

Toward the Sustainable Management of Decontaminated Soil and Waste in Fukushima

- What Factors to be Considered for Our Future?

Tetsuo Yasutaka
National Institute of Advanced Industrial Science and
Technology

My research target related FDNPP accident

Monitoring

Developing and standardized the monitoring methods of r-Cs in water.



Tsuji et al.,
(2019)STOTEN



Yasutaka et al.,
(2015)JNST

Monitoring and evaluate environmental dynamics.

Communication with former evacuee



Remediation

- Developing the volume reduction technology of rCs contaminated soil.
- Estimating Cost and effectiveness of the decontamination.



Estimated Cost of decontamination

	Total
Scenario 1	2.95 Trillion yen
Scenario 2	3.93 Trillion yen
Scenario 3	5.13 Trillion yen

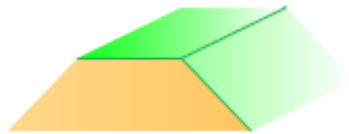
Yasutaka et al.,(2013)Plos One,
Yasutaka et al.,(2016)Jour.Env. Radio.
保高ら(2012)Radioisotope、高畑ら(2015)地盤工学J

Agenda

Main topic: Management of the huge amount of r-Cs contaminated soil (about 13million ton.)



1. Reuse of the contaminated soil



Applying Sustainable Remediation concept

2. Final disposal



Tentative result of interview

What factors need to be included to solve these issues.
The map;

Decontamination Process(2012-2017)

In order to recover the environment, decontamination work was carried out from 2012 to 2017.

1. Decontamination; To remove the contaminated soil and various materials.
2. Temporary storage sites; To move the soil to temporary storage sites near the decontaminated area and keep them for 3-7 years



Interim storage facility(2015-2045)

3. **To move** the contaminated soil to **interim storage facility** near the Fukushima Daiichi Nuclear Power Plant and keep them for 30 years.

The volume of contaminated soil is about 13 million ton



Decontamination Process(2012-2017)

1. Decontamination; To remove the contaminated soil and various materials.
2. Temporary storage sites; To move the soil to temporary storage sites near the decontaminated area and keep them for 3-7 years



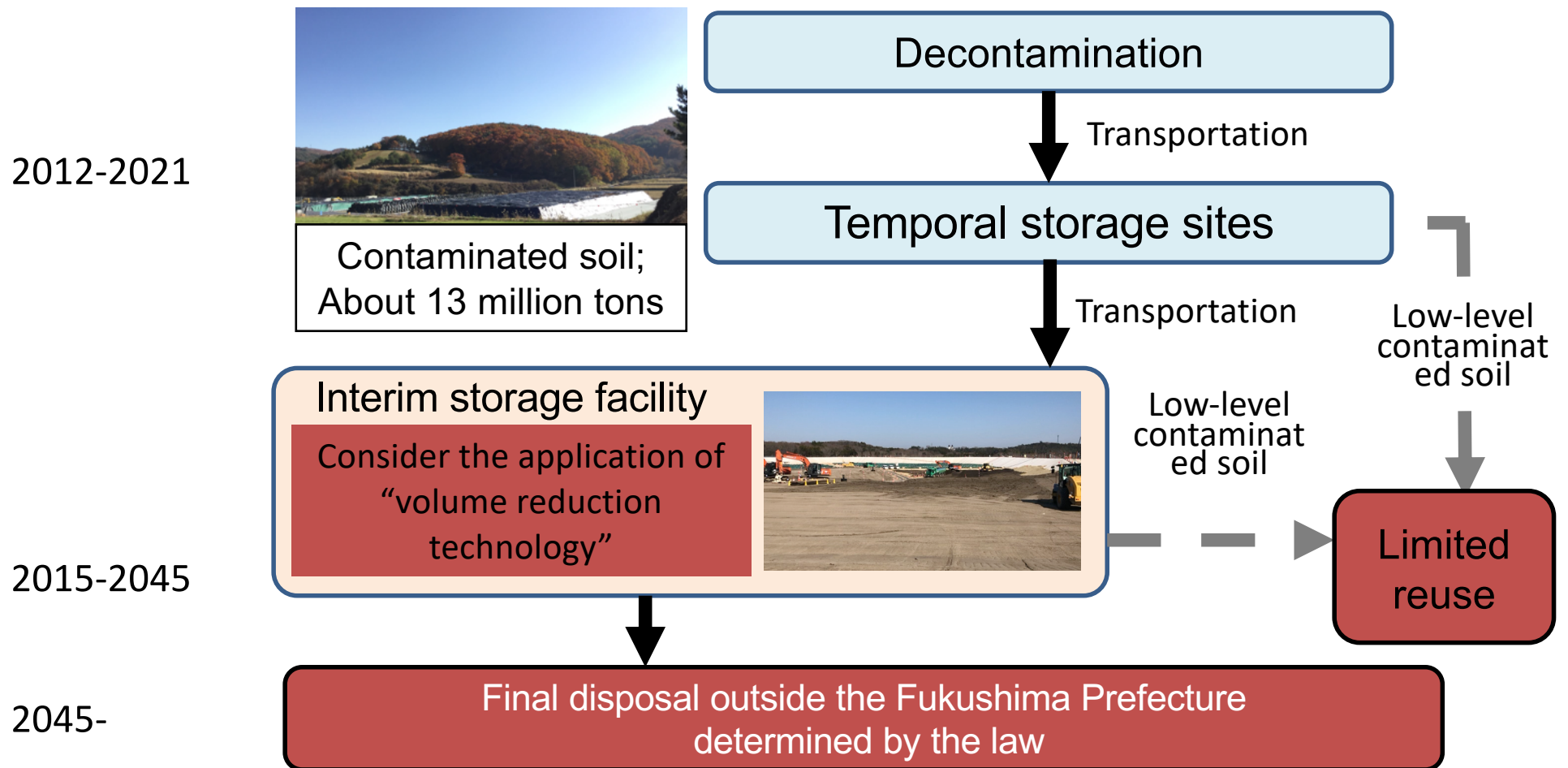
Interim storage facility(2015-2045)

3. To move the contaminated soil to interim storage facility near the Fukushima Daiichi Nuclear Power Plant and keep them for 30 years.

Final disposal facility (2045-)

4. The final disposal facility of the contaminated soil and waste will take place **outside the Fukushima prefecture until 2045.**

Overview of the environmental recovery process



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 “limited reuse” to the treatment of the low-level contaminated soil.

Concept on Safe Use of the Removed Soil after Recycling (MoE info.)

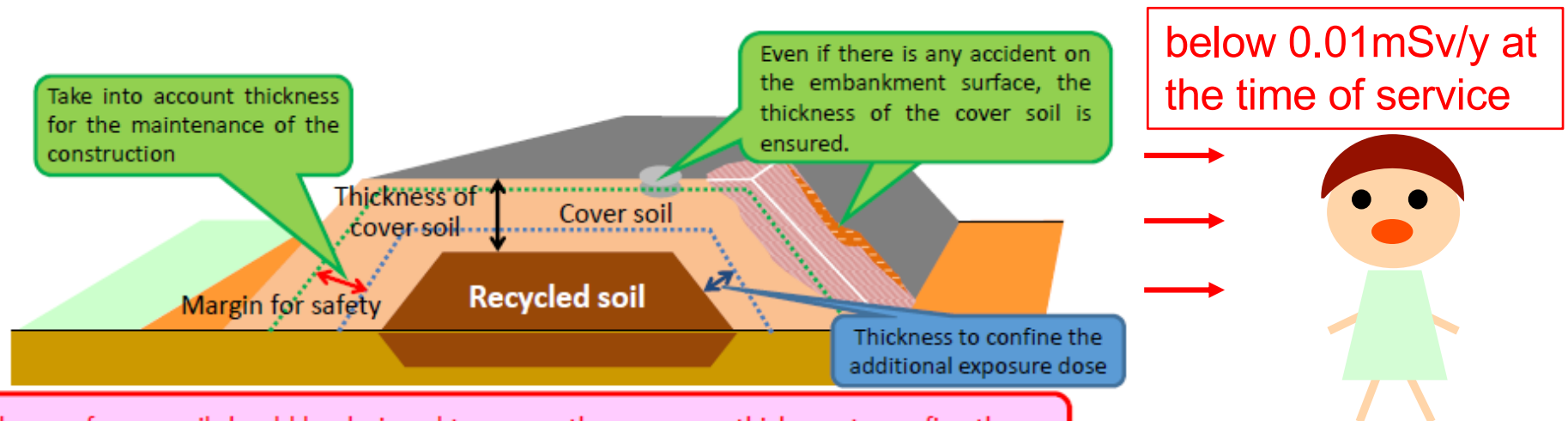
HP (<http://josen.env.go.jp/en/storage/>)

< Limited Use >

- The use will be limited to the material which is not assumed to change shape artificially for a long time period, e.g. **embankment materials for roads**, cover soil for waste disposal sites and landfill materials.

< Appropriate management >

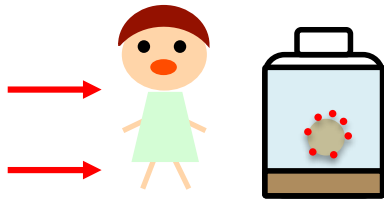
- The projects will be mainly public projects with a responsible management system.**
- The radioactive cesium concentration in the removed soil should be limited in order to **confine the additional exposure dose**.
- The additional exposure dose should be** below 1mSv/y during the construction and **below 0.01mSv/y at the time of service**.
- Covering soil should be installed, scatter and leakage should be prevented, ground form change should be observed, and the data should be recorded.



The thickness of cover soil should be designed to ensure the necessary thickness to confine the additional exposure dose, even when the general maintenance for the construction is conducted.

My opinion, the requirements for reuse the contaminated soil

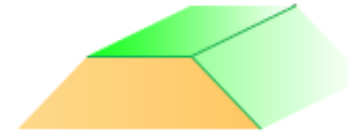
Safety



Point 1

Environmental safety

- External exposure
- Leaching to the groundwater



盛土材

Point 2

The quality of the material
for reuse purpose.

Is it enough?

Question

What do you think if you hear that the decontaminated soil (4000 Bq/kg) would be reused “safely” as an embankment material for a road 100 m away from your home?

1. No problem. I accept it.
2. Not accepted.
3. I could not judge from this information.

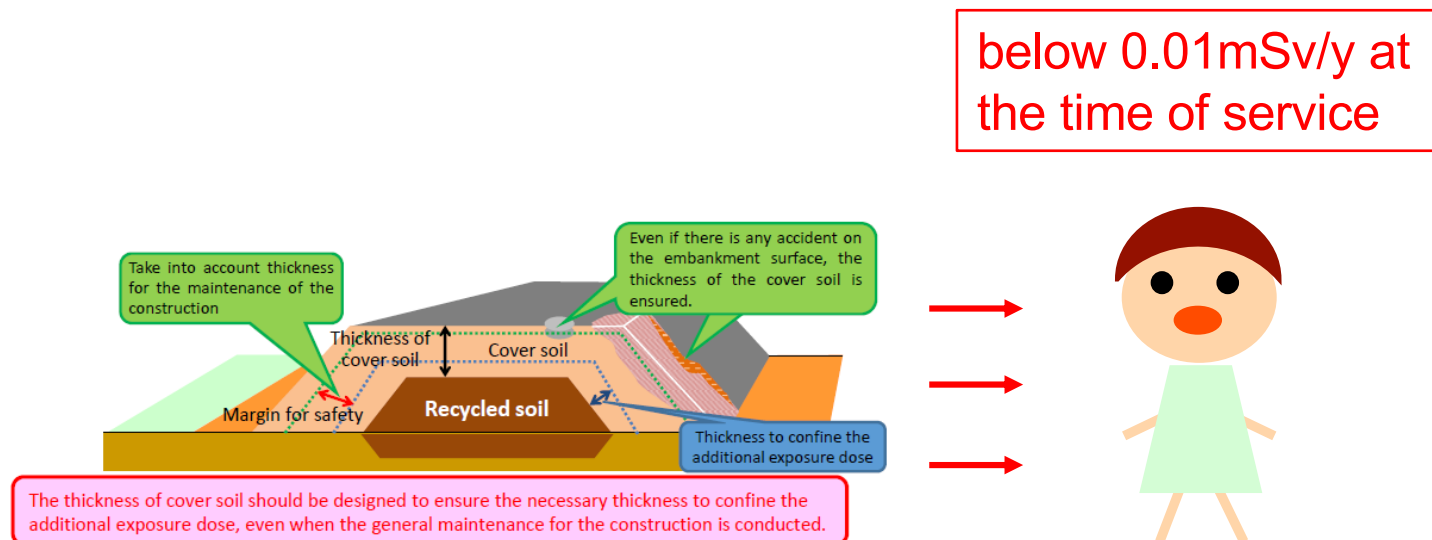
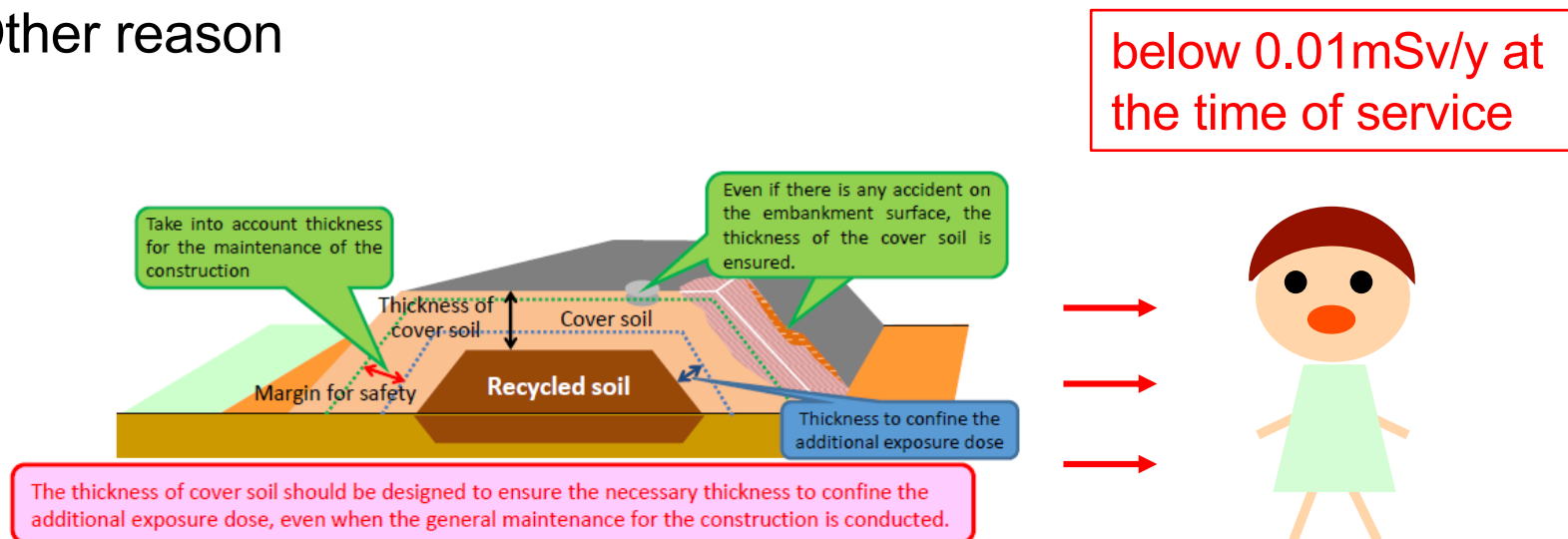


Figure : From the homepage of Ministry of the Environment

Question 2

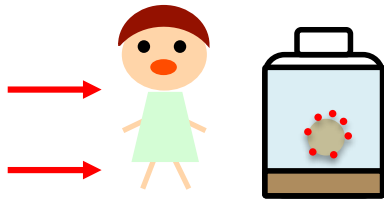
I want to ask the reason to people who answered the “2. Not accepted.”

1. Lack of the environmental safety.
2. Lack of the information.
3. Lack of the trust for the government.
4. Lack of the economical and social merit.
5. Lack of the reason why decontaminated soil used here.
6. Somehow
7. Other reason



My opinion, the requirements for reuse the contaminated soil

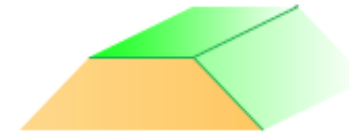
Safety



Point 1

Environmental safety

- External exposure
- Leaching to the groundwater



盛土材

Point 2

The quality of the material for reuse purpose.

Balanced decision making with stakeholder

Social aspect

Point 4

- Social acceptance of reuse
- Long term social impact
- Trust and liability in Government
- What to built using soil
- Why here?

Etc.

Economic aspect

Point 3

- Direct cost
- What to built using soil (Benefit for local government and people)

Etc.

Example of difference of the key factors for each stakeholder

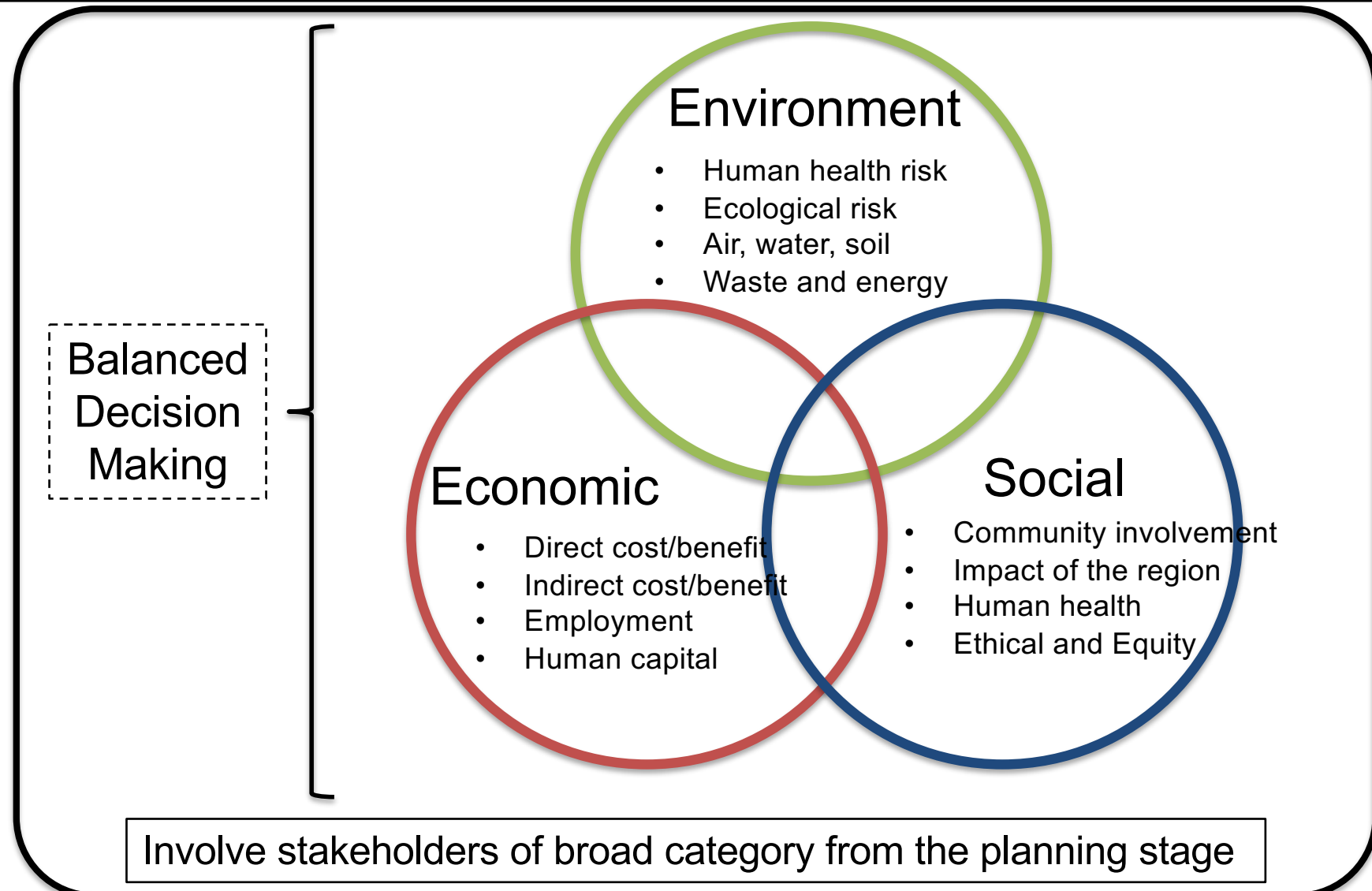
Key factors are varied for stakeholder and person

Category Stake holder	Environment	Economic	Social
Government	<ul style="list-style-type: none"> Long-term management External exposure Etc. 	<ul style="list-style-type: none"> Direct cost for reuse Reduce the volume of the final disposal Etc. 	<ul style="list-style-type: none"> Reduce the volume of the final disposal International consistency Etc.
Local government		<ul style="list-style-type: none"> What to built using soil Long term economical impact Etc. 	<ul style="list-style-type: none"> Long term social impact Etc.
Local people			<ul style="list-style-type: none"> Trust and liability in Government Long term social impact Etc.
.....			

- What is the benefit of the residents, local authorities and region.
- Understanding the difference of sense of values between stakeholders.
- Needs appropriate decision making framework considering these factors.

Sustainable Remediation

SuRF-UK defined Sustainable Remediation as “The practice of demonstrating, in terms of **environmental, economic and social indicators**, that the benefit of undertaking remediation is greater than its impact and that **the optimum remediation solution is selected** through the use of **a balanced decision-making process**.(SuRF-UK HP)” **with stakeholder.**



My opinion based my experience

Condition of social acceptance of reuse by stakeholder

- Needs appropriate decision making framework considering not only environmental but also social and economical factors.
- To decide based on the results of local discussions, but not on the premise of reuse.
- What is the benefit of the residents, local authorities and region. It is important to consider and discuss between stakeholder together what to use the decontaminated soil for.

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

Tetsuo Yasutaka¹ and Masahiro Osako¹

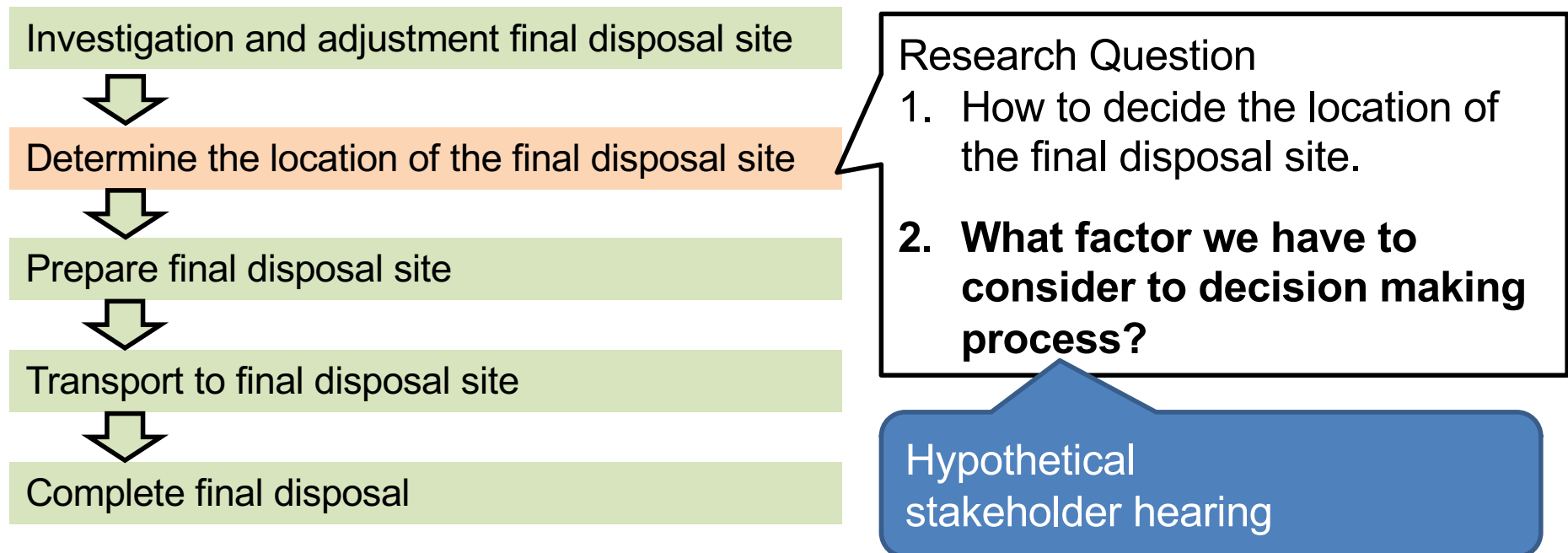
¹The Society for Remediation of Radioactive
Contamination in Environment

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.



■ 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

■ Data collection

- The interview will be recorded with the consent of the interviewee.

■ 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.
- Categorize the opinions to the sustainability categories, **Environment, Economy and Society.**

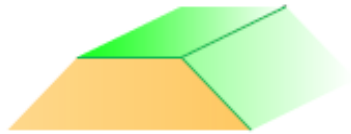
The part of the obtained suggestion of the requirement of the consensus building process of final disposal outside Fukushima

- Nationwide Information disclosure and sharing from the initial stage (providing benefit information as well as risk information associated with establishment of final disposal site.)
- Planning and decision making procedures that ensure fairness
- Involvement of a wide range of stakeholders
- Considering the “social and economic aspect” as well as “environmental safety”.
- Balanced decision making process/framework with stakeholder (Application of assessment methods that easily incorporate values of stakeholder)
- Preparing multiple options (alternatives)
- Flexible plan changes with fairness
- Avoid the regional conflicts between authority and residents.
- The challenge of incorporate the next generation opinion.

Conclusion

What factors need to be included to solve these issues.

1. Reuse of the contaminated soil



Applying Sustainable Remediation concept

2. Final disposal



Tentative result of interview

- 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**.