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ASSESSMENT OF POLLUTION STATUS IN RIVER ACHENCOVIL, KERALA

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Abstract: In the present study, the extent of pesticide and heavy metal pollution in Achencovil river was studied by taking water samples from three segments-upstream, midstream and downstream. The results showed that pesticide and heavy metal pollution was found to be highest at downstream, followed by mid stream. Most of them were totally absent or present in very low concentrations at upstream. Midstream possesses lesser amount of herbicide than downstream, while herbicides are not detectable at upstream. Only a trace amount of fungicides were detected from upstream. Moreover this study revealed that due to the impact of pesticides and heavy metals, most of the pollution tolerant species were present in mid and downstream segments while pollution intolerant were found to decrease in number in mid and downstream segments. However the pollution sensitive species was observed to be high in number at upstream.

Key words: Organo phosphorus pesticides, Organo chlorine pesticides, Carbamate pesticides herbicides, Fungicides, Heavy metals

INTRODUCTION

Pollution of aquatic environment with pesticides and heavy metals has become a worldwide problem, because they are not biodegradable and most of them have toxic effects on organisms (Macfarlane and Burchett, 2000). The rivers of Kerala have been increasingly polluted from the industrial and domestic waste and from the pesticides and fertilizer in agriculture. The present study was conducted on Achencovil river, one of the largest river in Kerala that influences the life of neighbouring towns socially, economically culturally and recreationally. Pesticides also have detrimental effects on natural ecosystems. Toxic effects can influence the survival or reproduction of aquatic species leading to the disruption of predator-prey relationships and a loss of biodiversity. Since pesticides and heavy metals are sensitive indicators for monitoring changes in the aquatic environment, the present study was conducted to know the pollution status in Achencovil river, in relation to its pesticides and heavy metal concentration.

MATERIALS AND METHODS

Water samples were collected yearly (2009-2012) from three segments of Achencovil river according to prescribed sample collection procedure in pre-wash and clean 300ml screw plastic containers as reported in APHA, 2005. Three insecticide families of pesticides, two families of herbicides and two of fungicides and seven heavy metals were identified and quantified from river Achencovil during the present study following the standard procedures described in APHA, 2005. Descriptive statistics were also conducted while statistical significance of differences ($P<0.05$) was determined by analysis of variance (ANOVA).

RESULTS

The presence of pesticides and heavy metals in Achencovil river was studied by analysing the amount of Organo phosphorus, Organo chlorine and Carbamate pesticides; herbicides, fungicides and heavy metals in water samples. Among the 5 Organo phosphorus pesticides analyzed shown on Table 1, Methyl chlorphiriphos and Monocrotophos were absent while Dimethoate (0.27 mg/l) reported highest concentration in the upstream. Monocrotophos (4.08 mg/l) and Ethyl chlorphiriphos (0.83 mg/l) recorded higher concentration in the midstream. The highest concentration of Methidathion (1.53 mg/l) and Methyl chlorphiriphos (0.27 mg/l) were marked in the downstream.

Table 1. Concentration (mg/l) of Organo phosphorous pesticides in water from the river Achencovil (mean ± SE)

No.	Pesticides	Upstream	Midstream	Downstream
1	Methyl chlorphiriphos	0	0.18±0.07	0.27±0.02
2	Methidathion	0.18±0.18	1.21±0.09	1.53±0.05
3	Ethyl chlorphiriphos	0.18±0.18	0.83±0.09	0.73±0.13
4	Monocrotophos	0	4.08±0.94	3.28±1.02
5	Dimethoate	0.27±0.03	0.005±0.001	0.005±0.001

Table 2. Concentration (mg/l) of Organo chlorine pesticides in water from the river Achencovil (mean±SE)

No.	Pesticides	Upstream	Midstream	Downstream
1	Penta chlorophenol	0	1.13±0.11	1.52±0.36
2	Chlordane	0.003±0.0006	0.005±0.0006	1.28±0.03
3	Mirex	0	1.59±0.31	2.23±0.57
4	Heptachlore	0	0.075±0.08	0.29±0.03

Table 3. Concentration (mg/l) of Carbamate pesticides in water from the river Achencovil (mean±SE)

No.	Pesticides	Upstream	Midstream	Downstream
1	Aldicarb	0	2.36±0.003	2.24±1.006
2	Thiodicarb	0	2.43±1.3	1.69±0.34
3	Carbaryl	0.07±0.07	0.39±0.13	0.20±0.1
4	Oxamyl	0.39±0.09	0.38±0.2	0.75±0.18
5	Carbofuran	0	0.005±0.001	0.006±0.001

Table 4. Concentration (mg/l) of Herbicides and Fungicides in water from the river Achencovil (mean±SE)

No.	Herbicide/Fungicide	Upstream	Midstream	Downstream
A	**Herbicides**			
1	Glyphosate	0	0.004±0.002	0.007±0.002
2	2-4-D	0	2.18±0.09	2.23±0.11
B	**Fungicides**			
1	Trycyclozole	0	0.16±0.07	0.29±0.02
2	Hexaconazole	0.02±0.01	0.20±0.1	0.25±0

Upstream segment of river Achencovil reported negligible amount of Organo chlorine pesticides (Table 2). Only a slight concentration of Chlordane (0.003 mg/l) was recorded from here. Downstream possess highest concentration of Penta chlorophenol (1.52 mg/l), Chlordane (1.28 mg/l), Mirex (2.23 g/lm) and Heptachlore (0.29 mg/l). The intensity of all these pesticides were less in the midstream compared to downstream. Among the Carbamate pesticides; Aldicarb, Thiodicarb and Carbofuran were absent in upstream. Oxamyl (0.75 mg/l) and Carbofuran (0.006 mg/l) were higher in the downstream (Table 3), while midstream recorded highest concentration of Aldicarb (2.36 mg/l), Thiodicarb (2.43 mg/l) and Carbaryl (0.39 mg/l).

Herbicides were totally absent in the upstream (Table 4), while a trace amount of fungicides were detected from upstream (Hexaconazole-0.02 mg/l). Downstream reported highest concentration of Glyphosate (0.007 mg/l), 2-4-D (2.23 mg/l), Trycyclozole (0.29 mg/l) and Hexaconazole (0.25 mg/l) respectively. Midstream possesses lesser amount of herbicides and fungicides than downstream.

Among the 7 heavy metals detected and quantified, the concentration of zinc (4.28 mg/l) was reported highest at midstream (Table 5). Zinc, cadmium, manganese and iron are absent in the upstream while concentration of copper (9.08 mg/l) was higher in the upstream. The amount of chromium (3.58 mg/l) and lead (0.009 mg/l) were higher in the midstream. The highest values of manganese (3.62 mg/l), cadmium (0.02mg/l) and iron (1.35 mg/l) were detected from downstream.

upstream also indicates the over usage of these pesticides at this segment. The recorded values of carbamate pesticides were within the limit of WHO-guideline value, showing that its extend of pollution are very less. Midstream possesses lesser amount of herbicide than downstream, while herbicides are not detectable at upstream. Only a trace amount of fungicides were detected from upstream. The concentration of almost all herbicides and fungicides fall within the WHO-guideline value, indicating lesser pollution load by these chemicals in Achencovil river.

Among the analyzed heavy metals, Copper was detected above the limit at all three segments. This could be associated with human activities such as the use of chemicals and copper-based fungicides by farmers (Egila and Nimyel, 2002). Among zinc, manganese, iron and lead; zinc, manganese and iron are not detected at upstream segment. Lead and Zinc were present within the permissible limit at all segments. The highest concentration of iron was detected at downstream, which was above the acceptable limit while manganese present only at downstream is also above the permissible limit. The reason for this may be due to the presence of fertilizers, organic and inorganic chemicals, alkalis, chlorine and basic steel works foundries at this segment. The concentration of chromium recorded higher than the acceptable limit at all three segments with highest value at midstream. This may be explained as a result of the occurrence of textile mills, leather tanning industries, steel and metal work foundries, cement, asbestos and flat glass plants and motor vehicle plating workshops around the nearby areas of this segment. Cadmium was detected highest concentration at downstream and this

Table 5. Concentration (mg/l) of Heavy metals in water from the river Achencovil (mean±SE)

No.	Heavy metals	Upstream	Midstream	Downstream
1	Zinc	0	4.70±0.29	4.28±0.54
2	Copper	9.08±0.21	5.01±0.24	2.61±0.88
3	Manganese	0	0	1.35±0.33
4	Iron	0	2.83±1.23	3.62±1.23
5	Chromium	2.51±1.38	3.58±1.2	2.25±1
6	Cadmium	0	0.004±0.003	0.02±0.02
7	Lead	0.005±0.0006	0.009±0.005	0.002±0.0006

DISSCUSION

The water quality characteristic of aquatic environment arises from a multitude of physical, chemical and biological interactions. In the present study, the extent of pesticide and heavy metal pollution in Achencovil river was found to be highest at downstream. Most of them were totally absent or present in very low concentrations at upstream. It can be explained by the precipitation of suspended solids, which are usually transported from the upstream segment and also may be due to intensive use of pesticides in the nearby agricultural lands. Among Organo phosphorus pesticides; Dimethoate reported highest concentration in the upstream while all others were very less. Similarly the presence of Chlordane, the only Organo chlorine pesticide recorded from value was above the acceptable limit. This could be attributed to the application of organic and inorganic chemicals, alkalis and fertilizers and also due to the presence of motor vehicle plating workshops near this segment.

Ecological effects of pesticides and heavy metals extend beyond individual organisms and can extend to ecosystems (Hartnik *et al.,* 2008). In this study, as the extent of pollution is found to be higher in the mid and downstream of Achencovil river, most of the pollution tolerant species are present in these two segments while pollution intolerant species are found to decrease in their number. Therefore, reliable information on the quality of water is essential for effective management and control of the water pollution.

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