**Corrigendum to 'Radiological Assessment of Weenen farmland Samples, KwaZulu-Natal, South Africa' [Proceedings of SAIP2019]**

The author list should read

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The correct abstract is as follows

**Abstract**

The radiological hazards were evaluated in the farmland of Weenen, in the province of KwaZulu-Natal, South Africa. In this study, gamma spectroscopy was used to measure the activity concentrations of the radionuclides in the field and control soil samples. The overall activity concentrations for $^{226}Ra$, $^{232}Th$, and $^{40}K$ were found to be 52±11, 44±4 and 511±56 $Bq.kg^{-1}$ respectively. The radiological hazard indices calculated from these activity concentrations were lower than the recommended safe limits except for absorbed dose rate which was higher than recommended. In particular, the mean values for the radium equivalent, absorbed dose rate, annual effective dose equivalent (AEDE) and external hazard were 123±24 $Bq.kg^{-1}$, 77±17 $nGy.h^{-1}$, 0.101±0.02 $mSv.y^{-1}$ and 0.33±0.033 respectively. The indices were lower than unity indicating the safety of the farm workers in the area.

## Corrections and Amendments

## Introduction:

Page 1, Second paragraph, Line 10-23 should read

The agricultural activities also contribute significantly to environmental radioactivity through phosphate fertilizers produced from the phosphate rock that is highly enriched in $^{238}U$ and $^{232}Th$ series [7, 8, 9, 10]. These radioisotopes made their way into the rock from dissolved uranyl complex in seawater during the geological formation of the phosphate rocks [9]. Consequently, the workers are subjected to an additional source of external radiation exposure [6] in agricultural fields. Fertilizers provide radiation outside the mines where radon gas inhalation is an issue [11], medical applications[12], and fallout from nuclear weapons tests and power plants failures where radiation scatters all over, such as the accident of Chernobyl nuclear power plant on 26th of April 1986 in Ukraine, Fukushima Daiichi nuclear power plant on 11th of March 2011 in Japan [13] and Three Mile Islands nuclear power plant on 29th of March 1979 in USA [14]. The $^{222}Rn$ gas contributes hugely in the total background radiation followed by cosmic and terrestrial sources [15]. The terrestrial radiations come from rocks and soils containing heavy metals of varying concentrations [9, 16]. The radiations are not uniform, but depend on the geographical and geological formation of the underlying rocks [4, 6, 5]. The farm workers are particularly exposed to radiological hazards because they spend lengthy hours working on land.

Page 2, Figure 1

The correct Figure 1 is as shown below


**Fig 1**: Google Earth views of A17 and C17


**Fig 2:** The fields that were sampled

**Fig 3:** LN tank, MCA and HPGe.

Further corrections and Amendments

3. Numerical Calculations:

3.1. The absolute efficiency of the detector

Page 3, Line 4: The correct text is

'The efficiency calibration curve of the detector was obtained from the standard sources as well and an empirical formula generated was used to find efficiencies of different signals in the $^{226}$Ra, $^{232}$Th and $^{40}$K:…'

Page 3, Line 7-11: The correct text is

'where ($E/E_o$), E (keV) represents the peak energy of a particular radioisotope of interest and $E_o$ = 1 keV. Eqn (1) is in agreement with [18] and produced a curve similar to those on work by [19, 20] which were simulated curves of standard liquid sources from NMISA and CSIR. The linearity and energy resolution of the detector were tested by using signals from these standard sources. For any γ - ray detector, the most important properties are the energy resolution and the detection efficiency of that detector…'

3.3. Evaluation of Hazard indices

Page 4, Equation 3: The correct equation is $Ra_{Eq} = C_{Ra} + 1.43C_{Th} + 0.077C_K$

Page 4, Line 4: This should read 'where $Ra_{Eq}$ is the radium equivalent, $C_{Ra}$, $C_{Th}$ and $C_K$ are the concentrations of $^{226}$Ra, $^{232}$Th and $^{40}$K in the sample.'

Page 4, Equation 4: This should read '$D_R = 0.429C_{Ra} + 0.604C_{Th} + 0.042C_K$'

Page 4, Line 12-15: The correct text is

'where $D_R$ is the absorbed dose rate, 0.429 for $^{226}$Ra series, 0.604 for $^{232}$Th series and 0.042 for $^{40}$K, are dose conversion factors in units determined from the ratio of absorbed exposure in air to the activity concentration in the soil [27]. The estimated annual effective dose was estimated using the following equation.'

Line 17-21, page 4: The correct text is

'where $D_R$ is the absorbed dose rate in (nGy.h$^{-1}$), T is (365×24×0.2) and F is conversion coefficient equivalent to (0.7×10$^3$ mSv/10$^9$nGy). The UNSCEAR reports used 0,7 Sv.y$^{-1}$ for the conversion coefficient from an absorbed dose in air to effective dose received by adults, and 0.2 for the outdoor occupancy factor [15, 23, 27] and the annual effective dose rate should be less than 1 mSv.y$^{-1}$ [28, 29]…'

Page 4, Equation 6: The correction equation is $H_{Eff} = \frac{C_{Ra}}{370} + \frac{C_{Th}}{259} + \frac{C_K}{4810}$

Line 24, Page 4: This should read

'where $C_{Ra}$, $C_{Th}$ and $C_K$ are as defined above. For safer limits, this index should be small than a unity.'

4. Results and discussion

Page 4, Line 6: This should read '$A_p = A_d$.'

Page 5, Figure 2: This is replaced with Table 1

**Table 1:** Activity concentration, Radium equivalent, Dose rate, Annual effective dose rate and External hazard index in soil samples.

| Activity Concentrations in soil samples and Radiation Hazard Indices | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Sample ID | Parameter | $^{226}$Ra (Bq/kg) | $^{232}$Th (Bq/kg) | $^{40}$K (Bq/kg) | Radium Equiv (Bq/kg) | Dose Rate (nGy/h) | AEDE (mSv/y) | External Hazard |
| Control | C17 | Ave±σ | 68±5 | 41±4 | 430±20 | 160±8 | 69±6 | 0.084±0.01 | 0.30±0.07 |
| | A4 | Ave±σ | 29±4 | 37±4 | 424±22 | 115±10 | 66±7 | 0.084±0.01 | 0.28±0.9 |
| Field | A17 | Ave±σ | 49±4 | 45±4 | 578±24 | 158±10 | 83±7 | 0.102±0.01 | 0.35±0.1 |
| | A1 | Ave±σ | 58±4 | 40±4 | 526±23 | 157±10 | 76±7 | 0.093±0.01 | 0.32±0.1 |
| | A2 | Ave±σ | 48±5 | 49±4 | 556±25 | 154±11 | 85±8 | 0.105±0.01 | 0.37±0.1 |
| | A3 | Ave±σ | 60±4 | 43±4 | 550±24 | 165±11 | 84±7 | 0.103±0.01 | 0.36±0.1 |
| | Overall | Min | 29±4 | 35±3 | 424±22 | 115±10 | 66±7 | 0.081±0.01 | 0.29±0.9 |
| | | Max | 68±5 | 49±4 | 578±24 | 160±8 | 85±8 | 0.105±0.01 | 0.37±0.1 |
| | | Ave±σ | 52±11 | 43±10 | 511±56 | 123±24 | 77±17 | 0.095±0.02 | 0.33±0.9 |

Page 5, Line 21-24: This should be replaced with the following text

'The mean equivalent activity concentrations for $^{226}$Ra, $^{232}$Th, and single occurring $^{40}$K from the field samples were found to be 23±4, 44±4 and 552±21 $Bq.kg^{-1}$, respectively.'

Page 5, Line 25-32: This should be replaced with the following text

'For the field samples, the mean radium equivalent was 158±21 $Bq.kg^{-1}$ and whereas for the control samples, the radium equivalent was 138±12 $Bq.kg^{-1}$. The external radiation hazard indices were found to be less than unity, which is within a permissible limit. The overall mean dose rate of the samples is 77±17 $nGy.h^{-1}$, which is higher than a recommended safe value of 55 - 60 $nGy.h^{-1}$ [5, 27]. The mean annual effective dose rate for the representative field samples was 0.101±0.02 $mSv.y^{-1}$, a value lesser than 1 $mSv.y^{-1}$ recommended by ICRP and UNSCEAR [5] as the limit for the public radiation exposure control. The external hazard index fell below a unity with an overall average of 0.33±0.03.'

5. Conclusion

Page 5-6, Line 1-16 replace with *The soil samples from different parts of a farmland were analysed for natural radionuclides emanating from the soil and continuous application of fertilizers. Only naturally occurring radionuclides were detected in the samples. On average, the overall $^{226}$Ra and the equivalent $^{232}$Th were 52±11 $Bq.kg^{-1}$ and 43±10 $Bq.kg^{-1}$ and the activity of the singly occurring $^{40}$K peak was 511±56 $Bq.kg^{-1}$ all as presented in Table 1 above. The absorbed dose rate is higher than the value of 55 $nGy.h^{-1}$ as it was found to be 77±17 $nGy.h^{-1}$. The average annual effective dose rate is 0.101±0.02 $mSv.y^{-1}$ below the value recommended by ICRP and UNSCEAR for radiation exposure control.

The samples C17 and A4 show a slightly lower potassium concentration in agreement with each other. A conclusion can be drawn that the higher potassium concentration in the field samples is due to the application of fertilisers. Thus, the application of fertilizers in the assessed fields, poses no significant radiological hazard to the farm workers. According to the data on UNSCEAR 2000, the concentrations of $^{238}$U, $^{232}$Th and $^{40}$K from this study are within world average. This is supported by both external hazard index and the average annual effective dose fall within a unity of their measurements.*