Measurement of background radiation

The publication by Sulekha Rao *et al.*[1] entails the measurement of radiation in three areas, i.e. Gopalpur, Chhatrapur and Rushikulya along the southern coast of Odisha by deploying TLD badges in different houses and later converting the data into annual dose equivalent in terms of mSv yr^{-1}. The attempt by the authors to measure background radiation of certain areas and then discuss various aspects of radiation and its health effects is quite informative and appreciable. However, certain statements made in the publication, as noted below, may be incorrect and amount to misleading the readers and the public at large.

(i) The abstract includes a statement that 'The average external gamma dose to people residing in the three sectors is 3.77, 4.47 and 3.57 mSv $year^{-1}$ respectively, which is ~3–4 times the international limit of 1 mSv $year^{-1}$.'

To say that the international limit of radiation is 1 mSv yr^{-1} is incorrect. Rather the permissible limit of radioactivity resulted from man-made activity for the general public is 1 mSv yr^{-1} over and above the natural background radiation (http://www.world-nuclear.org/info/Safety-and-Security/Radiation-and-Health/Nuclear-Radiation-and-Health-Effects/). That is, if the natural background radiation of a place is, say 3 mSv yr^{-1}, any man-made activity should not increase the background radiation to more than 3 + 1 = 4 mSv yr^{-1}. This permissible increase of radiation, which is 1 mSv yr^{-1} for the public, is 20 mSv yr^{-1} for the occupational workers. The authors have simply measured the natural background radiation at a particular place. Hence to say that the reading is more than the permissible limit is not only incorrect, but also misleading.

(ii) While discussing about high background radiation areas (HBRAs), the authors have plotted the value of the three areas against national average of some countries (figure 3), which is again a wrong way of data presentation. If the dose rates of three areas are to be plotted on a histogram, they should have been compared with other high background radiation locations of the world, viz. Ramsar in Iran, measuring more than 200 mSv yr^{-1}, Gurapari in Brazil measuring ~40 mSv yr^{-1} and ~20 mSv yr^{-1} in some places in Kerala. It may be noted that in Ramsar, Iran, several hot-water springs are present, and radioactivity is mainly due to radium and its decay products, which have been brought up to the Earth's surface by the hot springs. Historically, visitors as well as residents use this place as a natural spa.

(iii) The authors (p. 602) have mentioned that 'The continuous mining of the beach placers enhances the dose exhibited in this region, as observed in the present study'.

The authors may be aware that every place on the Earth records some amount of radiation. As mentioned by them quoting UNSCEAR in the first sentence of their publication, 'about 87% of the radiation dose received by mankind is from natural sources and the remaining is due to anthropogenic sources.' The natural source includes the inherent intrinsic radionuclides, e.g. U, Th, etc. in any natural substance. Some rocks on the surface of the Earth record higher radioactivity due to the presence of radioactive minerals. But they are all natural background radiation and in no circumstances can be construed as dangerous. The above statement would have been correct provided the authors had recorded the radiation level present during pre-mining activities and then compared it with the values recorded during the mining operations. Therefore, their conclusion is ambiguous and bereft of any facts.

(iv) The last but one sentence of the publication mentions that, 'In addition, the local groundwater aquifers should be isolated to avoid any contamination due to the leaching of radionuclides present'.

It would have been proper if the authors had collected groundwater at different places, measured its radionuclide content, compared with adjoining areas having no mineral deposits before drawing any conclusion.

In the backdrop of the article and otherwise realized many times that not much of information on radiation and environment is available even with advanced community. While the Department of Atomic Energy (DAE) is engaged in public awareness activities countrywide through various mechanisms, it is suggested that educational Institutes should include this aspect in their syllabus at various levels.

1. Sulekha Rao, N., Parial, Kajori, Koide, Hiroaki and Sengupta, D., *Curr. Sci.*, 2015, **109**(3), 600–603.

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Response:

(i) The exploitation of various heavy minerals along the coastal sands of Odisha, is based on wet methods/dredging for more than a decade. This is not the most optimum technique, if the mineralized zones are irregular and discontinuous/heterogeneously distributed, as observed in the present study area. The social and environmental impact in coastal zones or 'riverine places' like Odisha and Andhra Pradesh coast, makes it less efficient compared to other methods being used throughout the world (for similar deposits), like mobile methods with a smaller (environmental) footprint. There are numerous standard references in this regard, which are easily accessible through the internet. It should also be noted that the region studied, as given in our publication, belongs to that which is composed of rocks like charnockites, khondalite, migmatitic gneisses, etc. which have monazites, zircons, xenotime and other radioactive minerals with higher enrichment (of thorium and uranium). These naturally occurring minerals which occur as opaque minerals having very high radioactivity[1–3] contribute to heavily reworked (eroded) sediments depending on a variety of coastal processes like marine transgressions/regressions, storms, fluvial and aeolian activity and precipitation. The concentration of the radionuclides changes drastically depending on the scale/magnitude of the processes, specially during the Quaternary (Holocene). Some of the widely acclaimed studies