# Assessment of Background Radiation Level in Different Locations of Bangladesh

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**Abstract**

Environmental Radiation and Radioactivity monitoring has become important nationally and internationally to generate baseline database. In this study, the background radiation levels have been measured at 16 districts of Bangladesh along with the Rooppur Nuclear Power Plant area of Pabna and the sea-beach areas of Cox's Bazar. Calibrated beta-gamma survey meter and digital survey meter (GAMMA SCOUT) were used for the measurement of dose level where reading was taken by placing the survey meter at a height of 1m from the ground (gonad level). Natural background radiation is the main source of radiation for public. The observed average background radiation dose rate of 16 districts of Bangladesh is found to be (2 ± 0.66) $mSvy^{-1}$ (except Cox's Bazar beach side), whereas according to UNSCEAR-2000 the worldwide average background dose rate is 2.45 $mSvy^{-1}$. On the other hand, in the beach areas of Cox's Bazar region has contributed much higher background radiation level, where maximum background radiation level is 38.89 $mSvy^{-1}$. But apart from Cox's Bazar beach side the background radiation level is much lower in and around Cox's Bazar town, where minimum background radiation level is 1.40 $mSvy^{-1}$. So the background radiation level in Cox's Bazar district is varied from 1.40 $mSv.y^{-1}$to 38.89 $mSv.y^{-1}$. Presence of Monazite and Zircon in the sand of the beach areas of Cox's Bazar region has contributed such higher background radiation level. Moreover background radiation dose level of Dhaka region for 10 years from 2006 to 2015 have been measured on monthly basis, where no significant change has been observed even after the accident of Fukusima nuclear power plant in Japan.

***Keywords:*** Background radiation level, beta-gamma survey meter, nuclear power plant area, base line study.

## 1. Introduction

Environmental Radiation and Radioactivity monitoring has become important nationally and internationally to generate baseline database. Naturally occurring radionuclides of terrestrial origin are present in the earth's crust since its origin. All living organisms of the planet are exposed to natural radiation, which is mainly due to the activity concentration of primordial radionuclides $^{232}Th$, $^{238}U$ and their product of decay, in addition to the other natural radionuclide $^{40}K$ present in the earth' crust [1]. These primordial radionuclides have longer half-lives, that they survived since their creation and decaying to attain the stable state and produces ionizing radiation in various degrees. The cosmic component, on the other hand, originates from outer space as cosmic rays whose contribution to the background changes mainly with elevation and latitude. Cosmic radiation can also contribute significantly in areas at high altitudes [2-4]. The cosmic ray exposure becomes double for every 1500 meters above the earth's surface. Cosmic rays are the dominant source of ionization in the atmosphere from an altitude of 70 km down to around 1 km [5]. Apart from these naturally occurring radiation in the atmosphere and terrestrial sources, it has been reported and proven that human activities such as those due to the quest for technological advancement and comfort application, have gradually led to the increase of background ionizing radiation and even in some cases, much above recommended tolerable level [6]. Again human activities have led to the depletion of the ozone layer, increased the cosmic rays reaching the earth's surface and thereby affect the background radiation [7].

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The natural or artificial radioactive nuclides that are present in the environment, constitute the background radiation level. Background radiation is the main source of radiation exposure for human beings. Natural background radiation contributes significantly (about 80%) to the annual effective dose received by the general population [1, 8]. There are few regions in the world, which are known for high background radiation areas (HBRAs), are due to the local geological and geochemical effects and cause enhanced levels of terrestrial radiation [1, 4]. Selected pockets of Brazil, China and India are reported under the grip of high background radiation [9]. Presence of monazite sand along the beaches of these regions, among other factors, has contributed to these dreaded radiations [10]. In most places on the earth, the natural radioactivity varies only within narrow limits, but in some places there are wide deviations from normal levels because of abnormally high levels of radioactive minerals. Excessive and prolonged exposure of live to radioactive elements however, have a general deteriorating side effect on health. So we can say, we all are in the midst of a radiation environment, however low it may be, and it is not possible to avoid radiation exposure from natural sources altogether. All what is needed and is possible is to be conscious of this fact with a constant endeavor to control the radiation from man-made sources to levels as low as is reasonably achievable.

In Bangladesh, to fulfill the increasing demand of electricity throughout the country there is no alternative of Nuclear Power Reactor. For the protection of population from nuclear hazards it is essential to know the base line data of environmental radiation and radioactivity. It is also regulatory prerequisite for the installation and operation of Nuclear Power Reactor. Therefore, the measurement of natural background radiation is the most important and immediate concern to the general population.

For this study, the natural background radiation levels were measured at 16 districts of Bangladesh along with the Rooppur Nuclear Power Plant area of Pabna and the sea-beach areas of Cox's Bazar during the period from 2000 to 2015. Moreover background radiation dose level in and around Dhaka city for 10 years from 2006 to 2015 have been measured on monthly basis.

## 2. Materials and Method

The natural background radiation levels were measured at 16 districts of Bangladesh. Geiger-Muller based micro-Roentgen survey meter and digital survey meter ( GAMMA SCOUT ) were used for dose level measurements which are based on instantaneous techniques and we have employed this technique due to their versatility in the field work. Reading was taken by placing the survey meter at a height of 1 m from the ground. For Geiger-Muller based micro-Roentgen survey meter, the reading in μR/h were converted to nGy/h using the conversion factor of 8.7 nGy/μR (from the definition of Roentgen). The absorbed doses in nGy/h were further converted to annual effective doses (AED) in mSv/y by using the following formula:

$$AED\ (mSv/y) = D_{(out)} \times T \times OF \times CC$$

Where, $D_{(out)}$ is outdoor absorbed dose rate; T is time in hour for one year (8760 h); OF is the Occupancy Factor of 0.2 for the outdoor exposure and CC is the Conversion Coefficient, which is 0.7 Sv/Gy [1].

## 3. Results and Discussion

The overall annual average values of natural background radiation measured in different areas of Bangladesh are found to be lower than other areas of the world according to table-1. Total annual effective dose from natural radiation sources to Bangladeshi population is found to be (2 ± 0.66) mSv/y in comparison to the global value of 2.455 mSv/y [1]. Slightly higher background radiation dose levels are found in Dinajpur, Rangpur area which may be due to presence of hard rock i.e. basement rock at shallow depth. Slightly higher reading are also found in and around Sylhet area which may be due to contribution of uranium bearing sandstone. It may be noted that the background radiation are almost same for most of the areas of Bangladesh.

**Table 1:** Measurement of background radiation dose level in different location of Bangladesh

| Location | Position | | Average Backgroud Radiation Dose (mSv/y) |
|---|---|---|---|
| Dhaka | $23^0$42′37.44″N | $90^0$24′26.78″E | 2.00 ± 0.47 |
| Tangail | $24^0$14′59.42″N | $89^0$54′59.58″E | 1.75 ± 0.38 |
| Barisal | $22^0$42′17.89″N | $90^0$22′12.47″E | 2.14 ± 0.24 |
| Patuakhali | $22^0$27′50.19″N | $90^0$20′28.36″E | 2.10 ± 0.26 |
| Comilla | $23^0$27′42.7″N | $91^0$11′6.11″E | 1.18 ± 0.42 |
| Rangamati | $22^0$39′26.46″N | $92^0$10′23.77″E | 2.10 ± 0.34 |
| Chittagong | $22^0$20′18.24″N | $91^0$49′54.05″E | 1.73 ± 0.48 |
| Rangpur | $25^0$44′47.9″N | $89^0$15′5.98″E | 3.17 ± 0.57 |
| Mymenshing | $24^0$45′22.9″N | $90^0$24′23.26″E | 1.75 ± 0.43 |
| Pabna (Rooppur) | $24^0$0′23.18″N | $89^0$14′13.92″E | 1.47 ± 0.36 |
| Rajshahi | $24^0$22′26.4″N | $88^0$36′4.1″E | 1.80 ± 0.18 |
| Dinajpur | $25^0$37′38.82″N | $88^0$38′16.04″E | 3.40 ± 0.47 |
| Sylhet | $24^0$53′56.54″N | $91^0$52′19.13″E | 2.74 ± 0.60 |
| Jamalpur | $24^0$55′10.74″N | $89^0$56′53.23″E | 1.27 ± 0.51 |
| Kushtia | $23^0$54′10.08″N | $89^0$7′9.95″E | 1.36 ± 0.34 |

In most places on the earth, the natural radioactivity varies only within narrow limits, but in some places there are wide deviations from normal levels because of abnormally high levels of radioactive minerals, such as monazites and zircons. From the table 2, in the beach areas of Cox's Bazar region has contributed much higher background radiation level, where maximum background radiation level is 38.89 $mSvy^{-1}$. But apart from Cox's Bazar beach side the background radiation level is much lower in and around Cox's Bazar town, where minimum background radiation level is 1.40 $mSvy^{-1}$. So the background radiation level in Cox's Bazar district is varied from 1.40 $mSvy^{-1}$ to 38.89 $mSvy^{-1}$. Presence of Monazite and Zircon in the sand of the beach areas of Cox's Bazar region has contributed such higher background radiation level.

**Table 2:** Minimum and maximum background radiation dose level in different location of Cox’s Bazar district

| Location | Position | | Backgroud radiation dose level (mSv/y ) | |
|---|---|---|---|---|
| | | | Minimum | Maximum |
| Cox’s Bazar | 21$^0$27′13.97″ N | 91$^0$58′3.54″ E | 1.40 | 38.89 |

Beach sands are mineral deposits formed through weathering and erosion of either igneous or metamorphic rocks. Among the rock constituent minerals are some natural radionuclides that contribute to ionizing radiation exposure on Earth. GB3 (Beach placer deposits around the world are known for their economic concentrations of heavy minerals such as monazite, zircon, ilmenite, rutile, garnet and sillimanite. Those enriched in radioactive minerals are of special interest for their use in nuclear industry [11, 12], and potential for environmental hazard engendered from natural radiation [12-14].

**Table 3:** The gamma dose rates in air of the Cox’s Bazar District are compared with the values reported from other parts of the world and the World average

| Area, Country | Minimum dose (mGy/y) | Maximum dose (mGy/y) | Refference |
|---|---|---|---|
| Cox’s Bazar, Bangladesh | 1.40 | 38.89 (Beach Area) | Present study |
| Ramsar, Iran | - | 149 | [1] |
| Ramsar, Iran | 0.61 | 260 | [15] |
| Kerala, India | 1.75 | 35 | [1] |
| Guarapari, Brazil | 0.79 | 789 | [1] |
| World Average | 0.16 | 0.82 | [1] |

From table 3, the areas in Iran, India and Brazil are all due to local geologic and geochemical effects, giving rise to very high and very localized radiation exposure. UNSCEAR (2000) reports maximum dose rates of Guarapari, Brazil of 789 mGy/y on beaches of monazite sands [15]. The background radiation levels in different areas of Bangladesh are shown in fig. 1.

Background radiation dose level in and around Dhaka City for 10 years from 2006 to 2015 have been measured on monthly basis is shown in bar diagram of fig. 2, where no significant change has been observed even after the accident of Fukusima nuclear power plant in Japan.


**Fig. 1** Background Radiation Levels in different areas of Bangladesh

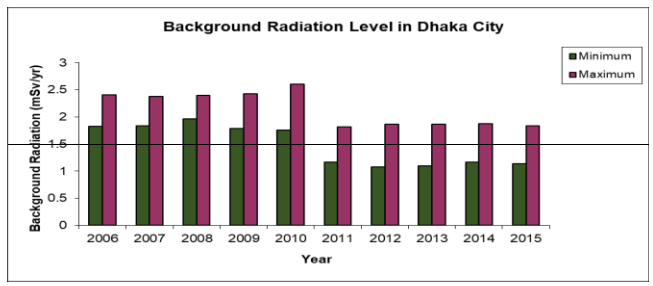


**Fig. 2** Background Radiation Level in Dhaka City of Ten Years

## 4. Conclusion

From this study, the observed average background radiation dose rate of 16 districts of Bangladesh is found to be (2 ± 0.66) mSvy$^{-1}$ (except Cox’s Bazar beach side). According to UNSCEAR-2000 the worldwide average background dose rate is 2.45 mSvy$^{-1}$. Moreover background radiation dose level of Dhaka region for 10 years from 2006 to 2015 have been measured on monthly basis, where no significant change has been observed even after the accident of Fukusima nuclear power plant in Japan. So these data could be taken as a baseline data. There is a need for continuous environmental monitoring program in order to determine any change due to artificial radioactivity releasing from the nuclear installation in case of incident/ accident. In future, multi method approach for more accuracy and comparison of results can be adopted.

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