IMPACT OF WATER POLLUTION ON THE PROPERTIES OF AGRICULTURAL SOIL

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Abstract: In developing countries, especially in urban areas where water shortage and poverty encourage people to use polluted water in agriculture. Raw or treated wastewaters are used by farmers, but even treated wastewaters frequently do not meet WHO and FAO standards for irrigation water. The present paper is aimed towards the assessment of agricultural soil properties due to irrigation with contaminated River water affected by textile and chemical industrial effluents at Nagda, Ujjain (Western Madhya Pradesh) in India. The impacts of irrigation River water on soil physical and chemical properties were studied at both up and downstream of the Chambal River. Plots irrigated with fresh water and non cropped, non irrigated plots were used as controls (upstream). Soil samples were collected from three Stations irrigated with treated effluent water over different periods of as long as 50 years. Soil samples were collected at two depths of 30 and 60 cm, and during wet and dry seasons. The results revealed that seasonal variation influences soil quality when irrigated with treated polluted water. Among Different soil properties, pH and electrical conductivity of water extracts, and major soluble and exchangeable cations (Ca, Mg, K, and Na) etc. are collapsed and found below WHO standards. River water from Station 2 and 3 was containing high COD, BOD values content and the soil irrigated with this water was showing the poor status of the nutrients. The study emphasizes the need to carefully examine irrigation water quality and particularly calcite residual alkalinity and suggests that wastewater quality is likely to cause deep and irreversible damages to irrigated soils. Based on the overall results of this research, it can be concluded that reusing treated effluent water for irrigation is environmentally unhealthy with respect to soil quality. Thus, untreated municipal and treated industrial effluents can cause an environmental threat to ground water resources and affects soil quality and agricultural plant productivity.

Keywords: Effluent water, heavy metal, nutrient status, COD, BOD.

Introduction: The lack of water resources and the competition between different uses i.e. domestic, agricultural and industrial is increasing with time. The reuse of industrial and urban wastewater has increased in many places principally because of demand by the agriculture sector. Adverse environmental impacts such as soil degradation and groundwater contamination are frequently associated with the use of wastewater from industrial sources. Many scientists have documented adverse effects of different industrial effluents on the growth of plants dye waste water has also been found toxic to several crop plants [1],[2],[3],[4]. With the ever increasing demand on irrigation water supply, farmlands are frequently faced with utilization of poor quality irrigation water. Due to shortage of canal/river irrigation water farmers use industrial effluents which being discharged in canal/river. Soil physiochemical properties are adversely affected by high concentration of heavy metals, rendering contaminated soils unsuitable for crop production. Metals can also be transported from soil into groundwater resulting in to soil contamination and inhibiting growth of plants [5]. Soils contaminated with toxic metals from point sources are potential exposure routes for surrounding population. The heavy metals accumulate in the plant material grown in these soils, which will ultimately go to human body through food chain directly or indirectly causing a number of physico mental problems [6]. The objective of the present study is to assess the impact of industrial effluent on soil quality adjoining the River Chambal and water quality at Nagda in different stations.

Material and Methods: Description of Study stations: Nagda is very close to tropic of cancer at 23'27N and 75'25 and 517 meters above MSL.Nagda is a city and municipality in Ujjain district in the Indian state of Madhya Pradesh. River Chambal receives water from different Industries and sewage from Nagda town. Waste after coming from the factory complex runs in a channel for about 3km and joins River Chambal near Juna Nagda. Accordingly some of the farmers of villages are using this effluent mixed water for irrigating different crops including soya bean, wheat, vegetables and fruits etc. By keeping this view it was thought that this activity of the industrial complex and municipality may cause the adverse effect not only over environment but also health hazards to the farmers.

Station 1. This station is located at upstream at Methwasa village. Human activities are reduced here to bathing and fishing. This station was taken as the reference station (control) owing to The absence of discharge coming into the River from industries

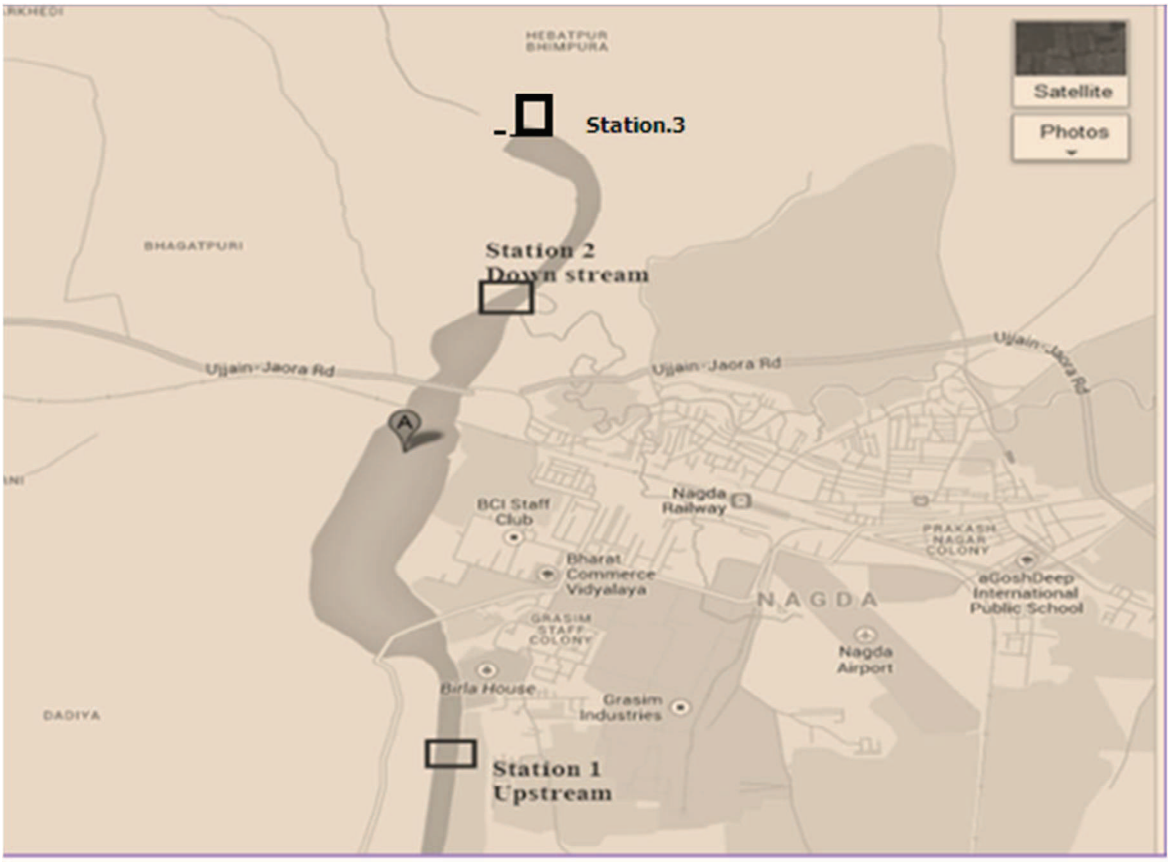

Fig.1. Showing Study areas at Chambal River

Station 2: This station is located near Mukteswar temple near Juna Nagda. The discharges of industrial complex and domestic waste are drained into this station. It is poorly vegetated. It is about 4 km away from station 1.

Station.3. This station is located about 2 km far away from station 3. It is located between the village Juna Nagda and Gidhgarh. It is also poorly vegetated.

The soil (adjoining the industrial complex) and water effluent samples were collected from three different sites of Chambal River at Nagda region during winter of the year 2011. The collected samples have been analyzed to determine their physico-chemical characteristics. The water and soil samples were collected in morning time. Temperature and *p*H was recorded on the field. Samples were collected in cleaned acid washed plastic bottles and sterilized plastic bags and stored at 4°C. The soil samples have been analyzed for various parameters as *p*H, electrical conductivity (EC), percent organic carbon (OC), nitrogen (N) and organic matter (OM), available phosphate (P) and potash (K). The effluent samples were analyzed for *p*H; electrical conductivity (EC); cations and anions. Physicochemical parameters of water and soil were done by standard methods [7].

Statistical analysis: Student's' test was applied to observe the significance of difference between control and experimental groups.

Results and Discussion: The water discharged during the manufacturing processes of the industrial complexes at Nagda may cause the adverse effects over environment. The physico-chemical properties of soil (adjoining the polluted zone of the Chambal River) of agricultural region and the water used for irrigation in Juna nagda, Gidhgarh area of Nagda were analysed in the present study. A wide variation in the physico-chemical properties of both soil of agricultural region and the water in Chambal River were found in the present study. Different samples of soils and water from the Nagda area showed difference in the physico-chemical characteristics from one another with respect to chemical characteristics, as expected due to a relatively wide spectrum of dyes manufacturing sources and due to presence of dyes and chemical in the textile effluent. The physicochemical characteristics of the water from 3 different stations differed substantially from one another with respect to chemical characteristics, as expected due to a relatively wide spectrum of dyes manufacturing sources. The *p*H of the effluents ranged from 8.4-10.5 and electrical conductivity (EC) from 3.5-4.55 mmhos/cm and temperature 22.0-26.0°

C. Cations (Ca2+, Mg2+, Na+ and K+) and anions (HCO3 -, CO3 - and Cl-) concentration of the water also show a wide variation. The results exhibited that cations ranged from: Ca2+ (11.9 -99.1 mg/L), Mg2+ ((5.6 – 8.9 mg/L), Na+ (22.1.2-38.2 mg/L) and K+ (0.5-4.5 mg/L) Phosphorous (0.44-1.87 kg/ha) and K (16.1 - 57.0 kg/ha) (Tab.1). Both, BOD and COD values in experimental stations 2 and 3 were high. In addition, the high levels of TDS and suspended solids in the water systems increased the BOD and COD, which depleted DO in the water ecosystem. The levels of TDS in broad sense therefore reflect the pollutant burden on the aquatic system [8]. The soil samples adjoining the textile effluent, of agricultural region of Nagda were also show great variation in the physico-chemical properties. The *p*H of the soil samples ranged from 7.7-10.1 and EC from 0.53- 1.14 mmhos/cm. respectively. Values of nitrogen (N), phosphate (P) and potash (K) concentration in the soil samples were also shows to have great variability

Ph also changes soil permeability which results in polluting underground resource of water [9]. These results are in accordance with the results of Nosheen et al [10], who reported that textile wastes are highly alkaline. Long-term irrigation with such effluents can increases EC, organic carbon content and heavy metals accumulation in soils [11], [12], [13]. The present investigations were in agreement with the results of the survey conducted by Gupta *et al*. [14]. EC is the capacity of water to carry ions, so it depends on the presence of ions and their concentration. Concentration of ions also shows variation in Juna nagda area which might be the reason of variability of EC in the samples of water and soil. The above data also suggest that the water from second and third stations is highly polluted and not suitable for agricultural use. The nutrient status of the samples showed that the soil quality of the surrounding field was poor and the effluent discharged into the River has been affecting the physicochemical characteristics of the soil. Through this study, it is concluded that the industrial effluent has significantly changed water quality of Chambal River at Nagda and consequently some chemical elements also increased in the soil of the irrigated farmland. The work presented here only threatened the chemical quality of a segment of River, but it is equally important to extend the study to include identification and chemical analysis of plants grown on soils receiving this water and microbial analysis of soil [15].

Table-1.Physico-chemical analysis of water

Parameter	Station1	Station2	Station3
Temperature (0C)	22 ± 0.53	22.1 ± 1.00	24.0 ± 1.00
Ph	8.8 ± 0.36	8.8± 0.40	8.4 ± 0.31
Turbidity (NTU)	21.3 ± 0.55	22 ± 1.08	52 ± 1.01
Conductivity (μScm-1)	400 ± 0.04	410 ± 0.65	430 ± 0.53
TSS (mg/l)	110 ± 1.53	102 ± 2.00	112 ± 1.53
Total alkalinity (mg/l)	65 ± 1.96	117 ± 1.20	107 ± 1.00
Chlorides (mg/)	230 ±1.08	118 ± 0.85	152 ± 1.07
COD (mg/l)	28 ± 1.53	72 ± 1.53	56 ± 1.00
BOD (mg/l)	39 ± 1.00	135 ± 1.73	59 ± 1.00
Oil and grease (mg/l)	10 ± 0.76	12 ± 1.00	8 ± 0.58
Sulphide (mg/l)	26 ± 1.53	30 ± 1.00	56 ± 1.00

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Table-2. Chemical Characteristic of Soil Extract

Parameter	Station 1	Station2	Station3
pH	7.7 ± 0.03	8.4 ± 0.17	10.1 ± 0.10
Conductivity (dSm1)	0.53 ± 0.06	1.14 ± 0.01	0.36 ± 0.01
Ca++ (meq/l)	11.98 ±0.01	98.15±0.02	79.00 ± 0.17
Mg+ + (meq/l)	5.8 ± 0.06	8.9 ± 0.01	8.2 ± 0.01
Na+ (meq/l)	3.15 ± 0.02	22.1 ± 0.01	38.2 ± 0.10
K+ (meq/l)	0.53±00.1	04.5 ± 0.01	0.5 ± 0.01
Organic carbon %	2.20 ± 0.06 1.	39 ± 0.01 0.	65 ± 0.02
Nitrogen (kg/ha)*	122 ± 0.02	149 ± 0.01	137 ± 0.58
Phosphorous(kg/ha)*	0.44 ± 0.01	1.80 ± 0.10	0.87 ± 0.01
Potassium (kg/ha)*	16.1 ± 0.02	19.1 ± 0.10	57 ± 0.02

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