pest Management (IPM) Programmes. UNIDO has been instrumental in establishing the Indian Pesticide Development Centre (PDC)/Institute of Pesticide Formulation Technology (IPFT).

UNIDO has been involved in the development of biopesticides and of methodologies for the assessment of regulations and methods for chemical and biological safety. Furthermore, projects on the safe use of pesticides and the removal of pollutants have been successfully implemented. UNIDO's Regional Network on Safe Pesticide Production and Information for Asia and the Pacific (RENPAP) has been promoting the

development and use of Neem-based biopesticides in Asia and the Pacific. India's Pesticide Development Centre has been identified as the focal point for the proposed programme. This will be the first effort to develop Neem-based pesticides in an integrated way and to provide an alternative to chemical pesticides. Furthermore, UNIDO is the implementing agency of the on-going project in India for *Technical Support for the Development and Production of Neem Products as Environment Friendly Pesticides*.

UNIDO is the developing world's most important repository of industrial information and knowledge. Based on its long involvement with the issues raised here the Organization can offer comprehensive services. They range from simple advice and counsel, to providing engineers for the implementation of the global POPs treaty.

III. Conclusions

Because of their unique properties, POPs pose a special kind of challenge that makes it impossible for any nation to remedy the problem by acting alone. They can travel thousands of kilometers in complex journeys on air and water currents, and through the food web, inevitably making one country's contamination the world's problem. POPs are now ubiquitous, with a widespread distribution across the earth, including regions where they have never been used.

Nations in the North and South are starting to work together on several fronts to develop legally binding agreements to restrict the use of POPs. Much of the discussion to date has focused on the global ban of the "dirty dozen". There is a real need to keep the momentum going and to offer eco-friendly alternatives.

The shift away from POPs and other toxic chemicals must build on the significant steps taken to date and continue at an even faster rate, spurred by much greater investments of money and energy. Viable alternatives are not the problem. Many are already in use or in practice around the world. The challenge is to make these alternatives more widely known and available and to accelerate research, community-based activities, and other initiatives such as other modes of agricultural production – including organic agriculture.

The United Nations is central to any global efforts to solve problems that challenge humanity. Cooperating in this effort are more than 30 affiliated organizations of the UN system. UNIDO, as the specialized agency of the United Nations in industrial development in developing countries and countries with economies in transition, has accumulated significant knowledge in the field of POPs. UNIDO offers a comprehensive range of solutions to help developing countries overcome the barriers they face in their efforts to implement an integrated preventive environmental strategy and its systematic, continuous application in the phasing out of POPs.

To keep the momentum going, UNIDO is endeavoring to establish activities that are meant to be both preparatory and catalytic for global, regional and national actions. UNIDO sees its crucial role in addressing the following issues:

- Raising awareness

This is accomplished through seminars, conferences and workshops; through media campaigns and demonstration projects; and through dialogue with governmental and industrial decision-makers, industrial associations and other representative bodies. The intention is to provide participants with an overall picture of the global POPs problem, and to focus in some detail on the nature of the problem in countries or in regions, as well as to give consideration to possible mechanisms for understanding and addressing environmental releases of POPs that may be occurring. Among the topics discussed are alternatives to POPs, case studies of POPs problems in a region, as well as studies of how some countries have addressed these problems. Furthermore, UNIDO initiates a number of immediate actions involving the development and sharing of information; the evaluation and monitoring of the success of implemented strategies; the identification and inventory-taking of POPs; the assessment of available destruction capacity; the identification of sources of dioxins and furans and aspects of their management.

- Information management and dissemination

UNIDO can train relevant personnel on how and where to obtain and disseminate data and information on POPs. This will lead to the establishment of a network of POPs contact points for information exchange, with special attention to the delivery of information to developing countries and countries in transition.

- Technology transfer and presentation of alternatives

UNIDO is a specialist in assisting technology transfer. UNIDO can help to create and build up the capabilities of countries and industries to evaluate, transfer and install alternative techniques and methodologies that can lead to the reduction / elimination of the releases of POPs. Furthermore, UNIDO can promote alternative substances for various uses of POPs and can also make information available on the experience gained with respect to the various substitutes / techniques / projects already tested under the auspices of UNIDO.

UNIDO's support, expertise and encouragement for POPs-related research in developing countries is now more than ever in high demand. So is its help to these countries to shift to environmentally sound alternatives, e.g. more appropriate products, manufacturing and disposal processes, and pest management practices. UNIDO manages the financial and technological assistance it receives from industrialized countries either directly or through multilateral development banks.

IV. Discussion points

Based on their differing environmental and economic situations, developing countries and countries in transition face different problems caused by POPs. Because of their unique properties POPs do not respect national boundaries, and therefore pose a special kind of challenge that makes it impossible for any one nation to remedy the problems acting alone. The nature and magnitude of the problem is such that it calls for collective

action at the international level. What kind of solutions is UNIDO able to offer from a global perspective and what has been done so far?

- Women in the South – 60% of the agricultural workforce – are marginalized and disadvantaged. Yet they play a major role in the agricultural sector. Therefore, what kind of special efforts should be made to ensure that they benefit from any assistance given on POPs?

- There are now ever more pesticides used globally as Southern countries are on a strong drive to industrialize, especially in their agricultural sector. This basically means an intensification of large-scale, capital intensive, monocropping with high pesticide inputs. Agriculture dependent on external chemical inputs is still promoted by many governments, especially in the South.

  → Even though UNIDO already has successful operations, how can it be explained that UNIDO has not been able to persuade governments to change their approaches?
  → Would the use of *Bacillus thuringiensis* (Bt) toxin-producing transgenic plants be a better solution?
  → Could the use of bio-pesticides like the Neem-based pesticides, which are natural products derived from plants, be an environmentally sound alternative to chemical pesticides?

- Based on its core technical knowledge, UNIDO might be the UN organization best fit to implement the POPs convention. In which way could member states facilitate UNIDO to reach this goal?
  Today, several UNIDO presented solutions are based on developed countries expertise, but in which perspective are developing countries seeing their role to keep the momentum going?

The Table1: The 12 POPs Designated for International Action

1. PESTICIDES	
Hexachlorobenzene (HCB): Fungicide used for seed treatment of wheat, onions, and sorghum. Also found as an impurity in several pesticide formulations. Also found as an industrial by-product	**Endrin:** Insecticide used mainly on field crops such as cotton and grains. Used as a rodenticide to control mice and voles. Also used to combat birds.
Mirex: Stomach insecticide used to combat fire ants and leaf cutters, harvester termites, mealy bug, and yellow jacket wasps. Also used as a fire retardant in plastics, rubber, and electrical goods.	**Toxaphene:** (a mixture of more than 670 chemicals) Insecticide, primarily used to control insect pests on cotton and other crops. Used also to control insect pests on livestock and to kill unwanted fish in lakes.
Chlordane: Broad-spectrum contact insecticide used on agricultural crops including vegetables, small grains, maize, other oilseeds, potatoes, sugarcane, sugar beets, fruits, nuts, citrus, cotton, and jute. Also used on home lawns and gardens. Also used in control of termites.	**Heptachlor:** Stomach and contact insecticide, used primarily against soil insects and termites. Also used against cotton insects, grasshoppers, some crop pests, and to combat malaria.
DDT: Insecticide used on agricultural crops, especially cotton, and insects that carry diseases like malaria and typhus.	**Aldrin and dieldrin:** Insecticides used for crops like corn and cotton. Also used for termite control.
Note: Wildlife and humans can come in contact with the above-listed pesticide chemicals by breathing contaminated air, by eating contaminated food or by drinking or washing in contaminated water. Exposure occurs to the foetus when it absorbs chemicals to which the parent has been exposed.	
2. INDUSTRIAL CHEMICALS	
Polychlorinated biphenyls (PCBs): Used for a variety of industrial uses, including in electrical transformers and large capacitors, as heat exchange fluids, as paint additives, in carbonless copy paper and in plastics.	**Hexachlorobenzene (HCB):** An industrial chemical used to make fireworks, ammunition, synthetic rubber. Also is a by-product of the manufacture of industrial chemicals including carbon tetrachloride, perchlorethylene, trichloroethylene and pentachlorobenzene.
Note: PCBs have a documented history of adverse effects in wildlife and acutely exposed human populations. There are some demonstrated estrogenic effects in wildlife, as well as human foetal exposures associated with neural and development changes, and long-term effects on intellectual function. HCB is toxic via inhalation, ingestion, and dermal contact, and is a WHO Class 1A "extremely hazardous" product. It is a known animal carcinogen and a "possible" human carcinogen. Shown harmful to stomach, intestines, liver, and kidneys; can affect nervous system, and cause reproductive and developmental defects. Can cross mammalian placenta to affect the unborn.	
3. UNINTENTIONAL BY-PRODUCTS	
Dioxins: Not produced commercially by intention and have no known use. They are by-products resulting from the production of other chemicals, like pesticides, polyvinyl chloride, chlorinated solvents and other chlorinated solvents.	**Furans:** A major contaminant of PCBs. By-product often bonded to dioxin. Actually a group of 115 cogeners with same biological effect as dioxins but less potent.
Note: Dioxins and furans can be created in car emissions, and in emissions from the incineration of hospital waste, municipal waste, hazardous waste, or the incineration of coal, peat, and wood. Dioxins are formed when chlorine is burned in the presence of certain precursors to dioxin. Chlorine in incinerators comes from such sources as polyvinyl chloride (PVC) vinylidene chloride (plastic wrap), chlorinated solvents, paint strippers, and pesticides. Dioxins are formed by processes that are used by metal smelters, refineries, and cement kilns. Toxic effects of chlorinated dioxins appear to be due to interference with fundamental biochemical messenger systems, including reproductive disturbances, diminished intellectual capacity, and cross-generational toxic effects.	

Information extracted from: "Assessment Report" on the 12 prioritized POPs, distributed by the International Programme on Chemical Safety (IPCS), beginning in 1995. *

ANNEX: Technical papers

THE TABLE 2: PERSISTENCE OF THE TWELVE POPS
Taken from International Council of Chemical Associations (ICCA) paper 7/97 (revised 29 April 1998) Procedure for identifying further POP candidate substances for international action.

Substance	**Half-life in air**	**Half-life in water (temperate climate)**	**Half-life in soil (temperate climate)**	**Half-life in sediment (temperate climate)**
DDT	2 days	> 1 year	> 15 years	no data
Aldrin	< 9.1 hours	< 590 days	approximatel y 5 years	no data
Dieldrin	< 40.5 hours	> 2 years	> 2 years	no data
Endrin	1.45 hours	> 112 days	up to 12 years	-
Chlordane	< 51.7 hours	> 4 years	approximatel y 1 year	no data
Heptachlor	No data	< 1 day	120-240 days	no data
HCB	< 4.3 years	> 100 years	> 2.7 years	-
Mirex	No data	> 10 hours	> 600 years	> 600 years
Toxaphene	< 5 days	20 years	10 years	-
PCBs	3 - 21 days	> 4.9 days	> 40 days	-
Dioxins (2,3,7,8- And 1,2,3,4-TCDD)	around 9 days	> 5 years	10 years	> 1 year
Furans (2,3,7,8-)	7 days	> 15.5 days	no data	no data

THE TABLE 3: LOG K_{OW} VALUES AND BIOACCUMULATION DATA AND VAPOR PRESSURE OF THE 12 POPS
Taken from International Council of Chemical Associations (ICCA) paper 7/97 (revised 29 April 1998) Procedure for identifying further POP candidate substances for international action.

Substance	**Log K_{ow}***	**BCF (wet)****	**Vapor pressure (Pa)[4]**
DDT and metabolites	6.5	3,900 to 91,000	0.00002
Aldrin	5.1 - 7.4	10,710	0.01
Dieldrin	5.4	2,100-34,700	0.005
Endrin	5.2	4,200-49,800	0.003
Chlordane	6.0	7,100-37,800	0.0011
Heptachlor	4.3 - 5.3	1,100-20,000	0.01
HCB	5.9	7,800-22,000	0.0015
Mirex	7.1	18,100-20,400	0.0001
Toxaphene	> 5.0	19,500-70,800	0.002
PCBs	6.9	57,000-800,000	0.2 to 0.00003
Dioxins (2,3,7,8-)	7.0	7,900-344,000	0.12 to 1.1E-10 (decreases with increasing chlorination
Furans (2,3,7,8-)	5.82	2,570-66,000	0.00039-5.0E-10 (decreases with increasing chlorination)

*** K_{ow}**: The K_{ow} or octanol-water partition coefficient is a way of measuring a substance's propensity to bioconcentrate. It relies on dissolving the substance in a mixture of water and a solvent called octanol. The greater the ratio of the compound's concentration in octanol to its concentration in water, the more fat-soluble the compound and the more likely it is to bioconcentrate. Thus, the log K_{ow} is used as an indication of a chemical's potential for bioconcentration.

**** BCF**: The bioconcentration factor or BCF is based on laboratory studies and is defined as "the concentration of a substance in or adsorbed on an organism or specified tissues thereof divided by the concentration of the substance in the surrounding medium at steady state" (UNEP/POPS/INC/CEG/2/3).