How to confront the risk of radioactivity

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Published online: 27 June 2012
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It has been a little more than a year since 11th of March 2011 when the great East Japan earthquake of magnitude 9.0 hit at Tohoku region, leading to the consecutive hydrogen explosion accident of the Fukushima I Nuclear Power Plant and the release of radio-active compounds to environments. According to the report by Meteorological Research Institute, the amount of radioactive cesium released to the atmosphere summed up to forty quadrillion Becquerel (Bq), equivalent to 20 % of the counterpart in Chernobyl. The issue of the nuclear power plant accident is not over yet: 10–100 million Bq of radioactive cesium per month is being discharged, which is a big obstacle for the regeneration of Tohoku region. The epitome of the entire problem is disaster waste, which amounts to 20 million tons. The disaster waste is possibly contaminated with radioactive cesium of 100–200 Bq. Since radioactive cesium contained in the disaster waste is concentrated into bottom and fly ashes during an incineration process, municipalities have hesitated to accept the ashes due to damage caused by rumor. Although the Tokyo Metropolitan Government accepted the treatment of the disaster waste, the amount for the treatment is only dozens of tons per day.

Towards decontamination of regions contaminated with radioactive cesium, several hundred million US dollars have been spent to date. However, there is no agreement yet on the methods for management for excavating the contaminated soil and its subsequent disposal. Municipalities are having a hard time gaining consensus among the stakeholders for finding temporary storage facilities for

contaminated soil, which is preventing them in proceeding with the excavation and decontamination. According to governmental policy, contaminated soil stored in temporary storage must be transferred to an interim or intermediate storage facility, where its amount will be reduced and kept for no more than 3 years. However, Municipalities do hesitate to construct a facility for interim or intermediate storage. Decision of a final disposal and treatment site is, hence, not yet in the sight.

Right after the accident, food and drinking water contamination with radioactive iodine became an issue even in Tokyo, 250 km away from the nuclear power plant. For a while tap water used for feeding milk to infants was prohibited. Half life of radioactive iodine is 8 days and no radioactive iodine in tap water is detected a year after the accident. Newspapers reported concentrations of radioactive cesium in rice, vegetables and mushrooms. On televisions, specialists (almost all are professor emeritus in universities) are assuring the citizens that the current level of contamination in foodstuff is safe since the level is not as high as the tentative regulatory standards for foods. However, when they are asked “Are you sure that there is no impact on human health?”, they frequently equivocate. But the citizens, especially the young mothers with children remain skeptical.

The interim regulation of radioactive cesium in foods is shown in Table 1, where all foods are classified into five categories, i.e. drinking water, milk and dairy products, vegetables, cereal, meat, egg, fish and others. Effective dose of 5 mSv per year is evenly assigned to each category and, additionally, the amount of intake to a human is taken into consideration for the determination of the interim regulation. From this April, a new strict regulation has been adopted with an effective dose of 1 mSv per year by taking into account the effect of radioactive cesium on a child.

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Table 1 The interim and new regulations on radioactive cesium in Japan

	Interim regulation (Bq/kg) ^a	New regulation (Bq/kg) ^b
Drinking water	200	10
Milk and dairy products	200	50
Vegetables	500	100 ^c
Cereals		
Meat, egg, fish and others		
Baby food	–	50

^a The values represent the sum of radioactive cesium (^{134}Ce and ^{137}Ce)

^b The values represent the sum of radioactive cesium, strontium and plutonium. The new regulation has been enforced in April 2012

^c These three categories are defined as general foods

This regulation in regulatory concentration is significantly lower than the counterpart determined by EU and Codex Alimentarius Commission. In light of sensitivity of currently used measurement apparatus for radioactive cesium, more sensitive apparatus will be needed to support the new regulation. High compliance costs however create uncertainty of successful enforcement.

There is general anxiety among the Japanese population about intake of radioactive compounds. The amount of internal exposure from natural radioactive compounds (such as ^{40}K) in foods is annually 0.41 mSv in average. Adding this with the internal exposure by radon and external exposure from space and earth, the amount of exposure for a Japanese is 1.5 mSv per year. The Ministry of the Environment is working to determine which districts are vulnerable to additional radioactive exposure over natural radioactive exposure.

Taken together, the regulation on radioactive cesium appears strict. In terms of carcinogenicity risk, no threshold exists; hence, the risk of carcinogenicity reportedly increases even under slight radiation exposure. However, according to the report by International Commission on Radiological Protection, there is no scientific evidence that risk of carcinogenicity positively correlates with the amount of radioactive exposure in case of low radiation exposure of <100 mSv. Radioactivity resulting from the nuclear power plant accident makes it difficult for the Japanese who have experienced the impact of atomic bombs, to readily trust the risk of radioactivity based on these reports. We therefore need to answer the question about exposure to radioactivity: “How safe is safe?”.