

## Abstract

### [Project Information]

Project Title : Research to Renovate and Recover an Integrated Environment in the Restoration Area Surrounding the Interim Storage Facility

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Keywords : Final disposal outside of Fukushima, utilizing pattern language, regional integrated assessment models, public acceptance, consensus-building framework

### [Abstract]

This study consists of the following three research tasks for the out-of-prefecture final disposal of removed soil and waste. and the environmental restoration of the recovery area around the interim storage facility. (1) Propose a scenario for a technological system that combines efficient and low-cost technologies to achieve effective utilization and out-of-prefecture final disposal of removed soil and other materials. (2) To propose a future design that can serve as a reference for a concrete image of the reconstruction of the interim storage facilities and the surrounding area. (3) Assess the social acceptability of various options for smooth and fair consensus building for the out-of-county final disposal of removed soil and other materials, and establish a consensus building framework that takes into account social and economic aspects.

(1) Three volume reduction scenarios for removed soil and waste were considered. A final disposal system based on these scenarios was also proposed. In order to realize the volume reduction scenarios considered, two technical issues were investigated: direct cement solidification and maximum enrichment of molten fly ash containing radioactive Cs. The hydrogen gas generation behavior resulting from the enrichment of radioactive Cs was evaluated and it was suggested that the amount of hydrogen gas generated could be higher than previously assumed. Stabilized bodies

(final waste bodies) resulting from volume reduction have been extensively studied and their respective safety assessments have been reviewed. In addition, the durability of the engineered barriers to the respective stabilized bodies was experimentally clarified.

(2) A future vision was developed for the realization of a decarbonized future community in the area surrounding the interim storage facility, based on local resources and cooperation with local residents. Four regeneration scenarios (Quiet, Active, Prosperous and Vibrant) were proposed based on the premise of maximizing the use of local capital. In addition, a framework that reconciles scientific evidence and social consensus building was presented through dialogue with residents using pattern language and the construction of a regional integrated assessment model. In ecosystem monitoring, one of the regional capitals, we visualized natural resilience through quantitative assessment of biodiversity and carbon sequestration.

(3) Through national and international online questionnaires, postal report questionnaires, semi-structured interviews and citizens' workshops, a detailed analysis was carried out of the key issues of importance to stakeholders, social acceptability and characteristics of the decision-making process. The project also focused on the preservation and visualization of the historical and cultural heritage of the area surrounding the interim storage facility, contributing to the transmission of memories and records through large print journals, digital content and projection mapping produced in collaboration with local residents. In addition, by synthesizing the knowledge gained and organizing and presenting a set of 14 policy proposals, the project provided knowledge to inform policy decisions on the reuse and final disposal of the removed soil.

### [References]

- Canet, L., Takada, M., & Yasutaka, T. (2024) Comparative qualitative and quantitative analysis of guidelines for nuclear accident recovery. *Radioprotection*, 59(2), 69-79. doi: 10.1051/radiopro/2023043
- Fujii, S., Takada, M., & Yasutaka, T. (2025) Post-accident changes in the interests of residents of a municipality near the Fukushima Daiichi Nuclear Power Station: Text analysis of residents' town meeting minutes. *Radioprotection*, in press, doi:10.1051/radiopro/2024045
- Murakami, M., Takada, M., Shibata, Y., Shirai, K., Ohnuma, S., & Yasutaka, T. (2024) Exploring the differences and influencing factors between top-down and opinion-reflective approaches regarding public acceptance of final disposal of soils removed after the Fukushima nuclear accident. *Radiation Protection Dosimetry*, 200(16-18), 1514-1518. doi:10.1093/rpd/ncae017
- Ohnishi, S., Osako, M., Nakamura, S., Togawa, T., Kawai, K., Suzuki, A., Yoshida, K., Gomi, Tsuji, T. (2024). A Framework for Analyzing Co-Creation Value Chain Mechanisms in Community-Based Approaches: A Literature Review. *Sustainability*, 16(7), 2919.
- Shibata, Y., Cui, Q., Souma, Y., Tsujimoto, M., Ue, H., Kihara, N., Takamoto, M., Yasutaka, T. & Ohnuma, S. (2025) Opinion changes among participants in citizen participation workshops: a case study on the final disposal of removed soil outside Fukushima Prefecture. *Frontiers in Environmental Science*, 13, 1507210. doi: 10.3389/fenvs.2025.1507210.
- Shirai, K., Takada, M., Murakami, M., Ohnuma, S., Yamada, K., Osako, M., & Yasutaka, T. (2023). Factors influencing acceptability of final disposal of incinerated ash and decontaminated soil from TEPCO's Fukushima Daiichi nuclear power plant accident. *Journal of Environmental Management*, 345, 118610. doi:10.1016/j.jenvman.2023.118610
- Takada, M., & Schneider, T. (2023) Radiation doses to non-human species after the Fukushima accident and comparison with ICRP's DCRLs: A systematic qualitative review. *Radioprotection*, 58, 181-195. doi:10.1051/radiopro/2023017
- Takada, M., Murakami, M., Ohnuma, S., Shibata, Y., & Yasutaka, T. (2024) Public Attitudes toward the Final Disposal of Radioactively Contaminated Soil Resulting from the Fukushima Daiichi Nuclear Power Station Accident. *Environmental Management*, 73, 962-972. doi:10.1007/s00267-

024-01938-w

Takada, M., Murakami, M., Ohnuma, S., Shibata, Y., & Yasutaka, T. (2025) Public perception and underlying values regarding final disposal of radioactively contaminated soil from a large nuclear accident. *Environmental Management*, 75, 822–834. doi:10.1007/s00267-025-02124-2

Yamada K., Ichikawa T., Arai H., Yasukochi T., Endo K. (2024), Study on the mechanisms of retardation of cement hydration by zinc and acceleration of hardening by sodium aluminate from crystallographic phase analysis, *Journal of Material Cycles and Waste Management*, <https://doi.org/10.1007/s10163-024-02059-6>.

Shibata, Y., Cui, Q., Souma, Y., Tsujimoto, M., Ue, H., Kihara, N., Yasutaka, T., & Ohnuma, S. (under review) Evaluating discourse quality in citizen participation workshops with a focus on the diverse common

goods: A case of the final disposal of the removed soil from Fukushima Prefecture.

Souma, Y., Shibata, Y., Tsujimoto, M., Cui, Q., Nakazawa, T., Tatsumi, T., Arima, Y. & Ohnuma S. (under review) Effect of the discussion frame on finding a compromise: A group decision experiment on the final disposal of removed soil outside Fukushima.

Souma, Y., Shibata, Y., Tsujimoto, M., Cui, Q., Nakazawa, T., Tatsumi, T., Arima, Y. & Ohnuma, S. (under review) The effect of discussion frames on discourse quality: A group decision experiment about the removed soil issue in Japan.

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