Radioactive Pollution in Water

Why in News

Recently, radioactive pollution in water and associated health impacts have been reported in many parts of the globe.

Key Points

- **About:**
    - Radioactivity is the **phenomenon of spontaneous emission of particles** or waves from the unstable nuclei of some elements. There are **three types of radioactive emissions: Alpha, Beta and Gamma.**
        - Alpha particles are positively charged He (Helium) atoms, beta particles are negatively charged electrons and gamma rays are neutral electromagnetic radiations.
    - Radioactive elements are naturally found in the earth's crust. **Uranium, thorium and actinium are three NORM (Naturally Occurring Radioactive Materials)** series that contaminate water resources.
    - A small amount of radiation is found in all types of water **but the extended amount of radiation is harmful to human health.** Radioactivity in drinking water **can be determined by a gross alpha test.**
    - Radioactivity **is measured in Becquerel (SI unit) or in Curie.** The **unit Sievert** measures the quantity of radiation absorbed by human tissues.
- **Sources:**
    - **Natural:**
        - **Radiotoxic Elements in Aquatic System: Radium,** a descendant of the NORM series, is one of the radiotoxic elements found in aquatic systems and can be penetrated into groundwater via (i) aquifer rock dissolution (ii) decaying of 238U and 232Th, or (iii) desorption processes.
            - Radium is a radionuclide formed by the decay of uranium (U) and thorium (Th) in the environment.
        - **Magma:** Sometimes, magma also releases radioactive gases into the environment.
        - **Soil Sediments:** Percolation of NORM from the soil sediments to the aquifer **causes groundwater contamination.**
    - **Anthropogenic:**
        - **Atmospheric Deposition of Cosmogenic Radionuclides:**
            - Atmospheric deposition (both dry and wet) of cosmogenic radionuclides add radioactive nuclei in the surface water.
            - Cosmogenic radionuclides are radioactive isotopes which are produced by natural processes and distributed within the Earth system.

- **Nuclear Reactors and Warheads:**
    - Nuclear reactors and nuclear warhead experiments are the key sources of human-induced radionuclides discharge. Nuclear reactors produce radioisotopes (Cobalt-60, Iridium-192, etc) that hand out as sources of gamma radiation in radiotherapy and numerous industrial appliances.
    - Nuclear power plants placed at the coastal regions add to the radiological contaminants in the marine water by releasing atomic wastes. Water is also used as coolants in these powerhouses, which also get contaminated.
- **Dumping of Radioactive Waste:**
    - The application of radioactive elements in **nuclear weapons, X-rays, MRI and other medical equipment causes their exposure to human beings.** Dumping of these radioactive **wastes in surface water bodies causes water pollution.**
- **Mining:**
    - Mining activities of radioactive elements like uranium and thorium also pollute surface and groundwater.
- **Nuclear Accidents:**
    - Radioactive pollution due to nuclear submarine accidents and sinking have been reported.
    - The Rocky Flats plant in Colorado, Fukushima and the Chernobyl nuclear disaster are some examples of such nuclear accidents.

- **Health Impacts:**
    - **Radiation Syndrome:**
        - Human tissues absorb radiation through polluted water and foodstuff, which can cause serious health risks. High doses of radiation can cause acute radiation syndrome or dermal radiation injury.
    - **Disorders in Human Physiology:**
        - Exposure to radiation causes various disorders in human physiology, including cancer, leukaemia, genetic mutations, cataracts, etc.
    - **Mutation and Structural Alteration:**
        - Genetic effects ionizing **radiation induces mutations in germ cells** (male sperm cells and female egg cells), resulting in **structural alteration in germ cell DNA** that are passed on to offsprings.
        - Hereditary disorders can lead to **premature death and severe mental illness.**

Way Forward

- Nowadays, proper analysis and monitoring of radioactive pollutants are also required for a safe water supply. Prevention and precaution measures can check the anthropogenic sources of radioactive contamination in water resources.
- Various treatment methods like aeration, reverse osmosis, ion exchange and granule carbon adsorption are effective remedial measures for treating the radioactive contaminated water.

Source: DTE