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RESEARCH ARTICLE

IMPACT OF AGRO-CHEMICALS ON THE POLLUTION STATUS OF CHOSEN POINTS IN RIVER GIRI, HIMACHAL PRADESH, INDIA

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ABSTRACT

Environment gets degraded more rapidly in spite of various remedial measures undertaken. The man-made activities, abundant usage of inorganic fertilizers and pesticides have still worsened the problem. This in turn affects the water bodies very severely making it unfit for drinking, domestic and even agricultural purposes. In this background, the present work was initiated to analyze the extent of deterioration of water in a defined stretch of River Giri, Himachal Pradesh, India. The physical and chemical qualities of water were analyzed and the extent of pollution was found out and presented in detail.

INTRODUCTION

Synthetic pesticides have contributed to some of the increased agricultural yield over the last 50 years. Because of these benefits, pesticide use has become widespread and the global agro-chemical market has continued to expand. Pesticides are intended to deliberately kill living organisms. This can result in adverse impacts on the environment, wildlife and human health. Pesticides indirectly affect organisms and the environment by breaking food chains and disrupting the natural balance of an ecosystem. Herbicides may reduce the availability of appropriate habitats for predators which can result in a decline of predators and a pest outbreak. Predators and non-target organisms can also be affected by the direct contact of pesticides. Other direct effects with humans include poisoning, infertility, cancer, and even neurological disorders for those using organophosphates. Though agrochemical pesticides are very important in crop protection, their intensive use over the years may result in environmental problems such as contamination of soil and ground water. When these pesticides are applied to protect crops from pests and diseases only around 15 percent of the proportion hits the target and the rest distributed in the soil and air as residual proportion. Characteristics that may influence the leaching of pesticides in the ground water and the adjacent aquatic systems such as rivers, ponds, pools, etc., include the amount of rainfall, soil damage, the depth of the ground water below the soil surface, the distance of open water system from the region of application, and the mobility of the pesticide and its degradation process, as well as agronomic factors such as timing, rate and method of the pesticide application and the use of irrigation and cover crops (FAO 2000, Wyman *et al.* 1985, Helling and Gish 1986).

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MATERIALS AND METHODS

In the present investigation an attempt was made to study the impact of pesticides on River Giri, Himachal Pradesh. Himachal Pradesh, a hilly state of India known for apple and other stone fruits, and green vegetables. Various kinds of pesticides are being used by the orchardists and farmers to save their crop from the attack of insect and pests. The economy of the people totally depends on the fruit crops and vegetables.The area of investigation is located in the southern east district of Himachal Pradesh. The district in outer Himalayan range commonly called as Shivaliks between 77^0 01' 12'' and 77^0 49' 40''east longitude and 33^0 22' 30" and 31^0 01' and 20" north longitude. Attempt was being made to study the various physio-chemical parameters of the water in Giri River, one of the tributaries of River Yamuna. The River originates from the Churdhar Mountain of district Sirmour of Himachal Pradesh at an altitude of 12000 ft. River Giri flows down to the border of Solan and Sirmour districts of Himachal Pradesh.The present investigation was carried out in an area of 5 km along the River Giri from Katal to Maryog in 2012 from July to December. Water samples were collected from three sites at regular time interval during the morning hours between 9 to 11 am in polythene bottles, brought to the laboratory immediately and analyzed for their physico-chemical parameters. All the parameters were analyzed as per the standard procedures (APHA, 1985).

RESULTS AND DISCUSSION

In order to assess the impact of pesticides on the water quality that influence the fresh water bodies in river Giri, water quality assessment was undertaken during the critical period of July, September and November. The samples were taken from three different sites of study area for water quality parameters assessment.

Table 1. Physical examination of water samples at different sites of River Giri during July to December 2012 (Mean±SD)

Description of sites	Temperature (^{0}C)	Turbidity NTU	TDS (ppm)	Conductivity (mhos)
Katal	27.5±0.08*	57.8±0.09*	278.0±1.41	285.0±6.35
Karganoo	29.4±0.09*	58.0±0.07*	275.1±2.42*	290.2±3.22
Maryog	29.2±0.08*	59.0±0.06*	280.5±3.61*	287.0±7.37

*- The mean value differences are significant at 5% level of ANOVA (SNK)

Temperature

During the study period there was rainy season from July to September, and therefore, temperature did not show marked fluctuation. It showed little variation from July to September. The temperature recorded during early July (evening) was maximum i.e. 29.4^{0}C at Maryog and the minimum 27.5 at Katal (Table 1). Water temperature is affected by air temperature, storm water, runoff water, turbidity and exposure to sunlight. The temperature also affect the other parameters such as salinity, alkalinity, dissolved oxygen, conductivity, etc., These in turn may affect the COD and BOD, increased metabolic rate and physiological reactions of organisms (Jawale and Patil, 2009).

Turbidity

Turbidity is a measure of how particles suspended in water affect water clarity (Saxsena, 1987). It is an important indicator of suspended sediment and erosion levels. Typically it will increase sharply during and after rain fall. Elevated turbidity will also raise water temperature, lower dissolved oxygen, prevent light from reaching aquatic plants which reduces their ability to photosynthesize and harm fish gills and eggs. In the present study turbidity was maximum at site no. 3 (Maryog) that was i.e., 59 NTU in the evening sample of July to December 2012 and minimum i.e., 57.8 NTU at site no. 1 (Katal) (Table 1). Increase in turbidity decreases the dissolved oxygen and prevent light to reach the aquatic plants and animals. Large amount of suspended matter may log the gills of fish and may kill them directly.

Total Dissolved Solids

In the present study the total dissolved solids (TDS) was found to be a maximum of 280 ppm at site no-3 (Maryog) and minimum at site no-2 (Karganoo) i.e, 275ppm during the month of July to December 2012 (Table 1). These high dissolved solids generally are of inferior palatability and induce an unfavourable physiological reaction in the transient consumers.

Table 2. Chemical examination of water samples in the river Giri during July to December 2012 (Mean±SD)

Parameters	Sample collection sites		
	Katal	Karganoo	Maryog
pH	8.9±0.1*	9.1±0.2*	9.0±0.1*
DO (mg/l)	20.0±1.14	19.8±0.66	19.9±0.08
COD (mg/l)	118.0±1.41*	120±0.61*	109±1.41*
BOD (mg/l)	59.0±1.41*	62.0±1.30	63.0±0.66
Sulphate (mg/l)	11.0±0.63	10.6±0.20	10.8±0.63
Chloride (mg/l)	160.0±1.41*	157.0±1.33*	116.7±1.08*
Floride (mg/l)	2.0±0.08	2.0±0.14	2.1±0.15
Magnesium (mg/l)	11.9±0.16*	12.4±0.08*	11.6±0.14*
Total Hardness (mg/l)	302.0±0.85*	295.0±0.89*	298.0±1.41*
Nitrate (mg/l)	10.2±0.08	10.1±0.08	9.9±0.89
Nitrite (mg/l)	7.6±0.14*	8.0±0.63	7.5±0.89*
Iron (mg/l)	0.05±0.01*	0.06±0.01*	0.04±0.01
Ammonia (mg/l)	2.4±0.14	2.5±0.83*	2.1±0.63*
Phosphate (mg/l)	0.1±0.01*	0.2±0.01*	0.02±0.00*

*- The mean value differences are significant at 5% level of ANOVA (SNK)

Conductivity

The significant increase in conductivity is an indicator that the discharged pollutants have entered the water. Higher conductivity results from the presence of various ions including nitrate, phosphate and sodium. The electrical conductivity of the river Giri at site-2 (Kargaroo) was found maximum during the July to December 2012 i.e. 290 mhos and value was minimum at site-1 (Katal) i.e. 285 mhos (Table 1). The fluctuation in electrical conductance may be due to the increased consumption of inorganic fertilizers and the accumulation of pollutants in the water.

pH

The pH is the measure of hydrogen ion (H^+) concentration in the water. The pH scale ranges from 0-14 with a pH of 7 being neutral. A pH below 7 is acidic and a pH of above 7 is alkaline or basic. pH value was observed to be a maximum of 9.1 at site No. 2 (Karganoo) and minimum of 8.2 at site No.1(Katal) which are at par with each other. The increase in pH may be due to the pesticides and fertilizers used in the fields by farmers to increase the productivity and to protect their crops from the attack of insects and pests.

Dissolved Oxygen

Levels of dissolved oxygen vary depending on factors including water, temperature, and time of day, season, depth, altitude and rate of flow. Water at higher temperatures and altitudes will have less dissolved oxygen. Dissolved oxygen reaches its peak during the day. Dissolved oxygen was measured in mg/l. In the present study the maximum value of dissolved oxygen was observed to be 20 mg/l at site No.1 (Katal) and minimum 19.8 mg/l at site No.2 (Karganoo) in the month of July. This concentration of dissolved oxygen may affect the aquatic organisms at large. The dissolved oxygen may decrease with increase in altitudes, salinity and turbidity.

Chemical Oxygen Demand (COD)

Chemical oxygen demand is one of the important factors in the water quality parameter. It is the oxygen required by the organic substances to oxidize them by a strong chemical oxidant. Oxygen enters the water primarily through direct diffusion at the air water interface and through plant photosynthesis. Direct diffusion is relatively insignificant unless there is considerable wind and wave action. In the present study the value of chemical oxygen demand was maximum in July to December 2012 at site No. 2 (Karganoo) i.e. 120 mg/l while the lowest value was found at site No.3(Maryog) i.e. 109 mg/l.

Biological Oxygen Demand (BOD)

Consumption of oxygen by the fishes is biological oxygen demand. Fish consume less oxygen at colder temperatures, greatly reducing overall oxygen demand. The BOD value was maximum in the month of July to December 2012 that was 63 mg/l at site No.3 (Maryog) and the lowest value was recorded at site No.1 (Katal) i.e; 59 mg/l.

Sulphates

Sulphates are the naturally occurring anions in natural water. In arid and semiarid regions it is found in higher concentration due to the accumulation of soluble salts in soil and shallow aquifers. In the present study the sulphate anion was maximum in the water sample taken from site No1 (Katal) i.e. 11 mg/l and minimum value of sulphate anion was 10.6 mg/l at site No 2 (Karganoo).

Chlorides

Chloride is one of the constituents of natural water occurring abundant in nature. Chloride level showed a drastic variation in different samples. The chloride level was very much reduced in the month of July of December 2012. The recorded level was maximum i.e., 160 mg/l at site No1 (Katal) and minimum at site No-3 (Maryog) i.e., 116.7mg/l which were much varying.

Florides

The floride level during the period was recorded to be maximum at 2.1mg/l at site No.3 (Maryog) and 2.0mg/l at other two sites (Katal and Karganoo).

Magnesium

The magnesium level was recorded as the highest value in this period of July to December 2012 i.e. 12.4 mg/l at site No 2 (Karganoo). The lowest value of magnesium recorded was 11.6 mg/l at site No.3 (Maryog).

Total Hardness

The hardness level is equal to the combined carbonate and bicarbonate alkalinity. It is referred to as carbonate hardness. Hardness values greater than the sum of carbonates and bicarbonates alkalinity is referred to as carbonate hardness. Hardness values greater than the sum of the carbonate and bicarbonate alkalinity are referred to as non carbonated hardness. In the present study the maximum value was observed in the period i.e., 302 mg/l at site No.1 (Katal). The minimum value was observed at site No.2 (Karganoo) i.e. 295 mg/l.

Nitrate

Natural levels of nitrate are usually less than 1 mg/l. In the present study the maximum value of nitrate was measured in the period as 10.2 mg/l at site No.1 (Katal). The minimum value of nitrate recorded was 9.9 mg/l at site No.3 (Maryog).

Nitrite

Water with low dissolved oxygen may slow the rate at which ammonium is converted to nitrite and finally nitrate. Nitrite and ammonium are far more toxic than nitrate to aquatic life. The maximum value of nitrite was observed at site No.2 (Kangaroo) i.e., 8mg/l during the period. The minimum value was recorded at site No.3 (Maryog) i.e., 7.5 mg/l.

Iron

Iron is one of the most abundant elements of the rocks and soil ranking forth by weight. Normally iron will precipitate out of solution upon exposure to adequate concentration of oxygen at a pH greater than 7.0. In the present study the iron content was highest in the period i.e., 0.06 mg/l at site No.2 (Karganoo) and the lowest at site No.3 (Maryog) i.e., 0.04mg/l.

Ammonia

Two forms of ammonia are ionized and unionized. The unionized form of ammonia (NH_3) is extremely toxic while the ionized form (NH_4^+) is not. Both forms are grouped together as total ammonia. The maximum value of ammonia observed during the period was 2.5 mg/l at site No.2 (Kangaroo) and minimum at site No.3 (Maryog) i.e., 2.1 mg/l.

Phosphate

Phosphate induced algal blooms may initially increase dissolved oxygen via photosynthesis, but after these blooms die, more oxygen is consumed by bacteria aiding their decomposition. Larger streams may react to phosphate only at level approaching 0.1 mg/l while small streams may react to levels of phosphate at 0.01 mg/l or less. In the present study the maximum value observed during period was 0.2mg/l at site No.2 (Kangaroo) and minimum at site No.3 (Maryog) i.e., 0.02 mg/l. Many of the more than 1000 pesticides currently used in most of the countries of the world inadvertently reach the aquatic ecosystems. There are several possibilities for pesticide penetration into water, substrates and aquatic biota. Pesticides enter into the aquatic ecosystem through surface runoff of pesticides used in agriculture and forestry, undoubtedly the most significant one.

Conclusion

The results of the present investigation reveal the physico-chemical characteristics and the quality of water in chosen points in River Giri, Himachal Pradesh, India. The various study zones in different monsoon seasons showed seasonal fluctuation and the effect of pesticide load in the vicinity of the river caused due to agricultural activities also exhibited a drastic change in the above parameters. The study indicates that the river is rich in nutrients and simultaneously polluted as well. Therefore proper treatment and management is being required to check and rectify the entry of drains into river Giri.

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