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Some Trace Elements Investigation in Ground Water and river water of Karur Town, Tamil Nadu, India

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ABSTRACT

Ten ground water and river water samples were collected in and around Karur Town during summer and rainy seasons and analyzed in order to find out pollution impact. The heavy metal analyses of Cd, Fe, Mn, Cu, Cr, Zn and Pb were performed for the water samples. This study aims at detecting the possibilities of ground water quality deteriorations due to the improper solid waste dumping with special reference to heavy metal pollution. From the data, it is shown that the heavy metals are present exceed the permissible limit. It is a well known fact that the heavy metal ions are potentially toxic to human health and could be quite detrimental for human life. Our study suggests the preventive measures which are to be adopted to control the contamination of excess of heavy metals present in the ground water and river water around this region.

Key words: Groundwater, heavy metal pollution, seasonal variation.

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INTRODUCTION

Heavy metals are grouped within the category of environmental toxins and the investigations of toxic heavy metals such as Fe, Mn, Cu, Zn, Cd, Cr, Ni and Pb place special importance on environmental samples. These heavy metals are much toxic and have a tendency to accumulate in the body and may result in chronic damage. The natural concentration of metals in fresh water varies depending upon the metal concentrations in the soil and the underlying geological structures. There is a very much need to develop trace element analysis technique that allows separation of the different elemental species prior to trace element analysis[1].

Heavy metals are bio-concentrated and bio accumulated in one or several components across food webs. Metal bio accumulation can be of great importance from health point of view, especially for human at the end of the food chain. An important source is the transfer of heavy metals from industrial, agricultural wastes, soil and sediments to man and plants. The distribution of heavy metals in ground water, river water and its sediments can provide an evidence of anthropogenic impact on aquatic ecosystems.

The study is aimed to assess the concentration of trace metals of ground water, river water and sediment samples of the study area. The trace metal such as cadmium, iron, manganese, copper, chromium, zinc and lead are analyzed. The results are tabulated in table 1, 2, 3, 4, 5 and 6. The results are discussed as follows.

RESULTS AND DISCUSSION

Cadmium

The mean values of cadmium are found in the range of 0.04-0.19 ppm and 0.02-0.17 ppm for groundwater samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of cadmium are observed in the range of 0.12-0.17 ppm and 0.11-0.17 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of cadmium are found in the range of 0.11-1.55 ppm and 0.40-1.50 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6).

The values of cadmium exceed the permissible limit of 0.03 ppm in all the groundwater samples in summer and rainy seasons with slight seasonal fluctuations[2]. The maximum value is found at stations 4A, 6A, 7A and 10A for groundwater sample. This may be due to leaching of dumping wastes and anthropogenic activities. When compared to groundwater, the cadmium concentrations are higher in river water samples in summer and rainy seasons.

The values of cadmium exceed the permissible limit of 0.03 ppm in all the river water samples in summer and rainy seasons[2]. High values of cadmium are found at stations S4, S7 and S8 for river water and sediment samples. High values of cadmium may be due to agricultural runoff and textile wastes. Cadmium is considered to be toxic, if its concentration exceeds 0.01 ppm both in drinking and irrigation water[3].

The sediment samples have a maximum cadmium concentration in most of the sampling stations in summer and rainy seasons. The cadmium values exceed the permissible limit of prescribed WHO values. This may come from natural sources, leached from rocks and soils according to their geochemical mobility or come from anthropogenic sources, as a result of human land occupation and industrial operation.

Iron

The mean values of iron are found in the range of 1.23-1.9 ppm and 0.79-1.68 ppm for ground water samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of iron are found in the range of 2.31 – 3.79 ppm and 3.29 – 1.74 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of iron are found in the range of 2.64 – 4.06 ppm and 1.37 – 1.55 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6)

The values of iron are more than the permissible limit of 0.3ppm for all the ground water samples in summer and rainy seasons[2]. The maximum value of iron is found at stations 5C, 8C and 8D in summer. This may be due to the weathering of rocks and also by the discharge of effluent and other wastes to surface that percolated into the groundwater [4].

The value of iron is more than the permissible limit of 0.3 ppmof all the river water samples in summer and rainy seasons[2]. The maximum value of iron is found at the stations S2, S5 and S10 in summer seasons. This may be due to the contribution by addition of agricultural runoff and also by the discharge of industrial effluents.

The values of iron exceed the permissible limit of 0.3 ppm[2] for all the sediment samples in summer and rainy seasons. The maximum value of iron is found at the stations S6, S7 and S8 in summer season. The high level of iron in sediment samples of the study area may be attributed to the discharge of iron laden wastes and effluent replete with corroded iron pipes, containers and scrapes in the water body and litho logical or crustal origin[5].

Manganese

The mean values of manganese are found in the range of 0.30 – 0.57 ppm and 0.21 – 0.42 ppm for groundwater samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of manganese are found in the range of 0.75 – 1.81 ppm and 0.35 – 0.46 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of manganese are found in the range of 0.43 – 1.48 ppm and 0.37 – 0.46 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6)

The values of manganese exceeded the permissible limit of 0.03 ppm[2] for all the ground water samples in summer and rainy seasons. The maximum value of manganese is found at the stations 1A, 1C, 4A and 7C in summer. This may be due to the influence of domestic wastes, natural geological rocks and intrusion of industrial effluents.

The values of manganese are more than the permissible limit of 0.03 ppm[2] of all the river water samples in summer and rainy seasons. The maximum value of manganese is found at stations S5, S6, S7 and S8 in summer.

The values of manganese are more than the permissible limit of 0.03 ppm[2] of all the sediment samples in summer and rainy seasons. The maximum value of manganese is found at stations S3, S5 and S6 in summer. Increase in manganese in the river water samples may be due to the influence of domestic wastes, natural geological rocks and industrial effluents[6].

Copper

The mean values of copper are found in the range of 1.2 – 1.56 ppm and 0.75 – 1.42 ppm for ground water samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of copper are found in the range of 1.34 – 1.51 ppm and 0.17 – 0.86 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of copper are found in the range of 1.38 – 1.51 ppm and1.21 – 1.4 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6)

The values of copper exceed the permissible limit of 0.05 ppm[2] for all the groundwater samples in summer and rainy seasons. The maximum value of copper is found at stations 2B, 5B, 8B, 8C and 9C in summer, which may be due to intrusion, industrial and domestic wastes[4]. Minerals dissolution also lead to enhance the high value of copper.

The values of copper are slightly higher than the permissible limit of 0.05 ppm[2] for all the river water samples in summer and rainy seasons. The maximum value of copper is found at station S2 and S6 in summer. This may be due to landfill operations and addition of agricultural wastes water addition of fertilizers mixed in the river.

The values of copper exceeded the permissible limit of 0.05 ppm[2] for all the sediments water samples in summer and rainy seasons. The maximum value of copper is found at stations S1 and S6 for sediment samples. Copper enters the water system through mineral dissolution and industrial effluents[7]. The high amount of copper also may be due to the presence of silicates of clay. Copper toxicity is related to several health concerns, including stomach cramps, nausea, vomiting, diarrhea, cancer, liver damage and kidney disease.

Chromium

The mean values of chromium are observed in the range of 0.17 – 0.49 ppm and 0.13 – 0.35 ppm for ground water samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of chromium are recorded in the range of 0.21 – 0.49 ppm and 0.21 – 0.27 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of chromium are found in the range of 0.23 – 0.37 ppm and 0.2- 0.24 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6).

The values of chromium exceed the permissible limit of 0.05 ppm[2] for all the groundwater samples in summer and rainy seasons. The maximum value of chromium is found at stations 1A, 1D, 2D and 3B. Leaching of pigments, mordents and dyes from the textile wastes and percolation of river water may contribute to the high concentration of chromium. When compared to rainy season, the high value of chromium is observed in summer and it may be due to the evaporation effect[8].

The values of chromium exceed the permissible limit of 0.05 ppm[2] for all the river water samples in summer and rainy seasons. The maximum value of chromium is found at stations S1, S7, S8 and S9 in summer season. Anthropogenic sources of emission of chromium in the surface water from municipal wastes, paints and pigment wastes, textile wastes, and agricultural runoff let into the river, which may lead to increase the concentration of chromium in river water samples[8]. The same result was supported by[9].

The values of chromium exceed the permissible limit of 0.05 ppm[2] for all the sediment samples in summer and rainy seasons. The maximum value of chromium is found at stations S7, S8 and S9 in summer season. The chromium content in sediment is on gets increase due to pollution from various sources of industrial wastes, agricultural and sewage runoff. The high value of chromium content is a hexavalent form of chromium that causes a wide range of human health effects including mutagenic and carcinogenic risks.

Zinc

The mean values of zinc are found in the range of 7.40 – 9.45 ppm and 7.35 – 9.04 ppm for groundwater samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of zinc are found in the range of 7.44 – 8.99 ppm and 5.5 – 8.24 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of zinc are found in the range of 7.93 – 9.14 ppm and 5.56 – 8.05 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6). Zinc is an essential trace element found in virtually all food and potable water in the form of salts or organic complexes.

The values of zinc are observed within the permissible limit of 5.0 ppm[2] for all the groundwater samples in summer and rainy seasons. The maximum value of zinc is found at stations

1A, 5D, 6B, 7A, 7, 8C and 10B. The high value of zinc is observed in summer. The high value of zinc may be due to intrusion of agricultural inputs, domestic wastes discharges and addition of industrial effluents into the groundwater[10].

The values of zinc exceed the permissible limit of 5.0 ppm[2] for all the river water samples in summer and rainy seasons. The maximum value of zinc is found at stations S1, S4, S5, S6 and S7 are located in the vicinity of agricultural hub and its agricultural runoff might be the probable source of zinc[11].

The values of zinc exceed the permissible limit of 5.0 ppm[2] for all the sediment samples in summer and rainy seasons. The maximum value of zinc is found at stations S1, S3 and S7, which may be due to major sources of zinc, that in clouds industrial emissions, composed materials and agrochemicals [12].

Lead

The mean values of lead are found in the range of 0.50 – 0.82 ppm and 0.57 – 0.75 ppm for groundwater samples in summer and rainy seasons respectively (Table 1 & 2). The mean values of lead are found in the range of 0.57 – 0.78 ppm and 0.65 – 0.72 ppm for river water samples in summer and rainy seasons respectively (Table 3 & 4). The mean values of lead are found in the range of 0.66 – 0.97 ppm and 0.41 – 0.6 ppm for sediment samples in summer and rainy seasons respectively (Table 5 & 6).

The values of lead slightly exceeded the permissible limit of 0.05 ppm[2] for all the groundwater samples in summer and rainy seasons. The maximum value of lead is found at stations 1A, 5D, 6A, 6B and 9B. The high value of lead is observed in summer. This implies that lead contamination in some of the water sources could be attributed due to anthropogenic activities. The high value of lead is due to percolation of textiles water, industrial wastes and bleaching water may percolate into the ground water. The values of lead exceed the permissible limit of 0.05 ppm[2] for all the river water samples in summer and rainy seasons. The maximum value of lead is found at stations S1 and S10. Addition of agricultural runoff, textile wastes and sewage, may increase the concentration of lead in river water samples.

The values of lead exceed the permissible limit of 0.05 ppm[2] for all the sediment samples in summer and rainy seasons. The maximum value of lead is found at stations S9 and S10. The high concentration in the sediment of the study area may be attributed to lead laden effluent discharged into the ecosystem. The presence and detection of lead in the sediment of the study area may be attributed to lead – laden effluents discharged into the ecosystem. The use of lead in industrial processes and consumer product like batteries, gasoline additives, rolled and extruded products, cable sheathing, paints, alloys and pigment may also account for this[13].

The high concentration of lead poisoning has been recognized as an occupational illness for centuries and it is linked with both severe and subtle health damages. The higher concentration of lead in drinking water has adverse effect on central nervous system, blood cell and may cause brain damage[14].

Table – 1. The mean values of trace metal concentrations of groundwater samples during April 2012, 2013 and 2014

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
1A	0.05	1.27	0.53	1.39	0.49	9.41	0.81
1B	0.05	1.32	0.31	1.20	0.17	8.73	0.73
1C	0.05	1.40	0.52	1.41	0.28	8.70	0.77
1D	0.05	1.23	0.41	1.27	0.34	8.38	0.73
2A	0.11	1.41	0.47	1.29	0.27	8.47	0.75
2B	0.10	1.27	0.45	1.56	0.27	8.72	0.75
2C	0.06	1.47	0.41	1.38	0.26	8.82	0.76
2D	0.09	1.55	0.44	1.45	0.34	8.66	0.75
3A	0.13	1.35	0.37	1.56	0.29	8.26	0.75
3B	0.12	1.33	0.30	1.33	0.33	8.67	0.73
3C	0.05	1.37	0.44	1.28	0.31	9.19	0.73
3D	0.07	1.51	0.30	1.35	0.28	8.82	0.77
4A	0.19	1.32	0.57	1.47	0.27	8.55	0.74
4B	0.11	1.42	0.43	1.46	0.28	8.50	0.79
4C	0.06	1.35	0.37	1.45	0.27	8.54	0.70
4D	0.07	1.48	0.39	1.47	0.25	8.25	0.50
5A	0.08	1.36	0.43	1.35	0.23	8.90	0.79
5B	0.11	1.44	0.41	1.56	0.28	8.90	0.75
5C	0.07	1.90	0.45	1.38	0.25	7.40	0.77
5D	0.04	1.73	0.31	1.48	0.19	9.45	0.82
6A	0.17	1.46	0.40	1.46	0.23	8.95	0.82
6B	0.12	1.32	0.41	1.46	0.23	9.25	0.82
6C	0.04	1.51	0.41	1.45	0.20	7.94	0.75
6D	0.05	1.40	0.44	1.41	0.22	8.30	0.79
7A	0.18	1.34	0.46	1.50	0.23	9.40	0.72
7B	0.09	1.40	0.40	1.34	0.18	8.50	0.76
7C	0.07	1.71	0.50	1.37	0.23	9.25	0.72
7D	0.06	1.36	0.40	1.38	0.24	8.75	0.76
8A	0.10	1.68	0.44	1.44	0.17	8.65	0.75
8B	0.11	1.31	0.45	1.50	0.23	8.25	0.78
8C	0.08	1.70	0.40	1.53	0.28	9.25	0.77
8D	0.05	1.87	0.41	1.44	0.23	8.20	0.73
9A	0.09	1.35	0.39	1.44	0.22	8.65	0.78
9B	0.09	1.44	0.36	1.40	0.20	8.65	0.81
9C	0.06	1.61	0.44	1.56	0.23	8.55	0.73
9D	0.08	1.46	0.34	1.41	0.25	8.45	0.77
10A	0.09	1.46	0.37	1.41	0.23	7.85	0.74
10B	0.11	1.49	0.43	1.40	0.19	9.25	0.77
10C	0.04	1.41	0.40	1.49	0.18	8.85	0.75
10D	0.04	1.34	0.45	1.39	0.19	8.50	0.78

All the values are expressed in ppm

Table – 2. The mean values of trace metal concentrations of groundwater samples during December 2012, 2013 and 2014.

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
1A	0.03	1.07	0.41	1.08	0.13	9.04	0.68
1B	0.08	1.16	0.25	0.99	0.14	8.41	0.68
1C	0.05	1.24	0.38	1.28	0.26	8.33	0.64
1D	0.08	0.79	0.27	1.21	0.23	7.40	0.69
2A	0.10	1.24	0.34	1.02	0.20	7.35	0.75
2B	0.09	1.16	0.27	1.14	0.18	8.33	0.74
2C	0.02	1.19	0.30	1.25	0.16	8.13	0.62
2D	0.09	1.33	0.36	1.16	0.17	8.27	0.65
3A	0.16	1.19	0.31	1.25	0.22	7.82	0.68
3B	0.03	1.20	0.23	1.16	0.20	8.05	0.67
3C	0.08	1.20	0.33	1.11	0.21	8.82	0.62
3D	0.05	1.28	0.21	1.16	0.35	8.60	0.69
4A	0.15	1.17	0.42	1.24	0.22	7.78	0.70
4B	0.06	1.23	0.30	0.75	0.21	8.00	0.68
4C	0.07	1.18	0.27	1.28	0.25	8.05	0.64
4D	0.09	1.19	0.32	1.27	0.20	7.46	0.68
5A	0.08	1.16	0.37	1.24	0.13	8.50	0.71
5B	0.06	1.29	0.28	1.39	0.17	8.40	0.69
5C	0.04	1.58	0.34	1.20	0.19	7.80	0.68
5D	0.04	1.37	0.25	1.21	0.21	8.78	0.73
6A	0.16	1.23	0.34	1.28	0.16	8.53	0.72
6B	0.12	1.26	0.29	1.20	0.23	8.45	0.75
6C	0.03	1.18	0.29	1.28	0.16	7.68	0.57
6D	0.05	1.21	0.37	1.24	0.16	7.85	0.68
7A	0.17	1.16	0.35	1.25	0.16	8.68	0.62
7B	0.04	1.23	0.28	1.18	0.16	7.98	0.66
7C	0.03	1.35	0.27	1.29	0.29	8.64	0.70
7D	0.11	1.18	0.31	1.17	0.16	8.25	0.61
8A	0.14	1.68	0.34	1.30	0.14	7.92	0.62
8B	0.03	1.25	0.38	1.25	0.16	7.70	0.66
8C	0.09	1.28	0.27	1.27	0.18	8.65	0.73
8D	0.12	1.60	0.32	1.30	0.15	7.45	0.69
9A	0.02	1.40	0.32	1.29	0.17	8.01	0.71
9B	0.04	1.19	0.32	1.15	0.16	8.42	0.69
9C	0.04	1.26	0.34	1.34	0.17	7.75	0.67
9D	0.04	1.36	0.28	1.24	0.19	7.75	0.69
10A	0.15	1.18	0.32	1.42	0.16	7.48	0.67
10B	0.08	1.24	0.35	1.24	0.14	8.02	0.68
10C	0.03	1.31	0.33	1.27	0.14	8.36	0.68
10D	0.07	1.32	0.38	1.18	0.16	8.09	0.63

All the values are expressed in ppm

Table – 3. The mean values of trace metal concentrations of river water samples during April 2012, 2013 and 2014

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
S1	0.13	3.79	0.75	1.41	0.49	8.99	0.77
S2	0.12	3.52	0.92	1.51	0.21	8.45	0.75
S3	0.13	2.85	1.06	1.41	0.28	7.44	0.76
S4	0.17	2.31	1.07	1.4	0.23	8.79	0.72
S5	0.15	3.04	1.34	1.38	0.23	8.99	0.67
S6	0.14	3.38	1.81	1.51	0.3	8.87	0.76
S7	0.16	3.50	1.34	1.43	0.34	8.33	0.74
S8	0.16	3.09	1.41	1.47	0.37	8.45	0.75
S9	0.15	2.93	1.29	1.37	0.39	8.73	0.7
S10	0.15	3.04	0.95	1.34	0.27	8.55	0.78

All the values are expressed in ppm

Table – 4. The mean values of trace metal concentrations of river water samples during December 2012, 2013 and 2014

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
S1	0.13	3.29	0.42	1.19	0.24	8.24	0.69
S2	0.11	3.22	0.35	1.24	0.26	7.31	0.71
S3	0.17	2.69	0.44	1.17	0.27	6.31	0.65
S4	0.16	1.74	0.39	1.31	0.26	5.52	0.68
S5	0.14	2.73	0.46	1.19	0.26	7.89	0.72
S6	0.12	2.84	0.43	1.2	0.24	7.31	0.67
S7	0.16	3.01	0.41	1.25	0.25	7.97	0.65
S8	0.17	2.62	0.41	1.19	0.25	6.99	0.65
S9	0.12	2.83	0.41	1.18	0.21	7.34	0.71
S10	0.12	2.73	0.42	1.19	0.21	6.96	0.68

All the values are expressed in ppm

Table – 5. The mean values of trace metal concentrations of sediment samples during April 2012, 2013 and 2014.

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
S1	0.13	3.30	0.62	1.51	0.27	9.14	0.76
S2	0.11	3.43	0.88	1.49	0.23	8.40	0.75
S3	0.11	3.19	1.22	1.50	0.26	8.59	0.75
S4	1.55	2.69	0.93	1.50	0.28	8.42	0.76
S5	1.16	2.69	1.29	1.41	0.23	8.73	0.74
S6	0.11	4.06	1.48	1.51	0.29	8.60	0.66
S7	1.50	3.81	1.02	1.38	0.37	8.70	0.77
S8	1.06	3.72	1.01	1.41	0.34	8.32	0.75
S9	1.07	2.98	0.87	1.49	0.35	7.93	0.77
S10	1.16	2.64	0.43	1.48	0.27	8.28	0.76

All the values are expressed in ppm

Table – 6. The mean values of trace metal concentrations of sediment samples during December 2012, 2013 and 2014.

Stations	Cadmium	Iron	Manganese	Copper	Chromium	Zinc	Lead
S1	0.76	1.39	0.43	1.32	0.22	7.96	0.46
S2	0.40	1.37	0.45	1.31	0.24	7.36	0.55
S3	0.46	1.39	0.45	1.31	0.21	6.31	0.51
S4	1.50	1.51	0.42	1.26	0.20	5.56	0.43
S5	1.05	1.44	0.41	1.40	0.22	8.05	0.41
S6	0.73	1.55	0.43	1.30	0.21	7.32	0.46
S7	1.49	1.54	0.37	1.36	0.21	7.97	0.54
S8	1.09	1.38	0.46	1.21	0.20	7.05	0.60
S9	1.05	1.42	0.43	1.34	0.21	7.34	0.60
S10	1.11	1.47	0.41	1.38	0.21	7.20	0.57

All the values are expressed in ppm

CONCLUSION

The values of cadmium exceed the permissible limit in all the sampling stations of groundwater and river water samples in summer and rainy seasons. This may be due to regular addition, agricultural runoff and industrial wastes. The values of iron exceed the permissible limit for most of the groundwater samples and exceed the permissible for all the river sampling stations in summer and rainy seasons. This may be contributed by weathering of rocks and also by the discharge of effluent and industrial wastes on a surface that percolated into the groundwater. The values of manganese exceed the permissible limit in all the sampling stations of groundwater and river water samples in summer and rainy seasons. The values of copper exceed the permissible limit in all the sampling stations of groundwater and river water samples in summer and rainy seasons. The maximum value of copper is found at some stations. The values of chromium exceed the permissible limit in all the sampling stations of groundwater and river water samples in summer and rainy seasons. The values of zinc are found exceed the permissible limit in all the sampling stations of groundwater and river samples in summer and rainy seasons. The values of lead slightly exceed the permissible limit in most of the sampling stations of groundwater and river samples in summer and rainy seasons. Lead contamination of the groundwater may be the result from textile and sewage. The ground water source will be completely polluted and become unfit for drinking and other purpose. Hence, this is high time to preserve and protect this precious resource. For this, precautionary measures should be immediately taken to avoid the consequences.

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