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Original Research Paper

Environmental

ASSESSMENT OF THE IMPACT OF WASTEWATER USE ON SOIL PROPERTIES IN THE FRINGE AREA OF JALGAON CITY

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ABSTRACT The concern of this study is to determine the quality of soil when irrigated using treated wastewater TWW in comparison with soil irrigated with groundwater. Thus, about six soil samples from fringe area of Jalgaon city were examined to assess the soil behavior when using wastewater.Results showed decreased in pH unit from 8.06 in soil irrigated with ground water to 6.68 in soil irrigated with wastewater. Evaluation of individual parameters which have risks for human health and environment was performed. Physicochemical properties of soil irrigated with wastewater were higherwhen compared to those obtained with soil irrigated using groundwater respectively; for EC, TDS, Na, K, P, and N. On the other side, this research showed that the soil irrigated with wastewater has the best concentration of organic matter, which was equal to (2.14) (%) compared to (0.67) (%) obtained for soil irrigated with groundwater. Therefore, the investigationshowed that treated wastewater can efficiently be used as fertility source for soil; alongside that wastewater irrigation had a high impact on soil pollution.

KEYWORDS : Soil; Wastewater; Groundwater; Irrigation.

INTRODUCTION

Mankind is currently confronted with one of the greatest challenges in its history, thus how to adequately use its limited freshwater resources. In this context, the challenge is the shortage of water sources, which led to the use of wastewater for agriculture purposes. The reuse of treated wastewater for irrigation is a practical solution to overcome water scarcity, especially in arid and semiarid regions [1]. However, there are several potential environmental and health risks associated with this practice [2]. According to Kiziloglu et al. [3], wastewater has a high nutritive value that might develop plant growth. It had been showed that soil irrigated with wastewater contained 4.1% of organic particles by weight, but these particles harbored up to 47.8% of the total soil carbon and 41.7% of nitrogen, and thus represented an important storage of energy and nutrient for microorganisms [4]. Despite the obvious benefits of TWW (Treated wastewater) irrigation, the human and environmental health recorded many concerns of this process [5]. Potential pre-harvest sources of contamin ation include soil, feces, green or inadequately composted manure [6]. Application of contaminated irrigation water to soil also represents possible sources of contamination. Bani Al harth area, with a total surface of 269 km2 and, located near Sana'a city capital of Yemen, it's considered an important area to vegetables production. Scarcity and high cost of fresh water in that region caused reused effluent from Sana'a Wastewater Treatment Plant (SWTP). Although, wastewater use in the world—there is poor wastewater treatment in (SWTP). The aim of this research was to investigate and discuss the impact of irrigation with treated wastewater (TWW) on the physico-chemical properties of the soil.

2. MATERIAL AND METHODS

2.1. Soil sampling Soil samples irrigated with wastewater and groundwater were selected to compare the impact of water source on the soil from 3 sites across Jalgaon city Location and (Fig. 1). The sites were a commercial vegetable farms and it is considered one of the most important site to supply vegetable markets in nearby cities. Six (06) samples of soil were collected randomly from 3 farms in three times between September and December 2017. One irrigated with wastewater direct from wastewater canal of sampling location S_2 (Immersion method) supporting by pump machine other irrigated with shallow well with dimensions of about 50m^2then 5 points at depth of 20 cm in all farm were chosen to take sample. The sampling points were distributed all over the farm to ensure appropriate spatial coverage of the farm. Samples were mixed then analyzed sample was taken from the mixture. The sites were of commercial vegetable farms.

Fig. 1: Map of sampling locations of the fringe area of Jalg aon city

2.2.1 Physicochemical parameters

2.2.1.1. pH determination 20g of soil was soaked in 50 ml distilled water and mixing well until dissolved. Leave the solution 16 hours. Then the pH was determined by using a pH meter after calibration [7].

2.2.1.2. Electrical conductivity (EC) determination 50 g of soil was taken then drops from distilled water were added with stirring until reaching saturation paste. Solution was left 16 hours. Centrifuging at 1500 tour/ min for 4-5 min was done. Then we measured from supernatant with an EC meter at 25°C, [8].

2.2.1.3 Phosphorus (P) determination 2.5g of soil was weighted in beaker 250 ml. Then 50 ml (NaHCO3, 0.5N at pH 8.5) was added and the mixture is then stirred in a reciprocating stirrer for 30 min - 1 hour. The solution was filtered through filter paper < 20m. Then P was determined by using a UV Visible Spectrophotometer at 825 nm [9].

2.2.1.4 Sodium (Na) and Potassium (K) determination 4g of soil was dissolved in 100 ml of Ammonium acetate. Then the solution was filtered. Na and K were measured with a flame photometer [10].

2.2.1.5 Organic Matter determination 0.5-1g of dry soil was weighted in beaker 250 ml. Then 15 ml (Potassium Bichromate, K2Cr2O7, solution 1 N) was added and 20 ml of H2SO4 acid. Then 50ml was titrated with Mohr's salt (0.5 N). [11].

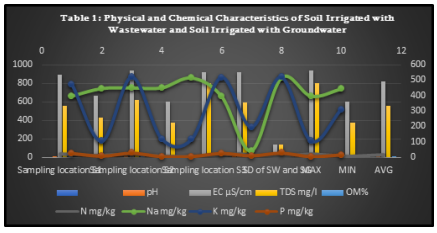
3. RESULTS AND DISSECTION

1. Physicochemical Estimation: Results presented in Table 1 represented physicochemical analyzing of soil samples from two soil types; soil irrigated with wastewater SW and soil irrigated with groundwater SG.

Table 1: Physical and Chemical Characteristics of Soil Irrigated with Wastewater and Soil Irrigated with Groundwater

Parameter	Sampling location S_1		Sampling location S_2		Sampling location S_3		SD of SW and SG	MAX	MIN	AVG
	SW	SG	SW	SG	SW	SG				
pH	7.67	7.24	7.53	8.06	6.87	6.68	0.470794246	8.06	6.68	7.341667
EC μS/cm	891	663	941	598	921	918	137.4748462	941	598	822
TDS mg/l	552.6	428	614.4	369	798.8	589	138.195977	798.8	369.4	558.7833
OM%	2.14	0.81	2.09	0.67	1.67	2.09	0.614123133	2.14	0.67	1.578333
Na mg/kg	398	447	451	451	516	397	40.02776814	516	397	443.3333
K mg/kg	472	104	519	119	115	517	195.6541734	519	104	307.6667
P mg/kg	26.64	8.29	28.13	5	5.32	26.3	10.47610204	28.13	5	16.61167
N mg/kg	37.31	21	34.31	8	14	39.3	12.01864755	39.32	8	25.65667

SW soil irrigated with wastewater, SG soil irrigated with groundwater, EC Electrical conductivity, TDS Total Dissolved Solids and OM Organic Matter.



3.1.1. **pH** Analysis showed that the wastewater soil pH ranged from 6.68 to 8.06. Soil pH directly affects the life and growth of plants because it affects the availability of all nutrients in the soil [11]. Between pH 6.0 and 6.5, most plant nutrients are in their most available state [11]. Our result agrees with Mutenguet al., [12], Kiziloglu et al. [3]; Anginet al. [13] who explained that the use of TWW for irrigation can have detrimental effects on soil quality. These include decreased soil pH and increased salinity. Decreasing of soil pH is perhaps due to the included acidic components in wastewater which convert to acidic compounds which lead to reduction pH value [14]. Values in both types of soil consider generally less than 8.4 of FAO, 1985 [15] recommendation.

3.1.2. **Electrical conductivity (EC)** Irrigation with wastewater was resulted in an increase in EC from 598 to 941 S/cm with an average of 822µS/cm. The EC explains the presence of salinity which is the most important indicator regarding to fields irrigated with wastewater [16]. In all, these values considered slightly normal according to the limits recommended by [17] therefore the EC of the two types of soil according to this limited, could be caused moderate salinity problem [18]. Indeed to combat this salinity is possible by applying more normal water than the plant needs to remove the salts from the root zone by leaching [19].

3.1.3. ORGANIC MATTER

The Organic matter is generally considered as an essential constituent of soil fertility because of its role in physical, chemical and biological processes to supply the plants with the nutrients and also helps soil to keep the moisture [20]. The amount of organic matter was found in range between 0.67 - 2.14%. These results imply that wastewater contains organic matter compounds. This is in agreement with several studies which have shown that TWW irrigation increases soil's organic matter [3, 21].

3.1.4. Phosphorus (P) Phosphorus is considered one from the important nutrients that has direct effect on the growth and productivity of plant [19]. Average values of Phosphorus were high in soil irrigated with wastewater, 28.13 mg/kg, compared to 5 mg/kg in soil irrigated with groundwater. These results are reliable with those of Sacks and Bernstein [19] and Akponikpe et. al., [20] who have a sure indicator that TWW irrigation with wastewater enhances soil phosphorus.

3.1.5. Nitrogen (N) In parallel, using wastewater led to improve total nitrogen in soil which was significantly high in SW and the average of both soils irrigated with different water was 25.65 mg/kg. Similar results were found by Akponikpe et. al., [20] and Mutengu et. al., [12]. It is known that N and P are considered as the important macro nutrients that are required by crops for ample growth. We noted that both types of soils had less than 0.1 of % total N. However, FAO Guidelines, [15] considered soil that has Less than 0.1 % of total N is poor soil.

3.1.6. Sodium (Na) Results showed that the amount of sodium (Na^+) in soil irrigated with wastewater was 516 compared to 397 mg/kg recorded in the soil irrigated with groundwater. Sodium is one of most unease among the specific toxic ions. It is reported that sodium directly have an effect on the availability of crop water and causes unfavorable physico-chemical changes in the soil, particularly to soil structure. It can disperse soil thus leading to decreased permeability, lowered shear strength and increased compressibility [1, 13, 7, 21, 22]. In our case the concentration of sodium in the soil obtained in the various locations still below the toxic levels.

3.1.7.Potassium(K) Potassium is measured the second significant macro element for soil and crop productivity. It is said that potassium normally required for agricultural crop production would be supplied by the effluent [23]. Results showed that irrigated soil with wastewater contains large amount of Potassium. It was observed that there is increase in value of potassium in the soil irrigated with wastewater (519 mg/kg) than the other type of soil (104 mg/kg).

CONCLUSION

Considering these results, we can have concluded that using wastewater or polluted water sources without adequate safeguards draw attention to several issues. There is existing of optimize in soil properties with raising of Organic Matter and decries of pH unit but on the other hand there is persistence of the contamination in local environment such as soil irrigated with wastewater which led to potential health risks for farmers and consumers alongside environmental actual risks. Thus, there is need to draw as future goal to go on the study on idea around the efficient way to develop efficient and sensitive process for removing pollutants from certain interesting matrices related to foods chain.

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