Measurement of Radiocaesium in an Irrigation Pond in the Neighborhood of the TEPCO Fukushima Daiichi Nuclear Power Station

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1. Introduction
Fukushima Prefecture has about 3700 agricultural ponds, which serve the important purpose of supplying irrigation water for paddy fields. The discharge of radioactive substances, mainly radiocaesium, into agricultural reservoirs in the aftermath of the March 2011 accident at the Tokyo Electric Power Company’ s Fukushima Daiichi nuclear plant has caused significant pollution of these reservoirs. Dissolved radiocaesium is considered more harmful to rice cultivation than its other forms. Therefore, in order to ensure the safety of irrigation water, it is critical to understand the movement of dissolved radiocaesium. Relatively high concentrations of dissolved radiocaesium have been observed in ponds located in areas of Fukushima Prefecture that are known to exhibit large amounts of radiocaesium deposition, such as Okuma Town. This work aimed to study the characteristics of ponds exhibiting relatively high concentrations of dissolved radiocaesium. To this end, this report describes the results of a water quality survey in an irrigation pond located within 5 km from the nuclear power plant.
2. Methods
The target pond is located 5 km from the nuclear plant in Okuma town, Fukushima Prefecture. An airborne survey carried out in the area on April 29, 2011, shows a high Cs-137 deposition amount of about 3 MBq/m^2 in the vicinity of the reservoir body. The water quality survey was performed once or twice a month from March to November 2016. Water samples for Cs-137 analysis were pre-treated in situ by the filter cartridge method (FCM), and subsequently analyzed using a Ge semiconductor detector in the laboratory. A part of the water samples were transported to the laboratory and filtered using a membrane filter with a pore size of 0.45 μm. This membrane filter method (MFM) is the standard pre-treatment method in the analysis of dissolved radiocaesium. Other water quality parameters, such as pH, electrical conductivity (EC), turbidity, temperature, major inorganic ions, total organic carbon (TOC), dissolved organic carbon (DOC), total nitrogen (TN), dissolved nitrogen (DN), fluorescent chlorophyll, etc. were also measured.
3. Results
The water quality survey was performed 14 times during the monitoring period. Concentrations of total Cs-137(tCs-137) and dissolved Cs-137(dCs-137), measured by FCM, were 2.3–53 Bq/L, and 1.2–6.7 Bq/L, respectively. Radiocaesium concentration was corrected to the concentration of the samples day. The errors of measurement for dCs-137 and pCs-137 were 1.3–6.1% and 2.6–6.3%, respectively.
The feature of correlation coefficient between Cs-137 and other water quality parameters are as follows. Turbidity and suspended solids were extremely highly correlated with tCs-137 concentrations, which also showed correlation with chlorophyll fluorescence, blue-green algae, and TN. Turbidity and SS were also correlated with dCs-137, though not as strongly as with tCs-137. Further, the dCs-137 concentrations also showed correlation with water temperature, DN, TN, chlorophyll fluorescence, blue-green algae, and NH_4. Concentrations of dCs-137 obtained by the MFM were about 0.5 times those obtained by the FCM; dCs-137 concentrations were obviously low.

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