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Study of Some Heavy Metals Concentrations from the Soil of Selected Areas at the North Part of Basrah, Iraq

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Abstract - The current study was conducted in the north of Basra to show the state of contamination and how it is affected by different pollutants. including heavy elements and some important environmental indicators of the soil. The study period extended from September 2021 to June 2022 to determine the concentrations of some heavy metals in the soil in (wet-dry) where six elements were estimated, namely zinc, copper, lead, nickel, cadmium, and Iron in the exchangeable phase and the residual phase of the soil Heavy elements have been extracted by standard methods and determined by using an atomic absorption spectrometer, as well as the determination of total carbon organic matter (TOC %) and soil texture. Total organic carbon results are shown in the current study in the soil, where the highest value of total organic carbon (TOC %) was recorded in the dry season in Al-Hawyer region station-1which has a value of 0.480 % and a rate of 0.207 % . The lowest value, was 0.02 % and recorded in the AL-Deer Nillage at station-5, with a rate of 0.183 % but the highest value of carbon in the total organic matter (TOC %) in the wet season was recorded in the Al-Nashwa region (0.615 %) at station with a rate of 0.355 % and the lowest value of 0.125 % was in the Al-Hawyer region station-1، and at a rate of 0.16%. The results of heavy metals for the study area in the soil in the dry season of the exchangeable phase showed that the highest rate of elements (zinc, copper, lead, nickel, cadmium and iron) 60.18, 53.37, 22.95, 57.86, 7.46 and 720 µg/g respectively and the lowest rates recorded were : 20.94, 15.01, 11.96, 23.81, 3.11 and 502.32 µg/g As for the results of heavy elements in the residual phase of the soil (zinc, copper, lead, nickel, cadmium and iron), it recorded the highest rates : 93.24, 20.78, 31.63, 77.82, 9.98 and 751 µg/g where the lowest recorded rates were : 47.29, 8.08, 17.19, 53.28, 9.98 and 550.86 µg/g respectively in the wet season. The heavy weight of the study area in the soil of the exchangeable phase showed that the highest rate of the elements zinc, copper, lead, nickel, cadmium, and iron was: 152.70, 25.35, 20.07, 88.32, 6.73, and 703 µg/g respectively ،the lowest recorded rat 17.24, 2.03, 17.10, 20.11, 2.69 and 274 µg/g respectively. The results of heavy metals in the residual phase. The residual zinc element ranged rate between 5.04-41.84 µg/g while the copper element ranged from 0-23.99 µg/g and the lead element ranged from 12.16-24.22 µg/g as for nickel, it ranged between 39.73 and 62.95 µg/g and cadmium ranged from 5.31-10.70 µg/g finally rates of iron elements were also between 504.18 and 721 µg/g.

دراسة تركيز بعض العناصر الثقيلة في التربة لمناطق مختارة في شمال البصرة، العراق

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المستخلص - أجريت الدراسة الحالية في شمال البصرة لبيان حالة التلوث ومدى تأثره بالملوثات المختلفة ومنها العناصر الثقيلة وبعض المؤشرات البيئية المهمة للتربة امتدت فترة الدراسة من ايلول ٢٠٢١ لغايه حزيران ٢٠٢٢ لتحديد تركيز بعض العناصر الثقيلة في التربة والمياه في الموسمين (الجاف-الرطب) حيث قدرت ست عناصر وهي (الزنك-النحاس-الرصاص-النيكل-الكادميوم والحديد) في الطور المتبادل والطور المتبقي بالنسبة للتربة وقد استخلصت العناصر الثقيلة بطرق قياسيه وباستخدام جهاز مطياف الامتصاص الذري ، بالإضافة لذلك تناولت الدراسة تحديد إجمالي الكربون العضوي (TOC%) ونسجه التربة ، اظهرت نتائج العناصر الثقيلة لمنطقة الدراسة في التربة في الفصل الجاف للطور المتبادل ان اعلى معدل للعناصر (الزنك-النحاس-الرصاص-النيكل-الكادميوم-الحديد) كانت (٦٠,٨١ـ ٥٧,٧٣ـ ٢٢,٩٥ ـ ٥٧,٨٦ ـ ٧,٤٦ و ٧٢٠) مايكرو غرام / غرام ، على التوالي واقل معدل سجل(٢٠,٩٤ـ ١٥,٠١ـ ١١,٩٦ ـ ٢٣,٨١ ـ ٣,١١ و ٥٠٢,٣٢) مايكرو غرام / غرام ،على التوالي اما نتائج العناصر الثقيلة في الطور المتبقي للعناصر (الزنك-النحاس-الرصاص-النيكل-الكادميوم والحديد) كانت اعلى معدل (٩٣,٢٤ ـ ٢٠,٧٨ـ ٣١,٦٣ ـ ٧٧,٨٢ ـ ٩,٩٨ ـ٧٥١) مايكرو غرام/غرام, على التوالي واقل معدل سجل (٤٧,٢٩ ـ ٨,٠٨ ـ ١٧,١٩ ـ ٥٣,٢٨ ـ ٦,٢٣ و ٥٥٠,٨٦) مايكرو غرام/غرام، على التوالي اما في الفصل الرطب فقد اظهرت نتائج العناصر الثقيلة لمنطقة الدراسة في التربة للطور المتبادل ان اعلى معدل للعناصر (الزنك-النحاس-الرصاص-النيكل-الكادميوم والحديد) كانت ١٥٢,٧٠ ـ ٢٥,٣٥ـ ٢٠,٠٧ ـ ٨٨,٣٢ ـ ٦,٧٣ و ٧٠٣) مايكرو غرام/غرام، على التوالي اما اقل معدل سجل ١٧,٢٤ ـ ٢,٠٣ ـ ١٠,١٧ ـ ٢٠,١١ ـ ٢,٦٩ و ٢٧٤) مايكرو غرام/غرام ،على التوالي اما نتائج العناصر الثقيلة في الطور المتبقي لعنصر الزنك تراوح اعلى واقل معدل بين ٥,٠٤ ـ ٤١,٨٤ مايكرو غرام/غرام اما عنصر النحاس فقد تراوح بين ٠ ـ ٢٣,٩٩ ميكروغرام/غرام وعنصر الرصاص تراوح بين ١٢,١٦ ـ ٢٤,٢٢ مايكرو غرام/غرام ، اما عنصر النيكل فقد تراوح بين ٣٩,٧٣ ـ ٦٢,٩٥ مايكرو غرام/غرام، وعنصر الكادميوم تراوح بين ٥,٣١ ـ ١٠,٧٠ مايكرو غرام/غرام، اما عنصر الحديد تراوح اعلى واقل معدل بين ٥٠٤,١٨ ـ ٧٢١ مايكرو غرام/غرام .

الكلمات المفتاحية: التلوث المعادن الثقيلة تربة شمال البصرة

Introduction

The term heavy elements cover most elements with atomic numbers over twenty and a density of more than 5g/cm3. The importance of most heavy elements in the living system is due to their ability to form complex organic compounds in addition for being active centers for a large number of enzymes so that they perform functions in the life system, despite their presence in very low concentration cover most of the element, and an excess or deficiency of these elements leads to physiological damage to the living organisms (Al-Saad *et al*., 2003). These elements are an important class of pollutants that have lethal effects and sub-lethal effects on living organisms (Younus and Al-Khafaji, 2020). There are two major sources of heavy metals in the aquatic environment of southern Iraq, natural and anthropogenic (Saleh *et al.*, 2021). In recent years, soil Contamination by heavy metals has received great attention as a global environmental issue and the sources of release of heavy metals into the soil, especially urban soils, are coal burning, fuel, vehicle emissions, mining operations fertilizer and pesticide use, municipal solid waste disposal, and other wastes (Wei and Yang, 2010). It is important to assess the heavy elements in the soil before planting and harvesting crops. Heavy metals may pose a great danger to humans, crops, animals, and water, which may come from oil and gas production activities such as drilling, construction, production, transportation, and use. These elements enter the food chain, increasing the risks to human health (Khudhur *et al.*, 2016). The presence of toxic elements in the soil can prevent the biodegradation of organic pollutants (zhou *et al.*, 2016). The only effective way to remove heavy metals is to extract the polluting elements and it can be achieved by many physical and chemical treatments of the soil, and both methods are expensive and affect the quality of the soil (Borymski and Piotrowska-Seget., 2014). Heavy metals can be a double-edged sword with potentially beneficial and dangerous effects on animal, plant and human life depending on their concentrations, toxicity, and ability to accumulate in the aquatic environment (Al-Maarofi *et al.*, 2013). The accumulation of heavy metals in the human body may severely injure various organs, especially the respiratory, nervous and, reproductive systems. (Huat *et al.*, 2019)

Materials and Methods

Soil samples were collected from six stations in north of Basrah in 2020 and transferred to the laboratory for various analyses. Soil texture was measured according to Folk (1974), and total organic carbon (TOC) in the soil samples was measured according to the combustion method (Ball, 1964).

Extraction of exchanged heavy elements:

Heavy metal ions were extracted in the alternating phase from the soil weighing 1g of the dry sample and placed in a test tube of Teflon (50 ml) with a tight lid, to which 30 ml of hydrochloric acid (0.5 N) was added and placed in a vibrator for a period of time. 16 hours after that, it was separated in a centrifuge at a speed of 4500 rpm for 20 minutes, then the solution was transferred to special plastic bottles, which were kept until measurement by an atomic absorption spectrometer (Chester and Voutsinou, 1981).

Extraction of the Residual heavy elements:

The Residual precipitate part was taken and the digestion process was performed on it for the purpose of extracting the ions of the remaining elements in the soil. The samples were centrifuged at 4500 rpm for 20 minutes to get rid of the wash water and the precipitate was transferred to a Teflon beaker, avoiding any loss of precipitate. sample was evaporated to near dryness at a temperature of 80 C, then 5 ml of concentrated nitric acid were added and evaporated at a temperature of 80 C to near dryness, and then 5 ml of a mixture of hydric acid, fluoric and perchloric acid were added in a ratio of 1:1. After that, evaporated to near dryness and the solution was placed in clean and labeled plastic bottles. The volume was completed with distilled water to 50 ml for the purpose of examination with an atomic absorption spectrometer (Sturgeone *et al.*, 1982).

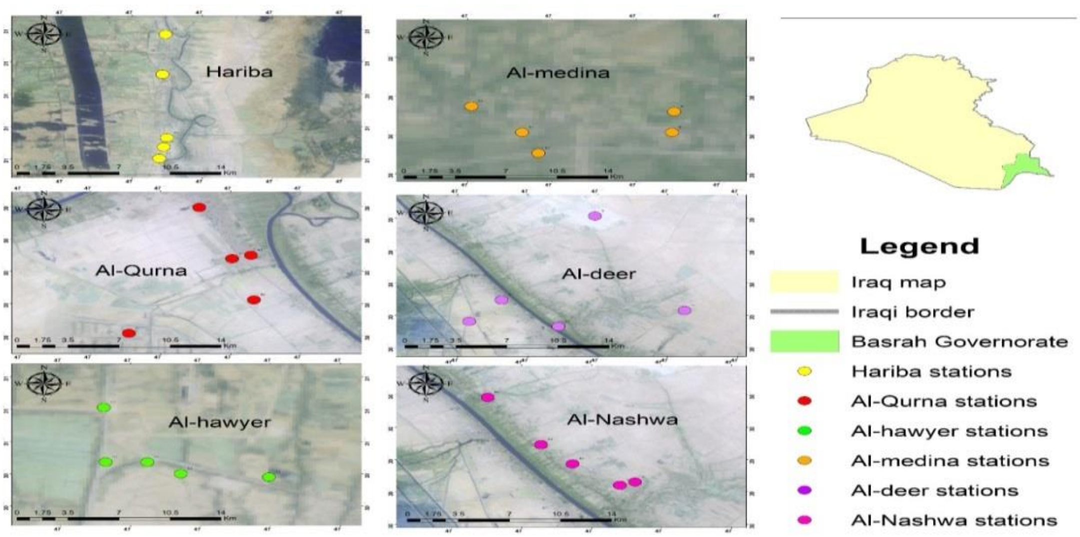


Figure 1. A map showing the sampling areas

Results

Soil Texture:

Table (1) shows the percentage values of the Grain Size Analysis of soil in the study area, where the clay values ranged between 66.16 and 1,825 in the Madinah and AL-Nashwa region, respectively. As for sand, they ranged between 6.56 and 16,491 in the Al-Qurna and Al-Deir regions, while the values for the green were It rang from 24,755-91,053 in Al-Nashwa and Hariba, respectively

Table 1. Measurement of soil texture.

St.no	Locations	Clay %	Sand %	Silt %	Texture
1	Al-Hawyer	6.425	6.858	86.716	Sandy Silt
2	Al-Madinah	1.825	7.197	90.978	Sandy Silt
3	Al-Qurna	3	6.566	90.433	Sandy Silt
4	Hariba	2.25	6.697	91.053	Sandy Silt
5	Al-Deir	3.975	16.491	79.534	Sandy Silt
6	Al-Nashwa	66.16	9.084	24.755	Silty Clay

Total Organic Carbon (TOC):

Figures (2 and 3) show the values of total organic carbon in the soil of the study area, where the highest value in the dry season at Al-Hawyer region (station-1) and was 0.480 with an average of 0.207, while the lowest value was recorded (0.02) in Al-Deir (station-5) with a record rate of 0.183. As for the highest value in the wet season, was 0.615 station, with a rate in the Al-Nashwa of 0.355, and the lowest value 0.125 in Al-Qurna station (station-3), with a rate of 0.161.

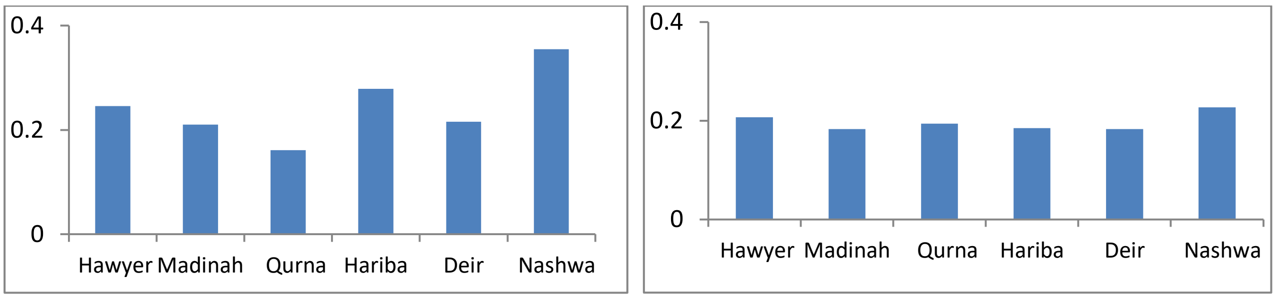


Figure 2. Values of Total Organic Carbon (%) in: (A) dry season and (B) wet season

Heavy Metals:

Zinc

The results of the concentration of zinc element in the soil samples of the study area are shown in Figure (4) The values of the exchanged phase ranged during the dry season between 20.94 and 60.81 µg/g and the highest value was recorded in Al-Hawyer region station-1 and the lowest in the Hariba region station-4.The residual phase ranged between 47.29 and 93.24 µg/g, where the highest value was recorded in the AL- Madinah village station-2, and the lowest value in Al-Nashwa station-6,while the results of the values of zinc during the wet season in the soil samples (Figure 5) showed that the values for the alternating phase changed from 17.24 to 152.70 µg/g, with the highest value was recorded in the AL-Madinah area in the fourth station and the lowest value in the Al-Nashwa region in the second station, while the remaining phase ranged between 5.04 and 41.84 µg/g and the highest value was recorded in the Al-Nashwa region in the fourth station and the lowest value In the area of Al-Hawayr station-1.

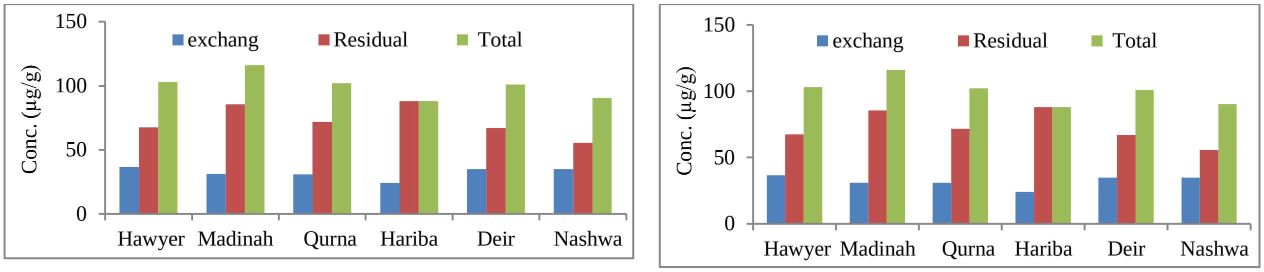


Figure 3. Concentrations of zinc (µg/g) in: (A) dry season and (B) wet season

Copper

The results of the concentration of copper in the soil samples of the study area indicated that (Figure 6) the values of the exchanged phase in the dry season ranged between 15.01 and 57.73 µg/g with the highest value at AL-Qurna region station-3 and the lowest value in the AL-Hariba region station-4, whereas the values of the residual phase ranged between 8.08 and 20.78 µg/g and the highest value was recorded in the Madinah village station-2 and the lowest value in the Al-Nashwa region station-6.(2.03 - 25.35 µg/g) and the highest value was in the Al-Nashwa region station-6 and the lowest value was in the Al-Hawyer region station-1, while the residual phase (Figure7) ranged between 0-23.99 µg/g and the highest value was recorded in the AL-Qurna region station-3 and the lowest value in the monastery area in the second station.

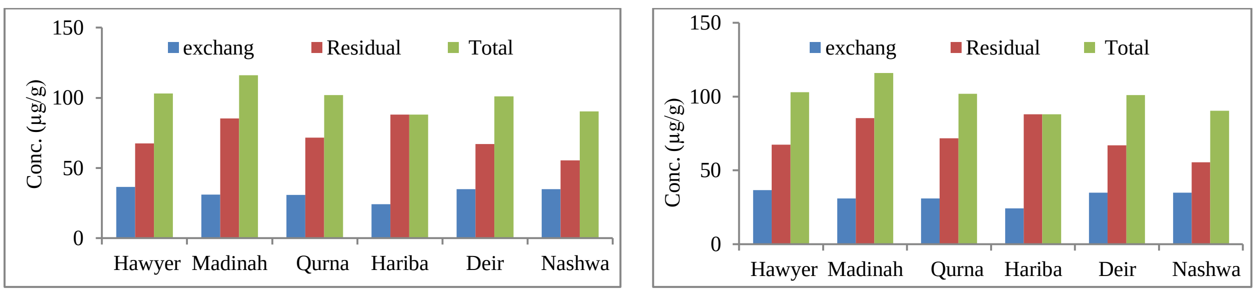


Figure 4. Concentrations of copper (µg/g) in (A) dry season and (B) wet season

Lead

The results of the lead element concentration in the soil samples are shown in Figure (5). The values of the exchanged phase in the dry season ranged between 11.96 and 22.95 µg/g and the results showed that the highest value was in the AL-Hawyer region station-1 and the lowest value in the Medina village station-2. The Residual phase value ranged between 17.19 and 31.63 µg/g, where the highest value was recorded in the Madinah village station-2 and the lowest value in the Hariba region station-4, The results of the lead values during the wet season in the soil samples (Figure9) indicated that the values for the exchanged phase were changed from 10.17-20.07 µg/g, where the highest value was recorded in the AL-Deir area station-5 and the lowest value in the Madinah village station-2, while the results of the residual phase ranged Between 12.16- 24.65 µg /g the highest value was in Al-Hawyer region station-1 and the lowest value in the Madinah village station-2.

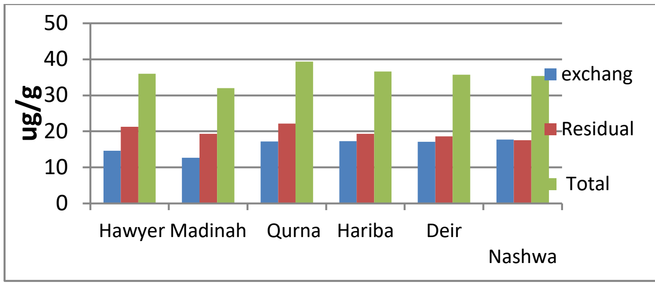


Figure (8) Concentrations of Lead (ug/g) dry season

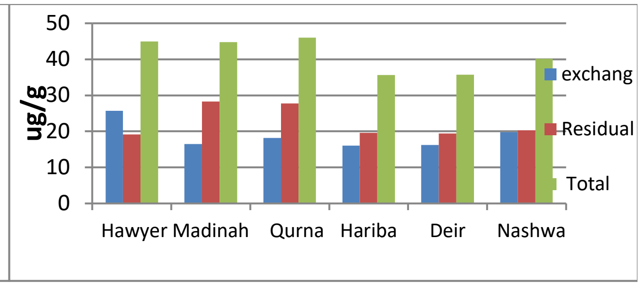


Figure (9) Concentrations of Lead (ug/g) wet season

Nickel

The concentration of nickel in the soil samples in the study area (Figure10), showed the values of the exchanged phase during the dry season ranged between 23.81and57.86 µg/g and the highest value appeared in Al-Hawyer region station-1, and the lowest value in the Hariba region station-4. The Residual phase values ranged between 53.28 and 77.82 µg/g where the highest value was recorded in the Hariba region station-4 and the lowest value in the ecstasy region in the fourth station, As for the results of nickel values during the wet season in soil samples (Figure ١١) for the exchanged phase, it was the changed from 20.11-88.32 µg/g and the highest value was in Al-Hawyer region station-1 and the lowest value in the Hariba region station-4, while the values of the residual phase changed between 39.73 - 62.95 µg/g with the highest value at in Al-Hawyer area station-1 and the lowest value in the Hariba region station-4.

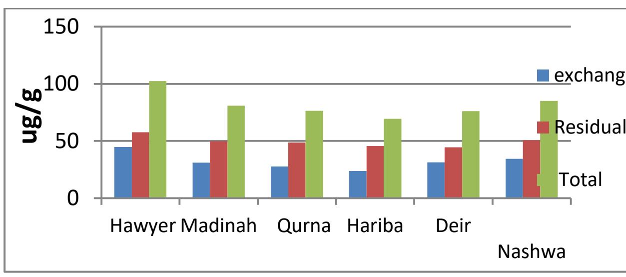


Figure (10) Concentrations of Nickel (ug/g) dry season

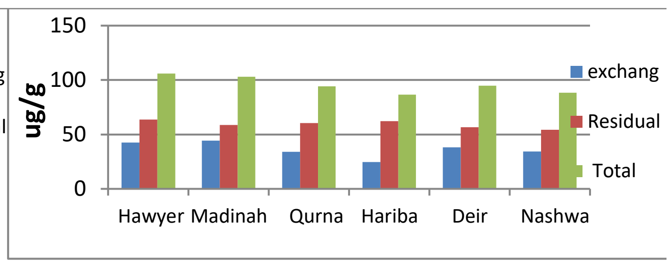


Figure (11) Concentrations of Nickel (ug/g) wet season

Cadmium

The results of the concentration of cadmium element in the soil samples at the study area (Figure 12) suggested that where the values of the exchanged phase during the dry season ranged between 3.11and 7.46 µg/g and the highest value was at AL-Qurna town station-3 and the lowest value AL-Medina region station-2 the values of the residual phase ranged between 6.22 - 9.98 µg/g where the highest value was recorded in the Al-Nashwa region station-6 and the lowest value in the Hariba region station-4, As of the results for the values of cadmium during the wet season in the soil samples (Figure13), the values for the exchanged phase change from 2.69 and 6.73 µg/g, with the highest value was recorded in Al-Deir station-5 and the lowest value in Al-Hawyer station-1, while the residual phase ranged from 5.31 - 10.70 µg/g and the highest value was recorded at Al Hawyer station-1 and the lowest value at AL-Madinah area station-2.

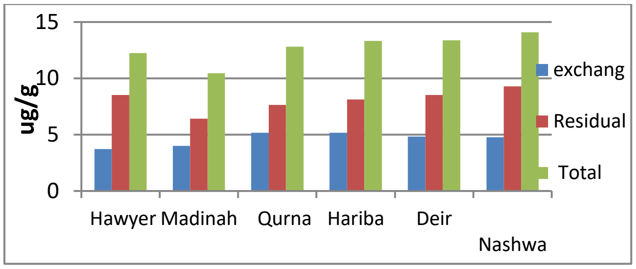


Figure (12) Concentrations of Cadmium (ug/g) dry season

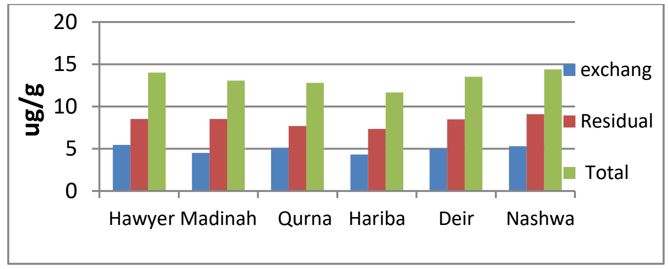


Figure (13) Concentrations of Cadmium (ug/g) wet season

Iron

The results of iron concentrations in the soil samples (Figure14) indicated, that the values of the exchanged phase during the dry season ranged from 502.32 – 720 µg/g and the highest value was recorded at Al-Hawyer station-1 and the lowest at Hariba region station-4.The Residual phase ranged between 550.86 – 751µg/g where the highest value was recorded at AL-Qurna region station-3 and the lowest value at Al-Deir station-5 The results of the iron values during the wet season in the soil samples (Figure15) showed that the values of the exchanged phase ranged between 274 – 703 µg/g where the highest value was recorded at Madinah station-2 and the lowest value at Al-Nashwa station-6, while the values of the residual phase ranged between 504.18 and 721 µg/g the highest value was recorded in Al-Hawyer region station-1 and the lowest value in the Qurna region station-3.

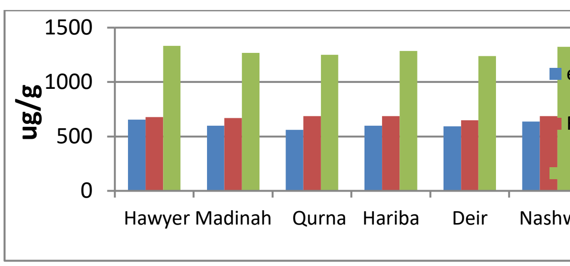


Figure (14) Concentrations of iron (ug/g) dry season

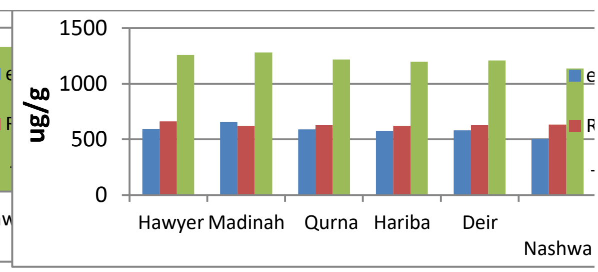


Figure (15) Concentrations of iron (ug/g) wet season

Soil Contamination Assessment

Geo accumulation Index (I-geo)

zinc

The values of I-geo for zinc of the soil samples in the study area (Figure16) during the dry season, indicated that the highest value was 0.325 at the AL-Hawyer station-1 and the lowest value 0.190 at Al-Nashwa station-6. During the wet season (Figure 17), the highest value (0.406) was recorded at station-3 and the lowest value (0.080) AL-Qurna station-3.

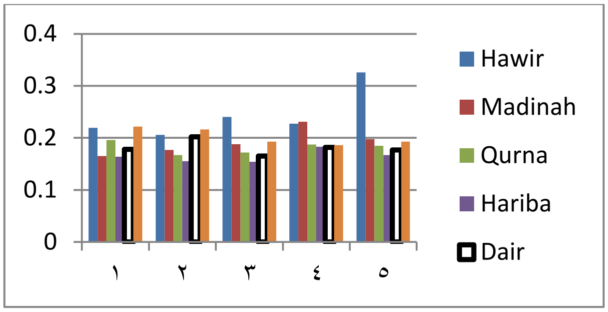


Figure (16) value (I-geo) (Zn)

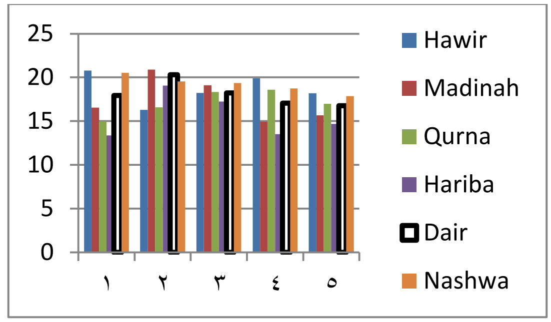
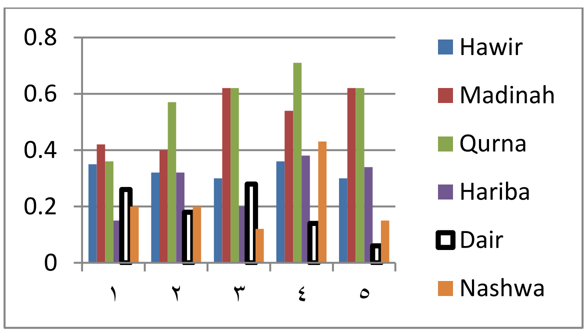


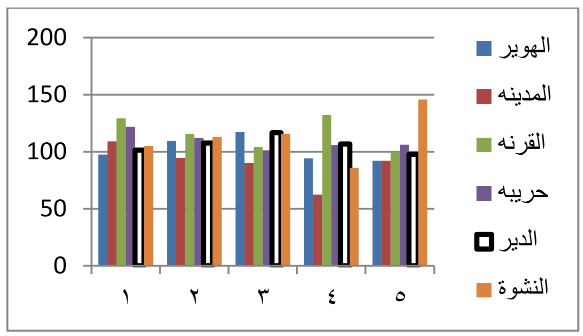
Figure (17) value (I-geo) (Zn) wet season dry season

Copper

I-geo values of the copper at the soil samples in the study area during the dry season (Figure18), showed that the highest value (0.246) was recorded at AL-Qurna station-3, and the lowest value (0.084) was recorded at Al-Nashwa station-3, While the copper values during the wet season (Figure19) recorded the highest rate (0.14) at AL-Qurna station-3 and the lowest value (0.01) at AL-Deir station-5.



Figure(18)value (I-geo) (cu) dry season



Figure(19) value (I-geo) (cu) wet season

Lead

The highest value of (I-geo) for the lead element in the soil samples at the study area (Figure 20) in the dry season was 0.757 at Al-Hawyer station-1, and the lowest value (0.460) was recorded at station-4 Hariba. As for the wet season (Figure 21), the highest value (0.599) was recorded at AL-Qurna station-2, and the lowest value (0.319) in the Madinah station-2.

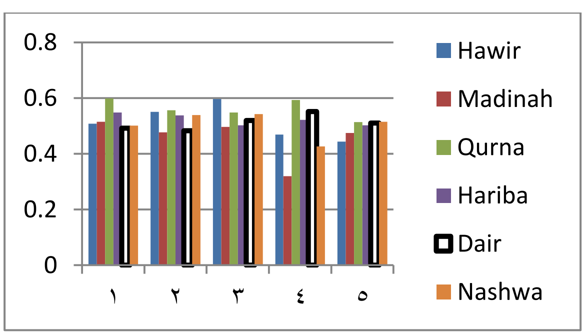


Figure (20) value (I-geo) (PB) dry season

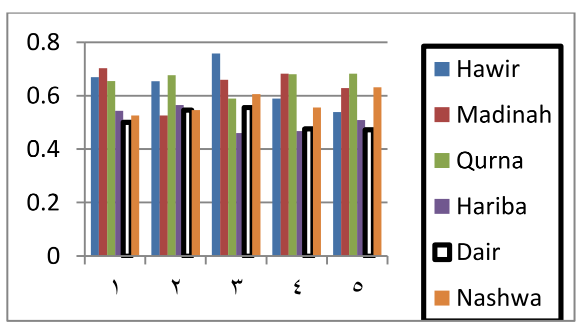


Figure (21) value (I-geo) (PB) wet season

Nickel

The I-geo value of nickel in the soil samples at the study area in the dry season (Figure 22), the highest (0.293) was recorded at Al-Hawyer station-1 and the lowest rate (0.188) at Hariba region station-4, During the wet season (Figure 23), the highest value of nickel was 0.326 in Al-Hawyer area station-1 and the lowest value 0.154 at station4- Hariba

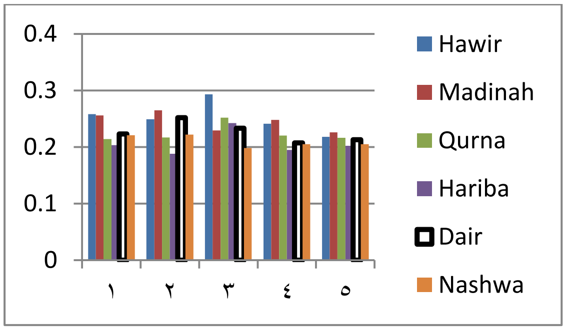


Figure (22) value (I-geo) (Ni) dry season

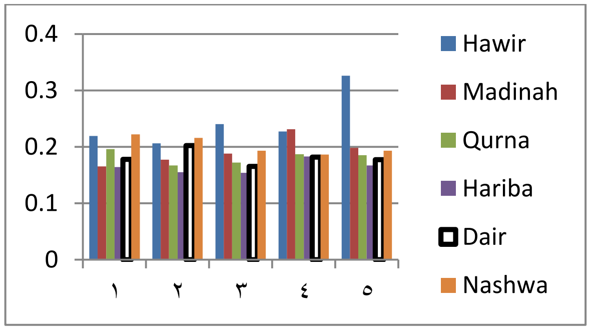


Figure (23) value (I-geo) (Ni) wet season

Cadmium

The highest I-geo value of cadmium in the soil samples during the dry season (Figure 24), was (20.893) recorded in Medina station-2, while the lowest rate (13.36) was recorded in the Hariba area at station-4, As for the values of cadmium during the wet season (Figure 25), the highest value (21.493) was recorded in AL-Deir station-5 and the lowest value (12.466) at AL-Madinah station-2.

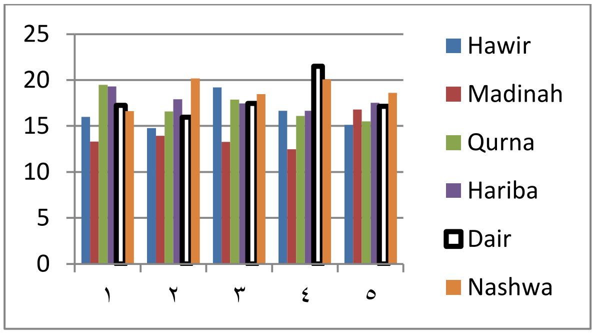


Figure (24) value (I-geo) (cd) dry season

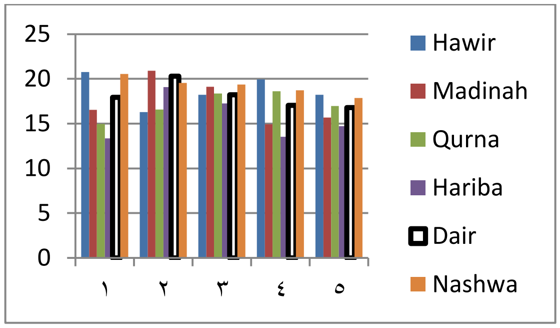


Figure (25) value (I-geo) (cd) wet season

Enrichment Factor:

Zinc

The highest value (EF) of zinc at the soil samples in the study area during the dry season (Figure 26), was recorded (65.80) AL-Deir station-5, and the lowest value (35.92) was recorded at Al-Nashwa station-6, During the wet season (Figure 27), the highest value (80.43) was recorded at the Hariba area station-4 and the lowest value (15.56) at AL-Qurna station-3.

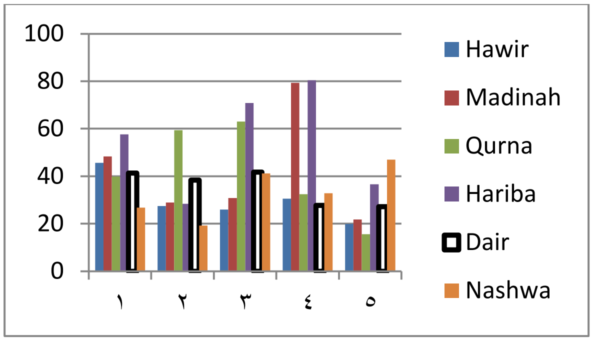


Figure (26) the enrichment factor (Zn) dry season

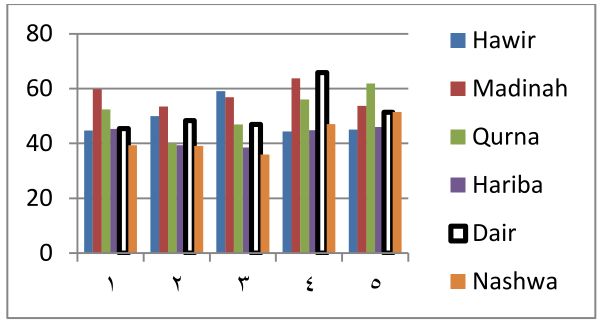


Figure (27) the enrichment factor (Zn) wet season

Copper

The highest value (EF) of copper in the soil samples during the dry season (Figure 28),(48.67) was at Al-Qurna station-3 and lowest (15.82) at Al-Nashwa station-6, While during the wet season (Figure 29), the highest value (31.66) was recorded at AL-Qurna station-3 and the lowest value (5.36) at Al-Nashwa region station-6.

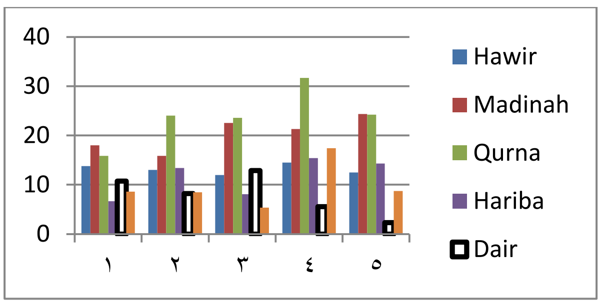


Figure (28) of the enrichment factor (cu) dry season

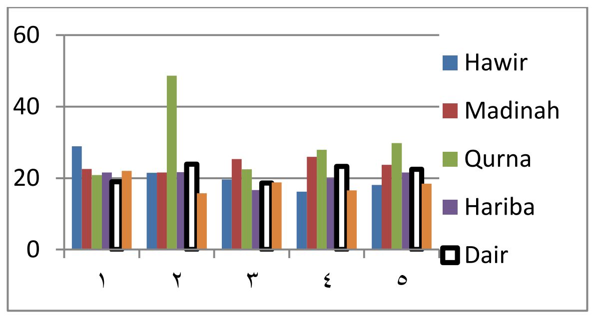


Figure (29) of the enrichment factor wet season

Lead

The highest (EF) of lead in the soil samples during the dry season Figure (30), value (of 147.19) was recorded AL-Qurna station-3, and the lowest value (79.65) was recorded Hariba station-4, As for the results of lead during the wet season (Figure 31), the highest value (145.64) was recorded at Al-Nashwa station-6, and the lowest value was (85.87) at Al-Nashwa station-6.

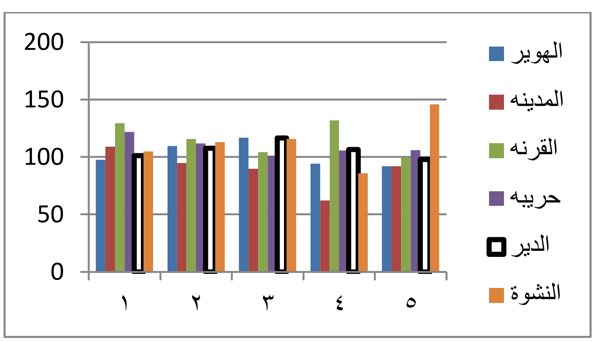


Figure (30) of the enrichment factor (Pb) dry season

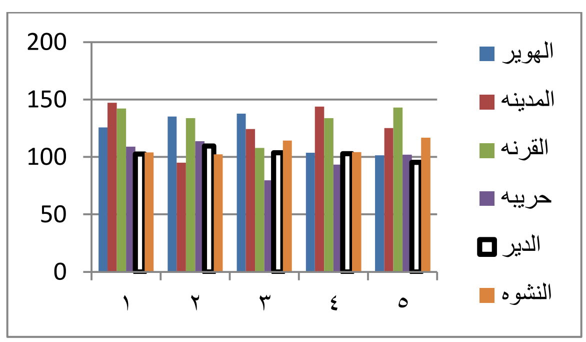


Figure (31) of the enrichment factor (Pb) wet season

Nick

The highest value (EF) of nickel in the soil samples during the dry season (Figure 32), (53.74) was recorded at Madinah station-2, while the lowest value (37.40) was recorded at Al-Nashwa station-6, As for the wet season (Figure 33), the highest value was (67.56) at Al Hawyer area station-1 and the lowest value (31.04) at Hariba station-4.

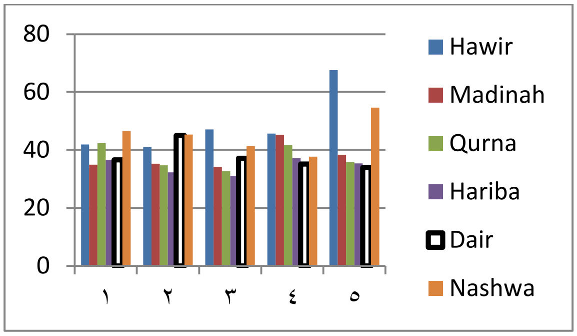


Figure (32) of the enrichment factor (Ni) dry season

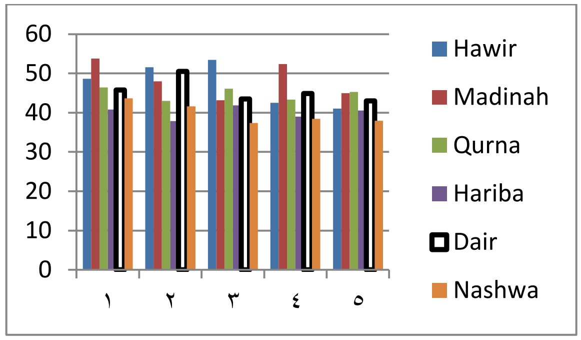


Figure (33) of the enrichment factor (Ni) wet season

Cadmium

The highest value (EF) of cadmium in the soil samples during the dry season (Figure 34) was (4065.17) at AL-Deir station-5, and the lowest value (2676.28) was recorded at the Hariba station-4, The results of cadmium during the wet season (Figure35) recorded the highest rate (5254.23) at Al-Nashwa station-6 and the lowest value (2398.84) at AL-Madinah station-2.

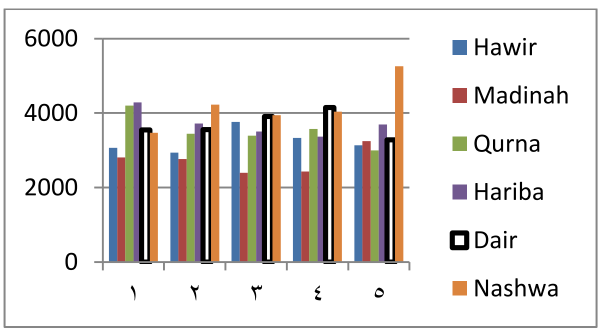


Figure (34) of the enrichment factor (cd) dry season

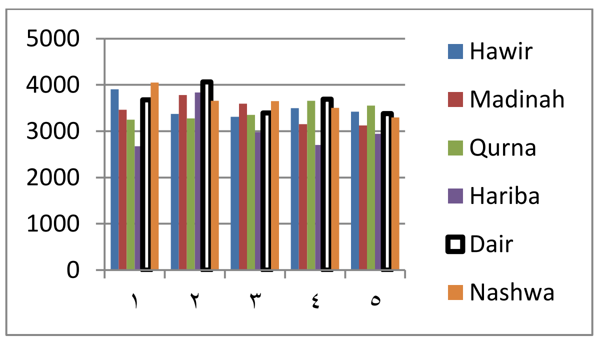


Figure (35) of the enrichment factor (cd) wet season

Contamination Factor

Zinc

The highest value (CF)) of zinc in the soil samples in the dry season (Figure36) was (1.62) at Al-Hawyer station-1, and the lowest value (0.95) was recorded at Al-Nashwa station-6, As for the results in the wet season (Figure37), the highest value (2.03) was recorded at AL-Madinah station-2, and the lowest value was (0.40) at AL-Qurna station-3.

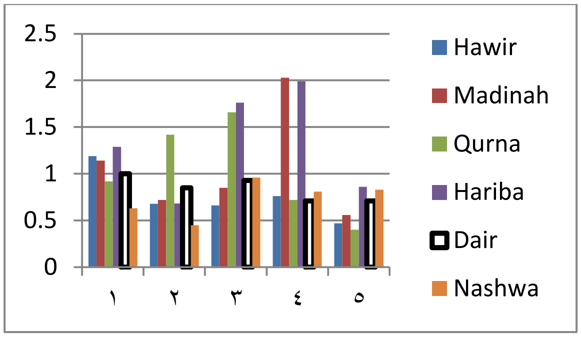


Figure (36) of the Contamination factor (Zn) dry season

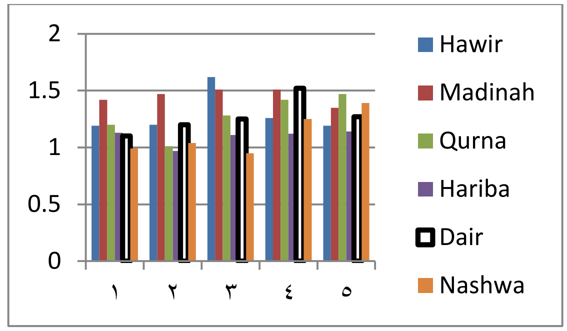


Figure (37) of the Contamination factor (Zn)wet season

Copper

The highest value (CF)) of copper in the soil samples during the dry season (Figure 38), was 1.23 in the AL-Qurna station-3 and the lowest value (0.42) at Al-Nashwa station-6, The copper valves during the wet season (Figure39) were high (0.71) at AL-Qurna station-3 and low in value (0.12) at Al-Nashwa station-6.

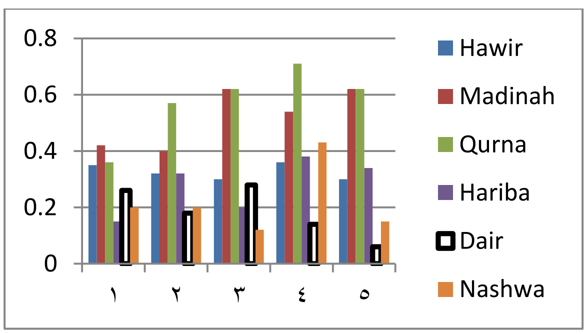


Figure (39) of the Contamination factor (cu) wet season

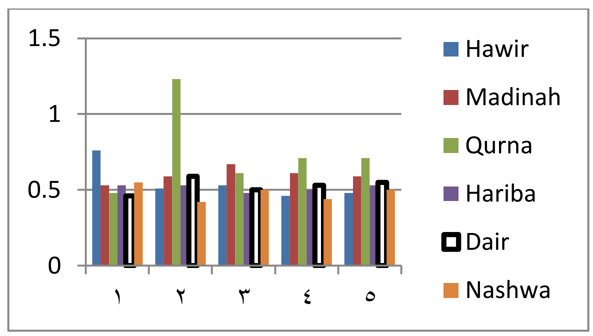


Figure (38) of the Contamination factor (cu) dry season

Lead

The highest value (EF) of lead element in the soil samples in the dry season (Figure 40) was value 3.78 at Al-Hawayr station-1 and the lowest value was 2.30 at Hariba station-4, As for the results of lead during the wet season (Figure 41), the highest value (2.99) was recorded at AL-Qurna station-3 and the lowest value (1.59) at AL-Medina station-2.

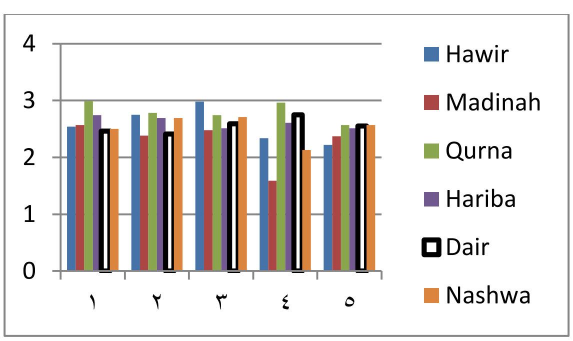


Figure (40) of the Contamination factor (Pb) dry season

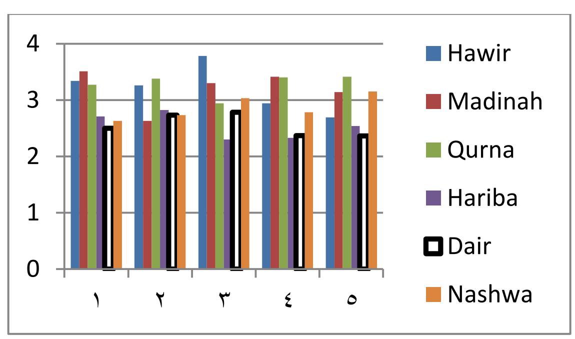
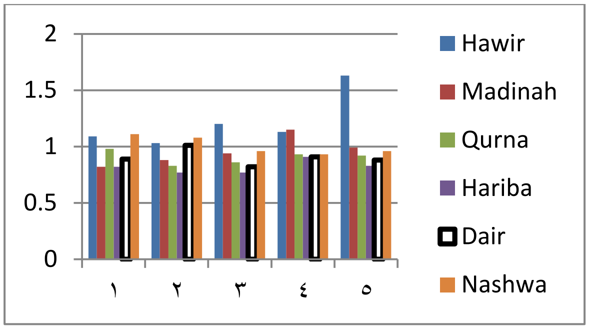


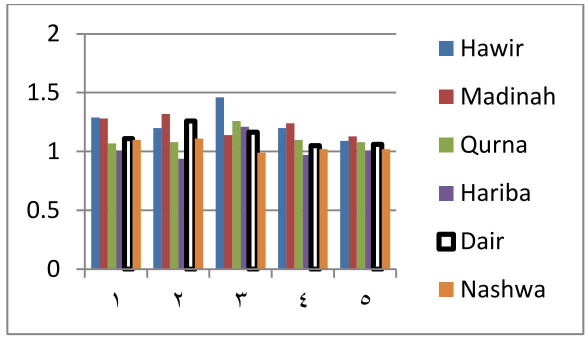
Figure (41) of the Contamination factor (Pb) wet season

Nickel

The highest value (CF) of nickel in the soil samples in the dry season (Figure 42), (1.46) was recorded at Al-Hawyer station-1, and the lowest value (0.94) was recorded at AL-Hariba station-4, As for the values of nickel during the wet season (Figure 43), the highest value (1.63) was recorded at Al-Hawayer station-1, and the lowest value was (0.77) at the Hariba station-4.



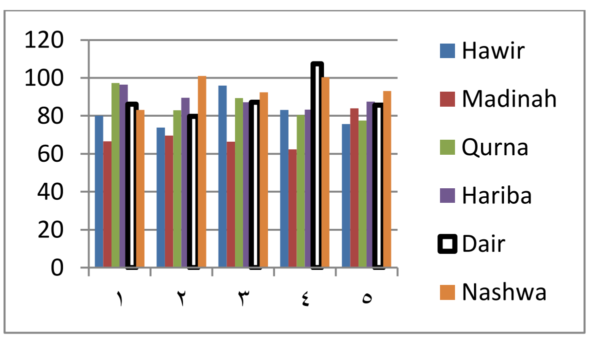
Figure(42) of the Contamination factor (NI) dry season



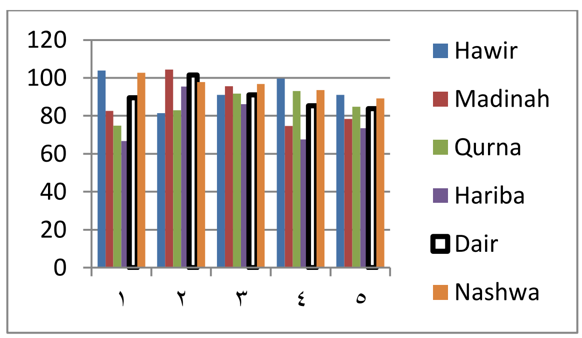
Figure(43) of the Contamination factor (NI) w season

Cadmium

The value of the Contamination factor of cadmium in the soil samples in the dry season (Figure 44), was 104.46 at AL-Madinah station-2, and the lowest value (67.6) at AL-Hariba station-4, As for the values of cadmium during the wet season (Figure 45), it showed the highest value (107.46) at AL-Deir station-5 and the lowest value (62.33) at AL-Madinah station-2.



Figure(44) of the Contamination factor (cd) dry season



Figure(45) of the Contamination factor (cd) wet season

Discussion

Soil Texture:

The results of the grain size analysis of the studied soil showed that the soil was sandy silty at the five stations and silty clay at the sixth station

Total Organic Carbon (TOC):

When observing the values of total organic carbon, we note that its percentage is low relative to the studied soils due to the lack of organic matter, as well as due to the lack of natural processes of oxidation of organic matter by microorganisms and the long distance of the study area from human activity such as agricultural contributions like agricultural fertilizers and industrial waste in the study area

Heavy Metals:

Through the results, we find that there is a high percentage of Contamination due to the use of pesticides, the use of chemicals in agriculture, the proximity of the study area to transportation its proximity to oil Contamination, and because of household waste, sewage, and in the environment, in addition to the impact of transportation and fuel combustion (Thorpe and Harrison, 2008). Al-Halfy *et al.*, (2021) In the North Rumaila field, found that the zinc concentration is lowa compared to the current study, due to the lack of environmental factors in the study area.It was also found that there is a high percentage of copper Contamination because the studied lands are agricultural lands, close to areas of oil Contamination, close to rivers and transportation routes, and because of the corrosion of brake linings on highways, in addition to the effect of car exhaust, tire residues, and other oil pollutants in increasing the concentration of copper in the soil of the area. According to the current results, there is a high percentage of lead Contamination caused by the excessive use of chemical fertilizers and pesticides, as well as the proximity of the study area to areas of oil Contamination and household waste in the environment, and its concentration in the environment increases indirectly as a result of the destruction and decomposition of organisms (Kwon and Lee, 2001). There is a high percentage of nickel Contamination due to dust caused by wind and fuel oil due to the proximity of the study area to public roads and car traffic, and oil Contamination The use of some phosphate fertilizers is also an important source of nickel in the environment as a polluting material in a study conducted by Al-Hassan,(2011) on the soil of Basra, it was found that the concentration of formed nickel Approximate nickel values in the current study. Through the values of the current results, it was found that the percentage of cadmium Contamination is medium due to the lack of human activity in the study area because the study area is agricultural land as well as due to the lack of use of mineral fertilizers, especially phosphate fertilizers and agricultural herbicides, (Scragg, 2006). The current results showed that the percentage of iron Contamination is high, and the reason for this is the proximity of the study area to oil Contamination as well as because the iron element increases at absorption with the increase in the content of clay and organic matter in the soil in addition to the expected sources of iron in the soil due to cars (Alex *et al.*, 2017).

Soil Contamination Assessment:

The results of the (I-geo) values for the elements (zinc, copper, lead, nickel, cadmium, and iron) in the soil of the study area, the results zinc element were unpolluted to low Contamination, while the results of the copper element were unpolluted to low contamination, and the results of Lead was unpolluted to little polluted and nickel was unpolluted to little polluted. As for cadmium, the study area is considered to be very polluted. As for the results of iron values, the geochemical aggregation factor is stable in the two seasons.

Enrichment Factor:

Through the results of the enrichment factor of the elements zinc, copper, lead, nickel, cadmium, and iron) in the soil of the study area, the results of the zinc element were highly enriched in the wet season and had a very high percentage of enrichment in the dry season, through the values of the results of the enrichment factor of copper The copper element is highly enriched in the dry season and has an important percentage of enrichment in the wet season, as suggested by Atgin *et al.*, (2000), Through the results of the enrichment factor of the lead element, it was shown that the element of lead is highly enriched in the dry and wet seasons. As for the results of the values of the enrichment factor for cadmium, they showed that cadmium is highly enriched in the wet and dry seasons. As for the results of the values of iron, the enrichment factor is constant in both seasons.

Contamination Factor:

Through the results of the Contamination factor values of zinc in the soil of the study area, it was shown that the zinc is moderately polluted in the wet season and is less polluted in the dry season. Lead is highly polluted in the dry season and moderately polluted in the wet season, As for nickel, the element is moderately polluted in the wet season and little polluted in the dry season. Through the results of factor values, it is suggested that cadmium is highly polluted in both seasons (dry-wet). As for the results of the iron element values, the Contamination factor is constant in the two seasons.

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