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EVALUATION OF WATER QUALITY OF UPPER WARSAK GRAVITY CANAL FOR IRRIGATION WITH RESPECT TO HEAVY METALS

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ABSTRACT

The present research study was designed to analyze the impact of irrigation water of upper Warsak gravity canal on soil and plants. The water samples were collected and analyzed for pH, EC and heavy metals Zn, Cu, Fe, Cd, Ni, Pb and Cr. The pH of irrigation water ranged from 7.91 to 8.00 with an average value of 8.07. The electrical conductivity of irrigation water ranged from 0.24 to 0.27 dSm^{-1} with an average value of 0.25 dSm^{-1}. Heavy metals Zn, Cu, Fe, Cd, Ni, Pb and Cr content of irrigation water ranged from 0.11 – 0.15, 0.58 – 1.81, 0.32 – 3.15, 0.003 – 0.287, 0.01 – 2.27, 0.05 – 1.114 and 0.0080 – 0.27 mg L^{-1}, respectively. Water of upper Warsak gravity canal was slightly high in pH, but not as high to induce any problem in soil for plant growth. The EC of all the water samples was within the permissible limits and was suitable for irrigation. The heavy metal concentration of Zn and Cr were found below toxic range, while Fe, Pb, Cu, Cd and Ni were found in excessive quantities at some locations. Therefore, this source of water cannot be used for irrigating crops directly consumed by human beings. Soil irrigated with this water was also studied for pH, EC and heavy metals. The pH and EC of the soil samples ranged from 7.88 – 9.01, and 0.10 – 0.73 dSm^{-1}, respectively, with an average value of 8.37 and 0.170dSm^{-1}, respectively. AB-DTPA extractable Zn, Cu, Fe, Cd, Ni, Pb, and Cr ranged from 0.804 – 1.54, 1.360 – 4.742, 3.396 – 21.960, 0.004 – 0.572, 0.22 – 3.66, 0.04 – 6.02 and 0.06 – 1.42 mg kg^{-1}, respectively. Zinc, Ni, Pb and Cr were found below toxic level, while Cu, Fe and Cd were in excessive quantities. Plants grown on these soils were also studied for heavy metals Zn, Cu, Fe, Cd, Ni, Pb and Cr, and it was noted that with the exception of Zn, Ni and Cr rest of the metals were found in excessive quantities. It was concluded that the water of upper Warsak gravity canal is polluted with heavy metals and those crops, which are utilized directly by human beings such as reddish, carrot, cucumber and salad etc. should be avoided to irrigate with such water at some points.

Keywords: water quality, gravity channel, heavy metal, toxic element, irrigation.

INTRODUCTION

The problem of pollution which is undesirable change in the physical, chemical and biological characteristics of air, water and soil which affects human life, lives of related other useful living things like animals and plants is attracting the attention of people around the world. Even increasing urbanization and industrialization has generated an increase in the municipal water (Sewage water + Industrial effluents), which in turn has intensified the environmental pollution. The disposal of sewage effluents and municipal water is a major problem for big cities. The land application of appropriately treated materials, however, has frequently bean demonstrated to be a safe and effective means for the recovery of beneficial waste constituents. (Plant nutrients) while also improving the soil physical and chemical properties.

The use of polluted water in the immediate surroundings of the big cities for the growing of vegetables is a common practice in our country. Although the this water is considered to be a rich source of organic material and plants nutrients, yet it also contains sufficient amounts of soluble salts and heavy metals like iron, manganese, copper, zinc, lead etc. When this water is used for the growing of crops for a long period, these heavy metals may accumulate in soil and that may be toxic to the plants and also cause deterioration of soil (Kirkhan, 1983).

The rate of uptake of such toxic metals by plants is governed by their concentration in the soil solution. So the crops grown on such soils may accumulate heavy metals in excessive amounts in various food parts, (Chaney, 1973) which ultimately may result in a clinical problem in animals and human beings throughout the world.

Water pollution, contamination of streams, canals and lakes by substances harmful to the living things is common when these supplies pass on through cities or populated area. Plants and animals require water that is moderately pure, and they cannot survive if their water is loaded with toxic chemicals or harmful microorganisms. Severe water pollution can kill large numbers of fish and other animals and also degrade crop quality. Pollution makes streams canals and lakes waters unpleasant to look at, to smell, and to swim in. People who ingest polluted water can become ill, and, with prolonged exposure, may develop cancers or bear children with birth defects "water pollution, (Online Encyclopedia, 2001).

In recent years sewage farming through land disposal is emerging as a possible solution for the prevention of aquatic pollution. But before avocation for land disposal of effluent, their effect on soil system should receive utmost attention. Any adverse impact of the effluent on soil characteristics may lead to ultimate loss of soil fertility. Keeping in mind the above points

this study has been designed to evaluate the water quality of Upper Warsak Gravity canal in terms of its heavy metal content and its effect on the soil and plants irrigated with this water.

MATERIALS AND METHODS

Sampling:

Twenty-six water samples were collected from the Upper Warsak Gravity canal at a distance of one kilometer, starting from Aziz Abad to Siphon. Similarly the soil and plants samples, irrigated and grown with the same water, were sampled (twenty-six each). The soil and plant samples were prepared for analysis using standard methods. The soil and water sample were analysed for pH, EC and heavy metals i.e. Zn, Cu, Fe, Cd, Ni, Pb and Cr (Richard. 1954, Walsh 1971,and Halvin and Soltanpour 1981). The plant samples were also analysed for heavy metals using Wet- digestion method of ashing.

RESULTS AND DISCUSSION

Seventy-eight water, soil and plant samples (twenty-six each) were included in the present research study. The samples were analyzed for pH, electrical conductivity (EC) and heavy metals i.e. Cu, Pb, Zn, Fe, Cd, Ni and Cr to study the irrigation water quality with respect to heavy metals and their impact on plants and soil. The locations and chemical characteristics of irrigation water are given in Tables 1 and 2.

Table-1. Location, pH and EC of irrigation water and Soil samples.

		Water samples		Soil samples	
Sample No	**Location**	**pH**	**EC** d Sm^{-1}	**pH**	**EC** d Sm^{-1}
1	Azizabad	8. 04	0. 24*	8. 15	0. 14
2	Mian morcha	8. 11	0. 24	8. 34	0. 11
3	Badraga	7. 91*	0. 24	8. 28	0. 12
4	Ikramullah khan Kally	8. 11	0. 25	8. 41	0. 11
5	Sheikh Abad	8. 17	0. 25	8. 48	0. 13
6	Nasir Bagh	8. 16	0. 26	8. 49	0. 13
7	Taj Abad	7. 95	0. 25	8. 57	0. 13
8	Pak. Rural Academy	8. 18	0. 25	8. 27	0. 14
9	Pawaka	8. 04	0. 25	8. 40	0. 14
10	Abdara (Air port)	8. 12	0. 25	8. 39	0. 16
11	Sikandar khan Garhi	8. 09	0. 27*	8. 40	0. 14
12	Kaga Wala	7. 93	0. 26	8. 35	0. 12
13	Bada Ber	8. 11	0. 26	8. 42	0. 16
14	Dehli Der –1	8. 03	0. 25	8. 32	0. 14
15	Dehli Der –11	8. 08	0. 26	8. 12	0. 41
16	Shagi Camp	8. 10	0. 25	7. 88*	0. 73*
17	Miskeen Camp	8. 07	0. 25	8. 48	0. 12
18	Surizai Mera	7. 98	0. 25	8. 54	0. 22
19	Mati Bachay	8. 20*	0. 26	8. 37	0. 13
20	Scap	8. 10	0. 25	8. 31	0. 13
21	Mian Sami-u-Ddin Garhi	8. 00	0. 25	8. 34	0. 11
22	Baghwanan-1	8. 16	0. 26	8. 42	0. 13
23	Baghwanan-11	8. 11	0. 25	8. 37	0. 11
24	Kaskai	8. 04	0. 25	8. 26	0. 14
25	Afsar khan Garhi	8. 19	0. 25	8. 30	0. 1 0*
26	Siphon	7. 98	0. 26	9. 01*	0.19

	Water samples		Soil samples	
Parameters	**Range**	**Average**	**Range**	**Average**
pH	7. 91 - 8. 20	8. 07	7. 88 – 9. 01	8. 37
EC (d Sm^{-1})	0. 24 - 0. 27	0. 25	0. 10 – 0. 73	0. 17

Chemical characteristics of irrigation water and soil:

pH:

The pH of the water samples ranged from 7.91 to 8.20 (Table-1) with an average value of 8.07. The pH of all the water samples is within the permissible limits. According to Shainberg and Oster (1985) reported that the pH of irrigation water is not an accepted criterion of water quality because it tends to be buffered by the soil and most crops can tolerate a wide pH range. The pH values of the soil samples varied from 7.88 to 9.01, with an average value of 8.37 (Table-1). The highest pH value was recorded at the Siphon, while the lowest at the Shagi Camp. Table-1 shows that all the soil samples were relatively high and saline in nature, but however, not reached to the extent to create any salinity problem in the soil. However, at the Siphon, Taj Abad and Surezai Mera, the values were above 8.5, especially at the Siphon. Consequently, there is a chance of existing a significant amount of sodium carbonate in the soil. Because, according to Henry (1976), that soil saturated up to 15 % contain a significant amount of sodium carbonate and the pH value may be between 8.5 and 10.

Electrical Conductivity (EC):

The EC of irrigation water ranged from 0.24 to 0.27dSm^{-1}, being higher at Sikandar khan Garhi and lowest at Aziz Abad (Table-1). It is clear that the EC of all the water samples within the permissible limits. The EC values of soil samples varied from 0.10 to 0.73dSm^{-1}, with an average value of 0.170 d Sm^{-1}(Table-1). The highest EC value was recorded in the soil of Shagi Camp; while the lowest value was observed in the soil of Afsar Khan Garhi.The EC of all the soil samples were non-saline and will not contribute any harmful effect to agricultural land and crop.

Heavy metal concentrations of water samples:

Heavy metals were investigated in all samples of water, collected from the Upper Warsak Gravity canal (Table-2). The concentration of Zn ranges from 0.01 to 0.15 mg L^{-1}, Cu 0.58 to 1.81mg L^{-1} , Fe 0.32 to 3.15 mg L^{-1} , Cd 0.003 to 0.28 mg L^{-1}, Ni 0.01 to 2.27 mg L^{-1}, Pb 0.05 to 1.14 mg L^{-1} and Cr 0.008 to 0.27 mg L^{-1} (Table-3). Highest Zn concentration was observed at the Kaskai, while lowest concentration was in Pawaka. The highest concentration of Cu was found in Miskeen Camp. Similarly, highest Fe concentration was found in the water of Kaga Wala, Cd in Afsar khan Garhi, Ni in Mati Bachay, Pb in the water of Taj Abad and Cr in Nasir Bagh. From the results, it is clear that Zn and Cr were within the permissible limits for irrigation, while Cu, Fe, Cd, Pb and Ni were found beyond the permissible limits of the NEQs standards.

Table-2. Location and Zn, Cu, Fe, Cd, Ni, Pb Cr (mg L^{-1}) of irrigation water.

S.No	Location	Zn	Cu	Fe	Cd	Ni	Pb	Cr
		----------mg L^{-1}----------						
1	Aziz Abad	0.12	0.74	0.32*	0.03	0.17	0.05*	0.008*
2	Mian Morcha	0.10	0.70	1.14	0.17	0.01*	0.46	0.13
3	Badraga	0.08	1.51	1.16	0.05	1.33	0.06	0.17
4	Ikramullah khan Kallay	0.14	1.45	1.20	0.26	1.15	0.14	0.15
5	Sheikh Abad	0.09	1.54	1.50	0.16	0.66	0.72	0.10
6	Nasir Bagh	0.03	1.53	1.67	0.07	1.90	0.11	0.27*
7	Taj Abad	0.02	0.58*	2.19	0.02	1.11	1.14*	0.05
8	Pak.Rural Academy	0.10	0.82	1.74	0.15	0.84	0.49	0.01
9	Pawaka	0.01*	0.85	2.34	0.02	0.73	0.54	0.01
10	Abdara	0.03	0.70	1.69	0.003*	0.54	0.30	0.02
11	Sikandar khan Garhi	0.02	0.70	2.24	0.007	0.14	0.46	0.17
12	Kaga Wala	0.06	0.72	3.15*	0.02	0.19	0.56	0.10
13	Bada Ber	0.01	0.68	2.20	0.01	0.43	0.24	0.09
14	Dehli Der-1	0.01	0.68	2.47	0.13	0.30	0.47	0.16
15	Dehli Der-11	0.08	1.45	2.24	0.19	0.48	0.54	0.05
16	Shagi camp	0.01	1.39	2.96	0.08	1.68	1.04	0.02
17	Miskeen camp	0.09	1.81*	2.19	0.14	0.52	0.28	0.01
18	Surizai Mera	0.02	1.44	2.10	0.18	1.74	0.78	0.02
19	Mati Bachay	0.08	1.41	2.25	0.04	2.27*	0.73	0.15
20	Scap	0.06	1.50	2.91	0.03	1.19	0.40	0.06
21	Mian Samiuddin Garhi	0.11	1.44	2.29	0.25	0.27	0.63	0.13
22	Baghwanan-1	0.09	1.48	2.18	0.21	0.95	0.30	0.04

23	Baghwanan-11	0.05	1.49	2.12	0.02	0.37	0.50	0.09
24	Kaskai	0.15*	1.42	2.24	0.16	1.17	0.62	0.02
25	Afsar khan Garhi	0.07	1.32	2.06	0.28*	1.06	0.46	0.02
26	Siphon	0.12	1.02	2.09	0.05	0.28	0.26	0.11

Table-3. Ranges and average values of Zn, Cu, Fe, Cd, Ni, Pb and Cr (mg L^{-1}) of irrigation water.

Heavy Metals	**Range** (mg L^{-1})	**Average** (mg L^{-1})	**C.V** %	**No of samples above safe limits**
Zn	0.01 - 0.15	0.07	3.26	- (0% toxic)
Cu	0.58 - 1.81	1.17	32.20	16 (61.54%toxic)
Fe	0.32 – 3.15	2.02	29.63	18 (69.23%toxic)
Cd	0.003 - 0.28	0.10	77.57	12 (46.16%toxic)
Ni	0.01 – 2.27	0.84	71.86	10 (38.46%toxic)
Pb	0.05 –1.14	0.47	56.44	10 (38.46%toxic)
Cr	0.008 – 0.27	0.08	77.30	- (0% toxic)

AB-DTPA extractable heavy metals:

Heavy metals were investigated in all samples of soil, collected along the canal from farmer's fields from the same points, where the water samples were collected (Table-4). The concentration of Zn ranges from 0.80 to 1.54mg kg^{-1}, Cu 1.36 to 4.74mg kg^{-1}, Fe 3.39 to 21.96mg kg^{-1}, Cd 0.004 to 0.57mg kg^{-1}, Ni 0.22 to 3.66 mg kg^{-1}, Pb 0.04 to 6.02mg kg^{-1} and Cr 0.06 to 1.42mg kg^{-1} (Table-5). Highest Zn concentration was observed in the Kaskai soil. The highest concentration of Cu was found in the soil of Ikram ullah Khan Kallay. Similarly, highest Fe and Cd concentrations were found in the soils of Bada Ber, Ni in the soil of Mati Bachay, Pb in the Surezai Mera soil and Cr in the soil of Afsar Khan Garhi.

From the results, it is clear that all the heavy metals, except Zn and Cr, have exceeded the permissible limits of WHO standards.

Table-4. Location and AB-DTPA extractable concentration of heavy metals (Zn, Cu, Fe, Cd, Ni, Pb and Cr mg kg^{-1}) in soil samples.

S. No	**Location**	**Zn**	**Cu**	**Fe**	**Cd**	**Ni**	**Pb**	**Cr**
		---------- mg kg^{-1} ----------						
1	Aiza Abad	1. 00	2. 24	12. 84	0. 05	3. 36	0. 28	0. 40
2	Mian Murcha	1. 27	2. 68	10. 60	0. 10	0. 40	1. 40	0. 98
3	Badraga	0. 97	2. 37	10. 28	0. 21	2. 10	1. 14	0. 58
4	Ikramulla khan kallay	1. 16	4. 74*	19. 80	0. 06	0. 30	2. 20	0. 68
5	Sheikh abad	0. 97	2. 24	9. 24	0. 06	0. 40	2. 68	0. 76
6	Nasir Bagh	0. 81	2. 18	3. 39*	0. 09	0. 88	0. 86	0. 36
7	Taj abad	1. 12	1. 79	5. 01	0. 22	0. 56	0. 60	1. 40
8	Pak Rural Academy	0. 89	3. 57	7. 07	0. 03	1. 74	2. 10	0. 50
9	Pawaka	1. 05	4. 15	19. 63	0. 08	1. 50	0. 56	0. 40
10	Abdara	1. 19	1. 36*	6. 7 8	0. 02	0. 94	0. 92	0. 94
11	Sikandar khan Garhi	0. 89	3. 52	8. 47	0. 004*	0. 98	1. 64	1. 02
12	Kaga wala	1. 01	4. 15	10. 72	0. 02	0. 96	0. 96	0. 22
13	Bada Ber	1. 04	3. 26	21. 96*	0. 57*	0. 88	3. 34	0. 16
14	Dehli Der-I	0. 97	3. 64	8. 40	0. 04	0. 66	0. 38	0. 68
15	Dehli Der-II	1. 16	2. 70	6. 83	0. 08	0. 22*	2. 66	0. 92
16	Shagi camp	0. 85	1. 58	9. 77	0. 17	2. 96	0. 56	0. 06*
17	Miskeen camp	0. 82	3. 71	7. 91	0. 01	2. 12	0. 66	0. 58
18	Surizai Mera	0. 96	2. 62	14. 67	0. 24	0. 76	6. 02*	0. 62
19	Mati Bachay	0. 96	2. 39	19. 90	0. 11	3. 66*	1. 54	1. 10
20	Scap	0. 93	3. 31	18. 32	0. 07	1. 02	1. 04	0. 10
21	MianSami-ud-din Garhi	0. 88	2. 63	13. 20	0. 42	0. 90	2. 18	0. 82
22	Baghwanan-I	0. 98	2. 83	16. 54	0. 26	0. 54	1. 56	0. 70
23	Baghwanan-II	1. 07	2. 81	11. 89	0. 04	2. 30	0. 56	0. 86
24	Kaskai	1. 54 *	3. 16	20. 78	0. 01	0. 76	1. 86	0. 48
25	Afsar khan Garhi	0. 83	1. 53	17. 40	0. 34	2. 68	1. 22	1. 42*
26	Siphon	0. 80*	1. 93	14. 70	0. 34	0. 94	0. 04*	0. 92

Table-5. Ranges and average values of AB-DTPA extractable Zn, Cu, Fe, Cd, Ni, Pb, and Cr (mg kg $^{-1}$) of soil samples.

Heavy Metals	Range (mg kg^{-1})	Average (mg kg^{-1})	C.V %	No of samples above safe limits
Zn	0.80-1.54	1.005	18.60	- (0 % toxic)
Cu	1.36-4.74	2.85	30.50	26 (100%toxic)
Fe	3.39-21.96	12.54	41.98	25 (96.15 % toxic)
Cd	0.004-0.57	0.14	100	4 (15.38%toxic)
Ni	0.22-3.66	1.33	78.15	- (0 % toxic)
Pb	0.04-6.02	1.50	81.15	- (0 % toxic)
Cr	0.06-1.42	0.48	49.47	- (0 % toxic)

Heavy Metals Content of Plants By Wet-Digestion:

Heavy metals were determined in all samples of plants, collected along the canal from farmer's fields from the same points, where the water and soil samples were collected (Table-6). The concentration of Zn ranges from 1.80 to 14.60mg kg $^{-1}$, Cu 8.40 to 19.70mg kg $^{-1}$, Fe 143.97 to 349.11mg kg $^{-1}$, Cd 0.10 to 0.24mg kg $^{-1}$, Ni 1.40 to 9.80mg kg $^{-1}$, Pb 2.00 to 48.00mg kg $^{-1}$ and Cr 0.07 to 2.90mg kg^{-1} (Table-7). The highest Zn concentration was observed in sample taken from Ikram ullah Khan Kallay in sugarcane, while the lowest Zn concentration was found in corn from Sikandar Khan Garhi. The highest concentration of Cu was found in sample taken from Bada Ber in corn, while the lowest in Sorghum from Mian Morcha. Similarly, the highest Fe concentration was observed in sample taken from Dehli Der-1 in corn, while the lowest concentration was found in sugarcane from Shagi Camp. Similarly, the highest concentration of Cd was found in sample taken from Mati Bachay in sugarcane, while the lowest in corn from Mian Samiuddin Garhi. The highest concentration of Ni was found in sugarcane from Mati Bachay, while the lowest in sorghum from Kaga Wala. Similarly, the highest concentration of Pb was found in sugarcane from Mati Bachay, while the lowest was also found in sugarcane from Aziz Abad. The highest concentration of Cr was found in sample taken from Pawaka in sorghum, while the lowest in sugarcane from Scap.

From the results, it is clear that Zn, Ni and Cr were in safe limits, while Fe, Pb, Cu and Cd were found beyond the permissible limits of the WHO standards.

Table-6. Location, type of crop and wet digestion concentrations of Zn, Cu, Fe, Cd, Ni, Pb and Cr (mg kg $^{-1}$) in plant samples.

S. #	Location	Type of Crop	Zn	Cu	Fe	Cd	Ni	Pb	Cr
1	Aziz Abad	Sugarcane	8.30	8.70	185.10	0.12	4.7	2.00*	0.23
2	Mian Morcha	Sorghum	10.70	8.40*	173.45	0.19	1.9	9.90	1.23
3	Badraga	Corn	14.40	11.40	246.31	0.12	8.8	13.00	1.44
4	Ikramullah khan Kallay	Sugarcane	14.60*	16.40	289.27	0.16	5.7	33.00	1.61
5	Sheikh Abad	Corn	2.80	12.70	309.13	0.2	3.8	13.00	0.27
6	Nasir Bagh	Corn	1.90	11.70	217.60	0.22	6.9	37.00	0.30
7	Taj Abad	Corn	2.60	11.00	232.15	0.15	6.0	39.00	0.74
8	Pak Rural Academy	Sorghum	2.30	13.10	194.76	0.16	5.2	18.00	0.40
9	Pawaka	Sorghum	8.30	12.90	270.81	0.13	2.9	20.00	2.90*
10	Abdara	Sorghum	9.60	17.40	293.09	0.21	5.4	34.00	2.43
11	Sikandar Khan Garhi	Corn	1.80*	16.30	327.10	0.18	4.8	16.00	0.13
12	Kaga Wala	Sorghum	6.70	17.60	239.82	0.23	1.4*	6.00	0.69
13	Bada Ber	Corn	12.60	19.70*	280.43	0.11	6.8	18.00	0.14
14	Dehli-Der-I	Corn	9.00	18.10	349.11*	0.17	7.6	31.00	0.12
15	Dehli-Der-II	Sorghum	10.80	18.40	267.24	0.14	8.4	26.00	0.10
16	Shagi Camp	Sugarcane	7.70	14.70	143.97*	0.18	3.5	28.00	0.19
17	Miskeen Camp	Sorghum	3.60	18.30	218.08	0.11	8.3	36.00	0.11
18	Surizai-Mera	Sorghum	6.20	19.10	269.87	0.19	9.1	46.00	0.80
19	Mati_Bachay	Sugarcane	9.60	18.50	294.38	0.24*	9.8*	48.00*	0.11
20	Scap	Sugarcane	13.20	18.90	265.03	0.17	6.9	41.00	0.07*

21	Mian S. Din Garhi	Corn	10.60	13.30	307.40	0.10*	6.2	29.00	0.11
22	Baghwanan-I	Corn	6.50	15.60	179.46	0.16	9.6	9.60	0.83
23	Bagwanan-II	Corn	12.00	12.80	274.60	0.15	8.9	25.00	0.43
24	Kaskai	Sugarcane	8.80	16.20	310.81	0.12	8.8	15.00	0.87
25	Afsar Khan Garhi	Sorghum	5.80	14.30	285.19	0.17	6.8	2.80	0.20
26	Siphon	Sugarcane	12.90	17.50	228.97	0.13	2.6	15.00	0.11

Table-7. Ranges and average values of wet digestion heavy metals Zn, Cu, Fe, Cd, Ni, Pb and Cr (mg kg^{-1}) of plant samples.

Heavy Metals	**Range** (mg kg^{-1})	**Average** (mg kg^{-1})	**C.V** %	**No of samples above safe limits**
Zn	1.80 – 14.60	8. 20	47.61	- (0 % toxic)
Cu	8.40 – 19.70	15.16	21.21	24 (92.30% toxic)
Fe	143.97 – 349.11	255. 91	19.86	25 (96.15% toxic)
Cd	0.10 – 0.24	0. 16	23.70	26 (100% toxic)
Ni	1.40 – 9.80	6. 18	39.02	- (0 % toxic)
Pb	2.00 – 48.00	23. 51	55.18	25 (96.15% toxic)
Cr	0.07 – 2.90	0. 64	98.73	4 (15.38% toxic)

CONCLUSION

The following conclusion can be drawn from this research study:

- The Zn, and Cr were within the permissible limits for irrigation while Fe, Pb, Cu, Cd and Ni were found in excess range.
- pH of the irrigation water was slightly alkaline and it may develop salinity problem in the soil in long term use.
- EC of the irrigation water was found normal and suitable for irrigation purposes without any harmful effect on soil and crops.
- pH of the soil samples was found slightly alkaline but not as high to induce any salinity problem in the soil, except at the siphon area.
- EC of all the soil samples was found non-saline and will not contribute any harmful effect to agricultural land.
- Heavy metals like Cu, Fe and Cd were found in excessive amount in most of the soil samples, while in plant samples Fe, Pb, Cu and Cd were found in excessive amounts.
- Zn, Ni, Pb and Cr were found in safe limits in all the soil samples.
- All the plant samples were found in safe limits of Zn, Ni and Cr.

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