Results of monitoring survey on radiation in Niigata Prefecture due to the Fukushima Daiichi Nuclear Power Plant accident

NIIGATA PREFECTURE

FDNPP: Fukushima Daiichi Nuclear Power Plant, RDR: Radiation Dose Rate, RA-Cs: Radioactive Cesium, RA-I: Radioactive Iodine

1. Introduction

To investigate the impact in Niigata Prefecture of the FDNPP accident, the Niigata prefectural government has been measuring the level of RDR and radioactivity of environmental samples since March 2011. In this report, we present the results of the 10-year monitoring survey on radiation in Niigata Prefecture, up to March 2021. Details of the results will be made available on the Niigata prefectural website.

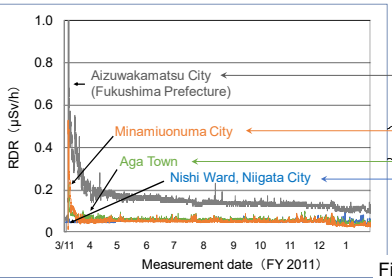
2. Measurement target and Method

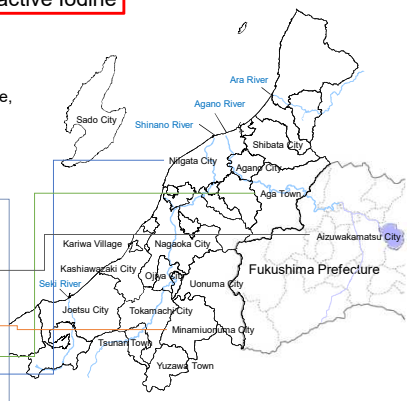
After the FDNPP accident, the Niigata prefectural government has measured the level of RDR and radioactivity of fallout, river water, tap water, and agricultural, forestry, livestock and marine products distributed in Niigata Prefecture. RDR were measured using NaI (Tl) scintillation detectors. For the determination of gamma-ray emitting radionuclides in environmental samples, a germanium semiconductor detector was used.

3. Results and Discussion

● Radiation dose rates (RDR) (Figure1)

Immediately after the FDNPP accident, portable monitoring posts were installed at six locations in Niigata Prefecture. RDR temporarily increased in Aga Town and Minamiuonuma City. The maximum value was 0.527 μSv/h (March 15, 2011) observed in Minamiuonuma City. After that, these values declined to normal (0.016-0.16 μSv/h) after March 17, 2011. It showed the impact of the FDNPP accident was limited.





Map of Niigata Prefecture

Fig.1 RDR in Niigata Prefecture

● Fallout (Figure 2)

RA-Cs exceeding the maximum of past measurements was detected in monthly fallouts collected in March 2011 in Nishi Ward of Niigata City, Kashiwazaki City, and Kariwa Village. In April 2011, the amounts in fallouts of Cs-134 and Cs-137 were 35 Bq/m^2/month and 33 Bq/m^2/month as maximum values, respectively. We started sampling in Joetsu City in July 2011 and in Sado City in August 2011, but there were no values of note. No radioactivity exceeding pre-accident levels had been detected by 2015.

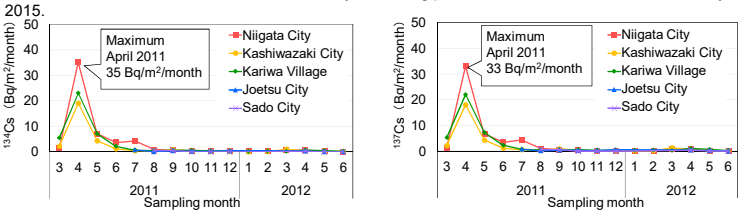


Fig.2 RA-Cs in monthly fallout

● Soil (Figure 3)

The concentration of RA-Cs in agricultural soil was measured at five sites in Niigata Prefecture in April every year since 2011, and 116 Bq/kg-dry was detected as maximum. The low concentration detected in Minamiuonuma City in 2011 is thought to be due to the snowfall at the time.

● Sea sediment (Figure 4)

Sea sediments around the mouths of various rivers in Niigata Prefecture (Agano River, Ara River, Shinano River, Seki River, etc.) were measured. The concentrations of RA-Cs at the mouth of the Agano River were relatively high, with the maximum value of 153 Bq/kg-wet detected in November 2011. It was confirmed that RA-Cs transferred from the estuary to the offshore area over time. In May 2020, Cs-134 was no longer detected at all measurement points.

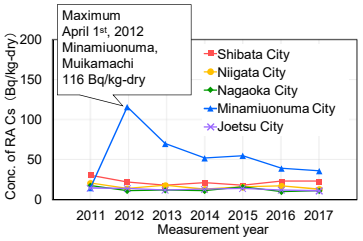


Fig.3 RA-Cs in agricultural soil

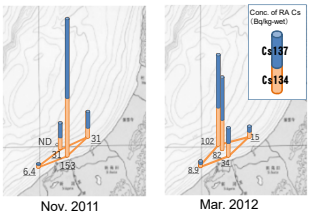


Fig.4 RA-Cs in sea sediment

● Tap water (Figure 5)

11,572 tap water samples were measured at 165 facilities in all municipalities in Niigata Prefecture. The maximum concentration of RA-I was 79 Bq/kg on March 20, 2011 at the facility treating water from the Agano River. RA-Cs was not detected at any facilities.

● Agricultural products (Figure 6)

8,401 agricultural products from Niigata Prefecture were measured. RA-I was detected only in Tsubomina (a kind of vegetable) measured on April 27, 2011. RA-Cs was detected in 383 samples of 34 species. RA-Cs exceeding the criteria was detected only in wild mushrooms and Koshi-abura (edible wild plants).

Wild mushrooms: 327 samples of 27 species were measured, and RA-Cs was detected in 18 species, 172 samples in total. Of these, 6 samples values exceeded the criteria, the maximum was 450 Bq/kg raw in Shiro-numeriiguchi.

Koshi-abura: RA-Cs was detected in 110 of 158 samples measured, 21 of which exceeded the criteria, with the maximum value of 240 Bq/kg raw.

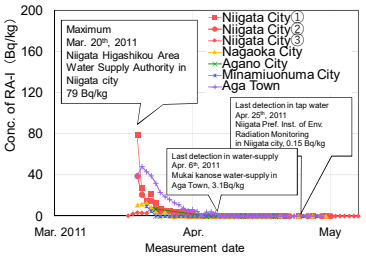


Fig.5 RA-I in tap water

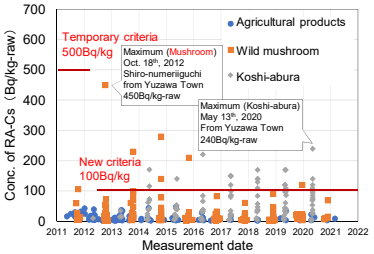


Fig.6 RA-Cs in agricultural products

● Livestock products (Figure 7)

18,707 cattle and 1,116 livestock products of 6 other species from Niigata Prefecture were measured. Of these, RA-Cs was detected in 124 samples of cattle that might have been fed rice straw contaminated by RA-Cs from other prefectures, but all were within the criteria.

● Marine products (Figure 8)

873 samples of 88 species were measured. RA-Cs was detected in 62 samples of 11 species, but all were within the criteria. The ratio of detected RA-Cs was higher in rivers and lakes than in the sea. RA-Cs was no longer detected earlier in Ayu fish than in Iwana fish. The reason for this is thought to be that Ayu fish live for only one year in their range, while Iwana fish live for several years.

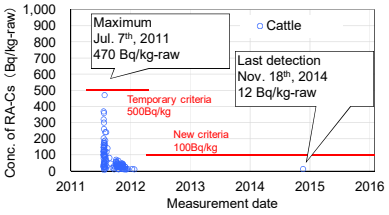


Fig.7 RA-Cs in livestock products

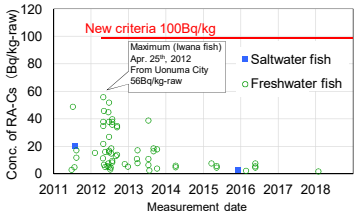


Fig.8 RA-Cs in marine products

● Wild animals (Figure 9)

250 samples of 7 species were measured. RA-Cs was detected from 178 samples of 4 species. RA-Cs exceeding the criteria detected only in Tsukinowa-guma (Black bear), and 760 Bq/kg-raw was detected as maximum.

● Sludge from water treatment plants (Figure 10)

522 samples of machine dewatered sludge at 11 facilities were measured. RA-Cs was detected from 384 samples at 6 facilities, and 17,003 Bq/kg-wet was detected as maximum.

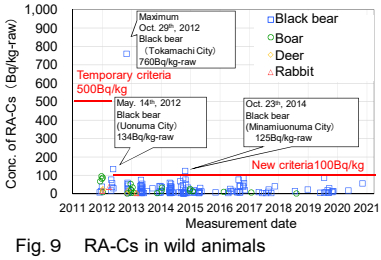


Fig. 9 RA-Cs in wild animals

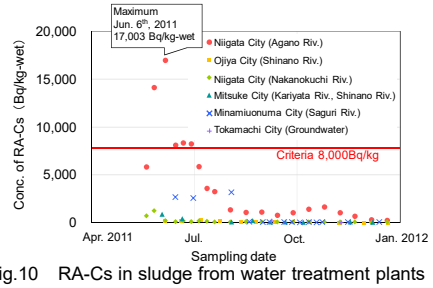


Fig.10 RA-Cs in sludge from water treatment plants

● Others

The Niigata prefectural government measured RDR at school yards and beaches, by monitoring vehicles, etc., and measured radioactivity in environmental samples (seawater, daily fallout, soil, river sediment, raw tap water, daily meals, school lunches, food brought by citizen, breast milk, sewer sludge, incineration plant ash, leaf mold (compost), gas station car wash sludge and sediment such as water collection cells, etc.).

Conclusion

- Immediately after the FDNPP accident, the Niigata prefectural government has been measuring the level of RDR and radioactivity of environmental samples (fallout, river water, tap water, and agricultural, forestry, livestock, and marine products distributed in Niigata Prefecture).
- Since the westerlies and mountain ranges prevented the direct arrival of radioactive substances, few artificial radioactive substances exceeding the criteria were detected in environmental samples.
- We found the following three points.
  (1) RA-Cs that entered Niigata Prefecture via rivers, fallout, etc. is artificially concentrated in sludge from water treatment plants, incineration plant ash, etc.
  (2) RA-Cs is transferred to certain living organisms, such as edible wild plants (especially Koshi-abura), wild mushrooms, wild animals, and becomes concentrated.
  (3) Sediment containing RA-Cs that has fallen to the ground is transported by rain and river water and moves to downstream areas over time.
- These results were evaluated that "Radioactive substances from the FDNPP accident were confirmed in Niigata Prefecture, but it was considered that the impact on the environment was limited and the level of radioactivity had no impact on health" by the committee which consists of academic experts and others.
- The Niigata prefectural government will continue to measure the concentration of radioactive substances in edible wild plants, wild mushrooms, and wild animals that have been confirmed to exceed the criteria, and confirm the changes in the concentration.