



The Effect of Untreated Sewage Water on some Soil Properties in Region of Khabat - Erbil - Iraq

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ABSTRACT

This investigation was done to determine how untreated sewage spilling Khabat region main sewers affected the chemical and physical characteristics of the soil. In order to measure the concentration of calcium (Ca^{++}), magnesium (Mg^{++}), and chloride (Cl), as well as the soil's electrical conductivity (EC), total dissolved salts (TDS), and total hardness (TH), samples of soil were taken at a depth of between 10-15 cm. In comparison to control samples, which were taken 200 meters away from the main stream and were not affected by untreated sewage, soil samples near to the main stream had significantly higher concentrations of the element's calcium, magnesium, and chloride.

The concentration of these elements in the soil increased along with the percentage of dissolved salts, which in turn caused the total hardness and conductivity of the soil to increase. This indicates that the soil near the main stream is contaminated, which primarily affects the plant and animal life in the area. The study recommended finding solution for the sewage water plant in the Khabat region, that untreated water not be dumped directly into the ground to prevent contamination and groundwater access, and that efforts be made to use this water after it has been treated for various purposes.

Keywords: sanitation, soil pollution, chemical and physical properties.

INTRODUCTION

The term "soil pollution" refers to conditions that affect the soil and alter its natural, chemical, or biological attributes and properties in a way that negatively impacts the people, animals, and plants that live on its surface. Any physical or chemical alteration to the ground that prevents its usage can also be referred to as soil contamination (Al-Mansoori, 2018).

Proper reuse of wastewater is an environmental protection measure and it is better than discharging treated wastewater to surface water. Because this measure saves large amounts of fresh water currently used for irrigation purposes to meet the growing needs for fresh water in the cities of developing countries. It is also noted that the strategic importance of managing and using municipal wastewater reclaimed for agricultural uses has increased in regions of the world with limited water resources. The reuse of wastewater has two main purposes: the first is that it improves the environment by reducing the quantities of waste (treated or untreated) that are discharged into waterways and the second Preserving water resources by reducing the demand for fresh water extraction. (Amman, Jordan's Regional Center for Environmental Health Activities, 2003).

The hydraulic conductivity, infiltration rate, water retention, and organic carbon of soil are all impacted by wastewater. Additionally, wastewater enhances the situation's micronutrients, microbial population, and accessible elements (N, P, and K). Cadmium, chromium, lead, and nickel are just a few of the hazardous chemicals and heavy metals found in wastewater, all of which are harmful to plants and the soil. When harmful metal concentrations exceed allowable limits, water poses a risk to both human and animal life (Sushil *et al.*, 2019).

The haphazard and unplanned use of treated and untreated wastewater has negative impacts on the environment that are significant and destructive to the soil, agricultural crops, surface and ground water, human health, and the environment as a whole. It accumulates in the soil and then is transmitted through the food chain to plants, animals and humans, causing serious diseases and leading to significant changes in the physicochemical properties of the soil (Alzoubi *et al.*, 2014).

A review of scientific sources showed that treated water has many benefits, including preserving the environment by treating this water and returning it to nature again. It also works to sustain agriculture, as treated water is used to irrigate crops and green spaces. It is another source of irrigation water for most agricultural crops. And in different regions of the world (Ali *et al.*, 2011). Sewage water, or known as black water is considered one of the most serious public health problems in most third world countries because most of these countries do not have an integrated sewage network. Rather, in some cities there is no sewage system, as is the case in the Khabat region, where most residential neighborhoods lack new sewage systems in the area are connected to sewage networks. Also, there is no treatment and reuse of sewage water in a drainage place in the area, as its water leaks without treatment outside a place towards the nearby farms and forests.

MATERIALS AND METHODS

The region of Khabat is located at a distance of 37 km west of Erbil Governorate, and its center is on the public road that extends between Erbil and Mosul between longitudes (35:43°) and (07:44°) west and (53:35°) and (34:36°) Fig. (1). The samples were taken near the sewage station, which is located about 2 km south of Khabat region.

Twelve soil samples (4 ×3) were collected, the method reported by the researcher (Johnson and Curl 1972) was followed as follows the next:

- The first site denoted by the symbol A, and these samples are taken directly from the edge.
- The second site, symbolized by the symbol B, is 10 meters away from the stream.
- The third site, symbolized by the symbol C, is 30 meters away from the stream.
- The fourth site, which is symbolized by the symbol D, is called Al Shahed, and is 200 meters away from the stream.

Three duplicate samples were taken from each site, samples were taken at a depth of 10-15 cm and soil samples were placed directly in clean plastic bags Fig. (2).

It was examined in the central laboratory of the College of Agriculture and Forestry, University of Mosul.

How to prepare the soil extract:

Were added in 50 mg of soil distilled water with shaking for a quarter of an hour or making an extract 1:1 and filter with filter paper.

A certain amount of the above extract was taken and calcium, magnesium and chlorine were measured by washing method as mentioned in the ICARDA method (soil and sample analysis).

Electrical conductivity (EC) measurement was performed with an EC meter, the device was immersed inside the above extractor and a reading was taken.

pH measurement (the degree of reactivity of the soil):

Using a pH meter, the device was immersed in the above extract and a reading was taken.

Preparation of soil solution for determination (calcium, magnesium, chlorine):

The concentration of the elements (calcium, magnesium, chlorine) in the soil extract was measured in mg/L units according to the spectroscopic method (AOAC, 1984) using a flame atomic absorption device. Atomic absorption Spectrophotometer Flame.

Determination of total hardness:

The total hardness of the samples was estimated in mg/L according to the method of (Abbawi and Mohamed,1990).

Determination of electrical conductivity:

The electrical conductivity (Ems/cm) of the samples was measured by a device model (multi 340i) from the German company WTW according to the method (Abbawi and Mohamed,1990).

Determination of the number of dissolved salts:

The number of dissolved salts in the soil extract was estimated according to the method of (Chaturvedi and Sanka, 2006).

pH measurement:

A weight of 10 gm was taken from each soil sample and 20 cm³ of distilled water was added to it, then the suspension was shaken to prepare the water extract, where the pH was measured using a pH meter. (Chaturvedi and Sanka, 2006).

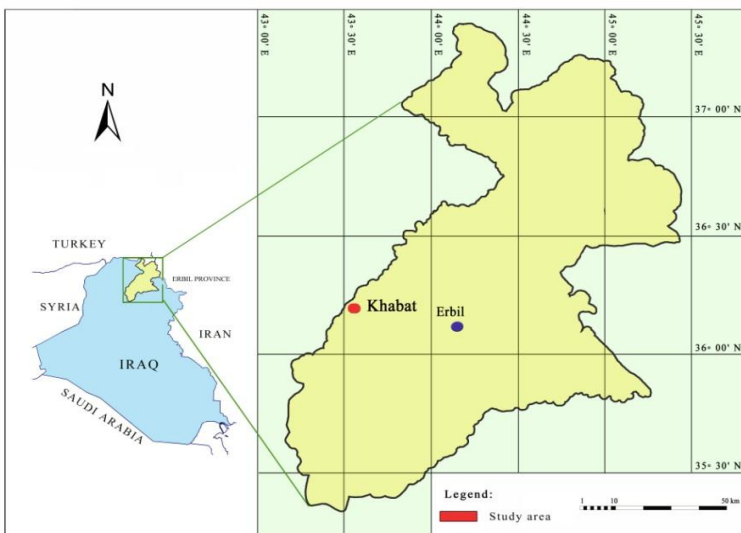


Fig. 1: Location map of study area, Khabat



Fig. 2: Sampling point

Statistical analysis:

The results were analyzed statistically using the CRD statistical program and the least significant difference test (LS. D) was used. (In the analysis of variance at the probability level) $P < 0.01$.

RESULTS AND DISCUSSION

Calcium (Ca⁺⁺), magnesium (Mg⁺⁺), and chloride (Cl⁻) concentration:

The ratio increases from the bank to soil samples at a distance of 10 and 30 meters, and we notice a significant decrease in their concentration in the soil as it is not affected by sewage water, as shown in Figs. (3, 4, 5). These elements are more concentrated in samples taken close to the stream, and the ratio increases from the bank to soil samples taken at these distances. This is consistent with the study of (Mleitan *et al.*, 2019).

This trend in the soil by moving away from the source of polluted water can be attributed to contaminant dilution. Moving away from the source of polluted water helps to reduce the concentration of contaminants, including calcium, magnesium, and chlorine, in the surrounding soil. By distancing from the pollution source, the soil is less likely to receive high levels of these elements, mitigating potential adverse effects on soil health and plant growth.

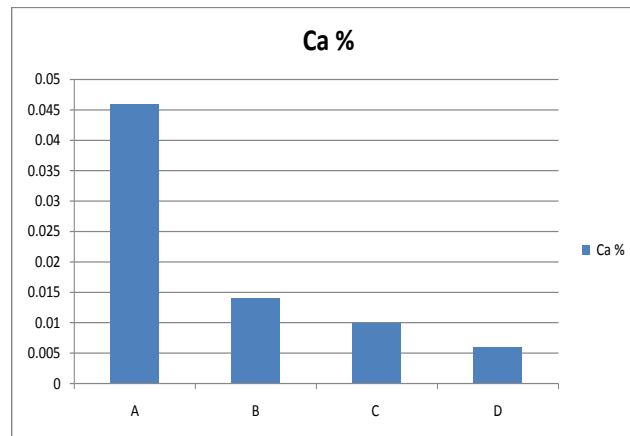


Fig. 3: The ratio of calcium ions (mg/l) Ca⁺⁺ in the soil

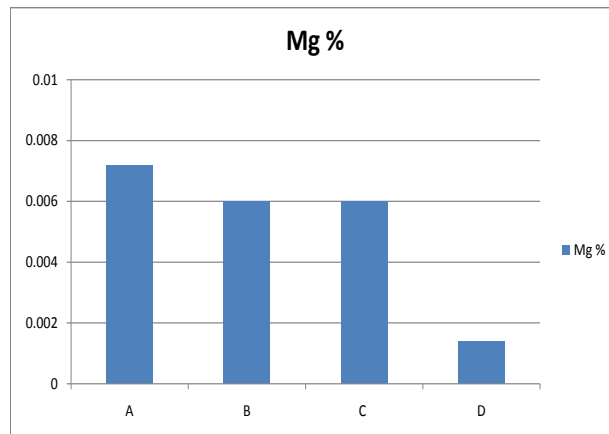


Fig. 4: The ratio of magnesium ions (mg/l) (Mg⁺⁺) in the soil

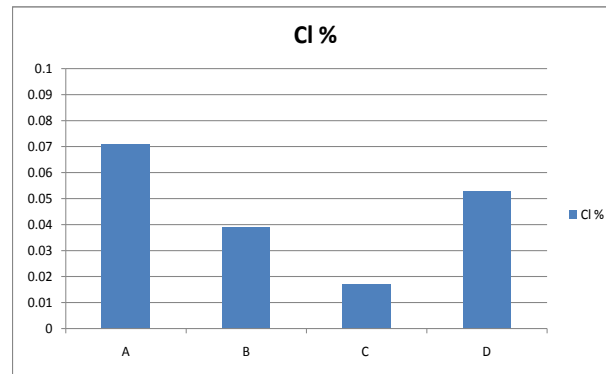


Fig. 5: Percentage of chloride ions (mg/I) Cl⁻ in the soil

Total dissolved salts (TDS):

From the results of the TDS in and Fig. (6), the concentration of total dissolved salts (TDS) in the soil samples near and affected by the sewage plant was high and ranged between 1130- (ppm) 3170. As for the control samples, the percentage of total dissolved salts was (TDS) about (ppm) 1880. The statistical analysis also showed that there is a significant difference between the control sample D and the samples close to the source of pollution (A, B), and the large difference between the control samples and the samples close to the main stream in the concentrations of total dissolved salts (TDS). An indication of contamination of the soil near the stream, and this is consistent with the study of (Mleitan *et al.*, 2019; Al-Rasheed and Mutawakel, 2013).

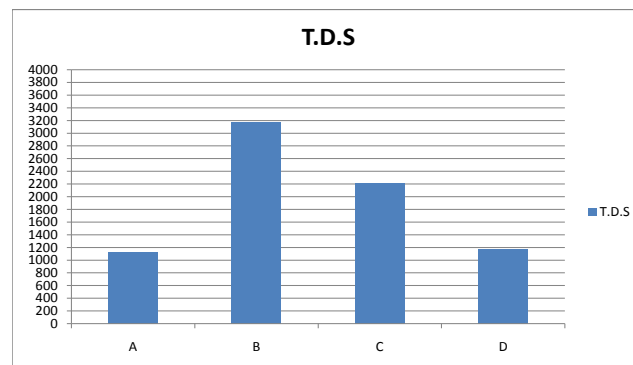


Fig. 6: Total dissolved salts (mg/I) TDS

Soil electrical conductivity EC:

The electrical value is directly proportional to the total amount of dissolved sludge, and according to the following Fig. (7) in soil samples from the main stream (ms / cm). In contrast to the control samples, which were 0.40 (ms/cm) with weak conductivity because they contained low percentages of total dissolved salts (TDS), and this was confirmed by statistical analysis, which showed a significant difference between the control sample D and samples close to the source of pollution. (B, C) This is in agreement with the study (Mleitan *et al.*, 2019) and the study (Al-Rasheed and Mutawakel, 2013). The decrease in EC in some soils, especially on the riverside, may be due to flooding of fields. When the fields are constantly flooded, there is a downward movement of water to the lower horizons and soluble salts also move into these waters, which leads to lower EC (Mehdi *et al.*, 2003). The high EC of some soils irrigated with wastewater can be attributed to the large number of ionic substances and soluble salts, due to the salt content of the local wastewater (Mojiri and Aziz, 2011).

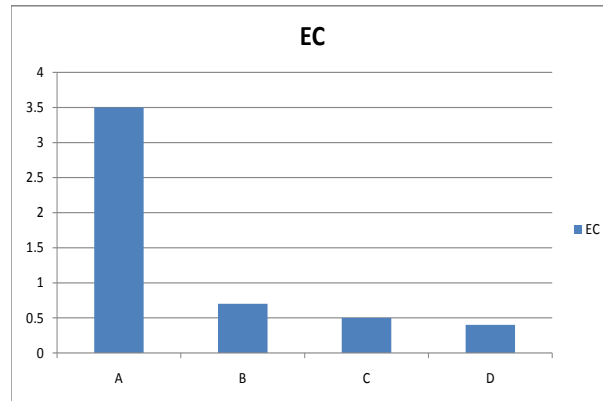


Fig. 7: Soil electrical conductivity (EC) MS/CM

Total hardness TH

The results demonstrated a statistically significant increase in the concentration of total hardness in samples near the source of pollution, which ranged from which are 0.145- 0.025% compared to the control sample far from the source of pollution, which was 0.06%, as shown in Fig. (8). Due to the high concentration of chloride ions, calcium, and magnesium in the soil close to the source of the pollution, where the total hardness increases with the concentration of these elements, as shown in Figs. (3, 4, 5), there is a significant difference between the control sample D and the sample close to the source of pollution (C), and this is considered a natural result (Mleitan *et al.*, 2019).

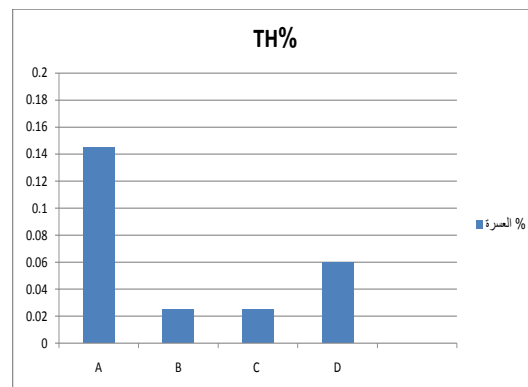


Fig. 8: Total hardness (mg/l) TH of soil

pH:

The difference in soil pH can be attributed to various factors such as the filtration action of water, the nature of the soil, and the mechanical composition. Soil acidity varies from one type to another and sometimes depending on the location of the soil. From the pH results and Fig. (9), Edge and near main stream samples have an average pH between: 7.3 and 6.3.

Soil near the main stream is considered to have low acidity. Since the soil's pH in the control samples was 7.4, it is considered to be just very little alkaline. The findings of the soil analysis make it abundantly evident that the average pH in the polluted soil is lower than the average determined in the uncontaminated soil, and the increase in pH is due to neutral.

This is in line with the research (Al-Rasheed and Mutawakel, 2013), but statistical analysis shows that there are significant differences between the control sample and samples taken close to the source of pollution. According to Algozar and Suresha (2016), the pH balance in some types of soil irrigated with wastewater may be caused by the breakdown of organic matter and the creation

of organic acids (Khai *et al.*, 2008; Vaseghi *et al.*, 2005). Due to the substantial salt content of wastewater, pH values are higher (Bhat *et al.*, 2011).

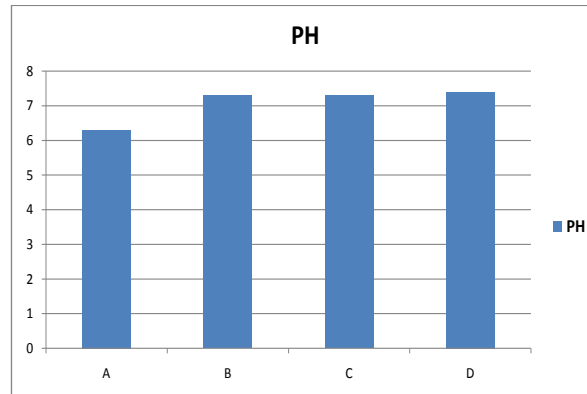


Fig. 9: Soil pH

Organic matter:

According to the OM data in Fig. (10), there is a higher concentration of these organic elements in the samples taken close to the stream, and the ratio drops as one moves away from the bank to the soil samples by 10 and 30 meters, respectively. 2.96%. The OM rate for the control samples was around 2.48% (Green Facts, 22 April 2007). Moving away from a source of polluted water can contribute to a decrease in the percentage of soil organic matter for two reasons;

1. Polluted water often carries various contaminants that can deposit on the soil surface or infiltrate into the soil profile. These contaminants can include industrial pollutants, heavy metals, pesticides, or other harmful substances. Deposition of such contaminants can hinder the decomposition and accumulation of organic matter in the soil.
2. Polluted water may contain toxic substances that can directly or indirectly affect soil organisms responsible for the decomposition of organic matter.

It is clear from the results of the soil analysis that the average degree of OM in the polluted soil is more than the average of the measurement in the uncontaminated soil.

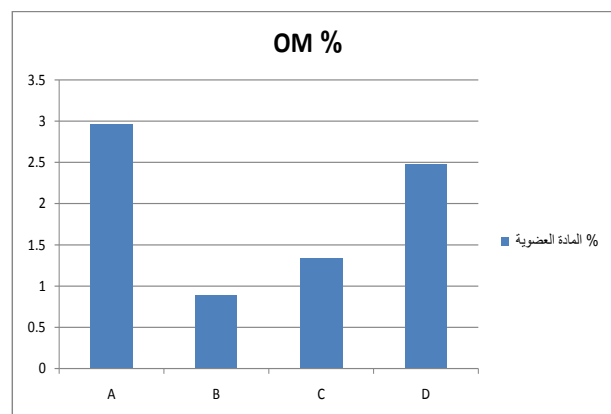


Fig. 10: Soil organic matter

CONCLUSION

The study confirmed the contamination of the area, concluding that the characteristics of the soil studied had witnessed a noticeable change, which indicates the area was polluted with this type of water. The occurrence of many environmental problems that directly affect the quality of the environment, and some of these negative effects can be described as very serious, as they make the area unsuitable for plants and forests in the region, for grazing animals, and for picnic. The occurrence of air pollution with toxic and unpleasant gases emitted from the pollution source, such as hydrogen sulfide (H₂S) and ammonia (NH₃).

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تأثير مياه الصرف الصحي غير المعالجة على بعض خواص التربة في منطقة خبات/ اربيل/ العراق

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الملخص

تم إجراء هذا التحقيق لتحديد مدى تأثير مياه الصرف الصحي غير المعالجة المتسربة على المجاري الرئيسية في منطقة خبات على الخصائص الكيميائية والفيزيائية للتربة. من أجل قياس تركيز الكالسيوم (Ca^{++})، والمغنيسيوم (Mg^{++})، والكلوريد (Cl)، وكذلك الموصلية الكهربائية للتربة (EC)، تم أخذ عينات من الأملاح الذائبة الكلية (TDS) والعسرة الكلية (TH) على عمق يتراوح بين 10-15 سم. بالمقارنة مع عينات التحكم التي تم أخذها على بعد 200 متر من مجرى الرئيسي ولم تتأثر بمياه الصرف الصحي غير المعالجة، فإن عينات التربة القريبة من المجرى الرئيسي تحتوي على تراكيز أعلى بكثير من عناصر الكالسيوم والمغنيسيوم والكلوريد. في التربة مع زيادة نسبة الأملاح الذائبة، مما أدى بدوره إلى زيادة العسرة الكلية وموصلية التربة. هذا يدل على أن التربة ملوثة بالقرب من المجرى الرئيسي، مما يؤثر بشكل أساسي على الحياة النباتية والحيوانية في المنطقة. وأوصت الدراسة بإيجاد حل لمحطة مياه الصرف الصحي في منطقة خبات، بعدم تصريف المياه غير المعالجة مباشرة في الأرض لمنع التلوث والوصول إلى المياه الجوفية، وبذل الجهود لاستخدام هذه المياه بعد معالجتها لأغراض مختلفة.

الكلمات الدالة: مياه الصرف الصحي، التربة الملوثة، الخصائص الكيميائية والفيزيائية.