ESTIMATION OF RADIATION DOSE RATE LEVELS AROUND AZARA TOWN. AWE LOCAL GOVERNMENT AREA OF NASSARAWA STATE, NIGERIA

BY

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CERTIFICATION

This is to certify that this project was carried out in the Department of Biochemistry and Molecular Biology, Faculty of Natural and applied Science, Nasarawa State University, Keffi.

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DEDICATION

This work is dedicated to the Lord God Almighty for His Abundant Grace and Mercy over my Life and all that is mine.All the Glory belongs to you, Oh God.

Am also dedicating this to the loving Memory of my Late father Ven. S.B.G. Oıasehinde, mygreatest Mentor and motivator. Rest on Dad.

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I want to specifically acknowledge all the Lecturers in the Department of Biochemistry and Molecular Biology for their dedication to bring out the best in me. I didn't think I will be able to cope with studies after leaving school for more than two decades. You all made this PGD programme possible and worthwhile for me. God bless you all. My sincere gratitude goes to my Supervisor, Dr. C.C. Nweze. Your understanding and tolerance makes all the difference. May the Lord bless you real good. Mrs. A. U. Ijeomah, my Assistant Project Supervisor. May the Lord bless you for your patience and dedication to imparting knowledge.

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GOD BLESS YOU ALL

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ABSTRACT

Radiation dose rate level monitoring was carriedout around Azara town and miningsites close to the town. A Radiagem 2000 Survey meter was used. Areas monitored include different location in Azara Town, mining Vent 17 and mining Vent 18. It was observed that the dose equivalent rate varied from 0.0 15 ± 0.002 to 0.241 ± 0.005μSv/hr with a mean value of 0.1411μSv/h. Some of these results though slightly above the standard background radiation(0.133μSv/h), they are below the International Commission on Radiological Protection (ICRP) maximum permissible limit of 0.57μSv/hr and may not pose any danger to the mining workers, the inhabitants of Azara village and the environment at large. This project work also revealed that the dose rate at Azara village is essentially from natural background radiation. This implies that the village is safe and there has been no radioactive contamination from the activities of the mining sites on the people and the environment. This however, may not be the same for too long a time, depending on the mining activities in the future.

CHAPTER ONE

INTRODUCTION

Background radiation is defined by the International Atomic Energy Agency as "Dose or dose rate (or an observed measure related to the dose or dose rate) attributable to all sources. *(IAEA 2007).*

Natural radioactive mineral deposits are found in suitable geological environments. Their occurrences in outcrop enhance the background radiation of the area. High exposure level of these deposit may be harmful for people residing in the region. The greatest contribution to mankind's exposure comes from natural background radiation, and the worldwide average annual effective dose is 2.4mSv/yr. *(UNSCEAR 1998).* However, much higher levels of .exposure are usual forinhabitants of natural high background radiation areas (HBR As). High level of radiation above the earth is mainly due to naturally occurring radioactive elements in the earth's crust such as Uranium (238U), Thorium (232Th) and Potassium (40K). Areas at high altitudes are also more affected by Cosmic Radiations.*(UNSCEAR 1998).* The levels due to the terrestrial background radiation are related to the types of rockfrom which the soils originate. Higher radiation levels are associated to igneous rocks such as granite and lower levels with sedimentary rocks. There are some exceptions however, since some shale and phosphate rocks have a relatively high content of radionuclides*(UNSCEAR1998).*

Human beings have always been exposed to ionizing radiation from the earth. Quarry and mining activities which involves blasting, digging, and crushing of rocks release radionuclide in the formof dust particles into the atmosphere and the radiological implication of these radionuclides is due to gamma exposure of the body and irradiation of the lung from inhalation and ingestion of radon and its daughters(*UNSCEAR 1998).* Therefore, theassessment of gamma radiation dose from natural sources is of particular importance as natural radiation is the largest contributor to the external dose of the world population*(UNSCEAR 1998).* Evaluation of external gamma dose due to the natural sources is essentialas these doses vary depending upon the concentrations of natural radionuclides, 238U, 232Th with their daughters, and 40K, present in the rocks and soils which further depends upon the local geology of each region in the world *(Rodenos, et al.,1994).*

Radiation is feared all over the world because of the adverse health effects it possess onoverexposure to it. This concern is even much higher with people living in closeproximity with mining operations/sites. It is however of worth to note that radiation is presenteverywhere, in everything in our environment and even in our bodies. There is Cosmic Radiation made up of protons, alpha particles and heavy nuclei bombarding the earth from space. They interact with atmosphere resulting intolarge numbers of gamma rays, neutrons and mesons contributinghigh radiation dose burden to man even at sea level*(Aduemezia, et al., 2012).*

Other natural radiation includes the terrestrial gamma rays from land, sea and walls ofhouses we live. We are also internally exposed from radiation emitted by radio-nuclides absorbed into the body through the food we eat and milk we drink. Examples of such radio-nuclides are potassium-40, heavy elements and carbon-14. Although generally the background radiation contributes more than 60% of the annual radiation dose burden to man, howeverthe radiation levels in most places are too weak to cause any deleterious effects on man.

Although the level of dose burden from natural radiation is low, there is still a level of risk, though small, but not zero. It has been reported that averagely the radiation exposure rate lies in the range of 0.08-0.1 5µSv/hr*(Gordon Linsley, et al., 1997).*According to about 95% of the world's population is assumed to live in areas of normal background radiation with outdoor dose r ate ranging from 0.024 to 0.160 μSv/hr*(UNSCEAR 1993).*

The harmful effects of radiation can be categorized into (i) Deterministic radiation (Tissue reaction) and (ii) Non deterministic radiation risks.

Deterministic effects have threshold dose below which effects are not probable such as erythema, radiation dermatitis, alopecia etc; whereas non deterministic effects have nothreshold dose and include carcinogenesis and genetic effects. The public and people working at mining sites receive various doses of ionizing radiation from both naturally occurring and man-made sources. The level of doses received depends on the occupation, level of radiation in the environment and where an individual lives. Depending on where an individual lives, some people receive an exposure in the range of lmSv/yr from cosmic radiation from outer space and from naturally occurring isotopes in the ground, air, food and water *(Oluwafisoye, et al., 2009).*

Radiation from many sources is omnipresent on the earth surface, consequently man is continuously irradiated. The level of the natural radioactivity in the soil and in the surrounding environment as well as the associated external exposure due to the gamma radiation depends primarily on the geological and geographical conditions of the region.*(UNSCEAR 2000).* The geological and geographical definition of an environment dictate to a good degree the radionuclides contained in the soil and rocks there. *(TchokossaSoil,et al., 2012).* Soil contains small quantities of radioactive elements along with their progeny. *(Olarinoye,et al., 2010)*

Other Radiation effects on human include:

- Loss of Hair at high dose rate.
- At very high doses, radiation kills nerve cells and small blood vessels, and can cause seizures and immediate death.
- The thyroid gland is susceptible to radioactive iodine. In sufficient amounts, radioactive iodine can destroy all or part of the thyroid.
- At very high doses, the blood's lymphocyte cell count will be reduced, leaving the victim more susceptible to infection. This is often referred to as mild radiation sickness. Early symptoms of radiation sickness mimic those of flu and may go unnoticed unless a blood count is done. According to data from Hiroshima and Nagaski, show that symptoms may persist for up to 10 years and may also have an increased long-term risk for leukemia and lymphoma.
- Intense exposure to radiation at high doses would do immediate damage to small blood vessels and probably cause heart failure and death directly.
- Radiation damage to the intestinal tract lining will cause nausea, bloody vomitingand diarrhea. This will occurs at high doses. The radiation will begin to destroy thecells in the body that divide rapidly. These include blood, GI tract, reproductive and hair cells, and harms their DNA and RNA of surviving cells.
- Sterility due to damaging of the sex cells
- Leukemia

1.2 Justification

This Project strives to assess the radiation level, and their possible risks effects to the mining workers and the people living within Azara villageand its environs. The values obtained for radiation from this work will form part of the baseline data for environmental impact assessmentof radiation on Azara village. The data may also be used in the future to assess the impact of mining activities on the environment over a long period of time.

1.3 Statement of Hypothesis

In a place where serious mining activities is going on over a long period of time, it is expected that background radiation emission from such sites will be much greater than normal and thus posses a serious health challenge for villages that are in close proximity to the mining sites.

1.4 Aim

The aim of this work is to monitor and quantitatively document the backgroundradiation levels within Azara village and the mining / quarry site using a radiation monitor.

1.5 Specific Objectives

Assessment of radiological risk associated with naturally occurring radioactive materials (NORM) at Azaravillage and the mining sites close to it.

1.5 Significant of the Study

The outcome of thisstudy will be used to advice the community / authority on the effect of elevated radiation doseson the health of the people and the measures to be taken forthe protection of the inhabitants of Azara Villager in the nearest future.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background radiation

Radiation is energy that propagates through matter or space. Radiation energy can be electromagnetic or particulate. Radiation is usually classified into non-ionizing (visible light, TV, radio wave) and ionizing radiation. Ionizing radiation has the ability to knock electrons off of atoms, changing its chemical properties. This process is referred to ionization (hence the name, ionizing radiation). Ionizing radiation is the main concern for health effects since it can change chemicals' properties in the human body. *(UNSCEAR 2003).*

Radiation comes from many sources including cosmic rays from the universe, the earth, as well as man-made sources such as those from nuclear fuel and medical procedures.

Radiation has been used in many industries including diagnostic imaging, cancer treatment (such as radiation therapy), nuclear reactors with neutron fission, radioactive dating of objects (carbon dating), as well as material analysis.*(Aduemezia. et. al., 2008)*

The world is naturally radioactive and approximately 82% of human-absorbed radiation doses, which are out of control, arise from natural sources such as cosmic, terrestrial,and exposure from inhalation or intake radiation sources. In recent years, several international studies have been carried out, which have reported different values regarding the effect of background radiation on human health.*(UNSCEAR 1998)*

Gamma radiation emitted from natural sources (background radiation) is largely due to primordial radionuclides, mainly 232T h and 238U series, and their decay products, as well as 40K, which exist at trace levelsin the earth's crust. Their concentrations in soil, sands, and rocks depend on the local geology of each region in the world. Naturally occurring radioactive materials generallycontain terrestrial-origin radionuclides, left over since the creation of the earth. In addition, the existence of some springs and quarries increases the dose rate of background radiation in some regions that are known as high level background radiation region. The type of building materials used in houses can also affect the dose rate of background radiations.

More than sixty radionuclides can be found in the environment, which can be divided into three general categories:

- Primordial (which formed before the earth creation)
- Cosmogenic (which formed as a consequence of cosmic ray interactions)
- Human produced (which formed due to human actions; they are minor amounts compared to natural).

Radionuclides are found naturally in air, soil, water, and food. Natural radioactivity is common in the rocks and soil that constitute planet earth, in water and oceans, and in bull ding materials and homes. There is no place on earth that has no natural radioactivity.*(Ramachandran T V. 2011).*Some radioactive nuclides are detectable in soil. They belong to natural radionuclides such as the members of the uranium and thorium decay series. More specifically, natural environment radioactivity and the associated external exposure due to gamma radiation depend on the geological andgeographical conditions and appear at different levels in the soils of each region in the world. *(Tzortzis M. et. al., 2004)(UNSCEAR 2000).* The specific levels of terrestrial radiation are related to the geological composition of each lithologically separated area and to the content of the rock from which the soils originated in each area in the radioactive elements of thorium (232Th), uranium (238U), and potassium (40K).

All building materials contain various amounts of radioactivity. For example, materials derived from rock and soil contains natural radionuclides of the uranium and thorium series and the radioactive isotope of potassium. Artificial radionuclides can also be present, such as cesium (137Cs), resulting from the fallout from weapons testing and the Chernobyl accident. All these can be sources of both internal and external radiation exposures. Internal exposure occurs through the inhalation of radongas, and external exposure occurs through the emission of penetrating gamma rays. *(UNSCEAR 2000).* Considering that about 50% of natural exposure of people is from radon gas, it is the leading cause of cancer patients suffering from respiratory and gastrointestinal system problems, and the highest percentage of radon that enters the human body is from drinking water and breathing. Once radon in water supplies reaches consumers, it may result in human exposure via inhalation and direct digestion. Radon in water transfers into the air during the rains, flushing toilets, washing dishes, and washing clothes. The aerosols tend to deposit in the lungs, where they release radiation that has been shown to increasethelikelihood of lung cancer. Radon can also reach other body tissues through ingestion, resulting in radiation exposure to the internal organs. Ingestion of radon is believed to increase the risk of stomach cancer. *(Oluwafisoye. et al., 2009).* Besides the effect of soils in population exposure by using them as building material, they can affect the human body by taking the food containing radionuclide, which enters the food chain from deeper soil layers and also tainting the ground water.

Owing to the inevitable effects of radiations and health risk from these exposures, it is necessary to investigate all reported data in the last few years.

2.2 Cosmic Rays

Cosmic radiation originates from the sun, stars, collapsed stars (such as neutron stars), quasars, and in the hot galactic and intergalactic plasma. It has many components, such as X-rays, gamma rays, and particles, which may be mesons, electrons, protons, neutrons or hyperons.

The initial energy of the individual particles constitutes a broad spectrum from a few electron volts (eV) to about 1,020 eV. Cosmic radiation loses energy as it penetrates the atmosphere. The protective shield of the atmosphere and the earth's magnetic field prevent the soft energy radiation components from penetrating the atmosphere.

Generally, the natural dose rates from cosmic rays depend strongly on the altitude and slightly on the latitude. The latitude effect is due to the charged particle nature of the primary cosmic rays, and the effect of the Earth's magnetic field, which tends to directions away fromthe equator and toward the poles. At the sea level the cosmic radiation contributes on the average of 0.27 mSv/year to the human body. At the ground level, only a small fraction of that is due to neutrons. Cosmic radiation dose increases with altitude.*(EPA 2016).*At 2.5 k m, it is about 0.55 mSv/year on the order of 60 times greater 17 mSv/year. At a slightly higher altitude of 15 km and 60° magnetic latitude, it levels off and reaches a maximum of 30 msv/year.

2.3 Terrestrial Rays

Terrestrial radiations from natural radioactive elements in the ground, stones, trees, and walls of houses contribute on the average about 0.28 m Sv/year. The terrestrial sources vary significantly from place to place. These are categorized into building materialsand soils surface.

2.3.1 Radioactivity in Buildings

Determining population's exposure to radiation from building materials is important, because almost 80% of human life is spent indoors. (Tzortzis. et. al., 2004) All building materials mostly constitute rock and soil; these two raw materials include natural radioactive isotopes such as 232Th and 238U decay series and 40K(UNSCEAR 2000)

2.3.2 Radioactivity in Soils Surface

It is important that the natural radioactivity, which exists in the soils surface, must be investigated because to determine the population's exposure to radiation from building materials,such as soils. The concentration of potassium usually ranges from 1,000 to30,000mg/kg. It is usually lower but more variable in the basaltic rock region (1,50-20,000mg/kg) than in acidic (high concentration of Si02) rock regions. For example, in granite rock, the concentration is soften about 29,000 mg/kg.

Radium (226Ra) is the most important radionuclide in the 23W decay chain from the radiobiological viewpoint; therefore, the measurements of 226Ra concentration in building materials are considered as reference in all investigations. Natural radionuclides in building materials may cause both external exposure, caused by their direct gamma radiation, and internal exposure from radon gas. Most of the terrestrial background radiation is due to potassium and to elements of the uranium series (238U to 206Pb), thorium series (232Th to 209Pb), and actinium series (235U to 207Pb). Each of these series consists of manyalpha, beta and gamma emitters. The concentration of these radioactive isotopes in thesoil and water varies greatly.

It is important to mention that soil, by being used as building material, can affect a population's exposure to radionuclides; they can also affect the human body by taking food that contains radionuclides; these radionuclides enter the food chain from the deeper soil layers, besides tainting the ground water,Because of this effect, several surveys have estimated the distribution of natural and synthetic radionuclides in soil profiles and in the surface layer of the soil.(Tzortzis. *et. al.*, 2004)

2.3.3 Radioactivity in foods

Food, water, and air usually contain trace amounts of alpha emitters from the uranium, thorium, and actinium series. Some of the radon (222Rn, and to a lesser extent 220Rn and 219Rn) gas diffuses into the food supply. For example, the radon in the ground and in the water, and its many decay products, precipitate onto the field and onto the vegetation in thefield. Because these radioactive elements perfuse into the food chain and affect the human body, several investigations were carried out to determine the concentration of the major trace elements in food.(Shahbazi-Gahrouei, *et al., 2003)*

Table 2 shows examples of concentrations of major trace elements in actual foodsamples.

Table 2: Typical concentration of some of the major trace elements in foods

Food	Na Bq/kg	Mg Bq/kg	P Bq/kg	Cl Bq/kg	K Bq/kg	Ca Bq/kg	Mn Bq/kg	Fe Bq/kg	Cu Bq/kg	I Bq/kg
Beef	840	240	1,670	760	3,380	110	0.24	28	0.80	0.09
Halibut	1,110	240	2,110	880	3,040	130	0.24	7.00	1.60	0.50
Oysters (raw)	4,710	390	1,430	6,280	0,040	940	0.39	56	36.00	1.00
Green beans	230	260	4,440	330	2,510	650	0.26	11	1.26	----
Peaches	150	110	150	50	2,560	60	0.11	4	0.1	0.1
Chiken	910	270	2,00	790	3,720	14	0.27	15	3.00	----
Mix. Veg.	400	380	1,010	140	1,130	80	0.34	4	0.80	0.05
Bacon	8,200	130	1,080	1,251	2,390	130	0.13	8	----	----

Shahbazi-Gahrouei, *et al.*, 2003: Natural radiationAdvanced.

In the human body, the concentration of activity of potassium (40K), carbon (14C), tritium (3H), polonium (21OPo), and 226Ra is 63, 66, 133, 0.0002, and2.7 x 105Bq/kg, respectively.The concentrationof natural radioactivity in food is often in the range of 40-600 Becquerel per kilogram of food. For example, the radioactivity from potassium alone may be typically 50 Bq/kg in milk, 420 Bq/kg in milk powder, 165 Bqlkg in potatoes, and 125 Bq/kg in beef.

2.4 Effects of Radiation on Humans, Plants and the Environment

There are four main types of ionizing radiation: electrons (also known as beta), photons (mostly gamma ray and X-ray), charged particles (alpha) and neutrons. In a nuclear reactor, the radiation is formed due to the decay of radioactive isotopes, which are produced as part of nuclear reactions inside the reactor.

Each ionizing radiation type interacts with the body differently but the end results are similar. When radiation enters a body, it can deposit enough energy that can directly damage DNA or cause many ionizations of atoms in tissues that would eventually cause da mage to critical chemical bonds in the body.*(*Aduemezia. *et. al., 2008*). The mechanisms of how radiation damages tissues and the degree of damage of each type of radiation are different. However, the a mount of radiation needed to cause permanent damage to the tissue depends on the total dose to the body, the type of radiation, and the amount of time it takes to get that amount of radiation (dose rate). Also, depending on the total dose and/or dose rate, the effect can be acute (happen right away such as radiation bums, sickness, nausea) or delayed (long-term, such as cancer).

2.5 Health Effects of various Doses/Dose Rates

Radiation dose is measured in Rad or Gy (1Gy 100 Rad). However, the most often reported two units that have been mentioned in the media are Sievert (Sv) and Rem (1Sv = 100 Rem). These are defined as dose equivalent, which accounts for the different effectseach type of radiation have on the body. The Sievert and Rem are units used by regulatory authorities to control radiation release and exposure.*(ICRP 1991)*

It is important to note that the health effects of radiation exposure vary for different doses. It is important to note dose is different from dose rate. Dose refers to the total amount of exposure, while dose rate refers to the exposure per unit of time (typically per hour)

An acute dose (received in a few days) above 250-400 Rem (2.5 – 4.0 Sv) is considered to be lethal for at least half of the population exposed. Not much is known about doses between 50 Rem and 250 Rem (500 mSv and 2500 mSv), but the exposed person will experience acute radiation sickness. The symptoms of such exposure can include nausea, vomiting, diarrhea, burns, and hair loss, but may ormay not lead to near term death. Below this level, no acute symptoms have been observed. For radiation exposure of less than 50 Rem there is the potential for delayed effects such as non-specific life shortening, genetic effects, fetal effects, and cancer, but little is known about the long term consequences of exposures in this range. For doses less than 25 Rem there are not enough data to determine if such an exposure can cause any long-term effects on human health.*(UNSCEAR 1993)*

2.6 Summary of the Effects of radiation on the human body

Effects of Radiation on the Human Body

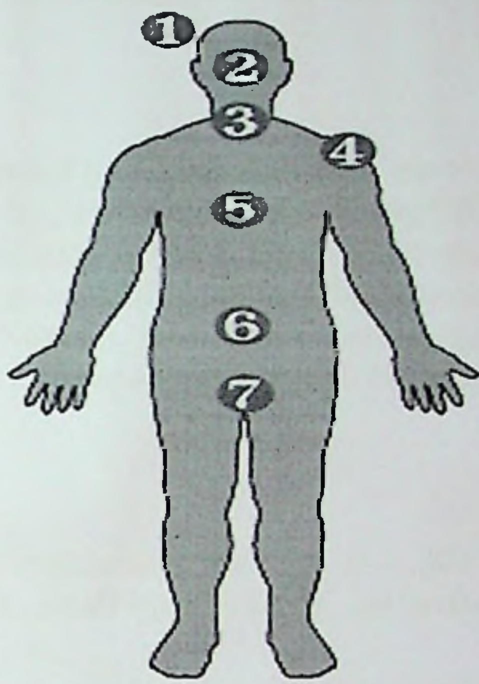


Figure 1.

Summary of the different parts of the human body that can be affected by radiation.

Sourse: atomicarchive.com

(1) Hair

The losing of hair quickly and in clumps occurs with radiation exposure at 200 rems or higher.

(2) Brain

Since brain cells do not reproduce, they won't be damaged directly unless the exposure i s 5,000 rems or greater. Like the heart, radiation kills nerve cells and small blood vessel s, and can cause seizures and immediate death.

(3) Thyroid

The certain body parts are more specifically affected by exposure to different types of radiation sources. The thyroid gland is susceptible to radioactive iodine. In sufficient amounts, radioactive iodine can destroy all or part of the thyroid. By taking potassium iodide, one can reduce the effects of exposure.

(4) Blood System

When a person is exposed to around 100 rems, the blood's lymphocyte cell count will be reduced, leaving the victim more susceptible to infection. This is often referred to as mil d radiation sickness. Early symptoms of radiation sickness mimic those of flu and may go unnoticed unless a blood count is done.According to data from Hiroshima and Nagaski, show that symptoms may persist for up to 10 years and may also have an increased long-term risk for leukemia and lymphoma.

(5) Heart

Intense exposure to radioactive material at 1,000 to 5,000 rems would do immediate da mage to small blood vessels and probably cause heart failure and death directly.

(6) Gastrointestinal Tract

Radiation damage to the intestinal tract lining will cause nausea, bloody vomiting and diarrhea. This is occurs when the victim's exposure is 200 rems or more. The radiation will begin to destroy the cells in the body that divide rapidly. These including blood, GI tract, reproductive and hair cells, and harms their DNA and RNA of surviving cells,

(7) Reproductive Tract

Because reproductive tract cells divide rapidly, these areas of the body can be damaged at rem levels as low as 200. Long-term, some radiation sickness victims will become sterile. *(atomicarchive.com 1998)*

CHAPTER THREE

3. Materials and Methods

3.1 Materials

The RD S-200 Universal Survey Meter is an excellent, portable multipurpose radiation meter for a wide range of applications. It is especially designed for situations where accurate measurements at low dose rate levels are of importance. The meter has an interface for tile external gamma probes GMP-12H/12L or beta/contamination measurement probe GMP-11/15. A connector for the attachment of the meter to a PC is located at the bottom part of the meter and is equipped with protective cover. The RDS-200 utilizes field-proven measurement electronics and can also be used as a local display unit with the RADOS AAM-90 Area Monitoring System. The meter measures u-radiation and beta radiation with an external probedetector.

It also measures equivalent dose rate within 0.05mSv/h-10 mSv/h. The meter was calibrated by the National Institute of Radiation Protection and Research, University of Ibadan, Ibadan-Nigeria. Readings were obtained between the hours of 1200 and 1600 hours Ten (10) locations were strategically selected in thestudy for adequate coverage of Azara Village and its mining sites. These includes:

1. The market square
2. 100 meters away from the market square
3. At the king's palace
4. 100 meters away from the king's palace
5. At the mining site-Vent 17
6. At the mining site Ventl8
7. 100 meters from mining site-Vent 17
8. 100 meters from the mining site Vent 18
9. At the mining site vent 19
10. 100 meters from the mining site vent 19

These areas record high population flux throughout the day. The monitor was suspended in air at one meter above the ground level. At least five readings were taken in each location and the mean values were recorded

3.1.1 Study Area

Figure1:Source, Researchgate.net

The study area is situated at Nasarawa State. The State is within the MiddleBelt of Nigeria which lies between latitude7°45 and 9°25N of the equator and between longitude7° and 9°37E of the Greenwich Meridian.

Azara mining site is located in Awe Local Government Area of Nasarawa State. The geographical coordinates 8°22'North ,90151East and has an altitude of 181.5m above sea level (Obaje,*et.al.*,2006).

In the study area, the vegetation type is dominantly characterized with southern guinea savanna and some elements of northern guinea savanna with interspersion of grassland, tree savanna, fringing wood land or gallery forest along the valleys (Chaanda,*etal,.2010*).

The people in the study area are mainly farmers. The major crops they produce include yam, cassava, melon, guinea corn, and other grains in large quantities for both consumption and trade. Substantial numbers of nomads reside in the area and are the main suppliers of milk, eggs, butter, hides and skin. The indigenous people are mainly farmers and the Hausas are petty traders.

3.2. METHOD

A total of 50 measurements were taken across Azara Village and the surrounding mining sites.

CHAPTER FOUR

RESULT AND DISCUSSION

Generally, from the result, the average dose rates for each area ranged between0.110±0.001μSv/hr to 0.241±0.0011μSv/hr. The mean value from the mining Vent 18 shows the highest dose rate with the value 0.241±0.0011μSv/hr while the doserate from the Market Square was the lowest with the value 0.015±0.002μSv/hr.

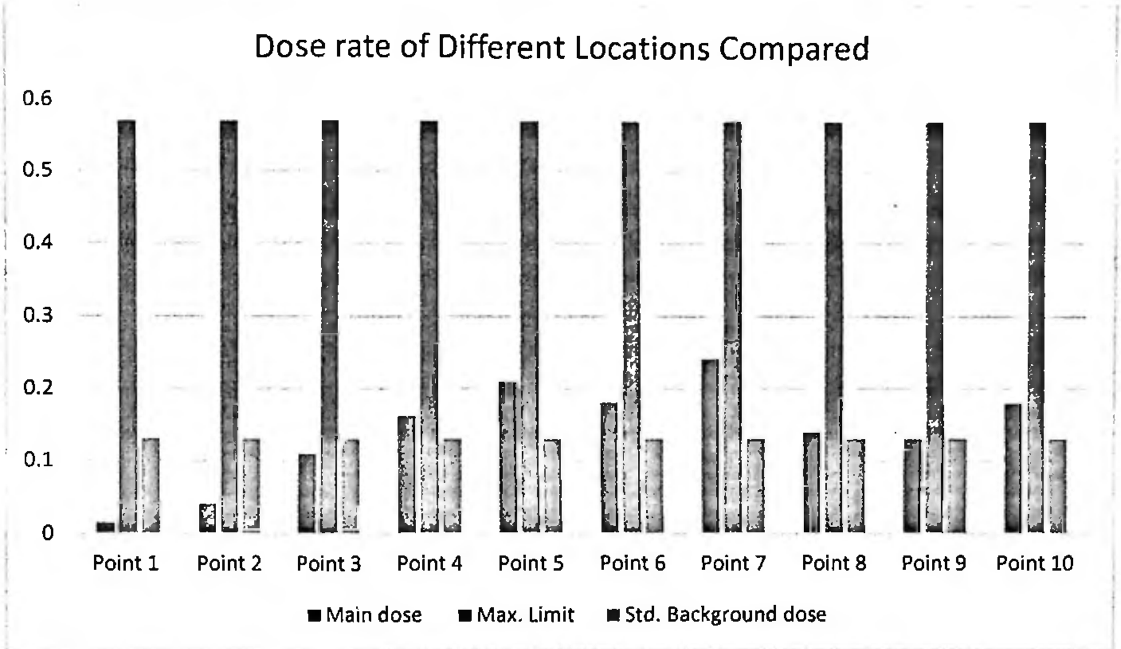
Data for the mean dose rates of the area measured are presented in the Table below.

S/No	Location	RADO S200 (uSv/h) (mean values ± standard deviation
Point 1.	The market square	0.015 ± 0.002
Point 2.	100 meters away from the market square	0.041 ± 0.001
Point 3.	The king's palace	0.110 ± 0.001
Point 4.	100 meters away from the king's palace	0.163 ± 0.001
Point 5.	At the mining site-Vent 17	0.210 ± 0.005
Point 6.	100 meters from the mining site-Vent 17	0.181 ± 0.002
Point 7.	At the mining site Ventl8	0.241 ± 0.001
Point 8.	100 meters from the mining site Vent 18	0.140 ± 0.000
Point 9.	At the mining site vent 19	0.180 ± 0.002
Point 10.	100 meters from the mining site vent 19	0.130 ± 0.000
	Total mean value	0.1411 ± 0.001

The total number of data point is 50.

4.3 Chart

Below is a Chart comparing the background dose rate from points to the Standards


Dose rate of Different Locations Compared
0.6
0.5
0.4
0.3
0.2
0.1
0
Point 1
Point 2
Point 3
Point 4
Point 5
Point 6
Point 7
Point 8
Point 9
Point 10
Main dose
Max. Limit
Std. Background dose

CHAPTER FIVE

SUMMARY DISCUSSIONCONCLUSION AND RECOMMENDATION

5.1 Summary

The highest dose level of 0.241 ± 0.001μSv/hris obtained at point 7 (mining Vent 18) which is largelydueto theradioactive half-life is above the standard background radiation (0.133μSv/hr) but below the ICRP maximum permissible limit of 0.57μSv/hr and may not pose any danger.

The lowest dose level was recorded at point 1 (the market place) with a value of 0.015 ± 0.002μS/hr. This reading is quite below the standard background radiation limit of 0.133μSv/hr and thus the radiation dose at the market place is the lowest in Azara village.

The radiation doses at Points 2, 3 and 10 (which represents 100 meters from the market place, the kings palace and 100 meters from mining vent 19), with values 0.041± 0.001μSv/hr, 0.110 ± 0.001μSv/hr and 0.130 ± 0.000μSv/hr respectively are all below the standard background radiation limit.

The radiation doses at points 4,5,6,8 and 9 (which represents100 meters from the kings palace, mining vent 17, 100 meters from mining vent 17 and 100 meters from mining vent 18), with values 0.164 ± 0.001μSv/hr, 0.210 ± 0.005μSv/hr, 0.181 ± 0.002μSv/hr, 0.140 ±0.000μSv/hr, and 0.180 ± 0.002μSv/hr,are all above the standard background radiation dose but below the ICRP maximum permissible limit of 0.59μSv/hr

However, research on the Assessment of radioactivity concentration in soil ofsome mining areas in central Nasarawa state using Eggon, Wamba and Farm Ruwa asa case study revealed an elevated maximum annual equivalent dose rate (mSv/y) of 0.466 ± 0.2mSv/h.*(Ibrahim et al.,2013).*

Using the mathematical representation:

Annual equivalent dose rate(msv/y) = δ x μ x24 x365 x 10^{-3}*Tayyeb et al.,(2012)*Where δ= Equivalent dose rate in micro sievert per hour (μSv/hr)

μ= Occupancy factor (which is 0.2 for outdoor)

This is equivalent to 0.2549μSv/hr; a higher dose rate compared to Azara village reading.

Therefore the percentage increase in Dose rate between Azara Village research work and Nasarawacentre is calculated thus:

% increment = increase in maximum dose ratesx 100

Azara maximum dose rate

= 0.255 - 0.241x 100

0.241

= 5.8%Increase in dose rate

Also a research on Effective dose from natural background radiationinKeffi and Akwanga towns, central Nigeria showed that, the effective maximum dose of Akwanga was 0.31±0.04 mSv/yr; and that of Keffiwas 0.25± 0.04mSv/yr,respectively.*TermiziRamli et al., (2014)*. These values are equivalent to0.1769 ± 0.02μSv/hr and 0.1426 ± 0.01μSv/hr.

The percentage reduction in dose rate = reduction in max dose rate.X 100

Azara dose rate

=0.241 - 0.1769 x 100

0.241

= 26.59% reduction in dose rate

5.2 Conclusion and Discussion

Mining activities has the potential of increasing the radiation dose received by individuals' resident at close proximity to the site. This is essentially because the minerals and raw materials containradionuclide of natural or terrestrial origin. The result obtained in this workclearly indicate that members of the public residing in close proximity to the mining sites and minners, are likely going to receive a significantly higher doses over some decades which may eventually resultin a consequentially adverse health situation associated with high dose of irradiation. Development of disease conditions such as: Sterility, mutation resulting in giving birth to offsprings with serious disability and abnormalities, cancers of various typesand a host of other serious health issues may occur.

From the results obtained in table 2, point 6 which is 100 meters from the mining vent 17 has a dose level of 0.181± 0.002. This value is lower than the dose rate level of 0.210 ± 0.005 obtained at mining vent 17 itself. The distance of 100 meters can be said to be responsible for the variation in the dose rate and thus we can deduce that the closer the mining activities is, the higher the dose level, the further away the mining operations is, the lesser the dose level.

Previous research work carried out on the Effective dose from natural background radiation in Keffi and Akwanga townshere in Nassarawa state revealed thatKeffi has a maximum dose of 0.176 ± 0.02μSv/hr and Akwanga has a maximum dose of 0.142±0.01μSv/hr (TermiziRamli et al., (2014). Comparing these dose levels obtained to the ones obtained in the mining village of Azara, which has a maximum value of 0.241 ± 0.001; the effect of the mining activities varies and is bound to increase with time and as seen in the Azara result that is already more than the readings obtained from Keffi and Akwanga towns; Azara town in a matter of a few decades will have a dose reading that will be totally unhealthy for its inhabitants

Other research work on the assessment of radioactivity concentration in soil of some mining areas in central Nassarawa state has also been carried out using Eggon, Wamba and FarinRuwa as a case study. (Ibrahim et al.,) (2013). The research study reveals a maximum high background radiation dose level of 0.254μSv/hr. This dose level is much higher than the standard minimum value of 0.133μSv/hr and also higher in value compared to the dose obtained at the mining village of Azara. This is indicative of the fact that with time, the dose level of Azara village is bound to increase appreciably with continued unregulated mining activities to the level that it will start to impart negatively on the health of the inhabitants of the village as enumerated in chapter 2; 2.3.2 as effects of radiation on the body.

5.3 Recommendations

Appropriate and modern mining technologies should be employed if mining operations must go on in Azara village. Proper sheilding mechanism must be provided at the vicinity of the mining site-to prevent effective protection for the non-mining populace. Appropriate government policies protecting the ecosystem and laws should be enacted for the protection of the people and the mining environment, the mining area needs to be continuously monitored.

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APPENDIX

Calculations

Thesecondhighestdosewasrecordedattheminingsitevent17withavalueof0.210±0.005 μSv/hr.

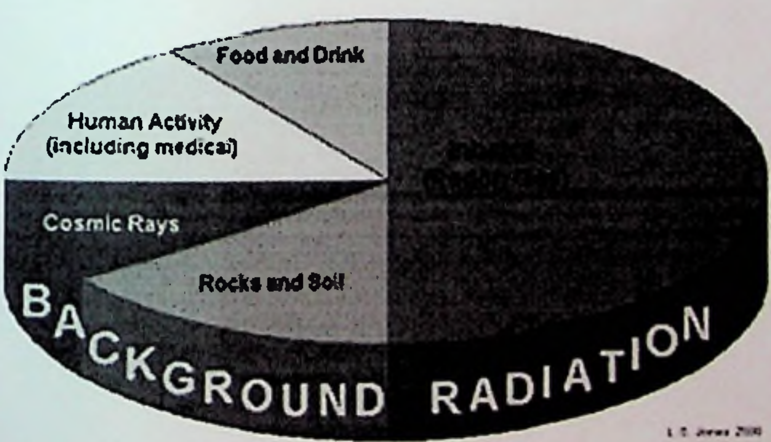
Thetotalmeanvalueoftheprojectworkis= <u>submissionofthemeanvalues</u>

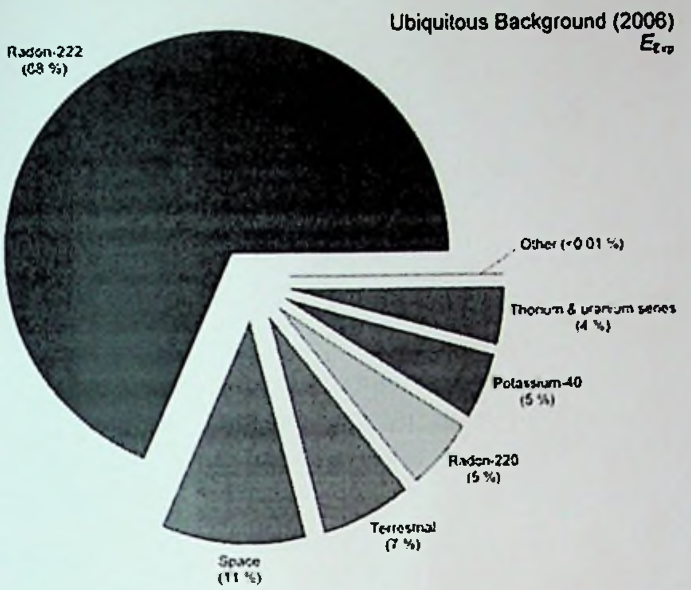
totalnumberofthevalues

<u>1.411</u>=0.1411±0.001μSv/hr

10

TheChartsbelowexpressestheamountandpercentagesofparameterscontributingtobac kgroundradiation.





Source:cyberphysics.co.uk(2006)