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Study of industrial effluent water irrigation on soil properties of Bhandara District

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Abstract — Industrial effluents released to river and canal causes the problem of environmental pollution with their toxic metals and further influences soil health of surrounding areas. Therefore, the experiment was undertaken to evaluate the effect of industrial effluent on soil chemical properties collected from various sites of Bhandara industrial area. Five surface soil samples (Soil irrigated with effluent water (2 samples), effluent water after confluence, contaminated river water and well water) at a depth of 0-15 cm were collected from the irrigated soils and characterized during the year of 2015-16. The study revealed that, fertility status of soil was influenced with effluent water irrigated soils. It was observed that, soil physio-chemical properties varied from place to place and ranged from 8.02 - 8.06, 0.58 - 1.26 dSm^{-1} and 4.98 - 8.16 g kg^{-1} pH, EC and organic carbon respectively. Primary nutrients also found that is available NPK in effluent water irrigated soil were range from (231.12 - 304.12, 8.62 - 20.10, and 298.87-325.20 $kgha^{-1}$ respectively. Major sources of micronutrients (Fe, Mn, Zn, Cu) and heavy metals (Pb, Cd, Ni and Cr) in effluent irrigated soil ranged between (9.10-18.04, 6.12-12.94, 2.08-4.35, 2.01-3.52 mg kg^{-1}) micronutrients and heavy metals (2.16-2.58, 0.06-0.20, 1.18-1.50, 0.36-0.58 $mgkg^{-1}$) respectively. The results indicated that the effluent mixed waste water is good source of nutrients, which could be better potential for irrigation. Blending of effluent water and good quality water is feasible to adopt for crop production in Bhandara Industrial surrounding areas. However it is necessary to assess soil periodically to monitor the adverse effect of heavy metals.

Keywords— ***Heavy metals; Industrial effluent water; Micro nutrients; Soil properties;***

INTRODUCTION

Soil and water pollution is a great challenge of today's civilization. Usually river, canal, well and bore well water used irrigation purpose. Now a days, industry in rural and urban residential areas are increased and plenty of potable water used for processing and manufacturing of materials. Industry waste water i.e., effluent water discharged into local environment which leads to pollution. Improper use of untreated wastewater and disposal increased contaminant level in surface water and almost all rivers are polluted. The untreated industrial effluent is the main source of pollution of river water containing variable amount of heavy metals lead to increase in concentration of metals in soil and vegetable, which is grown using the polluted water [1]. Irrigation water scarcity negatively influences the crop production and available industrial effluent water one of the option for agricultural use. Effluent water contains variable amount of metallic cations [2]. The effect of industrial effluent irrigation on soils of Hyderabad (India) and observed that the continuous use of effluent for irrigation resulted in increased contents of silt and clay of the soil resulting in higher CEC [3]. The essential nutrients were high in these soils and are useful for availability to plant. The accumulation of Diethylene triamine penta acetic acid (DTPA) extractable and total micronutrients and heavy metal was observed in effluent-irrigated plots. Similarly, their content with increased depth was less due to low mobility of these metals. The continuous irrigation with raw effluent over the years led to accumulation of soluble salts and the heavy metals in soils. Eventhough bacteria and viruses are high in effluent water, their limited use in cultivation will enhances the soil fertility.

Bhandara city and around area is growing faster with population and industries. It is fondly called as “District of Brass city'' owing to the presence of large brass products industry. Bhandara is also famous for the Ordnance factory. Many thousand hectors of agricultural land are being irrigated with untreated sewage water and effluents. The limited research work on effect of industrial effluent water on soil properties and heavy metals accumulation in soils of industrial area around Bhandara district were conducted. In this view, it is necessary to study the impact of heavy metal accumulation on soil of industrial area.

MATERIALS AND METHODS

The present study of industrial effluent water irrigation on soil properties of Bhandara District of Maharashtra State was undertaken during the year of 2015-16 to evaluate the effect of industrial effluent on soil chemical properties from various sites of Bhandara industrial area**.** It covers the part of Warthi industrial area (Sunflag Iron & Steel Co. Ltd), which is one of the largest industrial area. Our study area lies in between latitude 21^{0}21'14'' and longitude 79^{0}38'45'' on survey of India toposheet No. 55L/13. Bhandara district also famous for ordinance factory, It spans a total area of 175.63 hectares. The villages selected for sampling were Warthi, Pandharabodi, Jamni and Sirsi. This industrial effluent water abruptly used for irrigation during rabi season.

Sampling locations were selected after every 1-2 km approximately in order to study the overall impact. Five surface soil samples Soil irrigated with effluent water (1 and 2), effluent water after confluence, contaminated river water, and well water at a depth of 0-15 cm were collected from the effluent water irrigated soils. About 1.0 kg representative soil sample from each of the 15 cm layer was collected and processed for characterization. Soil physico-chemical property analyzed using standard protocol mentioned as described [4].

RESULTS AND DISCUSSION

The effluent water irrigated soils (Table 1) in the study area are moderately alkaline in reaction with pH ranging from 8.02 to 8.06 and found to be lower in well irrigated soil which is slightly alkaline in reaction. The EC values of effluent irrigated and contaminated river water irrigated soil ranged between 0.58 to 1.26 dSm^{-1} and found to be lower in the well water irrigated soils. This can be attributed to addition of solutes in soil by way of effluent irrigation. Similar findings were also observed [5, 6].

It was observed that the organic carbon content of effluent irrigated and contaminated river water irrigated soil were higher (4.98 to 8.16 g kg^{-1}) than that of well water irrigated soils (2.82 g kg^{-1}). These findings are in conformity with the work of [7] who reported that distillery effluent irrigated soil increase in organic carbon, it may be because of presence of higher C amount in distillery effluent samples. Few studies also reported that, the mean organic carbon content (8.6 g kg^{-1}) in treated sewage water irrigated soil as compared to tube well irrigated soil [8].

Available N, P and K in effluent and contaminated river irrigated soil ware ranged from 231.12 to 304.12, 8.62 to 20.10 and 298.87 to 325.20 kg ha^{-1} respectively. These findings are in conformity with the work of [9] reported that there was an increase in available N and K content of soil in treatment receiving effluent irrigation. The DTPA extractable micronutrients Fe, Mn, Zn and Cu and heavy metals viz. Pb, Cd, Ni and Cr in effluent irrigated soil ranged between 9.10 to 18.04, 6.12 to 12.94, 2.08 to 4.35, 2.01 to 3.52 mg kg^{-1} and heavy metals 2.16 to 2.58, 0.06 to 0.20, 1.18 to 1.50, 0.36 to 0.58 mg kg^{-1} respectively (Table 2). The results showed that, the DTPA extractable micronutrients and heavy metals were higher in effluent irrigated soils as compared to well water irrigated soil. Our results are corroborating with [10-12]. The sewage irrigation for 20 years resulted into significant buildup of DTPA- extractable Zn, Cu, Fe, Ni and Pb in sewage irrigated soils over adjacent tube well water irrigated soils [10]. Heavy metals persist in soils and can be adsorbed in soil particles or leached into ground water. The level of the metals in soil around the industrial area of Pali, Rajasthan, India was found to be significantly higher than their normal distribution in soil [11]. Toxic metal content (Pb, Ni and Cd) of soil increased due to irrigation with cycle industrial effluent as compared to tube well irrigated soils [12]. Rapid industrialization and urbanization have created enormous problems of environmental pollution in terms of generating the variable quantity and quality of effluents. To safeguard the environment, these effluents have either to be treated prior to their disposal into water courses or may be used for crop production if permissible from quality point of view. However, irrigation with sewage and paper/pulp mills effluent had enriched the soil mainly with respect to N, P, K and enhanced crop yields considerably.

CONCLUSION

This study explained the effect of industrial effluent water irrigation on soil physic chemical properties and changes of four villages of Bhandara district.

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REFERENCES

[1]. Prabhu P. C., 2009. Impact of heavy metal contamination of akaki river of Ethopia on soil and metal toxicity on cultivated vegetable crops. *J. Environ. Qual.* 5(2): 272.

[2]. Saif M. Saleem, Midrar-ul-Haq and Kazi Suleman Memon, 2006. Heavy metals contamination through industrial effluent to irrigation water and soil in Korangi area of Karachi (Pakistan). *Int. J. Agri. Biol*. Vol. 7(4): 646-648.

[3]. Reddy, G. Ramohan and K. Jeevan Rao 2002. Effect of sewage irrigation on soil properties. Proceedings of International Conference on Industrial Pollution and Control Technologies: ICIPACT, December 7-10, 2002, JNTU, Hyderabad.

[4]. Jackson, M. L,. 1967. Soil chemical analysis. Prentice Hall India Pvt. Ltd, New Delhi.

[5]. Mahawar, P. and A. Akhtar, 2015. Physico-chemical characterization of soil and effluent of dye industries in Kaithun region of Kota, Rajasthan. *Int. J. Pure App. Bio. Sci.* 3(2): 419-422.

[6]. Giri, J., A. Srivastava, S. P. Pachauri and P. C. Srivastava, 2014. Effluents from paper and pulp industries and their impact on soli properties and chemical composition of plants in Uttarakhand, India. *J. of Environment and Waste Management* 1(1): 26-32.

[7]. Antil, R.S., Arora, U. & Kuhad, M.S. (1999). Leaching and transformation of urea in soils treated with sewage water and distillery effluent. Proceedings of International Conference on Contaminants in Soil Environment in Australasia Pacific Region, pp. 464-466, New Delhi, India, Dec. 12-17, 1999.

[8]. Tiwari, R. C., P. K. Saraswat and H. P. Agarwal, 2003. Changes in macronutrients status of soil irrigated with treated sewage water and tube well water. *J. Indian Soc. Soil Sci.*, 51(2):150-155.

[9]. Sahare D. ,S. K. Rajput and P. R. Dwivedi. 2014. Impact of irrigation of in dustrial effluents on soil plant health. *Int. J. on Recent and Innov.Trends in Computing and Communication.* Vol 2(12): 3916-3925.

[10]. Rattan, R. K., S. P. Datta, P. K. Chhonkar, K., Suribabu,. and A. K., Singh, 2005. Long-term impact of irrigation with sewage effluents on heavy metal content in soils, crops and groundwater- a case study. *Agriculture, Ecosystems and Environment* 109, 310-322.

[11]. Krishna, A. K. and P. K. Govil, 2004. Heavy metal contamination of soil around pali industrial Area, Rajasthan, India. *Environmental Geology*. 47:38-44.

[12]. Antil, R.S.; Kumar, V., Kethpal, T.S., Narwal, R.P., Sharma, S.K.,Mittal, S.B., Singh, J. & Kuhad, M.S. 2004. Extent of land degradation in different agro-climatic zones of Haryana. *Fertilizer News*, 49:47-59.

Table 1. Fertility status of soil as influenced by industrial effluents

	Source of irrigation water	pH	EC (dsm^{-1})	OC ($g\ kg^{-1}$)	Available N ($kg\ ha^{-1}$)	Available P ($kg\ ha^{-1}$)	Available K ($kg\ ha^{-1}$)	$CaCO_3$ ($g\ kg^{-1}$)
a)	**Soil irrigated with effluent**							
	Sample-1	8.06	1.26	8.16	304.12	20.10	325.20	4.62
	Sample-2	8.04	1.20	8.12	289.14	16.65	320.22	3.87
b)	**Soil irrigated with water after confluence**							
	Sample-3	8.02	1.18	6.52	248.16	12.50	314.52	3.52
c)	**Soil irrigated with contaminated river water**							
	Sample-4	7.86	0.58	4.98	231.12	8.62	289.87	3.32
d)	**Soil irrigated with well water**							
	Sample-5	7.56	0.63	2.82	184.90	6.81	232.12	2.42

Table 2. DTPA Extractable micronutrient & heavy metal status of soil as influenced by industrial effluents

	Source of irrigation water	Fe	Mn	Zn	Cu	Pb	Cd	Ni	Cr
		($mg\ kg^{-1}$)							
a)	**Soil irrigated with effluent**								
	Sample-1	18.04	12.94	4.35	3.52	2.58	0.20	1.50	0.58
	Sample-2	16.21	9.65	4.20	2.32	2.42	0.12	1.32	0.47
b)	**Soil irrigated with water after confluence**								
	Sample-3	12.18	8.82	3.16	2.12	2.38	0.08	1.22	0.41
c)	**Soil irrigated with contaminated river water**								
	Sample-4	9.10	6.12	2.08	2.01	2.16	0.06	1.18	0.36
d)	**Soil irrigated with well water**								
	Sample-5	6.10	3.20	1.10	1.08	1.20	0.02	0.70	0.22