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Liability for Groundwater Contamination from Pesticides in the Godavari Plain of Parbhani district

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Abstract

Some ground water samples in Parbhani district have had a designated Maximum Contaminant Limit (MCL) of pesticides in drinking water set by the U.S. Environmental Protection Agency (EPA). Residues of several pesticides were monitored in the ground water from Godavari river basin in Parbhani district for one year (2010-11). Most of the samples were found to be contaminated with residues of Hexachlorobenzene (HCB) and Dichloro-diphenyl-trichloroethane (DDT). Aldrin, endosulfan and heptachlor were also detected in some samples. Pesticides are indispensable in modern agriculture, but their use and/or misuse may lead to serious water quality problems-- problems that could impair the use of water for crop and animal production or even human consumption. The impact of agricultural chemicals on groundwater quality has become an issue of national importance.

Key Words: Groundwater, Godavari Plain of Parbhani, Pesticides analysis

Introduction

Pesticide contamination of ground water is a subject of national importance because ground water is used for drinking water by about 50 percent of the Parbhani people. This especially concerns people living in the agricultural areas where pesticides are most often used, as about 95 percent of that population relies upon ground water for drinking water. Our ancestors believe that soil acted as a protective filter that stopped pesticides from reaching ground water. Studies have now shown that this is not the case. Pesticides can reach water-bearing aquifers below ground from applications onto crop fields, seepage of contaminated surface water, accidental spills and leaks, improper disposal, and even through injection waste material into wells.

Pesticides are mostly modern chemicals. There are many hundreds of these compounds, and extensive tests and studies of their effect on humans have not been completed. That leads us to ask just how concerned we should be about their presence in our drinking water. Certainly it would be wise to treat pesticides as potentially dangerous and, thus, to handle them with care. We can say they pose a potential danger if they are consumed in large quantities, but, as any experienced scientist knows, you cannot draw factual conclusions unless scientific tests have been done. Some pesticides have had a designated Maximum Contaminant Limit (MCL) in drinking water set by the U.S. Environmental Protection Agency (EPA), but many have not. Also, the effect of combining more than one pesticide in drinking water might be different than the effects of each individual pesticide alone.

There is a common misconception among people that groundwater is generally safe for human consumption. However, it is not correct to presume that ground water is generally safe owing to qualitative changes in ground water, especially in the high-density residential areas where sewage and industrial disposal practices are not proper. Certain pesticides are found to disturb the enzymatic activities of the body which leads to different types of diseases [1]. A list of most commonly used pesticides with acceptable daily intake [2] is given in Table1 [3]. The various diseases/adverse effects produced due to some commonly used pesticides are listed in Table-2[3].

Table 1 Some most commonly used pesticides with their acceptable daily intake concentrations

Pesticide	Maximum acceptable values (µg/l)	Pesticide	Maximum acceptable values (µg/l)
Alachlor	20.00	DDT	2.00
Aldrin/Dieldrin	0.03	HCB	1.00
Carbofuran	5.00	Heptachlor	0.03
Chlordane	0.20	Methoxychlor	20.00

Table.2 Most Commonly used pesticides and their health hazards

Pesticides	Diseases/adverse effects
Aldrin	Attacks the nervous system, convulsion, repeated dosage damages the liver, carcinogenic
BHC	Liver tumour
Captan	Abnormality in the eyes and brain, carcinogenic
Chlordane	Carcinogenic
DDT	Liver damage, carcinogenic, destroys enzymatic activities
Endosulfan	Carcinogenic
HCH	Highly toxic, bone marrow damage, mutagenic, teratogenic, carcinogenic
Heptachlor	Liver damage, carcinogenic
Malathion	Low toxic but sometimes carcinogenic
Methoxychlor	Low toxic but sometimes carcinogenic
Mirex	Carcinogenic

Study area

Parbhani district covers an area of about 6250.58 km^2. The district is divided into 9 administrative Sub-units (Tahsils)- Parbhani, Gangakhed, Sonpeth, Pathri, Manwath, Palam, Selu, Jintur, and Purna. Godavari is the only main river in the district. Dudhana and Purna are other sub-rivers of Godavari. The length of the river is 79 km in the district and flows from west to east through Pathri, Gangakhed and Palam talukas and enters in to Nanded district. A sub river of Godavari, Dudhana flows in Selu, Jintur, Parbhani and Purna talukas and enters to Hingoli district. A Yeldari dam is constructed on Purna River at Jintur taluka of the district.

The leachability of the pesticides in groundwater is controlled by the nature of the soil and the pesticides themselves [4]. The pattern of pesticide use, their degradation products, soil texture and the total organic matter in the soil are important factors for this process. Fine texture soils, in general, inhibit pesticide leaching because of either low vertical permeability or high surface area which enhances adsorption of pesticides. The high organic matter content in the soil dissolves the pesticides and checks their transportation into the soil. pH and the temperature of the soil are also important factors for the leachability of pesticides [5,6,7,8]. However, the mass flow of water through the soil profile is also an important factor for the leaching of pesticides in groundwater.

Parbhani District Map

Material and Method

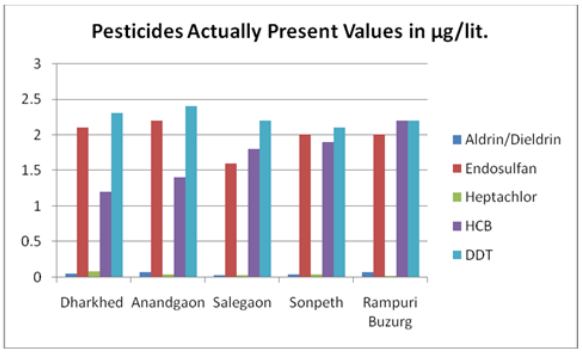
Water samples were collected from Bore Well and Hand Pump (23 Bore Wells and 12 Hand pump) from pre monsoon and post monsoon. Water sample were taken directly from Bore well, Hand pump and filled into 500 ml polyethylene bottles, which were previously acid-washed and rinsed with portions of distilled water and water sample, fitted with tight lids. These samples were analyzed for the presence of organochlorine insecticide residues. Five pesticides were initially selected due to the frequency of their occurrence: Aldrin, endosulfan and heptachlor, Hexachlorobenzene (HCB) and Dichloro-diphenyl-trichloroethane (DDT). According to the EPA they all have been detected in many states, and have the potential to reach levels which exceed health based standards. They are all associated with serious health effects including cancer.

Results and discussion

Agricultural use of pesticides should be part of an integrated pest management (IPM) strategy that includes biological and cultural control, pest monitoring, crop rotation, and other applicable practices. When a pesticide is needed, its selection should be based on site characteristics and the pesticide's effectiveness, toxicity to non-target species, costs, half-life, etc. Presence of endosulfan isomers (α and β), endosulfan sulfate, heptachlor and its metabolites, α-chlordane, γ-chlordane and methoxychlor and predominance of p,p' -DDT among ΣDDT reflects that the quality of ground water in the area has deteriorated to a dangerous proportion making it unfit for drinking and irrigation purposes. The concentrations of Aldrin, Heptachlor, Endosulfan, HCB and DDT in all the samples were above the permissible limits prescribed by the European Commission Directive for drinking

purposes. Pesticides Actually Present Values in the following places in the Godavari River plain near Parbhani recorded highest concentration of them are as follows.

Pesticide	Dharkhed (µg/l)	Anandgaon (µg/l)	Salegaon (µg/l)	Sonpeth (µg/l)	Rampuri Buzurg (µg/l)
Aldrin/Dieldrin	0.05	0.07	0.03	0.04	0.07
Endosulfan	2.10	2.20	1.60	2.00	2.00
Heptachlor	0.09	0.04	0.03	0.04	0.02
HCB	1.20	1.40	1.80	1.90	2.20
DDT	2.30	2.40	2.20	2.10	2.20



Recommendations

Government should implement a public information and education program that emphasizes the importance of proper use (and disposal) of fertilizers and pesticides including the use of non-toxic alternatives whenever possible. The program should be directed to individuals, farmers, appropriate businesses, and government entities. Government should support Ecology's recommendations to enhance fertilizer and pesticide research, education, and technical assistance. The villages should have a program for household fertilizer and pesticide hazardous waste disposal. It is strongly recommended that the government proceed with a full scale program that will establish a series of advisories and controls on the application of pesticide and fertilizers. The district should evaluate the possible impact on water resources of chemical applications of fertilizers and pesticides in wellhead protection areas.

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