

ICRP-QST Symposium on Radiological Protection of People and the Environment in  
the Event of a Large Nuclear Accident  
大規模原子力事故における人と環境の放射線防護に関する ICRP-QST シンポジウム  
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# Monitoring, Remediation, and Communication.

モニタリング・環境修復そしてコミュニケーション

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# My research target related FDNPP accident (原子力災害に関係した研究活動)

## Monitoring

Developing and standardized the monitoring methods of r-Cs in water.  
(水中の放射性セシウムモニタリング手法の開発と標準化)



Monitoring and evaluate environmental dynamics.  
(モニタリングと環境動態評価)



## Remediation

Developing the risk analysis and management method of rCs contaminated soil (13million ton).  
(汚染土壌のリスク評価・管理)



I mainly researched on

- Developing the volume reduction technology. (減容化技術開発)
- Estimating Cost and effectiveness of the decontamination. (除染の効果やコストの評価)

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

## 1. Monitoring and communication

**How to share the result of the environmental survey with the local people. Our experience in Yamakiya.**

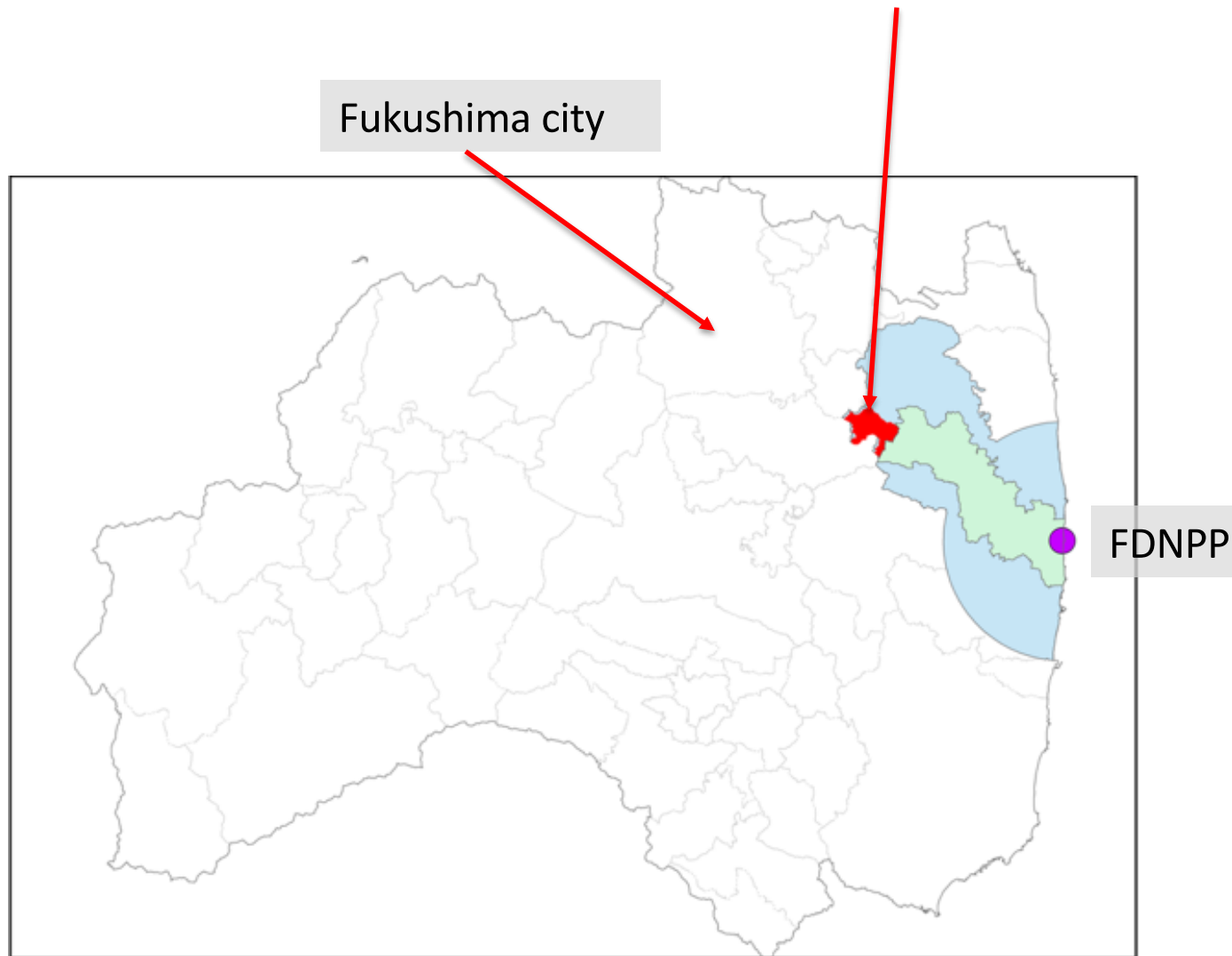


## 2. Remediation and social acceptance

**How to manage the huge amount of radio-Cs contaminated soil in Fukushima more sustainably?**



# 川俣町山木屋地区 (Yamakiya District in Kawamata Town)



2011.April	Government announce “Evacuation order”.
2017.March	Lift of the evacuation order.

Spring



Summer



Eustoma

[Akihiko Kondo-Lab.Chiba Univ.  
http://www.llsci.net/klab/act/fukushima/index.html](http://www.llsci.net/klab/act/fukushima/index.html)

**Restart from 2014**

## Restart the rice cultivation



## Restart the local festival from 2017



ICRP Dialog seminar in Yamakiya in  
Nov.25-26, 2017

山木屋の住民の方たちと現状を共有するダイ  
アログ

～国際放射線防護委員会（ICRP）の協力  
による対話の継続～

Supported by Kawamata town and  
Yamakiya residents

# Environmental survey and dialogues with residents

AIST and Chiba university have started the investigation from 2011.

(産総研と千葉大学は2011年から調査を開始)

We have held several dialogues (1-3 times per year) with Yamakiya farmers.

(年間1-3回、地元住民の方々と対話)

## Topics

Results of the environmental survey

(環境調査の結果)

Their anxiety and interest

(住民の方々の心配や興味)

Discussion on the monitoring target

(環境調査の対象の議論)

Local agricultural promotion association  
(農振会)



Genkatsu Kanno

Chiba.Univ.

Akihiko Kondoh,  
Tatsuaki Kobayashi

AIST

Tetsuo Yasutaka  
Wataru Naito

# Example of the our monitoring targets in Yamakiya (我々のモニタリング対象の一例)

## River



Tsuji et al.,(2014) Water Res.  
Tsuji et al.,(2019) STOTEN

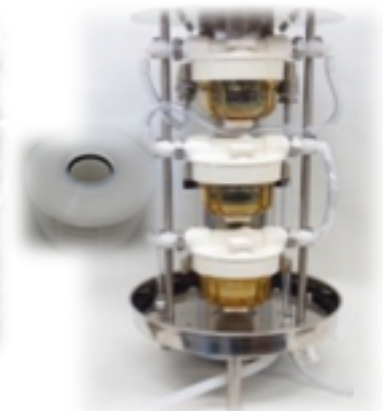
## Groundwater



## Stream water



## Developed monitoring device



Yasutaka et al., (2013)JNST  
Yasutaka et al., (2015)JNST

## Litter in forest



## Leaf



## Wild Plant



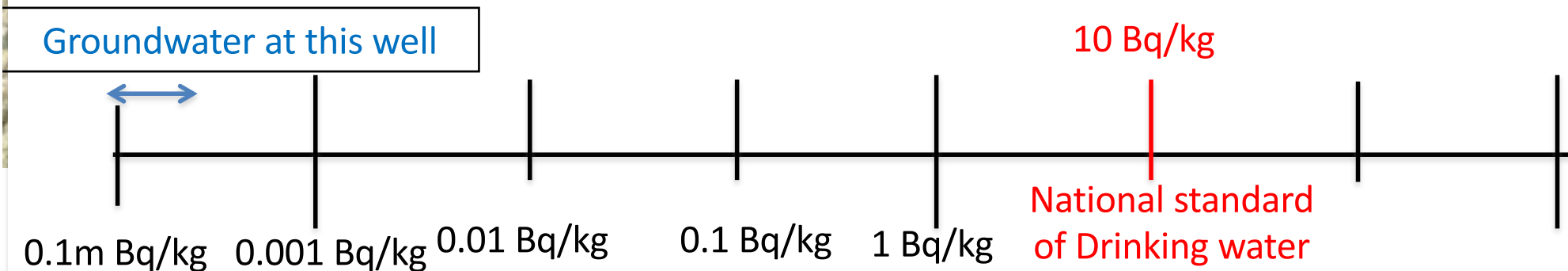
## Vegetable



Takada et al., (2016)Chemosphere  
Kurihara et al., (2018a)Jour. Env. Radio.  
Kurihara et al., (2018b) Jour. Env. Radio.



**Result of the groundwater monitoring, 0.3-0.5 mBq/L.  
Concentrated 2000L of groundwater for measurement.  
(地下水モニタリングの結果)**



## Meeting with local residents (地域住民との会合)

- We reported results of environmental survey to residents 1-3 per year during 2012-2018 at small meeting. (我々は、2012年～2018年まで、年間1-3回程度、住民の方に調査結果の報告をした。)



**4 Suggestion posed on our experience.  
(But these are obvious things)**

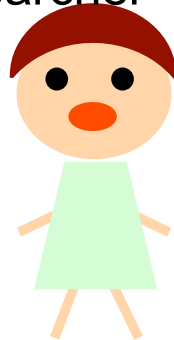
# Suggestion posed on our experience 1.

## Feedback the research results to the residents.

### 研究結果を住民にしっかりと伝える。

- When we conduct the field survey at the affected area, in many case, cooperation of residents or local authority is essential condition. (我々が被災地で環境調査に入る際に、多くの場合、地域住民や行政の協力が不可欠である。)
- The residents of the disaster struck areas are also victims. Researchers must be always aware that they are putting a burden on them. (被災地の住民は被災者であり、調査への協力は被災者の負荷になっていることを認識する必要がある。)
- For this type of the research, I think that feedback the research results to the resident should be an obligation of the researchers. (調査結果とともに被災地域へ貢献することは、研究者の義務ではないか、と個人的には考えている。)

Researcher



Residents



## Suggestion posed on our experience 2.

**Create the atmosphere that local population can easily talk.**

ステークホルダー(地域住民)が話しやすい雰囲気を作る。

- Instead of a school-style briefing with a large number of people, **a round table discussion with a small number of people** is more desirable. (多人数・スクール形式の勉強会よりも、互いに顔が見える形で少人数での勉強会が好ましい)
- Working together, such as doing farm work and preparing lunch before meeting would increase the trust in both groups. (勉強会の前に一緒に農作業をしたり、お昼ごはんを作るといった協働をすると、双方の信頼感が増す事が多い。)

Not preferable: School style



Image

Preferable:



with



## Suggestion posed on our experience 3.

### Understand the interests of residents. 住民の興味を理解する。

- There is a gap between the researcher's interest and what residents would like to know. (研究者の研究対象興味と地域住民が知りたいことは違う。)

#### Gap of the interest (ギャップの事例)

Researcher's Interests(e.g.)  
研究者の興味(例)

Residents's anxiety/  
interests(e.g.)  
地域住民の心配・興味(例)

Agricultural land  
農地

Leaching characteristics  
of the rCs from the soil

The concentration of  
Rice and vegetable

Forest  
森林

Spatial distribution of  
rCs in the forest

The concentration of  
Mushroom and wild plant

- Important to notice and understand the anxiety/ interest of the residents (地域住民の心配・興味を知り、理解することが重要)。
- Important to discuss and decide the research target considering the interest /anxiety of residents and local authority(not always). (地域住民の心配／興味に基づいて研究対象を決めることも時には重要である。)

内藤 & 保高(2019) 水環境学会誌42(3),を基に考察を深めている。  
Based on Naito and Yasutaka(2019) Journal of Japan Society  
on Water Environment 42(3)

## Suggestion posed on our experience 4.

### Communicate in easy-to-understand terms (わかりやすく伝える。)

- Do not use technical terms, complex figures and tables used at academic presentations, effort should be made to make the information with simpler and clear.  
(学会発表のような複雑な図表・説明ではなく、情報が明確に伝わる方法が望ましい)
- It is also important to prepare a comprehensible summary which can be understood at a glance(e.g. one shown below).  
(後で読んで分かるように、わかりやすいサマリーを作る。)

#### Example rule for us

- + Finish talking within 10 minutes per researchers.  
(10分以内で話を終える)
- + Don't use technical terms.(専門用語は使わない)
- + Prepare the simple summary with big font (over 12 )(フォントはできるだけ大きくする。)

“Personal” feelings toward communication with society  
after a environmental disaster  
災害後の社会とのコミュニケーションに関する「個人的な」所感

- The disaster related research need to be local residents and authority centered as well as scientific accuracy secured.  
(災害関連研究は、サイエンスであると同時に、前提として、被災地／被災者を中心に考える必要がある。)
- It should be based on principles such as “to feedback of the research results to the people”, “to understand of needs of the people”.  
(具体的には、「調査結果のフィードバックする」、「ニーズの把握する」、という心構え、などが必要ではないか。)
- Therefore, I believe environmental research and monitoring also has a roll in science for society.  
(環境モニタリング・研究は、地元住民に役立つ情報として、「社会のための科学」という役割がある、と考えている。)

## 2. Remediation and social acceptance

**How to manage the huge amount of radio-Cs contaminated soil in Fukushima more sustainably?**





# Decontamination Process(2012-2017)

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

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



The volume of contaminated soil is  
**About 13 million ton**

If you need more detailed information, please see the MOE HP.: 日本語 <http://josen.env.go.jp/> 英語 <http://josen.env.go.jp/en/>

# Decontamination Process(2012-2017)

1. Decontamination(除染); To remove the contaminated soil and various materials.
2. Temporary storage sites(仮置場); 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. 中間貯蔵施設: To move the contaminated soil to **interim storage facility** near the Fukushima Daiichi Nuclear Power Plant and keep them for 30 years.

# Estimated decontamination cost, not include final disposal site

	Total 合計
Scenario 1	2.95 Trillion yen (兆円)
Scenario 2	3.93 Trillion yen (兆円)
Scenario 3	5.13 Trillion yen (兆円)

Cost include Decontamination- Interim storage site

- Yasutaka, T. et al., (2013). PloS one, 8(9),e75308. DOI: [10.1371/journal.pone.0075308](https://doi.org/10.1371/journal.pone.0075308)
- Yasutaka, T., & Naito, W. (2016). Journal of environmental radioactivity, 151, 512-520

## Japanese Government have paid 2.9兆円 until 2017

環境省(2018)東京電力福島第一原子力発電所事故により放出された放射性物質汚染の除染事業誌  
<https://www.env.go.jp/press/files/jp/108735.pdf>

# Decontamination Process(2012-2017)

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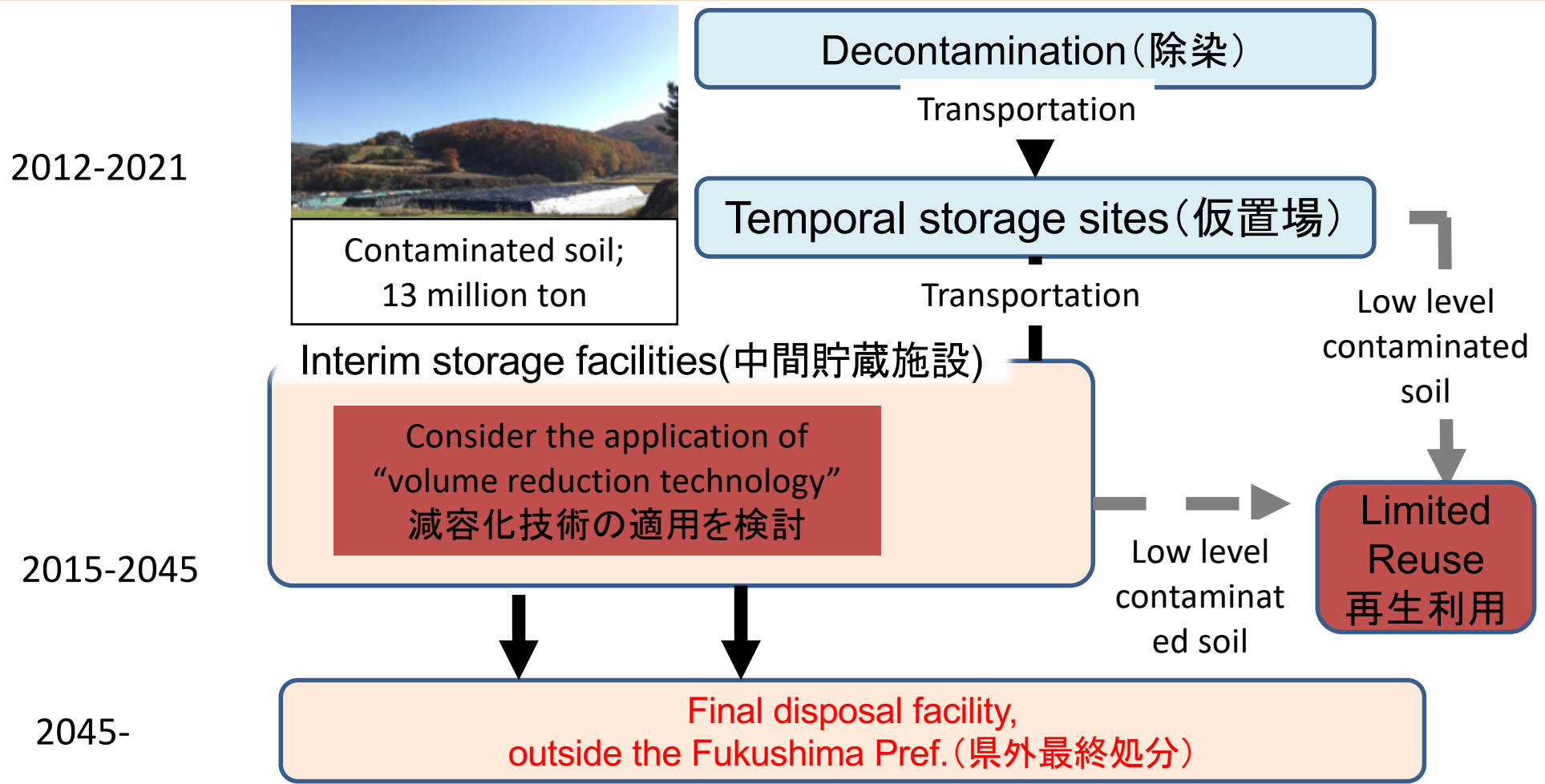
## Interim storage facility(2015-2045)(中間貯蔵施設)

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-)(県外最終処分)

4. 県外最終処分: The final disposal facility of the contaminated soil will take place **outside the Fukushima prefecture until 2045.**

# Over view of the environment recovery process, Volume reduction technology and limited reuse



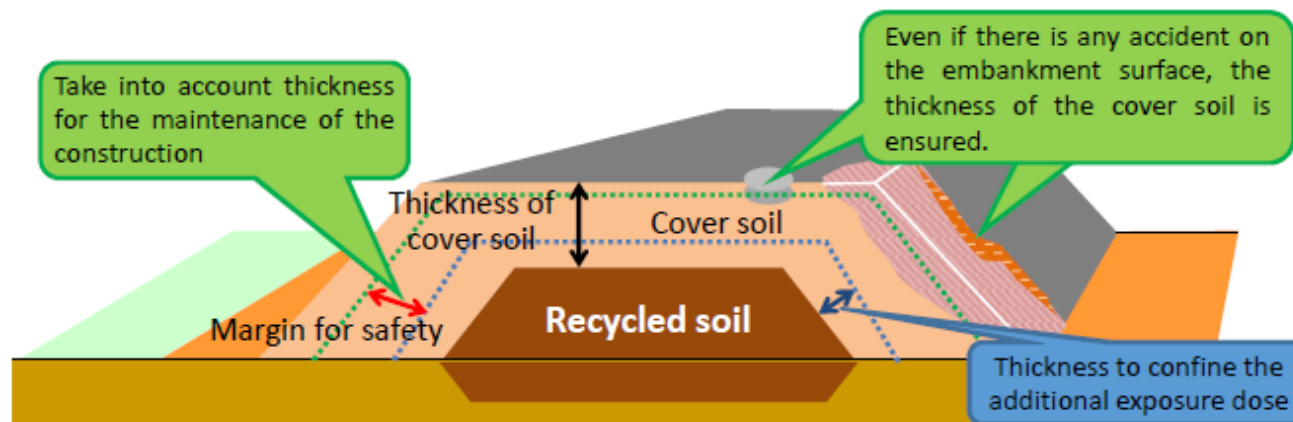
For reduce the volume of contaminated soil transporting the Final disposal facility, Ministry of Environment have started to consider the application of "volume reduction technology" and " Limited reuse" of the low level contaminated soil.  
 県外最終処分をする土壌量を削減するために、減容化技術の適用、再生利用を検討している。

## < 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.

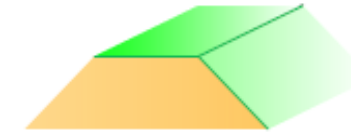
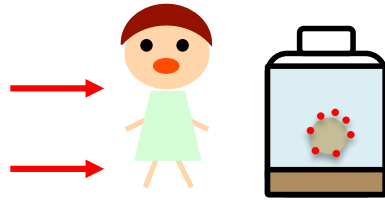
## < Appropriate management >

- 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.

## Academic science アカデミックな科学



盛土材

### Point 1

#### Environmental safety 環境安全性

- External exposure for residents;  $<0.01\text{mSv/year}$
- Leaching characteristics; Low

### Point 2

#### The quality of the material for reuse purpose.

- 再生用途に応じた材料品質
- Embankment strength

# Is it enough?

# Question

What do you think if you hear that the decontaminated soil would be reused “safely” as a embankment material for road 1 km away from your home?

1. No problem. I accept it.
2. Accept because I consider its social significance.
3. It depend on the term.
4. Absolutely, not accepted.

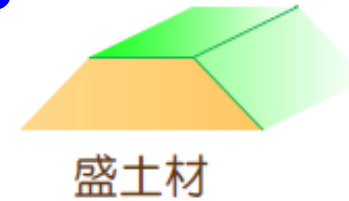
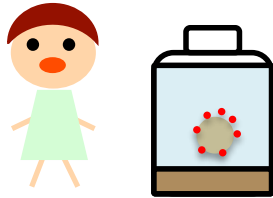
「あなたは、自分が居住する家から1km先で除去土壌等が道路盛土として“安全に”再生利用されると聞いた場合、どう思いますか？」

1. 問題ない。
2. 社会的意義を考えて受け入れる。
3. 条件による。
4. 絶対に嫌だ。

Factor of anxiety or sense of values is depend on the individual.  
(不安要素や価値観は人によって異なる。)



## Academic science アカデミックな科学



**Point 1**  
**Environmental safety**  
環境安全性

**Point 2**  
**The quality of the material  
for reuse purpose.**  
再生用途に応じた材料品質

## Socioeconomic aspects

**Point 3**  
**Cost/benefit analysis**  
費用効果分析

**Point 4**  
**Securing sites for reuse**  
有効利用先の確保

**Point 5**  
**Social acceptance of reuse by  
stakeholder**  
再生利用における  
ステークホルダーの社会受容

# Condition of social acceptance of reuse by stakeholder

## My opinion based my experience

- **Stakeholder involvement**
  - **Who is stakeholder?**(だれがステークホルダーか?)
- **Appropriate decision making framework.**
- **What is the benefit of the residents, local authorities and region.**(地元住民、行政、地域のベネフィットはなにか)
- **Understanding the difference of sense of values between stakeholders.**(ステークホルダー間の価値観の相違を理解する)

- **To decide based on the results of local discussions, but not on the premise of reuse.**(再生利用ありきではなく、地域とともに決めるべきことと考える。)

# Issue of selection the location of final disposal site

Generally important matter for communication and consensus building about environmental issue.

(一般的な環境問題におけるコミュニケーション・合意形成に必要なこと)

- Information disclosure and accessibility from the initial stage (初期段階からの情報公開)
- Participation of the wider stakeholder (幅広いステークホルダーの参画)
- Preparing multiple options (alternatives) (複数のオプション(代替案)の準備)
- Application of evaluation methods that make it easy to incorporate stakeholder values(ステークホルダーの価値観の多様性を考慮した評価手法の適用)
- Flexible plan changes (柔軟な計画変更)
- Fairness of the procedure(手続き的公正性)

Issue of selection the final disposal site

- Spatial issues: How to select the place in all prefectures/cities except Fukushima pref.(空間的課題:福島県を除く全都道府県が対象)
- Time Issues : Can the current generation properly consider next-generation issues? (26 years later) 時間的課題:次世代の課題(26年後)

保高(2019)廃棄物資源循環学会誌 30(1)をベースに考察を深めた, Yasutaka (2019) Material cycles and waste management research,30(1)

# Thank for your attention

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