

POPs in the Central American Region, sources and environmental concentrations.

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Introduction

Persistent organic pollutants (POPs) have been a cause for concern in the Central American Region, their predominant use having been in agriculture, energy, industry and waste management.

Several efforts have been made in the Region to identify sources as well as health and environmental impacts of POPs. A recent effort to identify, evaluate and analyze this information was the "Regionally Based Assessment of Persistent Toxic Substances" (RBA-PTS) of the United Nations Environmental Programme/Global Environmental Facility¹, which included Central America and the Caribbean as one of the 12 regions assessed. The Central American Institute of Studies on Toxic Substances (IRET) of the Universidad Nacional of Costa Rica coordinated the study for this Region.

Methodology

The compounds evaluated included the twelve POPs defined by the Stockholm Convention on Persistent Organic Pollutants 2001: aldrin, endrin, dieldrin, chlordane, DDT, toxaphene, mirex, heptachlor, hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs). Atrazine, endosulfan and polycyclic aromatic hydrocarbons (PAHs) were added as further, regionally important chemicals.

Data compiled for the Central American countries (Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama) for the "Central America and the Caribbean, Regional Report"² of the RBA-PTS project is analyzed and presented. Additional data were collected and analyzed from pesticide importation data bases of the ministries of agriculture of the Region (IRET/UNA database of pesticide imports for the Central American countries). Updated data on PCBs and potential sources of PCDDs, PCDFs and PAHs were collected through interviews from official sources (Min. of Health and Min. of Environment) and other information from regional reports^{3, 4}.

Results and Discussion

Large quantities of pesticides have been and are imported for use in the agricultural sector and for vector control. The major crops, which vary within the Region, are coffee, sugarcane, banana, orange, pineapple, corn, cotton, vegetables, rice, cocoa, beans and roots. Agriculture is being diversified following negative experiences of monocropping, pesticides as almost the only method of pest control, as well as to meet the requirements of the products exported to international markets. Pesticides are used also on livestock and in household applications.

A number of PTS pesticides were introduced into the Region during the 1950's. Their use was intensified in the Region along with the economic integration of the countries. The majority of organochlorine (OC) pesticides were banned in Central America in 1980s. DDT, heptachlor, lindane, mirex and pentachlorophenol are only restricted in at least one Central American country, however most countries do not report current importation of these compounds. Pentachlorophenol is an exception, Honduras and Nicaragua reporting the importation of 4.9 and 0.7 tons of pentachlorophenol respectively in 1998-1999. The total use of DDT for vector control in the Region has been estimated at 84995 tons (1950-1998). Nicaragua and Belize were the last countries in the Region to discontinue the use of DDT, it was used until 1991 and 1998, respectively³.

Before banning, the use of OC pesticides seems to have been greatest for DDT, endrin, heptachlor and toxaphene but there is variation between countries and time periods, and insufficient data. Several countries of the Region used DDT by itself or in mixtures with compounds such as toxaphene, aldrin and dieldrin to control agricultural pests, mainly on cotton. Atrazine and endosulfan are widely used today, except for Belize where endosulfan was banned in 1985. Calculated volumes of endosulfan per 1000 of population were highest for Guatemala (8.9 kg) and Costa Rica (6.6 kg) in 1998-1999. A recent update indicates that the use of these two compounds is increasing, based on

importation data for 2003 and 2004 compared to 1999-2000 for Guatemala and Costa Rica.

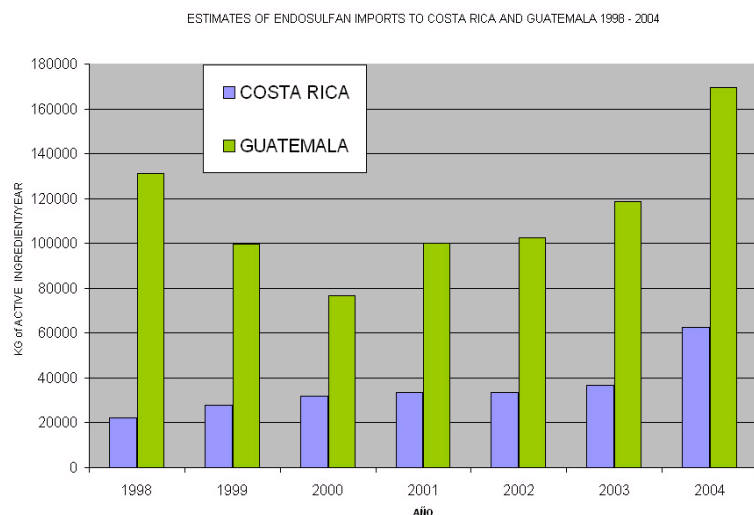


Fig 1. Estimates of endosulfan imports to Costa Rica and Guatemala 1998 - 2004

PCBs were introduced in Central America (as in the rest of the world) during the 1950s and 1960s in cooling systems, heat transfer fluids, capacitors and transformers. They may also have been used as lubricants and carrier substances in paints, plastics, paper and pesticides. The use of PCBs in electrical transformers represents the single largest source of PCBs in the region. Large amounts of transformers imported decades ago are still in use. Through maintenance of electric devices most of the changed PCB containing oil was discharged in a non-appropriate way. PCB containing oil is used by a minority

of the population as a popular remedy against arthritis and joint pains. There is no comprehensive national inventory of PCB stocks and uses in the Region. Recently, however, several countries started with the national inventory.

Solid waste incinerators with inadequate clean-up technologies have been targeted as important contributors to total emissions to air, including dioxins. Other sources of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDF) include cement kilns, pulp mills using the kraft process, asphalt mixing plants, catalyst regeneration at petroleum refineries, cigarette smoking, crematoria, and the pyrolysis of brominated flame retardants. Burning of crops, agricultural, municipal and household waste, wood and tire are additional potential sources of dioxins and furans in the region. Incinerators that operate at low temperatures are widely used for the disposal of hospital wastes. Forest and scrub fires are common in many countries of the Region. Between 2000 and 2001, 34000 forest fires were reported in the region, 9500 of which took place in Honduras and Nicaragua. In El Salvador, the annual number of forest fires is estimated at 1200, affecting an area of 3500 ha. There are no inventories or studies on dioxin sources or emissions in the Region.

Sources of polycyclic aromatic hydrocarbons (PAHs) in the region are power generation, extraction and refining of crude oil, and in combustion engines, including traffic emissions. The petroleum industry, including extraction and refining of crude oil, is a major source of PAHs in the Region. These operations have led to contamination of water, soil and air. Inadequate incineration and burning, as described for PCDDs and PCDFs, are a source also of PAHs. Waste oil adds to the burden of PAHs contamination. Large quantities of oily waste have been discharged into the environment leading to contamination of waterways, coastal areas and soil. Some used oil has been stockpiled.

Obsolete stocks represent a problem awaiting solution. At least 70 tons of DDT is stocked in the Region, and some 275 tons of toxaphene, most of it in Nicaragua. Further stocks contain aldrin, chlordane, endrin, and heptachlor. Some of the stocks, such as PCBs and obsolete pesticides including PTSS, have been exported outside the Region for incineration. During 2003 and 2004, 710 tons of PCB contaminated oils were exported from Costa Rica. Approximately 325 tons of transformer oil containing PCBs is stored in Panama and 165 tons in El Salvador. Stocks of PCBs in all the countries are awaiting full inventory and disposal.

Data on POPs in air, marine and fresh water, terrestrial ecosystems, foods and human biological samples is scattered and difficult to interpret. Most data are isolated spot samples with various rationales and methodologies. Lack of comparability and often insufficient documentation of determinants of the levels makes interpretation difficult. As expected, DDT/DDE levels in different environmental compartments decreased after the use of DDT was discontinued, also in human adipose tissue and human milk. This is seen, for example, in a longitudinal monitoring of DDT in the diet in Guatemala during 1981-1997. DDT was banned in Guatemala in 1979 and reached low levels around 1987 and approached zero in 1993. Other formerly ubiquitous OC insecticides were banned in 1988. During the 1970's, levels of DDT as high as 200 mg/kg were detected in the fat of meat intended for export. Residues of endrin, dieldrin and toxaphene were also frequently found.

Occasional high recent values were observed, probably indicating recent usage. Thus, during 2001-2002, concentrations of p,p'-DDT determined in air using XAD-based passive samplers were 30-40-fold (44.2-48.7 ng/sample) in Belmopan, Belize compared with other OC pesticides and p,p'-DDT levels in a mountain district Monteverde, Costa Rica (1.8-2.8 ng/sample). In 1995-1997, high concentrations of 9.0 mg/kg p,p'-DDT were detected in marine sediments in the estuaries of Golfo de Fonseca, Pacific Honduras, while concentrations of other OC insecticides were below 0.1 mg/kg. High concentrations of DDT and toxaphene in Pacific coastal lagoons were

observed in Nicaragua in 1995.

The incidence of acute pesticide poisonings in humans is high in Central America. The data are scarce for the period in which OC compounds were used intensively, more recently endosulfan poisonings are reported for several countries. Between 1986 and 1987 in Guatemala, 8.1% of all pesticide poisonings registered by the Ministry of Health and the Guatemalan Institute of Social Security (57 cases) were caused by OCs (aldrin and endosulfan). Forty-two percent of all cases were associated with occupational exposure, 36% with accidental exposure, and 23% were suicide attempts. In 1999, endosulfan caused 26 poisonings (12% of all poisonings during the first half of 2001). During 1998-2000, the pesticide poisoning surveillance system in El Salvador received reports on 150 poisonings with OC pesticides, the vast majority caused by endosulfan, with 4 reported deaths. The Ministry of Health reported 72 cases in year 2000 and 31 cases in 2001 caused by OC pesticides, mainly endosulfan (60 in 2000 and 20 in 2001). The share of POPs pesticides as cause of poisoning in the registry of hospitalization of the Costa Rican Social Security Institute between 1976 and 1985, decreased from 9.9% in 1976 to 2.3% in 1985. Endosulfan was identified as one the substances causing deaths during 1980-1986. The Ministers of Health of the seven Central American countries and Dominican Republic agreed to recommend in June 2000 the restriction of 12 major poisoning causing pesticides, including endosulfan⁵. Nevertheless this compound has not been restricted and the importation of endosulfan shows a significant increase based on the estimates presented for Guatemala and Costa Rica (Fig.1).

Chronic nervous system effects of long-term occupational exposure to DDT were investigated in Costa Rica comparing the neurobehavioral performance of retired malaria control workers with a reference group of retired guards and drivers. DDT exposed workers did worse than controls on tests assessing neurobehavioral functions. Performances deteriorated with increasing years of DDT application. The results could not be explained by exposure to cholinesterase-inhibiting pesticides or other confounders.

Enhancement of clean technologies in agriculture, industry and waste management is a key issue in the reduction of the POPs load in the Region. It includes the strengthening of practices that prevent the use, formation and releases of POPs; safe disposal of waste oil and obsolete stocks of POPs and transformers containing PCBs; building of capacity of non-combustion technology for the treatment of POPs wastes; containment of diesel engine emissions; and creation of a database or clearinghouse of alternatives to POPs. Regulatory development, enforcement and compliance calls for major improvements.

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