8–11 Future Behavior of Radiocesium on Land

—Prediction of Radiocesium Behavior on Land for 30 Years—

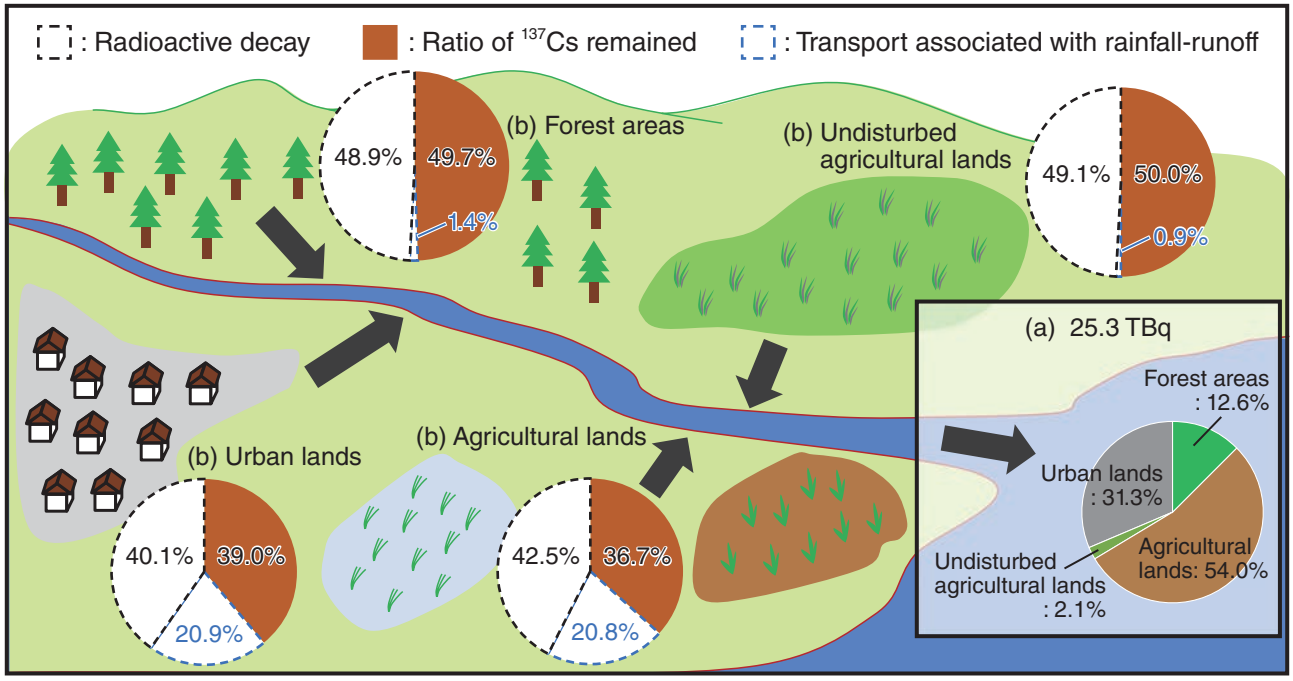

Fig.1 (a) The ^{137}Cs transport into the ocean through the river in 30 years after the accident and the relative contribution of each land use category to the transport and (b) the ratio of ^{137}Cs remained in each land use category after 30 years, and ratio of decrease in the ^{137}Cs content on land

(a) The relative contribution shows the ratio of ^{137}Cs transported from each land use category to the total transport into the ocean. (b) The ^{137}Cs deposited on each land use category decreases due to radioactive decay and transport associated with rainfall-runoff. The pie chart shows the ratio of ^{137}Cs remained after 30 years, and the decrease ratio of radioactive decay and transport associated with rainfall-runoff.

Most of the radiocesium (^{137}Cs) deposited on land in the accident at TEPCO's Fukushima Daiichi Nuclear Power Station (FDNPS) remains on land. The ^{137}Cs deposited on land is transported into the ocean through rivers by rainfall-runoff. Therefore, predicting the long-term behavior of the ^{137}Cs remaining on land and the ^{137}Cs transported into the ocean is important to understand the long-term impacts of ^{137}Cs on human health and the environment. Since the temporal trends of ^{137}Cs transported by rainfall-runoff vary greatly depending on land use, it is essential to consider the characteristics of the ^{137}Cs behavior in each land use category. Therefore, to reflect these characteristics, we developed a ^{137}Cs prediction model that considers the behavior of ^{137}Cs in soil and vegetation by land use.

We predicted ^{137}Cs behavior in the Abukuma River basin, which is the largest river basin near FDNPS. This model can analyze the processes of water, soil, and ^{137}Cs transport into the ocean through rivers by rainfall-runoff. Since no large-scale decontamination work was conducted in the target basin, the impact of the decontamination work was not considered. A comparison of the predicted results with monitoring data confirmed that the model reproduces the behaviors of ^{137}Cs in land and river well. According to the prediction results, the ^{137}Cs transported into the ocean through the river in 30 years after the accident is estimated to be 25.3 TBq (1 TBq = 10^{12} Bq) corresponding to 4.6% of the ^{137}Cs deposited in the target basin. The contribution of the total transport from urban lands and agricultural lands corresponded to 85.3% of the total transport (Fig.1(a)). These results indicated that areas with human activities (urban lands and agricultural lands) contributed greatly to the ^{137}Cs transport into the ocean. In the 30 years after the accident, ^{137}Cs that was deposited in forest areas, undisturbed agricultural lands, urban lands, and agricultural lands was removed by rainfall-runoff by 1.4%, 0.9%, 20.9%, and 20.8%, respectively, and remained at 49.7%, 50.0%, 39.0%, and 36.7%, respectively (Fig.1(b)). Thus, the ^{137}Cs remained in the areas with human activities decreased faster than that in areas without human activities (forest areas and undisturbed agricultural lands). These results suggested that human activities enhance the reduction of ^{137}Cs remaining in land.

The predicted results of the long-term behavior of ^{137}Cs in land provide useful information for evaluating future radiation exposure doses and the impacts of ^{137}Cs on organisms. In future studies, the long-term prediction of ^{137}Cs in basins near FDNPS will be conducted, considering the impact of human activities such as decontamination work.

This study was conducted as part of collaborative research with Osaka University.

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Reference

Ikenoue, T. et al., Thirty-Year Simulation of Environmental Fate of ^{137}Cs in the Abukuma River Basin Considering the Characteristics of ^{137}Cs Behavior in Land Uses, Science of The Total Environment, vol.876, 2023, 162846, 12p.