



Levels and Distribution of OCPs, (specially HCH, Aldrin, Dieldrin, DDT, Endosulfan) in Karhera Drain and Surface Water of Hindon River and their Adverse Effects

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ABSTRACT

The river water pollution with organochlorine pesticides from agricultural activities, industrial activities and domestic sewage has received great attention during recent years. The organochlorine pesticides are very dangerous and harmful because of their tissue degradation and carcinogenic character in nature. Liquid-Liquid extraction followed by GC-ECD, was used for the determination of α , β , γ - HCH, Aldrin, Dieldrin, *o,p'*-DDT, *o,p'*-DDD, *p,p'*-DDD & Endosulfan in Karhera Drain & Hindon River. High concentration of β -HCH was detected in the surface water collected from Karhera drain (32 ng/l), Mixing point (28.34 ng/l) & D/S of out fall Karhera drain (24.56 ng/l). α -HCH was detected in the surface water collected from Karhera drain (19.8 ng/l), Mixing point (17.45 ng/l) & D/S of out fall Karhera drain (14.3 ng/l). *o,p'*-DDT was detected in the surface water collected from Karhera drain (5.89 ng/l), Mixing point (4.58 ng/l) & D/S of out fall Karhera drain (3.76 ng/l). *o,p'*-DDD were detected in the surface water collected from Karhera drain (5.34 ng/l), Mixing point (4.89 ng/l) & D/S of out fall Karhera drain (3.78 ng/l). *p,p'*-DDD were detected in the surface water collected from Karhera drain (8.43 ng/l), Mixing point (7.27 ng/l) & D/S of out fall Karhera drain (6.29 ng/l). The concentration of α , β -HCH, *o,p'*-DDT, *o,p'*-DDD, *p,p'*-DDD was found to be much higher than the EC water quality standards in the water samples from sampling location posing a high risk to the common people.

Key words: Organochlorine pesticides, GC-ECD, Surface water, Survey.

INTRODUCTION

Organochlorine compounds can be persistent environmental contaminants and may be accumulated through the food chain to the aquatic organisms to fish and humans, depending basically on their hydrophobic properties.

Persistent organic pollutants (POPs) persist in the environment for a long time; they are prone to long range transport; they can be carried through the upper levels of the atmosphere. There is a particular concern about the trace quantities of highly chlorinated compounds that are found in the environment; they can also enter the food chain

mainly through the intake of animal fats. Some pesticides are selective. They act against limited group of organism because they affect some aspect of metabolism specific to a limited number of plants, animals, or microbes. Pesticides are broad-spectrum affecting a wide range of organisms and more likely to pose a danger to non-target species.

The world health organization indicates that adverse effects of pesticides on human health are much as at least 20,000 deaths and million illnesses every year result from pesticide misuse. Persistent organochlorine compounds may be related to point sources e.g. industrial discharges and domestic sewage, but more frequently, as in the case of pesticide pollution. It can also be attributed to precipitation agricultural runoff etc most of the applied pesticides are subject to many transport and conversion products¹. POPs do not remain at their target site but often enter aquatic environment via soil percolation, air drift or surface run off affecting abundance and diversity of non-target species. Organochlorine compounds can be persistent environmental contaminates and may be accumulated through the food chain to the aquatic organisms². Factors that can increase toxicity of pesticides to aquatic biota at higher temperatures are higher solubility of toxicants in water, an augmented rate of uptake and blood flow & increased bio concentration. POPs causes headache, nausea, vomiting, diarrhea, paresthesias of lips and tongue, coarse tremor, convulsions, respiratory failure³.

A theoretical model of persistent pollutant behaviour in aquatic environment from laboratory studies was carried out by some scientists⁴.

Heavy loading of industrial effluent discharge directly into the Karhera drain places an intolerable burden on the river's natural ability to assimilate pollutants. Key contaminants identified within the effluents of these industries include a very high loading of organic pollutants and frequently pathogens as a result of contaminated raw materials entering the plants. It is erroneous to believe that these bodies of water could serve as a limitless dumping ground for wastes. Discharge of raw sewage, garbage are threats to the diluting capabilities of the oceans, lagoons and rivers in

major cities are grossly polluted⁵. The distribution of PCBs, HCH and DDTs and their ecotoxicological implication in Bay of Bengal, India, was reported⁶. Oxygen economy of any receiving water is of paramount aesthetic and economic importance. Determination of the self-purification capacity of water bodies has been the subject of researches by scientists around the world⁷. Pesticides values exceeding in Hindon river water indicates that the river is polluted and water is not fit for drinking, recreation, washing purposes and other purposes⁸. A survey in Northern India, has shown the presence of high concentration of both organochlorine and organophosphorus pesticides in the surface and ground water samples⁹.

Pesticide residues were detected even in fresh water areas of southern Japan where environmental management and protection is highly regarded¹⁰.

Agricultural practices within the Hindon river catchment have an important effect on the quality to the river surface water run-off from agriculture carries with it a no. of suspended pollutants particularly elevated suspended sediments due to soil erosion and agricultural chemicals such as pesticides and fertilizers. The Karhera Drain receives large volumes of untreated sewage and municipal wastes from all population centers within the catchments & polluting the Hindon river.

MATERIALS & METHODS

Study area

The study area included four sample locations near Karhera village. They are U/S of out fall of Karhera Drain, Karhera Drain, mixing point of Karhera Drain & Hindon river, D/S of out fall of Karhera Drain. The first sampling site U/S of out fall of Karhera drain lies 28°41'9.06" north latitude and 77°23'34.30" east longitude, second sampling site Karhera drain lies 28°41'3.43" north latitude and 77°23'24.25" east longitude, third sampling site mixing point of Karhera drain & Hindon river lies 28°41'02.74" north latitude and 77°23'31.39" east longitude & fourth sampling site D/S of out fall of Karhera drain 28°40'57.16" north latitude and 77°23'32.45" east longitude as shown in Fig. 1.

To study the impact of industrial activity & agricultural activity, water sample collected from U/S of out fall of Karhera drain, Karhera drain, mixing point of Karhera drain & Hindon river, D/S of out fall of Karhera drain.

Sample Collection

For the present studies water samples were collected from the Hindon river & Karhera drain, at 4 different locations as shown in Fig. 1. These water sample was collected in the pre-washed glass containers closed with Teflon lined caps. After transportation to the laboratory, samples were stored at -20°C and extraction was normally done within 48 h.

Analytical Procedure

The pesticide residues were analyzed by gas chromatography (GC) using supported by electron capture detector under standard condition given in Table 1. This detector allows the detection of contaminants at trace level concentrations in the lower ppb range in the presence of a multitude of compounds extracted from the matrix to which these detectors do not respond. Liquid-liquid extraction followed by gas chromatographic detection was used for the determination of pesticide residues¹¹.

A multiresidue method, the simultaneous estimation of pesticides belonging to organochlorine and Organophosphorus groups in water using gas liquid chromatograph (GLC) equipped with capillary column and electron capture detector (ECD) was studied¹².

In general, the EPA protocols with certain modifications were used for the analysis. Water sample was filtered using 0.45- μm Whatman glass fiber filter paper, treated with 10 g of sodium sulfate and extracted thrice with 75 ml of methylene chloride. The combined extracts were filtered and concentrated in a vacuum rotary evaporator. The solution thus obtained was filtered with a pinch of sodium sulfate and made up to 5 ml with hexane. One microliter of the sample thus prepared was injected and analyzed. The detection limits (DL) for these compounds derived by use of a signal-to-noise ratio 1: 3. The analytical quality-control scheme included periodic analyses of organochlorine standard mixtures and ultrapure

water along with the samples. Using standard samples containing known amounts of pesticides, accuracy of the determinations was routinely checked. A hexane stock solution of organochlorine pesticide standard was prepared in a 10ml volumetric flask filled with hexane. Known amounts of the stock solution were added to samples 11 of ultrapure water in a volumetric flask and thoroughly mixed by inverting the flask three or four times to give standard water solutions. These standard solutions were stored similar to that of the samples. The results obtained for the various surface water samples are presented in Tables 2 & 3.

RESULTS AND DISCUSSION

The results of analysis of the water samples have shown the presence of organochlorine pesticides. The compounds detected were HCH (the isomers; α , β -HCH) *o,p'*-DDT, *o,p'*-DDD & *p,p'*-DDD. Results of the sample analysis are summarized in Table 3.

Many pesticides eventually end up in ground water and their transformation produces may remain for years¹³. Among the various pesticides analyzed only HCH & DDT residues were found in the surface water samples from the River Hindon as shown in Table 3. The highest concentration of 32 ng/l was observed for β -HCH in Karhera drain. In accordance with European Economic Commission for drinking water, the total pesticide level should not exceed 0.5 $\mu\text{g/l}$ and individual pesticide not greater than 0.1 $\mu\text{g/l}$ (EEC)¹⁴.

The high concentration of pesticides in the surface water could be attributed to the agricultural

Table 1: GC-ECD conditions

Conditions	Values
Injections volume	1 μl
Inlet pressure	7.00 psi
Injector temperature	250°C
Detector temperature	300°C
ECD makeup gas flow	40 ml/min
Oven programming	220-240°C at 2°C/min; 240-260°C at 1.0°C/min; 260-280°C at 5°C/min

Table 2: Retention time, % recoveries & minimum detection of OCPs

Pesticides	Retention time (min.)	% Recoveries	Minimum detection limit (ng)
α -HCH	3.83	90	.5
β -HCH	5.60	92	.6
γ -HCH	4.77	87	.4
Aldrin	7.35	88	.04
Dieldrin	8.25	90	.03
<i>o,p</i> DDT	15.11	82	.7
<i>o,p'</i> DDD	15.79	80	.4
<i>p,p'</i> DDD	16.15	86	.5
Endosulfan	16.67	87	.4

Table 3: Results of the Organochlorine pesticides analysis (ng/l)

Site	POPs							Endosulfan
	α -HCH	β -HCH	γ -HCH	Aldrin	<i>o,p</i> -DDT	<i>o,p'</i> -DDD	<i>p,p'</i> -DDD	
U/S	ND	ND	ND	ND	ND	ND	ND	ND
K-D	19.8	32	ND	ND	5.89	5.34	8.43	ND
K-M	17.45	28.34	ND	ND	4.58	4.89	7.27	ND
D/S	14.3	24.56	ND	ND	3.76	3.78	6.29	ND
Av.	12.89	21.23	ND	ND	3.56	3.5	5.5	ND
Min.	ND	ND	ND	ND	ND	ND	ND	ND
Max.	19.8	32	ND	ND	5.89	5.34	8.43	ND

ND = Not Detected

runoff resulting from the extensive agricultural activity in the banks of these locations.

The predominance of α , β -HCH, *o,p'*-DDT, *o,p'*-DDD & *p,p'*-DDD residues in the water samples

Table 4: Village: Karhera (Hindon River), District – Ghaziabad

Total Number of families	47
Total population	310
Total number of Males	166
Total number of females	144
Total number of children of age less than 18 years	146
Total number of people of age more than 60 years	19
Monthly medical expenditure	Rs. 15500

Analyzed, indicate the liberal application of these pesticides by the local farmers owing to its low cost. HCH, commonly called as Lindane, is still used most extensively for human vector control because of its insecticidal property and long-lasting effects. In India, even though its agricultural use is being phased out, the annual production of Lindane in 1996-1997 was 40 MT with a forecast of 50 MT in 1997-1998¹⁵.

The presence of very high concentrations of similar pesticides in fruits and vegetables produced in Ghaziabad considering the dietary daily intake of a common man which includes fruit, vegetables, cereals, milk and water was studied¹⁶.

The concentrations of the pesticides intake from these foodstuffs alone could be much higher than the acceptable daily intake¹⁷.

Table 5: No. of patients suffering from various ailments in village – Karhera

Cancer	0
Skin related	56
Neurological Disorder	1
Heart related	3
Stomach ailments	55
Others	29
Number of deaths in last five years due to serious ailments	3
Cancer	1
Heart Attack	1
Respiratory Diseases	0
Asthma	0
Paralysis	0
Stomach related	1
Other (T.B., Skin related, Fever etc.)	0
Facts related to drinking water	
Total number of families using private hand pumps as their drinking water source	0
Total number of families using government hand pumps as their drinking water source	0
Total number of families using tube wells hand pumps as their drinking water source	47
Abandoned hand pumps	47



Sample Location: K-U/S: U/S of out fall of Karhera Drain K-D: Karhera Drain
 K-M: Mixing point of Karhera Drain & river Hindon K-D/S: D/S of out fall of Karhera Drain

Fig. 1: Karhera Drain And Impact On River Hindon In Ghaziabad**CONCLUSIONS**

This assessment clearly shown that the Karhera drain heavily contaminated with a wide range of pesticides and their breakdown products. Standards are exceeded for both World Health Organization and Bureau of Indian Standards

requirements, by several order of magnitude. Nowhere within the Hindon River is the water free from levels of pesticides that are proven to be toxic to human health.

HCH (the isomers; α , β -HCH) o,p' -DDT, o,p' -DDD & p,p' -DDD have been detected and

indicated the growing awareness of its ill effects amongst the farmers. In most of the samples, the pesticide levels detected were much higher than EC drinking water quality standards. The survey noted the numbers of villagers within the total village population that are currently suffering from series illness. The most commonly observed illnesses include cancers, neurological disorders stomach/digestive disorders skin dermatitis and respiratory disorders as shown in Table 4 & 5. The result of the survey with in the populations of the Hindon river catchment is therefore undeniable. Villagers forced to drink the contaminated water of the Hindon river. My research work is based on the probability of pesticides finding into Ghaggar along with run-off¹⁸.

The evidence is therefore clear that the elevated levels of toxic contaminants found within the drinking water source at these villages will be having a devastating effect on the health of the local population. It can be inferred that the environment may be considerably degraded by these compounds, providing additional impact to the biota and bringing a potential risk to human health¹⁵.

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