DISTRIBUTION OF NATURALLY OCCURING RADIONUCLIDES AND MINERALOGICAL CHARACTERIZATION OF IJEBU-IFE, OGUN STATE NIGERIA.

BY

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INTRODUCTION

- Natural radionuclide's and Environment (UNSCEAR, 2000).
- Variation of natural radionuclides
- Sources of natural radionuclides

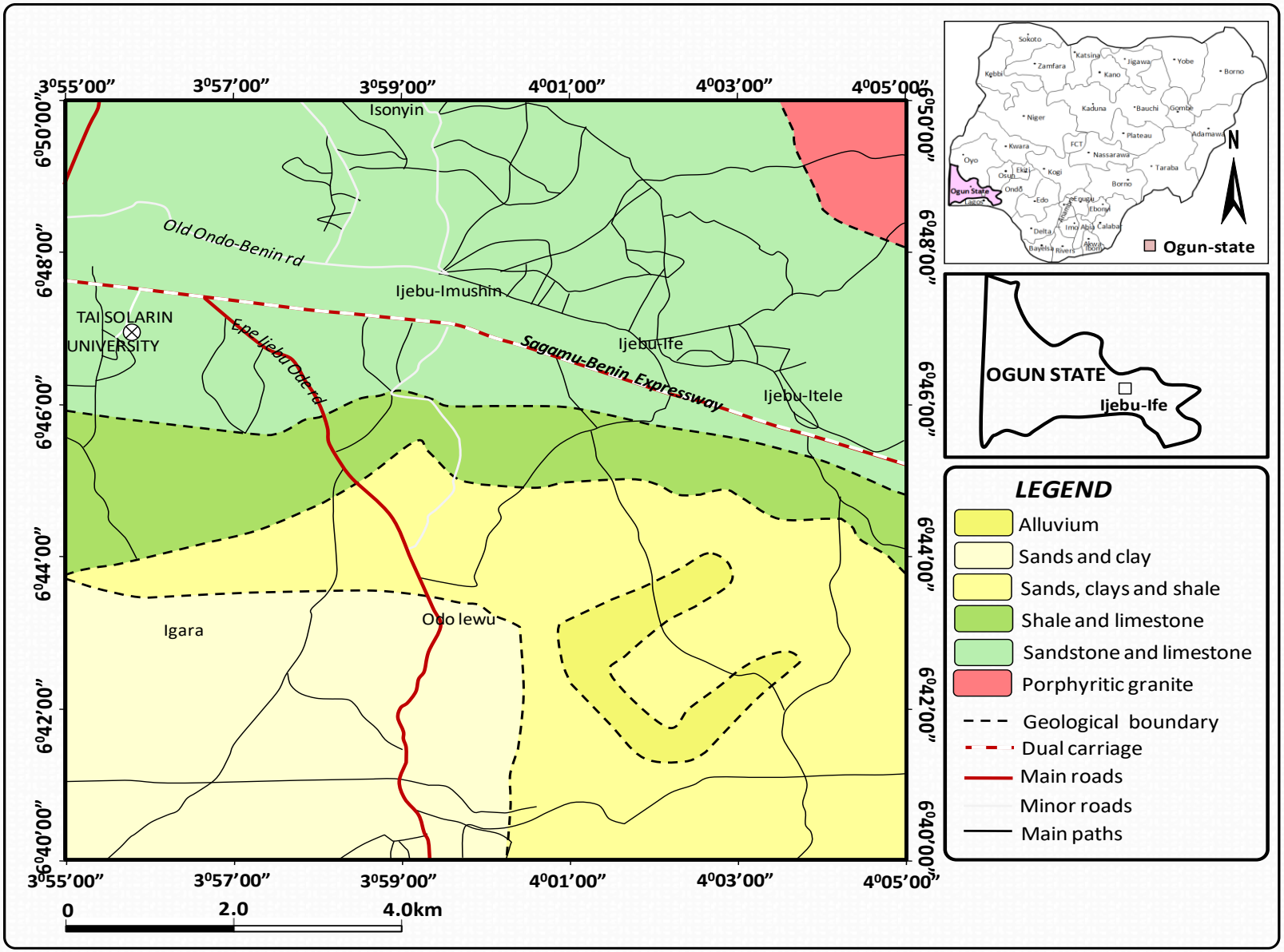
GEOGRAPHY AND GEOLOGY OF STUDY AREA

- Ijebu-Ife is situated at $6^{0}46^{1}00^{11}$ to $6^{0}48^{1}00^{11}$ North latitude, $4^{0}00^{1}30^{11}$ to $4^{0}03^{1}00^{11}$ East longitude. With 67 meters elevation above sea level.

- Ijebu-Ife, lies within the Dahomey basin which is an inland, offshore, coastal sedimentary basin in the Gulf of Guinea.

- Sand stone and Lime stone cover almost the whole portion of the study area.

IJEBU-IFE AND ENVIRONS



JUSTIFICATION

UNSCEAR, (1993)

Soil as a direct source (IAEA, 1990)

Knowledge of background radiation level

AIM AND OBEJECTIVES

The general objective of this study is to determine the naturally occurring radionuclides and mineralogical characterization of Ijebu-Ife, Ogun State, Nigeria.

AIM AND OBEJECTIVES

The specific objectives of this study are

- To determine the activity concentrations of the naturally occurring radionuclides in soil of Ijebu-Ife.
- To measure in situ radiation level
- To estimate the radiological doses and hazard indices of the soil
- To measure and compare in-situ and laboratory measurement of effective dose

AIM AND OBEJECTIVES

The specific objectives of this study are

- To determine the mineralogical characterization of soil in the study area.

- To relate radiation level with the geological and mineralogical characterization of the study area.

LITERATURE REVIEW

- Otwoma *et al.,* (2012),
- Ramasary et al., (2009b)
- Ramasary et al., (2009b)
- Navas *et al.,* (2002)

Materials and methods

- Sampling method
- Sampling preparation
- Sample analysis

RADIATION DOSE AND HAZARD INDICES CALCULATION

The following radiation hazard indices were determine in this study.

- Radium equivalent activity

$$Ra_{eq} = C_{Ra} + 1.43C_{Th} + 0.077C_k$$

- Absorbed Dose Rate

$$D = 0.427A_{Ra} + 0.662A_{Th} + .0.043A_K$$

- Annual Effective Dose

$$H_E = D \times T \times OF_{in} \times 10^{-3} = D \times (24 \times 365) \times 0.7 \times 0.4 \times 10^{-6}$$

RADIATION DOSE AND HAZARD INDICES CALCULATION

The following radiation hazard indices will be determine in this study.

- Internal hazard Index

$$H_{ex} = C_{Ra}/370 + C_{Th}/259 + C_k/4810$$

- External hazard Index

$$H_{in} = C_{Ra}/185 + C_{Th}/259 + C_k/4810$$

NB: The value of this index must be less than unity for the radiation hazard to be negligible (Avwiri, 2013).

RADIATION DOSE AND HAZARD INDICES CALCULATION

- Annual Gonadal Dose Equivalent

$$AGED\ (\mu Svy^{-1}) = 3.09C_{Ra} + 4.18C_{Th} + 0.314C_{K}$$

- Excess Lifetime Cancer Risk.

$$ELCR = H_E \times D_L \times RF$$

- Representative Gamma Index,

$$I\gamma = C_{Ra}/150 + C_{Th}/100 + C_K/1500 \leq 1$$

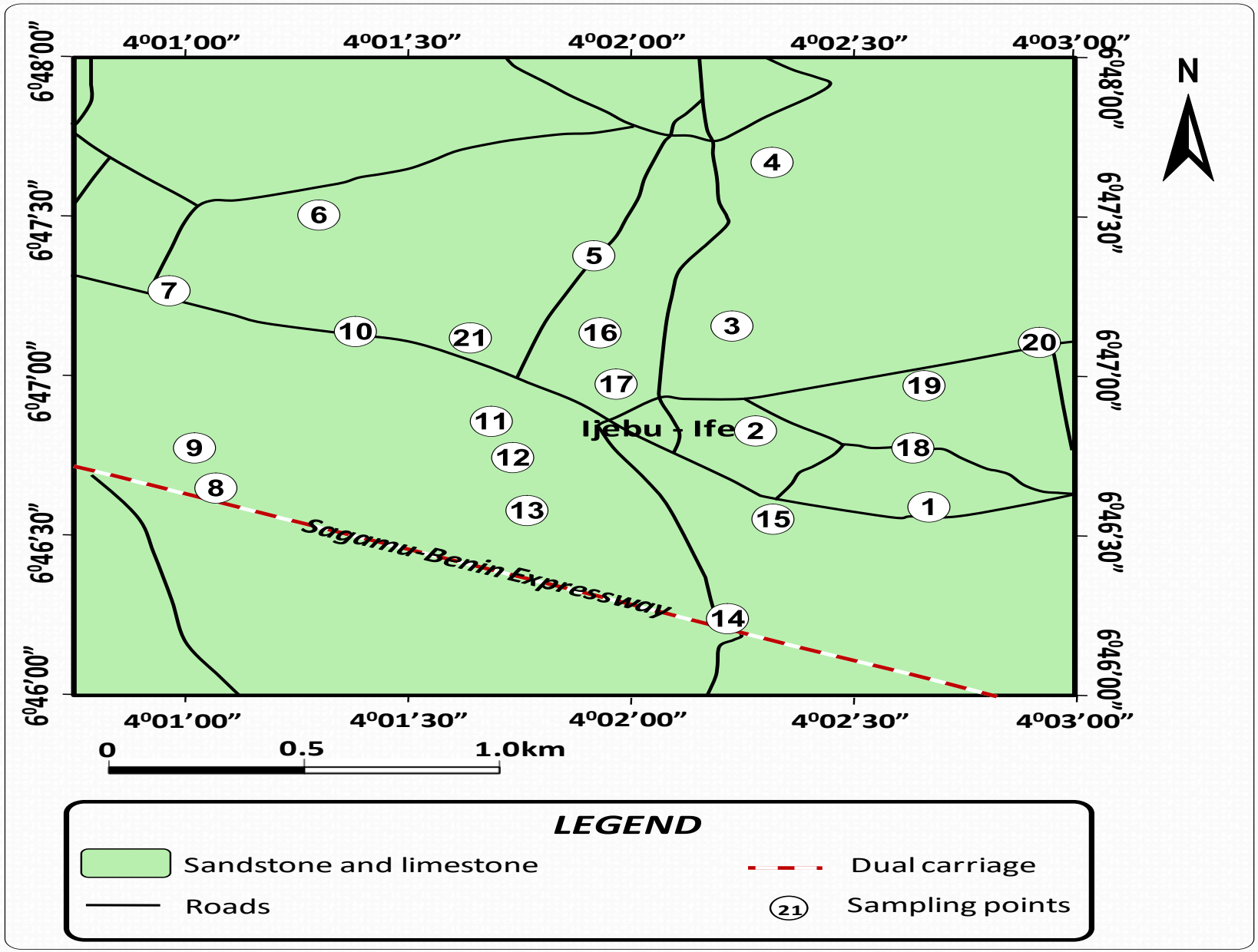
The value of Iγ must be less than unity in order to keep the radiation hazard insignificant.

RESULTS AND DISCUSSION

Table **4.**1: Names, coordinates and elevation of each sampling points

S/N	Sampling location	Sampling coding	Elevation (m)	Latitude (E)	Longitude (N)
1	FOWOBI	S01	62	$06^{0}46.604^{1}$	$004^{0}02.680^{1}$
2	IGBOMOKU 1	S02	69	$06^{0}46.841^{1}$	$004^{0}02.291^{1}$
3	IRANWO	S03	55	$06^{0}47.168^{1}$	$004^{0}02.238^{1}$
4	TIDESA	S04	74	$06^{0}47.678^{1}$	$004^{0}02.328^{1}$
5	EYIN-IDI	S05	43	$06^{0}47.387^{1}$	$004^{0}01.928^{1}$
6	OJUIGBO	S06	68	$06^{0}47.514^{1}$	$004^{0}01.311^{1}$
7	AIYEGBAMI 1	S07	69	$06^{0}47.278^{1}$	$004^{0}00.975^{1}$
8	OLUWERI	S08	54	$06^{0}46.663^{1}$	$004^{0}01.080^{1}$
9	ALEDO	S09	59	$06^{0}46.788^{1}$	$004^{0}01.032^{1}$
10	OJU OWO	S10	68	$06^{0}47.151^{1}$	$004^{0}01.393^{1}$
11	DLCM CAMP	S11	60	$06^{0}46.871^{1}$	$004^{0}01.698^{1}$
12	ODELAOBA	S12	64	$06^{0}46.758^{1}$	$004^{0}01.746^{1}$
13	ISHABODO	S13	46	$06^{0}46.593^{1}$	$004^{0}01.778^{1}$
14	IWAYE JUNCTION	S14	36	$06^{0}46.256^{1}$	$004^{0}02.228^{1}$
15	IWAYE	S15	63	$06^{0}46.566^{1}$	$004^{0}02.330^{1}$
16	ISESIN	S16	61	$06^{0}47.147^{1}$	$004^{0}01.942^{1}$
17	CENTRAL MOSQUE	S17	63	$06^{0}46.987^{1}$	$004^{0}01.978^{1}$
18	IGBOMOKU	S18	65	$06^{0}46.788^{1}$	$004^{0}02.644^{1}$
19	ODOLADELEPO	S19	58	$06^{0}46.982^{1}$	$004^{0}02.669^{1}$
20	ITAKO	S20	68	$06^{0}47.117^{1}$	$004^{0}02.928^{1}$
21	AIYEGBAMI	S21	65	$06^{0}47.131^{1}$	$004^{0}01.651^{1}$

Geological map showing the bedrock types that underlie the study area



RESULTS AND DISCUSSION

Table 4.2: Average absorbed dose rate and its corresponding effective dose equivalent for the In situ measurement

S/N	Sampling Location	Sampling Coding	Dose rate $\mu Svhr^{-1}$	In situ Dose rate ($mSvyr^{-1}$)
1	FOWOBI	S01	0.10	0.3506
2	IGBOMOKU 1	S02	0.04	0.1403
3	IRANWO	S03	0.06	0.2104
4	TIDESA	S04	0.04	0.1403
5	EYIN-IDI	S05	0.06	0.2454
6	OJUIGBO	S06	0.07	0.2104
7	AIYEGBAMI 1	S07	0.04	0.1052
8	OLUWERI	S08	0.04	0.1403
9	ALEDO	S09	0.02	0.0701
10	OJU OWO	S10	0.09	0.3156
11	DLCM CAMP	S11	0.05	0.1403
12	ODELAOBA	S12	0.06	0.2104
13	ISHABODO	S13	0.04	0.1403
14	IWAYE JUNCTION	S14	0.06	0.2104
15	IWAYE	S15	0.03	0.1052
16	ISESIN	S16	0.06	0.2104
17	CENTRAL MOSQUE	S17	0.05	0.1753
18	IGBOMOKU	S18	0.03	0.1052
19	ODOLADELEPO	S19	0.04	0.1403
20	ITAKO	S20	0.06	0.2104
21	AIYEGBAMI	S21	0.05	0.1753
		MEAN	**0.05±0.00**	**0.1820±0.15**
		MINIMUM	**0.02**	**0.0701**
		MAXIMUM	**0.10**	**0.3506**

RESULTS AND DISCUSSION

Table 4.3; Activity concentration of ^{40}K, ^{226}Ra and ^{232}Th using gamma ray spectrometry and its Radium equivalent

S/N	SAMPLE CODING	K Conc. (Bq/kg)	Ra Conc. (Bq/kg)	Th Conc. (Bq/kg)	Radium Equivalent (Bq/kg)
1	S01	320±28.53	7.76±1.71`	4.04±0.48	38.186
2	S02	30.06±2.94	5.38±1.30	5.61±0.61	15.717
3	S03	148.91±14.50	3.41±0.85	8.55±0.95	27.103
4	S04	120.73±11.37	2.60±0.63	1.14±0.14	13.526
5	S05	253.51±21.28	4.60±0.98	1.26±0.16	29.922
6	S06	249.87±22.48	2.12±0.52	3.42±0.42	26.251
7	S07	125.86±11.47	1.83±0.45	5.95.2.72	20.029
8	S08	68.34±7.33	5.03±1.28	0.59±0.08	11.136
9	S09	BDL	5.18±1.29	0.91±0.11	6.481
10	S10	150.95±14.82	8.91±1.84	6.43±0.73	29.728
11	S11	100.01±9.38	3.79±0.85	5.14±0.58	18.841
12	S12	18.03±2.21	4.46±1.14	5.48±0.64	13.685
13	S13	81.54±10.31	9.11±1.65	4.46±0.53	21.766
14	S14	106.87±10.39	8.49±1.91	7.37±0.83	27.258
15	S15	36.69±3.69	3.67±0.88	3.48±0.41	11.472
16	S16	160.99±15.14	4.63±0.99	6.21±0.68	25.907
17	S17	144.72±13.01	1.58±0.39	7.17±0.80	22.977
18	S18	87.34±8.86	2.14±0.45	BDL	8.865
19	S19	43.15±4.43	BDL	5.67±0.67	11.431
20	S20	191.40±17.19	2.64±0.68	4.65±0.52	24.027
21	S21	61.01±6.74	5.99±1.44	7.92±0.90	22.013
	MEAN	**119.08±11.24**	**4.44±1.01**	**4.55±0.62**	**20.111±1.80**
	MINIMUM	**BDL**	**BDL**	**BDL**	**6.481**
	MAXIMUM	**320±28.53**	**9.11±1.65**	**8.55±0.95**	**38.186**

RESULTS AND DISCUSSION

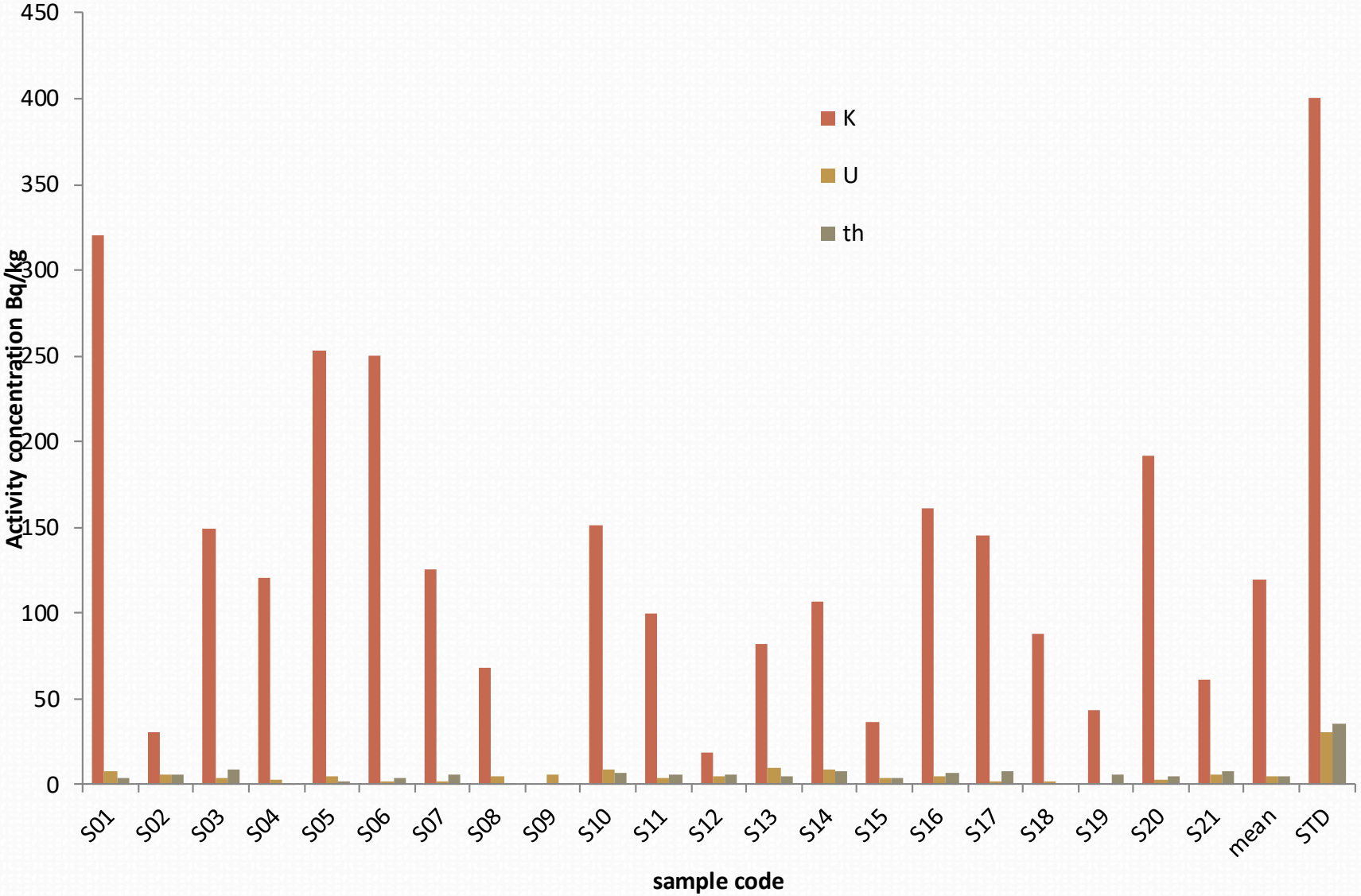


Figure 5; Activity concentration of 40K, 226Ra and 232Th using gamma ray spectrometry and its Radium equivalent

RESULTS AND DISCUSSION

Table 4.4: Air absorbed dose rates, annual effective dose and external hazard index for soils of Ijebu-Ife, Ogun State.

S/N	SAMPLE CODING	Absorbed dose rate $nGyhr^{-1}$	Annual Effective dose $mSvhr^{-1}$	External hazard index	Internal hazard index
1	S01	19.753	0.0485	0.1031	0.1241
2	S02	7.304	0.0179	0.0434	0.0570
3	S03	13.519	0.0332	0.0731	0.0824
4	S04	7.056	0.0173	0.0365	0.0436
5	S05	13.699	0.0336	0.0700	0.0824
6	S06	13.914	0.0342	0.0719	0.0766
7	S07	10.132	0.0249	0.0541	0.0590
8	S08	5.477	0.0134	0.0301	0.0437
9	S09	2.814	0.0069	0.0185	0.0315
10	S10	14.552	0.0357	0.0803	0.1044
11	S11	9.321	0.0229	0.0519	0.0611
12	S12	6.307	0.0155	0.0370	0.0490
13	S13	10.349	0.0254	0.0598	0.0834
14	S14	13.010	0.0322	0.0746	0.0966
15	S15	5.449	0.0134	0.0310	0.0409
16	S16	13.011	0.0319	0.0710	0.0825
17	S17	11.644	0.0286	0.0620	0.0663
18	S18	4.669	0.0115	0.0249	0.0297
19	S19	5.609	0.0138	0.0319	0.0309
20	S20	12.436	0.0305	0.0659	0.0720
21	S21	10.424	0.0256	0.0595	0.0756
	MEAN	**10.025±0.92**	**0.0246±0.00**	**0.0543±0.05**	**0.0663±0.06**
	MINIMUM	**2.814**	**0.0069**	**0.0185**	**0.0297**
	MAXIMUM	**19.753**	**0.0485**	**0.1031**	**0.1241**

RESULTS AND DISCUSSION

Table 4.5 Annual gonadal effective dose, excess life cancer risk and rep index for soils of Ijebu-Ife, Ogun State

S/N	SAMPLE CODE	ANNUAL GONADAL EFFECTIVE DOSE μSvy^{-1}	EXCESS LIFE CANCER RISK $\times 10^{-3}$	REPRESENTATIVE GAMMA INDEX
1	S01	141.38	0.07	0.31
2	S02	49.51	0.05	0.11
3	S03	93.03	0.03	0.21
4	S04	50.71	0.02	0.11
5	S05	99.08	0.04	0.21
6	S06	99.31	0.02	0.21
7	S07	70.05	0.02	0.16
8	S08	39.47	0.04	0.08
9	S09	19.81	0.04	0.04
10	S10	101.81	0.08	0.22
11	S11	64.60	0.03	0.14
12	S12	42.35	0.04	0.10
13	S13	72.40	0.08	0.16
14	S14	90.60	0.07	0.20
15	S15	37.41	0.03	0.08
16	S16	90.82	0.04	0.20
17	S17	80.29	0.01	0.18
18	S18	34.04	0.02	0.07
19	S19	37.25	0.00	0.09
20	S20	87.69	0.02	0.19
21	S21	70.77	0.05	0.16
	MEAN	**70.08±6.56**	**0.04±0.01**	**0.15±0.02**
	MINIMUM	**19.81**	**0.00**	**0.04**
	MAXIMUM	**141.38**	**0.08**	**0.31**

RESULTS AND DISCUSSION

Table 4.6: Comparison of mean activity concentration values in soil and air absorbed dose from some countries and UNSCEAR Report

Country	mean Activity Concentrations (Bq/Kg)			Absorbed dose
	^{238}U	^{232}Th	^{40}K	(nGy/hr)
Egypt	17	18	320	32
China	32	95	440	62
Greece	25	51	360	56
Spain	32	220.5	470	76
India	29	28	400	56
Portugal	44	33	840	84
Romania	32	21	490	59
Poland	26	38	410	45
Belgium	26	50	380	43
Bulgaria	45	21	400	70
Iran	28	19	640	79
Luxembourg	35	25	620	49
Denmark	17	27	460	52
Switzerland	40	30	370	45
United States	40	35	370	47
UNSCEAR (2000)	35	30	400	60
Present Study	**4.44±1.01**	**4.55±0.62**	**119.05±11.24**	**10.03±0.92**

RESULTS AND DISCUSSION

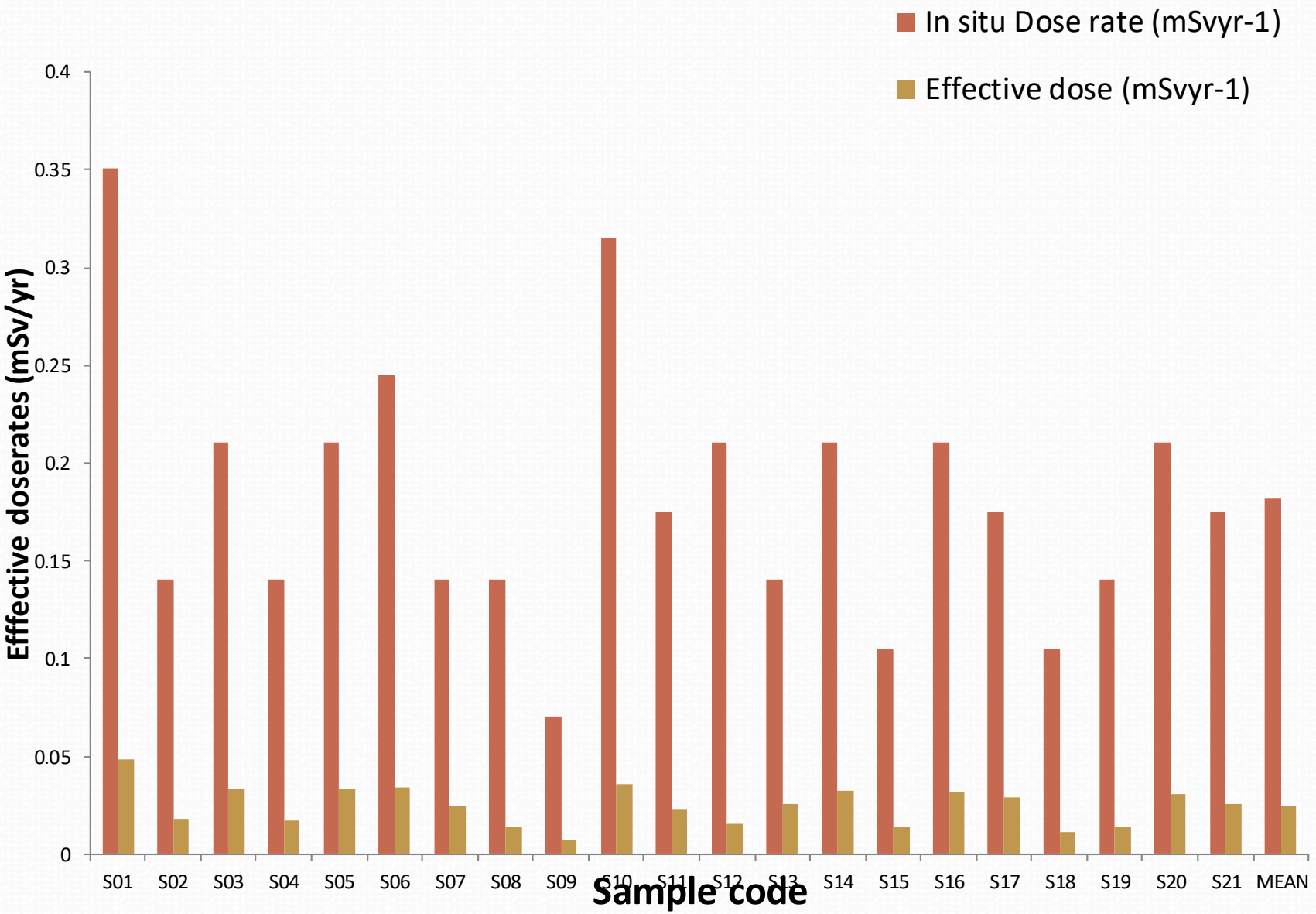


Figure 4.3: Effective dose in air measured using a survey meter and that measured in the laboratory from soil

RESULTS AND DISCUSSION

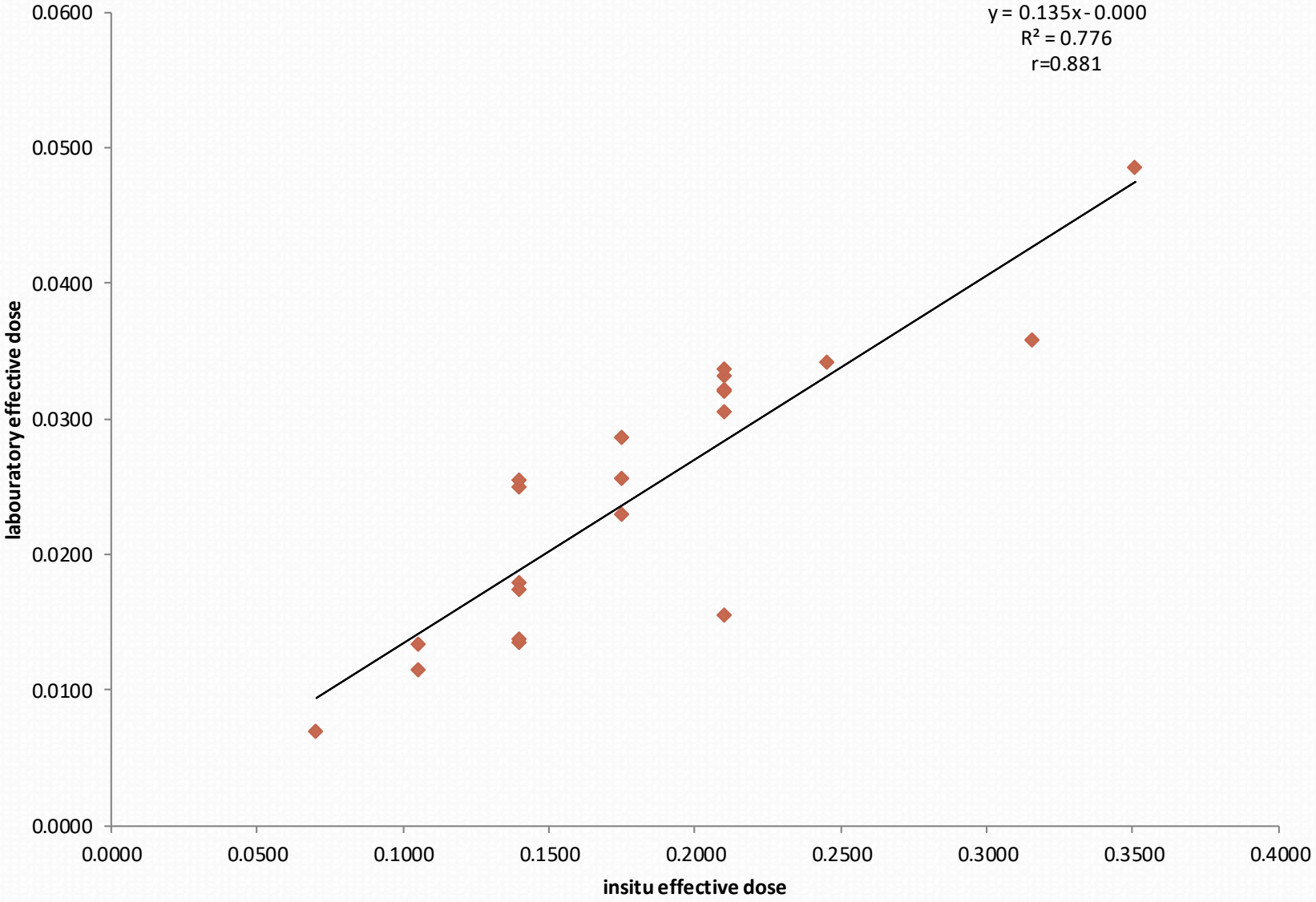
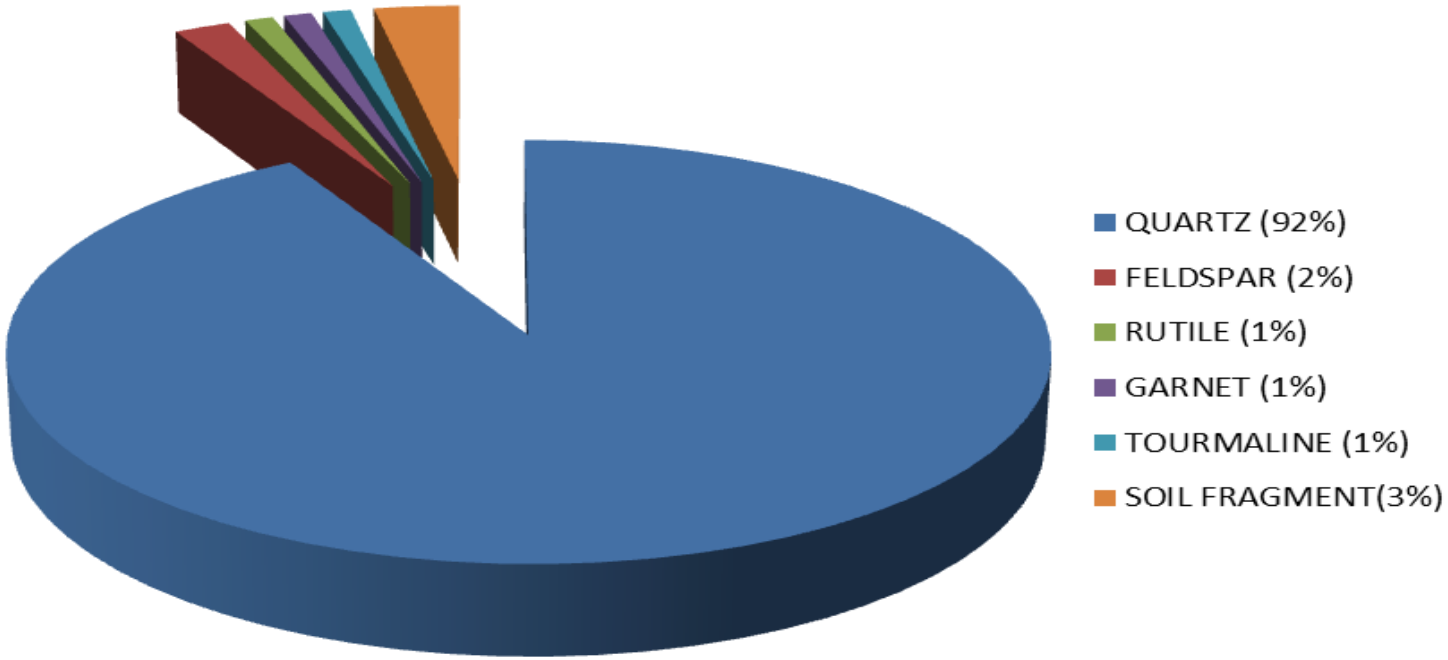


Figure 7 Scatter diagram of annual effective dose bysurvey meter reading and that measured in the laboratory for soil

RESULTS AND DISCUSSION



CONCLUSION

- Activity concentration of Naturally occurring radionuclide are below the recommended world average values .

- Low radioactivity level implies the presence of sand stone and lime stones as the underlying soil (Ramasamy *et al*., 2009).

CONCLUSION

- Ijebu- Ife Ogun state is safe for living, agricultural and other purposes, since the radiation doses are well below the world average values recommended by UNSCEAR, (2000).

- Ijebu-Ife Ogun State have no or insignificant radiological hazards since the radiological hazards calculated are less than unity

CONCLUSION

- In-situ measured effective dose was found to be higher than that measured from the activity concentration of naturally occurring radionuclide in the laboratory. Akinwale *et al.*, 2015).

- The generally low radiation level is due to the type of geology and underlying rock/soils (limestone and sand stone) present in the study area.

CONCLUSION

High composition of quartz in the study area also enhance the low concentration of radionuclides.

RECOMMENDATION

- Regular monitoring should be conducted to take care of unforeseen eventualities that may arise due to day to day human activities.

- Radiation level of other bedrocks types around the study area can be measured for comparrism study

CONTRIBUTION TO KNOWLEDGE

The following have been achieved:

- The activity concentrations of naturally occurring radionuclides in soil of Ijebu-Ife have been measured.

- In-situ radiation level have been measured

- The radiological doses and hazard indices of the soil samples have been evaluated.

CONTRIBUTION TO KNOWLEDGE

- In-situ and laboratory measurement of effective dose was compared
- Mineralogical characterization of soils in the study area have been determined.
- The radiation level has been related with the geological and mineralogical characterization of the study area

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Thank you !