Widespread use of DDT and HCH and some of its consequences in the former GDR

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Due to their universal insecticidal properties, DDT, HCH and lindane have rapidly been introduced on a large scale. For plant protection and pest control, DDT application in the GDR and in many western European countries was widely distributed. This occurred because they have their own production and they also imported these insecticides at a very reasonable rate from the socialist countries.

DDT

Table 1 shows some data of the DDT-production. In the GDR, DDT was produced in Bitterfeld, Karl-Marx-Stadt (now Chemnitz) and in Berlin. As an answer for the world-wide restrictions about DDT, its production and use in the GDR was restricted since 1970. In a step-by-step program, other compounds shown in Table 2 substituted the use of DDT.

Table 1. DDT production (tonnes/year) in some Western European countries during the period 1968-1973. *

Country	1968	1969	1970	1971	1973
GDR	7,500	6,400	3,500	1,600	2,500
F	3,600	5,000	5,000	5,000	4,000
R	4,400	4,000	4,900	4,000	4,000
SU	15,000	25,000			
US	63,200	55,800	26,900		

* Cited from ANONYM (ECETOC), 1988

Table 2. Step-by-step program for the replacement of DDT in agriculture and forestry

Year	Application field
1971	Carrots, allotment gardens
1972	Cabbages
1973	Fruit growing, pea
1974	Rape
1976	Potatoes

During 1983/84, DDT/lindane was illegally applied on approximately 260,000 hectares in the forestry. The reason for the top-secret application was the enormous occurrence of the nun *Lymantria monacha* (Figure 1).

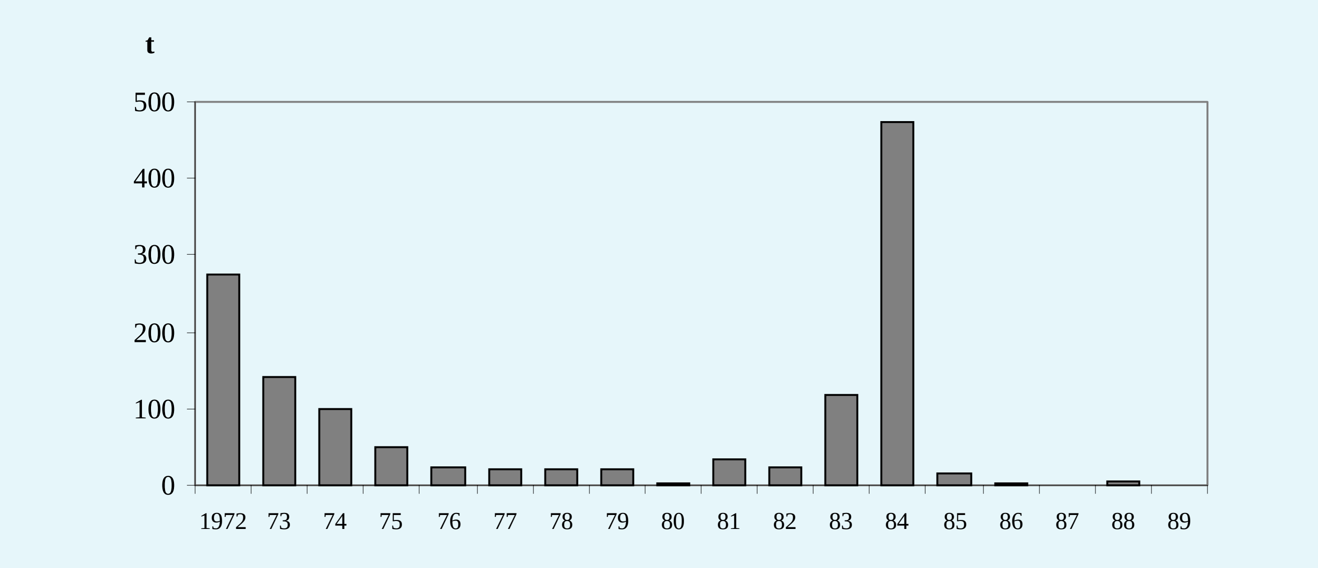

Figure 1. Amount of the consumed DDT (active component) in the GDR during the pe-riod 1972 - 1989 (Heinisch et al., 1993).

DDT is a non-polar compound with low water-solubility and easily fat-soluble (lipophile). For biomonitoring, some fatty matrices were used. A huge number of investigations on DDT were carried out and two representative examples are given below. Figures 2 and 3 show the concentration of DDT in the fat fraction of butter and in herring respectively.

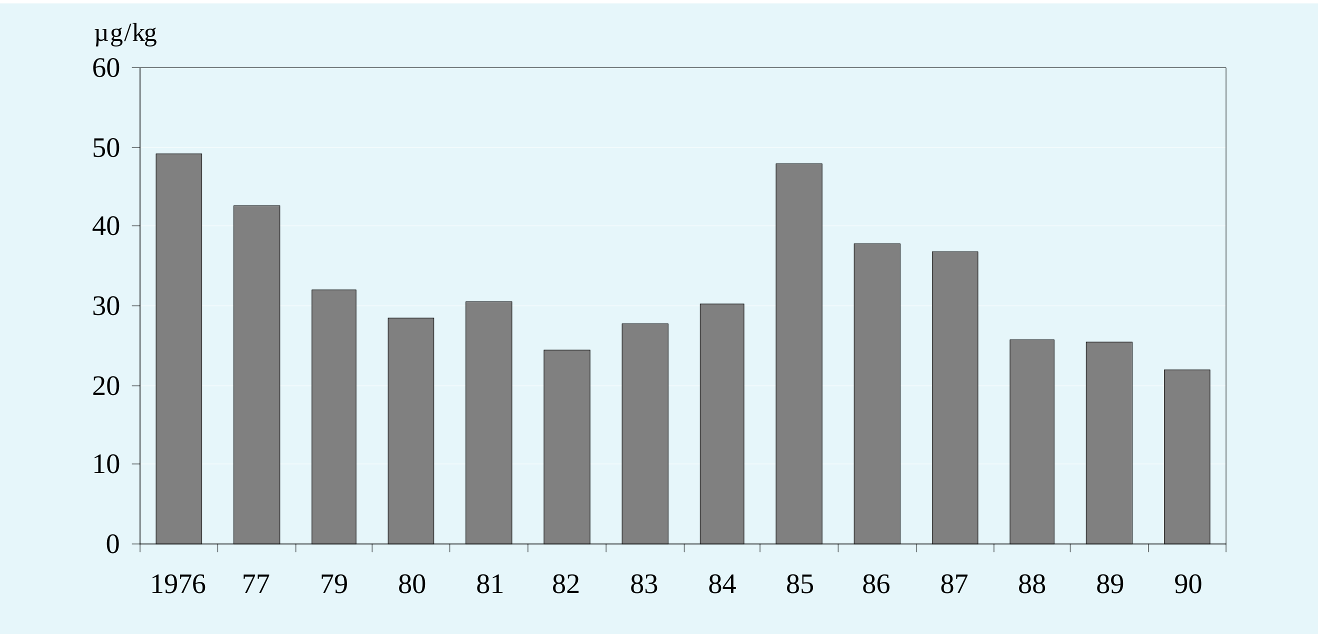

Figure 2. Levels of DDT and its metabolites (+DDE + DDD) in the fat fraction of butter in the Schwerin region (Heinisch et al., 1993)

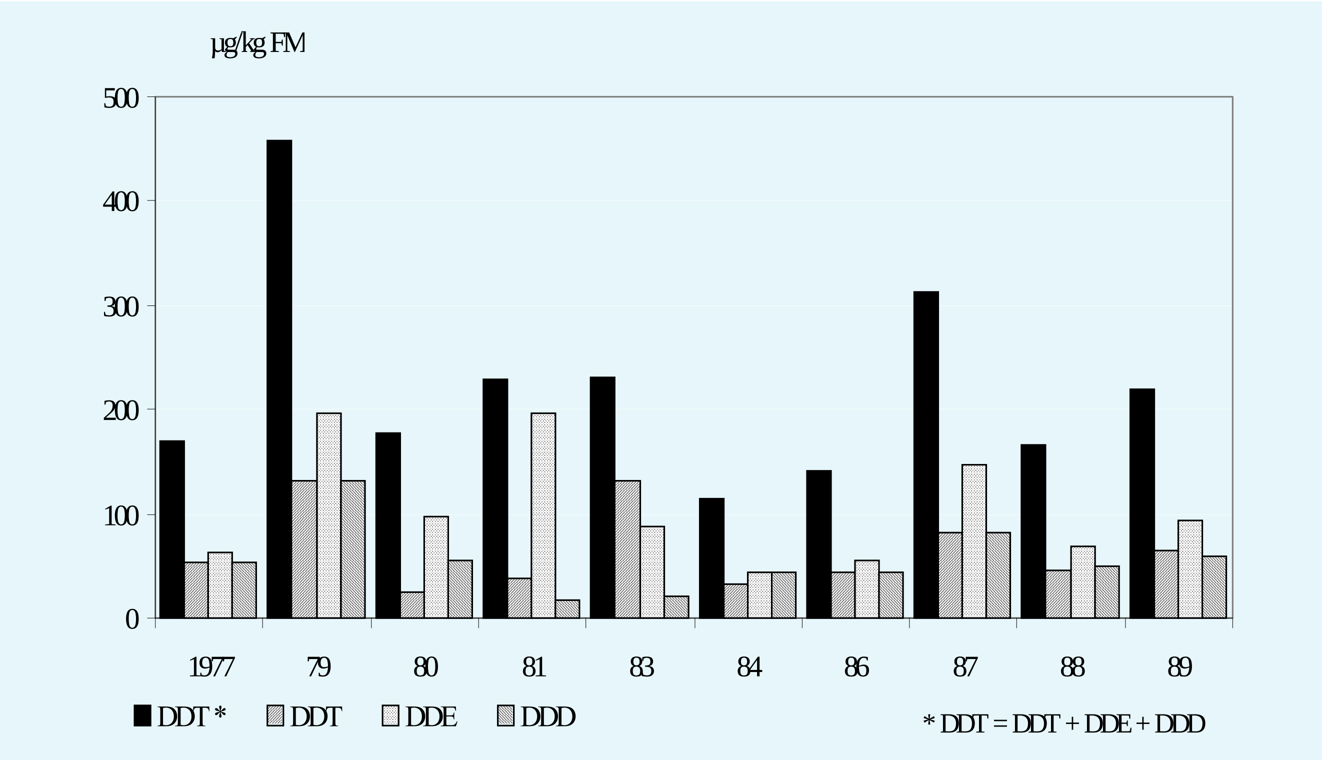

Figure 3. Levels of DDT and its metabolites in herring at ICES 26, Gotland basin, Baltic (Heinisch et al., 1993).

The very intensive application of DDT during 1983/84 and the minimum application in 1980 were evident by one to two years' retardation in butter and one to three years in the marine organisms.

HCH

The technical HCH contains a portion of approximately 15 % of lindane, which is the only HCH-isomer effective as an insecticide. Lindane has been produced commercially since 1949. Its production was not prohibited in Germany, but it was discontinued at the end of the 80's. A look at world-wide production reveals that, the annual average production during the period 1988 - 1993 was around 4,400 tonnes per year, while during the period 1990 - 1995, the figure was 3,222 tonnes per year. The annual average produced in the 90's in Western Europe alone was approximately 2,055 tonnes. Due to the fact that the production in Germany was stopped at the end of the 80's, no emissions were recorded in the last years but it can be assumed that a part of the overall imports of HCH was processed further. However, no emission data were available. According to UBA-FB (Ref. 2), the last agent containing lindane (a combination product of Lindane/Promecarb to prevent timber breeders) was used for plant protection in the forestry in the new German states till the end of 1994. In one farming agent lindane was still allowed until 31.12.97 for the control of beet beetles. No information was available on the quantities used.

As recently as 1996 a "permitted" wood preservative with a lindane content of 0.5 % was still on the market. Less than 9 tonnes of this product was produced during the years 1994 - 1996. The lindane was due to be replaced by another safe compound at the beginning of 1997 (UBA-FB, Ref. 2).

At a conservative estimate, there were about 15 tonnes lindane emissions during the year 1994. According to the available information, since the end of 1997, lindane was no longer used in the Federal Republic of Germany in pesticide applications and wood conservation, which are relevant for emissions. Although there is no prohibition, licensing practice has led to a situation in which licenses are restricted to exceptional cases. The future implementation of the European Biocide Directive will consolidate this situation. Table 3 shows some data on the production for technical HCH and lindane in the former GDR and other countries.

Table 3. Production of HCH and lindane in some countries during the period 1977-1984 (Heinisch, 1992).

Country	Quantity (tonnes per year)		
	Technical HCH	Lindane	Year
FRG	15,000	1,500	1977
GDR	5,225 2,110	733.5 150.7	1977 1982
France	28,000	3,000	1977
Spain	10,000	1,000	1984
E.C.		4,700	1981
Soviet Union	20,000	2,000	1984
India	30,000	3,000	1981
South American Countries	20,000	2,000	1979

The HCH and lindane production in the GDR was lower than in West Germany, France, and Spain etc. Therefore the amount of the by-products (approximately 80 %) was also smaller in these countries. HCH/lindane was produced in Berlin, Magdeburg, Karl-Marx-Stadt (now Chemnitz) and Bitterfeld.

Thanks to advances in the field of analytical chemistry, it was discovered that HCH-isomers are soluble in water to a certain extent (in the ppm-range). Also traces of solvents can easily be detected now. These advances led to the discovery of HCH pollution in the groundwater and in certain crops among other pollutants. A lot of work was done and we have a good knowledge on the occurrence, distribution, behaviour and persistence of γ-HCH in the biosphere components. These include aquatic and terrestrial environments with their biotic and abiotic elements (i.e. fishes, animals, plants, water, sediments and soils).

The unavoidable fact that there are no applications for about 80 % of the products has always been thought unsatisfactory. Unfortunately, until now no appropriate application or ingenuous use for the bulk of the residues has been found. Consequently, most of the residues have been dumped over the last 50 years. For this purpose, state-of-the-art techniques were used. It should be noted that originally the residues were considered harmless and insoluble in water. So no objections have been raised to the practice of using them for filling up unwanted holes or pits wherever they were encountered. In some cases, however, residues were dumped in a proper way so as to recycle them in the future.

In the new states of Germany the HCH dumps are located at "Regina" in Schiffsmühle (district Bad Freienwalde), "Antonie" and "Freiheit" near Bitterfeld and in "quarry I and II" near Emden (district Haldensleben). Furthermore residues are found at many locations in the environment. They were recorded in the soil of inundated regions, at places where the wind has spread flour-like residues which had been stored in the open air in large heaps, in illegal dumps, mixed up with household garbage, and in abandoned brown-coal mines and quarries.

In the abovementioned dump "Antonie", more than 100,000 tonnes of chloroorganic compounds including 76,000 tonnes HCH-isomers and 3,000 tonnes DDT were stored. The entry of the pollutants into the groundwater exceeded 300 kg HCH/a, further with more than 800 kg /a chlorobenzenes and more than 1,200 kg AOX/a. The distribution of the HCH-isomers within the dump is very unequal and near the surface the content is approximately 46 g HCH /kg soil.

Conclusions

The Federal Soil Conservation Act of Germany contains provisions on so-called abandoned polluted areas (Altlasten). These include for example shutdown landfill sites and former areas of industrial activity such as decommissioned factories. In the light of the particular risk potential involved here, a comprehensive and effective set of instruments for contaminated site management is realised, based on the following precept of clean up:

- Official determination, investigation and evaluation, by the competent authorities, of areas suspected of contamination;
- Commitments to self-monitoring and notification obligations to complement official monitoring of landfill sites and areas suspected of contamination;
- Possibility of requesting a private clean up plan to be responsible for cleaning-up process, including a summary of risk assessment;
- Possibility of submitting a clean-up contract;
- Information for those concerned on forthcoming clean-up measures

Though, an immense quantity of data concerning the HCH soil contamination for the new German states has been collected. But the data management is unsatisfactory till now, and critical reviews are not available. Because HCH is a toxic compound, which poses a very harmful threat to the public health and also causes a lot of stench, high priority has been given to the cleaning of HCH contaminated soil. Further examinations of the risk assessments of the HCH contaminated sites in Germany are absolutely necessary.

Full-scale experience on HCH remediation is limited. In all cases, HCH contaminated soil in the eastern part of Germany is temporarily stored but should be treated. The biological cover-ing by plants as a low-cost technique is only suitable by diffusion and under low contamina-tion levels. Retention of contaminated water is another procedure to reduce the HCH entry into the groundwater.

Supplementary to the many published thermal, physical, chemical and biological techniques like BCD, APEG/ KPEG and many other systems further detailed investigations are necessary. An option could be the dechlorinating of HCH by water gas (Beckers & Schuller, 1998).

The important factors affecting the choice of remediation approach include: remediation tar-gets, site specific considerations (soil type, hydrogeological conditions, land-use and loca-tion), strategic considerations such as 'fitness for purpose' and 'multi-functionality', after-care requirements, planning control of land-use, and waste and pollution control of remediation work. These and other factors have to be in balance if remediation strategies are to be optimised in a systematic manner. In addition, account has to be taken of the sustainable use of remediation technologies. The important aspects in this context are: the environmental impact of remediation options, residues, emissions, use of resources, pollution prevention and waste minimisation. In most cases the selection of the best available technology is a balancing act between the feasibility and the costs.

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