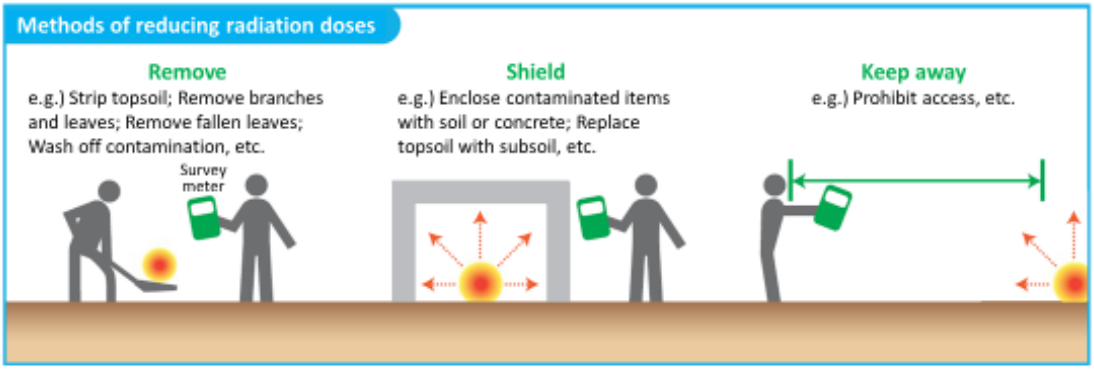
Decontamination

Reduction of Radiation Doses

Radioactive materials released into the air due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS fell onto the ground with rain, etc. and adhered to soil, vegetation, and buildings in people's living environment. Soil and vegetation, etc. thus contaminated are being removed through decontamination work. Removed soil and vegetation, etc. are shielded to prevent them from affecting the surroundings, thereby reducing radiation doses people receive from the environment.



Prepared based on the website, "Environmental Remediation," of the Ministry of the Environment

Radioactive materials released into the air due to the accident at TEPCO's Fukushima Daiichi NPS fell onto the ground with rain, etc. and adhered to buildings, soil, and vegetation, etc. across a wide area. Therefore, the national government has been striving to reduce additional exposure doses through decontamination such as removing those released radioactive materials.

There are three methods of reducing additional exposure doses to remove, to shield, and to keep away radioactive materials. Combination of these methods can reduce additional exposure doses efficiently.

The first is to remove radioactive materials adhering to soil, vegetation or buildings, etc. from people's living environment by such means as stripping topsoil, removing tree leaves, branches and fallen leaves, and washing and cleaning the surface of buildings.

The second is to cover radioactive materials with soil, etc. thereby shielding radiation and reducing ambient doses and exposure doses accordingly.

The third is to take advantage of the characteristic of radiation that the radioactivity intensity reduces as the distance increases (in inverse proportion to the square of the distance from the relevant radioactive material) (p.50 of Vol. 1, "Characteristics of External Exposure Doses").

If radioactive materials are kept away from people, exposure doses can be reduced. Therefore, one option is to prohibit access to places where radioactive materials exist.

These methods are combined and employed to reduce people's additional exposure doses.

(Related to p.174 of Vol. 1, "Three Principles of Reduction of External Exposure")

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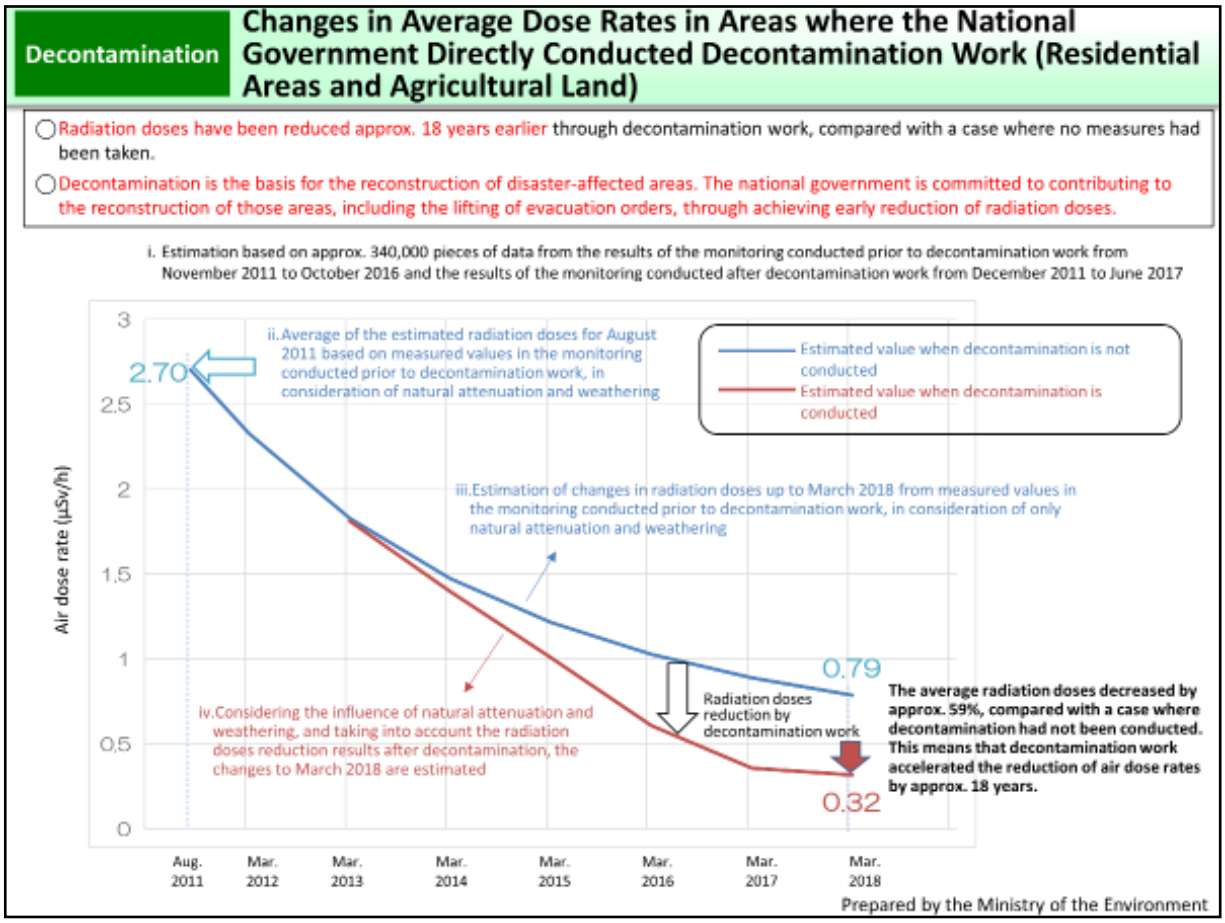

This figure shows decreases in doses of accident-derived radioactive materials as estimated based on approx. 340,000 pieces of data from the results of the monitoring conducted prior to decontamination work from November 2011 to October 2016 and the results of the monitoring conducted after decontamination work from December 2011 to June 2017.

The blue line in the graph shows air dose rates estimated based on the values of August 2011 only taking into account the influence of natural attenuation and weathering (natural factors such as wind and rain). The red line in the graph shows air dose rates estimated also taking into account the effects of decontamination. When comparing both of these air dose rates as of March 2018, it is known that the average air dose rates decreased by approx. 59% as a result of decontamination. This means that the reduction of air dose rates was accelerated by approx. 18 years through decontamination work.

In this manner, decontamination work has brought about an earlier reduction of radiation doses, while assisting the effects of natural attenuation of radioactive materials.

(Related to p.11 of Vol. 1, “Half-lives and Radioactive Decay”)

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This figure explains specific decontamination methods.

Even in areas where radiation doses are relatively low, fallen leaves and dirt containing radioactive materials are apt to accumulate under the leaves or in gutters of houses or in ditches on the street, causing higher ambient doses in the surrounding areas. At such locations, fallen leaves and dirt are removed and the relevant places are washed and cleaned.

There are areas where radioactive materials adhere to the shrubbery, underbrush or fallen leaves. Radioactive materials are removed through mowing of vegetation, pruning and removal of fallen leaves.

In areas where radiation doses are relatively high, other decontamination methods, in addition to those employed at areas with relatively low radiation doses, may need to be employed. For example, as radioactive materials mostly exist within a layer a few centimeters below the ground surface, effects of radioactive materials can be mostly diminished by stripping topsoil (for example, to a depth of 5 cm) or replacing topsoil with subsoil.

Areas where radioactive materials adhere to roofs and walls of buildings or on the paved road, relevant parts are washed and cleaned but such method may not be effective in cases where radioactive materials adhere firmly depending on the nature of their raw materials.

For farmland, proper methods need to be selected in consideration of the effects on agricultural products, as well as the effects on people due to exposure. In farmland plowed after the accident, radioactive materials exist little deeper from the ground surface. However, if all contaminated soil is removed, the farmland becomes unsuitable for farming. Therefore, at such farmland, various methods such as deep tillage (plowing soil as deep as 30 cm in principle) or inversion tillage (replacing topsoil with subsoil) (p.70 of Vol. 2, “Measures for Reducing Transfer of Radioactive Materials to Crops (1/5) - Decontamination of Farmland -”) are being employed.

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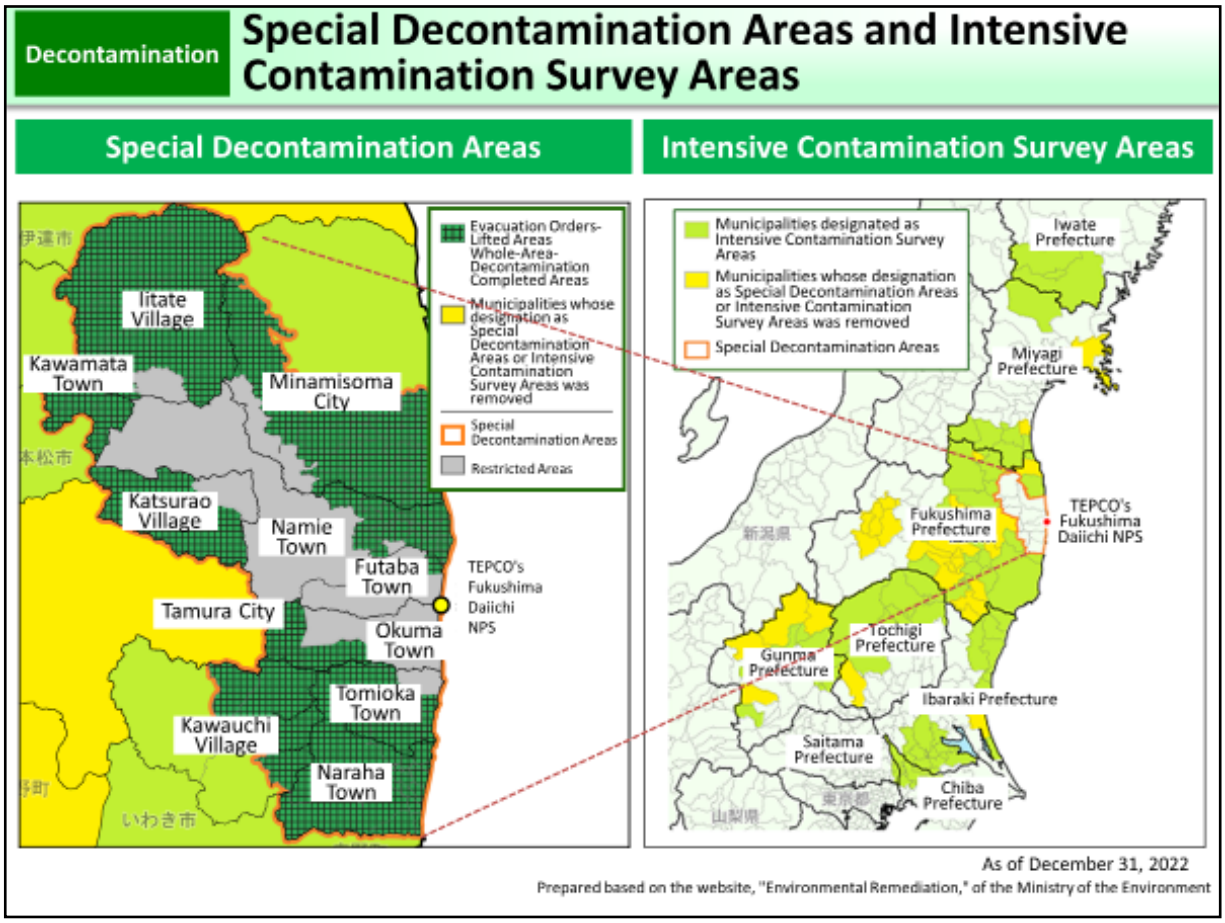

After the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS, the Diet enacted the Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District - Off the Pacific Ocean Earthquake that Occurred on March 11, 2011 (Act on Special Measures Concerning the Handling of Environment Pollution by Radioactive Materials) in August 2011.

Special Decontamination Areas and Intensive Contamination Survey Areas were designated as areas where decontamination is to be conducted under this Act on Special Measures.

Special Decontamination Areas are areas where the national government directly conducts decontamination work. 11 municipalities in Fukushima Prefecture which were once designated as a Restricted Area or a Deliberate Evacuation Area were designated as Special Decontamination Areas.

Intensive Contamination Survey Areas are areas where municipalities take the initiative in decontamination work, and a total of 104 municipalities in eight prefectures were designated as such. The national government has taken financial measures and technical measures to assist with decontamination work in these municipalities.

Whole area decontamination work was completed in all municipalities designated as Special Decontamination Areas by the end of March 2017. Thereafter, by the end of March 2018, whole area decontamination work was completed in all 100 municipalities in eight prefectures including Intensive Contamination Survey Areas, except for Restricted Areas.

In cases that there are any points where the effects of decontamination are not maintained after the completion of whole area decontamination work, causes are to be ascertained to the extent possible depending on the circumstances of individual points, and follow-up decontamination is to be conducted when it is found necessary by comprehensively taking into consideration the spread of the contamination and the effects and feasibility of decontamination work, in addition to additional exposure doses.

In Special Decontamination Areas, evacuation orders were all lifted by March 4, 2020, for all Habitation Restricted Areas and Preparation Areas for Lift of Evacuation Orders, and the designation as a Special Decontamination Area for Tamura City was removed in March 2022. Additionally, in Intensive Contamination Survey Areas, it was confirmed that radiation doses decreased to below 0.23 μSv/h in 30 municipalities by the end of December 2022, and the designation as Intensive Contamination Survey Areas was removed for these municipalities.

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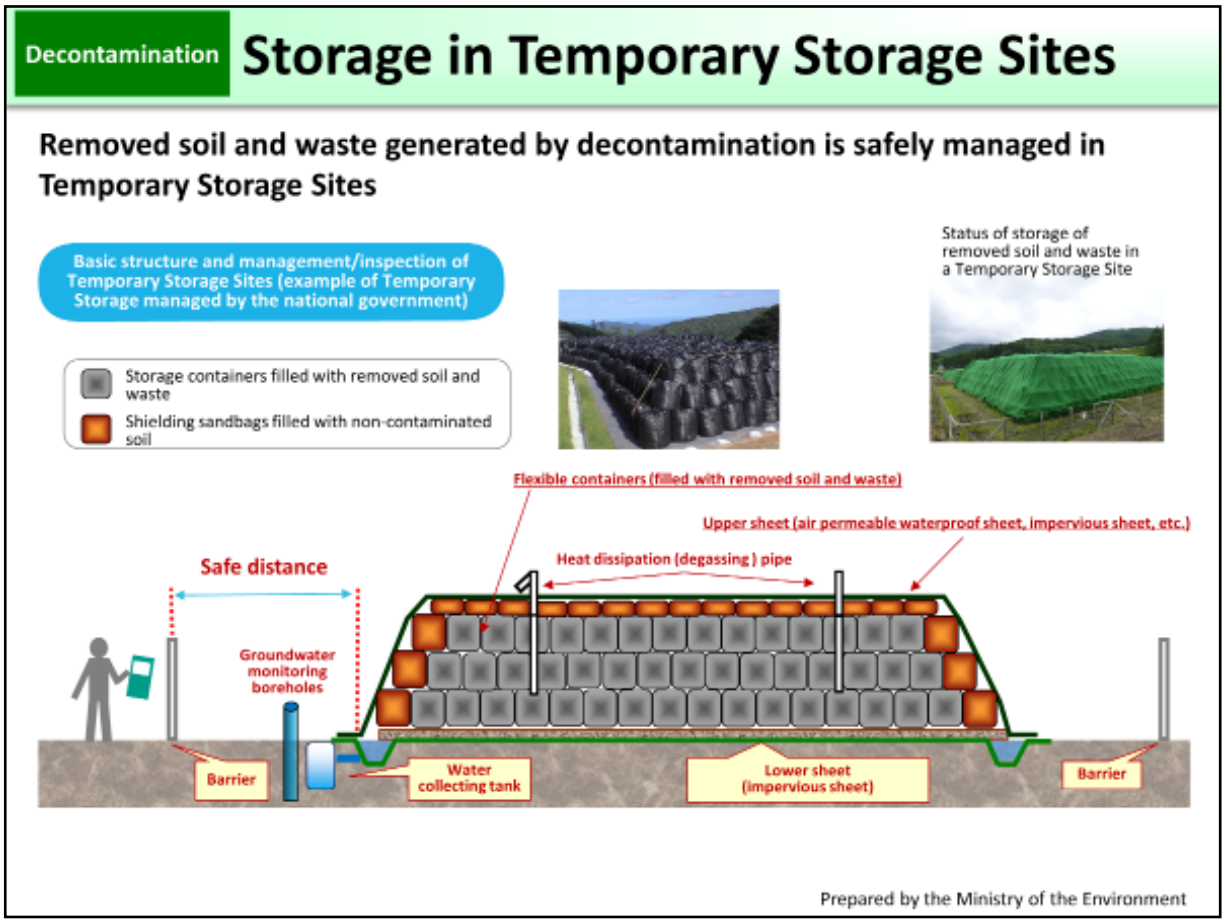

The soil and waste removed through decontamination work (removed soil and waste) are stored and managed temporarily on site or at Temporary Storage Sites.

Specifically, removed soil and waste are put in a container (flexible container, etc.) and placed on an impervious layer (impervious sheet, etc.), and is shielded sufficiently by such methods as placing sandbags filled with uncontaminated soil around the site to reduce ambient dose rates at the boundary to the same level as that in the surrounding areas.

Additionally, the site is covered with an impervious sheet, etc., thereby preventing scattering and leakage of removed soil and waste and further preventing infiltration of rainwater and resulting contamination of groundwater, etc.

Radiation doses at the site and radioactivity concentrations in groundwater are measured regularly.

Furthermore, from the perspective of keeping the site away from the public (securing distance), public access to the site is prohibited, and shortening of working hours and other measures are also considered from the perspective of reducing workers' exposure to radiation (p.174 of Vol. 1, "Three Principles of Reduction of External Exposure").

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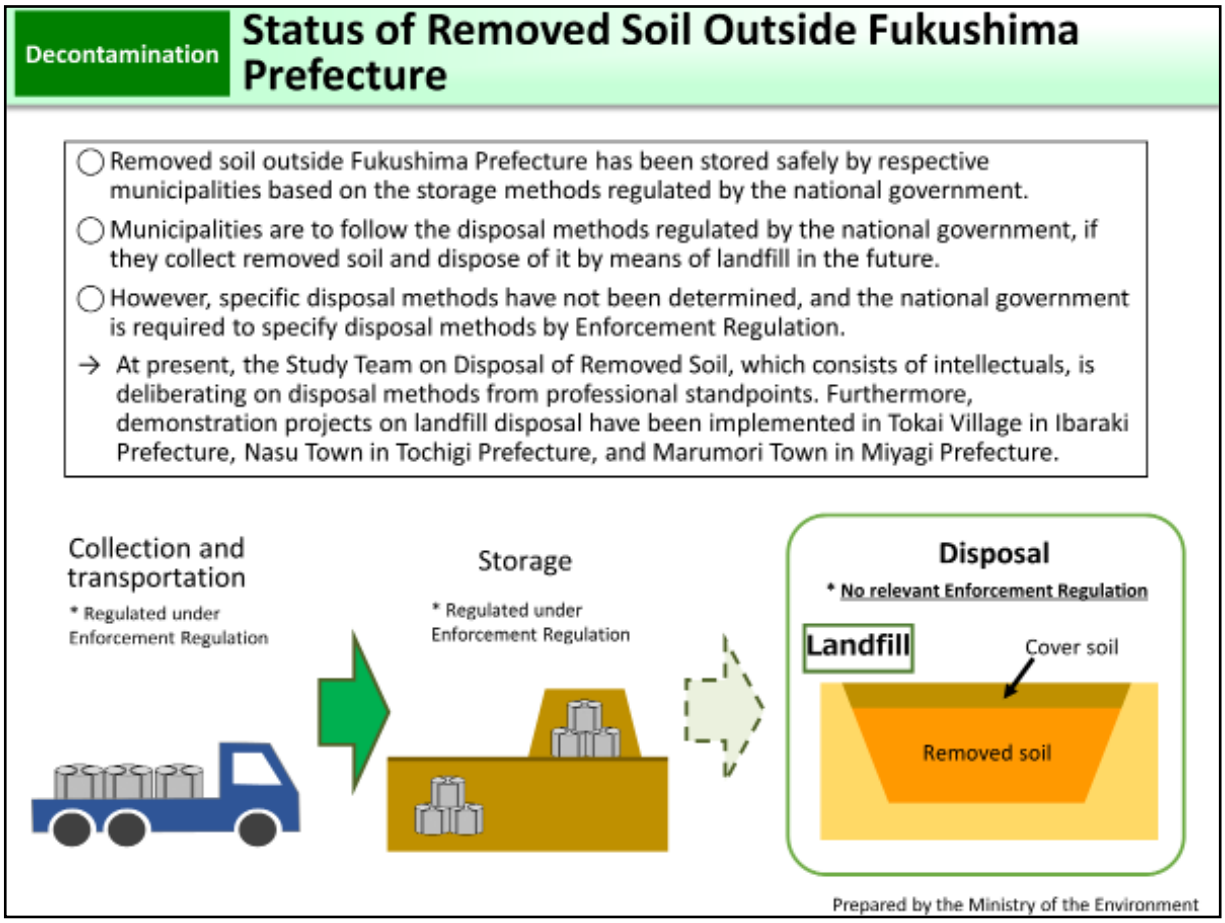

Removed soil outside Fukushima Prefecture has been stored safely by respective municipalities (decontamination entities) based on the storage methods regulated by the national government.

Municipalities are to follow the disposal methods regulated by the national government, in case of disposing of removed soil by means of landfill.

However, specific disposal methods have yet to be determined, and the national government is required to specify disposal methods by an Enforcement Regulation, etc.

Accordingly, the Ministry of the Environment (MOE) established the Study Team for Disposal of Removed Soil, which consists of intellectuals, in December 2016, and the Study Team has been continuing deliberations from professional standpoints. Furthermore, the MOE has been implementing demonstration projects on landfill disposal at three locations, Tokai Village in Ibaraki Prefecture, Nasu Town in Tochigi Prefecture (completed in March 2020), and Marumori Town in Miyagi Prefecture, with the aim of confirming influence on the workers and surrounding environments in case of disposing of removed soil by means of landfill.

Based on the results of the demonstration projects and deliberations by the Study Team, the national government will establish a necessary Enforcement Regulation and Guidelines.

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In addition to decontamination, comprehensive efforts for regenerating the forestry industry and ensuring safe and secure lives of the residents are indispensable for the regeneration of forests and forestry in Fukushima Prefecture. Based on the guideline, “Comprehensive Efforts to Restore Forests and Forestry in Fukushima,” which was compiled by the Reconstruction Agency, the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of the Environment in March 2016, relevant ministries and agencies have been carrying out measures comprehensively for those purpose, while obtaining the understanding of the people in Fukushima. The Reconstruction Agency, the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of the Environment jointly conducted the *Satoyama* Restoration Model Project in 14 municipalities (Kawamata Town, Hirono Town, Kawauchi Village, Katsurao Village, Soma City, Nihonmatsu City, Date City, Tomioka Town, Namie Town, Iitate Village, Tamura City, Minamisoma City, Naraha Town, and Okuma Town) based on the guideline, and the outcome was compiled and published in November 2020. Since FY2020, efforts for restoring *Satoyama* forests have been continued as the “*Satoyama* Restoration Projects” by expanding the coverage to 48 municipalities.

According to the knowledge obtained at the investigative committee on remediation established in the Ministry of the Environment, it is found that removal of sedimentary organic materials at locations 20m or further from the border of the forest adjacent to houses and farmland, etc. has little effect in reducing air dose rates at the forest border. Also, broad removal of sedimentary organic materials in forests may even make things worse, in ways such as increasing bad effects on trees due to causing erosion of dirt, etc. containing radioactive cesium or impoverishing the soil. Accordingly, under the basic policy to prioritize areas especially necessary from the perspective of protecting human health, decontamination of forests has been conducted within approx. 20m from the borders of the forests adjacent to houses or farmland, etc., in principle.

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