Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol. 3, No.3, 2013

Environmental Ionizing Radiation Distribution Profile in Jos and Environs

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Abstract
The environmental ionizing radiation distribution in Jos and environs were taken using a standard type gamma scout (GS.2 model, manufactured by GAMMA-SCOUT GmbH & Co. kG Germany) while the location coordinates were taken with the aid of a Garmin etrex H GPS receiver. The mean radiation levels were found to be 1.54± 0.13mSv/yr, 2.18± 0.20mSv/yr, 3.22± 0.25mSv/yr, 1.61± 0.14mSv/yr, 1.58± 0.13mSv/yr, 1.72± 0.19mSv/yr, 1.31±0.07mSv/yr, 2.47± 0.15mSv/yr at Farin Gada, Fudawa, Odus, Jib Village, Jacopiang, Building Materials, Beach Road and Tudun Wada respectively. Based on the results obtained, the mean radiation levels in all survey locations were above the acceptable limit of 1mSv/yr set up by the International Commission for Radiological Protection (ICRP). These high values may be attributed to the mining activities which have been taking place in most of these areas over the years. Other factors may be due to industrialization, quarrying activities and waste disposal of some consumer products that contains radioactive contaminants. Since these readings were above the acceptable limits, it indicates that these areas may be hazardous to health.
Keywords :Gamma scout, ionizing radiation ,health and Jos

Introduction

In Nigeria, environmental ionizing radiation profile has not received attention as many associate the risk of exposure to radiation only from atomic bombs and nuclear power plants. The risk of exposure to radiation is often ignored with attendant grave health consequences as it has been proved, man in his everyday experience is immersed in dangerous ionizing radiations occurring naturally in human environment (Hunt,1987). The exposure of humans to ionizing radiation from countless sources around the environment is evident. Some of which are cosmic rays and natural radionuclide sources in air, food and drinking water (NCRP, 1976).

In this work, the background ionizing radiation profile of Jos environment was studied. The Jos environment covering an area of 8600km, extending from latitude 9.5^0 N to longitude 8.5^0 E and lying within the Precambrian basement complex and Jurassic younger granites. It has been observed that high radiation levels from ^{40}K; ^{238}U and ^{232}Th have been associated with granitic and silicic igneous rocks which are the predominant among Jos rocks (Buchanan et al, 1971). In addition to these, it has been established that natural occurring radioactive materials (NORM) constitute 85% of radiation dose to man, man-made activities constitutes about 15% (Alausa et al, 2010). The implication of this statistics is obvious, there is the probability of increase in the ionizing radiation distribution in a given time interval, and with the increase in man's activities, it is reasonable to expect that they could also be high.

Nyango (2006) measured the background radiation within University of Jos campus environment and reported a mean equivalent dose of 2.059mSv/yr. Sadiq and Agba (2011) measured the background radiation in Akwanga, Nigeria, using an Inspector alert nuclear radiation meter and reported that the indoor readings ranged from 1.04 to 1.75mSv/yr while the outdoor readings ranged from 0.24 to 0.44mSv/yr. The Annual mean equivalent doses for indoor and outdoor backgrounds were 1.29±0.13 to 0.31±0.14mSv/yr respectively. Jwanbot et al (2012) measured the indoor background ionizing radiation in some Science laboratories in University of Jos-Nigeria and obtained a range of 2.081mSv/yr to 2.733mSv/yr.

Ionizing radiation has the ability to affect the chemical state of a material and so cause changes which are biologically important (Gallagher, 2008). Exposure to ionizing radiation can cause injuries and clinical symptoms; which may include a chromosomal transformation, cancer induction, free radical formation, bone necrosis and radiation catractogenesis (Norman, 2008). The injuries and clinical symptoms could be caused by both chronic and acute dose exposure. Because of the lethal effects of ionizing radiation, the practice has been to monitor and assess the levels of exposure and keep one's exposure to ionizing radiation as low as reasonably achievable (ALARA).

Materials and Method

The environmental ionizing radiation distribution were measured using a Gamma scout (GS.2 model, manufactured by GAMMA-SCOUT GmbH & Co. kG Germany) while the elevation and location coordinates of the survey locations were taken with a GPS receiver (Garmin *e*trex H). To adequately cover the designated survey location, 20 readings were taken at different points in each of the eight survey areas within Jos environment {Farin Gada, Fudawa, Odus (Maza road), Jacopiang, Jib village, Beach road, Building materials and Tudun Wada (Mado village)}. The lowest background reading was obtained at a distance of 100metres from each of the survey area which was used for correction with results obtained. The readings were taken while holding the Gamma scout at height 1metre above the ground until steady value was obtained on the device. This value (µSv/hr) was then converted to annual cumulative dose rate using the relation

$$\text{Cumulative radiation level} = \frac{m(\mu\text{Sv/hr}) \times 8760\text{hrs}}{1000} \quad (\text{mSv/yr})$$

Where : *m* is the Gamma-scout meter reading (UNSCEAR,1988). The results obtained are as shown in Figure 1-9.

Discussion

The results are as shown in Figures 1-9 indicates that the ionizing radiation distribution within Jos environment is above acceptable limit of 1mSv/yr for general public limit set up by the International Commission for Radiological Protection (ICRP). For the 8 survey locations, Odus area (Maza road) has the highest dose of 3.22± 0.25mSv/yr. Other locations also have high values of 1.54± 0.13mSv/yr, 2.18± 0.20mSv/yr, 1.61± 0.14mSv/yr, 1.58± 0.14mSv/yr, 1.58± 0.13mSv/yr, 1.72± 0.19mSv/yr, 1.31±0.07 mSv/yr, 2.47± 0.15 mSv/yr at Farin Gada, Fudawa, Jib village, Jacopiang, Building materials market, Beach Road and Tudun Wada respectively. These high values may be attributed to the tin mining activities which have been taking place in most of these areas over the years (Gyang & Ashano, 2005) as tin mine tailings were found to contain ^{226}Ra and ^{232}Th that are radioactive (Ademola, 2008). Another possible reason for some of this high values may be the rocks used for foundations of some buildings in these areas which were mostly igneous rocks and are believed to be rich in minerals like hircon, monazite, uranite, potassium, feldspar and biotite granite (Solomon et al, 2002).

Other factors may be due to

Increase in the disposal of consumer products such as tobacco, fertilizer, welding rods, kerosene lamps and watch dials (Ragheb,2010)

Quarrying activities which can enhance the natural background levels by bringing out large amount fof otherwise buried materials containing natural occurring radioactive materials onto the surface of the environment (Saleh et al, 2007).

Other technological waste such as televisions and computer video screens (EPA,2004)

Large population in these areas and with a very poor sanitation as well as drainage systems which causes erosion that may expose buried radioactive ores to the immediate environment (Sohrabi, 1990).

Apart from the geology, a given environment may experience seasonal dose rate variations due to precipitation, humus and vegetation (Holmes-Siodle and Adams, 1993).

Recommendations

Despite that the biological effects of low doses of radiation are not fully understood and the relationship between radiation dose and its carcinogenic effects are not fully established (Karam & Mortazavi, 2009), periodic measurement of the ionizing radiation profile should be done to ascertain any anomaly. It suffice to say therefore, that further research should be carried out to evaluate whether there have been any significant ionizing radiation related illnesses in these survey areas.

Conclusion

This study has established the presence of ionizing radiation in all areas where the work was carried out. This study has verified that the environmental ionizing radiation distributions within Jos were above the acceptable limit of 1mSv/yr set up by the ICRP. Since these readings were above the acceptable limits, it means that these areas may be hazardous to health.

References

Ademola, J.A. (2008). Exposure to high background radiation levels in tin mining area of Jos-Plateau, Nigeria.

Journal of Radiological Protection 28(1):93-99
Alausa, S.K; Odunaike; R.k; Alausa, I.M; Sosanya;F.M and Ajala, B.A(2002): Activity of natural radionuclide level in water of Ago- iwoye, Nigeria. *Iranian Journal of Radiation Research* 7(4):1-2
Buchanan M.S; Macloed W.N; Turner D.C and Wright E.A (1971): The geology of Jos Plateau . The younger granite complexes. *Nigeria Geol Surv bulletin* 32:1-160.
Gyang, J.D and Ashano, E.C (2005): Effects of mining on water quality and environment: a case study of parts of Jos Plateau, North central Nigeria. The Pacific Journal of Science and Technology 11(1):631-639.
Holmes–Siodle, A. and Adams, L. (1993): *Handbook of Radiation Effects.* Oxford University Press. 469 pp.
Hunt, S. E.(1987): Nuclear Physics for Engineers and Scientists (Low Energy Theory with Applications including Reactors and their Environmental Impact). Ellis Horwood Ltd, Chichester. 698 pp.
ICRP,(2006a): Assessing dose of representative person for the purpose of radiation protection of the public and the optimization of radiological protection: broadening the process. *ICRP publication* 101 36(3).

Jwanbot D.I and Ike E.E (1999): Measurement of permissible radiation level in minerals processing plants in Jos and Environs. *Journal of Environmental science* 2(1):2-8
Jwanbot, D.I; Izam M.M and Gambo,M (2012): Measuring of indoor background ionizing radiation in some Science laboratories in University of Jos, Jos-Nigeria. *Science World Journal* 7(2):5-8
Karam, P. A. and Mortazavi, M. J. (2009): High Levels of Natural Radiation in Ramsar, Iran: Should Regulatory Authorities Protect the Inhabitants? *Health Physics*. 82(1):87-93.
NCRP (1976): National Council on Radiation Protection and Measurement. NCRP report No. 50.
Norman, A and Kagan, A.K (2008): Radiation doses in radiation therapy are not safe. *Med. Phys.* 24(1):17101713
Nyango, C.B (2006): Measurement of radiation dose rate of University of Jos main Campus .Unpublished B.Sc project,University of Jos.
Sadiq, A.A and Agba, E.H (2011): Background radiation in Akwanga, Nigeria. *Journal of Working and Living Environmental Protection*. 8, No.1:7-11.
Saleh, I.H; Hafez, A.F; Motaneh, A; Elanany, N.H; Naim, M.A (2007): Radiological study of soils, foodstuff and fertilizer in the Alexandria region of Egypt. *Journal of Eng. Environ. Sci*. 31:9-17
Sohrabi M. Recent radiological studies of high level natural radiation areas of Ramsar. Proceeding of International Conference on High Levels of Natural Radiation (ICHLNR), Ramsar, Iran, 3-7, 1990.
Solomon, A.O; Ike, E.E; Ashano, E.C and Jwanbot, D.I (2002). Natural background radiation characteristic of basalt on the Jos Plateau and the radiological implication of the use of the rock for house construction. *African Journal of Natural Science* 5.
United Nations Scientific Committee for Effects of Atomic Radiation (1988). Ionizing Radiation: Sources and Effects. 44-89
U.S Environmental Protection Agency (2004). Radiation and life (www.epa.gov)

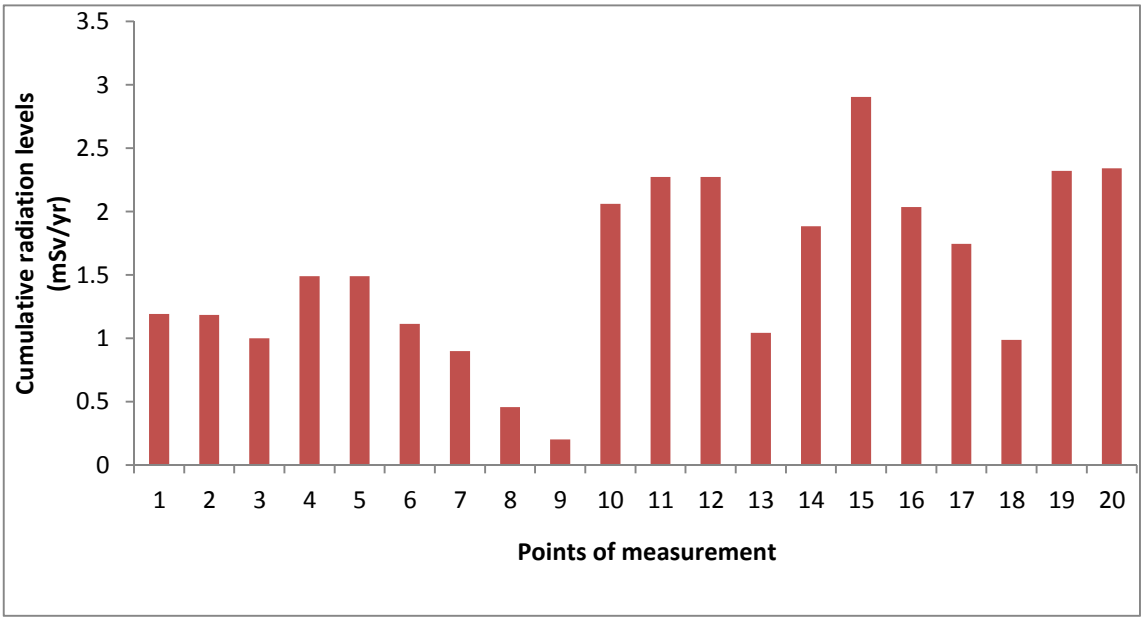

Fig.1: Cumulative radiation level against points of measurement at Farin Gada area.

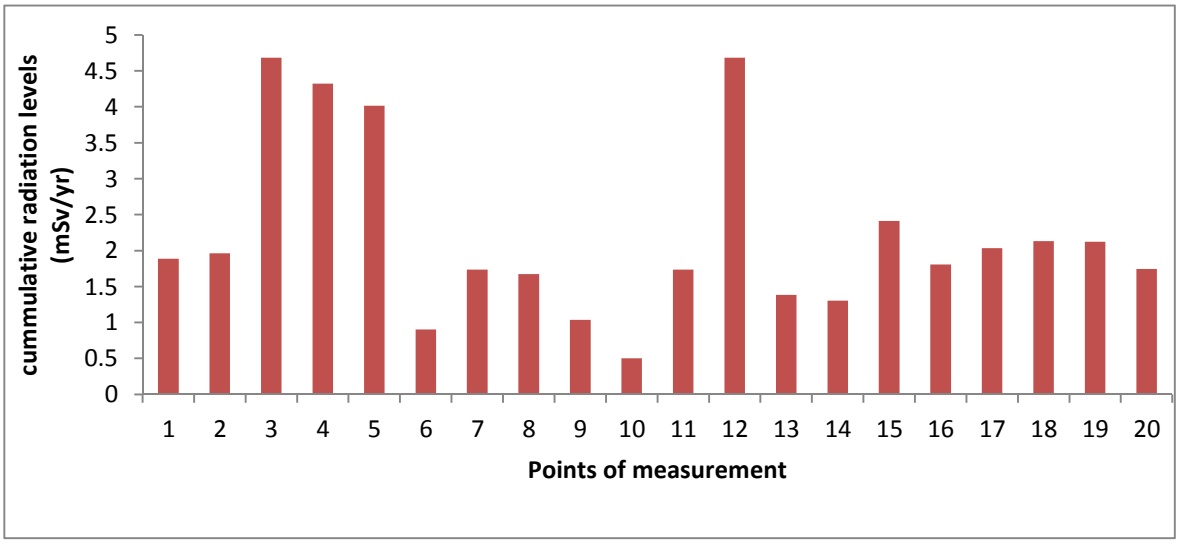

Fig.2: Cumulative radiation level against points of measurement at Fudawa area.

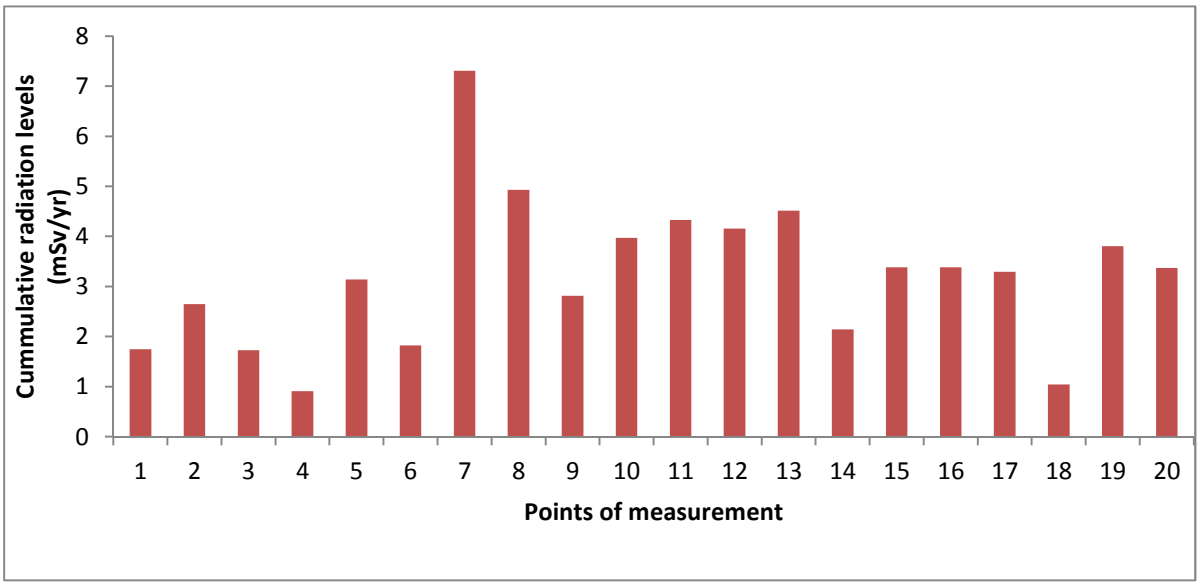

Fig.3: Cumulative radiation level against points of measurement at Odus(Maza road) area.

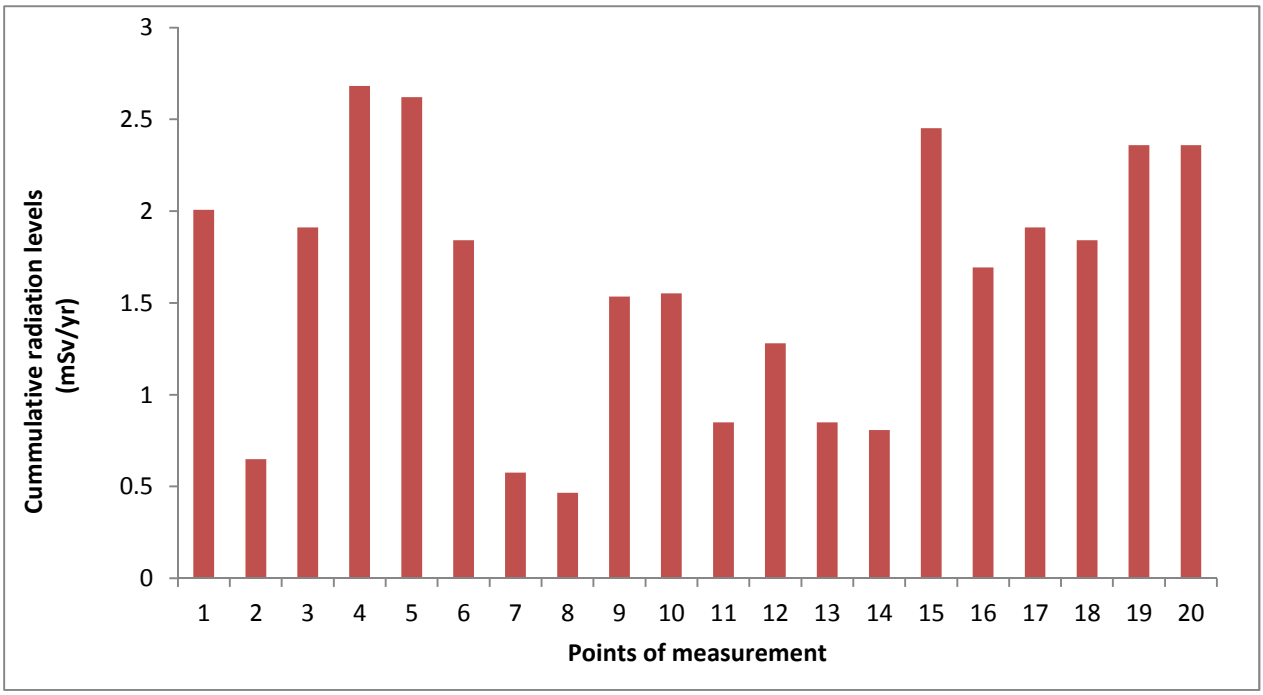

Fig.4: Cumulative radiation level against points of measurement at Jib village area.

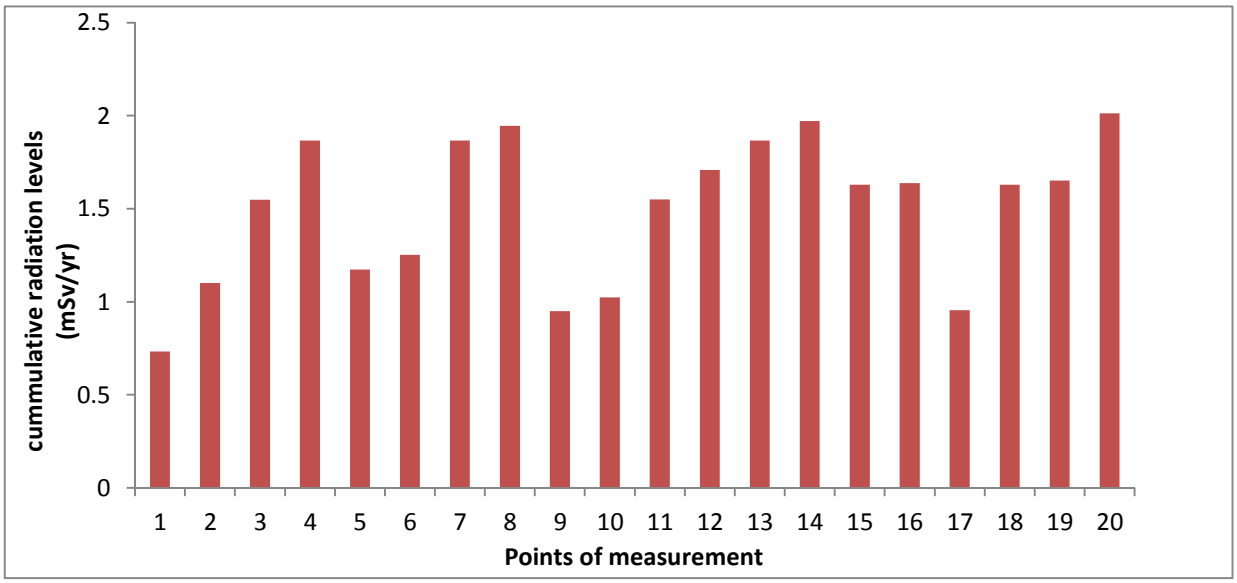

Fig.5: Cumulative radiation level against points of measurement at Jacopiang area.

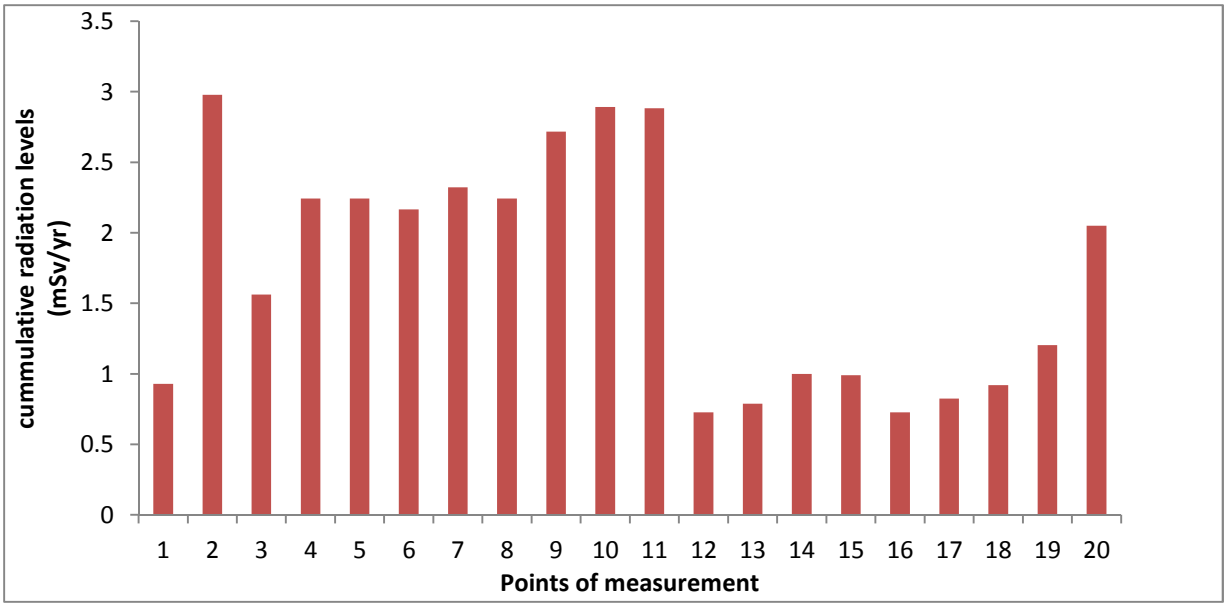

Fig.6: Cumulative radiation level against points of measurement at Building materials area.

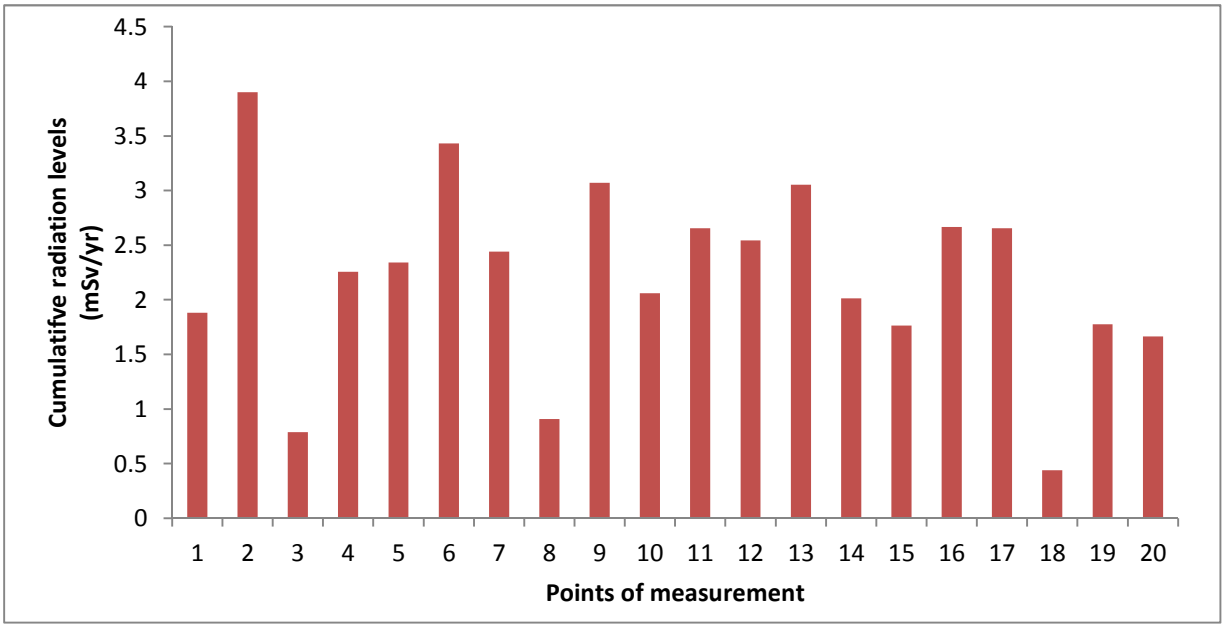

Fig.7: Cumulative radiation level against points of measurement at Beach road area.

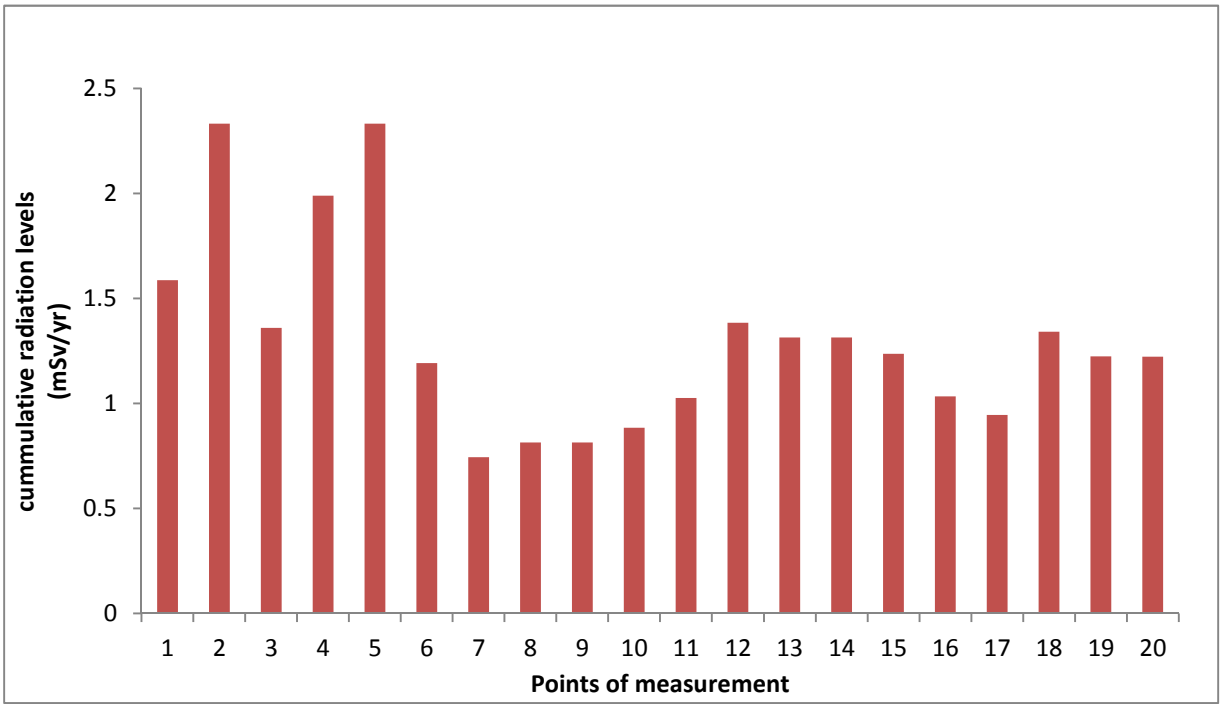

Fig.8: Cumulative radiation levels against points of measurement at Tudun wada area.

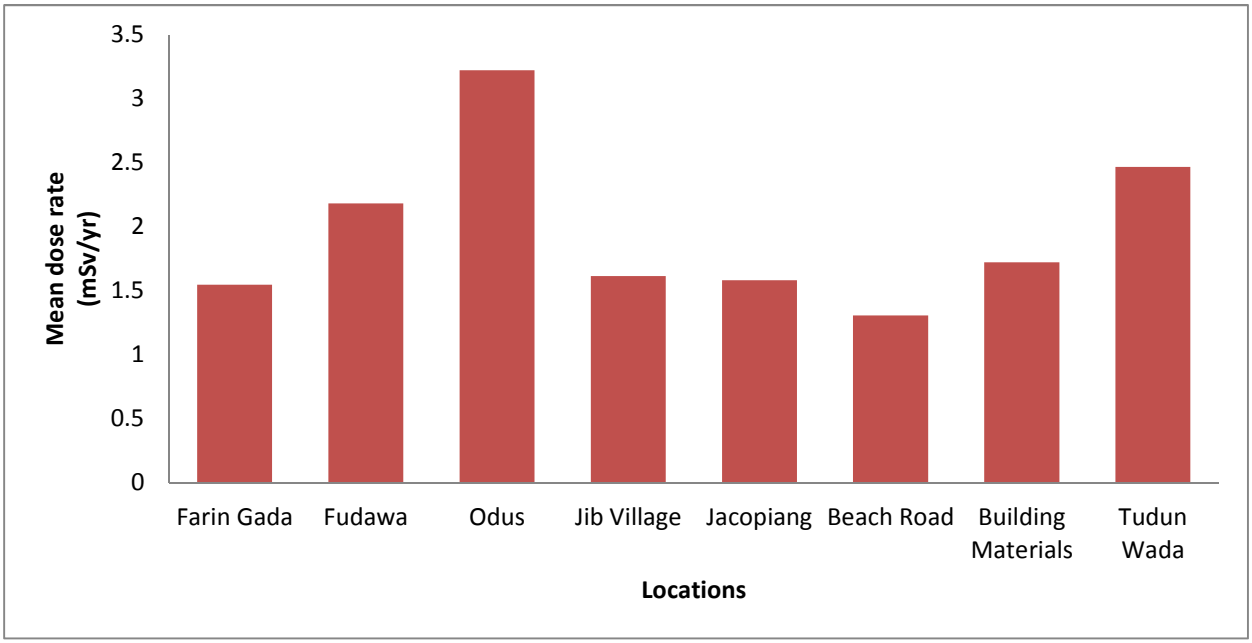

Fig.9: Mean dose rate against survey locations

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