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Heavy metal content in irrigation water samples of Erode district, Tamil Nadu

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Abstract
A detailed survey work was carried out in the contamination areas of Erode district, Tamil Nadu, India. A number of tanneries and textile industries have been established since the past three decades. It is reported that the effluents from these industries are directly discharged onto the surrounding land, irrigation fields and surface water bodies. As a result, it deteriorates the quality of irrigation water in the study area. The concentrations of various heavy metals namely (Cr, Cd, Ni and Pb) were estimated using Atomic Absorption Spectrometer. The average concentration of heavy metals in the irrigation water ranges from 0.076 - 1.249 ppm, 0.033 - 1.349 ppm, 0.003 - 0.284 ppm and 0.009 - 0.912 ppm for the metals Cr, Cd, Ni and Pb respectively.

Keywords: Mulberry, irrigation water-quality, heavy metals, tanneries and textile

Introduction
Mulberry (*Morus indica* L.) belongs to the family Moraceae a fast growing, deciduous and perennial plant. It is the sole food plant of the silkworm (*Bombyx mori.* L) for silk production. Mulberry cultivation and silk production together comprises sericulture due to an ecofriendly, agro-based, labour intensive, rural cottage industry providing subsidiary employment and supplementing the income of rural farmers especially the economically weaker section of the society Dandin *et al.,* (2000).

Water used for irrigation may vary greatly in quality aspects depending upon type and quantity of dissolved salts. Salts present in irrigation water may be of small but it will add significant amount of salt load to the irrigated fields. The suitability of water for irrigation is determined not only by the total amount of salt present but also by the kind of salt present in the irrigation water.

Deterioration of irrigation water quality is mainly anthropogenic through variety of industries. In India only 24 per cent of wastewater is treated (primary only) before use in agriculture and disposal into rivers (Minhas and Samra, 2004) [7]. Contamination of the river has increasingly become a serious problem in many of the river basins of the State. River basins like Palar, Tamirabarani, Cauvery, Noyyal, Bhavani and Amaravathy face serious pollution problems due to industrial effluents. There are about 10,000 garment manufacturers and 2100 bleaching and dyeing industries in India. Majority of them concentrated in the states of Tamil Nadu, Punjab and Gujarat. An estimate shows that textiles account for 14% of India's industrial production and around 27 per cent of its export earnings (Ministry of Textiles, 2004). Balakrishnan *et al.* (2008) [2] observed that there is no immediate threat for irrigation water quality due to dyeing and printing of textile industry of Kancheepuram but increase in salinity, sodicity, and presence of heavy metals like chromium, cadmium, nickel and lead in groundwater found to pose significant threat to the consumers.

The Noyyal river is the major source for irrigation, drinking water and other activities of the people living on both sides of the river. This river is the only source for around 30 tanks, 20 minor canals and two reservoirs in the river basin irrigating about 14,700 ha of land (Govindarajalu, 2003) [4]. The industrial effluent released by dyeing and bleaching factories in Tirupur, a major hosiery centre in South India, has become a serious issue because it has had severe impact on water bodies. The Noyyal River, a seasonal river, is a tributary of the Cauvery River passes through Tirupur. (Jacks *et al.*, 1994) [5].

Though there are proper regulations for effluents from industries, surface and groundwater is receiving partially treated or untreated effluents from the various sources. After semi-treatment or without treatment, the effluents are released into Noyyal river at various points. Jacks *et al.*, (1994) [5] Though there are variety of industrial pollution led to degradation of groundwater quality of Noyyal river, textile, dyeing and bleaching industries located in the banks of the river and clusters in other areas of the basin found to cause the major source of pollution.

Hence, an assessment of irrigation water quality to evaluate the heavy metals in irrigation water quality parameters in Erode district, Tamil Nadu.

Materials and Methods

The study was conducted in Department of Sericulture, Forest College and Research Institute, Mettupalayam Tamil Nadu. A detailed survey work has been carried by collecting the irrigation water samples from the polluted and non-polluted areas of Erode district to assess the heavy metal status in irrigation water. About 70 irrigation water samples were collected and analyzed for heavy metals namely chromium, cadmium, nickel and lead respectively. Water samples were collected from the selected sites and taken in pre-cleaned polyethylene bottles. The water samples after collected were immediately stored in cold storage of temperature 4ºC and transported for laboratory analysis.10 ml of the irrigation water sample was taken filtered using Whatman No.42 filter paper and the extract was used for analyzing total metal status using Atomic Absorption Spectrophotometer. Heavy metal concentration was estimated using the DTPA extractable by adopting the procedure given by Lindsay and Norvell (1978) [6].

Results and Discussion

The characterization of heavy metals in irrigation water such as chromium (Cr), cadmium (Cd), nickel (Ni) and lead (Pb) were shown in (Table 1.)

Table 1: Analysis of heavy metals in irrigation water samples collected from sampling sites of Erode district, Tamil Nadu

Sl. No	District	Block	Name of the village	Cr (ppm)	Cd (ppm)	Ni (ppm)	Pb (ppm)
1	Erode	Gobichettipalayam	Bommanaikanapalayam	1.113	0.846	0.041	0.009
2			Thasampalayam	0.960	0.641	0.027	0.071
3			Kugalur	1.063	1.321	BDL	0.077
4			Kullampalayam	1.189	1.113	0.384	0.293
5			Othakuthirai	1.092	0.536	0.003	BDL
6			Thaneerpanthalpudhur	0.136	0.142	0.004	0.027
7			Arakankottai	1.234	0.472	0.141	0.013
8			Vellankovil	0.921	0.741	0.211	0.029
9			Pichandipalayam	1.012	1.192	BDL	0.115
10			Polavakalipalayam	1.140	1.164	0.021	0.026
11			Gobichettipalayam	0.994	0.846	0.165	0.239
12		Nambiyur	Varapalayam	0.142	0.093	0.117	0.149
13			Kuppipalayam	1.043	0.576	0.232	0.351
14			Malayapalayam	BDL	BDL	BDL	BDL
15		Bhavani	Appakudal	0.764	0.931	0.071	0.193
16			Bhavani-1	1.064	1.142	0.116	BDL
17			Bhavani-2	0.848	0.432	0.033	0.501
18			Athani	1.035	1.284	0.039	BDL
19			Dharmapuri-1	1.103	1.061	0.129	0.193
20			Dharmapuri-2	1.116	0.637	BDL	0.023
21			Jambai	1.124	0.701	0.084	0.499
22			Kavundapadi	0.102	0.033	0.023	0.048
23			Kuttipalayam	1.022	0.329	0.032	0.079
24			Kuttipalayam-2	1.108	0.529	BDL	0.022
25			Kuttipalayam-3	1.147	1.296	0.146	0.912
26			West kuttipalayam	0.681	1.276	0.134	0.090
27			Odathurai	1.108	0.136	BDL	0.423
28			Palapalayam	0.769	0.843	0.144	0.761
29			P.mettupalayam	0.941	1.041	0.049	0.351
30			J.J Nagar	1.066	1.179	0.061	0.063
31			Vairamangalam-1	1.126	1.147	0.079	0.236
32			Vairamangalam-2	0.765	0.476	0.018	0.076
33			Kalingarayanpalayam	1.142	0.439	0.044	0.018
34		Antiyur	Vempathy	0.136	0.761	0.076	0.227
35			Unjapalayam	1.081	0.169	BDL	0.718
36			Osaipatti	0.897	1.041	0.049	0.029
37			Komputhotam	1.249	1.349	0.123	0.849
38		Perundurai	Palakarai	0.889	0.120	0.278	0.174
39			Pallapalayam	0.812	0.761	0.222	0.116
40			Veerachipalayam	1.095	1.072	0.086	0.043
41			Karattupalayam	0.939	0.829	0.174	0.188
42			Ponmudi-1	1.051	0.786	0.017	0.172
43			Ponmudi-2	1.004	0.678	BDL	0.023
44			Savadipalayam	1.107	1.249	0.281	0.619
45			Ellapalayam	0.089	0.075	0.012	0.043
46			Nallampatti	1.053	1.110	0.023	0.054
47			Thingalur	1.072	1.038	0.066	0.247
48			Singanallur	0.861	0.541	0.047	0.092
49			Vellode	0.794	0.646	0.084	0.193
50			Kanjikovil	0.654	0.438	BDL	0.072
51			Seenapuram	0.942	1.146	0.132	0.251

52			Pudupalayam	0.888	0.729	0.169	0.052
53			Vijayamangalam	0.821	0.641	0.111	0.039
54			Chinnamalampalayam	0.585	0.497	0.018	0.154
55			Thoranavavi	1.002	0.979	BDL	0.065
56			Ramanathapuram	0.785	1.047	BDL	BDL
57		Erode	Chettipalayam	1.096	0.865	BDL	0.081
58		Sathyamangalam	Modhur-1	BDL	0.156	0.084	BDL
59			Modhur-2	1.023	1.121	0.189	0.067
60			Sathyamangalam	0.161	0.089	0.046	BDL
61		Modakurichi	Karavalasu	1.089	0.546	0.109	BDL
62			Odakattuvalasu	0.943	0.621	0.036	BDL
63			Kasipalayam	0.182	0.096	0.048	BDL
64			Velampalayam	0.636	0.142	0.015	0.087
65			Kagam	1.116	0.372	0.171	0.089
66			Minnapalayam	0.947	0.723	0.254	BDL
67			KG. vasalu	1.032	0.476	0.142	0.115
68			Vadugapatti	1.142	0.956	0.041	0.036
69			Palliyuthu	0.894	0.578	0.007	0.093
70			Koothampatti	1.209	1.012	0.284	0.434
Average				0.931	0.742	0.101	0.196
Maximum				1.249	1.349	0.284	0.912
Minimum				0.076	0.033	0.003	0.009
SEd				0.256	0.359	0.078	0.220
CV %				27.51	48.38	77.40	112.05

With respect to Chromium (Cr), it is ranged from 0.076 to 1.249 ppm with an average of 0.931 ppm. The highest chromium concentration of 1.249 ppm was found at Komputhotam village of Antiyur block in Erode district. The lowest chromium concentration of 0.076 ppm was observed at Malayapalayam village of Nambiyur block in Erode district. The results are in accordance with literatures (Sathiyaraj *et al.,* 2017) [9] reported that in contaminated water samples of Erode (1.525 ppm), Pallapalayam (1.514 ppm) and Bhavani (1.431 ppm). Mohanakavitha *et al.,* (2019) [8] reported that in Kalingarayan canal was 1.004 ppm. The samples contain chromium concentration in above the maximum permissible limit is validated due to various anthropogenic activities, industrial effluents, old plumbing and household sewage (Warmate *et al.,* 2011) [10] and discharge of adjoining industries namely tannery, chemical manufacturing etc., and also large amount of particular matter in the canal, which retained chromium as absorbed ions.

Whereas, Cadmium (Cd) content was ranged between 0.033 and 1.349 ppm with an average of 0.742 ppm. The highest cadmium concentration of 1.349 ppm was indicated at Komputhotam village of Antiyur block in Erode district. The lowest cadmium concentration of 0.033 ppm was observed at Kavindapadi village of Bhavani block in Erode district. The similar findings were observed by with (Sathiyaraj *et al.,* 2017) [9] reported that in contaminated water samples of Erode (1.261 ppm), Pallapalayam (1.141 ppm) and Bhavani (1.087 ppm). Mohanakavitha *et al.,* (2019) [8] reported that in Kalingarayan canal was 0.001 ppm.

In terms of Nickel (Ni) concentration was ranged from 0.003 to 0.284 ppm with an average of 0.101 ppm. The highest nickel concentration of 0.284 ppm was recorded at Koothampatti village of Modakurichi block in Erode district. The lowest nickel concentration of 0.003 ppm was observed at Kullampalayam village of Gobichettipalayam block in Erode district. The results are in line with (Ahamed and Loganathan 2017) [1] reported that in ground water (0.035 ppm) and surface water (0.026 ppm). Mohanakavitha *et al.,* (2019) [8] reported that in Kalingarayan canal was 0.004 ppm.

The Pb concentration was ranged from 0.009 to 0.912 ppm with an average of 0.196 ppm. The highest lead concentration of 0.912 ppm was found at Kuttipalayam-3 village of Bhavani block in Erode district. The lowest lead concentration of 0.009 ppm was recorded at Bommanaikanapalayam village of Gobichettipalayam block in Erode district. The results are accordance with (Sathiyaraj *et al.,* 2017) [9] in contaminated water samples of Erode (0.045 ppm), Pallapalayam (0.154 ppm) and Bhavani (0.867 ppm). Ahamed and Loganathan (2017) [1] reported that in ground water (0.231 ppm) and surface water (0.264 ppm).

Overall, the justification for presence of heavy metal contamination in water is attributed due to the various cascade activities either directly or indirectly causes degradation of aquatic environment. Change in cropping pattern, high usage of pesticides, inorganic fertilizers to increase the productive potential of sites, had led to salinity of soils, ultimately change in biology of river and depleting of aquatic resources and water table in long run (Sathiyaraj *et al.,* 2017) [9].

Conclusion

The present study envisages the appraisal of irrigation water quality of Erode district. From the results of heavy metal analysis of textile effluents has been concluded that heavy metals namely chromium, cadmium, nickel and lead are very high in concentration compared to the standards prescribed by the WHO. The results of the study showed that due to unsafe disposal of textile waste water on the bare land, the organic, and inorganic chemical compounds present in the effluent have leached and found their way into the ground water. Hence, the potable water in the industrial area was significantly contaminated with cadmium, chromium, nickel and lead, which were used in the wet finishing process of textile process and released along with the effluent. In further, phytoremediation is novel technology that uses green plants for cleaning up of contaminated sites, as it seems to be a cost-effective, esthetically pleasant and may contribute to restore soil structure.

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