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# A Survey of persistant organochlorine pesticides residues in some Streams of the Cauvery River, Karnataka, India

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**Abstract:** Samples of water, sediments , Shrimps (Caridina sp.,Litopenaeus ,Macrobrachium, Neocaridina ) and fish Species( Etroplus suratensis, Murrels (Channa marulius) ,silver carp and Catfishes (Heteropneustes fossilis) ) were analysed for organochlorine (OCP's) residues in six streams of Cauvery river, near Mandya district. The important physico–chemical parameters were also analysed. Significant spatial variation was observed in water level, transparency, turbidity, depth, dissolved oxygen, colour, biochemical oxygen demand, nitrate, nitrite and total hydrocarbon among the physiochemical parameters of the study stations. All the parameters contained at least one of the pesticide residues analysed (α- HCH, β- HCH, γ- HCH, δ- HCH, p,p'DDT, p,p'DDE, p,p'DDD and Endosulphan) . Maximum Concentration of p,p'DDE Pesticides residue ( 0.96 µg $L^{-1}$ ) in water was found in Station 2 . Maximum Concentration of β- HCH Pesticides residue (82.22, 80.45and 79.23 µg $kg^{-1}$ ) in sediments was found in Station 1,3 and 5. However the concentration of all the pesticides residues was maximum in sediments except station 6 which is away from all pollution sources. Maximum Concentration of β- HCH pesticides residue (74.34 µg $L^{-1}$ ) in shrimp Caridina sp. Prevailed. And in fish species the maximum concentration of pesticide residue (α- HCH54.23 and β- HCH 44.68 µg $kg^{-1}$) was found in fish Etroplus suratensis.

**Keywords:** Organochlorine pesticides; Sediments; Shrimps; Fish Species; Cauvery river streams.

## Introduction

Pesticides constitute an important component in agriculture development and protection of public health in India since the tropical climate is very conducive to pest breeding. There are about 20 major diseases which have been brought under control by the use of pesticides. The major amongst them are malaria, filariasis, dengue, Japanese encephalitis, cholera and louse-borne typhus. In India, DDT spray was instrumental in reducing the annual incidence of malaria from 75 million in 1952 to present 2-4 million. Synthetic organic pesticides are used to control weeds, insects, and other organisms in a wide variety of agricultural and non-agricultural settings. The use of pesticides has helped to make the United States the largest producer of food in the world and has provided other benefits, but the use has also been accompanied by concerns about their potential adverse effects on the environment and human health. A potential pathway for adverse effects of pesticides is through hydrologic systems, which supply water for both humans and natural ecosystems. Water is one of the primary ways pesticides are transported from an application area to other locations in the environment. Pesticide contamination of ground water is a national issue because ground water is used for drinking by about 50 percent of the State population. Concern about pesticides in ground water is especially acute in rural agricultural areas where over 95 percent of the population relies upon ground water for drinking water.[1]

The Cauvery River is one of the major rivers of India, which is considered sacred. The river originates at Talakaveri in the western ghats in the state of Karnataka, flows generally south and east through Karnataka and Tamil Nadu and across the southern Deccan plateau through the southeastern lowlands, emptying into the Bay of Bengal through two principal mouths. The Kaveri River basin is estimated to be 27,700 square miles with many tributaries including the Shimsha the Hemavathi River, the Arakavathy River, Honnuhole River,LakshmanaTirthaRiver, Kabini River, Bhavani River, the Lokapavani River, the NoyyalRiver and the Amaravathi River. Rising in southwestern Karnataka state, it flowssoutheast some 475 mi (765 km) to enter the Bay of Bengal. East of the city of Mysore itforms the island of Sivanasmudra, on either side of which are the scenic SivnasamudramFalls that descend about 320 ft (100 m).The primary uses of Kaveri are providing

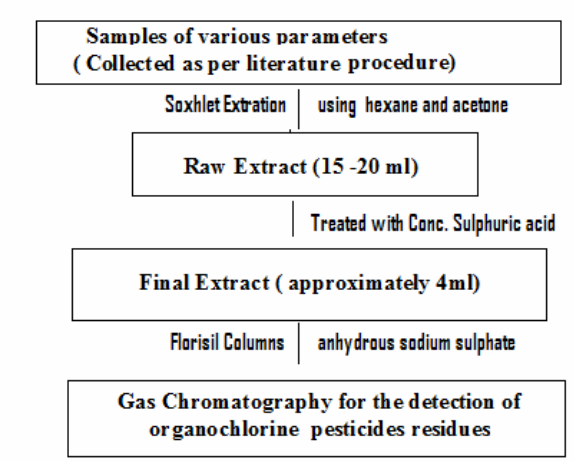
waterfor irrigation, water for household consumption and the generation of electricity. The cauvery, like many major rivers in general, in India faces many problems, including dry summers, wetland filling, large dams, and pollution.

Cauvery streams are homeostatic, physically controlled ecosystems, vulnerable to environmental changes from anthropogenic activities. However, the increase in human settlements, the agricultural wastes as organochlorine pesticides, and the direct discharges of sewage into the streams have given rise to severe pollution, jeopardising the ecology and biodiversity of these singular areas. Persistent compounds such as organochlorine pesticides (OCPs), besides their important function in agricultural development, have also been used to control transmissible diseases such as dengue and malaria in the local area. However, because of their persistence, bioaccumulation, and biomagnification features, they may represent a threat to the water system. This study performed in various streams of Cauvery river have revealed the presence of OCPs in water , sediments and in organisms. Six sampling stations (located at the point where Sugar and distilleries effluent is discharged, it's upstream and downstream) were selected for study. The description of each station is -Station 1 is located about 2.03km upstream of the sugar and distilleries effluent discharge point (Hanakere). Station 2 and 3 is the distillery effluent discharge point where the major human activities are bathing, laundering and fishing (Muttegere). Stations 4 is about 1.3km downstream of a sugar industry, which empties its wastes directly into one stream of the river (Taggahalli). Station 5 is close to the agricultural zone and with an abundant presence of mosquitoes, which has fostered the use of organochlorine insecticides (Padavapura) and Station 6 is fresh water stream away from pollutants and also not much anthropogenic activities (Hatna).[2]

## Material and methods

Methods for sampling i.e., collected samples were preserved in pre-cleaned plastic containers prior to analysis from the above said selected sites, placed in dark boxes and processed with 6 hours of collection, sorting and identification of Shrimps and Fish were done according to literature study[5]. Dissolved oxygen and biological oxygen demand were determined by the Winkler's method. Hydrogen-ion concentration (pH) and conductivity were measured in-situ with the Elico digital pH and Conductivity meters respectively. Total dissolved solids (TDS) were determined gravimetrically. Phosphate and nitrate were determined colorimetrically while flame photometry was used for the determination of sodium and potassium. Magnesium was measured using Atomic Absorption Spectrophotometer while calcium was analyzed with a Technicon Auto analyzer.

Pesticide analysis was done according to the procedures of UNEP-IAEA (1982).All solvents used were of analysis grade. Standards of pure compounds were prepared in mixtures containing pesticides. All samples were screened for pesticides and pesticide metabolites. Ethion and hexabromobenzene (HBB) were used as internal standards.




(Florisil is highly selective adsorbent which has found extensive use in preparative and analytical chromatography-mostly activated mgnesium silicate)

A Hewlett-Packard 6890 GC with ECD and HP-5 (30 m □0.25 mm, 0.25 m film thickness) capillary column was used with helium as the carrier gas and nitrogen as auxiliary gas. Conditions of the GC were: injector temperature 260□C; detector temperature 320□C; oven temperature 90□C; initial temperature 90□C; initial time 2 minutes; ramp 1, 30□C min–1; temperature 1, 180□C; time 1, 0.0 minute; ramp 2, 30□C min–1; temperature 2, 270□C, time 2, 0.0; final time 35 minutes; purge time 0.75 minutes; injection split-splitless.[5,6]

## Results and discussion

The results of the water quality measurement are summarized in (t**able-1**) Wide variations were observed in measured parameters at all stations (**figure-1**). Water depth, transparency, dissolved oxygen, biochemical oxygen demand, colour, nitrate, nitrite and total hydrocarbon showed significant spatial variations.[7-10] Water depth was significantly different in the four stations. Water transparency and dissolved oxygen were significantly lower in all stations except station 1. Colour, turbidity, conductivity, nitrate and nitrite were significantly higher in concentration in station 1.2 3 & 4 than in stations 5 & 6. Total dissolved solids (TDS), were significantly lower in all stations except station 6. The parameters were compared with the International Standards[11]. Dissolved oxygen level in

stations 1, 2 & 3 was lower than the minimum allowable limit (5mg/L) for aquatic life. Ammonium concentration in all stations except station 4 & 6 exceeded the 0.3 mg/L limit. All other physiochemical parameters including heavy metals were within the recommended limits in all stations.

The concentration of different organochlorine residues in water, sediments. Shrimps and fish is presented in Tables 2-5 and figures 2-5. All the parameters contained at least one of the pesticide residues analysed (α- HCH, β- HCH, γ- HCH, δ- HCH, p,p'DDT, p,p'DDE, p,p'DDD and Endosulphan) . Maximum Concentration of p,p'DDE Pesticides residue ( 0.96 µg $L^{-1}$ ) in water was found Station 2 . Maximum Concentration of β-HCH Pesticides residue (82.22, 80.45and 79.23 µg $kg^{-1}$ ) in sediments was found Station 1,3 and 5. However the concentration of all the pesticides residues was maximum in sediments except station 6 which is away from all pollution sources. Maximum Concentration of β- HCH Pesticides residue (74.34 µg $L^{-1}$ ) in shrimps (Caridina spp.,Litopenaeus ,Macrobrachium, Neocaridina ) was found Caridina spp. And in fish species( Etroplus suratensis, Murrels (Channa marulius) ,silver carp and Catfishes (Heteropneustes fossilis) ) the maximum concentration of pesticide residue (α- HCH54.23 and β-HCH44.68 µg $kg^{-1}$) was found in fish Etroplus suratensis.

## Conclusions

Despite the long time restriction or bane of the use of these organochlorine compounds, the contamination pattern for the selected samples of the above parameters from various stations of the Cauvery river was in the order S1 > S2 >S3 > S4 > S5 > S6. This may be attributed to the pollution from large number of distilleries, sugar industries, anthropogenic and Agricultural activities through out the year. These result demonstrate an accumulation of pesticides residues through food chain ( from soil-water-sediments-microbes crop fish-human) which is a serious matter of concern.

**Table-1: Water quality parameters of water samples collected from 6 Stations of Cauvery River**

| Parameters\Sample | WHO Standards | Station1 | Station2 | Station3 | Station4 | Station 5 | Station 6 |
|---|---|---|---|---|---|---|---|
| Turbidity (NTU) | - | 1224 | 1622 | 510 | 1780 | 520 | 270 |
| Colour (Pt. Co.) | 201 | 185 | 223 | 254 | 219 | 145 | 167 |
| TDS (mg\L) | 500-1500 | 980 | 1480 | 1620 | 478 | 1627 | 153 |
| DO (ppm) | 5.0-6.0 | 5.5 | 1.34 | 3.6 | 1.34 | 3.6 | 5.4 |
| BOD(mg\L) | 28-30 | 1.2 | 1.4 | 1.8 | 1.2 | 1.8 | 1.5 |
| COD(mg\L) | - | 54 | 25.7 | 17.5 | 25.2 | 17.5 | 23 |
| Conductivity(mV) | - | 3.0 | 8.9 | 55.9 | 8.8 | 55.9 | 3.5 |
| PH | 7-8.5 | 6.2 | 5.9 | 5.3 | 5.9 | 5.3 | 7.2 |
| P (ppm) | 5 | 6.5 | 6.2 | 8.5 | 5.1 | 8.5 | 6.1 |
| $NH_3$ (ppm) | 0.2 | 30 | 14.9 | 6.4 | 15.2 | 6.4 | 4.3 |
| $NO_3$ (ppm) | 20 | 0.0 | 0.0 | 0.05 | 0.0 | 0.05 | 0.01 |
| $NO_2$ (ppm) | - | 0.0 | 0.01 | 0.01 | 0.01 | 0.01 | 0.0 |
| $SO_4$ (ppm) | 42-45 | 0.4 | 0.06 | 0.09 | 0.08 | 0.09 | 0.0 |
| Cl (ppm) | 200-600 | 254 | 215 | 213 | 229 | 213 | 176 |
| Na (ppm) | 200 | 6.8 | 28 | 29 | 40 | 29 | 102 |
| K (ppm) | 75-200 | 6.2 | 15.4 | 12.1 | 16.2 | 12.1 | 12 |
| Ca (ppm) | 150-200 | 21 | 17 | 14.4 | 19 | 14.4 | 12 |
| Mg (ppm) | 50-150 | 23 | 21 | 12.3 | 21 | 11.6 | 12.7 |
| Total Hardness (ppm) | 200-600 | 118 | 117 | 96 | 117 | 106 | 75 |

**Table-2: Concentration of pesticides in water from Various Streams of Cauvery River**

| Pesticides and metabolites | Concentration of pesticides in water µg $L^{-1}$ | | | | | |
|---|---|---|---|---|---|---|
| | **Station 1** | **Station 2** | **Station 3** | **Station 4** | **Station 5** | **Station 6** |
| α- HCH | ND | 0.53 | 0.64 | 0.87 | 0.75 | ND |
| β- HCH | 0.45 | 0.49 | 0.56 | ND | 0.23 | ND |
| γ- HCH | 0.56 | 0.53 | 0.54 | 0.93 | 0.56 | ND |
| δ- HCH | 0.78 | ND | 0.48 | 0.63 | ND | 0.05 |
| p,p'DDT | 0.64 | 0.56 | 0.62 | ND | ND | ND |
| p,p'DDE | 0.53 | 0.96 | ND | 0.54 | 0.86 | 0.05 |
| p,p'DDD | 0.15 | 0.23 | 0.53 | 0.46 | 0.50 | ND |
| Endosulphan | 0.57 | ND | 0.03 | ND | 0.84 | ND |

ND-Below detection level <0.01 µg $L^{-1}$ / µg $kg^{-1}$

**HCH- Hexachlorocyclohexne, DDE- Dichlorodiphenyldichloroethylene,**
**DDD- Dichlorodiphenyldichloroethane , DDT- Dichlorodiphenyltrichlorethane**

**Table-3: Concentration of pesticides in Sediments from Various Streams of Cauvery River**

| Pesticides and metabolites | Concentration of pesticides in Sediments µg $kg^{-1}$ dry weight | | | | | |
|---|---|---|---|---|---|---|
| | Station 1 | Station 2 | Station 3 | Station 4 | Station 5 | Station 6 |
| α- HCH | 5.12 | 0.09 | 4.19 | 3.54 | 5.50 | 0.06 |
| β- HCH | 82.22 | ND | 80.45 | 2.23 | 79.23 | ND |
| γ- HCH | 4.57 | 0.56 | 4.50 | 2.17 | 3.76 | 0.05 |
| δ- HCH | 15.37 | 0.76 | 15.56 | 2.19 | 13.45 | ND |
| p,p'DDT | 0.98 | 0.34 | 1.23 | ND | 0.65 | ND |
| p,p'DDE | 3.31 | 0.73 | 4.56 | 0.89 | 2.98 | 0.09 |
| p,p'DDD | 4.45 | ND | 3.36 | 0.72 | 2.87 | ND |
| Endosulphan | ND | 0.56 | ND | 0.64 | ND | 0.06 |

**ND-Below detection level <0.01 µg $L^{-1}$ / µg $kg^{-1}$**

**Table-4** : **Concentration of pesticides in Shrimps from Various Streams of Cauvery River**

| Pesticides and metabolites | Concentration of pesticides in Shrimps µg $kg^{-1}$ dry weight | | | |
|---|---|---|---|---|
| | Caridina spp. | Litopenaeus spp. | Macrobrachium | Neocaridina spp |
| α- HCH | 6.54 | 0.07 | 0.42 | 3.54 |
| β- HCH | 74.34 | 0.98 | ND | 2.23 |
| γ- HCH | 7.23 | ND | ND | 2.17 |
| δ- HCH | 11.55 | 0.34 | 0.56 | 2.19 |
| p,p'DDT | 0.98 | 0.56 | ND | ND |
| p,p'DDE | 3.31 | 0.71 | 0.45 | 0.45 |
| p,p'DDD | 0.09 | 0.63 | 0.05 | ND |
| Endosulphan | 0.05 | ND | 0.05 | 0.74 |

**ND-Below detection level <0.01 µg $L^{-1}$ / µg $kg^{-1}$**

**Table-5 :Concentration of pesticides in Fish Species from Various Streams of Cauvery River**

| Pesticides and metabolites | Concentration of pesticides in Fish Species µg $kg^{-1}$ muscle | | | |
|---|---|---|---|---|
| | Etroplus suratensis | Murrels (Channa marulius) | silver carp | Catfishes (Heteropneustes fossilis) |
| α- HCH | 54.23 | ND | 0.56 | 3.54 |
| β- HCH | 44.68 | 0.05 | 0.98 | 2.23 |
| γ- HCH | 6.34 | 0.04 | 0.75 | 2.17 |
| δ- HCH | 12.54 | 0.05 | 0.66 | 2.19 |
| p,p'DDT | 0.77 | 0.06 | ND | ND |
| p,p'DDE | 3.28 | 0.05 | 0.34 | 0.09 |
| p,p'DDD | ND | ND | ND | ND |
| Endosulphan | ND | ND | ND | ND |

**ND-Below detection level <0.01 µg $L^{-1}$ / µg $kg^{-1}$**

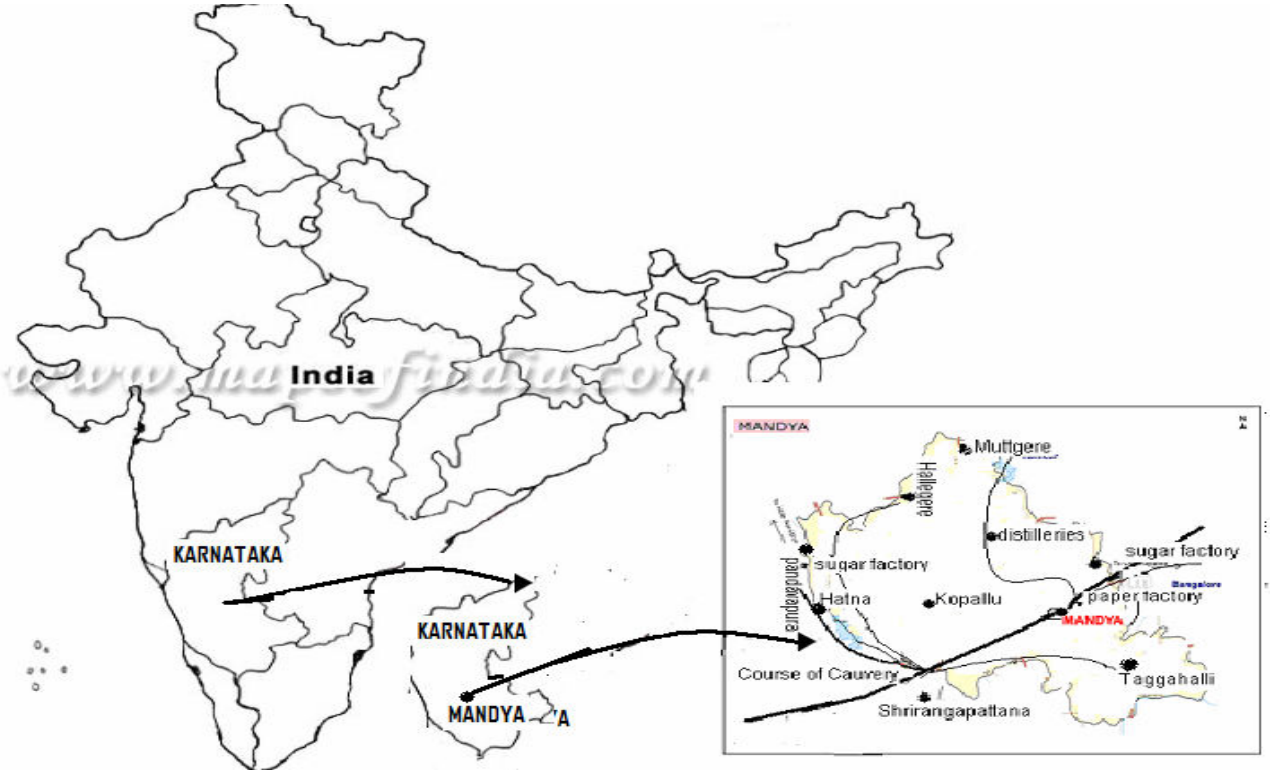


**Figure-1: Some Water quality parameters of water samples collected from 6 Stations of Cauvery River**

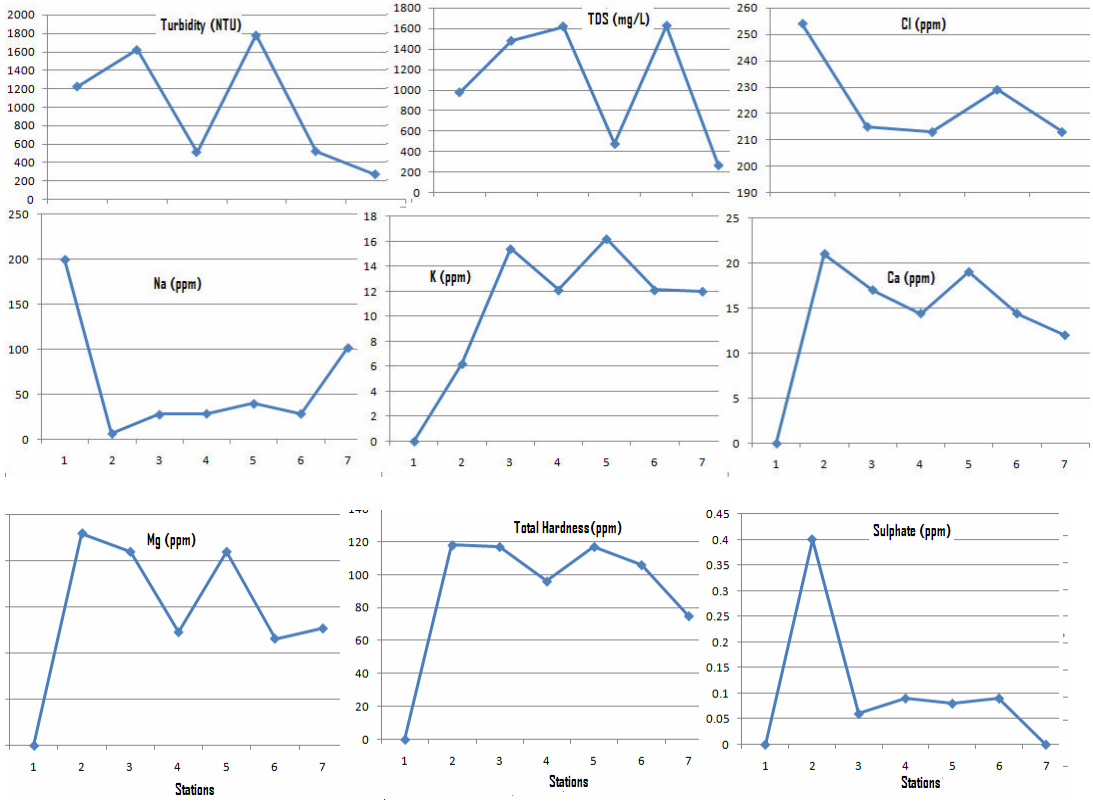



**Figure-2: Concentration of pesticides in water (µg $L^{-1}$) from Various Streams of Cauvery River.**

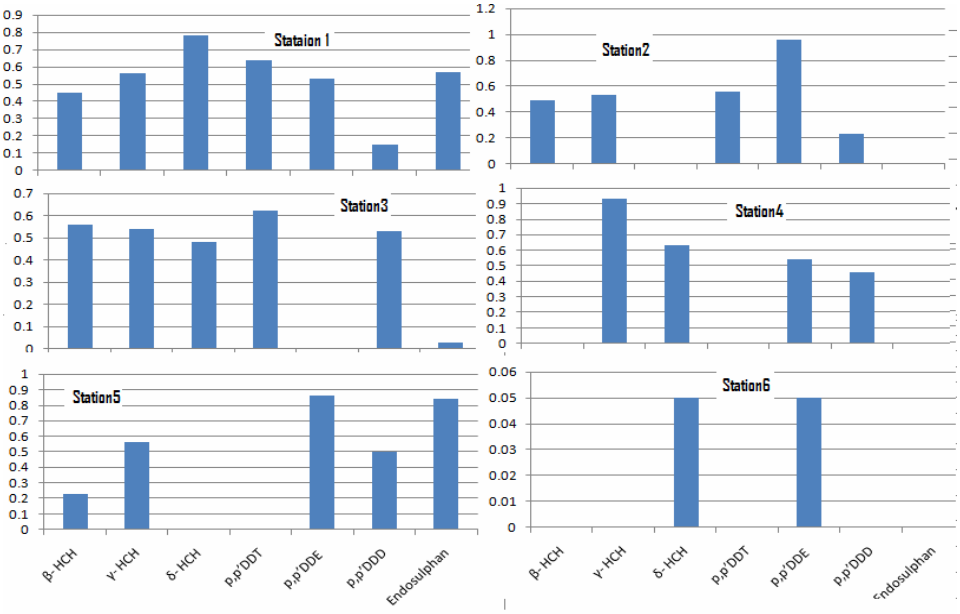


**Figure-3:Concentration of pesticides in Sediments (µgkg$^{-1}$) from Various Streams of Cauvery River**

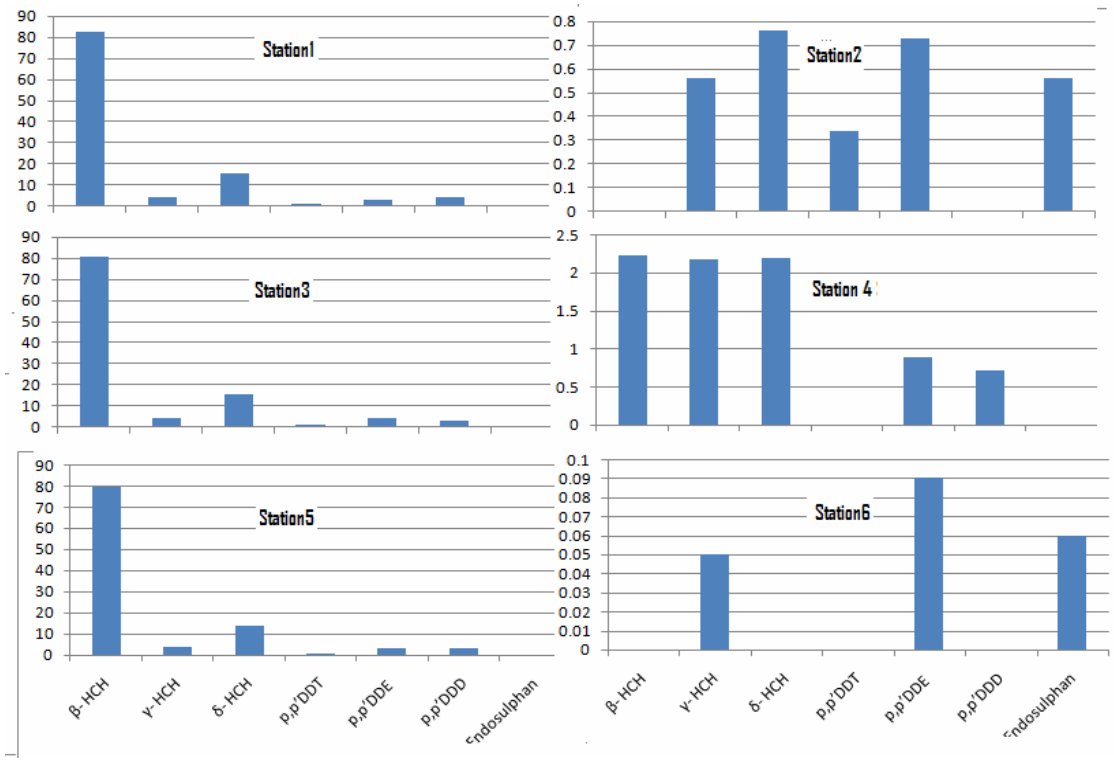



**Figure-4:Concentration of pesticides in Shrimps (µgkg$^{-1}$) from Various Streams of Cauvery River**

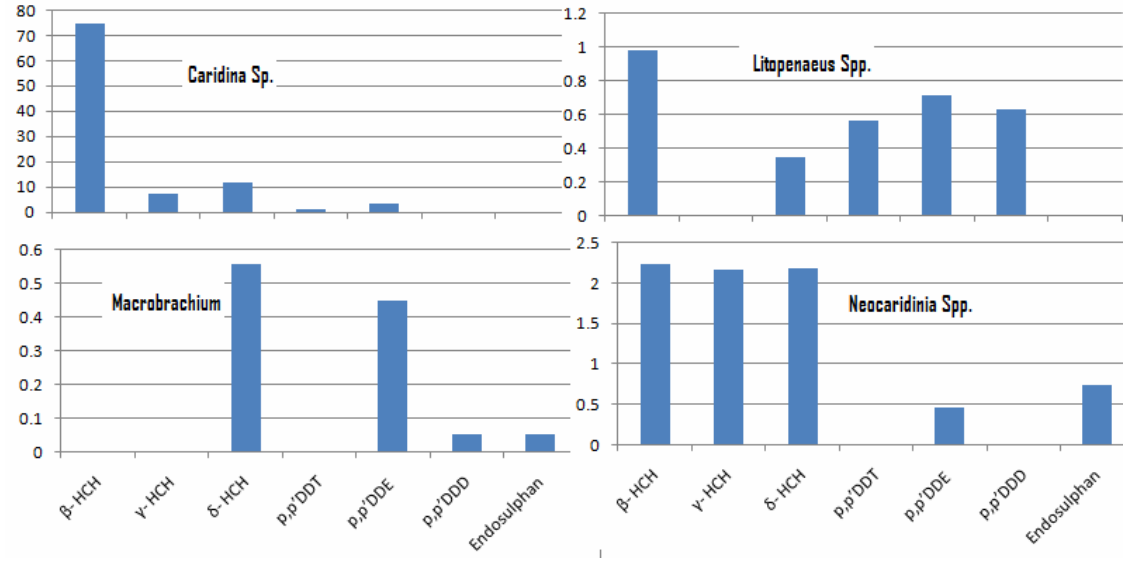
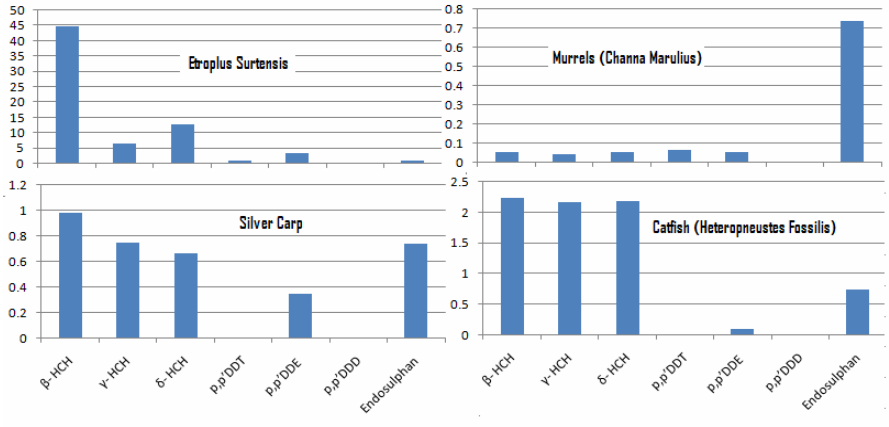
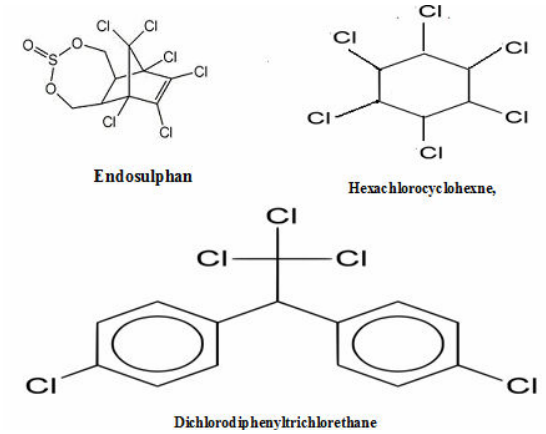


**Figure-5:Concentration of pesticides in Fish Species (µgkg$^{-1}$) from Various Streams of Cauvery River**

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