

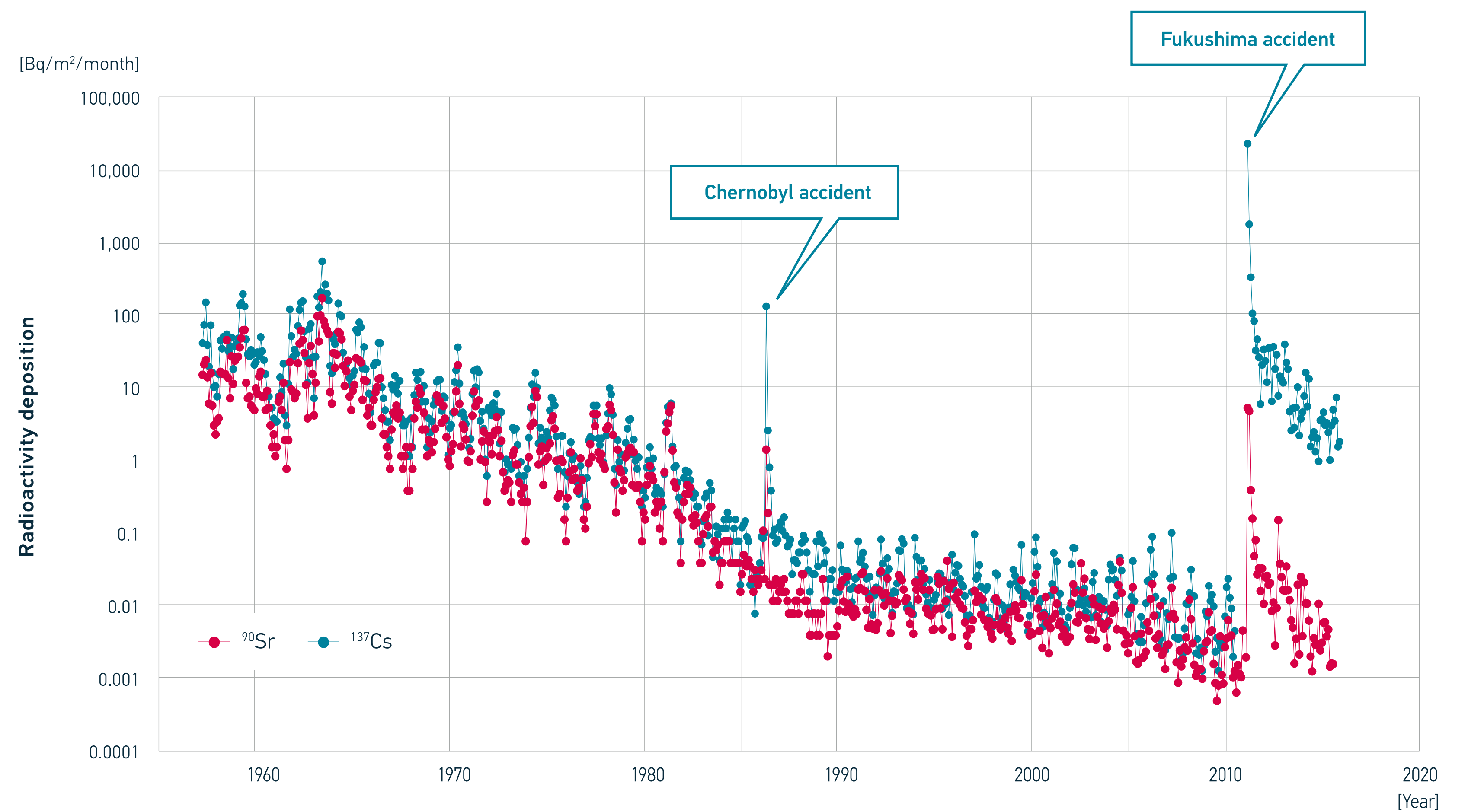
3 DEALING WITH RADIOACTIVE CONTAMINATION

FACT

RADIOACTIVE CONTAMINATION OF THE LAND

TEPCO Fukushima Daiichi Nuclear Power Plant, which was hit by the earthquake and tsunami, melted down and released large amounts of radioactive materials. People felt uneasiness and puzzled over unfamiliar hazards of radioactivity by cesium and strontium. However, we have lived with those artificial radioactive materials from 1940's when humans started to utilize nuclear power.

Regarding the Fukushima nuclear accident, how has the environment changed, and how did it affect people's lives?



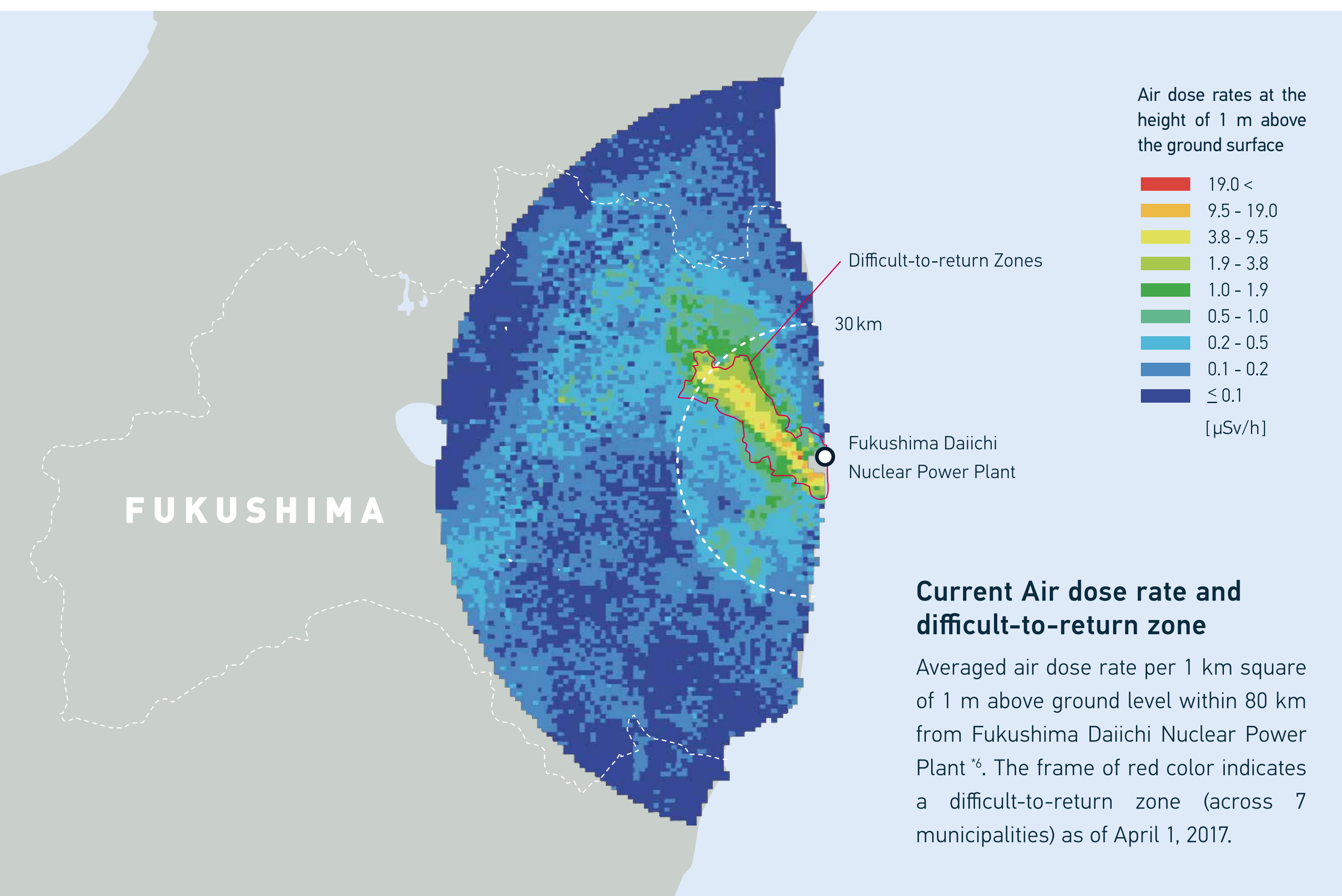
Fall out amount of artificial radioactive materials near Tokyo^{*1}

The amount of radioactive cesium and strontium is measured in fallout medium in raindrops collected every month. They originated from the atmospheric nuclear tests in 1945 to 1980, the Chernobyl nuclear accident in 1986, and the Fukushima daiichi nuclear accident in 2011. Observation areas: Koenji, Tokyo 1957-1980. Tsukuba, Ibaraki 1980-present.

RADIOACTIVE MATERIALS CARRIED ON THE WIND

The main radioactive materials released from the nuclear reactor are xenon (¹³³Xe), iodine (¹³¹I, ¹³³I), cesium (¹³⁴Cs, ¹³⁷Cs) and others. Some were gaseous and some were carried with fine particles in the air^{*2*}^{*3*}^{*4} and others were flying "grains" with a size of 1/1000 to a fraction of a millimeter^{*5}. These materials containing radioactivity carried by winds dropped onto the ground by their own weight or carried along with rain and snow and contaminated a wide area of eastern Japan.

Besides the radioactive decay, the air dose decreased through decontamination and by the "washing away" effect of wind and rain. There remains a high pollution area, which is designated as a "difficult-to-return zone", and access is strictly restricted.



Current Air dose rate and difficult-to-return zone

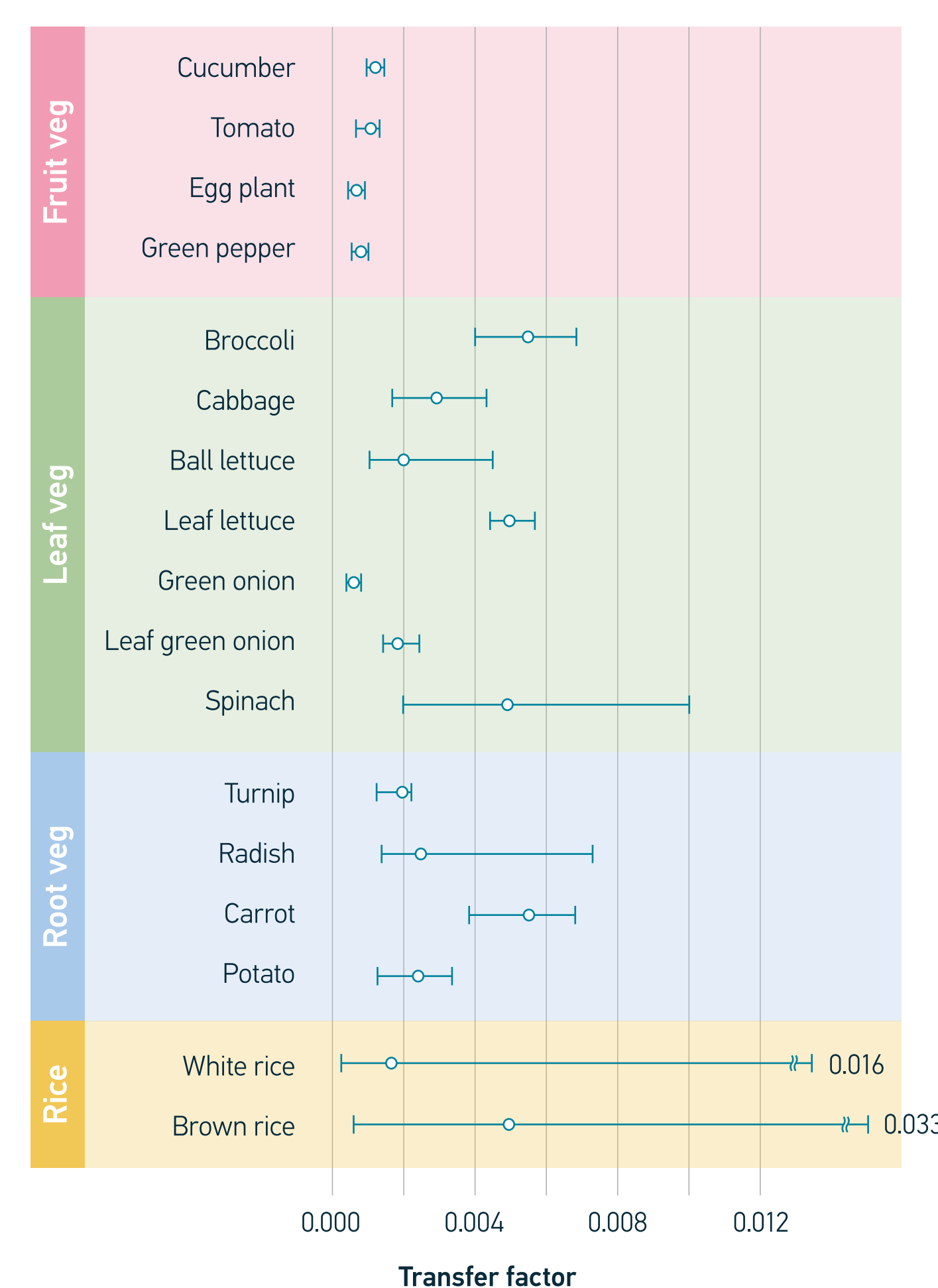
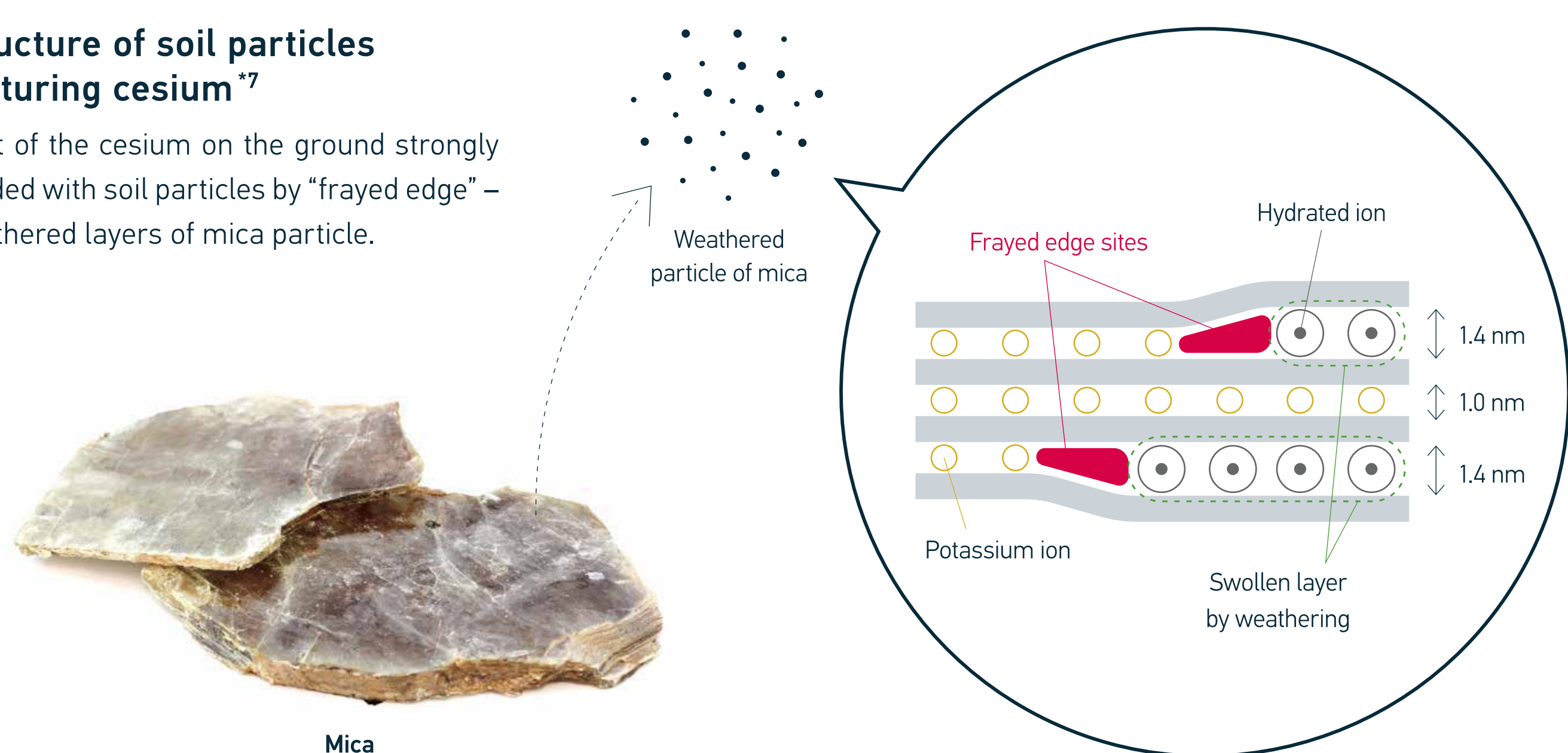
Averaged air dose rate per 1 km square of 1 m above ground level within 80 km from Fukushima Daiichi Nuclear Power Plant^{*6}. The frame of red color indicates a difficult-to-return zone (across 7 municipalities) as of April 1, 2017.

CESIUM STRONGLY BONDED WITH SOIL PARTICLES - AGRICULTURES IN CONTAMINATED FIELDS -

Agriculture in Fukushima suffered great damages due of the shipping suspension. Recent research has revealed that most of the radioactive cesium that contaminated land is strongly captured by soil particles and only a part of the cesium is transferred to plants. Plus, additional measures using potassium fertilization has drastically suppressed the transference level to plants.

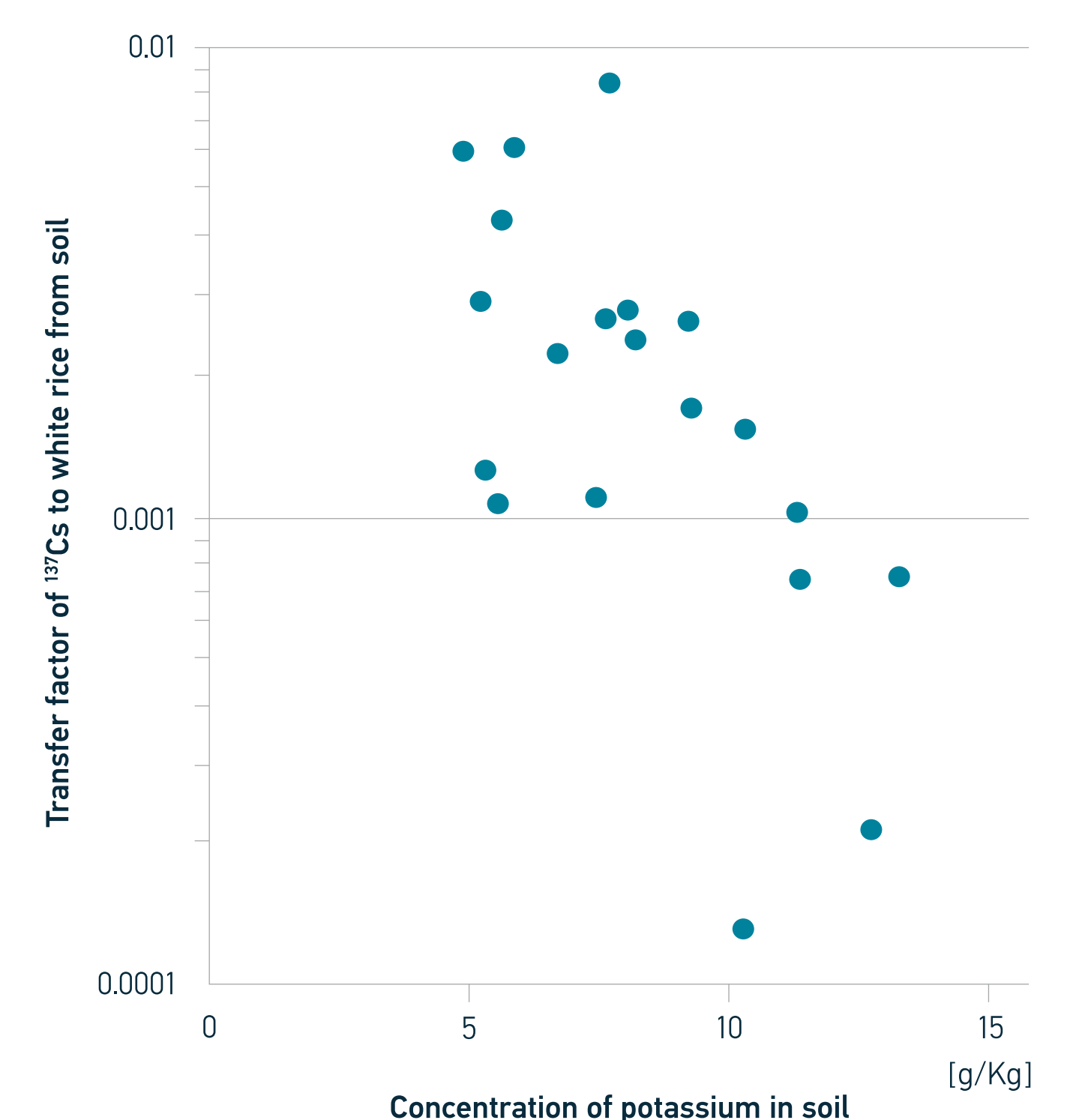
Structure of soil particles capturing cesium^{*7}

Most of the cesium on the ground strongly bonded with soil particles by "frayed edge" - weathered layers of mica particle.



Transfer factor of cesium in soil to agricultural products^{*8}

[Transfer Factor] = [Amount of ¹³⁷Cs per kg of product]/[Amount of ¹³⁷Cs per kg of soil]
Products with higher values have stronger power to absorb cesium.



Reduction of radioactive contamination by potassium fertilization^{*9}

The more potassium is supplied as a fertilizer, the lesser the cesium is transported to rice.

Reference *1 Meteorological Research Institute *2 Stohl et al., 2012, Atmos. Chem. Phys., 12, 2313-2343 *3 Kristiansen et al., 2016, Atmos. Chem. Phys., 16, 3525-3561 *4 Kaneyasu et al., 2012, Environ. Sci. Technol., 46, 5720-5726 *5 Adachi et al., 2013, Sci. Rep., 3, 2554 *6 Japan Atomic Energy Agency (This case is the part of the result obtained from "Investigation on Distribution Status of Radioactive Materials" that has been implemented as a commissioned project by the Ministry of Education, Culture, Sports, Science and Technology since FY2011 and the Nuclear Regulatory Authority from FY2012 to the present.) *7 Tsukada et al., 2011, J. Soc. Soil. Sci. Plant Nut., 82, 5, 408-418 *8 National Agriculture and Food Research Organization: for rice data; Komamura et al., 2005, Misc. Publ. Natl. Inst. Agro-Environ. Sci., 28, 1-56 *9 Tsukada et al., 2002, J. Environ. Radioact., 59, 351-363