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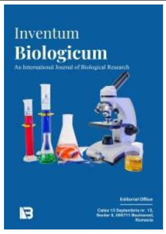

Research paper

Concentration of Different Insecticides and Fungicides in Godavari at Nasik during Different Seasons

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ABSTRACT

Pesticides are the chemicals which are used to kill pests in order to increase the crop productivity. However, their presence in other ecosystem may cause different impacts to both plants and animals. The concentration of different insecticides and fungicides in Godavari at Nasik during different seasons was investigated in the present study. The pesticides were determined by some proper procedures and protocols. Gas chromatography was used to know the concentration of pesticides. Different types of insecticides and fungicides were found in the water samples of Godavari river. The primary sources of pesticides were agricultural runoff from the adjacent agricultural fields. Hence, it is recommended that pesticide use should be limited and use of bio-pesticides may be encouraged.

1. Introduction

According to the World Water Assessment Program, the quality of the water accessible to everyone will deteriorate by 30% over the next two decades (WWAP, 2003). It is becoming more difficult to maintain aquatic ecosystems due to water constraint. Discharge of Industrial effluents, domestic waste and sewage without any treatment into the water bodies has resulted in deterioration of the quality of aquatic habitat. Indiscriminate discharge of industrial effluents is toxic to aquatic environment, creates water pollution, making water unfit for drinking, agriculture and for aquatic life (Quadros et al., 2001; Sukumaran, 2002; Patil and Lohar, 2009). This vast natural resource has turned into a scarce commodity with increased usage catering to the needs of ever-expanding population. Taking into consideration the importance of aquatic habitats, restoration and conservation of the same is now a must for the survival of species on the earth. Alarming signal about deterioration of aquatic ecosystem and scarcity of

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drinking water made UNESCO to declare 2005-2015: International Decade for Action "Water for Life". The priority is given to conservation and efficient use of global water resources. The development process must be both people-centered and conservation-based, as is very necessary. Progress will be slowed if we do not protect the natural systems that have supported our civilization for thousands of years.

It has been well recognized that the pollution of rivers and estuaries in India by pesticides is posing a serious problem from the public health and fisheries point of view. There are ample evidences to show that the mortality of fish was caused in many rivers by these pesticides discharged into them.

There are seven Indian states that are part of the Godavari river basin: Maharashtra, Telangana, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Odisha, and Karnataka. The Godavari river basin is divided into two parts: the upper and lower Godavari river basins. The Godavari river has a total length of around 1465 km and begins in Nasik, Maharashtra, at an elevation of roughly 1067 metres. It is the longest river in India. Dams constructed in India's Godavari basin are the most numerous and extensive of any other river basin in the country. River Ganga's drainage basin encompasses six Indian states: Chhattisgarh, Maharashtra, Andhra Pradesh, Madhya Pradesh, Karnataka, and Orissa, with the river flowing through each of them. By 2012, around 350 large and small dams and barrages had been constructed across the river basin.

In India about 126 total numbers of pesticides had been registered out which 69 pesticides are largely used; the remaining compounds are manufactured indigenously. In 1954-55 about 4,000 metric tons of pesticides (technical grade) were used in India which rose to about 70,000 in 1985-86 and it is estimated that by the end of 7 year plan, our consumption was 92,000 metric tons and now it reached above lakh tones. The Godavari river is also contaminated with different types of insecticides and fungicides due to influx of these chemicals into the water of Godavari. There are limited studies that have been conducted by the researchers to assess the concentration of these chemicals in Godavari river at Nasik. Hence, the present study is aimed to assess the concentration and accumulation of pesticides in the water of Godavari river in Nasik.

2. Methodology

2.1 Study Site

In order to conduct the physico-chemical analysis, six sample sites were chosen, namely (SI-SVIII) at Godavari. A total of six samples were collected in amber coloured vials, twice in triplicate. Drinking water samples were collected on a regular basis from chosen sampling sites during the first week of March, April, and May of this year for physico-chemical analysis.

2.2 Sample Collection

In order to conduct pesticide analyses water samples were collected from two sampling sites during the first week of each month. The samples were analysed in the laboratory. In each sampling station, the reported value was determined by taking the average of two samples acquired in three replicates at that sampling station and averaging those results together.

2.3 Extraction for Pesticide Analysis

Four sampling sites were used to gather water samples for pesticide analysis purposes. It was decided to use the locations of Godavari at Nasik. A 200-ml sample of water sample was extracted three times in a separating funnel, each time with 20 ml of ether/hexane solution (6:94, 15:85, and 50:50v/v, respectively), each time with 20 ml of ether/hexane solution. Following each extraction, the organic layers were collected in a 250-ml Erlenmeyer flask containing 5g of anhydrous Na_2SO_4 and stored at room temperature. In a rotavapor (Heidolph VV2001) operating at 90 rpm and 30 degrees Celsius, the extract was concentrated to 10 millilitres. After that, the extract was kept until it could be subjected to chromatographic analysis. Purification was accomplished by passing the extracts down a glass column (diameter 20 cm, inner diameter 0.8 mm) packed with florisil (10 cm) and Na_2SO_4 (2 cm), which was then eluted with ether/hexane solutions: 40 ml at 6:94v/v, 30 ml at 15:85v/v, and 20 ml at 50:50v/v. Following that, the extracts were concentrated to a final volume of 5 ml under the same circumstances as previously reported.

2.4 Gas Chromatography-Mass Spectrometry Analysis

The concentrated extract was evaluated using a splitless injection gas chromatography–mass spectrometer (GC–MS) operating in the mass spectrometry mode, according to the protocol. To analyse all pesticides, we used a gas chromatograph interfaced to an Accu TOF GCV ion trap mass detector with data system software to conduct calibration, acquire GC–MS spectra, and analyse the data.

2.5 Statistical Analysis

Analysis of variance was used to determine if there were statistically significant variations in mean values across sample locations and seasons (ANOVA). Significant difference and very significant difference were classified as p0.05 and p0.01, respectively, for statistical significance and highly significant difference. Calculations were made using the SPSS 19.0 statistical package to determine the coefficient of correlation between several physicochemical parameters.

3. Results

The concentration of different pesticides in water showed a spatial variation during winter season of 2019-2020 (Table 1, Fig. 1a,b). The highest concentration of Carbandazim (5.3±0.1 ng/l) was found at Site VII, followed by Site VI (0.54±0.01). Dimethomorph was detected at Site II & V only during winter season and α-BHC were found only at four sites (viz. I, VI, VII and VIII). The pp-DDT1 concentration (16.24±1.03 ng/l) was observed maximum at Site III and was not detected at Site V.

Imidacloprid, Flusilazole, Pyraclostorbin, p,p-DDT, Penconazole have not been reported at various sites in water. However, the concentration of Fenamidone was highest (3.76±0.002ng/l) at Site VII and the lowest concentration (0.83±0.01 ng/l) at Site VIII. Nevertheless, the concentration of pp-DDD was 10.87±0.09ng/l, 7.04±0.03 ng/l, 2.07±0.02 ng/l, 0.763±0.32 ng/l, 2.32± 0.02 ng/l, 1.03±0.002ng/l, 4.19±0.01 ng/l, 3.28±0.01ng/l, at Site I, II, III, IV, V, VI, VII, VIII respectively (Table 2, Fig. 2a,b).

The concentration of different water samples during pre-monsoon (2019-20) is shown in Table 3 and Fig. 3a,b. pp-DDE1 and pp-DDT1 were found at each site during pre-monsoon except at Site III and Site VII, respectively. The concentration of pp-DDD was 7.054±0.02ng/l, 11.042±0.4ng/l, 4.36±0.01ng/l, 2.26±0.01ng/l, 4.604±0.01ng/l, 2.061±0.01 ng/l, 4.74±0.02ng/l, 3.23±0.01 ng/l at Site I, II, III, IV, V, VI and VII respectively. Further, β-BHC was not detected at all the sites and Thiamethoxam found only at Site V, VI, VII, VIII.

The concentration of malathion was 2.33±0.02ng/l, 2.041±0.02 ng/l, 11.46±0.01 ng/l, 7.61±0.02 ng/l, 12.196±0.01 ng/l, 14.083±0.01 ng/l, 0.018±0.01 ng/l, and 0.002±0.01 ng/l, at Site I, II, III, IV, V, VI, VII, VIII respectively during pre-monsoon season. During post monsoon (2019-20) the concentration of fungicides and insecticides in water were not detected at most of the sampling sites. Parathion was reported almost at all the sites except at Site III. The concentration of pp-DDT1 and pp-DDD was 0.0871 ±0.01 ng/l, 0.131±0.02 ng/l, 0.053±0.01 ng/l and 2.012±0.02 ng/l, 3.21±0.01 ng/l, 7.35±0.02 ng/l respectively and was not found at other sites (Table 4).

4. Discussion

Lakes, streams, and river systems provide easy access to the hydrosphere, a significant part of Earth's ecology that contains around 0.3% of the planet's fresh water (UNESCO, 1998). River water, a valuable natural resource for humans, plays a crucial part in many aspects of existence for all living things. Agriculture, industry, tourism, and home life all rely on the river in some way. The River's ability to affect economic transformation is enormous (Patil et al., 2013). Many small towns and communities located near rivers have seen dramatic economic transformations in the last few decades (Kharke, 2008). There has been an increase in population, urbanization, industrialization, and encroachment on the river system during the last several decades (Muhammad et al., 2018; Bora and Goswami, 2017). There are a slew of human-caused water quality degradations linked to economic growth (Unde and Turkunde, 2008; Zhaoshi et al., 2017). It has a negative impact on the quality of the water (Das, 2013). If the amount of contaminants dumped into the river exceeds the river's ability to cleanse them, water quality degrades (Govorushko, 2010).

Table 1 Concentration (ng/l) of fungicides and insecticides in water samples of river Nasik at different sampling stations during the winter 2019-20

Analytes	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII
Carbandazim	0.007 ± 0.01	ND	0.013 ± 0.02	0.022 ± 0.02	0.010 ± 0.01	0.54 ± 0.01	5.3 ±0.2	0.40 ± 0.01
Azoxystorbin	0.003 ± 0.02	NQ	0.04 ± 0.02	ND	ND	0.31 ± 0.01	0.002 ± 0.01	0.081 ± 0.03
Imidacloprid	ND	ND	ND	ND	ND	ND	0.002 ± 0.01	0.012 ± 0.01
Flusilazole	ND	ND	ND	ND	ND	ND	ND	ND
Dimethomorph	ND	0.06±0.01	ND	ND	1.02±0.1	ND	ND	ND
Thiamethoxam	0.030 ± 0.01	0.010 ± 0.02	ND	ND	ND	2.3 ± 0.01	1.4 ± 0.02	4.2 ± 0.06
Fenamidone	0.024 ± 0.1	0.32 ± 0.0.3	0.002 ± 0.02	0.005 ± 0.01	0.17 ± 0.03	4.03 ± 0.02	9.27 ± 0.04	6.12±.02
Pyraclostorbin	0.002 ± 0.02	ND	ND	0.002± 0.02	1.02 ± 0.5	4.64 ± 0.1	12.62 ± 0.06	8.06 ± 0.11
Clothianidin	1.2 ± 0.01	ND	ND	ND	0.05± 0.1	3.42± 0.03	0.54 ± 0.03	0.62 ± 0.06
Iprovalicarb	3.26 ± 0.12	0.32 ± 0.01	ND	1.23 ± 0.01	3.27 ± 0.4	14.4 ± 0.2	6527 ± 0.01	5.39 ± 0.20
Hexaconazole	2.01 ± 0.1	0.75 ± 0.1	0.11 ± 0.02	0.05 ± 0.2	2.14 ± 0.1	8.81 ± 0.01	3.9 ± 0.02	4.6 ± 0.05
kresoxim methyl	2.0 ± 0.1	ND	ND	ND	0.12 ± 0.02	4.02 ± 0.01	11.9 ± 0.01	2.6 ± 0.04
Tridemefon	ND	ND	ND	0.002 ± 0.01	0.11± 0.3	6303± 0.02	8.2 ± 0.03	10.04 ± 0.05
Penconazole	0.002 ± 0.01	ND	ND	0.04 ± 0.02	3.13 ± 0.01	ND	ND	0.04 ± 0.2
Spinosad A	1.12 ± 0.01	0.031 ± 0.01	ND	ND	10.36 ± 0.02	11.27± 0.01	0.53 ± 0.01	0.02 ± 0.01
Methyl Parathion	1.11 ± 0.01	0.002 ± 0.0	ND	0.06 ± 0.1	0.14 ± 0.0	0.075 ± 0.01	1.04 ± 0.01	4.02 ± 0.01
pp-DDT1	9.76 ± 0.1	7.16 ± 0.2	15.23 ± 4.2	11.2 ± 0.4	ND	0.32 ± 0.0	2.77 ± 0.1	9.68 ± 0.32
pp-DDD	10.34 ±0 .5	15.2 ± 0.17	22.13 ± 0.1	15.23 ± 2.03	17.86 ± 0.21	21.30±0.01	17.2±0.02	10.14±0.01
Carbandazim	0.05 ± 0.1	0.12 ± 0.00	2.40 ± 0.02	0.004 ± 0.02	2.24 ± 0.12	7.25 ± 0.001	0.92 ± 0.0	10.87 ± 0.01
Azoxystorbin	10.03 ± 0.01	8.12 ± 0.01	23.63 ± 0.01	17.16 ± 1.05	12.18 ± 0.1	35.14 ± 0.02	0.62 ± 0.12	3.12 ± 0.1
Imidacloprid	0.32 ± 0.001	1.12 ± 0.2	0.005 ± 0.02	2.03 ± 0.01	0.014 ± 0.13	ND	ND	0.041 ± 0.2
Ethion	0.05 ± 0.1	0.12 ± 0.00	2.40 ± 0.02	0.004 ± 0.02	2.24 ± 0.12	7.25 ± 0.001	0.92 ± 0.0	10.87 ± 0.01
Malathion	10.03 ± 0.01	8.12 ± 0.01	23.63 ± 0.01	17.16 ± 1.05	12.18 ± 0.1	35.14 ± 0.02	0.62 ± 0.12	3.12 ± 0.1
Parathion	0.32 ± 0.001	1.12 ± 0.2	0.005 ± 0.02	2.03 ± 0.01	0.014 ± 0.13	ND	ND	0.041 ± 0.2

ND-Not Detected

Table 2 Concentration (ng/L) of fungicides and insecticides in water samples of river Nasik at different sampling stations during the Summer 2019-20

Analytes	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII
Carbandazim	ND	ND	0.30 ± 0.001	0.017 ± 0.01	2.08 ± 0.02	2.06 ± 0.01	3.76 ± 0.002	0.83 ± 0.01
Azoxystorbin	NQ	NQ	0.02 ± 0.01	ND	ND	0.32 ± 0.02	0.001 ± 0.01	0.080 ± 0.02
Imidacloprid	ND	NQ	ND	ND	ND	ND	ND	ND
Flusilazole	ND	ND	ND	ND	ND	ND	ND	ND
Dimethomorph	ND	ND	ND	0.051	ND	0.0051	ND	ND
Thiamethoxam	ND	ND	ND	ND	0.68 ± 0.2	2.87 ± 0.01	3.03 ± 0.001	1.03 ± 0.02
Fenamidone	0. 18 ± 0.01	0.75 ± 0.01	0.51 ± 0.001	2.02 ± 0.001	2.18 ± 0.002	2.77 ± 0.001	5.01 ± 0.001	3.13 ± 0.001
Pyraclostorbin	0.21 ± 0.01	ND	ND	ND	ND	ND	7.01 ± 0.01	5.42 ± 0.01
Clothianidin	0.86 ± 0.001	ND	ND	ND	ND	ND	0.007 ± 0.03	2.15 ± 0.002
Iprovalicarb	1.82 ± 0.02	2.76 ± 0.02	ND	0.11 ± 0.01	4.17 ± 0.03	12.4 ± 0.2	5.07 ± 0.01	3.29 ± 0.011

...Table 2 continued

Hexaconazole	2.13 ± 0.002	ND	0.02 ± 0.01	ND	2.04 ± 0.02	4.03 ± 0.01	0.052 ± 0.01	0.007 ± 0.003
kresoxim methyl	2.21± 0.1	ND	ND	ND	2.37 ± 0.02	4.54 ± 0.01	7.07 ± 0.01	1.2 ± 0.04
Tridemefon	ND	ND	ND	ND	ND	ND	4.02 ± 0.03	3.003 ± 0.05
Penconazole	ND	ND	ND	ND	5.08 ± 0.01	1.002 ± 0.01	0.57 ± 0.001	0.14 ± 0.002
Spinosad A	2.16 ± 0.02	2.01 ± 0.01	0.571 ±0.02	2.13 ± 0.01	2.06 ± 0.01	2.03± 0.01	0.024 ± 0.01	0.52 ± 0.01
Methyl Parathion	0.77 ± 0.01	ND	ND	0.013 ± 0.01	0.61 ± 0.01	0.02 ± 0.02	3.04 ± 0.01	2.65 ± 0.01
pp-DDT1	7.32 ± 0.02	2.14± 0.01	5.07 ± 3.2	2.014 ± 0.01	ND	ND	ND	2.42 ± 0.11
pp-DDD	10.87± 0.05	7.04 ± 0.03	2.07 ± 0.02	0.763 ± 0.32	2.32 ± 0.02	1.03 ± 0.002	4.19 ± 0.01	2.28 ± 0.01
Ethion	ND	0.062 ± 0.01	0.033 ± 0.01	ND	0.244 ± 0.02	1.05 ± 0.01	0.53± 0.1	2.02 ± 0.002
Malathion	4.13 ± 0.01	2.76 ± 0.02	10.21 ± 0.01	7.13± 0.07	10.19 ± 0.1	15.01 ± 0.01	ND	ND
Parathion	2.47 ± 0.02	2.13 ± 0.01	ND	0.76 ± 0.01	2.32 ± 0.02	ND	0.543 ± 0.01	2.326 ± 0.01

ND-Not Detected

Table 3 Concentration (ng/l) of fungicides and insecticides in water samples of river Nasik at different sampling stations during the pre-monsoon 2019-20

Analytes	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII
Carbandazim	0.001 ± 0.001	ND	0.001 ± 0.002	0.011 ± 0.01	2.203 ± 0.01	0.763 ± 0.02	1.031 ± 0.001	2.020 ± 0.001
Azoxystorbin	0.012 ± 0.001	NQ	0.001 ± 0.02	ND	ND	0.764 ± 0.001	ND	0.239 ± 0.01
Imidacloprid	ND	NQ	ND	ND	ND	ND	ND	ND
Flusilazole	ND	ND	ND	ND	0.002 ± 0.001	0.022 ± 0.01	ND	ND
Dimethomorph	ND	ND	ND	ND	ND	ND	ND	ND
Thiamethoxam	ND	ND	ND	ND	0.053 ± 0.01	2.092 ± 0.01	1.463 ± 0.001	2.862 ± 0.02
Fenamidone	0. 18 ± 0.01	0.84 ± 0.01	0.51 ± 0.001	2.01 ± 0.001	2.28 ± 0.001	2.87 ± 0.001	5.02 ± 0.001	3.23 ± 0.001
Pyraclostorbin	2.106 ± 0.02	ND	ND	ND	0.026 ± 0.001	ND	5.824 ± 0.01	6.036 ± 0.01
Clothianidin	0.14 ± 0.001	2.043 ± 0.01	ND	ND	ND	ND	0.402 ± 0.01	2.061 ± 0.01
Iprovalicarb	2.042 ± 0.02	0.652 ± 0.02	ND	ND	4.64 ± 0.02	11.79 ± 0.01	4.048 ± 0.01	3.086 ± 0.1
Hexaconazole	2.022 ± 0.02	ND	2.038 ± 0.02	0.006 ± 0.02	0.682 ± 0.02	1.864 ± 0.02	0.732 ± 0.01	0.028 ± 0.001
kresoxim methyl	2.46± 0.2	ND	ND	ND	2.04 ± 0.02	2.26 ± 0.01	8.032 ± 0.01	1.035 ± 0.01
Tridemefon	0.011 ± 0.01	ND	ND	ND	ND	0.023 ± 0.01	4.641 ± 0.02	4.082 ± 0.01
Penconazole	ND	ND	ND	0.003 ± 0.02	5.36 ± 0.02	3.14 ± 0.01	2.035 ± 0.01	0.518 ± 0.002
Spinosad A	0.764 ± 0.02	2.164 ± 0.01	0.058 ±0.02	1.106 ± 0.01	1.83± 0.03	2.48± 0.02	0.534 ± 0.01	2.31 ± 0.01
Methyl Parathion	2.623 ± 0.01	0.055± 0.01	ND	0.723 ± 0.01	0.751 ± 0.02	2.043 ± 0.01	2.862 ± 0.01	2.204 ± 0.01
pp-DDT1	7.521 ± 0.02	5.83 ± 0.02	4.226 ± 0.01	3.461 ± 0.01	0.032 ±1.02	0.293± 0.01	ND	3.816 ± 0.10
pp-DDD	7.054 ± 0.02	11.042 ± 0.4	4.36 ± 0.01	2.26 ± 0.01	4.604 ± 0.01	2.061 ± 0.01	4.74 ± 0.02	3.23 ± 0.01
Ethion	0.027 ± 0.01	0.126 ± 0.03	0.133 ± 0.02	0.027 ± 0.02	1.008 ± 0.02	2.020 ± 0.01	2.03 ± 0.3	1.48 ± 0.002
Malathion	2.331 ± 0.02	2.041± 0.01	11.461 ± 0.02	7.61 ± 0.01	12.196 ± 0.01	14.083 ± 0.01	0.018 ± 0.01	0.002 ± 0.01
Parathion	1.096 ± 0.01	2.832 ± 0.02	0.013 ± 0.11	2.559 ± 0.02	2.791 ± 0.02	1.345 ± 0.001	2.212 ± 0.01	0.781 ± 0.01

ND-Not Detected

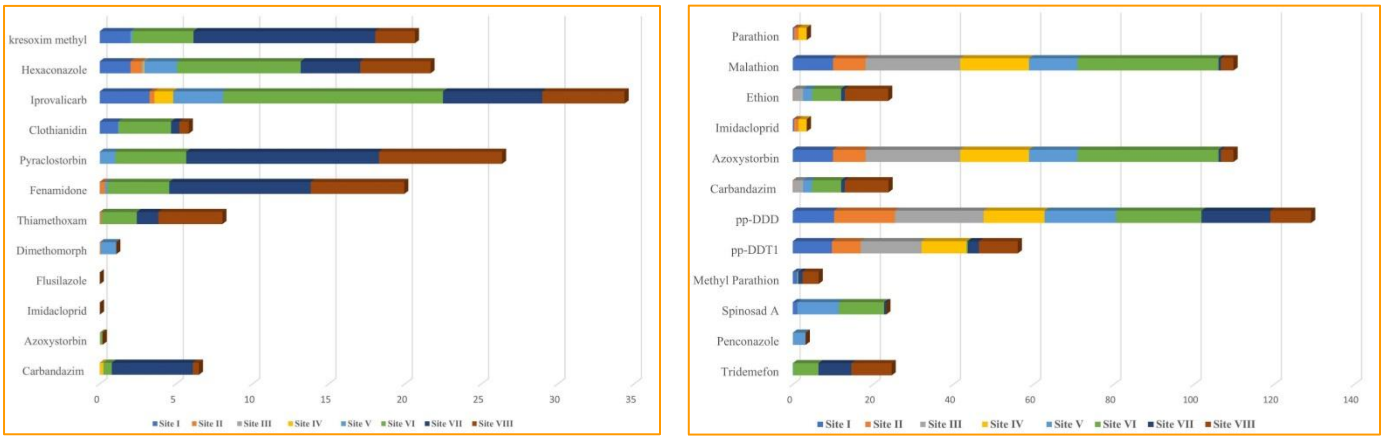

Fig. 1 (a & b) Concentration (ng/l) of Fungicides and Insecticides in water samples of River Nasik at different sampling stations during the winter 2019-20

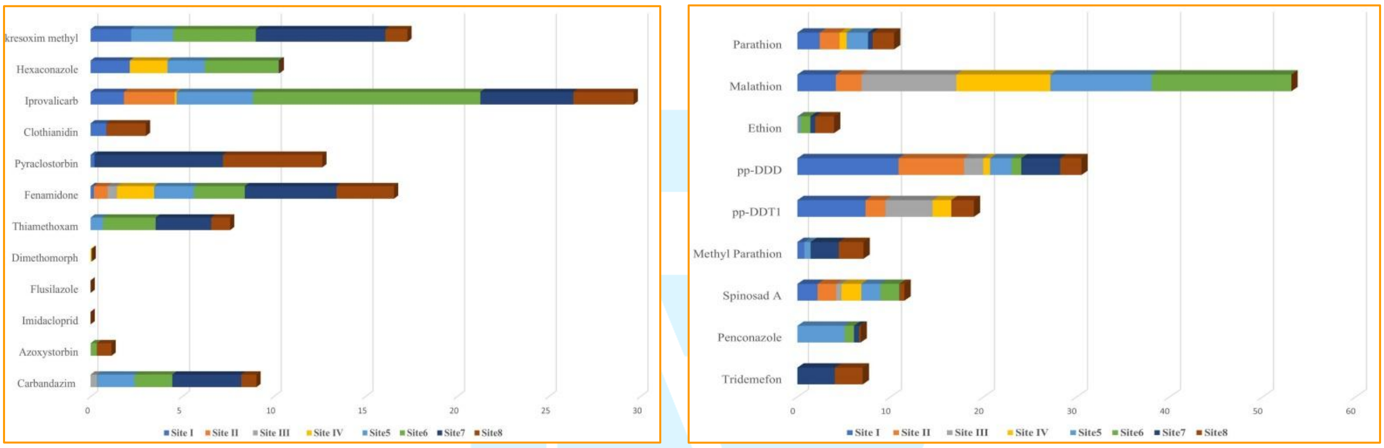

Fig. 2 (a & b) Concentration (ng/l) of Fungicides and Insecticides in water samples of River Nasik at different sampling stations during the Summer 2019-20

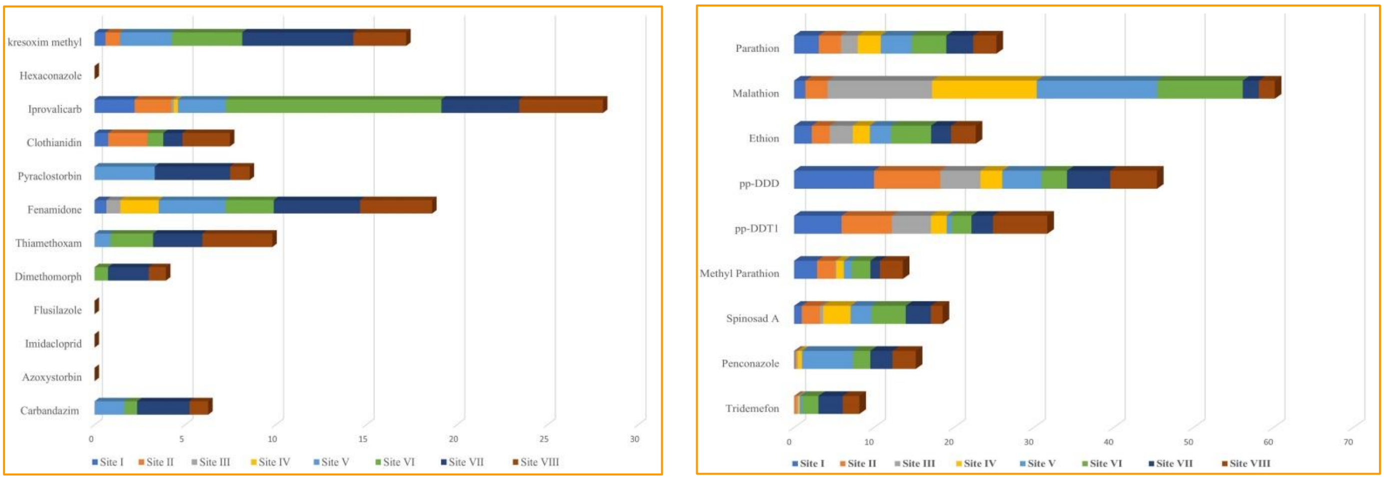

Fig. 3 (a & b) Concentration (ng/l) of Fungicides and Insecticides in water samples of River Nasik at different sampling stations during the Pre monsoon 2019-20

Table 4 Concentration (ng/l) of Fungicides and Insecticides in water samples of River Nasik at different sampling stations during the post monsoon 2019-20

Analytes	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII
Carbandazim	0.002	ND	ND	ND	0.023	0.531	2.610	3.022
Azoxystorbin	ND	ND	ND	ND	ND	ND	ND	2.310
Imidacloprid	ND	0.034	0.012	ND	0.230	1.062	4.062	0.743
Flusilazole	ND	ND	ND	ND	0.012	ND	ND	ND
Dimethomorph	0.052	0.007	ND	ND	4.062	0.771	2.360	ND
Thiamethoxam	0.001	0.0003	ND	ND	0.025	0.030	ND	0.0002
Fenamidone	0. 462	0.008	0.012	0.085	0.261	0.762	1.051	5.130
Pyraclostorbin	ND	ND	ND	ND	ND	ND	4.041	1.061
Clothianidin	ND	ND	ND	ND	ND	ND	ND	0.007
Iprovalicarb	0.063	0.421	ND	ND	ND	1.973	2.053	2.061
Hexaconazole	0.007	ND	0.603	ND	0.062	2.640	0.481	2.360
kresoxim methyl	0.001	ND	ND	ND	2.971	2.067	10.032	5.080
Tridemefon	ND	ND	ND	ND	ND	0.762	0.212	0.352
Penconazole	ND	ND	ND	ND	7.0621	0.831	0.503	2.089
Spinosad A	ND	ND	0.721	ND	2.614	1.517	ND	0.876
Methyl Parathion	1.610	2.060	ND	ND	ND	0.251	2.070	3.211
pp-DDT1	0.0871	0.131	0.053	ND	ND	ND	ND	6.31
pp-DDD	2.012	3.210	7.35	ND	7.042	4.061	5.065	2.248
Ethion	ND	ND	ND	ND	ND	0.0113	ND	2.261
Malathion	6.320	ND	5.040	4.011	7.915	7.010	ND	4.972
Parathion	0.0080	2.60	ND	3.014	2.910	5.401	2.01	2.096

ND-Not Detected

Agricultural run-off, wet and dry deposition, and other diffuse sources are the most prevalent causes of pesticide contamination in surface water, but possible point sources include sewage treatment plants and industrial facilities. Local factors such as climate, topography, and the proximity of waters to the site of application all influence the degree of contamination. In addition to physico-chemical properties of the pesticide - such as the octanol-water coefficient (KOW) and aqueous solubility - contamination is also affected by the degree of contamination.

Insecticides and fungicides are used in agriculture. When pesticides are used heavily in agriculture, they may accumulate in the environment. This has been seen in water, sediment, and mollusks in important aquatic ecosystems across the globe that are in close proximity to agricultural land. Recent reports of pesticide occurrence in water and sediment were observed by Allinson and colleagues (2015). The concentration of Fenamidone was highest (3.76±0.002ng/l) at Site VII and the lowest concentration (0.83±0.01 ng/l) at Site VIII. However, the concentration of pp-DDD was 10.87±0.09ng/l, 7.04±0.03 ng/l, 2.07±0.02 ng/l, 0.763±0.32 ng/l, 2.32± 0.02 ng/l, 1.03±0.002ng/l, 4.19±0.01 ng/l, 3.28±0.01ng/l, at Site I, II, III, IV, V, VI, VII, VIII respectively. The usage of pesticides is mostly governed by the aggressiveness of the pests and the types of crops being grown. In the past, it was only used on a very limited basis. Certain studies have shown a relationship between the use of pesticides and the use of fertilizer. Godavari river appears to be the most contaminated based on the concentrations of Carbandazim, Azoxystorbin, Imidacloprid, Flusilazole, Dimethomorph, Thiamethoxam, Fenamidone, Pyraclostorbin, Clothianidin, Iprovalicarb, Hexaconazole, kresoxim methyl, Tridemefon, Penconazole, Spinosad A, Methyl Parathion, pp-DDT1, pp-DDD, Carbandazim, Azoxystorbin, Imidacloprid, Ethion, Malathion, Parathion found in this river, which could be linked to industrial discharge and agricultural run-off of chemicals in the lakes and rivers.

Similarities in features amongst rivers indicate that they may include comparable types of pollution from nearby anthropogenic sources such as industrial and agricultural operations. Given the existence of a significant quantity of pesticides in the water systems, it is likely that the majority of South Asian nations are frequently utilizing pesticides that have been outlawed, resulting in deterioration of the overall water environment. Pesticide use for agricultural or other reasons is strictly regulated in most of the nations in this area, but owing to a lack of effective enforcement, most individuals do not adhere to the laws as they should. As a result, after reviewing around 136 relevant papers, we can outline some of the most important elements about this essential subject as follows.

Countries with a high concentration of industrial activity have the most contaminated water resources. Rivers in India are far more polluted than those in the United States. It was also shown by prior study conducted by others. The industrial and agricultural activities that take place along riversides in these nations are the most likely causes of pesticide pollution in the rivers.

However, owing to a lack of enforcement of environmental legislation in India, Godavari River monitoring team do not adhere to the norms and regulations in their respective jurisdictions.

These nations have a large number of Transboundary Rivers, all of which are interconnected. The extensive usage of pesticides in adjacent nations may have an adverse effect on their natural resources. As a result, constant monitoring is required to determine the precise quantity of chemical compounds being used in the vicinity of the Godavari River. Furthermore, the responsible authority or policymaker in each nation should take a proactive approach in order to prevent the illicit application and discharge of pesticides into Godavari River. According to our findings after analyzing the reported data and comparing them to standard guidelines, it is imperative to take appropriate actions and establish an effective process for eliminating pesticides from natural resources, particularly rivers. This is especially true before household and agricultural uses of pesticides.

As a final goal, this study will attempt to estimate levels of different kinds of pesticide residues present in the Godavari river of several South Asian nations. It is vital to have a comprehensive understanding of a major problem before developing a pesticide removal method or taking action against the usage of pesticide chemicals in any industry. The information gathered by this research might also be beneficial to scientists, politicians, environmentalists, and academics who are concerned with the poisoning of river systems by pesticides in general.

Rivers, streams, and their tributaries that flow through villages, towns, and cities acquire a huge quantity of pollutants, including surface runoff from fields (agricultural effluents) and industrial effluents, as well as toxins from the atmosphere. Ponds, lakes, and reservoirs are all adversely impacted by human activity in the same way. In the context of population increase and economic development, India is confronted with a major issue of natural resource scarcity, particularly in the area of water. In order to achieve sustainable development and conservation, it is necessary to do research.

During two-year investigation, the following pesticide classes were discovered in the Nasik river: carbandazim, azoxystorbin, imidacloprid, flusilazole, dimethomorph, thiamethoxam, fenamidone, pyraclostorbin, clothianidin, iprovalicarb, hexaconazole, kresoxim methyl, tridemefon Pesticide concentrations are highest in areas where human impact is greatest, according to the geographical distribution. Most pesticides that have been prohibited in India are still being used in Nasik, and these chemicals have made their way into the Nasik River, which is a terrible situation. Pesticides have also had a role in the altering of the physical and chemical characteristics of water, which has been linked to their presence. There have been other investigations undertaken in various rivers throughout the globe that have virtually reached the same conclusion. Pesticides were shown to cause changes in water quality, as stated by Palma et al. (2015) and Hu et al. (2014) in their studies.

Understanding the fate of pesticides in the Nasik river is critical for making reasonable judgments about how to prevent pesticide pollution in the waterway. Even though a pesticide's short-term access to surface waters and effects on nontarget species may be reduced by retention in Nasik sediment, the persistence of pesticides that are not destroyed fast poses a concern to the ecosystem and, ultimately, to the fish and water users in this region. Consequently, it is essential to understand both the processes involved in the retention and release of pesticides by sediments and the variables affecting these processes, as well as the mechanisms by which degradation takes place. Only a multidisciplinary approach to environmental research in the field of pesticide chemistry will be able to plan, manage, pursue, and integrate the results that will be required for the development of tools and techniques that will allow for effective environmental decision-making in the field of pesticide chemistry Strict controls for the use of pesticides in agriculture, the discharge of agricultural wastewater, and the operation of municipal sewage systems are very necessary to ensure that the estuarine and marine environment remains clean and sustainable.

Pesticide contamination of runoff water from paddy fields is a significant source of pesticide pollution in the research region. There were greater concentrations of cyanide in paddy-field sediments compared to those in non-agricultural regions. The existence of substantial human activities around Nasik Lake, as well as the cumulative influence of river runoff and wastewater discharge from paddy fields, may explain the variability in pesticide residue amounts in the non-agricultural region.

5. Conclusion

This investigation indicated that Godavari river systems under consideration are polluted by pesticides, with the presence of Carbandazim, Azoxystorbin, Imidacloprid, Flusilazole, Dimethomorph, Thiamethoxam, Fenamidone, Pyraclostorbin, Clothianidin, Iprovalicarb, Hexaconazole, kresoxim methyl, Tridemefon, Penconazole, Spinosad A, Methyl Parathion, pp-DDT1, pp-DDD, Carbandazim, Azoxystorbin, Imidacloprid, Ethion, Malathion, Parathion being particularly widespread. In certain water systems, the concentration levels of these popular pesticides are discovered to be greater than the required regulatory limits, demonstrating the unenthusiastic state of the river systems and posing a threat to the water's environment. The Godavari River in India, as well as the has been shown to have the highest concentrations of pesticides.

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