Fukushima wastewater release: unanswered questions and global concerns

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The decision by Japan to begin discharging the Fukushima wastewater into the ocean on August 24, 2023 was followed by protests from several countries, including China, Russia, Korea, Vietnam, and deep concerns from the international community. This decision is related to the aftermath of the Fukushima Daiichi nuclear disaster that occurred in 2011, which destroyed the cooling system of the nuclear power plant and caused the reactor cores to overheat. Much water was used to cool down the reactors fuel rods; about 1.3 million cubic meters contaminated water with highly radioactive material was generated, which can fill more than 500 Olympic swimming pools[1]. In order to reduce the levels of radioactivity, an Advanced Liquid Processing System (ALPS) was used to remove most radioactive contaminants from water. ALPS works by circulating water through a system of tanks and filters, which removes specific contaminants such as cesium and strontium, using a multi-step process that includes coagulation, flocculation, ion exchange, and absorption[1]. Japan's government and some scientists have argued that the ALPS-treated water is safe for release into the ocean. According to their claims, the discharged water poses minimal risk to human health and the environment. However, concerns about the long-term effects of this discharge remain in scientists′ minds.

The most significant worry revolves around substances that have the potential to endanger human health, including carbon-14, iodine-131, cesium-137, strontium-90, cobalt-60[2]. Particularly, the radioactive element of hydrogen called tritium, which cannot be removed from the polluted water. A few of the radioactive elements possess relatively brief half-life and would have already undergone decay within 12 years following the disaster. However, there are others that require a longer time to decay; for instance, carbon-14, which has a half-life exceeding 5000 years, will still be present. Reports indicate that most of the radioactive isotopes of concern, such as Cesium-137 (Cs-137) and Strontium-90 (Sr-90) have been reduced to insignificant levels leaving behind tritium (^{3}H) and Carbon-14 (C14) because the hydrogen in ^{3}H is radioactive and a component of the water molecule itself [3,4]. However, some scientists argue that high levels of tritium exposure can lead to a rise in intracellular reactive oxygen species, which can lead to the antioxidant system malfunctioning, damage to membrane lipids from peroxidation, and metabolic DNA damage[5,6]. Tritium could also accumulate in the marine food web, potentially affecting larger organisms that consume smaller contaminated ones. Similarly, Richmond, a member of a 5-panel scientist, set as an advisory committee to access the safety of releasing treated water from Fukushima for both the ocean and its dependent communities, after accessing the data provided by the Japanese government and Tokyo Electric Power Company (TEPCO), disclosed that there are still some unanswered questions about Carbon-14 and Tritium[2]. In addition, it was reported that a point source of radionuclides in Japan can be quickly transported by Pacific bluefin tuna to far-off ecoregions in California[7]. This release is happening near the Fukushima coast, where powerful ocean currents, such as the Kuroshio and Oyashio currents, converge. These currents, along with large cyclonic and anticyclonic eddies generated by their interactions, are expected to transport the radionuclides in various directions[8]. Some of the radionuclides are likely to be transported towards the East China Sea, where they may enter the Yellow Sea and Japan Sea to the north. The majority, however, would be carried eastward by the Kuroshio and Oyashio currents. The subtropical gyre in the Pacific Ocean would further distribute the radionuclides in a clockwise manner. Some of the radionuclides could also reach equatorial and tropical regions through the Mindanao Current and Indonesian through flow, potentially entering the Indian Ocean and eventually reaching the South Indian Ocean. From there, they may be redistributed globally by oceanic currents, including the Antarctic Circumpolar Current and the Agulhas Current.

There has never been a case of man-made release of water polluted by nuclear accidents into the sea, and there is no accepted standard for disposal since the peaceful use of nuclear energy by humans. Japan emphasized the safety of nuclear-contaminated water by citing the International Agency Atomic Agency (IAEA) full assessment report, which was published in July, 2023. The IAEA's evaluation of Japan's nuclear contaminated water drainage plan was actually conducted on the basis of a unilateral commission established by Japan and falls under the category of technical assistance and advisory assessment. As a result, it has no legal force as stated within the IAEA report and cannot confer legitimacy on Japan's nuclear contaminated water drainage plan. Furthermore, public concerns were heightened by a recent incident involving the leakage of contaminated water from pipes at the Fukushima plant. This incident was observed on the morning of Wednesday, February 7th, 2024, barely six months after the commencement of the first series of discharges, which is expected to last for several years. Adding to these anxieties is the uncertainty surrounding the pledged fund of over 100 billion yen (approximately $670 million) intended to compensate and aid local fishermen and the fishing industry. A court ruling in December relieved the government of its obligation to pay damages to Fukushima evacuees, casting doubt on the fulfillment of this promise.

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Japan has limited the scope of IAEA's evaluation, which excludes all other potential disposal methods besides sea discharge as well as the efficiency and long-term dependability of nuclear-contaminated water treatment technology. Only a small number of samples of nuclear-contaminated water unilaterally gathered by Japan will be compared between laboratories, and the assessment process is mostly reliant on the data and information unilaterally provided by Japan. The assessment conclusions are lacking in appropriate scientific and factual support, have significant limits, and are skewed in the scenario where data authenticity and information accuracy must be checked, as well as where there is a substantial lack of sample independence and representativeness.

The Japanese side has been unable to demonstrate the legality of the decision to discharge the water, the durability and dependability of the nuclear-contaminated water purification equipment, the veracity and accuracy of the data on the nuclear-contaminated water, the safety of the marine environment and human health, the thoroughness and efficiency of the monitoring programme, and the full consultation with stakeholders. It must be noted that if the water contaminated by the Fukushima nuclear plant is safe, there is no need to discharge it into the sea, and if it is not safe, discharge should not occur. Japan's insistence on discharging radioactive water into the ocean is unneeded, inappropriate, and unreasonable. More research is needed, to determine how it would impact marine life and the ocean floor.

The ocean belongs to everyone on earth. It is incredibly selfish and careless to start the Fukushima nuclear disaster's polluted water discharge into the ocean without consulting the interests of the world at large. We are concerned that this will set a bad example and that other countries may follow Japan's example and turn the world's oceans into garbage cans for their own nuclear waste. So, the world should work collectively to stop this misconduct and set international laws to prevent the discharge of nuclear sewage.

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