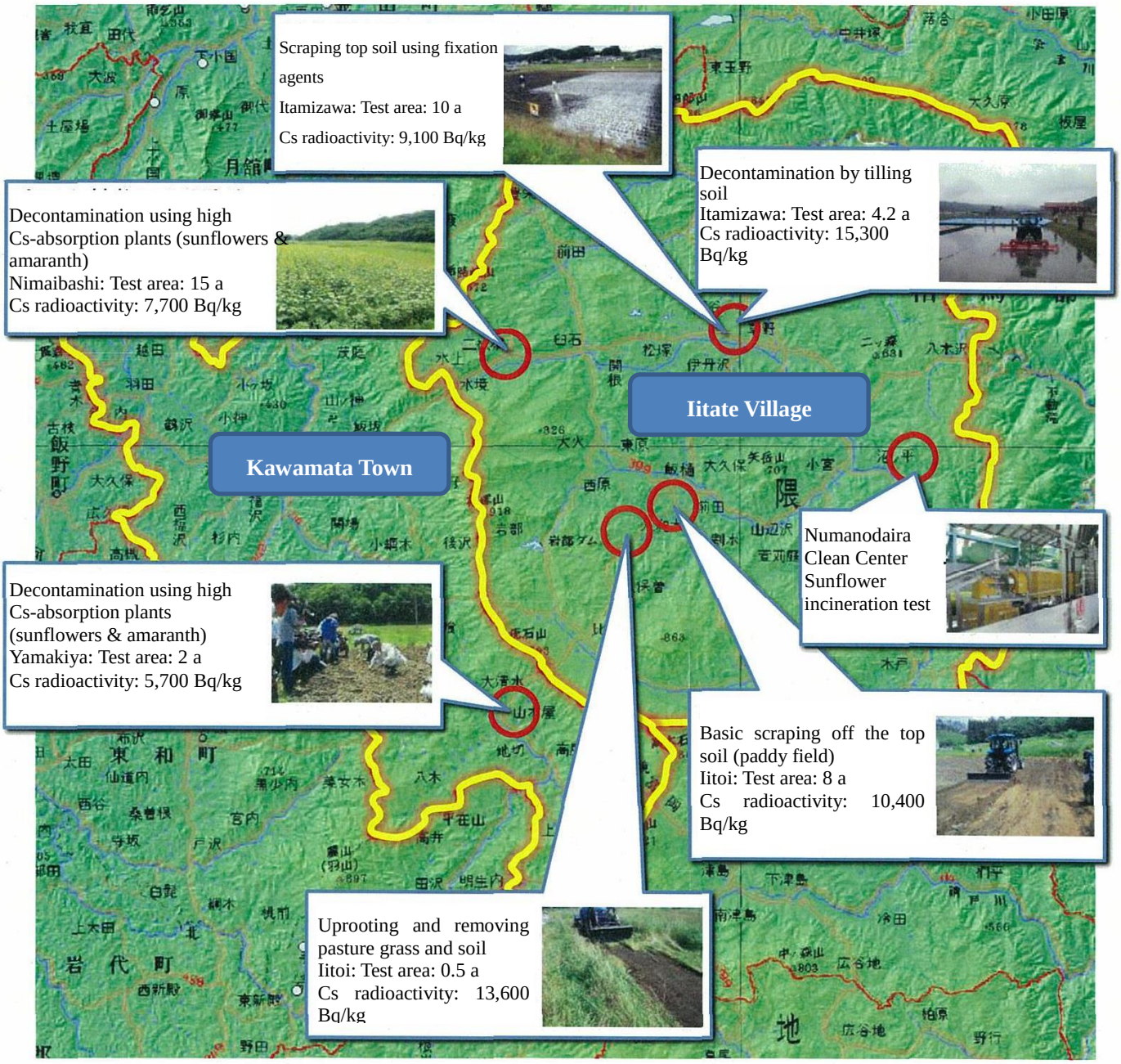
Annex 1 Approach for Residents Returning Home
- Development of Decontamination Technologies for Contaminated Agricultural Soil –
Overview of the Demonstration Tests



Cs radioactivity refers to the total concentrations of cesium-134 and -137 in the soil (Bq/kg, dry soil)

Demonstration tests in other areas

Turning and plowing
(inversion plowing; paddy field)
Motomiya City: Test area: 28 a
Cs radioactivity: 4,100 Bq/kg

Annex 2 Overview of the results of the demonstration tests for decontamination technologies

Technologies	Overview of the results obtained to date
Scraping of top soil	
1) Basic scraping Method of thinly scraping the top soil using farming equipment	● Radiocesium concentration in the soil was reduced from 10,370 Bq/kg to 2,599 Bq/kg (75 % reduction) by scraping off a soil layer of about 4 cm thickness. ● The ambient dose rate above the surface of the test field was reduced from 7.14 μSv/h to 3.39 μSv/h. ● The quantity of soil for disposal was about 40 m^3 (40 tons)/10 a. ● The time required to complete the scraping was about 55-70 min/10 a
2) Scraping using fixation agents Method of scraping the top soil after solidification using an agent	● In a demonstration test using a magnesium fixation agent, the top soil down to about 2 cm in depth was solidified in 7-10 days. ● Radiocesium concentration in the top soil was reduced from 9,090 Bq/kg to 1,671 Bq/kg (82% reduction) by scraping off a soil layer of 3 cm thickness. ● The ambient dose rate above the test field was reduced from 7.76 μSv/h to 3.57 μSv/h. ● The quantity of soil for disposal was about 30 m^3/10 a.
3) Uprooting and removing pasture grass and soil Method of scraping the top soil together with pasture grass using special equipment	● Radiocesium concentration in the top soil was reduced from 13,600 Bq/kg to 327 Bq/kg (82% reduction) by scraping off a soil layer 3 cm thick. ● The quantity of soil for disposal including grass was about 40 m^3/10 a. ● The time required to complete the scraping was about 250 min/10 a
Tilling and removing soil with water	
Method of separating soil from flooded fields after tilling	● The reduction rate of radiocesium concentration depends on the type of soil. In the preliminary test, the rate was estimated to be about 30-70%. ● In the demonstration test at Iitate Village, the concentration was reduced from 15,254 Bq/kg to 9,689 Bq/kg (36% reduction). ● The ambient dose rate above the test field was reduced from 7.55 μSv/h to 6.48 μSv/h. ● The quantity of soil for disposal was about 1.2-1.5 tons/10 a. ● The radiocesium concentration in the separated water was below the detection limit.
Turning and plowing	
Method of burying radioactive materials deep into the soil by turning the soil upside down to a depth of more than 30 cm.	● The radioactive materials localized on the top soil were dispersed into the soil to depths of 0-30 cm - with most of the materials dispersed at about 20 cm in depth - by turning and plowing to a depth of 30 cm. ● The ambient dose rate above the test field was: 0.66 μSv/h for non-plowed field, 0.40 μSv/h for plowing by the normal rotary method, and 0.30 μSv/h for turning and plowing. ● Work hours – 30 min/10 a ● Turning and plowing to the depth of 45 cm: The top soil was moved to the depth of 25-40 cm from the surface. ● Turning and plowing to the depth of 60 cm: The top soil was moved to the depth of 40-60 cm from the surface. Conventional farm tractors cannot be used for this. *Determination of the soil characteristics and evaluation of the groundwater level are required prior to plowing the soil.
Decontamination using high Cs-absorption plants	
Method to remove radioactivity in soil by growing plants with high Cs absorption capability	● The absorption rate of radiocesium in early-harvest sunflowers was 52 Bq/ kg-weight of the plant above ground. ● The absorbed amount per unit area was about 1/2000 of the amount in the soil at the time of seeding. The effect was minimal. ● Presently, this method cannot be applied because there are no plants with sufficiently high Cs absorption capability.

Annex 3 Strategy to select decontamination technologies for application to agricultural soil

The immediate goal is to reduce the radioactivity concentration of the agricultural soil to the contamination level of less than 5,000 Bq/kg (the areas of concern are 6,300 ha for paddy fields and 2,000 ha for agricultural fields)

● Methods generating soil for disposal, ○ Methods without generation of soil for disposal

<table>
<tr><td>Radiocesium concentration in the soil</td><td colspan="2">Agricultural fields</td><td colspan="2">Paddy fields</td></tr>
<tr><td>< 5,000 Bq/kg</td><td colspan="4">Apply turning and plowing (○) or technologies to grow plants that transfer less radioactivity (○) as required, in order to reduce the transfer of radionuclides to crops or to get the ambient dose rates as low as reasonably achievable.</td></tr>
<tr><td rowspan="2">≥ 5,000 Bq/kg
<10,000 Bq/kg</td><td colspan="2">Groundwater level</td><td colspan="2">Soil characteristics/groundwater level</td></tr>
<tr><td>Low (specific values to be discussed)
●Scraping the top soil
○ Turning and plowing</td><td>High (specific values to be discussed)
●Scraping off the top soil</td><td>Lowland soil
●Scraping off the top soil
●Tilling and removing soil using water
○ Turning and plowing (inversion plowing; the hardpan may be destroyed)</td><td>Upland soil
●Scraping off the top soil
●Tilling and removing soil using water (Effect is small compared with that for lowland soil)
○ Turning and plowing (inversion plowing; the hardpan may be destroyed)
(applicable only when the groundwater level is low)</td></tr>
<tr><td>≥ 10,000 Bq/kg
< 25,000 Bq/kg</td><td colspan="2">●Scraping off the top soil</td><td colspan="2">●Scraping off the top soil</td></tr>
<tr><td>≥ 25,000 Bq/kg</td><td colspan="2">●Scraping off the top soil
Scraping off a soil layer of more than 5 cm thickness
Need to discuss technologies that can be applied under high radiation exposure dose (e.g. using fixation agents to avoid dispersal of soil dust)</td><td colspan="2">●Scraping off the top soil
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</table>

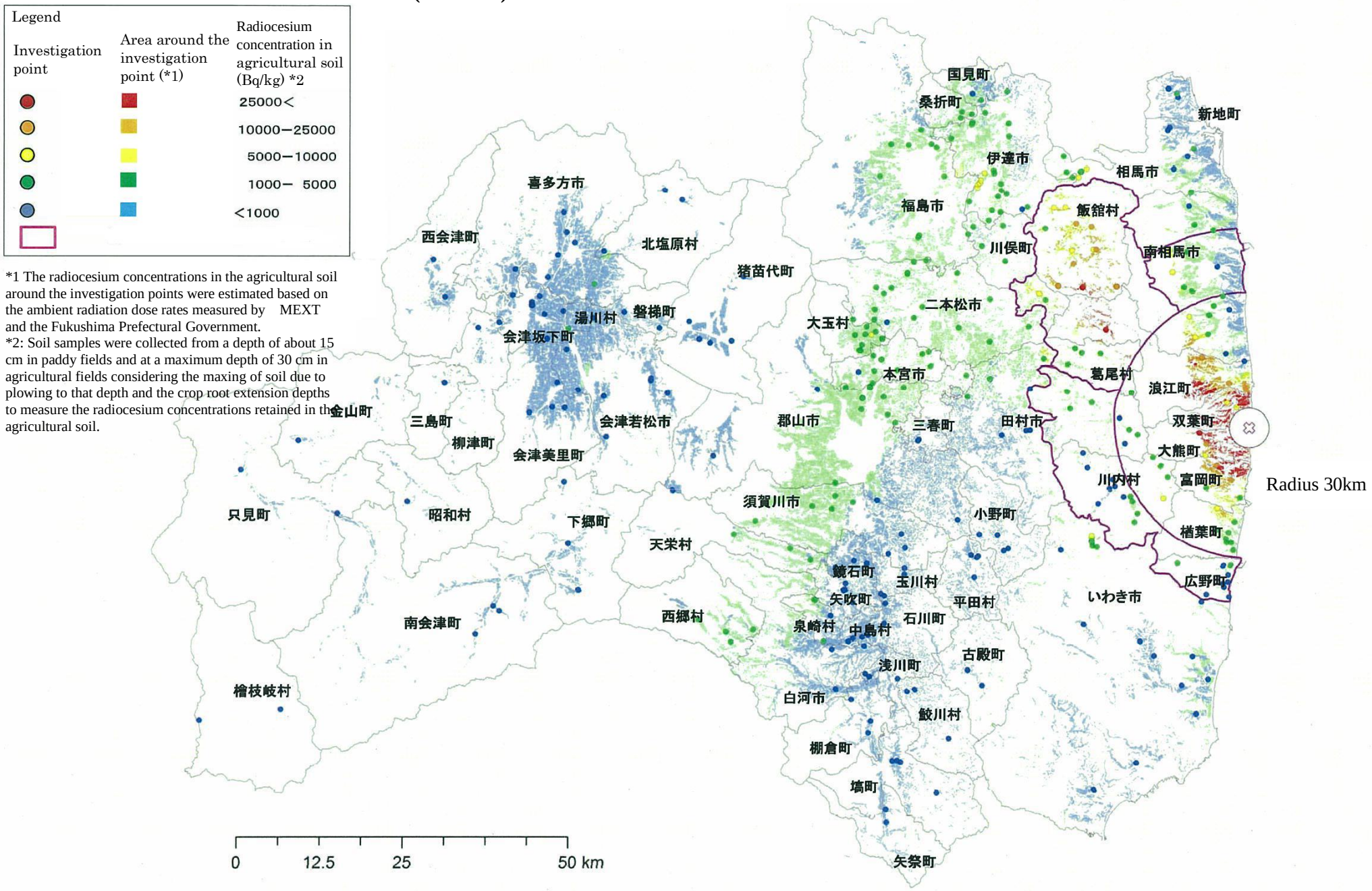
Management of soil, etc. for disposal

Soil for disposal	The demonstration test proved that a concrete container with radiation shielding capability and portability was effective for temporary storage of soil for disposal. Development of **technologies** to separate and remove radiocesium from the soil for disposal will be continued.
Vegetation residues	Investigation of radiocesium behavior during incineration will be continued due to the need to reduce the volume of vegetation residues. It was proved that a concrete container was effective for temporary storage of highly contaminated vegetation residues.

Note1) How to manage the weeds must be considered prior to implementing actual decontamination works. When root mats of pastures have already been established, the work should start by uprooting the pasture grass.

Note 2) According to the "Guidelines for Municipal Decontamination Work" issued by the Nuclear Emergency Response Headquarters on 26 August, the soil for disposal should be temporarily stored underground with water shielding and cover soil should be applied.

The distribution map of radioactive material concentrations in agricultural soil in Fukushima Prefecture
(Reference)



*1 The radiocesium concentrations in the agricultural soil around the investigation points were estimated based on the ambient radiation dose rates measured by MEXT and the Fukushima Prefectural Government.
*2: Soil samples were collected from a depth of about 15 cm in paddy fields and at a maximum depth of 30 cm in agricultural fields considering the maxing of soil due to plowing to that depth and the crop root extension depths to measure the radiocesium concentrations retained in the agricultural soil.

Radius 30km