Radiation Hazard Assessment by Measuring of Soil Radioactivity Levels in Al-anbar (Al-fallujah District) and Wasit Governorate in Iraq

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Abstract: Soil samples were collected from two region Al-anbar (Al-fallujah district) and Wasit of Iraq with an aim to determine the activity concentration using a coaxial high purity germanium (HPGe) detector based on high-resolution gamma spectrometry system. $^{226}$Ra, $^{232}$Th, the primordial radionuclide $^{40}$K, and the artificial radionuclide $^{137}$Cs were measured in the soil of the study area. The mean radioactivity concentration in Al-anbar (Al-fallujah district) and Wasit region due to $^{226}$Ra, $^{232}$Th, $^{40}$K, and $^{137}$Cs was (20.36, 11.08, 226.97, and 1.01 Bq kg$^{-1}$) and (23.01, 14.45, 290.64, and 2.22 Bq kg$^{-1}$), respectively. Radium equivalent activity ($^{Ra}_{eq}$), representative level index ($I_{\gamma}$), absorbed gamma dose rate ($D$) in air, total annual effective dose equivalent (AEDE) from the terrestrial gamma radiation, the external and internal hazard index were estimated. The mean of six hazard index values came out to be (53.67 Bq kg$^{-1}$, 0.38 Bq kg$^{-1}$, 24.78 Bq kg$^{-1}$, 0.15 mSv y$^{-1}$, 0.14 Bq kg$^{-1}$, and 0.19 Bq kg$^{-1}$) in Al-anbar (Al-fallujah district) and (66.17 Bq kg$^{-1}$, 0.49 Bq kg$^{-1}$, 32.08 Bq kg$^{-1}$, 0.20 mSv y$^{-1}$, 0.18 Bq kg$^{-1}$, and 0.24 Bq kg$^{-1}$) in Wasit, respectively. Present data have been compared with the published data for other regions of the world near from the study area and found to be safe for public and environment.

Keywords: Radiation Hazard, Annual Effective Dose, Gamma Spectrometry

1. Introduction

Human beings have always been exposed to natural radiations arising from within and outside the earth. The primordial radionuclides have radioactive decay half-lives that are approximately earth’s age. The exposure to ionizing radiations from natural sources occurs because of the naturally occurring radioactive elements in the soil and rocks, cosmic rays entering the earth’s atmosphere from outer space and the internal exposure through incorporation of these radionuclides into the body by inhalation or ingestion. These radionuclides and their radioactive decay products are an important source of earth’s radioactivity [1, 2]. The natural radioactivity in soil primarily comes from $^{238}$U and $^{232}$Th series and natural $^{40}$K. Artificial radionuclides can also be present such a $^{137}$Cs, resulting from fallout from weapons testing and from accidents such as Chernobyl. The radiological implication of these radionuclides is due to the gamma ray exposure of the body and irradiation of lung tissue from inhalation of radon and its daughters. The great number of decay products of $^{238}$U and $^{232}$Th series and $^{40}$K are the main components of external gamma radiation originating from soil. Therefore, the assessment of gamma radiation dose from natural sources is of particular importance as natural radiation is the largest contributor to the external dose of the world population [1]. The average annual radiation dose to world population is 2.8 mSv approximately 85% (2.4 mSv) of this comes from natural radionuclides of both terrestrial and cosmogenic origin [3]. $^{137}$Cs is regarded as the most important constituent of worldwide radioactive fallout. Sixty percent of the collective effective dose equivalent commitment from external radiation associated with past atmospheric...
nuclear weapon testing may be attributed to $^{137}$Cs. In the case of an accidental release of fission products from a nuclear power plant, cesium isotopes are especially significant due to their volatility and large inventory that builds up in the reactor over time. Therefore, measurement of $^{137}$Cs levels in soil is necessary in the environment of a studied area as such a data would serve as the baseline data. Its presence in soil would be an indicator that the area under study might have received some fallout radioactivity in the past [4]. The specific levels are related to the types of rock from which the soils originate. Higher radiation levels are associated with igneous rocks, such as granite, and lower levels with sedimentary rocks [1]. The radiation levels are associated with igneous rocks, such as granite, and lower levels with sedimentary rocks [1].

The present study deals with the measurement of specific cesium isotopes in soil. Its presence in soil would be an indicator that the area under study might have received some fallout radioactivity in the past [4]. The specific levels are related to the types of rock from which the soils originate. Higher radiation levels are associated with igneous rocks, such as granite, and lower levels with sedimentary rocks [1].

2. Materials and Methods

2.1. Description of Study Area

Soil sampling was carried out in 2011. The geological locate of the two governorate Al-anbar (Al-fallujah district) and Wasit at west and middle of Iraq. Soil samples were collected from three selected sites at Al-anbar (Al-fallujah district) governorate and six selected sites at Wasit governorate, which were chosen for two reasons: first record rise in cancers and birth defects rates in the surrounding residential areas of sites according to the information that has been obtained from hospital near the sites or from the governorate council and the second that these areas have seen some of them military operations were reconstruction and other division is the remnants of the wreckage of vehicles and wheels military destroyer and some rubble of buildings. The description of the study area has been reported elsewhere in reference [5]. Tables 1 & 2 were shown the description of the study area at Al-anbar (Al-fallujah district) and Wasit governorate respectively while Figure 1 was shown the soil sampling locations on map of Al-anbar (Al-fallujah district) and Wasit governorate respectively.

### Table 1. The description of the study area at Al-anbar (Al-fallujah district) governorate.

| Sample No. | Sample ID | Location description | Latitude  | Longitude  |
|------------|-----------|----------------------|-----------|------------|
| 1          | B.G.S1    | Golan background (its far 1000 m from Golan selected area). | 33.36864  | 43.76478   |
| 2          | S1-1      | Golan district near the railroad tracks (rubble, with height 2m and area (400 × 1000) m$^2$). | 33.36830  | 43.75455   |
| 3          | S1-2      | Golan district-residential neighborhood (rubble, with height 2m and area (250×400) m$^2$). | 33.35956  | 43.75394   |
| 4          | S1-3      | Golan district-rivers edge (rubble, with height 2m and area (4×100) m$^2$). | 33.35384  | 43.7591    |
| 5          | B.G.S2    | Al-shuhada district background (its far 1000 m from Al-shuhada selected area). | 33.33219  | 43.80234   |
| 6          | S2-1      | Al-shuhada district-residential region (rubble, with height 2m and area (250×600) m$^2$). | 33.32848  | 43.79225   |
| 7          | S2-2      | Al-shuhada district-land region (rubble, with height 2m and area (20×25) m$^2$). | 33.33928  | 43.79327   |
| 8          | B.G.S3    | Jubail district background (its far 1000 m from Jubail selected area). | 33.33281  | 43.77237   |
| 9          | S3-1      | Jubail district-dam way (rubble, with height 1m and area (25×50) m$^2$). | 33.32701  | 43.78090   |
| 10         | S3-2      | Jubail district-Flah Revir area (residential district). | 33.33965  | 43.77910   |
| 11         | S3-3      | Jubail district. | 33.34213  | 43.76955   |

### Table 2. The description of the study area at Wasit governorate.

| Sample No. | Sample ID | Location description | Latitude  | Longitude  |
|------------|-----------|----------------------|-----------|------------|
| 1          | B.G.S1    | Governorate office background (its far 1000 m from selected area). | 32.51353  | 45.81960   |
| 2          | S1        | Governorate council office (This site is subjected to a military strike, which has been reconstruction, and there are some debris and soil is left in strike place). | 32.50436  | 45.82496   |
| 3          | B.G.S2    | Alsharqiya Alkhajah region background (its far 1000 m from selected area). | 32.52886  | 45.78931   |
| 4          | S2        | Alsharqiya Alkhajah region (residual wreckage of military vehicle). | 32.52956  | 45.80229   |
| 5          | B.G.S3    | Taba healthy center background (its far 1000 m from selected area). | 32.51252  | 45.81259   |
| 6          | S3        | Taba healthy center. | 32.50632  | 45.81761   |
| 7          | B.G.S4    | Shield factory background (its far 1000 m from selected area). | 32.91072  | 45.06351   |
| 8          | S4        | Shield factory in Alaziziyia region (surface radiological survey / rubble, with height 1m and area 400 m$^2$). | 32.90719  | 45.07164   |
| 9          | B.G.S5    | Saad abn maath school background (its far 1000 m from selected area) | 32.90509  | 45.05841   |
| 10         | S5        | Saad abn maath school in Alaziziyia region (surface radiological survey for land of school which used as military replacement site | 32.91008  | 45.05025   |
2.2. Sample Preparation

At each site, samples were taken from layer down to 25 cm depth. Fine quality of the sample was obtained using sieve of 9 mesh size (2 mm particle size). An average 0.5 kg of soil was used per sample. Before measurement samples were dried in an oven at a temperature of 80°C for 8 hr. These samples were packed and sealed in a marinelli beaker and kept for about 3 week period to allow radioactive equilibrium among the daughter products of radon, thoron and their short lived decay products [6].

2.3. Sample Analysis

The samples were analyzed at MOST Gamma Ray Spectrometry laboratory. Using high- resolution gamma spectrometry system consists of coaxial High Purity Germanium (HPGe) detector. The detector has resolution of 2.0 keV and relative efficiency of 40% for 1.33 MeV gamma energy of Co-60. The detector was shield with lead of thickness 10 cm and internally lined with 3 mm copper to reduce the environmental gamma background radiation. The efficiency calibration of the system was employed by reference materials. The gamma ray spectrum was recorded using software GENIE-2000. $^{226}$Ra was assessed through the photo peaks of its daughters: $^{214}$Pb (352 keV) and $^{214}$Bi (609keV) furthermore the concentration of $^{232}$Th was determined through the photo peaks of $^{228}$Ac (911keV) and $^{212}$Pb (238.6 keV). $^{40}$K and $^{137}$Cs were measured directly from their 1460.8, 662 keV gamma ray peaks [5].

2.4. Radiation Hazard Indices

2.4.1. Radium Equivalent Activity

To represent their specific activities levels of $^{226}$Ra, $^{232}$Th, and $^{40}$K by a single quantity which take into calculation the radiation hazards related with them, a common radiological index has been used which is radium equivalent ($Ra_{eq}$). To define $Ra_{eq}$ activity, it can be assumed that 1 Bq/kg of $^{226}$Ra, 0.7 Bq/kg of $^{232}$Th or 13 Bq/kg of $^{40}$K give the same dose of gamma ray.

The mathematically defined by Eq. (1) [4 & 7]

$$Ra_{eq} = C_{Ra} + 1.43C_{Th} + 0.077C_{K} \leq 370$$

Where $C_{Ra}$, $C_{Th}$, and $C_{K}$ are the activity concentrations of $^{226}$Ra, $^{232}$Th, and $^{40}$K in Bq/kg

2.4.2. Representative Level Index ($I_r$)

The representative level index ($I_r$) used for the calculation of gamma radiation associated with the natural radioactive materials in the soil. It is calculated using Eq. (2). The safety value for this index is \( I_r \leq 1 \) [8 & 9]

$$I_r = \frac{C_{Ra}}{150} + \frac{C_{Th}}{100} + \frac{C_{K}}{1500} \leq 1$$
2.4.3. Air Absorbed Radiation Dose Rate

Adsorbed dose rate in air at a height of about 1 meter above the ground surface due to gamma radiations for uniform distribution of the naturally occurring radionuclides of 226Ra, 232Th and 40K is calculated using Eq. (3). The conversion factor of 0.462 nGy h^-1/Bq kg^-1 for 226Ra, 0.621 nGy h^-1/Bq kg^-1 for 232Th, 0.0417 nGy h^-1/Bq kg^-1 for 238U, and 0.136 nGy h^-1/Bq kg^-1 for 137Cs was calculated using Eq. (4 & 5). The conversion coefficient from the general public due to the radioactivity in soil was calculated using Eq. (4 & 5) the conversion coefficient from 2.4.4. Annual Effective Dose Rate

The annual effective dose rates expected to be received by organs. The internal hazard indexes (H<sub>i</sub>) are used [1, 4, 7]. In addition to the external hazard index, radon and its daughter, which is given by Eq. (7):

\[ H_{in} = \frac{C_{Ra}}{140} + \frac{C_{Th}}{259} + \frac{C_{K}}{4810} < 1 \]  

The values of the indices of external and internal radiation hazard index must be less than unity for the radiation hazard to be negligible.

3. Results and Discussion

The data in Table (3 & 4) are summarized of measurements of natural and manmade radionuclide (226Ra, 232Th, 40K, and 137Cs) concentration and radium equivalent in the collected soil samples from Al-anbar (Al-fallujah district) and Wasit governorate, respectively. The mean activity concentration at Al-anbar (Al-fallujah district) due to 226Ra, 232Th, 40K, and 137Cs was in soil samples of Wasit governorate, respectively. In Wasit governorate, the mean activity concentration due to 226Ra, 232Th, 40K, and 137Cs was 23.01, 14.54, 290.64, and 2.22Bq kg^-1, respectively. 137Cs concentration was detected very low at most of the places. Its concentration at Al-anbar (Al-fallujah district) governorate ranged from 0.00 to 2.3Bq kg^-1 with an average value of 1.01 Bq kg^-1 and at Wasit governorate was ranged from 0.70 to 5.06 Bq kg^-1 with an average value of 2.22 Bq kg^-1 and these concentration survey low at most of the places for that they don’t have any radiological important. The activity concentration of 226Ra, 232Th, and 40K in soil samples of studied area was compared with the value reported by other countries near from study area as shown in Table (5). The measured activity concentration of 226Ra and 232Th was close to the Syria and Iran for Al-anbar (Al-fallujah district) and Wasit. While the measured activity concentration of 40K was closed to Southern Jordan and Syria for two governorates. Furthermore, the world average concentrations for 226Ra, 232Th, and 40K in soil sample are 35, 30, 400 Bq/kg, respectively [7].

### Table 3. Activity concentrations of 226Ra, 232Th, 40K, and 137Cs and radium equivalent activity in soil samples from Al-anbar (Al-fallujah district) governorate.

| Sample ID | A.Conc. of 226Ra Bq/kg | A.Conc. of 232Th Bq/kg | A.Conc. of 40K Bq/kg | A.Conc. of 137Cs Bq/kg | Ra eq (Bq/kg) |
|-----------|------------------------|------------------------|----------------------|------------------------|---------------|
| B.G.S1    | 21.8                   | 13.5                   | 380.5                | 1.2                    | 62.70         |
| S1-1      | 17.4                   | 5.6                    | 137.02               | 0.85                   | 35.96         |
| S1-2      | 21.6                   | 14.8                   | 278.4                | 0                      | 64.20         |
| S1-3      | 22.5                   | 15.2                   | 271.6                | 0.5                    | 65.15         |
| B.G.S2    | 21.3                   | 13.02                  | 306                  | 1.9                    | 63.48         |
| S2-1      | 19.8                   | 6.9                    | 134.2                | 0.32                   | 40.00         |
| S2-2      | 19.4                   | 11.8                   | 233.8                | 1.7                    | 54.28         |
| S2-3      | 27.7                   | 19.9                   | 371                  | 0                      | 83.44         |
| B.G.S3    | 14.4                   | 9.6                    | 247                  | 0.3                    | 47.15         |
| S3-1      | 23.2                   | 4.6                    | 113.8                | 1.18                   | 38.54         |
| S3-2      | 14.7                   | 9.5                    | 177.4                | 2.3                    | 41.94         |
| S3-3      | 20.5                   | 9.4                    | 172                  | 1.9                    | 47.19         |
| Mean value| 20.36                  | 11.08                  | 226.89               | 1.01                   | 53.67         |
| Min value | 14.40                  | 4.60                   | 113.80               | 0.00                   | 35.96         |
| Max value | 27.70                  | 19.00                  | 371.00               | 2.30                   | 83.44         |
| Worldwide background soil standard | 10-50 | 10-50 | 100-700 | ≤ 370 |
and in Wasit is 66.17 Bq kg\(^{-1}\) samples were shown in Table 3 and 4. The mean radius of cooperation and development [7].

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All values were lower than the unity permissible limit. Equations (3, 4, and 5) were used to calculate the absorbed dose rate \(D(\text{nGy} h^{-1})\) and the effective dose rate \((\text{mSv} y^{-1})\) in outdoor and indoor air for Al-anbar (Al-fallujah district) and Wasit governorate, as shown in Tables (6) and (7) respectively. The values of the total absorbed dose rate ranged from 17.35 to 31.23 nGy h\(^{-1}\) with a mean value of 24.78 nGy h\(^{-1}\) for Al-anbar (Al-fallujah district) governorate and ranged from 19.46 to 46.18 nGy h\(^{-1}\) with a mean value of 32.08 nGy h\(^{-1}\) for Wasit governorate. All values are lower than the world average value of 60 nGy h\(^{-1}\) given by UNCEAR 2000 [7]. All calculated values of the effective dose rate for two governorates are far lower than the 1.0 mSv y\(^{-1}\) recommended by UNSCEAR 2000. Furthermore the calculated values are near from the values which were calculated in the previous study [9] using ReCLAIM program version 3.0 as shown in Figures (2 and 3) for Al-anbar (Al-fallujah district) and Wasit governorate, respectively.

Table 4. Activity concentration of \(^{226}\text{Ra}, ^{232}\text{Th}, ^{40}\text{K}, \) and \(^{137}\text{Cs}\) and radium equivalent activity in soil samples from Wasit governorate.

| Sample ID | \(\text{A.Conc. of } ^{226}\text{Ra} \text{Bq/kg}\) | \(\text{A.Conc. of } ^{232}\text{Th} \text{Bq/kg}\) | \(\text{A.Conc. of } ^{40}\text{K} \text{Bq/kg}\) | \(\text{A.Conc. of } ^{137}\text{Cs} \text{Bq/kg}\) | \(\text{Ra}_{eq} \text{(Bq/kg)}\) |
|-----------|----------------|----------------|----------------|----------------|----------------|
| B.G.S1    | 28.8           | 16.9           | 351.1          | 2.7            | 80.00          |
| S1        | 19.5           | 13.3           | 303.7          | 2.4            | 61.90          |
| B.G.S2    | 20.5           | 12.3           | 240.2          | 0.9            | 56.58          |
| S2        | 17.2           | 10.7           | 203.2          | 2.4            | 48.15          |
| B.G.S3    | 34.7           | 24.3           | 344.6          | 5.06           | 95.98          |
| S3        | 25.5           | 17.7           | 442.1          | 4.4            | 84.85          |
| B.G.S4    | 23.05          | 16.9           | 299.05         | 0.9            | 70.24          |
| S4        | 15.7           | 7.78           | 172.2          | 1.45           | 40.08          |
| B.G.S5    | 21.6           | 13             | 315.1          | 1.3            | 64.45          |
| S5        | 23.5           | 12.5           | 235.1          | 0.7            | 59.48          |
| Mean value| 23.01          | 14.54          | 290.64         | 2.22           | 66.17          |
| Min value | 15.70          | 7.78           | 172.20         | 0.70           | 40.08          |
| Max value | 34.70          | 24.30          | 442.10         | 5.06           | 95.98          |
| Worldwide|               | 10-50          | 100-700        | 10-50          | 10-50          |

Table 5. Activity concentration (Bq kg\(^{-1}\)) of natural radiouclides reported by various countries.

| Country            | \(\text{Ra}^{226}\) | \(\text{Th}^{232}\) | \(\text{K}^{40}\) | reference |
|--------------------|--------------------|--------------------|-----------------|-----------|
| Syria              | 19 (6-69)          | 24 (3-50)          | 336 (85-735)    | 10        |
| Southern Jordan    | 42.5               | 26.7               | 291.1           | 2         |
| Turkey             | 79                 | 62                 | 574             | 4         |
| Istanbul           | 27.7               | 32.5               | 388             | 10        |
| Iran               | 28                 | 22                 | 640             | 1         |
| World average      | 35                 | 30                 | 400             | 7         |
| Present study Al-anbar (Al-fallujah district) governorate | 20.36 | 11.08 | 226.89 | 5 |
| Present study Wasit governorate | 23.01 | 14.54 | 290.64 | 5 |

Table 6. The value of calculated radiation indices of soil samples for Al-anbar (Al-fallujah district) governorate.

| Sample ID | \(I_L\) | \(D(\text{nGy} h^{-1})\) | \(D_{\text{out}} \text{mSv} y^{-1}\) | \(D_{\text{in}} \text{mSv} y^{-1}\) | \(H_{\text{ex}} \text{mSv} y^{-1}\) | \(H_{\text{in}} \text{mSv} y^{-1}\) |
|-----------|---------|-----------------|-----------------|-----------------|-----------------|-----------------|
| B.G.S1    | 0.47    | 30.32           | 0.04            | 0.15            | 0.19            | 0.17            |
| S1-1      | 0.26    | 17.35           | 0.02            | 0.09            | 0.11            | 0.10            |
| S1-2      | 0.48    | 30.78           | 0.04            | 0.15            | 0.19            | 0.17            |
| S1-3      | 0.48    | 31.23           | 0.04            | 0.15            | 0.19            | 0.18            |
| B.G.S2    | 0.48    | 30.94           | 0.04            | 0.15            | 0.19            | 0.17            |
| S2-1      | 0.29    | 19.07           | 0.02            | 0.09            | 0.12            | 0.11            |
| S2-2      | 0.4     | 26.27           | 0.03            | 0.13            | 0.16            | 0.15            |
| S2-3      | 0.62    | 40.07           | 0.05            | 0.2             | 0.25            | 0.23            |
| B.G.S3    | 0.36    | 22.96           | 0.03            | 0.11            | 0.14            | 0.13            |
| S3-1      | 0.28    | 18.48           | 0.02            | 0.09            | 0.11            | 0.10            |
| S3-2      | 0.31    | 20.40           | 0.03            | 0.10            | 0.13            | 0.11            |
| S3-3      | 0.35    | 22.74           | 0.03            | 0.11            | 0.14            | 0.13            |
| Mean field soil value | 0.38 | 24.78           | 0.03            | 0.13            | 0.15            | 0.14            |
| Min       | 0.26    | 17.35           | 0.02            | 0.09            | 0.11            | 0.10            |
| Max       | 0.48    | 31.23           | 0.05            | 0.20            | 0.19            | 0.18            |
Table 7. The value of calculated radiation indices of soil samples for Wasit governorate.

| Sample ID | \((I_d)\) | \(D_{\text{nGy h}^{-1}}\) | \(D_{\text{int}}\) mSv.y\(^{-1}\) | \(D_{\text{out}}\) mSv.y\(^{-1}\) | \(D_{\text{total}}\) mSv.y\(^{-1}\) | Hex | Hin |
|-----------|-----------|----------------|----------------|----------------|----------------|-----|-----|
| B.G.S1    | 0.60      | 38.81          | 0.05           | 0.19           | 0.24           | 0.22 | 0.29 |
| S1        | 0.47      | 30.26          | 0.04           | 0.15           | 0.19           | 0.17 | 0.22 |
| B.G.S2    | 0.42      | 27.25          | 0.03           | 0.13           | 0.17           | 0.15 | 0.21 |
| S2        | 0.36      | 23.39          | 0.03           | 0.11           | 0.14           | 0.13 | 0.18 |
| B.G.S3    | 0.70      | 46.18          | 0.06           | 0.23           | 0.28           | 0.26 | 0.35 |
| S3        | 0.64      | 41.81          | 0.05           | 0.21           | 0.26           | 0.23 | 0.30 |
| B.G.S4    | 0.52      | 33.74          | 0.04           | 0.17           | 0.21           | 0.19 | 0.25 |
| S4        | 0.30      | 19.46          | 0.02           | 0.10           | 0.12           | 0.11 | 0.15 |
| B.G.S5    | 0.48      | 31.37          | 0.04           | 0.15           | 0.19           | 0.17 | 0.23 |
| S5        | 0.44      | 28.52          | 0.03           | 0.14           | 0.17           | 0.16 | 0.22 |
| Mean field soil value | 0.49 | 32.08 | 0.04 | 0.16 | 0.20 | 0.18 | 0.24 |
| Min       | 0.30      | 19.46          | 0.02           | 0.10           | 0.12           | 0.11 | 0.15 |
| Max       | 0.70      | 46.18          | 0.06           | 0.23           | 0.28           | 0.26 | 0.35 |

Figure 2. The annual effective dose comparison for Al-anbar (Al-fallujah district) governorate.

Figure 3. The annual effective dose comparison for Wasit governorate.

4. Conclusions

1. The measured activity concentration of \(^{226}\)Ra and \(^{232}\)Th was close to the Syria and Iran for Al-anbar (Al-fallujah district) and Wasit while the measured activity concentration of \(^{40}\)K was closed to Southern Jordan and
Syria for two governorates. Furthermore, the world average concentrations for $^{226}$Ra, $^{232}$Th, and $^{40}$K in soil sample are 35, 30, 400 Bq/kg respectively.

2. $^{137}$Cs concentration was detected very low at most of the places. Its concentration at Al-anbar (Al-fallujah district) governorate ranged from 0.00 to 2.3Bq kg$^{-1}$ with an average value of 1.01 Bq kg$^{-1}$ and at Wasit governorate was ranged from 0.70 to 5.06 Bq kg$^{-1}$ with an average value of 2.22 Bq kg$^{-1}$ and these concentration survey low at most of the places for that they don’t have any radiological important

3. The results obtained have shown that the effective dose rate values due to natural radioactivity of soil samples are far lower than the average world recommended value of 1.0 mSv.y$^{-1}$ and near from the values were calculated using ReCLAIM program version 3.0.

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