Radon Distribution in Baghdad Governorate by Using Remote sensing techniques

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Abstract. The Radon gas fixations were estimated for toxins condition with in Baghdad governorate utilizing Rad-7 device. The work comprises of 3rd sections; its initial segment incorporates the assurance of Rn222 gas fixations in air dust tests. The 2nd part includes measurements for radon in water in Baghdad. The third part includes radon in Soil in Baghdad. All these measurements were done to prepare maps for distribution of radon in soil, water, and air in using Arc-GIS system and landsat satellite image of Baghdad.

1. Introduction
Radon is radioactive noble inert gas without odor, color or taste found in all rocks and soil and cannot be detected it without special equipment. Researchers have concluded that the activity concentration of radon, thoron and their progeny are largely influenced by factors: building materials, topography, humidity, temperature, pressure, wind, and ventilation [1].

Radon occurs as a product of uranium decay and is an unstable radionuclide that disintegrates through short lived decay products before in the long run achieving the finished result of stable lead. The brief rot results of radon are in charge of a large portion of the risk by inward breath [2].

Radon and its rot items called radon little girls or radon descendants emanate exceptionally ionizing alpha-radiation. Rot items are suspended noticeable all around which we relax. In spite of the fact that the hazard is low when radon is weakened to amazingly low focuses in the open, radon in room air contributes up to half to the foundation radiation, be that as it may, in spots, for example, surrenderes and mines, it can gather up to unsafe fixations and may cause considerable wellbeing harm after long haul presentation. Certain kinds of topography, for example, rock and volcanic soils, and aluminous shale, will probably contain radon. On the other hand, low convergences of this gas are normal in rocks [3].

Many researchers have studied the concentration of heavy metals in soil, water and air using different techniques. For instance, S.P. Jeyapiiya and L. Shazli studied Remediation of heavy metal contaminated soil using different techniques [4]. Pushpanjali, et al. studied Soil Quality and Heavy Metal in Soils in Industrial Area in India [5].

In Iraq, many researchers have studied the concentration of radon using different techniques. For instance, Battawy [6], studied the indoor radon in factories in Iraq. These factories ranges from (36 to 125) Bq m-3 with an average of (60 Bqm-3). Ali, et al., studied radon using RAD7 in Najaf. The results indicate that the region has radioactivity levels within the natural limits.
2. Materials and Methods

Baghdad is the capital of Iraq. It is the largest city in Iraq in population. The city located in the northern regions of Iraq, on 33°20′N 44°23′E. Baghdad has maximum temperatures averaging 15.5 to 18.5 °C.

Radon focus was estimated in twelve distinct locales for atmosphere air, water and soil-in Baghdad city during 2015. The RAD-7 persistent radon estimating instrument from Drudge Company, USA, was utilized for dynamic estimations. RAD-7 is outfitted with the semiconductor α-locator and deals with the rule of the changing over vitality of α-particles straightforwardly into electrical signs [7].

Radon concentration in the atmosphere was measured in units of (Bq/m³). 1pCi/L = 37 Bq/m³ [8].

Keeping in mind the end goal to examine radon and thoron discharged of example to air, example encased to a segment and airborne radon/thoron estimated with nonstop screen of electrostatic kind (RAD-7, Durridge, USA).

The wind rate is 0.7 L min⁻¹. Room air was drawn from the delta and radon produced in the wind current framework estimated with RAD-7. The estimation interim was 1 h. The example weight is not the same as test to test.

The RAD H₂O is an accessory to RAD7 that measure a radon in water less than 30 pCi/L to greater than 105pCi/L. The lower limit of detection is less than 10 pCi/L.

![Fig. 1: Aerating a 250 ml water sample](image)

RAD7 measure radon of 3 different modes. Each set of readings includes four 5-minute cycles that in total takes 1 half hour. There are few types of soil-gas monitors that give real-time radon readings using the α-Probe model 711 to complete a radon soil depth profile, whereas the RAD-7 was used to measure the profile of the radon soil-gas in this study. Fig. (2) shows RAD-7 set up for soil measurements for one sample points of soil at waist city with the probe and a steel probe.

![Fig. 2: The RAD-7 soil-gas setup, including the electronic radon monitor](image)

Table (1): Radon concentration of Air, Water and Soil at Baghdad city
|   | Name of cities in Baghdad | Coordinates | Air concentration of Radon (ppm) | Water concentration of Radon (ppm) | Soil concentration of Radon (ppm) |
|---|--------------------------|-------------|---------------------------------|----------------------------------|-------------------------------|
| 1 | Sumar                    | 33° 25' 18" N, 44° 22' 5" E 33° 24' 54" | 3.56                             | 0.13                             | 48.1                          |
| 2 | Shaab                    | N, 44° 24' 34" E 33° 23' 20"           | 2.52                             | 0.13                             | 28                            |
| 3 | Sader                    | N, 44° 27' 30" E 33° 22' 50"           | 1.57                             | 0.167                            | 19.2                          |
| 4 | Kadhemiah                | N, 44° 20' 50" E 33° 22' 6.24          | 2.95                             | 0.055                            | 37                            |
| 5 | Adhamiah                 | N, 44° 21' 43.56" E                   | 3.1                              | 0.065                            | 42.1                          |
| 6 | Adil                     | 33° 11' 24" N, 44° 9' 0" E            | 2.67                             | 0.056                            | 22.5                          |
| 7 | Abu-ghreb                | 33° 17' 31" N, 44° 3' 56" E           | 3.43                             | 0.172                            | 51.6                          |
| 8 | Karada                   | 33° 18' 0" N, 44° 26' 0" E            | 2.87                             | 0.072                            | 14.2                          |
| 9 | Dora                     | 33° 15' 5" N, 44° 23' 31" E           | 3.73                             | 0.102                            | 43.6                          |
| 10| Zafarania                | 7" N, 44° 28' 11.17" E                | 3.12                             | 0.152                            | 49.2                          |
| 11| Dyiala                   | 4" N, 44° 30' 23.04" E                | 2.57                             | 0.16                             | 221                           |
| 12| Zubaida                  | 4" N, 44° 24' 10.07" E                | 3.98                             | 0.165                            | 50                            |
Fig. (3): the location of cities at Baghdad

Fig. (4): Radon concentrated in Baghdad Air

Fig. (5): Radon concentrated in Baghdad Water
Fig. (6): Radon concentrated in Baghdad Soil

Results and Discussion

The plots given in figures 7, 8, 9, 10, 11 and 12 show the measured versus predicted radon concentration values for these data set for ordinary kriging. Relatively high concentrations were producing in the south part of Baghdad for air, while in the west was for water, and also observed that these maps with high values distribution in several areas in south, west and north of Baghdad. The highest value of radon concentrated in Air at Al-Zubidia where reached (3.98 Bq/m3) and lowest at Sadar city (1.57 Bq/m3) while the highest value of radon concentrated in Water at Abo-ghreb (0.172 Bq/m3) and lowest at Kadhmiah city (0.055 Bq/m3), in soil the highest value of radon concentrated at Dyilal Bridge (221 Bq/m3) and lowest at Karada (14.2 Bq/m3). Geostatistical are used to map a range of environmental variables, particularly to generate probability maps show where variables exceed threshold, (Figures 10, 11 and 12) and showing the probability (counter lines) maps. Contour lines which join the locations of equal value to each other. In the case of a contour line representing radon concentration values, which it is drawn a line on a map at connects points of equal value. These addition methods utilize the accessible radon information in areas to appraise radon information for unmeasured zone which will render a powerful arrangement to alleviate the Rn focuses in Baghdad. Kriging is a geostatistical strategy, by and large used to insert the estimation of an irregular field at a surreptitiously area from qualities at watched areas. This technique produces expectation surface, as well as gives a blunder and vulnerability surfaces. The examination of radon information is helping in better understanding the radon issue in these territories. The examination of radon information and results got from geostatistical strategy to give data to the concerned specialists to make essential strides in assessing different strides to relieve radon focuses to satisfactory levels.

Fig. (7): Producing Air Radon concentration using geosatistical method (Ordinary Kriging technique).
Fig. (8): Showing Water Radon concentration using geosatistical method (Ordinary Kriging technique).

Fig. (9): Illustrated Soil Radon concentration using geosatistical method (Ordinary Kriging technique).

Fig. (10): Producing the probability (counters line) map for Air Radon concentration.
Fig. (11): Producing the probability (counters line) map for Water Radon concentration.

Fig. (12): Producing the probability (counters line) map for Soil Radon concentration.

Conclusions
From the result of Baghdad city clear that following:
1-The highest value of radon concentrated in Air at Al-Zubidia and lowest at Sadar city, the highest value of radon concentrated in Water at Abo-ghreb and lowest at Kadhmiah city, the highest value of radon concentrated in soil at Dyilal Bridge and lowest at Karada.
2-In geostatistics that are used in this study provided the tools requisite to determining the structure of the spatial variation to estimate radon concentrations. The increase with the sampling points, the data follow a normal distribution, can be used in interpolation technique.
3-After predicting the radon concentrations for unmeasured areas the interpolation techniques, it was observed that this technique showed better results which identify the areas with high radon concentration.
4-Interpolated data shows that more mitigation work is ahead for many areas that are not known before.

3. References
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