June 20, 2024
Practice in International Agricultural Development

Resilience Agricultural Sciences Starting from Fukushima

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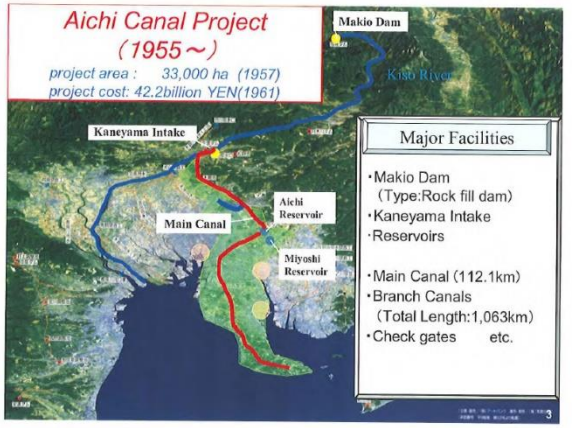
April 26, 2024
Tokuron-1/IPADS Development Studies(2024)

Agricultural Engineering

-Production system, Infrastructure, Irrigation-

Masaru Mizoguchi



Lab. of International Agro-Informatics
Graduate school of Agricultural and Life Sciences
The University of Tokyo

Challenge to solve the problems that lie in front of us

- What is the problem?
  - Find and set the right question
- How do we solve the problem?

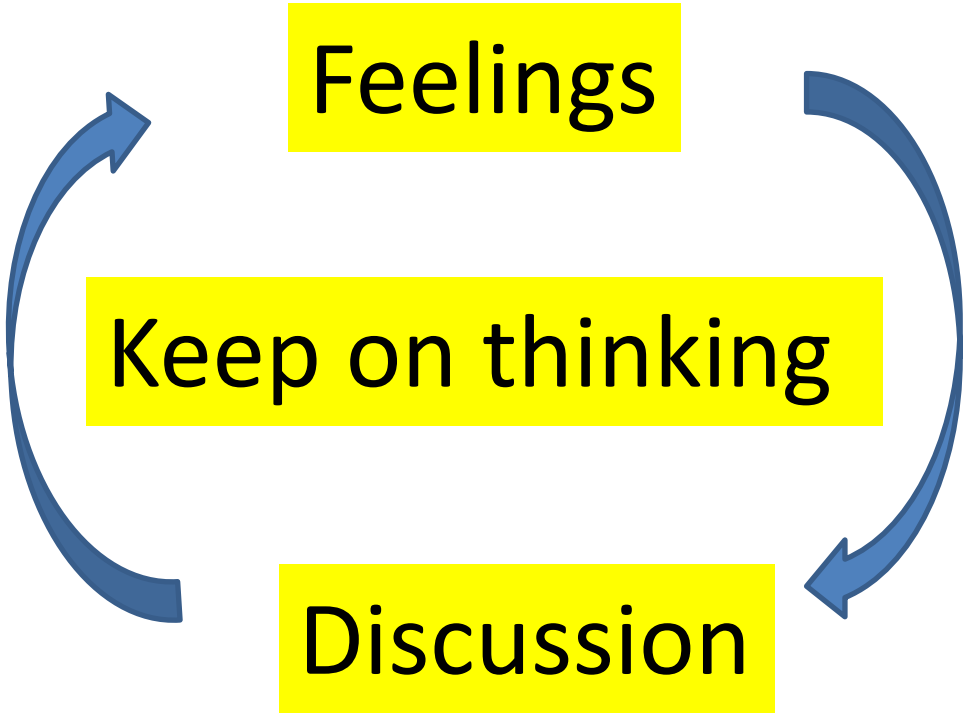
Project-Z by Mizo

Theory and Practice

- Notice the gap between theory and practice
- Understand the theory (Science)
  - Mathematics, physics, chemistry, biology, ecology,,,
  - Sociology, economics, political science,,,
- Know the practice (experience)
  - Field survey, interview, job training, internship,,,,

Where does the idea come from?

- Lecture?
- Book?
- TV?
- Internet?
- Practice?



To see real fields by yourself is most important!

Let’s watch movies and discuss!

- Made in Fukushima
  - https://www.madeinfukushima.com/
  - https://www.iai.ga.a.u-tokyo.ac.jp/mizo/lecture/noukoku-1/2024/Made_in_Fukushima.pdf
- **FUKUSHIMA REBORN**
  - https://www.metergroup.com/environment-case-studies/fukushima-reborn/
- The Rebirth of Fukushima
  - http://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/fukushima/media/The%20Rebirth%20of%20Fukushima-HD.mp4
- Toward the Revival of Iitate Village (Fukushima Restoration Association Introduction Video)
  - 飯舘村再生へ向かって（ふくしま再生の会　紹介動画）
  - https://youtu.be/fHKxT4gHQ7g (in Japanese)

Homework
レポート課題

- Submit a written plan of what you would like to investigate by actually going to Fukushima, referring to reference literature and web pages, such as http://www.iai.ga.a.u-tokyo.ac.jp/mizo/publec/201119Harvard.pdf.

- 参考文献やWebページを参考にして、福島に実際に行って調べたいことを計画書として提出しなさい。

Deadline: May 10, Friday

To: UTOL

Proposed Research Topics

1. Understanding the impact on biodiversity in Iitate Village, particularly plant biodiversity, using an interdisciplinary approach.
2. Comprehensive and in-depth understanding of the impact on local residents and their responses using an interdisciplinary approach.
3. Evaluating the impact of the nuclear accident on the income of farmers in Fukushima.
4. The relationship between soil radiation levels and the lives of local residents.
5. The Fukushima Special Support Education Promotion Plan.
6. Psychological impact on residents after the nuclear accident.
7. The impact of radiation on the ecosystem and wildlife in Iitate Village.
8. Evaluating the effectiveness of decontamination methods developed for the restoration of farmland.
9. Effects of efforts to restore and rehabilitate the ecosystem.
10. Assessing the efficacy of the Sunflower Project in Fukushima.
11. Video production.
12. Return rate of Fukushima residents.
13. Investigating the role of the government in constructing and engaging ecosystems to achieve significant improvements in a short period.
14. Current applications and future potential of ICT technology.
15. Creating a map of radioactive contamination on farmland.
16. Direct dialogue with local residents.
17. Hops cultivation and craft beer.
18. Impact of radiation on agriculture in Fukushima Prefecture.
19. Coastal fisheries.
20. Current state of radioactive contamination in rice, including I-131, Sr-90, and Cs-137.
21. Please classify the themes into three categories and describe their characteristics.

Analysis result by ChatGPT4o

- Question
  - Please classify the themes into three categories and describe their characteristics

- Answer

(1)Environmental and Ecosystem Impact and Recovery

(2)Social and Economic Impact

(3)Social Recovery and Education

https://www.iai.ga.a.u-tokyo.ac.jp/mizo/lecture/noukoku-1/2024/Proposed%20Fukushima%20topics.pdf

IPADS Field study pre-lecture

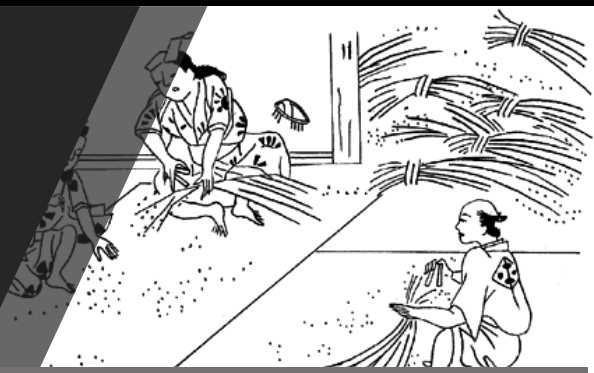
Resilience Agricultural Sciences Starting from Fukushima

INTRODUCTION

- 13 years have passed since the nuclear power plant accident
- Researchers from various fields have been involved in agricultural issues in Fukushima since the accident

HISTORY OF JAPANESE AGRICULTURAL TECHNOLOGY

- Dedicated farmers developed during the Edo and Meiji eras (1600-1900).
- Dr. Tokiyoshi Yokoi (1860-1927: a graduate of Komaba Agricultural School) in the Meiji era
  - saw that the agricultural scientists of the time, who had learned Western science, were trying to do things without seeing the actual field
  - ridiculed them at a lecture, saying, "Agricultural science flourishes, but agriculture dies".



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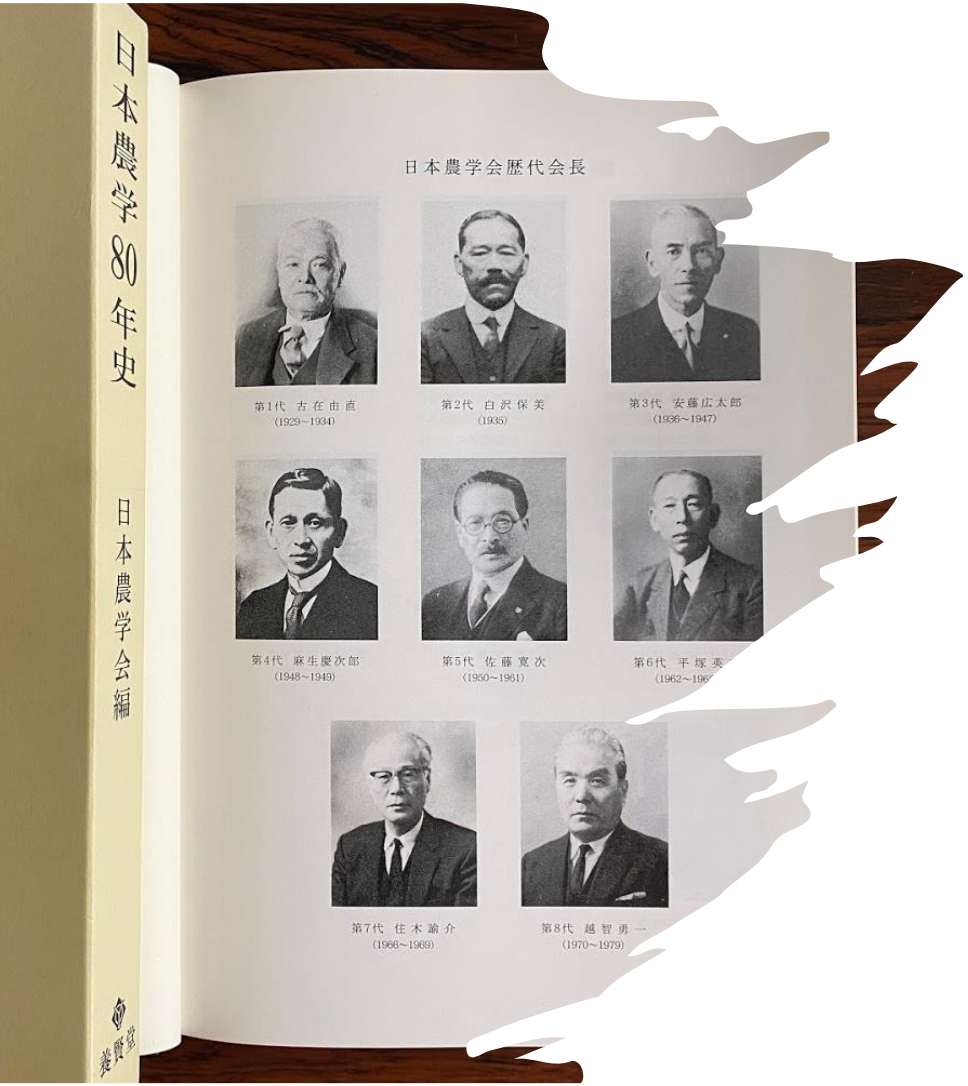
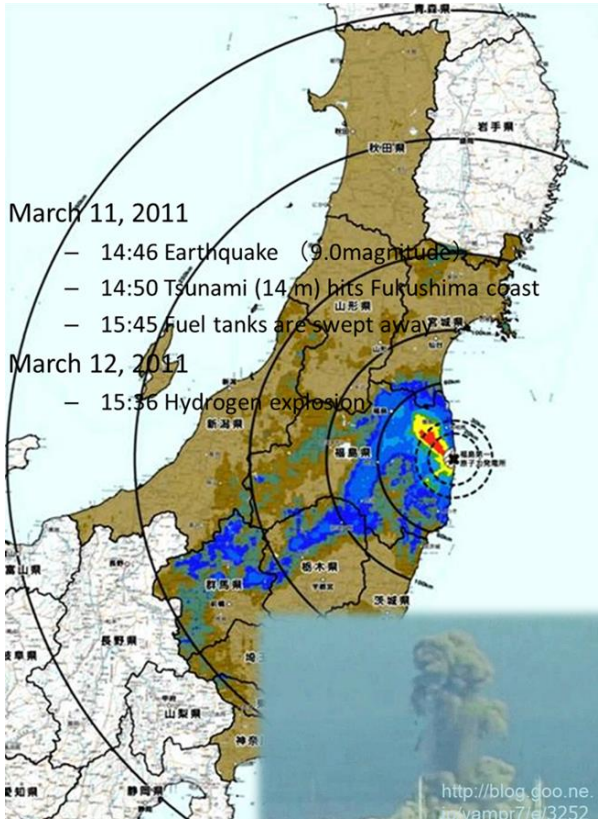


THE JAPAN SOCIETY OF AGRICULTURAL SCIENCES

- Modern agricultural science in Japan started
  - with the Veterinary Society in 1884,
  - and by 1929, 16 societies had been established,
  - and now consists of more than 50 societies reflecting the subdivision of research fields.
- The Society of Resilience Agriculture and Sciences became the 53rd society to join the Japan Society of Agricultural Sciences in 2020.

NUCLEAR POWER PLANT DISASTER IN FUKUSHIMA

- In March 2011, the Tohoku region was devastated by the tsunami caused by the Great East Japan Earthquake, and the coastal area of Fukushima Prefecture was contaminated by radioactive materials due to the nuclear power plant accident.
- While the 1986 Chernobyl accident was brought to an end with the sarcophagus treatment, the first human challenge to revive the region continues in Fukushima and accumulate its experiences as reconstruction knowledge for 13 years.
- In April 2023, the Japanese government made the Fukushima institute for Research, Education and Innovation (F-REI) which aims to be a world-class "Centre of excellence for creative restoration" that will serve as a dream and hope for realizing the reconstruction of Fukushima and the other parts of Tohoku region. (https://www.f-rei.go.jp/)



WHAT IS AGRICULTURAL SCIENCE?

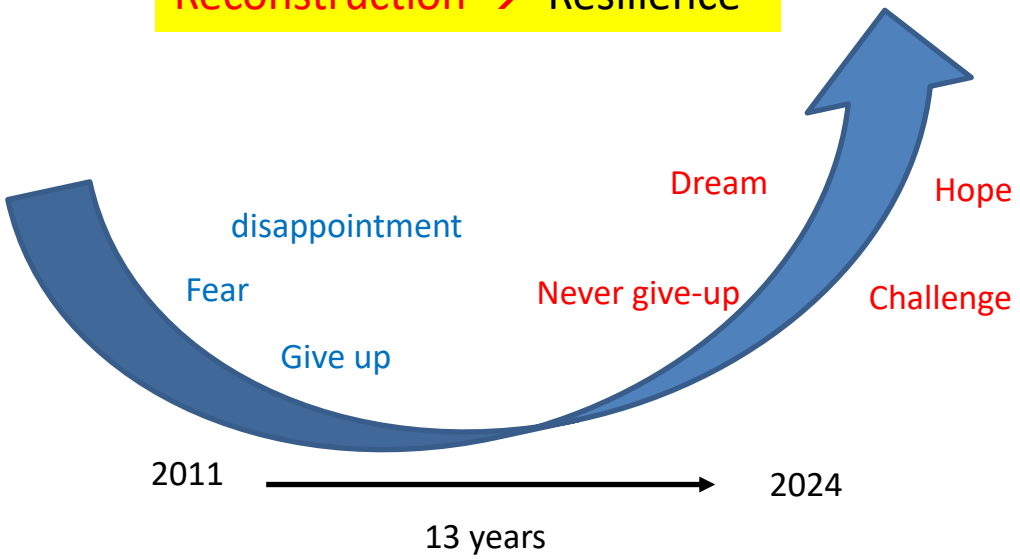
- RURAL AREAS
  - are places of food production and living environments
- AGRICULTURAL SCIENCE
  - is a discipline that works with the farmers.
  - In normal science, we search for literature and set a research theme
  - However in Fukushima, there are many issues arising from the nuclear power plant accident.
- We have a CHANCE
  - to ask dedicated farmers who have returned in the areas where evacuation orders have been lifted without defeated by adversity.
  - "Ask the rice about rice, and ask the farmers about agriculture."（Professor Yokoi）
- Only faculty members and students go to the fields in Fukushima and talk with the farmers, we will be able to see the real issues and come up with research themes.
  - FPBL (Field and Project-Based Learning)

WHAT IS RESILIENCE AGRICULTURAL SCIENCES

-NEW AGRICULTURAL SCIENCE

- Resilience: the ability to be happy, successful, etc. again after something difficult or bad has happened（Cambridge Dictionary）

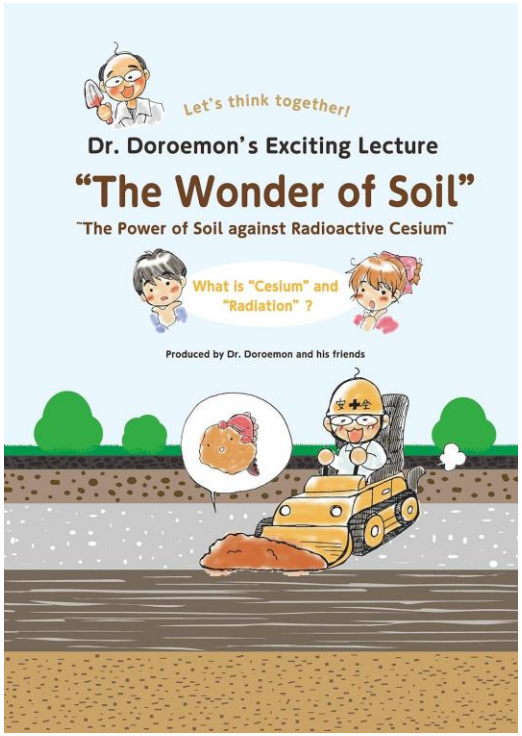
Reconstruction → Resilience



Soil decontamination is finished!

We need to make a new community with hope

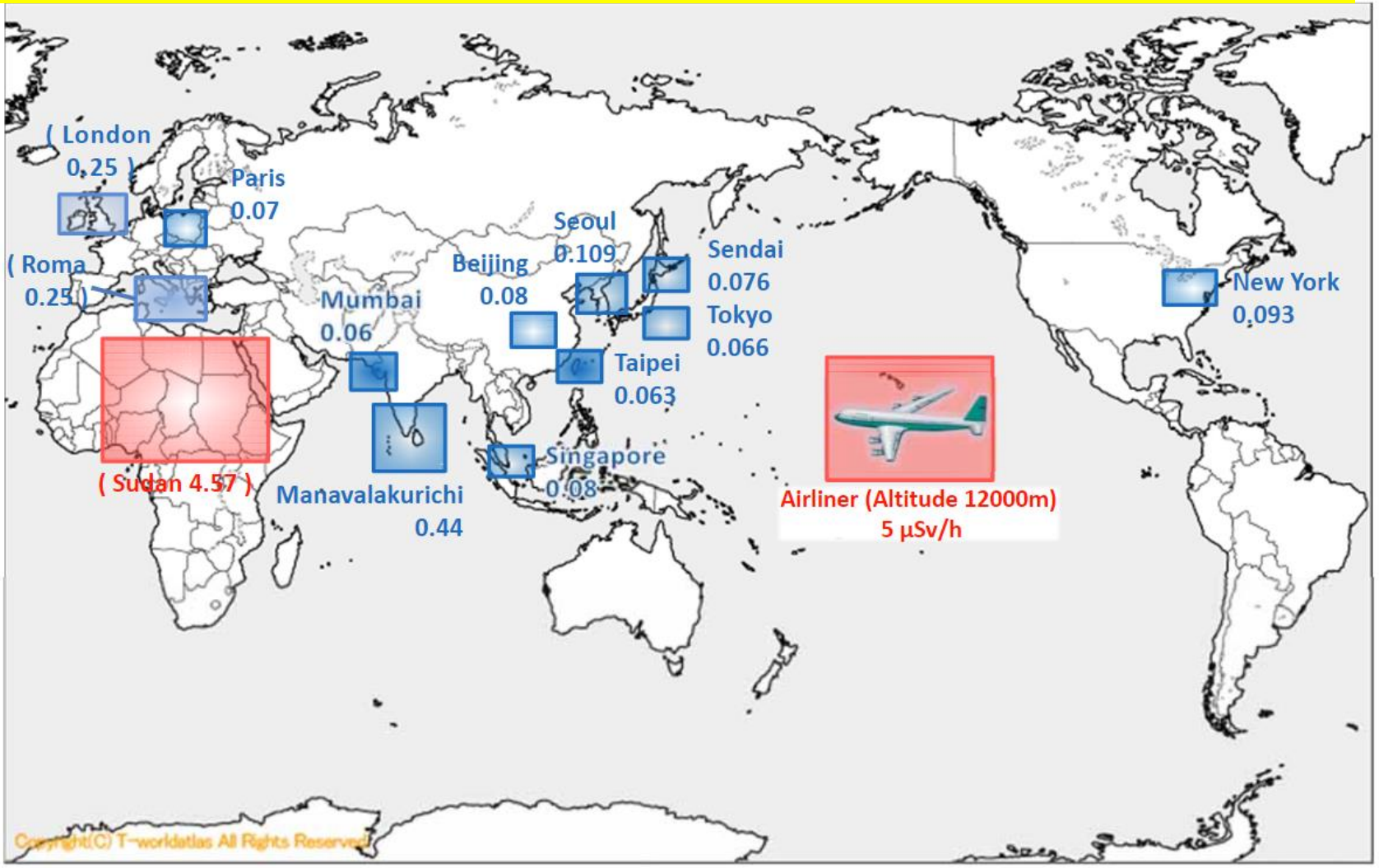
Brief introduction about radiation



https://www.iai.ga.a.u-tokyo.ac.jp/mizo/book/doroemon-book.html

Radiation dose in the world (uSv/h)

May 2011



http://www.ifs.tohoku.ac.jp/edge/radiation/Amount%20of%20radiation%20around%20the%20world%20june%2001,2011%20JP.pdf

Radiation in Daily-life

※Unit : μ Sv

Radiation dose (microsievert: μ Sv)

250,000

Upper limit of radiation dose permitted for people who engage in emergency work.

[250,000 μ Sv/year]

50,000

Upper limit of radiation dose permitted for radiation workers, police , and firefighters who engage in disaster prevention.

[50,000 μ Sv/year]

[～10,000 μ Sv/year]

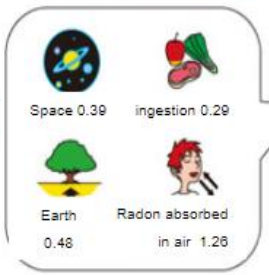
Radiation dose in Guarapari(Brazil) per year.

10,000

Chest CT scan

[6,900 μ Sv/each time]

[～2,400 μ Sv/year]



Global average

Natural radiation dose per year.

1,000

Dose limit for public per year (except for medical care).

[1,000 μ Sv/year]

Gifu ⇔ Kanagawa

Maximum difference of the average of natural radiation dose in each prefecture.

[～400 μ Sv/year]

gastrointestinal X-ray examination.

[600 μ Sv/each time]

100

An air travel between Tokyo and New York (RT).

(Increased cosmic radiation at high altitude.)

[～200 μ Sv/round trip]

[50 μ Sv/each time]

Chest X-ray examination.

[22 μ Sv/year]

Evaluated dose of radiation from radioactive substance emitted from the nuclear fuel reprocessing plant per year.

[50 μ Sv/year]

Standard dose of radiation around a nuclear plant (light water reactor).

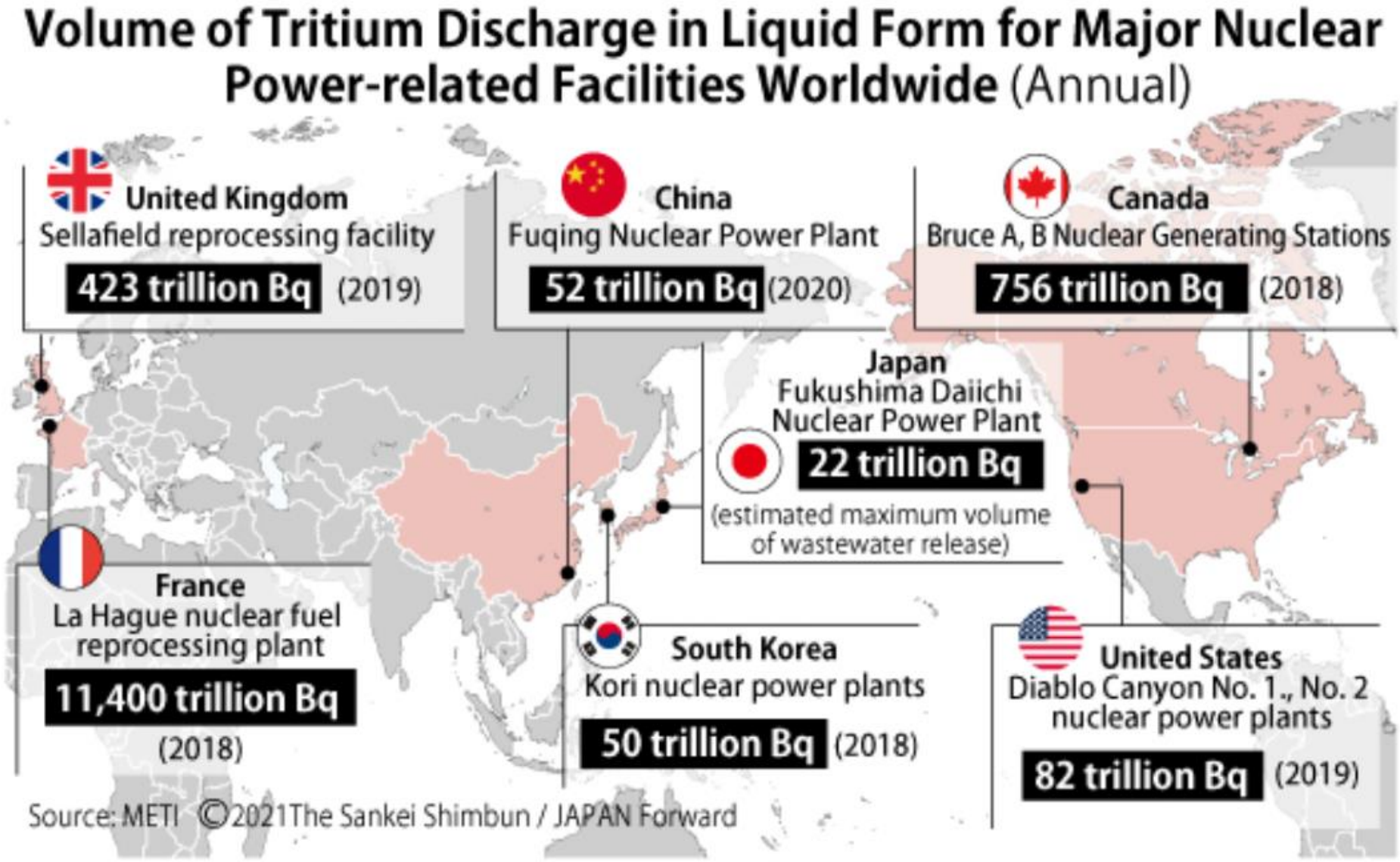
(Actual result is far below the value.)

[10 μ Sv/year]

Standard radiation dose from Clearance level.

10

(Ref) Average dose rate at the monitoring post of Tokyo (3/17 9:00～3/18 9:00, March) : 0.050 μ Sv/h = 438 μ Sv/y



https://japan-forward.com/china-and-south-korea-too-release-nuclear-plant-wastewater-into-the-oceans/

Agriculture and Rural Area

Agricultural Infrastructure

public works

Soil, Water, Rural Areas, Information

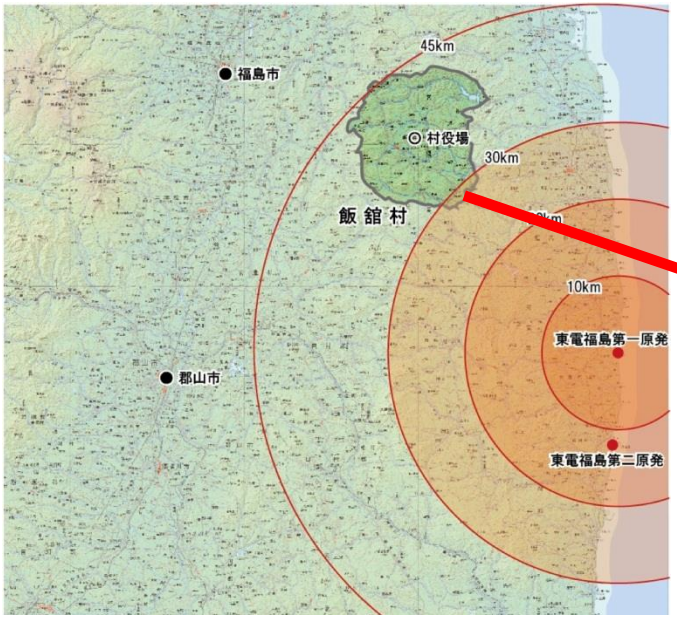
Supporting agricultural production

A behind-the-scenes role

March 2011

Nuclear power plant accident

Iitate Village in Fukushima Prefecture

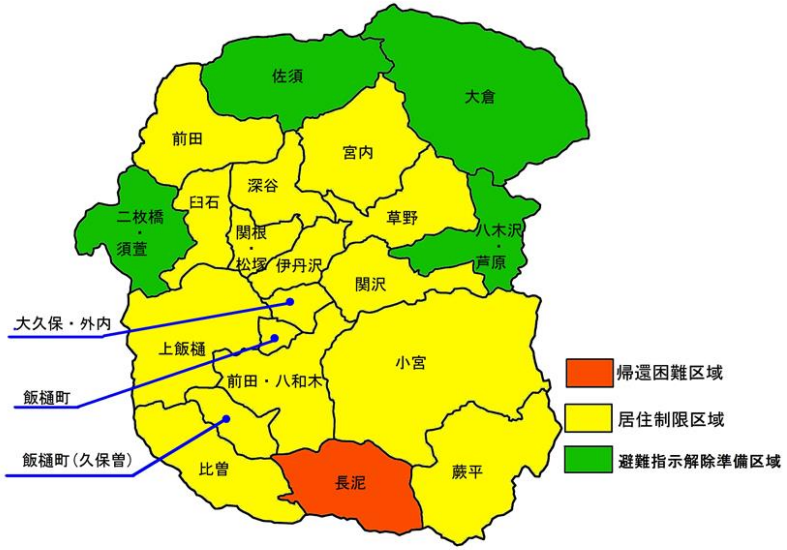


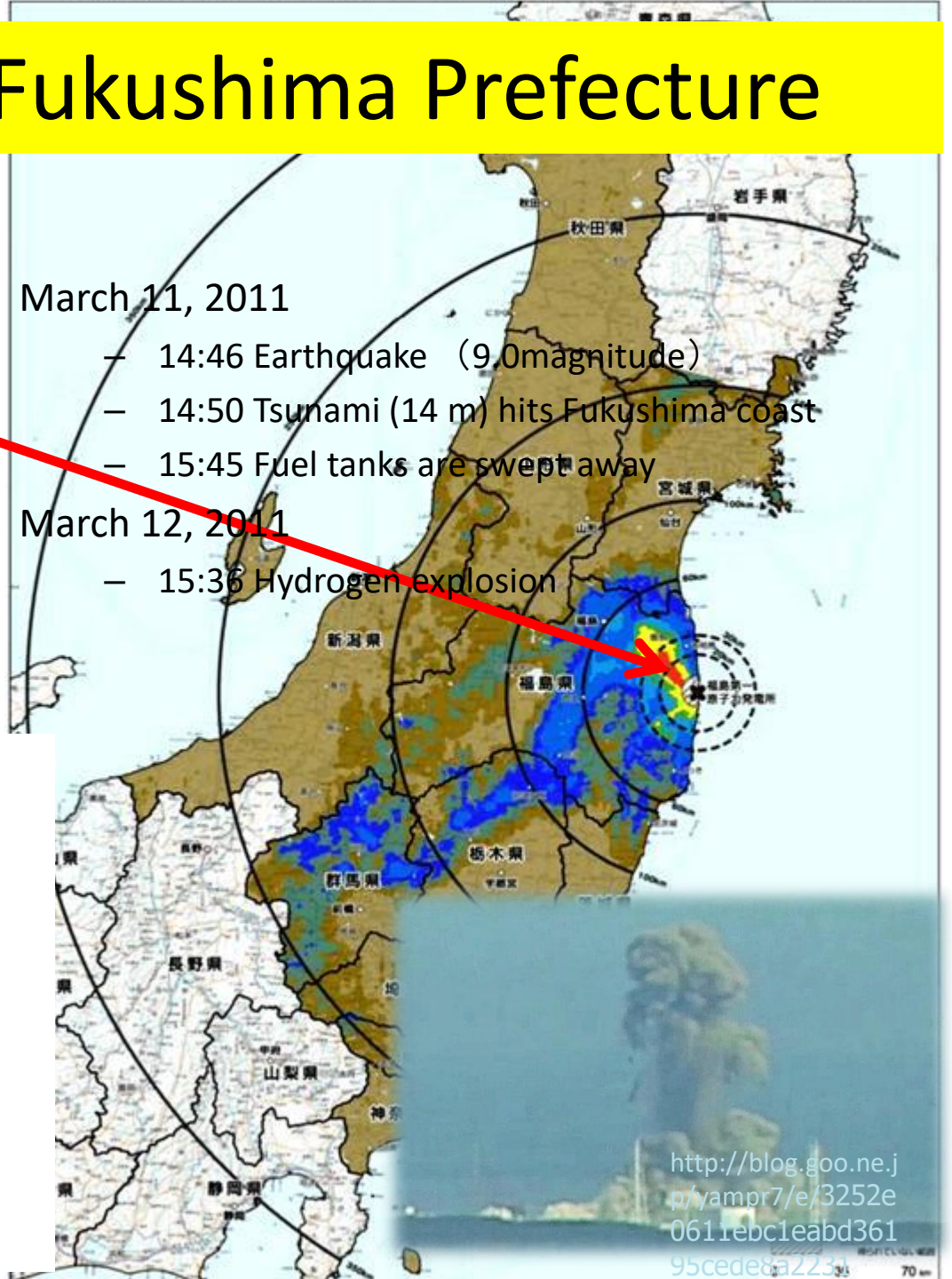
March 11, 2011

- 14:46 Earthquake （9.0magnitude）
- 14:50 Tsunami (14 m) hits Fukushima coast
- 15:45 Fuel tanks are swept away

March 12, 2011

- 15:36 Hydrogen explosion





How I acted immediately after the nuclear accident

(2011.3.11) **The Great East Japan Earthquake**

(2011.3.15) Establishment of the University of Tokyo's Fukushima Reconstruction Agricultural Engineering Council (UT-FRAE)

(2011.5.30) Seminar on Radioactive Cesium on Clay Surface

(2011.6.25) First visit to Iitate Village

(2011.7.10) Symposium talk: the "soil" of Iitate Village

(2011.8.30) Encounter with NPO:“RESURRECTION OF FUKUSHIMA”

(2011.9.4) UT-FRAE first Field Survey of Iitate Village

https://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/fukushima/media/150831mizo.pdf

History of development of farmland decontamination methods and agricultural revitalization

(2012.1.8) Frost Stripping Method
(2012.4.1) Mud Sweeping Method with a weeder machine
(2012.10.6) Student Tour of the Faculty of Agriculture, University of Tokyo
(2012.12.1) The burial method (contaminated soil burial method)
(2013.5.15) The Muddy Waters Forced Drainage method
(2013.6.6) Waterlogging Experiment in a Paddy Field
(2015.6.26) Drainage Survey of Farmland Soil after Decontamination
(2016.6.24) Decontamination experiment in forest (contaminated soil burial method)
(2017.3.21) Iitate flowerbed
(2017.3.31) Lifting the Evacuation Order
(2018.3.5) Collaboration Agreement between Iitate Village and the University of Tokyo
(2018.5.1) The birth of the sake “Like a Phoenix”
(2019.6)Nominated for Cannes Lions
(2019.8) Buckwheat Cultivation by Todai Murajuku

Please visit the following URL for the contents and photos of each item.
http://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/fukushima/201017.html

小宮の大久保さん方

東大院生ら協力

飯舘村の形の花壇が完成

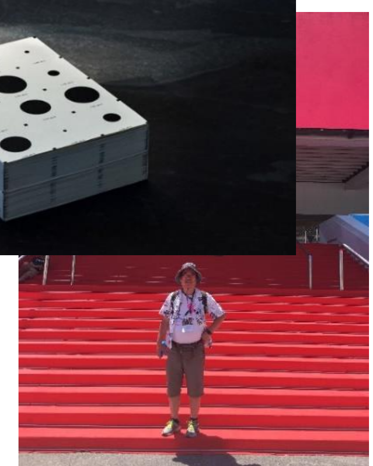
東京電力福島第一原発事故に伴う避難指示が三十一日に解除される飯舘村小宮の大久保金一さん(七七)方の畑に二十日、村の形をした花壇が完成した。花で復興の象徴を作ろうと活動する大久保さんの情熱を東京大の大学院生らが後押しした。

大久保さん（前列左から２人目）方で花壇を整備した東京大大学院の学生ら。前列左端が佐藤さん

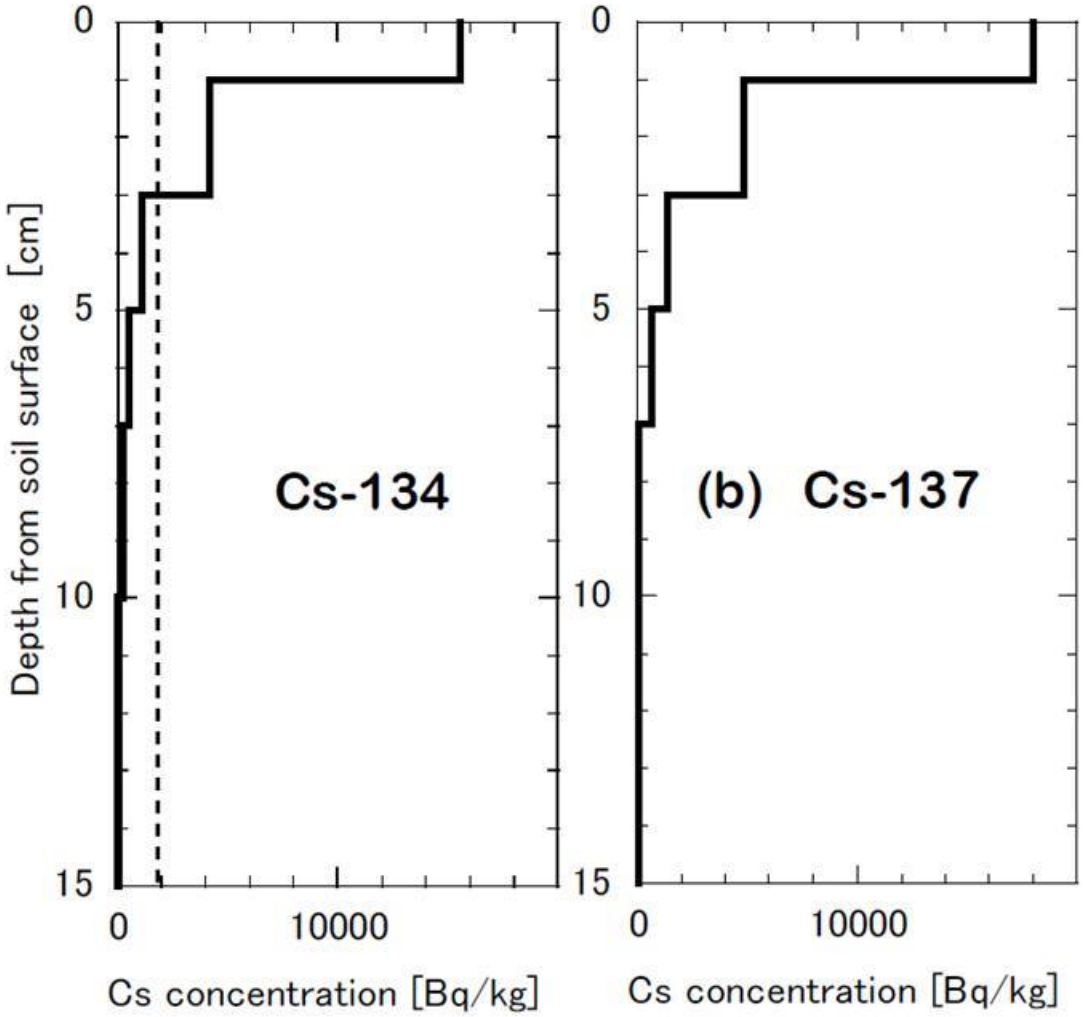
大久保さんは平成二十二年から自宅周辺で花の植栽を始めた。原発事故で避難を強いられたが、花の名所を構えてお世話になった人に恩返ししようと、桜の植樹やミズバショウの管理などに取り組んできた。

大久保さんの思いを知った村出身の佐藤聡太さん(二四)ら東京大大学院農学生命科学研究科農学国際専攻の学生でつくるグループ「いいはな」が授業で花壇のデザインを提案した。大久保さんから「アイデアを実現してほしい」と頼まれ、昨年

飯舘村が東大と連携協定



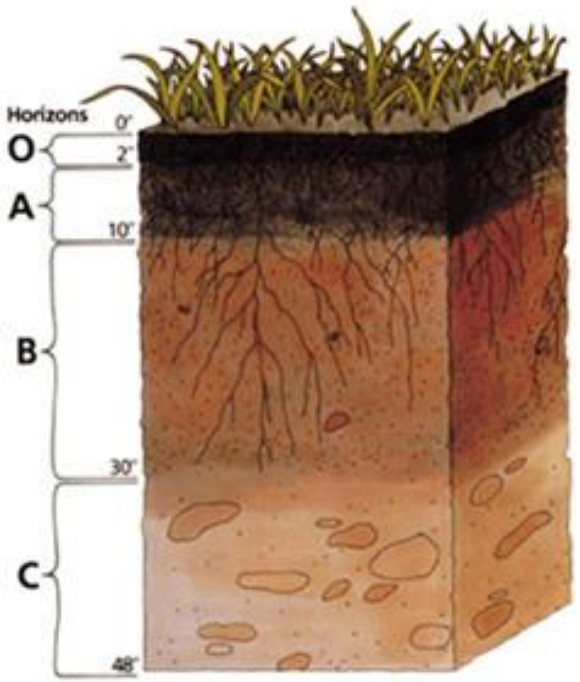
Vertical distribution of Cs in soil (24/5/2011)



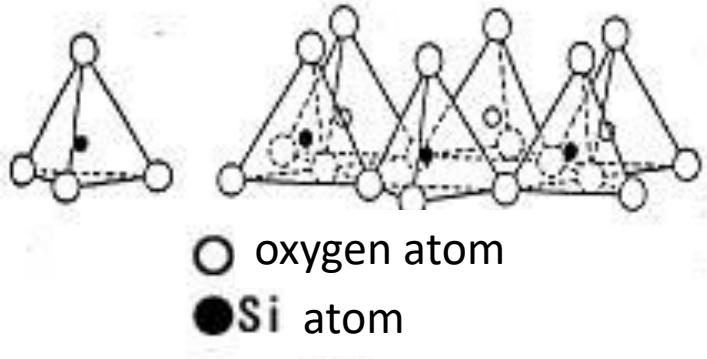
Shiozawa et al. (2011): Vertical concentration profiles of radioactive cesium and convective velocity in soil in a paddy field in Fukushima. Radioisotopes 60 : 323-328

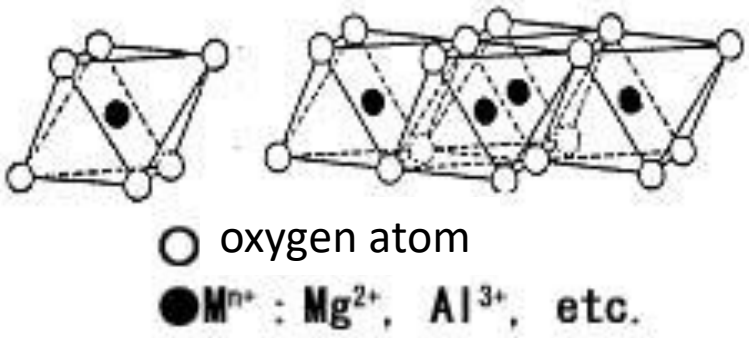
What is Soil?

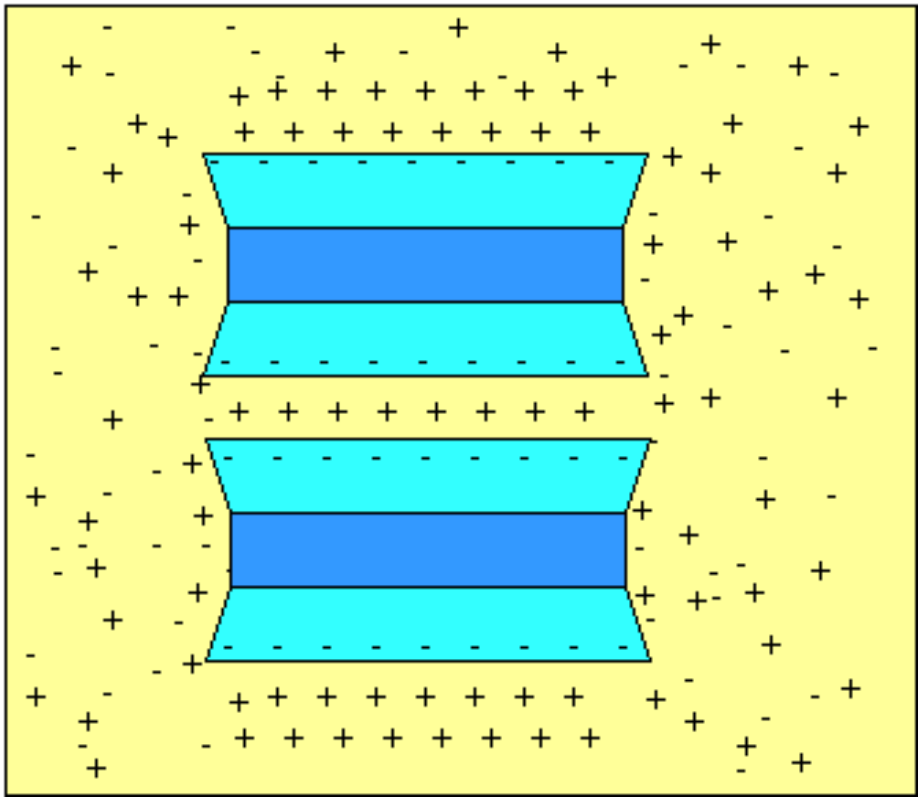
- What is soil composed of?
  - Soil particles, Water, Air
- Classification of Soil Particles
  - Classified by size
  - sand, silt, clay
- Properties of Clay
  - Hard to sink in water
  - Sludgy when it contains water
  - When it dries, it is stiff.

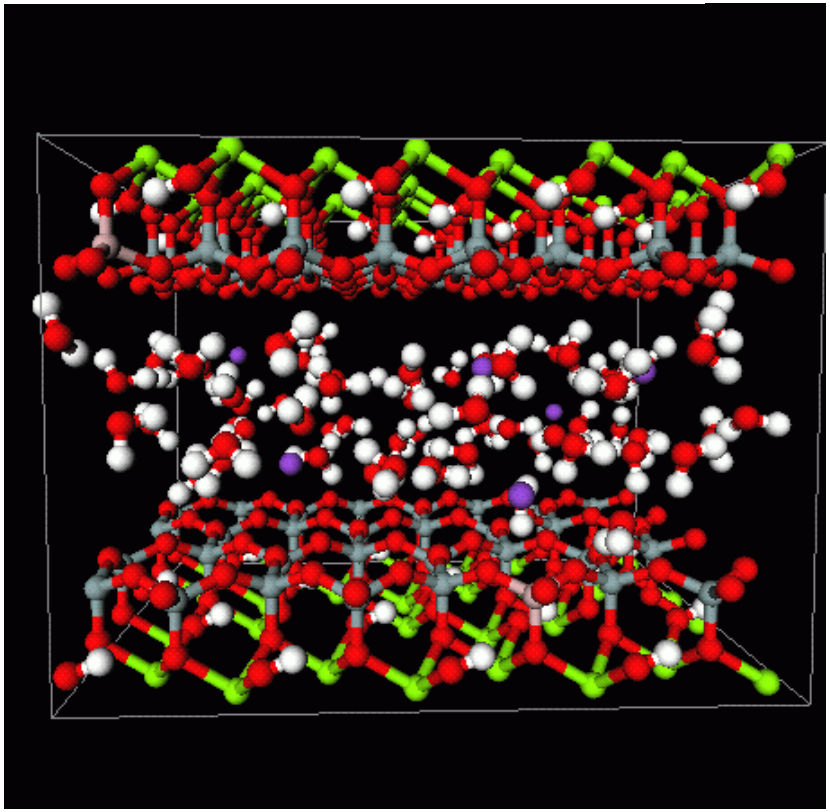


Clay Chemistry - Montmorillonite

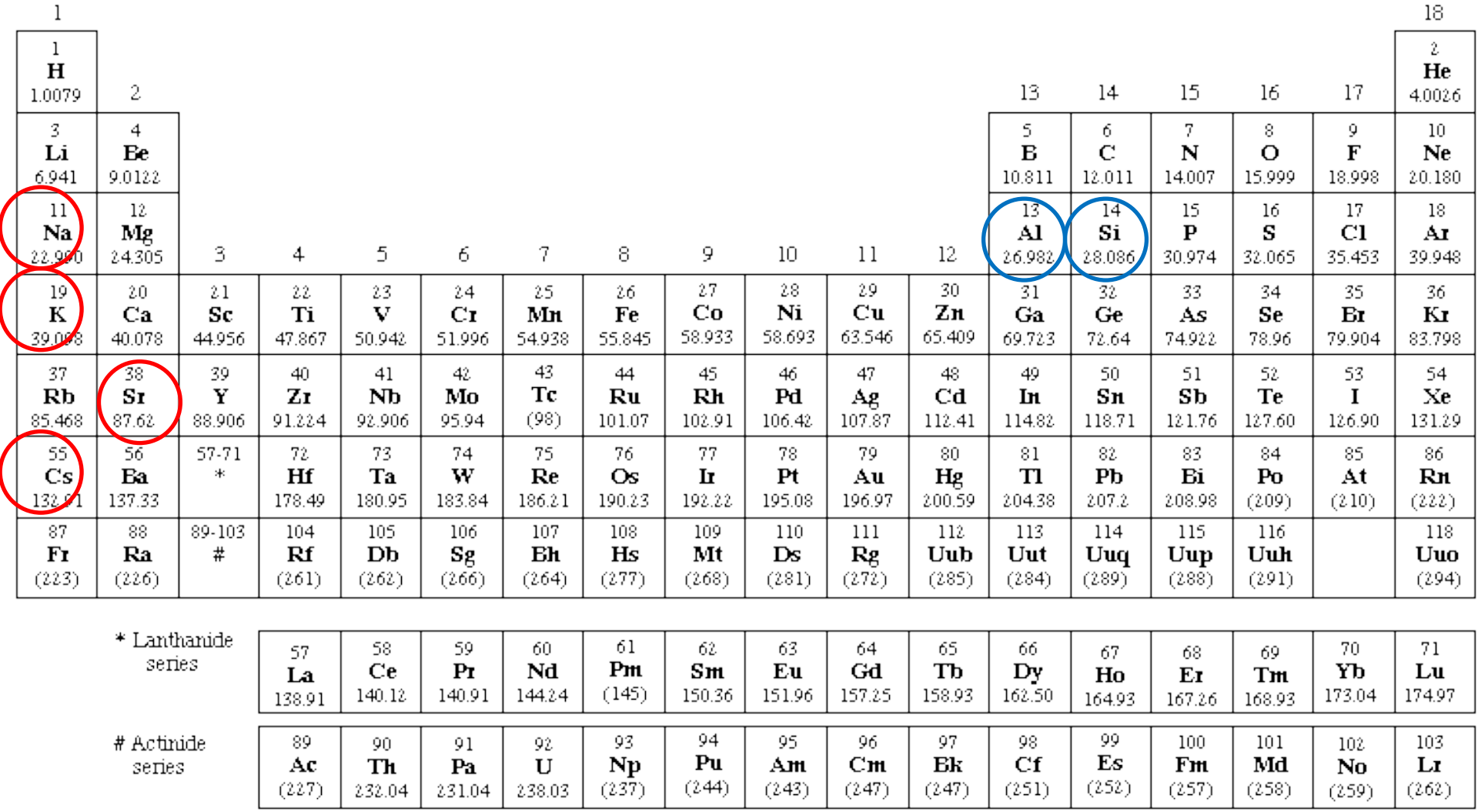






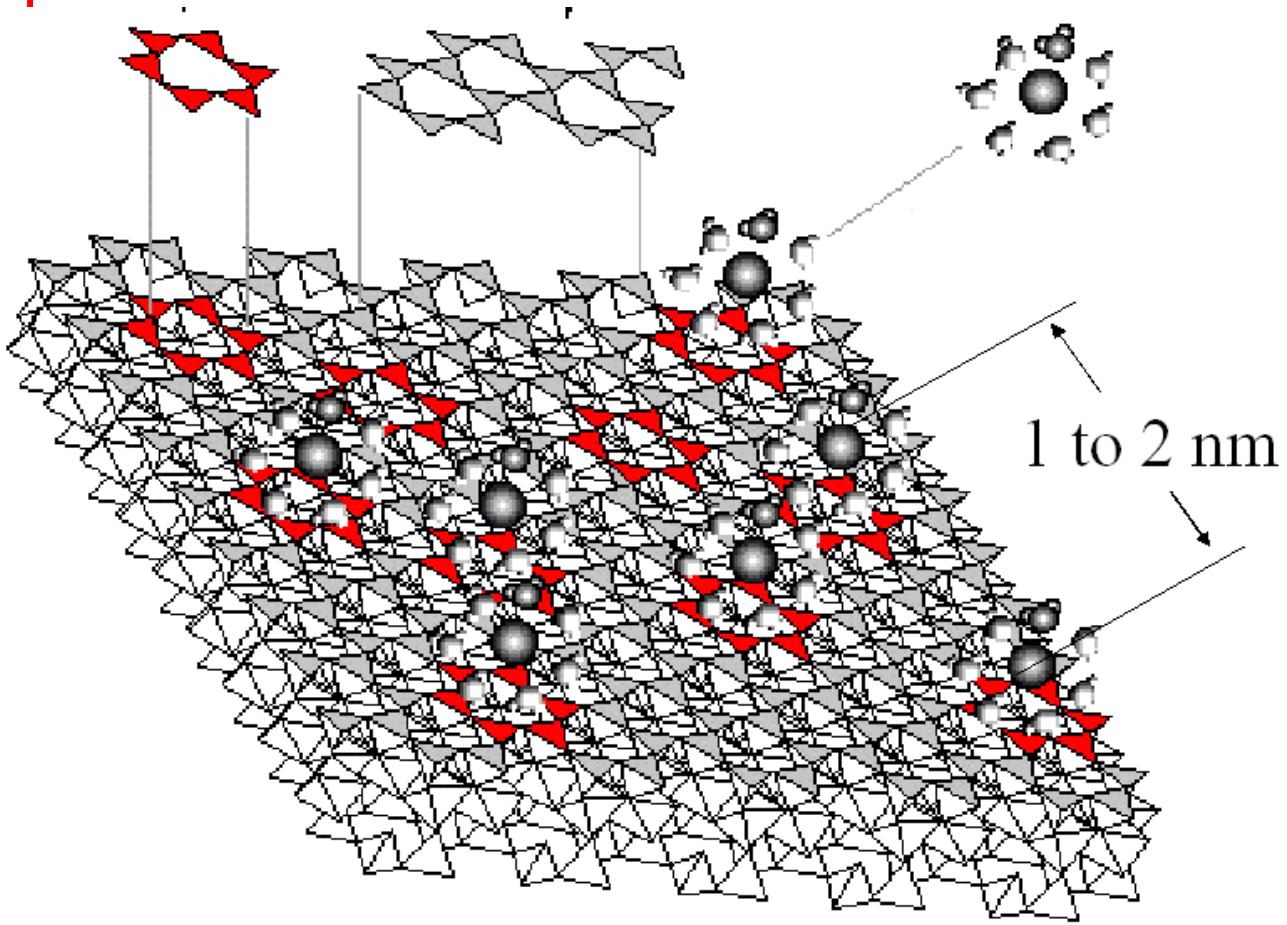


Exchangeable cations



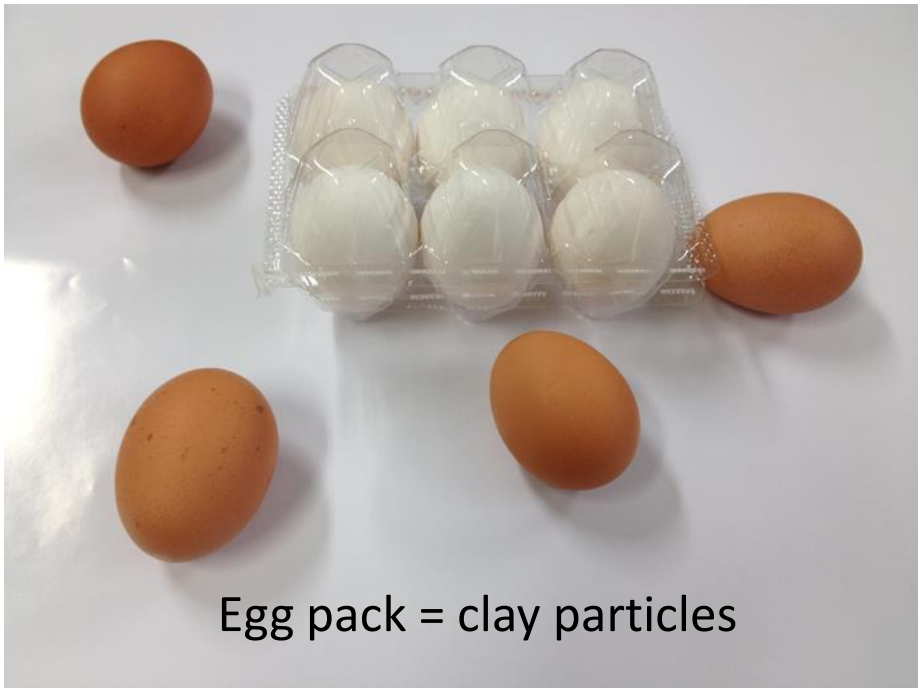
Radioactive cesium falls into holes in the clay surface!

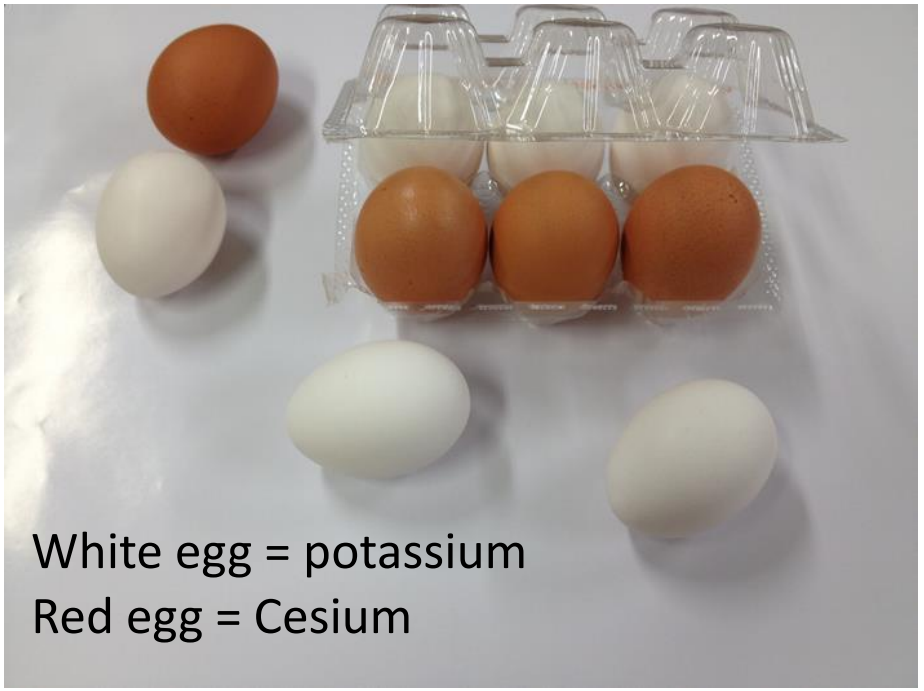
Hydrophilic Sites

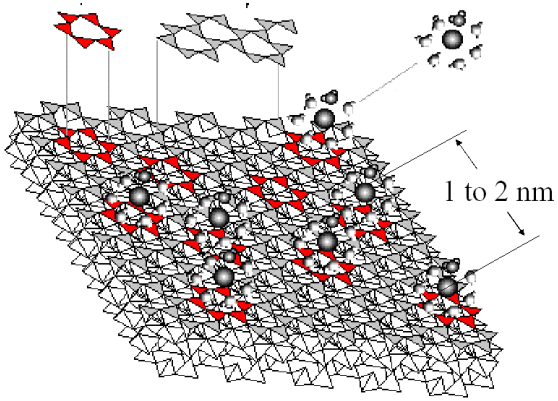


by Prof. C.T Johnston @Purdue Univ.

Radioactive cesium replaces potassium and is fixed in clay particles







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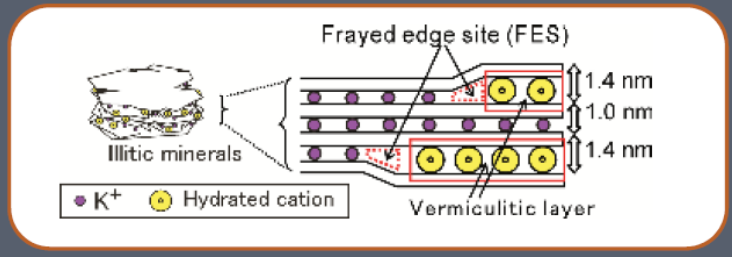
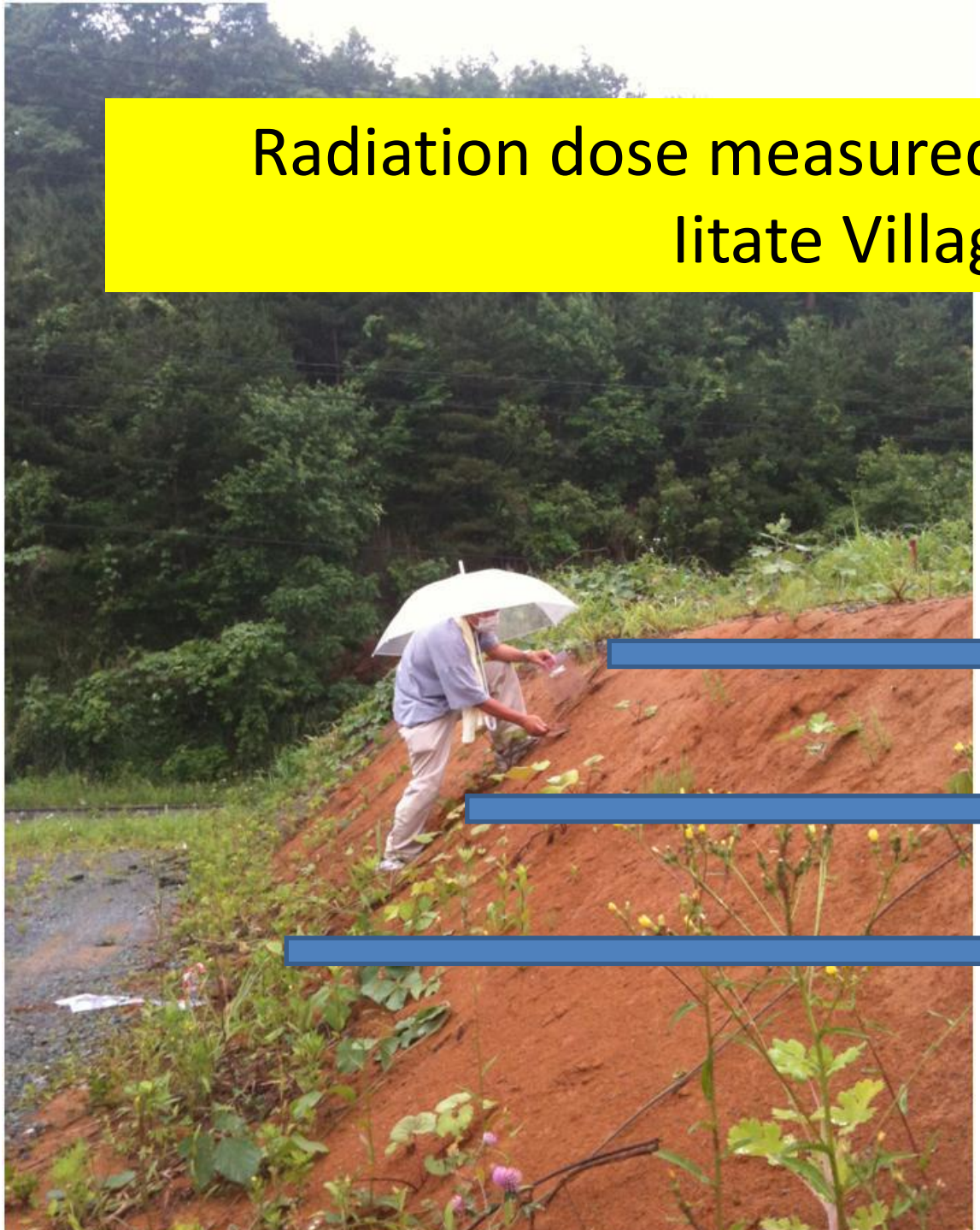


RIP(Radiocesium Interception Potential)
(Cremers et al., 1988 in Nature)

Radiation dose measured on a slope in Iitate Village (2011.6.25)



2.5 μSv/h

3.5 μSv/h

7.0 μSv/h

農林水産省

Official decontamination methods by Government

MAFF

Ministry of Agriculture, Forestry and Fisheries

From August, 2012

Stripping topsoil method

Soil puddling method

Deep plowing method

After the decontamination in litate

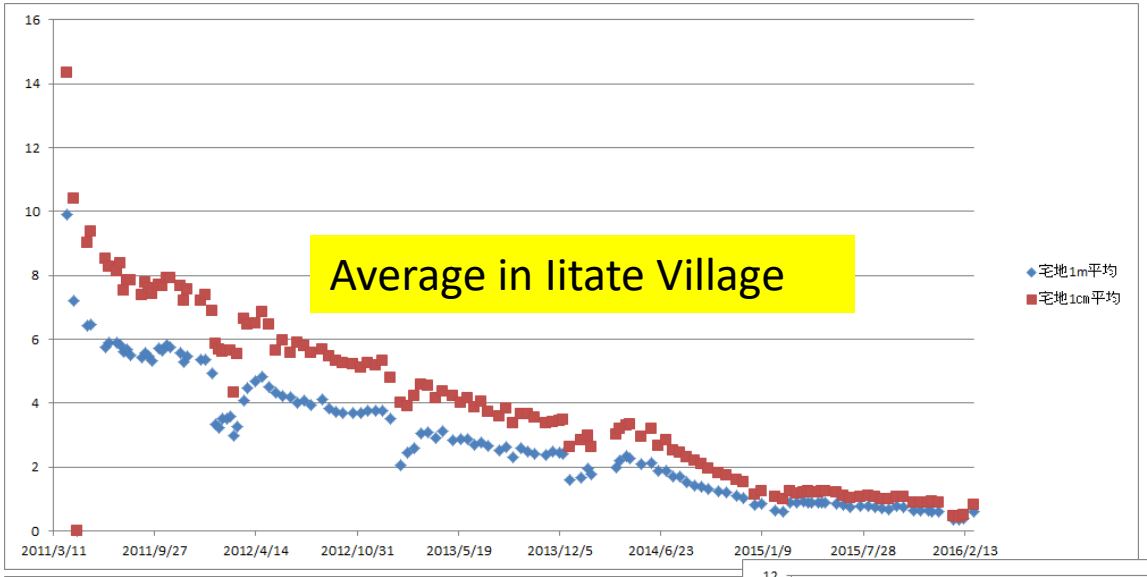
Decontamination work (2014.10)

“Temporal-temporal” storage space in a paddy

Soil dressing of farmland by sand (2015.3)

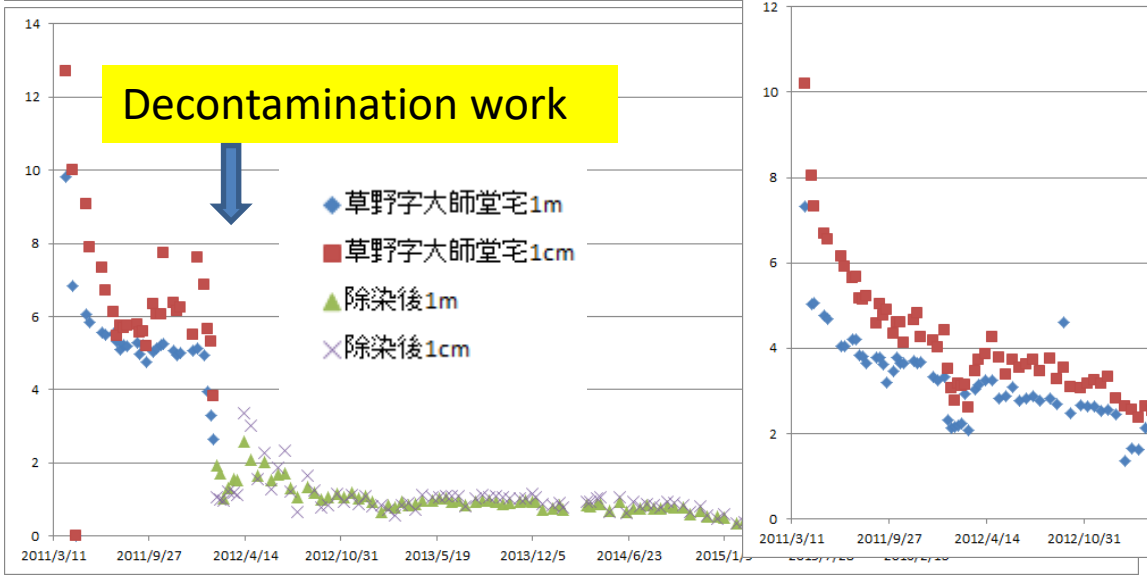
Click to movie

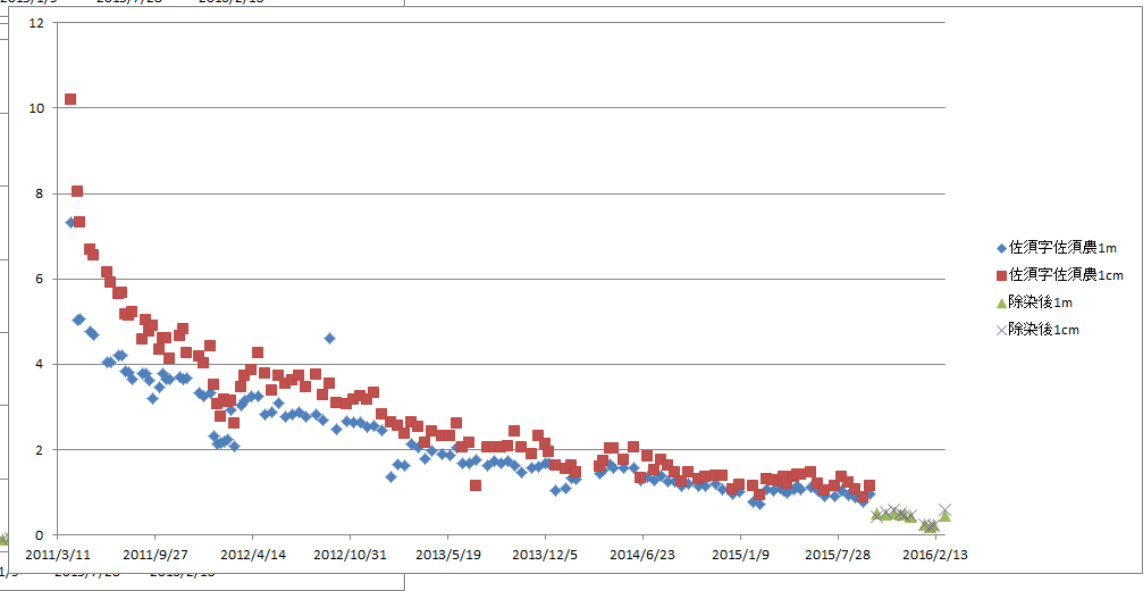
Change of Radiation dose in Iitate Village



Source:

http://www.fukushima-saisei.jp/mon/trendiitate/#00





Development of decontamination method farmers can do by themselves in paddy contaminated by radiocaesium in Fukushima

Prof. Masaru *Mizo*guchi
Dept. of Global Agricultural Science
Univ. of Tokyo

東京大学
THE UNIVERSITY OF TOKYO

Empathy & Collaboration

The Resurrection of Fukushima: Characteristics & Keywords

Goal: Recovery of the area
Collaboration
Independent Volunteers
Vitality from the varieties of participants
Knowledge, technics, work experience, network
Breadth of vision
Flexible handling
Detailed care

Power for Recovery
Experience, knowledge, Tradition, culture, wisdom

Villagers

Collaboration against Scattering

Empathy & Collaboration

Resurrection of Fukushima

ふくしま再生の会

Non-Profit Organization

Specialists
Science & Technology

Universities/ Research Institute

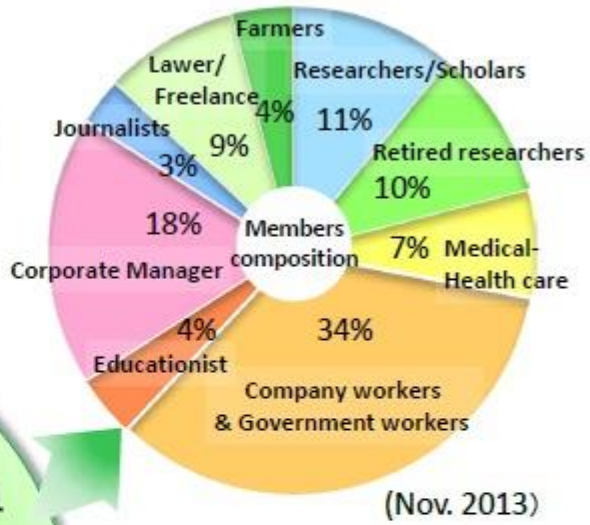
Interdisciplinary Collaboration

Public Service

National Prefectural Local

Overcome Sectionalism & Bureaucratism

Members



(Nov. 2013)

•Message from the leader of "Resurrection of Fukushima"

Practices utilizing the properties of cesium and clay (2012)

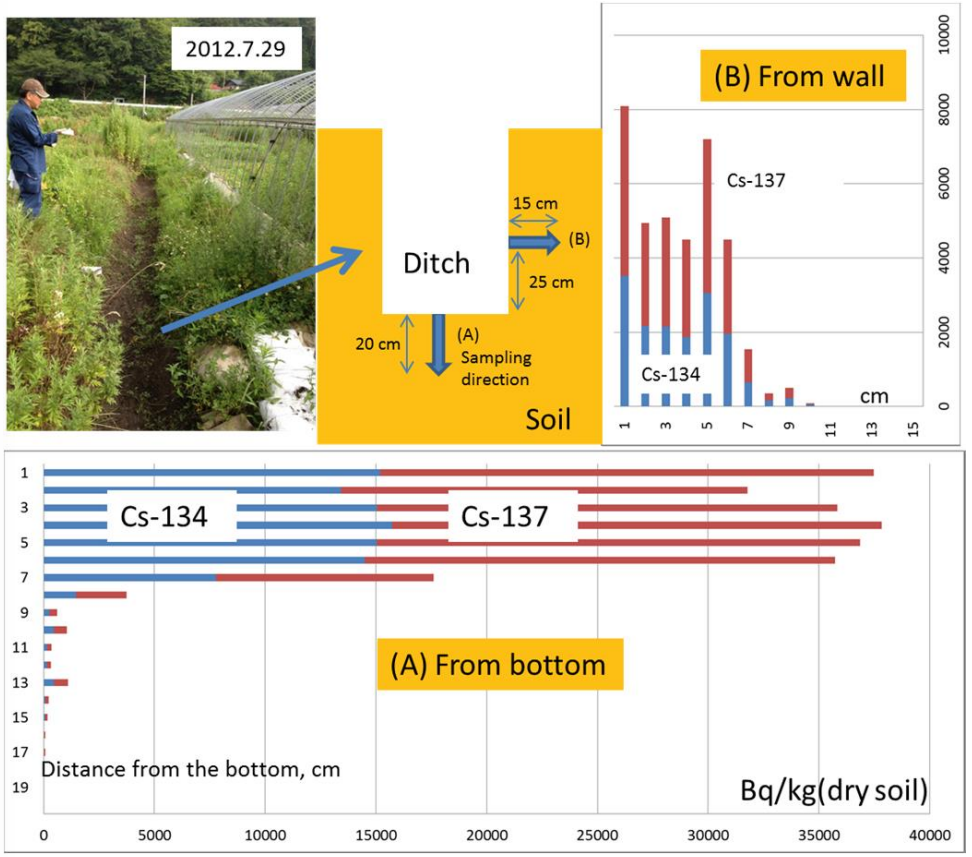
decontamination method by stripping frozen soil
（2012.1.8）

Rotary weeder method
(2012.4.1)

Made-method-2 (Komiya method)
Soil puddling + Deep plowing method (2013)

（2013.5.18）

Pour contaminated muddy water into the drain



A result of the radioactivity measured at each depth by sampling the soil of the bottom and sides of the groove after a dried-up

Cesium is not expected to immersion in the soil!

Why all right? – Soil Filtration function!

Fresh water comes out when muddy water is poured in the sand. When this operation is repeated, fresh water becomes slow to comes out. Clay particles with radioactive cesium are also trapped in the sand by this principle.

Made-method-1 (Sasu method)
Stripping topsoil + Deep plowing method

Burial of contaminated soil

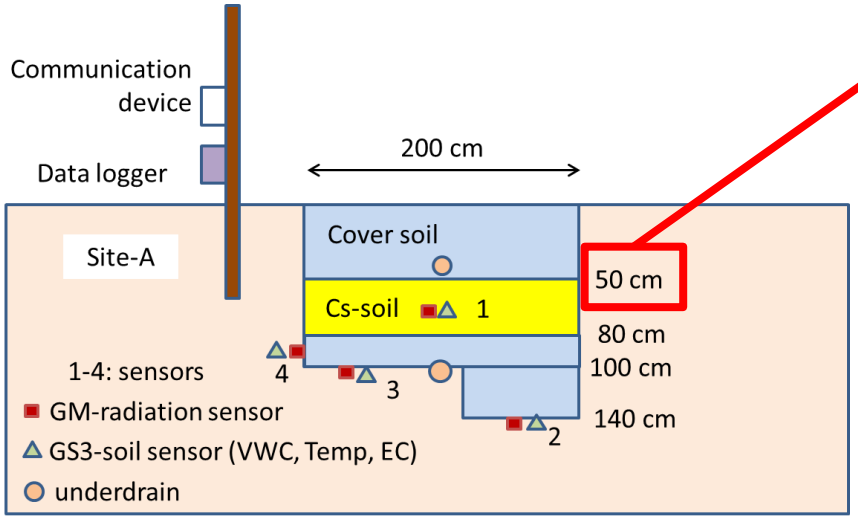
Compaction of soil

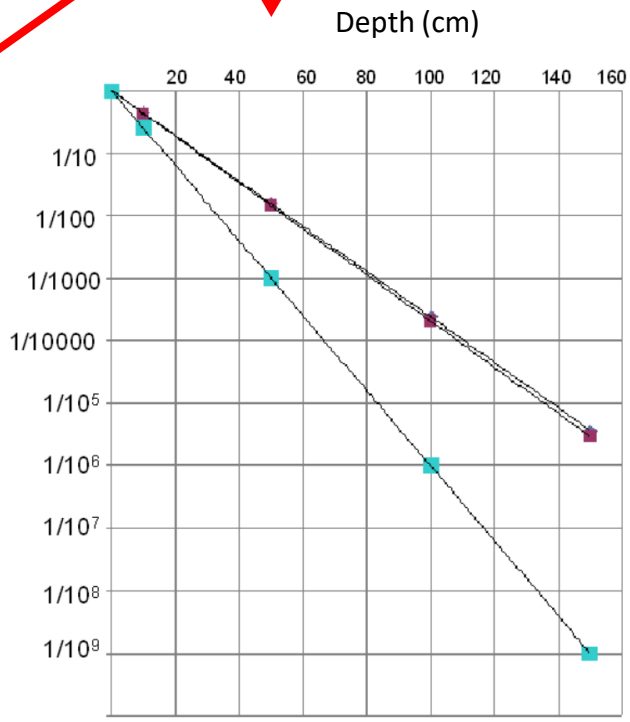
2012.12.1

Contaminated soil should be buried in the bare hole!

Because

1. Cs is fixed to clay minerals such as weathered mica in soil
2. Radiation dose is 1/100 to 1/1000 just bury 50cm deep!





Question?

Does NOT Cs leak out from the buried contaminated soil?

Measurement of soil radiation

- Instrument “Choshaku-kun”
- Easy to measure soil radiation in a well
- 1 m long, 3 cm in diameter
- with 10 pieces of GM tube arranged at 10cm intervals
- 3-5 min to measure

MISAO Network

有限会社ミサオネットワーク

Buried work

2014/5/18

2015/11/15

Measurement

15/3/21

16/3/20

16/11/6

17/3/12

17/12/9

18/3/11

19/3/10

20/3/11

21/3/26

22/3/13

23/4/1

24/3/24

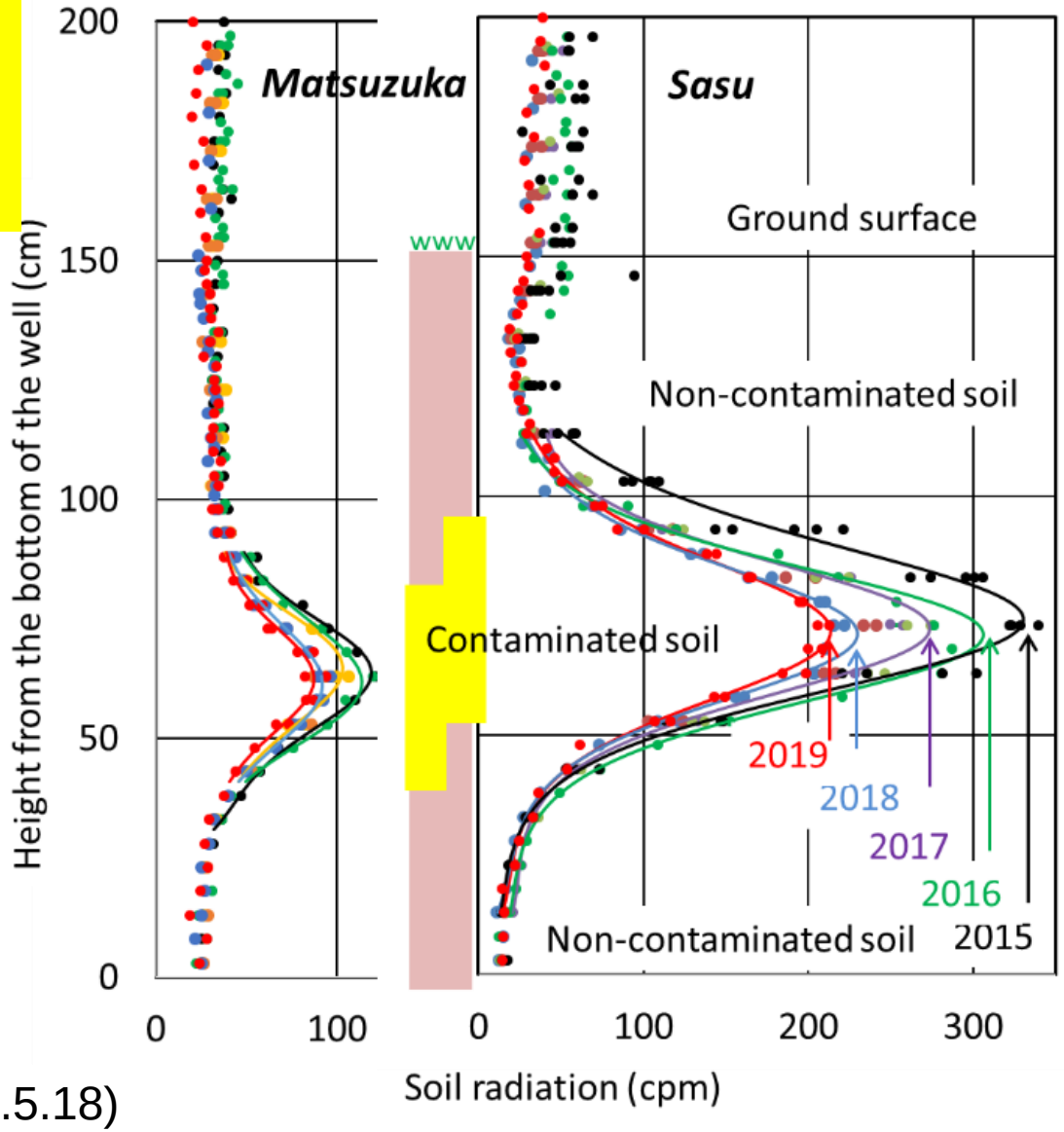
溝口勝 @msrmz · 2017年3月12日

返信先: @msrmzさん

松塚の猛史さんの田んぼで測定。**長尺**くんを固定する新兵器の三脚を作って投入。

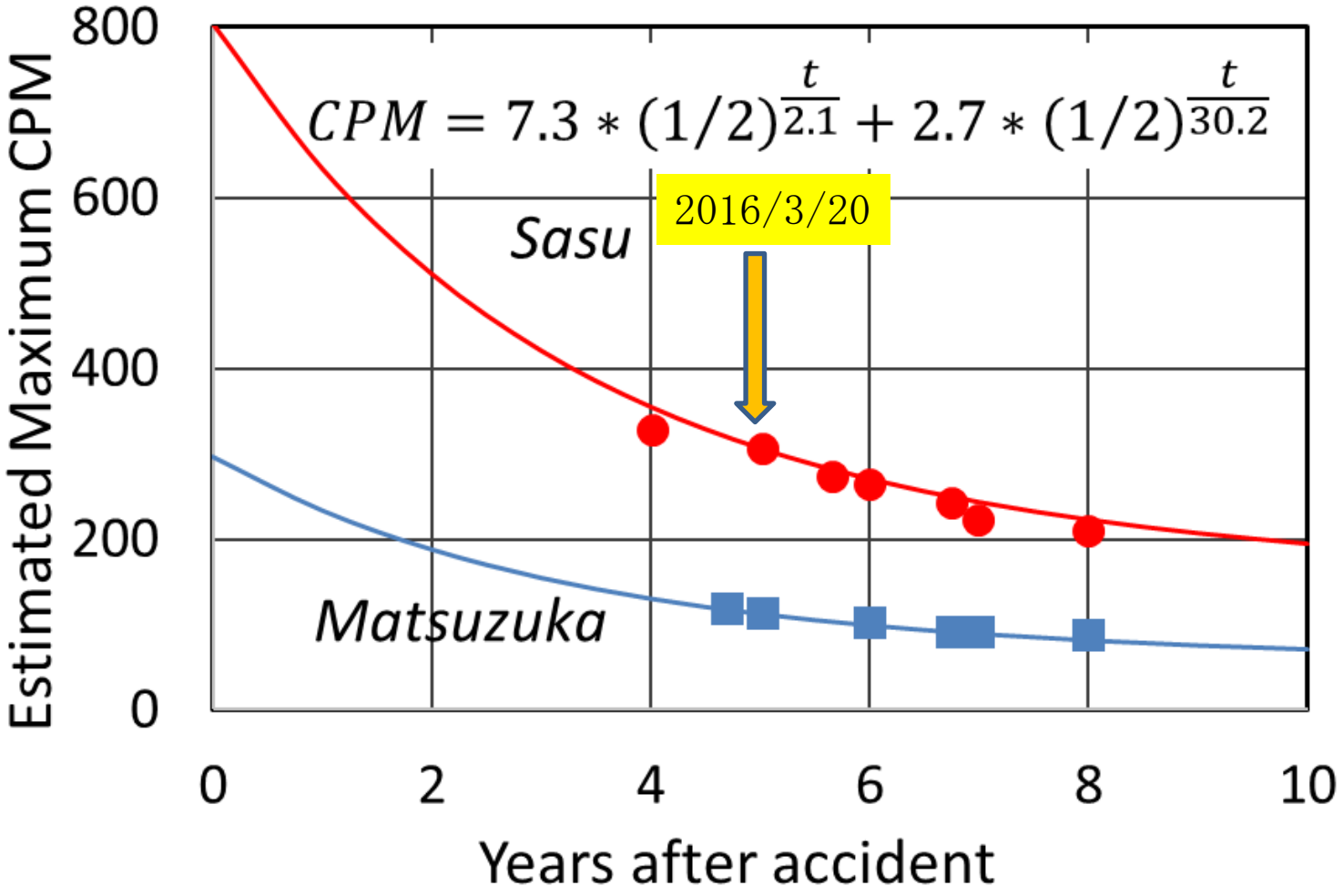
Profiles of soil radiation level

Burial of contaminated soil(2014.5.18)



- The peak depth of soil radiation has not changed
- The maximum of soil radiation levels are decaying naturally

Estimation of soil radiation with theory



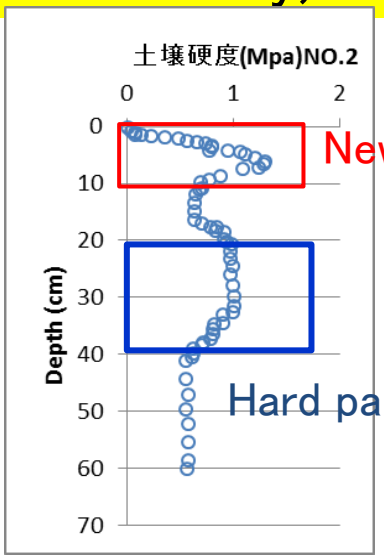
- The maximum of soil radiation is decaying, in line with theory.

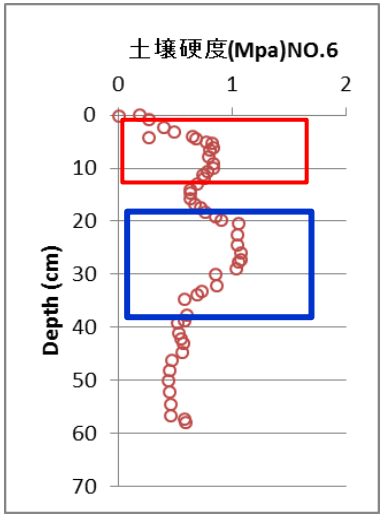
Revitalizing Agriculture in Fukushima

Rice cultivation trial by NPO since 2012

Restoration of degraded agricultural soils

(physical, chemical, and microbial activity)





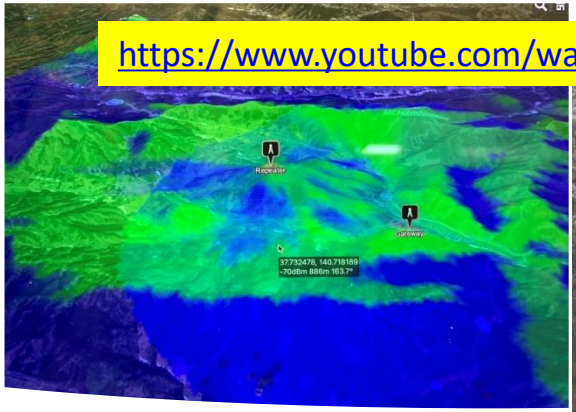
Restoration of farmland fertility and prevention of animal damage

- Compost Making Using IoT Sensors
  - Restoring soil fertility lost during decontamination work
    - A raccoon dog gnawing on a wire

      https://www.youtube.com/watch?v=egxkBRUlwuU

- Animal Monitoring Using ICT
  - Protect crops and fields from monkeys and wild boars

https://www.youtube.com/watch?v=uv9StLAzcNM



Coexistence with Nature

Monitoring of bird and animal damage

音に驚いて逃げるイノシシ（動画）

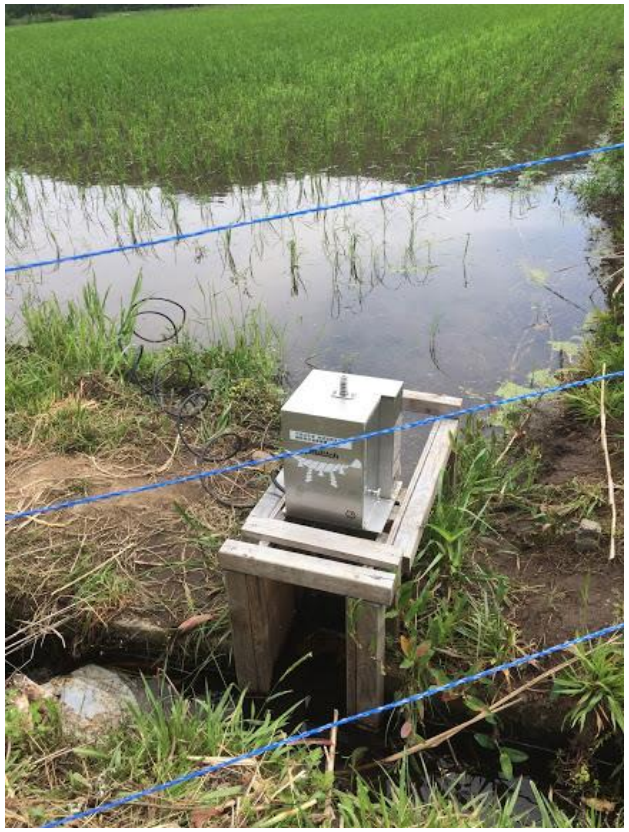
Wild boar flees when startled by sound

雪上の自分の足跡上を戻るサル（動画）

Monkey returning on his own footprints on snow

ICT Agriculture practice in Fukushima

Irrigation-water control in paddy field in Iitate Village, (2018)



1. Set Paditch

2. Add camera

3. Control gate

Conquer the world with Iitate sake

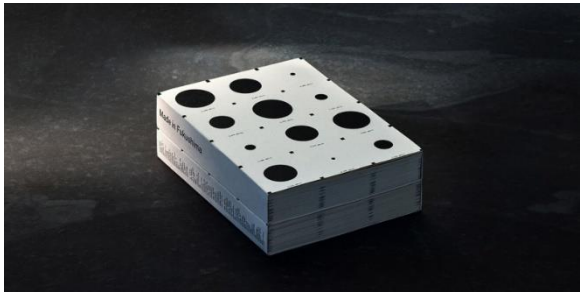
虎捕山の麓から　飯舘再生のために
スマート農業のテクノロジーで育てた酒米から純米酒が誕生しました

Sake without heat

Sake with heat

フィールド WiFi カメラによる酒米水田の監視

Cannes



https://www.madeinfukushima.com/

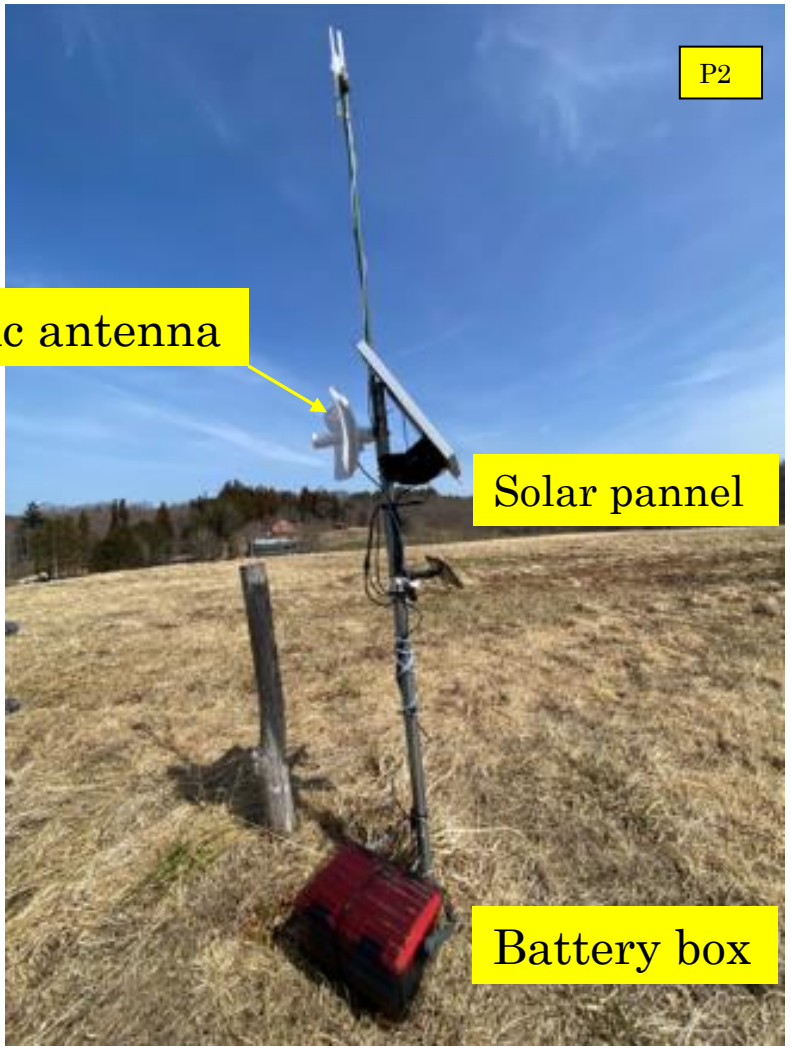
2019/6/19

You can buy it at Takasakiya in front of the Faculty of Agriculture, UTokyo!

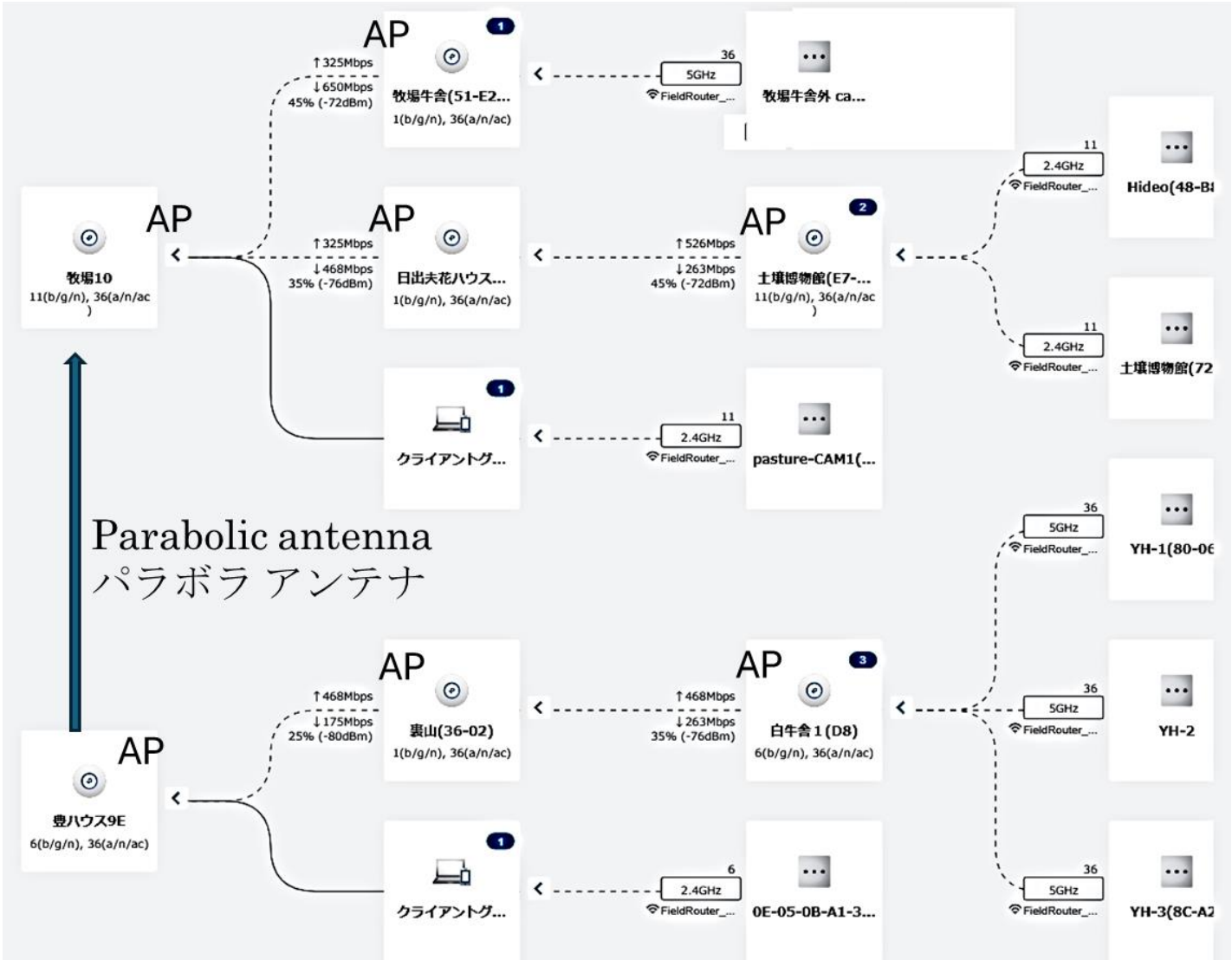
New challenge
in liitate Village

Layout of the two internet communication networks from home

Long distance communication using parabolic WiFi antennas



Topology of the long-range WiFi mesh network farm



Results and Discussion

(1) Confirmation of communication by WiFi camera

The WiFi mesh-net farm can be observed with an outdoor WiFi camera (e.g., Reolink Argus ECO/PT, which can be purchased for 10,000 to 20,000 yen including solar panels, Reolink) installed at the site.

- All of these images can be viewed in real time. If you put a micro-SD in the camera, it also records 8 seconds of video as standard. The camera also has an infrared (PIR) detection function, so by adjusting the sensitivity appropriately, it is possible to capture the appearance of wild boars and monkeys in addition to cows, as we reported at last year's Reconstruction Agriculture Society[3)]

Fig.4 Cows sunbathing outdoors

Fig.5 Cows eating food in A2 barn

Rural regeneration and youth education

Iitate Village field tours by soil scientists

Japanese Society of Soil Physics
27 Oct. 2013

The 5th International Workshop of CAAM
6-8 March 2016

Fukushima Reconstruction Knowledge Study Tour

(1) 2022.8.17-19　(2) 2022.11.19-21

FDN Power Plant(11.19)

Agricultural Experience(11.20)

Cattle barn tour(11.20)

Mayor Dialogue (8.19)

Farmers' Dialogue (11.20)

Beef bowl tasting (11.20)

Todai Mura Juku (Soba cultivation @ Hiso, 2019)

US student tour (24.5.22)

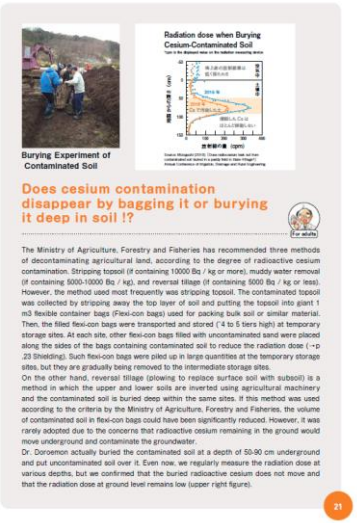
Agricultural soil education for the general public

Soil Museum (2018.4.29)

Publication of
Dr. Doroemon
（Kindle版）

Tour for high school students
（2019.9.14-15）

Japanese English Chinease



English

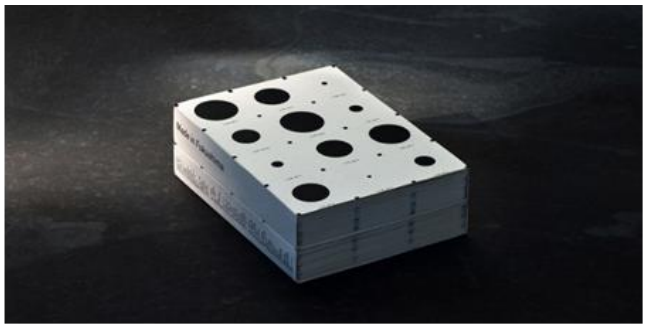
Tips for Resilience Agricultural Sciences
Keyword is FPBL

- Quotations of Prof. Tokitaka Yokoi (1860-1927)
  - Agricultural science flourished, but agriculture destroyed
  - Those who stand on the earth will not fall, those who live on the earth will not starve, those who protect the earth will not perish (the earth = soil)
  - Ask the rice about the rice, ask the farmers about the agriculture

- What should the Faculty of Agriculture do now?
  - Strengthen learning to discover and solve issues on site
  - FPBL (Field and Project-Based Learning) is important

CONCLUSION

- Agricultural science is the comprehensive science and technology.
  - However, it is now too diverse and fragmented!
- The new agricultural science is now trying to revive as a ***Resilience*** agricultural science like a phoenix from Fukushima, Japan.
- Let's go to the real field, and talk with the farmers!



https://www.madeinfukushima.com/

Read this book (Click)

Thank you for your attention

https://www.iai.ga.a.u-tokyo.ac.jp/mizo/hachi/hachi.html

https://momo-fukushima-date.jp/calender/

Hachi and peach are waiting for you in Iitate, Fukushima!