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The measurement activities of the non-profit organization Fukushima dialogue in Japan

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Abstract – Experience from Chernobyl and Fukushima has shown that the most reliable way to address radiation concerns is to enable affected people to conduct their own measurements and discuss the results within the co-expertise process, which is now recommended by the International Commission on Radiological Protection (ICRP). In the Hamadori region, evacuation orders have been progressively lifted, but despite generally low residual radiation levels, concerns remain among residents. In this context, the non-profit organization Fukushima Dialogue (NPO FD) was created to foster a practical radiological protection culture, empowering people to take informed actions to improve their living conditions. After briefly introducing NPO FD and the role of measurements in the co-expertise process, this article presents its recent measurement activities in Fukushima Prefecture, 14 years after the accident.

Keywords: Fukushima nuclear accident / Fukushima dialogue / radiation measurements / radiological protection culture / co-expertise process

1 Introduction

Post-accident management in Chernobyl demonstrated that the most effective way to address daily concerns of populations exposed to radioactivity is to involve them directly in radiation measurements. By conducting measurements themselves, supported by expert explanations and shared discussions, residents progressively understand where, when, and how they are exposed. This enables them to adopt individual and collective protective behaviors (Thu Zar *et al.*, 2022). Combined with local projects to improve living conditions, this approach inspired residents of Suetsugi, Japan, to initiate activities as early as summer 2011 after the Fukushima accident. With support from volunteers belonging to the International Commission on Radiological Protection (ICRP) a Dialogue initiative was launched in autumn 2011 (Lochard *et al.*, 2019) and Suetsugi residents developed an exemplary process until 2020, combining dialogues, measurements, and local projects—what ICRP now calls a co-expertise process (Miyai *et al.*, 2018; Lochard *et al.*, 2020; Ethos in Fukushima, 2022; ICRP, 2020).

Building on this experience, volunteers founded the Non-Profit Organization Fukushima Dialogue (NPO-FD) to continue the dialogues and respond to residents' questions about recovery. In early 2024, following repeated requests concerning residual radiation levels, NPO-FD reactivated its measurement expertise to provide residents with local assessments of their radiological situation. In cooperation with the Open Radiation consortium (Bottollier-Depois *et al.*, 2017) and Ibaraki University, the organization is developing projects to help Fukushima residents to adapt their lifestyle and better protect themselves.

2 The non-profit organization Fukushima dialogue

NPO-FD is a Specified non-profit Corporation under Japanese law (Fukushima Dialogue, 2025). Its activities originate from the series of dialogues organized by the ICRP between 2011 and 2015 (Lochard *et al.*, 2019). In 2016, local volunteers took over the organization, renaming it "Fukushima Dialogue." In June 2019, they formally established NPO-FD to continue the dialogues under the Japanese Non-Profit Organization Act. The NPO serves as a platform for

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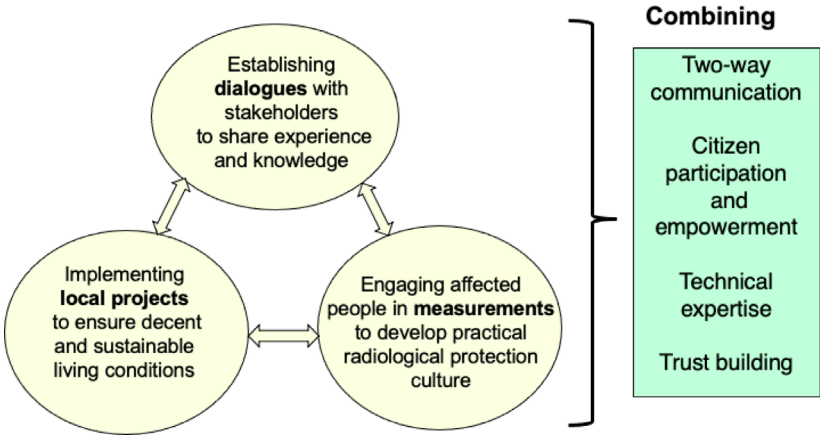


Fig. 1. Outline of the co-expertise process, based on three pillars namely dialogue, measurements and local projects.

rehabilitation of living conditions in areas affected by the nuclear accident, ensuring no one is left behind in shaping Fukushima's future.

To achieve this goal, the association organizes annual dialogue meetings in autumn on topics proposed by local stakeholders. It also provides advice on radiation protection, disseminates information on recovery at regional, national, and international levels, and publishes scientific and public outreach articles. As highlighted in the introduction, NPO-FD builds on the experience of members who participated in the Suetsugi co-expertise process to support residents in radiation measurements. It also contributes to national projects and cooperates with partner organizations abroad.

NPO-FD is governed by an eight-member Board of Directors currently chaired by Ms. Ryoko Ando. An Advisory Committee provides guidance on strategic directions and fosters cooperation with national and international organizations. Resources come from members' contributions, donations from individuals or organizations, subsidies from governmental bodies, and revenues generated by its activities.

3 The co-expertise process

The co-expertise approach originates from the ETHOS project conducted in Belarus in the late 1990s, which aimed to involve populations affected by the Chernobyl accident in improving long-term protection and living conditions (Hériard Dubreuil *et al.*, 1999; Lochard, 2013). Based on an empirical trial-and-error approach and influenced by research on risk governance emphasizing stakeholder involvement and trust (Renn, 1999), ETHOS paved the way for later developments in Fukushima (Takamura *et al.*, 2018; Yasutaka & Kanai, 2020; Igarashi, 2022). The approach is now embedded in ICRP recommendations for post-accident recovery (ICRP, 2020).

The co-expertise process relies on three pillars—dialogue, measurements, and local projects—to develop a "practical culture of radiation protection" enabling affected people to regain control of their daily lives. Figure 1 outlines this approach, which combines interactive dialogue with all stakeholders relying on scientific evidences and sound technical input.

Dialogue brings together diverse perspectives, allowing stakeholders to openly express their concerns, overcome the expert–layperson divide, and jointly reflect on protective strategies. Measurements make radiation visible in people's environment, helping them link daily activities to radiation doses received (Miyai *et al.*, 2018). This knowledge fosters protective behaviors, strengthens confidence in official information, and promotes community exchanges and environmental surveillance. Together, dialogue and measurements support local projects aimed at restoring safe and sustainable living conditions. Such projects enhance cooperation between residents, experts, and authorities, while ensuring transparency and fairness in decision-making (Schneider *et al.*, 2021).

For credibility, experts must combine scientific and ethical competence with attentive listening and transparent sharing of information. They must respect residents' autonomy and decisions, while maintaining long-term commitment. Successful co-expertise requires local leadership, involvement of national and international experts, adapted measurement tools, robust governance mechanisms, adequate resources, and above all patience.

4 The measurement activities of the NPO-FD

4.1 The OpenRadiation project

4.1.1 The ANCCLI/NPO cooperation

NPO-FD has long-standing ties with the French organization ANCCLI (see Box 1). After the ANCCLI director participated in the 23rd Fukushima Dialogue in November 2021 (Ando *et al.*, 2023), exchanges led to an official visit of ANCCLI members in Fukushima in spring 2024. During the visit, the ANCCLI delegation toured affected areas and provided NPO-FD with eight Openradiation sensors to facilitate citizen measurements of ambient radioactivity.

In September 2024, the ANCCLI director joined the newly created NPO-FD Advisory Committee, which advises on activities and partnerships. At its third meeting in January 2025, ANCCLI announced plans for a cooperation agreement between NPO-FD and selected French CLIs to conduct measurements around French nuclear power plants and compare results with Fukushima.

Box 1. Short presentation of ANCCLI and CLIs.

The ANCCLI (National association of local information committees and commissions), is a French organization that brings together local information committees and commissions (CLIs) related to nuclear facilities. The ANCCLI's missions are primarily focused on transparency, information and public participation regarding nuclear facilities (ANCCLI, 2025).

It coordinates and supports the CLIs which are responsible for informing local population about the activities of nuclear facilities. It promotes the dissemination of clear and accessible information on the risks, safety, radiation protection and environmental impact associated with nuclear facilities. The ANCCLI facilitates dialogue between nuclear operators, authorities, elected officials, experts and citizens to improve understanding and management of nuclear-related issues. It contributes to monitoring issues of nuclear safety, radiation protection and waste management, drawing on technical and scientific expertise.

The ANCCLI represents the CLI before national and international institutions to defend the interests of the local population concerned.

Altogether these missions aim to strengthen local democracy and security around nuclear facilities.

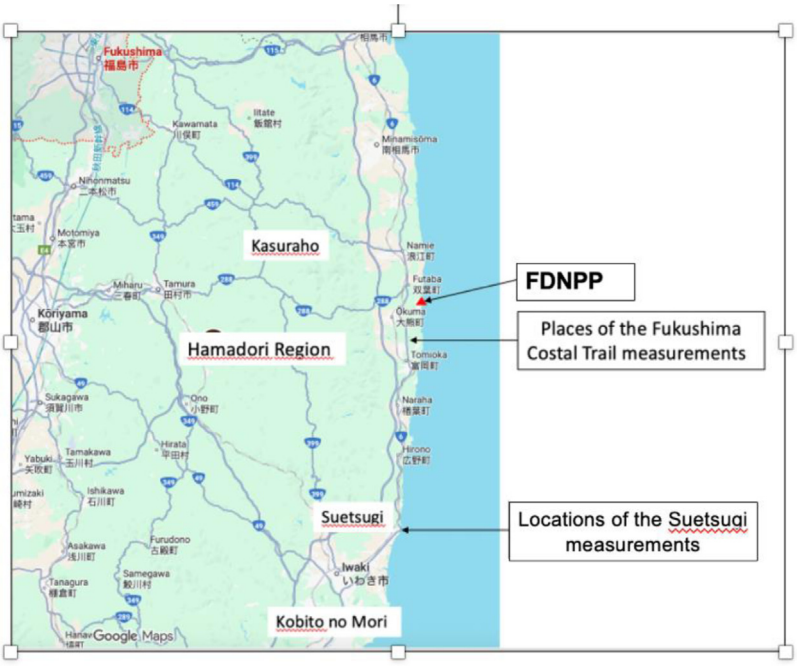


Fig. 2. Locations of the measurements implemented by the FDNPO in Japan.

4.1.2 The first common action between ANCCLI and the NPO-FD

To mark the United Nations International Disaster Risk Reduction Day (held annually on 13th October) which promote a global culture of risk awareness and disaster reduction, NPO-FD and ANCCLI conducted in October 2024 joint measurements of ambient equivalent dose rates using Geiger-Müller counters (Rium GM) compatible with the OpenRadiation application (Bottollier-Depois *et al.*, 2019). Volunteers followed standardized procedures, uploading OpenRadiation measurements on the interactive map. Results were analyzed using descriptive statistics. Normality of distribution was tested using the Shapiro-Wilk test. For comparison between groups, the rank sum test was used, with a significance threshold set at $p < 0.05$.

Between October 11th–21th, 2024, 27 ambient equivalent dose rate measurements were made in France in Pyrenees mountains, Brretagne, Orleans (close to the Dampierre NPP), Dunkerque (close to the Gravelines NPP) and Valduc (close to a nuclear research center), while technical issues limited NPO-FD to only one measurement. To compensate this unbalanced situations, all Fukushima NPO-FD data made with Open Radiation between September and December 2024 in Kasturao, Kobito no Mori and on the Fukushima Coastal Trail at the requests of the local population were included in the analysis. Figures 2 and 3 present the locations of the measurement places in Fukushima Prefecture and in France and Figure 4 presents the results, as median value and percentiles (rounded symbols represent outliers) which revealed no significant differences between France and Fukushima. French data showed a wide distribution (0.083–2.401 $\mu Sv \cdot h^{1}$), with 33% of French values above the reference value of 0.23 $\mu Sv \cdot h^{1}$ equivalent to an additional dose of 1 mSv assuming different exposure time indoors and outdoors defined by the Japanese authorities (Ministry of the Environment, 2023), mostly in naturally high-background regions such as Bretagne and the Pyrenees mountains.

Fig. 3. Locations of the measurements implemented by ANCCLI in France.

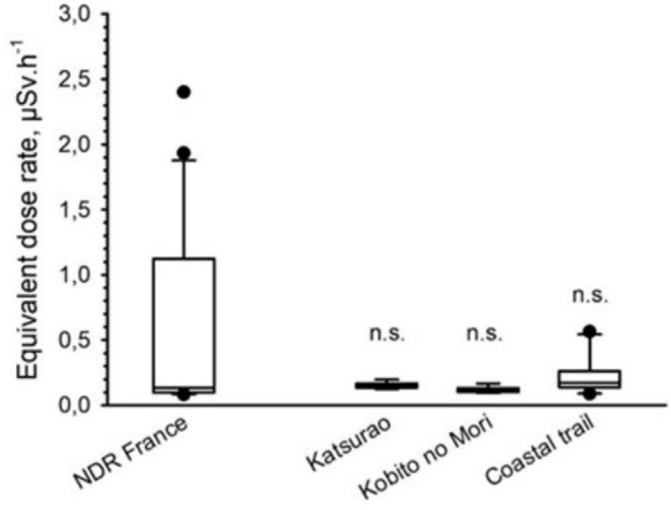


Fig. 4. Results of measurements performed by ANCCLI in France and FD-NPO in Fukushima Prefecture between September and December 2024.

4.1.3 The local measurements made at the service of the population

Following the receipt of the Open Radiation dosimeters, the NPO-FD was requested by various individuals or organizations to carry out measurements in different localities of the Fukushima Prefecture affected by the nuclear accident (Fig. 2). The following paragraphs briefly present the contexts and results of the measurements. All measurements have been done together with the requesting individuals.

4.1.3.1 The Katsurao Collective project

The Katsurao Collective project is run by a group of private facilitators that hosts artists for short stays in Katsurao Village and organizes workshops and related activities (Katsuaro Collective, 2025) (Fig. 5). These initiatives are supported by the Katsurao municipality with funds from the Reconstruction Agency for recovery. Most participating artists come from outside Fukushima Prefecture, with limited knowledge of local radiological conditions, and some expressed concern about radiation levels. In response, the Collective rented four OpenRadiation devices to conduct measurements during its activities. This practice reflects the belief, shared by a staff member, that citizen-led radiation monitoring complements official measurements, thereby enhancing reliability and leaving a meaningful legacy for future generations.

Between June 6th and June 16th 2025 the Katsurao Collective facilitators performed eight measurements, showing ambient equivalent dose rates of 0.127–0.196 µSv.h^{1} (Fig. 5), below the government's threshold of 0.230 µSv.h^{1}, equivalent to an additional annual dose of 1 mSv (Ministry of the Environment, 2023). For comparison, visiting artists conducted 18 measurements in the Katsurao area, with results ranging from 0.078–0.230 µSv.h^{1}, similar to those of the Collective. The highest dose rate was recorded in a forest a few kilometers north of Katsurao.

4.1.3.2 The 'Kobito no Mori' project

In preparation for opening a nature experience activity in Kaidomari-Tabitomachi, in southern Iwaki City in spring 2025, the private site owner requested NPO-FD's assistance to assess residual radioactivity and provide accurate information to future visitors. The facility, designed for both children and adults to engage with nature, opened in spring 2025 OpenRadiation measurements were conducted on July 11th 2024.

As with the previous action, results were retrieved from the OpenRadiation database. Recorded dose rates ranged from 0.095 to 0.167 µSv.h^{1}, with a median of 0.112 µSv.h^{1} (Fig. 6). These values are well below the government's recommended limit of 0.230 µSv.h^{1}, equivalent to an additional annual dose of 1 mSv (Ministry of Environment, 2023). However, no other measurements were published in the database within a 5 km radius of the planned facility, Kobito no Mori, during this period.

4.1.3.3 The 'Fukushima Coastal Trail' project

The Fukushima Coastal trail close to the FDNPP (Fig. 2) was launched in 2023, connecting to the Michinoku Coastal Trail in the south of the FDNPP previously initiated in 2019 by the Ministry of Environment of Japan to support the recovery process along the coast of the Pacific Ocean in the Tohoku region devastated by the huge tsunami in March 2011. The Fukushima Coastal Trail route experienced significant delays in some parts due to the prolonged evacuation orders around the Fukushima Daiichi Nuclear Power Plant. Two OpenRadiation sensors have been sent by the NPO-FD to the Fukushima Coastal Trail Association (FCTA). Measurements

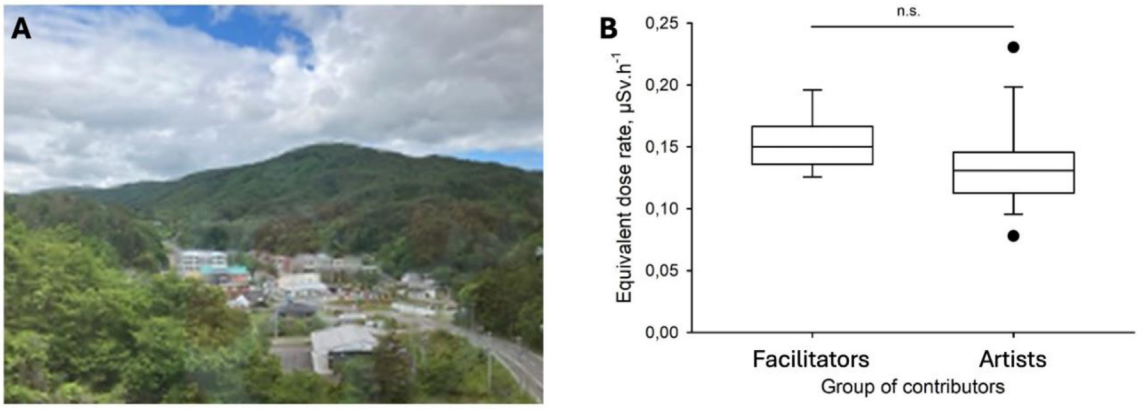


Fig. 5. A. Katsurao village. B. Results of measurements made by Katsurao Collective facilitators and the visiting artists in the Katsurao area, extracted from the OpenRadiation website. Results are given as median and percentiles (5%, 25%, median, 75% and 95%). Black dots are outliers. No statistical difference is observed between these two groups of results (Rank Sum test, p=0.052, n.s.).

Fig. 6. A. Picture of the Kobito no Mori site. B. Results of the nine measurements given as median and percentiles made in the nature experience place in Kobito no Mori, extracted from the OpenRadiation website.

were carried out between October 19th, 2024, and January 12th, 2025, by the FCTA (Fig. 7).

A total of 10 measurements were made during the period, at different places along the Fukushima Coastal Trail. Results from Fukushima Coastal Trail Association showed a mean ± SD of 0.212 ± 0.142 µSv per hour and a large dispersion of the results, with 30% of the results being above 0.230 µSv per hour (Fig. 7B). This is explained by the Fukushima Coastal Trail running close to the Fukushima Daiichi NPP and through some areas with a high natural background level. The highest measurement result was made close to the Tomioka city, with a value of 0.564 µSv per hour.

Since the Fukushima Daiichi NPP is frequently visited, there is a high number of measurements available in the OpenRadiation database. A total of 328 measurements were recorded during the period from October 10th, 2024, to January 12th, 2025, due to 11 different contributors visiting this area (Fig. 7B). The mean ± standard deviation of these visitors' results is 0,455 ± 0,538 µSv per hour, again with a large dispersion of results (range: 0.064–3,134 µSv per hour) (Fig. 7C). However, the comparison with results from FCTA did not show a significant difference (Rank sum test, p = 0.340, n.s.).

When looking at the distribution of results (Fig. 6B), 40% of all the results are above the value of 0.23 µSvper hour. Most of the results above this value are distributed in the 10 km radius around the Fukushima Daiichi NPP, but also in the Shimotsushima area, a forest area in the mountains north-east of the NPP. The comparison of measurement results from FCTA and visitors are consistent.

4.2 The Suetsugi project

In November 2023, NPO-FD members met with Suetsugi residents to review lessons learned from the co-expertise process conducted between 2012 and 2019 (Lochard *et al.*, 2020; Ethos in Fukushima, 2022) (Fig. 8). During the meeting, a resident raised concerns about the discharge of treated water containing tritium from the Fukushima Daiichi Nuclear Power Plant into the Pacific Ocean. While acknowledging tritium dilution offshore, he questioned whether tritium could re-concentrate in nearby bays. Neither experts nor residents could

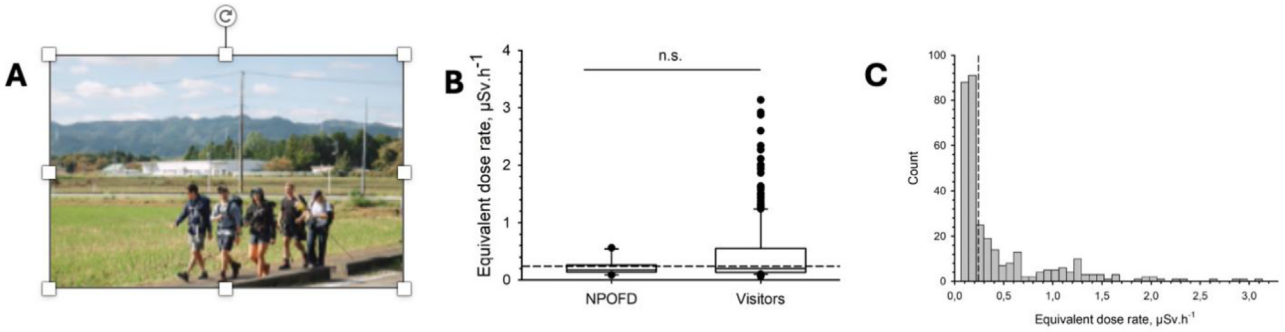


Fig. 7. A. Photo of people walking along the Fukushima Coastal Trail. B. FCTA and NPOFD measurements presented as median value and percentiles compared to measurements made by other people (visitors) in the Fukushima area. Rounded symbols represent outliers. The horizontal dashed line indicates the value of 0.23 µSv per hour and C. Frequency distribution of pooled data available in this area during the study period. The vertical dashed line indicates the value of 0.23 $\mu Sv.h^{-1}$.

answer definitively, leading to a joint decision to begin seawater monitoring.

Because tritium measurement requires specialized equipment unavailable to NPO-FD, Professor Yuji Torikai of Ibaraki University agreed to cooperate with residents and the NPO. In April 2024, a measurement campaign of tritium in sea water was carried out with local participants selecting sampling sites on the Suetsugi coast in consultation with university experts from the Ibaraki University (Figs. 2 and 9A). Results showed low concentrations due to dilution, with no significant differences before and after discharges. These findings were confirmed over time, providing reassurance to residents (TEPCO, 2024).

5 Discussion

Given the results of the recent NPO-FD's measurements with Open Radiation, two questions arise: 1- is it worth conducting more measurements given the low ambient radiation levels recorded in daily environments?, and 2- is it necessary to multiply citizen-based measurements when municipalities and public authorities already publish extensive data year-round?

Despite this paradox, NPO-FD considers that it is important to continue the monitoring activities, 14 years after the accident, for several reasons. Recent surveys indicate declining concern about radiation across Fukushima Prefecture, with levels now lower than in other regions (Murakami *et al.*, 2016; Mitsubishi Research Institute, 2023). Yet other studies show persistent anxiety among specific groups, notably mothers who gave birth in 2011–2012 and people directly affected by the earthquake, evacuation, or loss of housing (Ishii *et al.*, 2022; Takebayashi *et al.*, 2017; Fukasawa *et al.*, 2022). Research on reproductive anxiety has also highlighted gendered differences in perception: men in Fukushima generally report more confidence in their knowledge and greater belief in limited health effects of radiation (Ito *et al.*, 2024). Earlier studies likewise noted polarization in risk perception (Murakami *et al.*, 2016). Thus, while overall fear has declined, divergences between groups remain and in some cases have widened.

These differences make it difficult to address radiation issues in affected communities. Follow-up interviews with OpenRadiation users revealed that many participants lacked opportunities to discuss their concerns, or felt unable to do so. Such communication barriers suggest a deterioration of living conditions beyond direct fear of exposure.

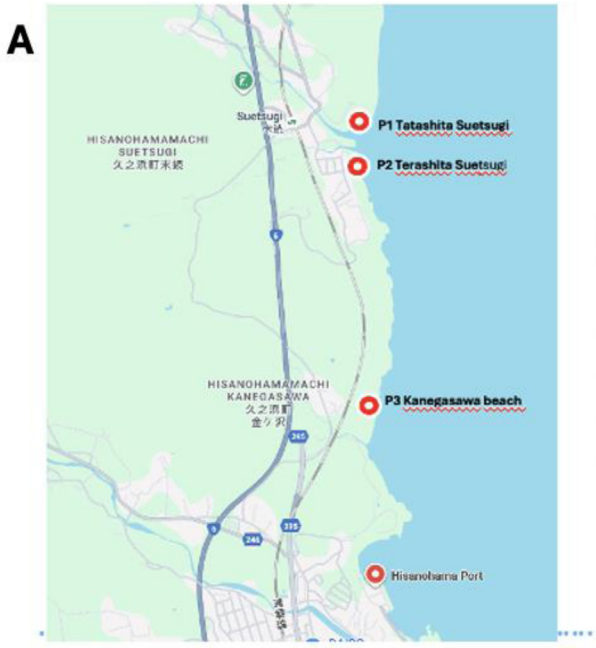
Official responses to inquiries often remain vague or euphemistic, reinforcing frustration and uncertainty. Many residents remain poorly informed about radiation impacts and yet fear speaking out. Even those with good knowledge may avoid discussing the issue, believing there is little cause for alarm. Questioning the safety of food products, for instance, risks being seen as damaging Fukushima's reputation. Producers and entrepreneurs likewise avoid raising concerns to protect their business or avoid scrutiny by authorities. NPO-FD observed that residents concerned about radiation rarely find a safe space to express their questions.

Government efforts to attract new residents to Futaba County have led to a sharp rise in in-migration, further increasing the need to share knowledge about radiation. These newcomers differ widely in awareness and perceptions, and many lack direct experience of the nuclear accident, making it increasingly difficult to establish a shared understanding of residual contamination.

In recent discussions, NPO-FD members noted that residents, including newcomers, found it difficult to talk about radiation. While most people did not believe that local radiation posed any health risks, a lingering unease cast a shadow of uncertainty over the future, echoing feelings immediately following the accident. Moreover, the radiological situation remains problematic in areas not yet decontaminated. NPO-FD visited Namie residents whose homes lie in the mountainous "Specified Basic Areas for Reconstruction and Revitalization." Evacuated in 2011 and still living elsewhere, many face the dilemma of returning after evacuation orders were partially lifted in March 2023. Because their homes had deteriorated during evacuation, most opted for demolition rather than resettlement, citing ambient contamination. Such cases where decontamination is difficult raise questions of equity regarding residual exposure and place heavy pressure on residents. Here, measurements help inform decisions about daily life and future living conditions.

Another strong motivation for citizen measurement is the desire to respond credibly to questions from outsiders about local dose rates. Survey data also show that, nationwide,

Fig. 8. A. The november 2023 meeting in Suetsugi. B. Sample collection by participants in April 2024.



B

Location	Tritium concentration ($Bq.l^{-1}$)
Before release campaign	
Tomioka	45.0
After the release campaign, August 2023 to March 2024	
P1: Terashita, Suetsugi	35.0
P2:Tateshita, Suetsugi	32.5
P3: Kanegasawa beach	38.8
P4: Hisanohama fishing port	38.8

Fig. 9. A. Map of sampling sites in Suetsugi located approximately 30 km south of the FDNPP (see Fig. 2). B. Results of the measurements of tritium activity in the sea before and after the release campaign on the Suetsugi coast. Between August 2023 and March 2024, TEPCO company made 4 discharges of tritiated water in the ocean off the coast of Tomioka, just south of FDNPP (TEPCO, 2024).

concern about long-term health effects for future generations remains higher than within Fukushima itself (Mitsubishi Research Institute, 2023)

This complex context led NPO-FD to collaborate with experts, such as in tritium monitoring, and to acquire tools to respond to residents' requests for measurements. Past experience has shown that radiation monitoring fosters confidence in recovery efforts, even more than three decades after an accident (Bertho *et al.*, 2019). Recent studies also highlight that action-oriented engagement enhances psychological resilience, with autonomous decision-making serving as a protective factor against depression. These positive effects can persist more than ten years after disaster (Kobayashi *et al.*, 2022; Sasaki *et al.*, 2022). Cooperation with ANCCLI, an organization experienced in radiation measurement and stakeholder dialogue, also reinforced NPO-FD's decision.

6 Concluding remarks

Given the current stage of recovery in Fukushima Prefecture, NPO-FD believes that promoting radiation measurements as part of the co-expertise process is vital for helping residents build a practical culture of radiation protection and make informed decisions for themselves and their families. These efforts complement those of public authorities, particularly Fukushima Prefecture and affected municipalities. More than simply providing information, they enable residents to (re)gain control over their lives individually and collectively by fostering open, supportive spaces where concerns about radioactivity and its management in daily life can be shared. Thus, radiation measurements as part of the co-expertise process should be included in guidelines for nuclear accident recovery (Canet *et al.*, 2024).

In practice, authorities and experts often treat residents' concerns as isolated issues, though many are shared across communities. Yet residents frequently hesitate to voice these concerns, lacking spaces where they feel safe discussing them with others. Community fragmentation, compounded by the presence of radioactivity, itself fuels anxiety. Implementing measurements through co-expertise, carried out directly by residents with expert support, offers a framework where people can both express themselves and build trustful relationships with experts and authorities. This is particularly important for the future of affected municipalities, especially as more young people move into previously evacuated areas, encouraged by local governments' efforts to attract newcomers.

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Conflicts of interest

The authors declare that they have no conflict of interest.

Data availability statement

The research data associated with this article are included within the article.

Author contribution statement

R. Ando, J. Lochard, J.M. Bertho: conceptualization and draft manuscript writing. Y. Lheureux, D. Sasaki, T. Schneider internal reviewing and finalization of the manuscript.

Ethics approval

Ethical approval was not required.

Informed consent

This article does not contain any studies involving human subjects.

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