SFRP 2021,
12-13 OCTOBER 2021,
Fukushima, 10 ANS APRES,

Current status of decontaminated soils and wastes, and challenges for their sustainable management

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10 Years After the Great East Japan Earthquake: Two Major Issues

Management of large amounts of contaminated soil and waste

Final disposal outside of the Fukushima prefecture in 2045 has been promised by the government and enshrined in the law.

Life after the return of former evacuation areas

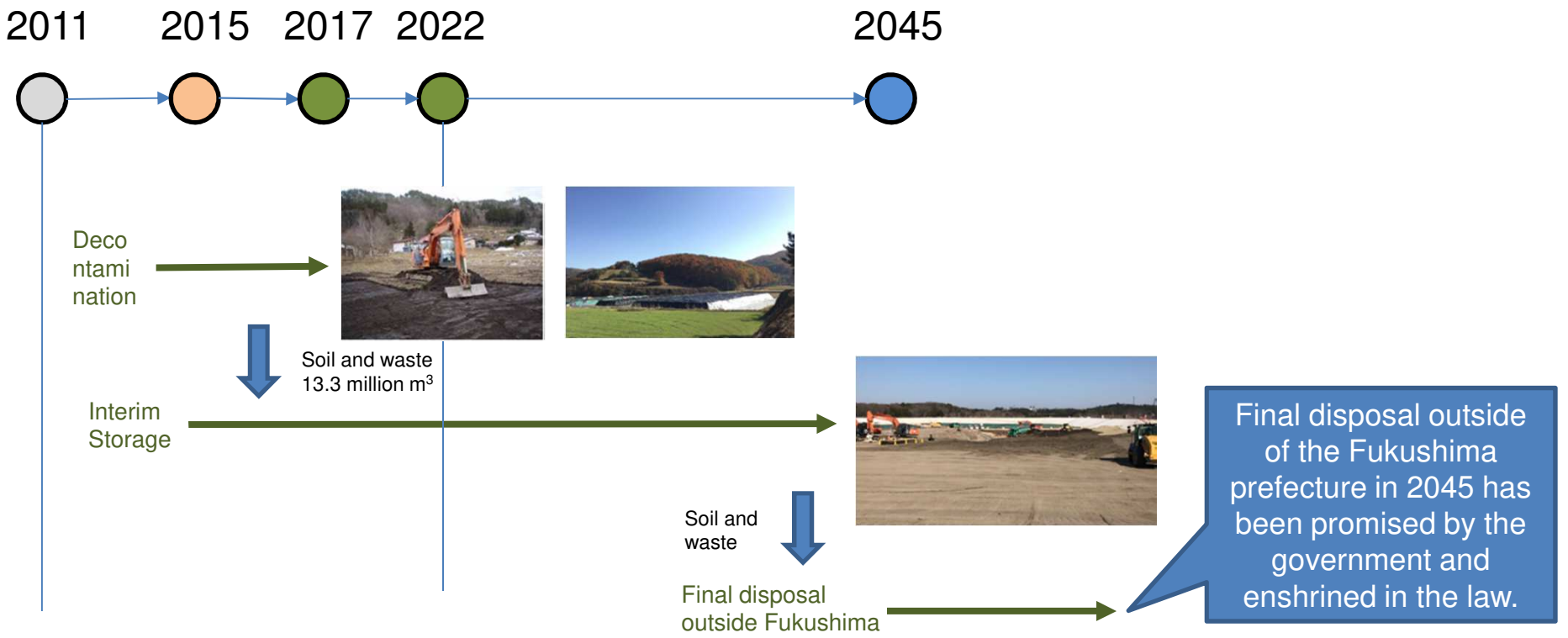
Dramatic acceleration of aging population

agenda

1. Overview of the decontamination and interim storage site

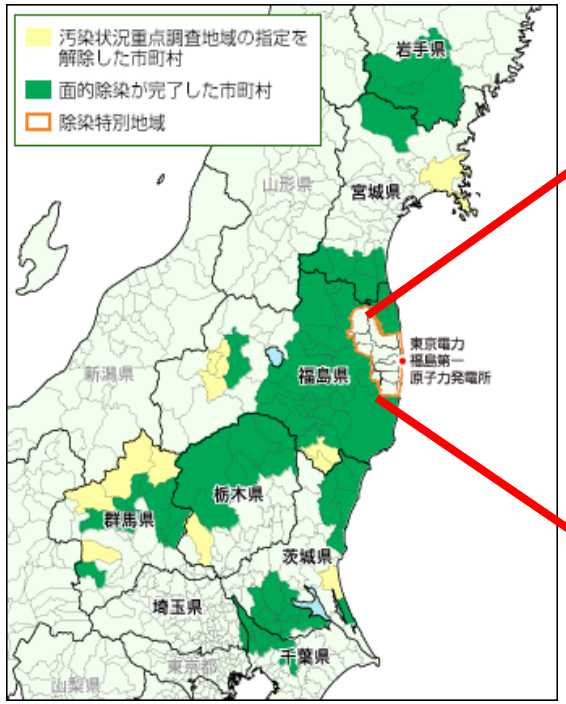
2. What factor we have to consider for the selection of the final disposal site. Tentative result of the stakeholder interview.

Government Schedule of decontamination



Decontamination Areas

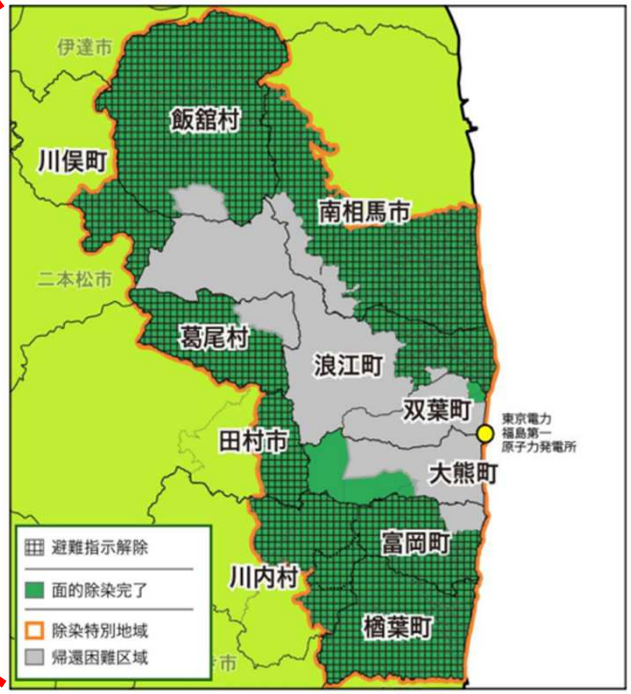
Intensive Contamination Survey Area (ICSA)



- The areas with more than 0.23μSv/h is the decontamination target for the ICSA
- Implementation of decontamination by municipality mayors based on the plan (the national government allocates the budget)

（地図出典：http://josen.env.go.jp/zone/index.html、
詳細な情報：http://josen.env.go.jp/material/pdf/josen_gareki_progress_201803.pdf）

Special Decontamination Area(SDA)



- Decontamination implementation by the National Government
- Whole area decontamination based on the Act on Special Measures was completed on March 19, 2018, excluding the Areas where Returning is Difficult (ARD)

Example of Decontamination

1. Residential area

Washing roof

Wipe the walls

High-pressure cleaning

High-pressure cleaning

Shot blast

Excavation

3.Forest

Branches and sediment removal were applied. Forests were only decontaminated within 20m of the living area. Therefore, most of the area has not been decontaminated.

（写真出典：http://josen.env.go.jp/about/method_necessity/method_area.html）
除染アーカイブサイト（http://josen.env.go.jp/archive/detail/?NE-01-P0032&category, P0030 and ）

2.Aglicultural area

Excavation of the surface soil

Waste was generated.
Mainly applied in SDA.

Turning over in the land

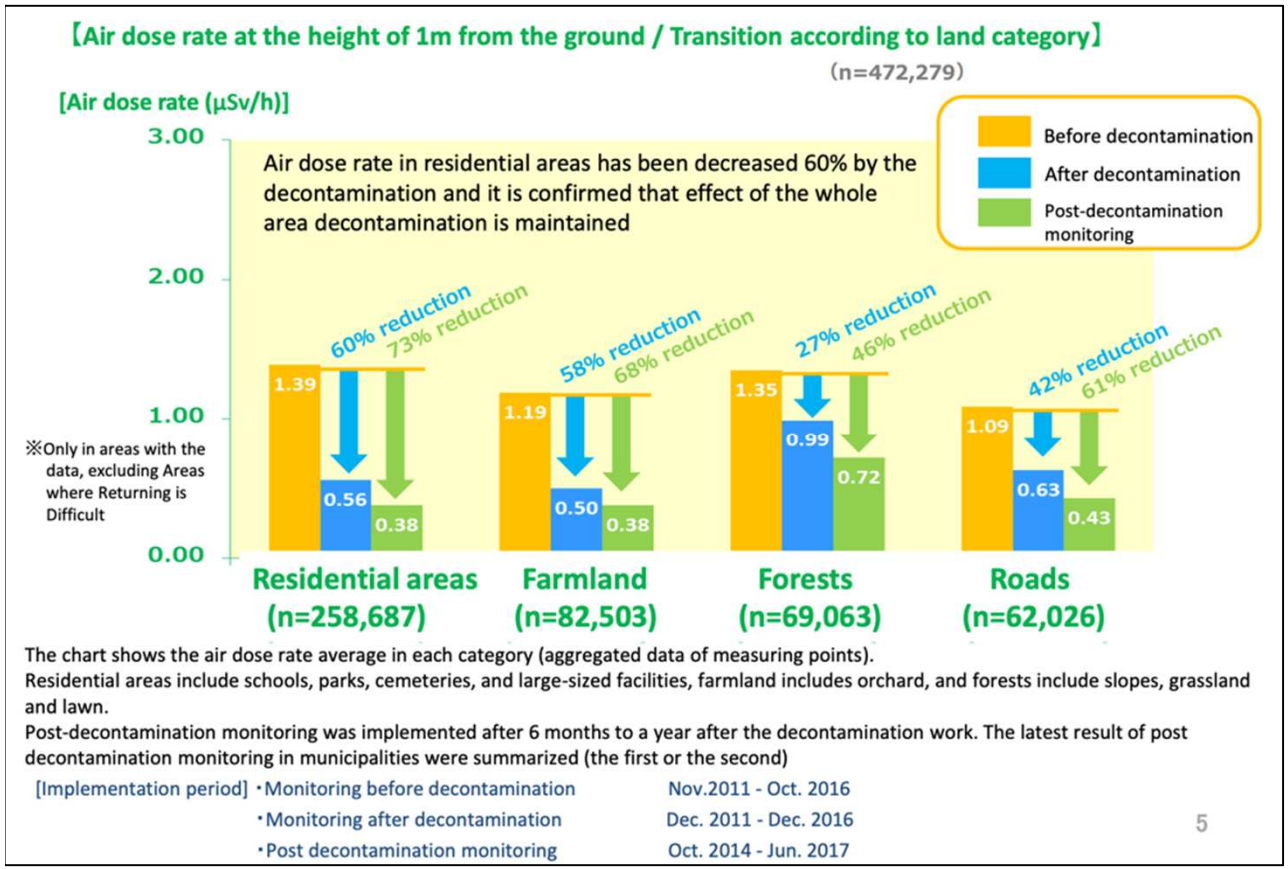
No Waste.
Mainly applied in ISCA.

Vertical replacement of soil

No Waste.
Mainly applied in ISCA.

農地写真出典：https://c-navi.jaea.go.jp/ja/remediation-work/2013-04-10-03-58-46/agricultural-land/agricultural-land-61-2.html

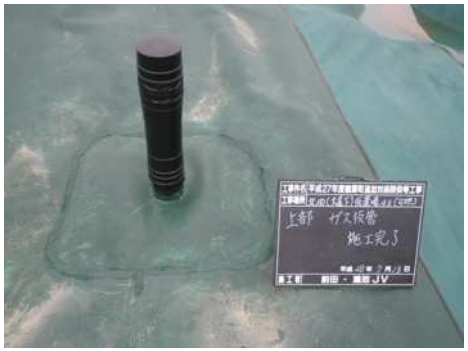
Effects of decontamination in SDA



MOE slide
http://josen.env.go.jp/en/pdf/environmental_remediation_1810.pdf

- Decontamination will not completely return the environment to its original state.
- The reduction in air dose ranged from 27% to 60%, and varied greatly depending on land use.

Temporary storage sites



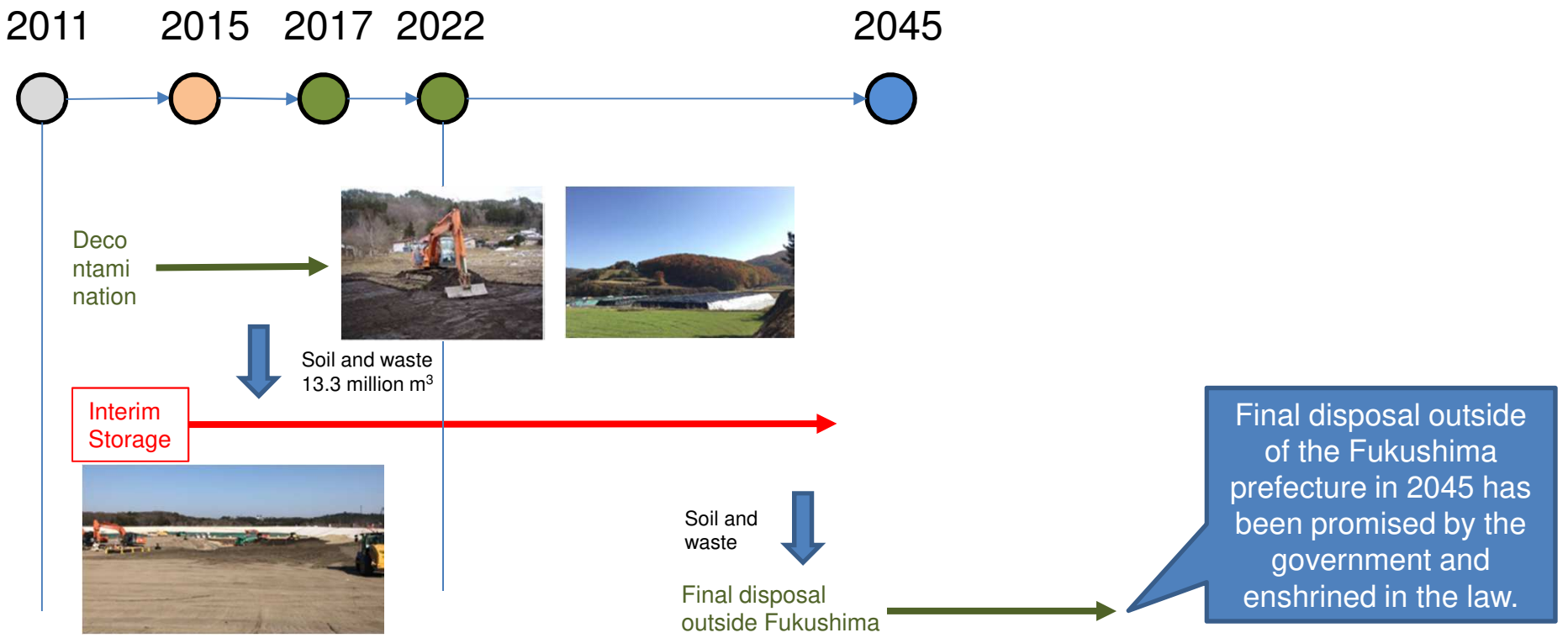
Methane gas venting pipes generated during storage of combustible materials

impermeable liner sheet installed at the bottom of the temporary storage site.

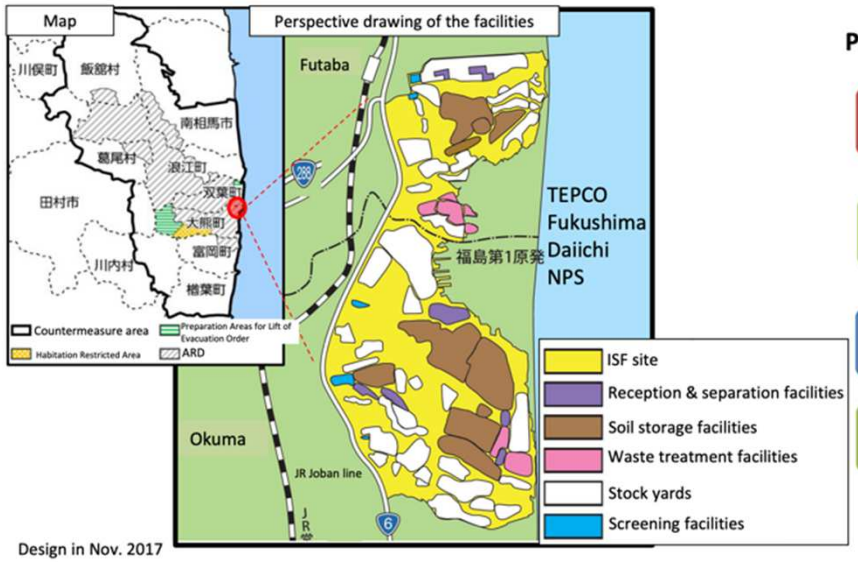
- Decontaminated soil and waste were stored Temporary storage sites near the decontaminated area and kept them for 3-7 years.
- A facility for safely storing removed soil and other materials near the decontamination site until they are transported to an intermediate storage facility.
- There were more than 1,000 temporary storage sites, but they are now being removed as they are being transported to interim storage facilities.

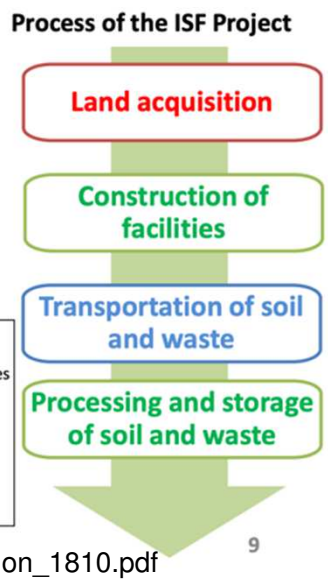
写真出典：除染アーカイブサイト
（http://josen.env.go.jp/archive/detailP0012,19,36 and 59）

Government Schedule of decontamination



Overview of the Interim Storage Facility





MOE slide: http://josen.env.go.jp/en/pdf/environmental_remediation_1810.pdf

Soil storage facility

Beautiful coast

- The facilities are being constructed in Okuma and Futaba towns surrounding the TEPCO's Fukushima Daiichi Nuclear Power Plant.
- The interim storage facility is a facility to safely and intensively store soil and waste generated from decontamination in Fukushima Prefecture until final disposal outside of the prefecture.
- The amount of soil to be stored is estimated to be 13 million m^3.
- The interim storage facility consists of
  - Reception and separation facilities,
  - Soil storage facilities,
  - Waste treatment facilities
  - Stock Yard

Summary of the Decontamination

Decontamination's advantage

- reduced air dose rate ranged from 27% to 60% and risk.(Environment)
- has also accelerated the lifting of evacuation orders. (Society)
- has also contributed to people's peace of mind. (Society)

Decontamination's disadvantage

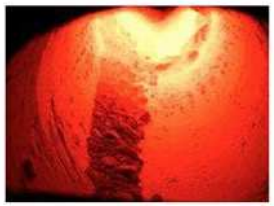
- Cost of decontamination and interim storage site is over 5.6 trillion yen(43 billion €).（Not including Final disposal site）(Economiy)
- Decontamination generated the waste. We need to manage it for along time. (Environment, Society and Economy)
- People in the area where the interim storage facility is located had to be evicted. (Society)
- The radioactive material has not been completely removed. (Environment)

Additional info.Overview of ”Volume reduction technology” and “Recycling”

In order to reduce the volume of contaminated soil to be transported to the Final disposal facility, the Ministry of the Environment has started considering the application of the “volume reduction technology” and “Recycling” to the treatment of the low-level contaminated soil.

Volume reduction technology

Soil washing
To classify clayey and sandy soils.



Heat treatment
Heat to 1300° C or higher to remove cesium.

Recycling

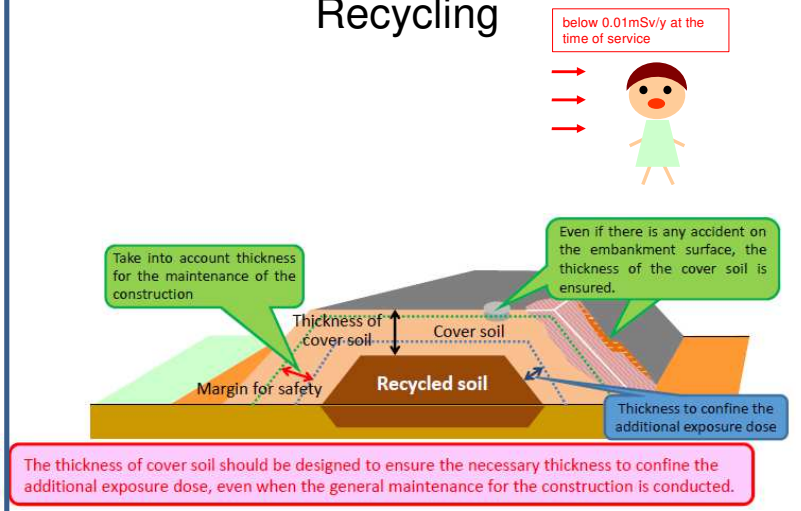


Figure : From the homepage of Ministry of the Environment

Reference :Yasutaka(2020) NEA Workshop on *PREPAREDNESS FOR POST-ACCIDENT RECOVERY PROCESS: LESSONS FROM EXPERIENCE*

What factor we have to consider for the selection of the final disposal site. Tentative result of the stakeholder interview.

Tetsuo Yasutaka[1] and Masahiro Osako[1]

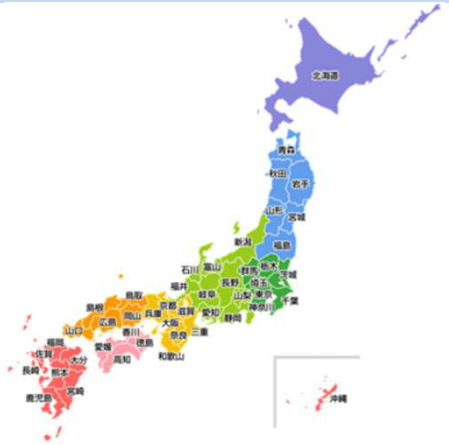
[1]The Society for Remediation of Radioactive Contamination in Environment

This work was financially supported by NIES and supported Kazuo Yamada(NIES), Kazuko Haga (Taiheiyo consultant), Yujiro Kuroda(Fukushima Prefectural Centre for Environmental Creation).

Purpose

Background

- The law determined the final disposal facility will take place outside the Fukushima prefecture until 2045.
- At present, details of the final disposal site structure, location setting process, etc. have not been determined.



1.Investigation and adjustment final disposal site

⇩

2.Determine the location of the final disposal site

⇩

3.Prepare final disposal site

⇩

4.Transport to final disposal site

⇩

5.Complete final disposal

Research Question

1. **What factor we have to consider to decision making process?**

Hypothetical stakeholder hearing

Hypothetical stakeholder hearing

■Purpose of the survey

The purpose of this survey is to sort out the important factors involved in the implementation of final disposal outside the Fukushima prefecture in future with interviews conducted with hypothetical stakeholders.

■Provision of basic information

・Decontamination, the interim storage facilities and the final disposal.
・Present potential multiple (4-5) scenarios for final disposal.

■Questionnaire

・What is important/necessary factors for selecting final disposal site for you
・Which scenarios are better for you (not this presentation)

■Interviewees：10 (6 residents of Fukushima included), High knowledge of radiation

	Male	Female
20's		1
30's	2	1
40's	2	3
50-60's		
70's	1	

Affiliation	Number
Professional worker	1
Former company executive	1
Municipal officials	4
Student and NPO	2
Research Academic	1

Data collection and analysis

■Data collection

- The interview will be recorded with the consent of the interviewee, and transcribed later.
- Also, the interviewer creates a field note (on some notices at the time of the interview) and uses it as a reference for analysis.

■Data analysis

- **Quantitative analysis: Through** interviews, the information on the important / necessary matters included in the talk of informers was conceptualized by the SCAT* (Steps for Coding and Theorization) method.
- **SCAT method to analyze qualitative data such as text information in 4 steps.**
  1. Notable words and phrases in the data: extract words related to the research questions
  2. Converted words: convert extracted words to general expression
  3. Concept outside the text to explain (2) words: sort into segments based on meaning of the contents
  4. Theme / Construct: describe theme and constructs of each segment
- **Categorize the opinions to the sustainability categories,**
  Environment, Economy and Society.

* Reference: Otani et al. ”Proposal of qualitative data analysis method SCAT by 4 step coding” Bulletin of the *Graduate School of Education* and Human *Development. Educational Sciences*.54(2), 27-44, 2007

Categorized index
:Important/necessary factors for selecting final disposal site:

Category	Index（provisional）	Concept
Society	Legal and Ethics	(1-2) Necessity of legal legitimacy and review of law
		(5-4) Necessity of changing rules by legitimate procedure
	Trust	(2-1) Lack of trust in the national government
		(2-5) Reliability of information sources
		(2-3) Active acceptance of the status quo
		(1-1) Anger based on self-experience at proposed disposal site
	Consensus building process and Fairness	(4-3) Respect for local decisions
		(4-4) Procedural fairness
		(4-2) Regional Conflicts and the Importance of Municipal Initiatives in the Location Selection Process
		(2-4) Diversity of opinions
		(3-4) Importance of motivation based on sharing social values.
		(3-8) Basic conditions for consensus building
		(3-3) Limitations of profit-driven consensus building
		(5-3) Possibility of prolonging (expiration)of the procedure
		(5-2) Limitation of bottom-up decision making
	Information sharing	(3-6) Understand and disseminate sufficient and organized grounds and background for disposal outside the prefecture 30 years later
		(5-1) Arrangement of conditions for voluntary acceptance by local governments
Economy	Direct cost benefits	(3-1) Perspective of considering final disposal site as infrastructure
		(6-1) Viewpoint of effective use of tax (National interests)
	Indirect cost benefits	(3-2) Providing information of benefits
Environment	Environmental risks	(2-2) Necessity of risk comparison with surroundings
		(3-7) Security assurance
	Environmental information	(3-5) Importance of hands-on experience to promote safety understanding
		(4-1) Promote understanding of scientific facts

From the result of the stakeholder interview, there are many comment of the Social aspect compared with Economy and Environment.

The requirement of the consensus building process of final disposal outside Fukushima prefecture from this interviews

1. Nationwide Information disclosure and sharing from the initial stage (providing benefit information as well as risk information associated with establishment of final disposal site.)
2. Planning and decision making procedures that ensure fairness
3. Involvement of a wide range of stakeholders
4. Considering the “social and economic aspect” as well as “environmental safety”.
5. Balanced decision making process/framework with stakeholder (Application of assessment methods that easily incorporate values of stakeholder)
6. Preparing multiple options (alternatives)
7. Flexible plan changes with fairness
8. Avoid the regional conflicts between authority and residents.
9. The challenge of incorporate the next generation opinion.
10. Project of reuse have a potential to support the drawing the future of the region (I know It's hard to get to that stage).

Conclusion

What factors should be included to solve these problems more sustainably?

- Environmental safety is primarily important.
- At the same time, we have to pay more attention to “social and economic aspect/factor” and to develop “balanced decision making process/framework with stakeholder ” to solve this problem sustainably.
- (My hope) These projects can play a role not only in recovering the environment but also in shaping the future of the region.

Acknowledgements:
I really thank for all interviewees for cooperating this interview and Kazuo Yamada(NIES), Kazuko Haga(Taiheiyo consultant), Yujiro Kuroda(Fukushima Prefectural Centre for Environmental Creation) for supporting interview.