

Assessment of Fertilizer Use Impact on Soil and Water Pollution in Haryana

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Abstract

A systematic survey was done to collect soil, plant, pond and tubewell water samples from Karnal, Panipat and Kurukshetra districts of Haryana under paddy-wheat cropping system. The quality analysis of ponds and tubewell waters indicated that all the pond waters had one or the other characteristics above permissible limits. The heavy metal concentration of tubewell waters varies from 0.03 to 0.15 mg/liter Cd, Tr to 0.46 mg/liter Pb ; Tr to 0.4 mg/liter Ni 0.15 to 0.29 mg/liter and Co from 0.34 to 0.39 mg/liter whereas in pond waters it ranges from 0.01 to 0.16, Tr to 0.44, 0.27 to 0.29 and 0.15 to 0.41 mg/liter of Cd, Pb, Ni and Co, respectively. Mostly the accumulation of heavy metals in soils confined to surface layer. Crops under study area were found to accumulate toxic in order of oilseeds > oilseeds > cereals > fodder but the concentration was found within the permissible limits.

Key words : Tubewell water, Pond water sample, Soil and Water samples, Toxic metals contents.

There is an increasing concern about occurrence of toxic elements with fertilization in the soil environment in concentrations which can be harmful for both, animal and human beings. No doubt, there is yield propelling effect of fertilizers, but at the same time some claims of dire consequences with fertilizer use particularly nitrogenous and phosphatic fertilizers. Phosphatic fertilizers contained various amounts of toxic metals such as Cd, Co, Cr, Hg, Mo, Ni and Pb. So their continuous and excessive use may have potentially harmful effect on soil-water quality, crop yield and ultimately to human health. There are districts in Haryana where farmers are continuously using higher doses of both nitrogenous and phosphatic fertilizers. Therefore, it was considered worthwhile to investigate the levels of heavy metals in soil, plants and waters under intensively cultivated areas of Haryana state.

Methods

To study the impact of fertilizer application on soil and water pollution, three districts of Haryana state namely, Karnal, Panipat and Kurukshetra having fertilizer consumption were selected. From each district two progressive villages were selected. A total number of 24 tubewell water, six pond water and

30 soil samples from (0—30, 30—60, 60—90, 90—120 and 120—150 cm) depth along with plant samples from the same fields were collected. The soil and water samples were analyzed for their physico-chemical characteristics and heavy metals concentrations by using standard methods.

The plant samples so collected were washed sequentially with tap water, acidulated water (0.01 N HCl), distilled water and deionized water. They were air-dried followed by oven drying at 60—65 C to a constant weight (Kenworthy 1964). The samples were ground in stainless steel grinder to pass through 40-mesh sieve and digested in diacid mixture of HNO₃ and HClO₄ (3 : 1). The micronutrients and heavy metal contents in the extract were estimated on atomic absorption spectrophotometer.

Results and Discussion

Physico-Chemical Characteristics

Soils of the study areas are in general neutral to slightly alkaline in reaction, low in organic carbon content, somewhat calcareous and sandy loam to loam in texture (Table 1). The physico-chemical characteristics of analyzed water sample are presented in Table 2. There was considerable variation in the character-

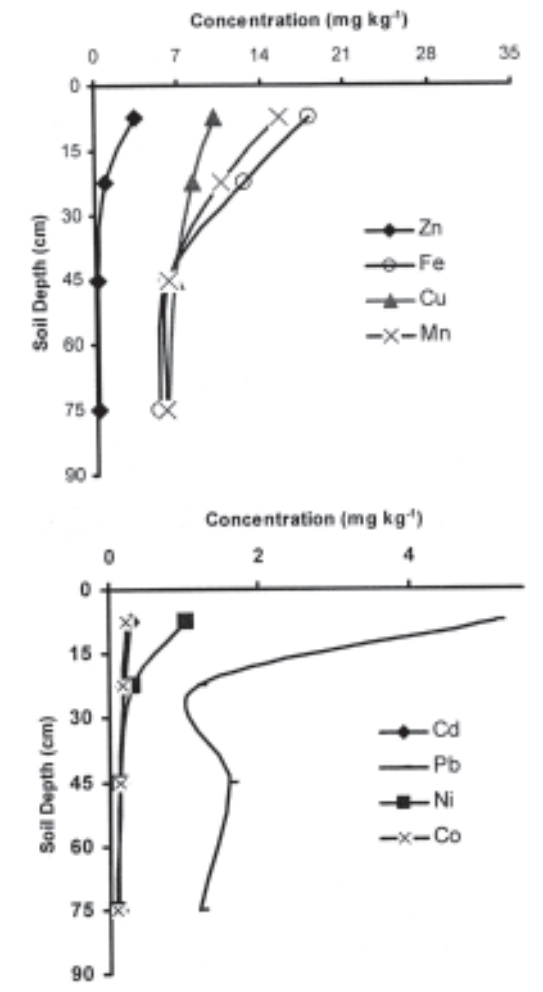


Figure 1. Depthwise distribution of micronutrients and heavy metals in soils.

Table 1. Physico-chemical characteristics of the soils of study area.

Location	Depth (cm)	pH (1:2)	EC (dS/m)	Organic carbon (%)	CaCO ₃ (%)	Texture
Karnal	0—30	7.94	0.22	0.39	Nil	SL-L
	30—60	7.94	0.18	0.29	Nil	SL-L
	60—90	7.86	0.17	0.24	Nil	SL-L
	90—120	7.80	0.22	0.20	Nil	SL-L
Panipat	120—150	7.91	0.17	0.18	0.50	SL-L
	0—30	8.38	0.29	0.38	0.66	SL-L
	30—60	8.43	0.39	0.26	0.60	SL-L
	60—90	8.40	0.43	0.26	3.28	SL-L
Kuru-kshetra	90—120	8.35	0.46	0.18	4.71	SL-L
	120—150	8.42	0.42	0.15	4.55	SL-L
	0—30	8.12	0.36	0.46	2.85	L
	30—60	8.18	0.33	0.30	1.07	L
	60—90	8.20	0.31	0.24	1.27	L
	90—120	8.27	0.30	0.28	1.55	L
	120—150	8.23	0.25	0.33	1.90	L

istics of tubewell and pond water. The pH value of tubewell water lies between 8.69 to 9.07 and that of pond water it varied from 8.90 to 9.21. Similarly the EC ranged from 0.90 to 1.13 dS/m and 1.84 to 3.07 dS/m in tubewell and pond waters, respectively thereby showing a wide variation within the study zone.

The constituents of alkalinity and salinity were found to be maximum in pond water. The chloride stretched from 0.9 to 1.2 meq/liter and 3.4 to 9.7 meq/liter in tubewell and pond water, respectively. The chloride in the groundwater may be contributed from mineral like appetite, mica, hornblende and also from liquid inclusion in the igneous rock (Das and Malik 1988). The chemical analysis of the tubewell and

Table 2. Characteristics of tubewell and ponds waters.

Location	pH (1 : 2)	EC (dS/m)	CO ₃	HCO ₃	Na (meq/liter)	Cl	Ca	Mg	SO ₄
Tubewell Water									
Karnal	8.69	0.91	0.9	6.6	8.3	3.4	1.0	3.4	2.9
Panipat	9.05	1.13	1.4	7.2	8.1	6.0	0.9	2.3	5.6
Kurukshetra	9.07	0.90	Nil	7.8	7.1	9.7	1.7	2.8	1.6
Pond Water									
Karnal	9.21	1.84	2.7	12.4	1.6	3.4	2.3	2.5	3.1
Panipat	8.90	2.15	1.7	8.0	4.4	6.0	2.1	4.8	7.3
Kurukshetra	8.82	3.07	Nil	19.5	12.3	9.7	3.5	3.8	3.8

Table 3. Heavy metal concentration (mg/liter) of tubewell and ponds waters.

Location	Zn	Cu	Fe	Mn	Cd	Pb	Ni	Cr	Co
Tubewell Water									
Karnal	0.06	0.01	0.75	0.09	0.13	0.31	0.26	Nil	0.39
Panipat	0.32	Tr	0.18	0.07	0.15	0.46	0.29	Nil	0.34
Kurukshetra	0.01	Tr	0.01	Tr	0.03	Tr	0.15	Nil	0.08
Pond Water									
Karnal	0.05	0.01	0.17	0.04	0.12	0.44	0.29	Nil	0.41
Panipat	0.05	0.01	1.35	0.06	0.16	0.43	0.29	Nil	0.40
Kurukshetra	0.02	Tr	0.17	Tr	0.01	Tr	0.27	Nil	0.15

pond water samples showed that the sulfate contents in the area ranged from 1.6 to 5.6 meq/liter and 3.1 to 7.3 meq/liter respectively. Which is within the WHO permissible limit of sulfate content (<200 ppm) for domestic purposes.

Heavy Metals and Water Pollution

Pollution of ground water by fertilizer application mostly caused by leaching. The magnitude of loss depends upon soil conditions, agricultural practices, agro-climatic conditions, types of fertilizers used and its method of application. Table 3 shows that the overall concentration of heavy metals in tubewell water ranged from 0.1 to 0.32, 0.01 to 0.75, Tr to 0.09, 0.03 to 0.15, Tr to 0.46, 0.15 to 0.29 and 0.08 to 0.39 mg/liter for Zn, Fe, Mn, Cd, Pb, Ni and Co, respectively. In pond waters it varied from 0.02 to 0.05 meq/liter for Zn, Tr to 0.01 meq/liter, Cu, 0.17 to 1.35 mg/liter. Fe, Tr to 0.06 mg/liter Mn, 0.01 to 0.16 mg/liter Cd, Tr to 0.44 mg/liter Pb, 0.27 to 0.29 mg/liter Ni and only 0.15 to 0.41 mg/liter Co, respectively. The concentration of Cr was not found in detectable amount in either of the water sample. The low levels of heavy metals and micronutrients in ground water may be due to their geo-chemical control system in the soils.

Soil Micronutrients and Heavy Metal Status

The data on depthwise distribution of available micronutrient and heavy metals are shown in Figure 1. All the micronutrients and heavy metals were

confined with in 0—15 cm and 15—30 cm soil depth and decreased thereafter with increase in soil depth. The increase in available micronutrients and toxic metals up to 30 cm soil depth is attributed to their movement along with finer fractions from surface to sub-surface (0—30 cm) layer during the process of eluviation. Therefore, a balance has to be made between excessive fertilizer use and inadequate replenishment of nutrients removed by successive harvests.

Heavy Metals Contents of Field Crops

Crops, commonly grown in the tubewell/canal irrigated areas in these districts are cereals (wheat), oilseed (raya) and fodder (oat and berseem). Among the heavy metal contents present in consumable part, the concentration of Pb and Ni were found to be comparatively high (Table 4). The concentration of Cr in fodder crops was found in traces and only low amount was detected in cereals and oilseed crops in the study area. These findings indicated

Table 4. Heavy metal concentrations (mg/kg) in crops.

Location	Crops	Pb	Ni	Cr
Karnal	Cereals	32.5	58.7	0.25
	Oilseeds	33.7	61.4	0.45
	Fodder	24.9	59.1	ND
Panipat	Cereals	33.9	58.2	0.50
	Oilseeds	37.5	63.2	1.20
	Fodder	35.9	56.7	ND
Kurukshetra	Cereals	36.8	57.3	0.20
	Oilseeds	36.3	61.3	0.12
	Fodder	30.2	59.4	ND

that the heavy metal concentrations under intensively cultivated and heavily fertilized areas are still low in quantity based on their permissible limits.

The results of this study therefore indicated that the long term and indiscriminate application of higher doses of fertilizers, particularly DAP which contains heavy metals may cause accumulation of heavy metals in surface and sub-surface soils Gupta et al. (1990) and the build up of heavy metals in soil profile may prove harmful not only to plants but also to consumers of the harvested crop.

Hence, in the best of our knowledge, not even a single case of metal toxicity in agricultural land either

due to application of fertilizers or soil amendments has been reported in the state so far.

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