

Disaster waste disposal

[Background]

Sendai City had formulated guidelines for disaster waste disposal in preparation against large-scale earthquakes. These guidelines defined the method for estimating the amount of disaster waste generated, the waste sorting classifications and disposal framework, and potential temporary waste collection sites.

[Response]

The large-scale tsunami that surpassed all expectations generated an amount of waste equal to roughly seven years' worth of waste in Sendai City. Owing to the experience in formulating a plan in advance, however, the city was able to implement disaster waste disposal policies from an early stage after the disaster, and ultimately completed disposing of all waste within three years of the disaster, as planned.

Thereafter, the plan was modified to also take tsunamis and floods into consideration to prepare against future disasters.

① Issues

In the wake of the Great East Japan Earthquake, the earthquake and tsunami posed the following three issues concerning waste disposal. The third issue, the "disposal of debris and tsunami sediment," posed a particularly large problem.

① Restoration of the waste disposal framework

Normally, garbage that is collected from households and business establishments in Sendai City by garbage trucks is incinerated at three plants, and incineration ash and non-burnable garbage are disposed of in a landfill. After the disaster, Sendai City needed to restore the damaged plants and garbage collection framework promptly.

② Restoration of the waste disposal framework

All three garbage incineration plants in the city were affected by the disaster and suffered damage, ground subsidence, power outage, etc. One of the plants was damaged considerably, but all plants resumed operations in approximately one month after the disaster.

Sendai City commenced the collection of household garbage four days after the disaster. With regard to garbage that does not decay, such as papers, plastics, cans, bottles and plastic bottles, the city asked citizens to keep them at home for the time being, for the following reasons: the amount of garbage

③ Setting up of temporary disaster waste collection sites for citizens' carry-in waste

In Sendai City, the earthquake disaster produced large amounts of oversized waste, including damaged household items. As it was difficult to process all such garbage at once, temporary waste collection sites were needed where garbage carried in by citizens could be stored for a limited time.

In 2007, Sendai City formulated guidelines for disaster waste disposal, prescribing the setting up of temporary collection sites for oversized waste in parks and other such places within the city in times of an earthquake disaster. Thus, temporary collection sites were set up in a total of eight parks (total area of 71,300m²) as prescribed in the plan, and garbage was

② Setting up temporary disaster waste collection sites for citizens' carry-in waste

Severe damage to household items in ordinary homes produced a large amount of garbage. Therefore, Sendai City needed to set up sites for their temporary storage and to establish a framework for receiving waste carried in by citizens.

③ Disposal of debris and tsunami sediment

Sendai City faced the need to dispose of large amounts of debris and tsunami sediment left by the tsunami. It also needed to dismantle and clear damaged houses. The prompt removal of debris was essential to search for people who had gone missing in the tsunami, but the amounts of debris and tsunami sediment that needed to be processed equaled roughly seven years' worth of garbage the city normally processes, and were more than could be handled by existing garbage incineration plants.

from households had increased, some of the disposal plants were under restoration, and there was a shortage of fuel for garbage trucks. Collection of these types of garbage was resumed approximately a month after the disaster.

Owing to the prompt recovery of its garbage disposal framework, Sendai City was able to provide assistance to neighboring cities and towns whose garbage disposal plants suffered severe damage by accepting and processing their garbage over the period from June 2011 to June 2012.

accepted at these sites until May 10, 2011. Garbage brought to the temporary collection sites was thoroughly sorted so it could be recycled as much as possible.



▲ Temporary disaster waste collection site

④ Disposal of debris and tsunami sediment (Budget:approx.79.9 billion yen)

① Disposal policies

Under the guidelines for disaster waste disposal, Sendai City established a method for estimating the amount of disaster waste so it could be promptly estimated in the occurrence of a large-scale earthquake. However, because tsunami damage was not originally assumed, the city decided to estimate the amount of disaster waste based on the number of damaged buildings and information obtained from aerial photos. As a result, the estimated amount was 1,350,000 tons of debris and 1,300,000 tons of tsunami sediment. Based on this estimation, the city aimed to remove all disaster waste within a year of the disaster and to complete their disposal within three years. The actual amount of waste generated was 1,370,000 tons of debris and 1,350,000 tons of tsunami sediment.

Also based on the above estimation, it was assumed that the entire amount of debris and tsunami sediment could be disposed of in landfill sites within the city, so Sendai City decided to handle them itself without sending them to other municipalities for disposal. At the same time, it decided to recycle the debris as much as possible from the perspectives of extending the life of landfill sites and of being considerate to the environment. Moreover, to contribute to the recovery of the regional economy that had declined due to the earthquake disaster, all operations related to the disposal of debris, such as the removal of debris and dismantling of damaged houses, were entrusted to businesses based in Sendai City.

In addition to the above, debris collection sites totaling an area of 100ha were developed in three locations in the eastern coastal region that suffered extensive damage, so that the disposal of debris could be managed within Sendai City. Furthermore, each site was outfitted with a temporary incinerator. This was because the amount of debris was enormous, and also because debris in tsunami-inundated areas were covered with salt due to seawater as well as tsunami sediment, the stable operation of existing incineration plants was expected to be hindered through problems such as corrosion of the facilities and low heat generation.

Sendai City was able to formulate the above policies as early as April 1, 2011 (three weeks after the disaster).

② Removal, sorting and recycling

Firstly from March 2011, debris and tsunami sediment that were obstructions to the search for missing persons were removed and taken to debris collection sites. Then, debris and tsunami sediment from roads, residential land, and farmland were removed in this order. Additionally, among individual homes and SME offices in Sendai City, those that were judged to be in danger of collapsing were decided to be dismantled and removed by the city to prevent secondary damage.

When thoroughly sorting the debris for recycling at debris collection sites, it was expected that an open area for sorting would be required, causing a decline in processing efficiency. Therefore, debris were roughly sorted into burnable waste, non-burnable waste, and recyclable waste at each site from where they were to be removed. Thereafter, the debris were carried in to collection sites and further sorted into more than ten smaller categories, including concrete debris, wood scraps, metal scraps, home appliances, and cars. Incineration for the 1,370,000 tons of debris was completed in September 2013, with disposal and recycling being finished later in December. 72% of material was recycled (980,000 tons).

Meanwhile, tsunami sediment was decided to be recycled after taking the necessary steps such as removing unwanted substances and mixing them with concrete debris. Of the 1,350,000 tons of tsunami sediment, 96% (1,300,000 tons) were recycled for use in national projects for the development of coastal levees and coastal disaster prevention forests, and as embankment material in projects for the development of elevated roads and seaside park by Sendai City.

Non-recyclable burnable waste was sequentially processed at the temporary incineration facility on the premises of debris collection sites, and the incineration ash was disposed of in a landfill site in Sendai City along with non-recyclable unburnable waste.

The above methods allowed Sendai City to gain an outlook for completing the disposal of debris and tsunami sediment at an early stage, so the city took on the disposal of 50,000 tons of debris from other cities.

The disposal of debris and tsunami sediment cost 79.9 billion yen (40.5 billion yen for their removal, 39.4 billion yen for their recycling and processing). Owing to efficient sorting and recycling, the initially estimated cost of 92 billion yen was able to be reduced by approximately 12 billion yen.



▲ A temporary incinerator



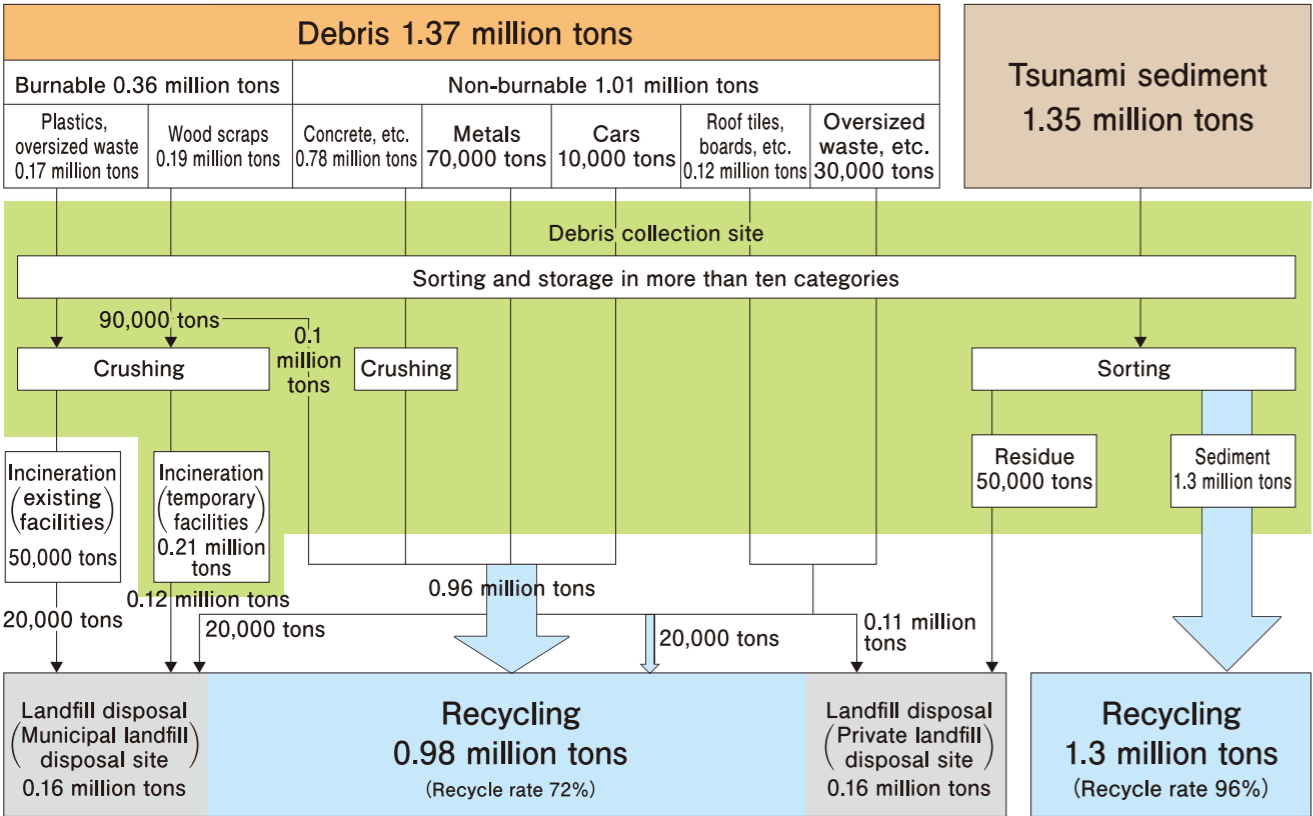
▲ Sorting the debris for recycling



▲ Incineration for the debris was completed in September 2013.



▲ Elevated road, which was developed from recycled tsunami sediment



▲ Recycling and disposal process of debris and tsunami sediment

③ Dissemination of information to citizens

With regard to the removal of collapsed houses and buildings, the national government proposed a policy that would allow them to be removed without the approval of their owners, as it was almost impossible to contact all relevant disaster victims. However, to obtain the approval of citizens as much as possible, Sendai City disseminated the following information to all citizens.

- The scheduled dates and areas of debris removal work (disseminated once a week via the city's official website and bulletin boards at evacuation centers)
- The installation of a dedicated telephone inquiry center for inquiries concerning debris removal
- The establishment of a system that allows citizens to be present at the site of removal work if they wish, by registering via a dedicated phone number
- The establishment of occasions to return valuables and keepsakes such as photo albums that are recovered during removal work to their owners (1,120 valuables and 9,780 keepsakes have been recovered)



▲ Returning valuables and keepsakes to citizens

④ The Sendai System

The below methods taken by Sendai City for the removal of debris were referred to as the "Sendai System," and were evaluated as prompt and effective post-disaster measures.

- To contribute to economic recovery, all operations related to debris removal were entrusted to businesses based in the city.
- Owing to thorough sorting and recycling in cooperation with the construction, dismantling and industrial waste industries in the city, Sendai City was able to dispose of all debris within the city without depending on other municipalities.

Industrial representatives gave presentations on the Sendai System as advanced practices at a public forum of the Third UN World Conference on Disaster Risk Reduction held on March 17, 2015.



▲ Public forum of the Third UN World Conference on Disaster Risk Reduction

⑤ Responses to the Great East Japan Earthquake

The guidelines for the disposal of disaster waste that Sendai City had formulated before the Great East Japan Earthquake occurred assumed the possibility of earthquakes but not tsunami damage. Therefore, the city had to fumble for how to address the many issues regarding the disposal of disaster waste generated by the tsunami. Nevertheless, it was able to take initial action in an appropriate manner owing to advance planning of disposal policies and cooperation with relevant local industries.

Based on the experiences and lessons of the Great East Japan Earthquake, Sendai City fully revised its disaster prevention plan in May 2013 in preparation against the next disaster, upon interviewing employees who engaged in disaster response at the time, reviewing its organizational framework and operations, and particularly adding information on operational details that would ensure prompt initial action. Furthermore, a new disaster waste disposal plan was formulated in March

2020, incorporating information on human resource development and development of resilient disposal facilities and including floods within the scope of disasters, in conformance with national guidelines.

There have been developments among private companies as well. For instance, in September 2015, the construction, dismantling and industrial waste industries entered into an agreement for mutual cooperation in lending and borrowing materials, equipment and fuel and holding regular exchanges of information. Thereafter, the abovementioned three industries and Sendai City entered into a four-party agreement for cooperation in the disposal of disaster waste, to further strengthen inter-industrial cooperation as a measure against future large-scale disasters.