Midterm Review in relation to the

Sendai Framework for Disaster Risk Reduction 2015 – 2030

Report

March 2023

Sendai City

International Research Institute of Disaster Science, Tohoku University (IRIDeS)

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Unless otherwise noted in the text, the content of this report is co-authored by Sendai City and the International Research Institute of Disaster Science, Tohoku University (IRIDeS). The authors of “3. Assessment Findings” are listed in the following table.

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1 Greetings

The Sendai Framework for Disaster Risk Reduction 2015–2030, a global policy guidance for disaster risk reduction, was adopted in our city, Sendai, in March 2015, as we were making steady progress toward recovery from the Great East Japan Earthquake. Taking this as a point of pride, the city and citizens of Sendai have worked together to improve the disaster risk reduction capabilities of the local area. In addition, as a gesture of reciprocation for the warm support we have received from a multitude of people both in Japan and abroad, we have endeavored to disseminate our experiences widely in order to contribute to disaster risk reduction around the world.

As the Sendai Framework for Disaster Risk Reduction 2015–2030 reaches its midpoint this year, midterm reviews are being conducted at the national level all around the world. This represents a critical opportunity to consider the second half of the Sendai Framework for Disaster Risk Reduction 2015–2030. Sendai has also decided to use this milestone to review the progress the city has made thus far.

Using Sendai as an example, this report serves to both evaluate and make public the progress that has been made with the specific goals set forth in the Sendai Framework for Disaster Risk Reduction 2015–2030. Apparently, this is the world's first initiative to conduct analytical assessment on a local government basis.

In preparing this report, Sendai City has worked in collaboration with the International Research Institute of Disaster Science, Tohoku University, a world-leading research base for disaster prevention science and an indispensable partner for the city to promote disaster risk reduction measures. We have strived to make our assessment as objective as possible.

Sendai has experience in overcoming numerous disasters working together with its citizens. This report will also serve as an opportunity to share with our citizens, once again, Sendai’s work in building a community of resilience, one that is resilient to disasters. Together, we will take new steps in disaster risk reduction measures during the second half of the Sendai Framework for Disaster Risk Reduction 2015–2030.

We also look forward to continuing to share our experiences and learnings with the rest of the world, including the methodology we employed in conducting out midterm assessment, in order to help achieve the successful implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 for the entire world.

We hope that this report will help strengthen disaster risk reduction measures in cities around the world.

March, 2023

Kazuko Kori
Mayor of Sendai

The International Research Institute of Disaster Science, Tohoku University (IRIDeS) was established about a year after the Great East Japan Earthquake. Our mission is to deepen disaster science and build practical research on disaster risk reduction, learning from the Great East Japan Earthquake, in order to prevent the repeat occurrence of such disasters.

Sendai offered its full support for the Third UN World Conference on Disaster Risk Reduction, held here in March 2015. The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at this UN conference. To promote its implementation, we engage in a range of research and practical activities, with a focus on collaborative efforts between industry, government, academia, and citizens in Japan and overseas.

To monitor the progress of the Sendai Framework for Disaster Risk Reduction 2015–2030, we require statistical data on disaster damage. The inadequacy of such data in countries worldwide is a challenge that we face, however. This led to the establishment of the Global Center for Disaster Statistics (GCDS) within IRIDeS, in order to support the development of disaster damage statistics and the monitoring of progress in implementing the Sendai Framework for Disaster Risk Reduction 2015–2030.

In addition, we established the World Bosai Forum as a forum for the discussion and sharing of information on constantly evolving disaster risk reduction issues, and have held discussions on the importance of disaster damage statistics. These initiatives were made in close collaboration with Sendai City, the birthplace of the Sendai Framework for Disaster Risk Reduction 2015–2030.

Having reached the halfway point of implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030, Sendai City and IRIDeS have conducted a joint assessment of the progress of implementing the Framework. As an example of monitoring conducted through disaster damage statistics provided by a local government, the publication of this review in a joint report is an extremely pioneering initiative.

Moving forward, Sendai and IRIDeS will continue to cooperate with each other and other related parties to disseminate information on disaster risk reduction efforts from Tohoku and Sendai. Working with others, our aim is to consider ways of responding to new disaster-related risks, accumulate knowledge, and make a contribution to disaster risk reduction on a global level.

March, 2023

Fumihiko Imamura

Director
International Research Institute of Disaster Science,
Tohoku University

2 Rationale

2.1 Purpose and background

The Third UN World Conference on Disaster Risk Reduction was held in 2015 in Sendai. As the host city of the conference, Sendai has worked to implement the Sendai Framework for Disaster Risk Reduction 2015–2030 (hereinafter referred to as “the Sendai Framework for Disaster Risk Reduction” or “the Framework”), the document produced as the outcome of the conference.

Incorporating the participation of diverse stakeholders (a principle of the Sendai Framework for Disaster Risk Reduction), Sendai City has taken note of lessons learned from disasters and has been building a disaster-resilient and environmentally friendly city that incorporates the perspectives of disaster risk reduction and environmental concerns into all measures (see p.7).

The Sendai Framework for Disaster Risk Reduction has reached the midpoint of its lifespan and is now undergoing a process of review by the United Nations Agency for Disaster Risk Reduction (UNDRR) and the Japanese government. In line with this, the purpose of the present undertaking is for Sendai City to reflect on its own initiatives, working in cooperation with the International Research Institute of Disaster Science, Tohoku University (IRIDeS). This collaborative project is based on the Agreement on Collaboration and Cooperation between Sendai City and Tohoku University (concluded on April 22nd, 2022) and will analyze and assess achievements and results of Sendai City initiatives, working in a manner modeled on the Sendai Framework for Disaster Risk Reduction.

This endeavor serves the dual purpose of considering initiatives for the second half of the Sendai Framework for Disaster Risk Reduction, while also presenting the methodology and findings of the reflection process both in Japan and internationally, thereby contributing to the disaster risk reduction around the world.

2.2 Midterm assessment implementation method

In carrying out the midterm assessment, we are conducting a review of initiatives taken to date, first in Sendai, modeled after the four priorities for action (Note 1) that appear in the Sendai Framework for Disaster Risk Reduction. In addition, in order to shed light on the results of these initiatives, IRIDeS has conducted an analysis based on statistical information held by Sendai City and an evaluation of the city's progress in implementing the seven global targets (Note 2) related to the expected outcome and goal of the Framework.

Note 1 Four priorities for action (from the Sendai Framework for Disaster Risk Reduction [outline]. Source: Ministry of Foreign Affairs website)

Priority 1: Understanding disaster risk

Priority 2: Strengthening disaster risk governance to manage disaster risk

Priority 3: Investing in disaster risk reduction for resilience

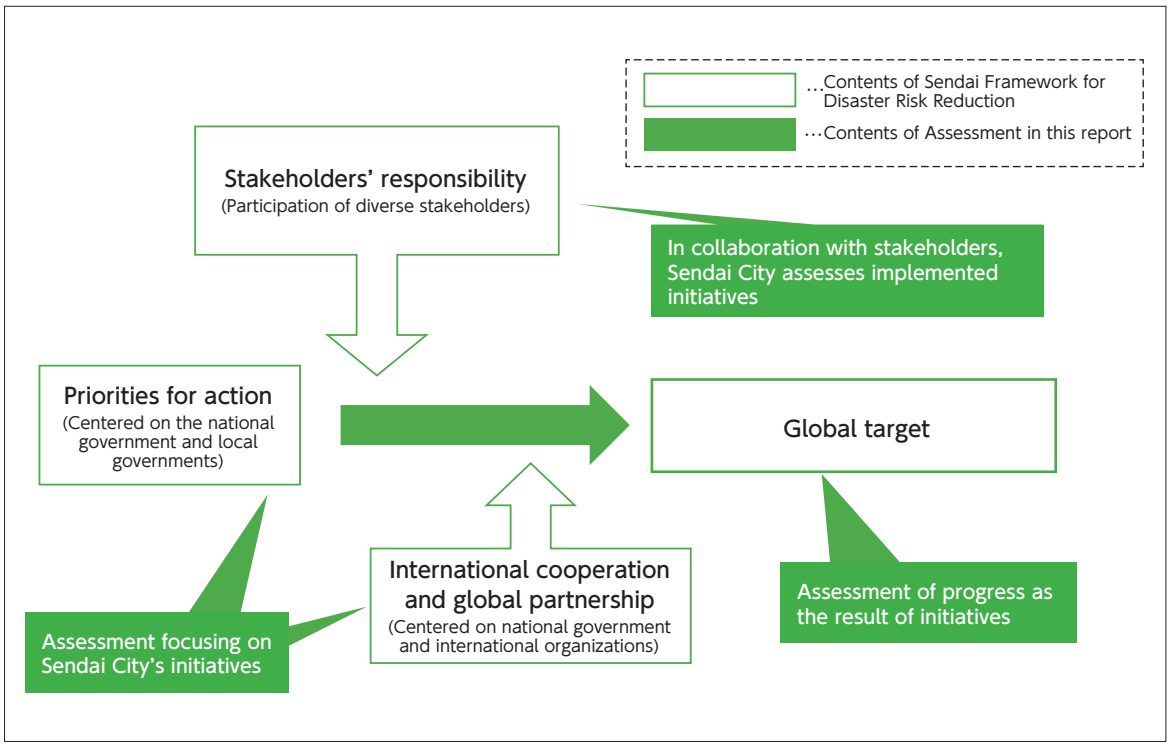
Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

* The promotion of the Sendai Framework for Disaster Risk Reduction requires that its priorities for action are advanced at national and local levels, in addition to the strengthening of international cooperation and global partnership and for the various stakeholders to carry out their roles (stakeholder responsibility).

Note 2 Seven global targets related to the expected outcome and goal of the Framework Source: Ministry of Foreign Affairs website

A) Number of mortalities B) Number of affected people C) Economic loss D) Damage to critical infrastructure	Targets aimed at reduction (to be reduced)
E) Number of countries with disaster risk reduction strategies (formulation of plans for disaster risk reduction) F) International cooperation G) Access to multi-hazard early warning systems and disaster risk information	Targets aimed at increase (to be increased or strengthened)

Diagram: Conceptual diagram of midterm assessment



3 Assessment findings

3.1 Initiatives taken prior to the Sendai Framework for Disaster Risk Reduction

(1) Initiatives taken prior to the Great East Japan Earthquake

Sendai has worked with its citizens to create a safe city. Based on the experience of the 1978 Miyagi Earthquake, Sendai became the first city in Japan to proclaim itself a Disaster-Resilient City the following year on June 12th, 1979. The same date was designated as Citizen Disaster Prevention Day.

In addition, the Great Hanshin earthquake of January 1995 acted as the impetus for creating a disaster-resilient city with even greater levels of safety, and the city's fundamental goal became the creation of a disaster-resilient city in which everyone is able to live with peace of mind. In March 1997, this came into being as the Sendai City Disaster Prevention Plan, whose aims included the promotion of disaster-prevention measures with a focus on countermeasures against large-scale earthquakes.

The disaster resulting from the Great East Japan Earthquake on March 11th, 2011 occurred in such a context. Its scale far exceeded assumptions made in disaster prevention measures and urban development efforts that had been undertaken prior to that time. The tremors, however, did not cause buildings to collapse, thanks to measures that had been taken in the past. This includes seismic-resistance measures for buildings in anticipation of the next Miyagi Earthquake off the coast, one that recurs periodically every several decades. On the other hand, unexpected damage did also occur, mainly due to the tsunami—a reminder of the threats posed by the forces of nature.

(2) Initiatives taken until the adoption of the Sendai Framework for Disaster Risk Reduction

While the Great East Japan Earthquake showed that past disaster risk reduction measures were effective to a certain extent, many precious lives were lost due to the massive tsunami that struck the eastern part of the city. Powerful and long-lasting tremors caused landslides and damage to retaining walls, and residential areas throughout the city suffered damage.

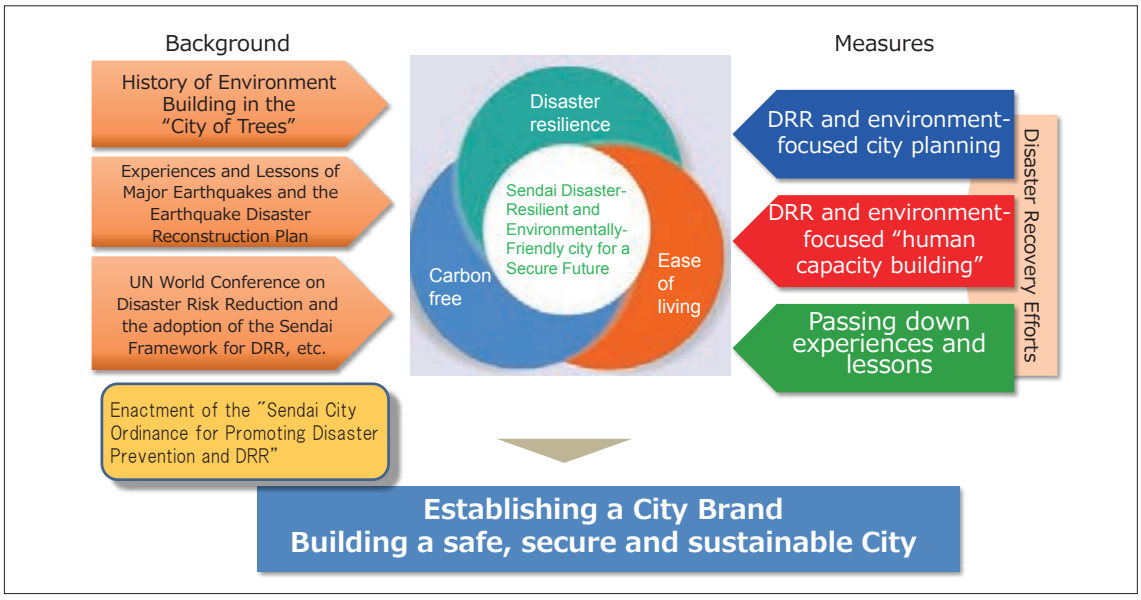
The Great East Japan Earthquake clearly demonstrated that there are limits to the amount of control that man-made structures can offer against the fury of nature. Consequently, the Sendai City Earthquake Disaster Reconstruction Plan, which was formulated in November 2011, does not aim for total disaster prevention involving control over nature. With an emphasis on the protection of human life, the plan has shifted toward disaster risk reduction—the minimization of damage in case of disasters—as its basis. The reconstruction plan encourages the protection of one's own self in case of disaster (self-help) and community support for those who need help, such as the elderly and people with disabilities (mutual aid). With regard to the reconstruction of eastern parts of the city—those that suffered the greatest tsunami damage—the plan incorporated the creation of new value and vitality rather than simply restoring the area to its pre-earthquake state. The strengthening of disaster risk reduction through the participation of diverse members of the population, including women and the younger generation, was later discussed during the

process of adopting the Sendai Framework for Disaster Risk Reduction.

In March 2015, the Third UN World Conference on Disaster Risk Reduction was held in Sendai thanks to the efforts of various stakeholders, including international organizations, the Japanese government, Tohoku University, and local economic organizations. The plenary session was attended by over 6,500 delegates: the United Nations Secretary-General; over 100 ministers, including 25 heads of state; government delegations from 185 countries; 49 intergovernmental organizations; 188 NGOs, and 38 international organizations. In addition, the public forum, which was held in conjunction with the plenary session, included symposia, exhibitions, and other events that attracted in excess of 150,000 people. It was one of the largest UN-related international conferences to have been held in Japan.

The Sendai Framework for Disaster Risk Reduction was the document produced as the outcome to the conference. Its adoption has resulted in "Sendai" becoming a common word in the field of disaster risk reduction around the world. In view of the significance of this fact, Sendai City is working on the Sendai Framework for Disaster Risk Reduction by promoting the creation of a disaster-resilient and environmentally friendly city based on three pillars: community development aiming for communities that are highly sustainable in the face of disasters; human capacity building aiming at the participation of a diverse range of citizens, irrespective of age, gender, or attributes; and the passing on of experiences and lessons learned from The Great East Japan Earthquake to the future and the rest of the world.

Diagram: Conceptual diagram for the building of a disaster-resilient and environmentally friendly city



3.2 Progress and results in implementing initiatives related to the four priorities for action

Under the supervision of IRIDeS, this document outlines results of Sendai City-promoted initiatives related to the four priorities for action, which have generally been carried out since the Great East Japan Earthquake.

Each initiative is classified according to the relevant priority for action and presented together with data that shows the state of progress in its implementation. An evaluation of the initiative's contribution to the achievement of the seven global targets is also included.

In addition, as the Sendai Framework for Disaster Risk Reduction makes a call for stakeholder responsibility and international cooperation and global partnership along with the promotion of the priorities for action, this section will also describe the results of initiatives carried out in collaboration with various stakeholders and those that make a contribution internationally.

3.2.1 Priority 1: Understanding disaster risk

Priority 1 emphasizes the importance of learning and understanding for disaster preparedness in relation to knowledge that can be gained and lessons that can be learned from past disasters and disaster risk reduction. It also calls for the utilization of various networks and methods for the collection and dissemination of information on disaster risk reduction.

Key initiatives undertaken by Sendai are as follows.

(1) Handing down experiences and lessons learned

To preserve the memory of the disaster for a long time and to put experiences and learnings from 2011 to use in future disaster risk reduction, concrete form must be given to memories of the disaster and mourning for its victims, and a process of handing down to future generations must take place. Based on this understanding, Sendai City works to hand down experiences within its staff; it manages memorial facilities and runs a video and photo archive related to the Great East Japan Earthquake. Working in collaboration with citizens and community groups, the city runs events and other activities that carry the experiences of learnings of Great East Japan Earthquake toward the future.

In addition, we will work to put our experience in overcoming numerous disasters to good use in the future, based on the understanding that disasters are inevitable and cannot be fully predicted. We will work with citizens to create a disaster-aware culture—which is to say, one that has the skills and knowledge to overcome disasters. Spreading this culture through Japan and around the world, we aim to contribute to disaster risk reduction on the global level.

Disaster Memorial Ruin Arahama Elementary School

Sendai 3/11 Memorial Community Center

(2) Promotion of Disaster Risk Reduction Education, Sendai Edition

In order to cultivate a society in which people are able to take appropriate action in the event of a disaster, a new disaster risk reduction education policy, the Disaster Risk Reduction Education Guide, Sendai Edition was put together after the earthquake, and disaster risk reduction education has been carried out in all municipal elementary and junior high schools in Sendai since FY2016. All schools have a head of disaster risk reduction who plays a central role in the promotion of disaster risk reduction education. Meanwhile, copies of Sendai-specific supplementary reading material for disaster prevention education have been distributed to all school children and are referred to in all their subjects.

To convey lessons learned from the Great East Japan Earthquake, together with information on disaster risks faced in the area, field trips to Disaster Memorial Ruin Arahama Elementary School are organized (involving all municipal elementary schools in Sendai since FY2022). A three-dimensional diorama is used to represent the local topography, and workshop-style classes are run for children to think about the region's disaster risks by themselves.

NOTE: Supplementary Reading Material for Disaster Risk Reduction Education, Sendai Edition

Supplementary reading material were created to convey lessons learned from the disaster to school children, to keep the memory of the disaster alive, and to help youngsters acquire correct information about disasters together with disaster response skills.

The reading material is designed to support independent learning for youngsters and contains activities such as learning tasks and boxes to fill in, together with stories from people who experienced the disaster. It is divided into three volumes: one for first to third graders in elementary school, one for fourth to sixth graders, and one for junior high school students. The material takes young people's developmental stages into consideration, while also reiterating important learning points so as to ensure retention.

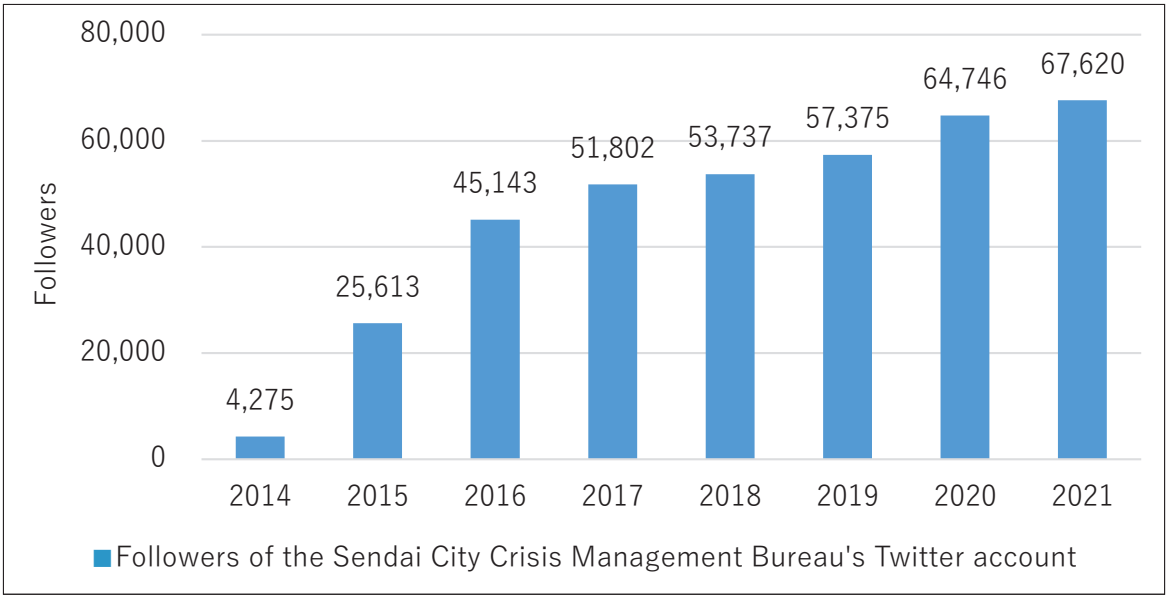
(3) Disseminating disaster risk information

A hazards map showing areas that may be affected by earthquakes, tsunamis, floods, landslides, and the bursting of reservoirs, together with ways in which to protect oneself from such disasters, has been created and is being distributed to citizens and promoted online.

Meanwhile, to ensure that appropriate evacuations take place when there is a risk of a disaster occurring, the number of outdoor public address systems providing tsunami information has been increased since the Great

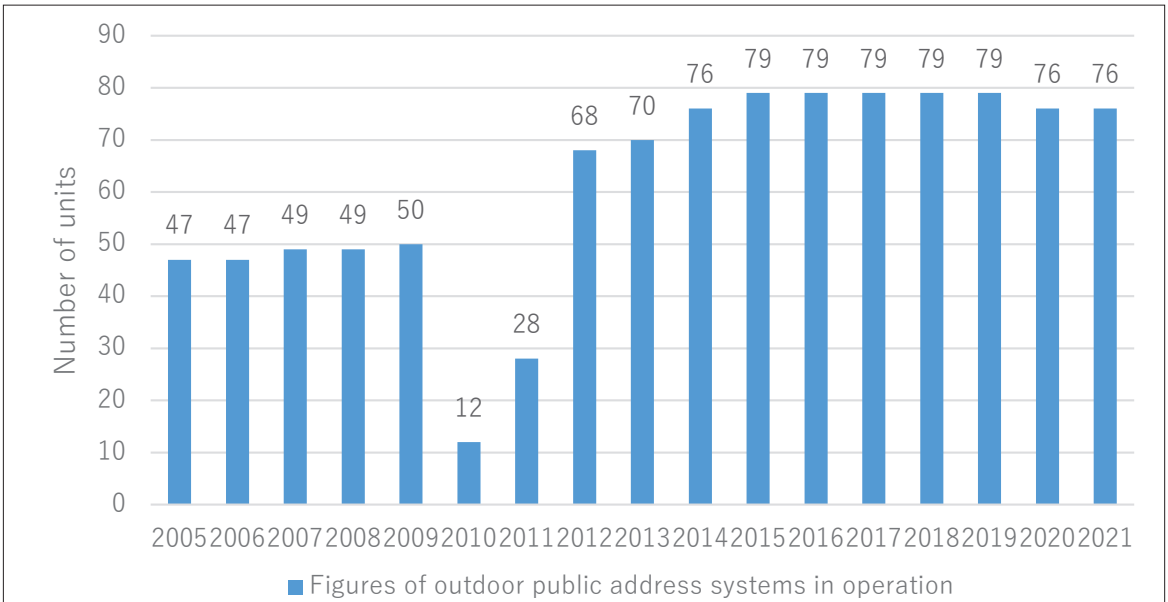
East Japan Earthquake. Social media accounts (Crisis Management Station on Twitter) have been set up, and information distribution via the Internet has been enhanced. People are being encouraged to check disaster and weather information, using these sources in conjunction with TV, radio, and other media as appropriate. Furthermore, advanced technologies such as drones are also being put to use, speeding up and increasing the number of communication channels.

Diagram: Followers of the Sendai City Crisis Management Bureau's Twitter account



(Source of data: Sendai City Crisis Management Bureau)

Diagram: Figures for outdoor public address systems in operation

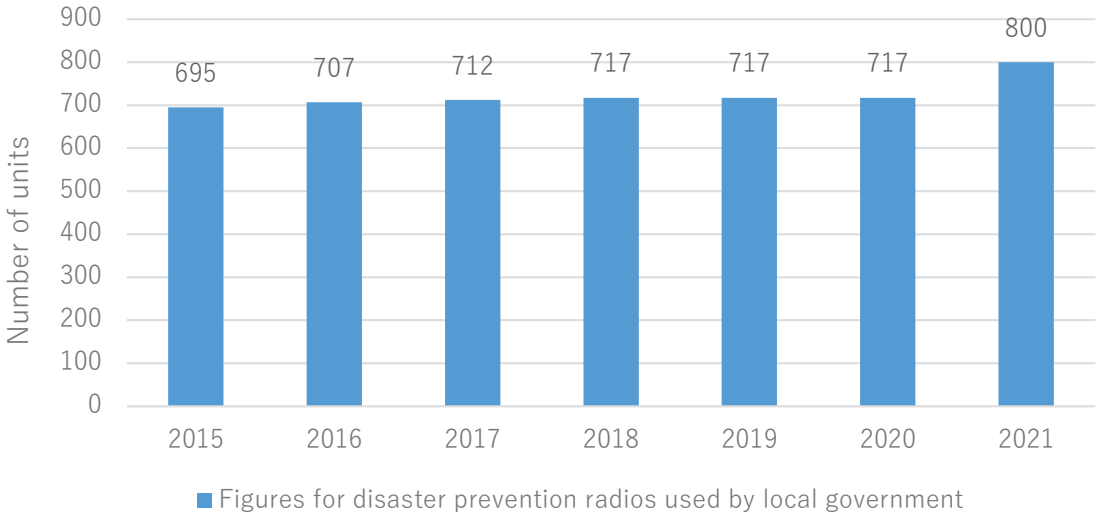


*1 The drop of 38 units in FY2010 was due to the tsunami caused by the Great East Japan Earthquake

*2 The reduction of 3 units in FY2020 was due to the replacement of units that were no longer serviceable. Replacement by high-performance units resulted in the removal of 3 units whose sound ranges would have overlapped.

(Source of data: Sendai City Crisis Management Bureau)

Diagram: Deployment figures for disaster prevention radios used by local government



*Type: digital mobile radio until FY2020; IP radio from FY2021

(Source of data: Sendai City Crisis Management Bureau)

NOTE: Tsunami Evacuation Announcement Drone

Based on the experience of the Great East Japan Earthquake and the need for multiplexed public information on tsunami evacuation, the tsunami evacuation information drone was put through a series of demonstration experiments commencing in 2019, with full-scale deployment commencing in October 2022.

The drone is equipped with a speaker and other equipment. When a tsunami warning is announced, the drone takes off and automatically flies along a predetermined route to publicize the evacuation.

This represents two world firsts: an automated drone being used to disseminate tsunami evacuation information and a drone being controlled by a dedicated LTE communication network. The use of the drone will facilitate the communication of more detailed and effective tsunami evacuation information to visitors to the areas along Japan's east coast.

Automatically landing Drone

(4) Seminars of the Sendai Framework for Disaster Risk Reduction

Since FY2016, Sendai and IRIDeS have been jointly holding a seminar targeting everyday citizens. Learning about the Sendai Framework for Disaster Risk Reduction, citizens can enhance their awareness about disaster risk reduction. Meanwhile, the city also gains through an increase in the number of people supporting disaster risk reduction in the region.

Participants learn about the contents of the Sendai Framework for Disaster Risk Reduction through lectures. In the Foundation Seminar, they make a presentation on their own activities, while in the Applied Seminar, they engage in discussions and workshops with other participants, the purpose of which is to catalyze their activities.

In November 2022, which marks the midterm point of the Sendai Framework for Disaster Risk Reduction, a special program was held to share information on the progress of the Framework's midterm review. (For details, see 4. Implementation of midterm assessment by citizens (summary of outcomes from the Special Edition Seminar/workshop that was part of the Sendai Framework for Disaster Risk Reduction Seminar) (p.49))

Diagram: Figures related to the Sendai Framework for Disaster Risk Reduction course (number of times held, number of participants)

Year held	Number of times held	Number of participants
2016	5	386
2017	2	123
2018	2	165
2019	2	125
2020	1	48
2021	1	48

(Source of data: Sendai City City Planning Policy Bureau)

IRIDeS evaluation of initiatives relating to Priority 1

The creation of hazard maps using geospatial information, together with initiatives directed at disaster risk reduction education and public awareness all promote the understanding of disaster risks. In addition, sharing information about our activities through workshops and similar events helps promote voluntary initiatives and network formation in the region.

In supporting the effective acquisition of a range of information related to disaster risk reduction, these efforts are felt to contribute to the achievement of global Target G in particular: "access to early warning systems, disaster risk information, etc."

3.2.2 Priority 2: Disaster risk governance for disaster risk management

Priority 2 calls for governments and communities to understand their respective roles and manage plans and schedules appropriately to reduce disaster risk. This priority also recognizes the need for all stakeholders to participate in disaster risk reduction and cooperate with each other.

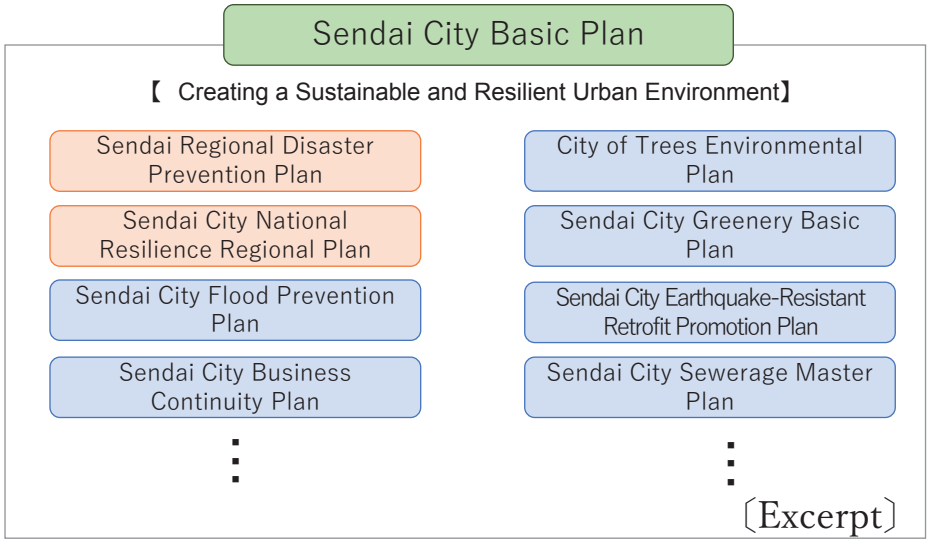
Key initiatives undertaken by Sendai are as follows.

(1) Sendai's Disaster Risk Reduction Strategy

Sendai considers disaster risk reduction strategy to be one of the pillars of its community development. The Sendai City Basic Plan 2021–2030 (formulated March 2021) is the city's basic guideline for community development. The Disaster-Resilient and Environmentally Friendly City Project, whose aim is to create a sustainable urban environment, sits under the plan and is worthy of mention, while plans for individual divisions have also incorporated elements of disaster risk reduction.

The Sendai City National Resilience Regional Plan formulated in November 2020) is a compilation of the Sendai Regional Disaster Prevention Plan (see p.13) and a range of measures for pre-event disaster risk reduction to reduce risk associated with large-scale disasters and for rapid recovery and reconstruction. It is being used to systematically promote community development by the city.

Diagram: Conceptual diagram of Sendai City's system for disaster prevention strategy



(2) Sendai Regional Disaster Prevention Plan

The Sendai Regional Disaster Prevention Plan is the most basic plan for disaster risk reduction in Sendai. Based on the provisions of Japan's Disaster Countermeasures Basic Act, its aim is to protect the lives, bodies, and property of Sendai citizens from disasters, which may include earthquakes, tsunamis, and storm and flood damage.

In March 2013, the plan was revised according to lessons learned from the Great East Japan Earthquake, incorporating into the basic policy issues

such as disaster mitigation to minimize damage in the event of a disaster, consideration for people requiring assistance in the event of a disaster, and the promotion of gender equality.

To promote mutual aid initiatives taken by local communities, the plan is divided into sections: Self-help and Mutual Aid, which concerns the activities of individual residents and neighborhoods; and Public Assistance, which concerns the activities of local government. It also stipulates the kinds of activities appropriate to each party. The plan developed mechanisms for stakeholders such as local residents to tackle disaster risk reduction, pre-dating the June 2013 revisions to the Disaster Countermeasures Basic Act.

Diagram: Amendments to the Sendai Regional Disaster Prevention Plan

Year	Revisions made
1964 onward	6 full revisions and 6 partial revisions since original formulation
2013	Full revision based on the Great East Japan Earthquake
2014	Full revision of section on disaster countermeasures for storm and flood damage and addition of section on nuclear disaster countermeasures
2015	Designation of designated emergency evacuation sites, etc.
2016	Review of designated evacuation centers to be opened during heavy rainfall events, etc.
2017	Revision of standards for staff assembly at designated evacuation centers during heavy rainfall events, etc.
2018	Establishment of criteria for issuing evacuation information for priority reservoirs for disaster prevention, etc.
2019	Establishing criteria for issuing early evacuation advisories, etc.
2020	Review of infectious disease control measures in evacuation centers, etc.
2021	Establishing criteria for issuing evacuation information for small and medium-sized rivers, etc.
2022	Changes to tsunami evacuation areas, etc.

NOTE: Revision of the Disaster Relief Act

At the time of the Great East Japan Earthquake, authority to implement disaster relief (the provision of emergency relief immediately after a disaster) rested with prefectural governments. Administrative work related to the construction of prefabricated temporary housing was, therefore, not delegated to Sendai City, resulting in long delays to the construction of the required number of units of temporary housing in the city.

In light of this experience, several cities including Sendai approached Tokyo for revisions to the legal system. In response, the law was amended in 2019, and designated cities were entrusted with the work of disaster relief.

In 2019, Sendai was designated a Relief Implementation City, enabling it to independently implement disaster relief. In addition, this will allow Miyagi Prefecture to focus on supporting other municipalities within the prefecture.

(3) Creation of areal evacuation center operation manuals

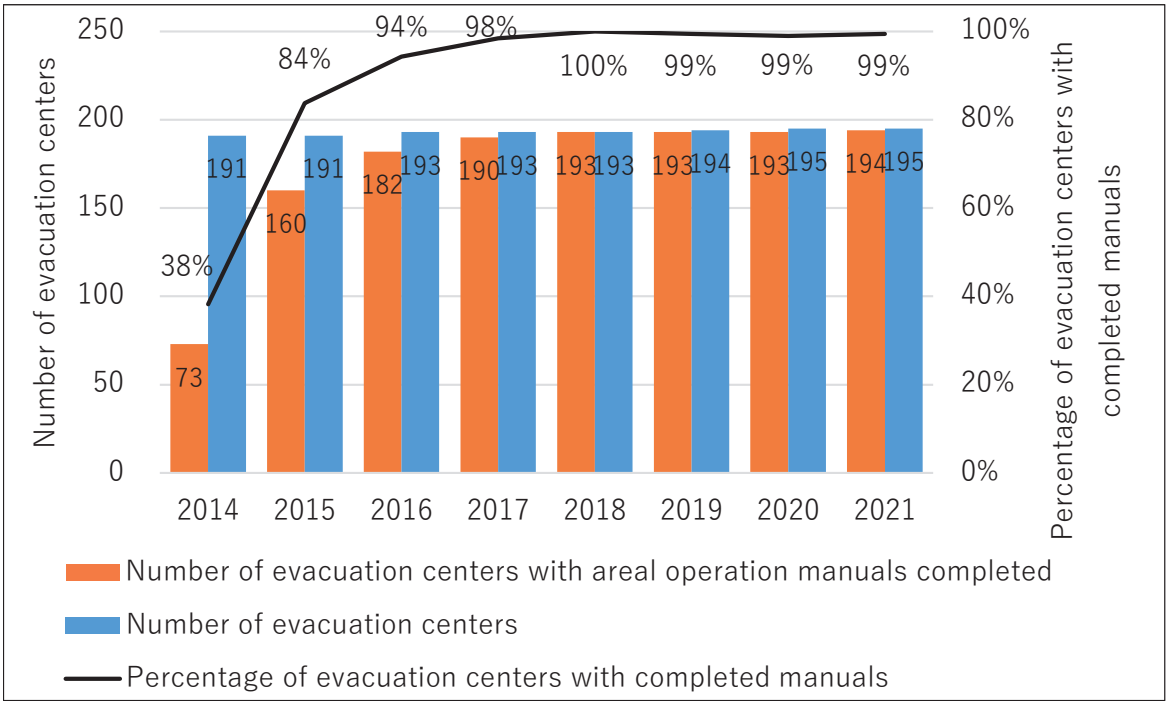
Working from issues that were experienced in the running of evacuation centers during the Great East Japan Earthquake and feedback from local community members who were involved in the management of such facilities, a new Evacuation Center Operation Manual was created and came into use commencing 2013. Using the manual as a blueprint, community groups such as neighborhood associations, local government, and the management of various facilities work together to rethink the running of individual evacuation centers, and are developing unique manuals for evacuation center operation that is tailored to the characteristics of the locality in each case.

Each local community is working on the operation of evacuation centers based on its particular manual for evacuation center management, taking into consideration the particular characteristics of the community and also incorporating a diverse range of needs, including those of women, people with disabilities, and foreigners.

To be able to respond to diversifying natural disasters and infectious disease countermeasures at evacuation centers, new blueprint content is being added. These include a new edition for evacuating during heavy rainfall events and additional points covering Covid-19 countermeasures. The addition of such content is then being reflected in the areal manuals for regional evacuation center operation.

(As of March 2023, percentage of evacuation centers with completed manuals is 100%.)

Diagram: Figures for evacuation centers with areal operation manuals completed



(Source of data: Sendai City Community Affairs Bureau)

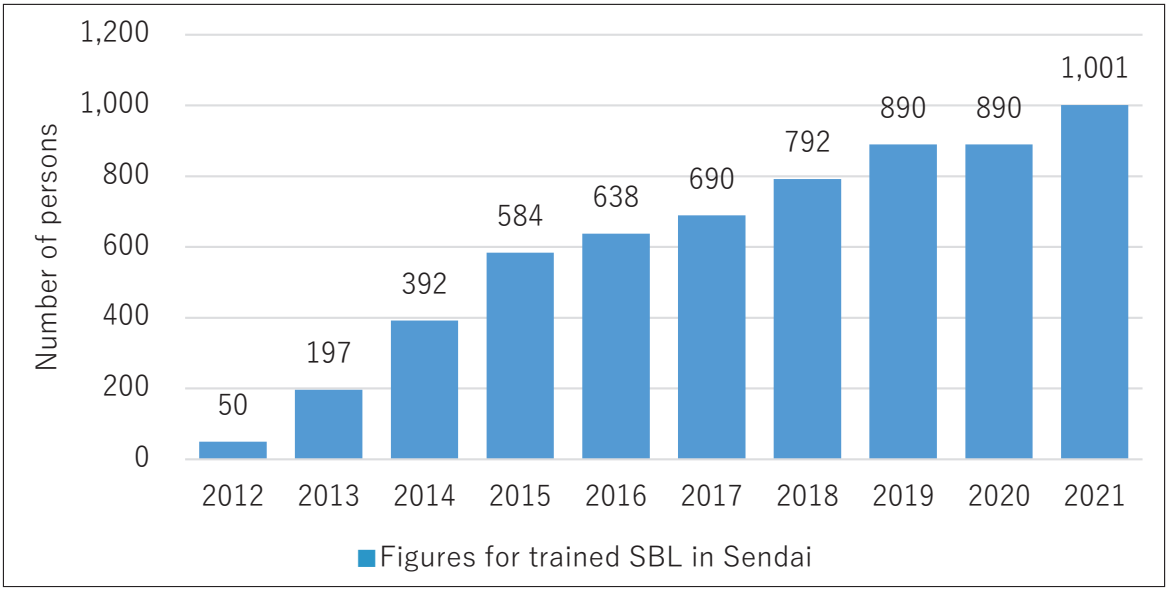
(4) Training of Sendai City Community Bosai Leaders (SBL)

Sendai City Community Bosai Leaders (SBL) play a central role in disaster risk reduction during non-disaster times through activities such

as the planning and implementation of effective drills or the formulation of independent disaster risk reduction plans tailored to the particular characteristics of a community. When disasters strike, the SBLs perform central activities for local independent disaster risk reduction organizations, including leading evacuations and carrying out rescue/relief operations.

In order to revitalize independent disaster risk reduction organizations and raise the level of local disaster risk reduction capabilities throughout the city, SBLs have been trained and registered through a training program specific to Sendai. To support active SBLs, refresher programs are also held each year. These enable SBLs to improve their knowledge and skills and also serve to strengthen cooperation among SBLs and with the local community.

Diagram: Figures for trained SBL in Sendai



(Source of data: Sendai City Crisis Management Bureau)

IRIDeS evaluation of initiatives relating to Priority 2

The adoption of a disaster risk reduction strategy and the assigning of roles to stakeholders helps mainstream disaster risk reduction across all sectors. It strengthens disaster risk governance, which serves to improve the disaster risk reduction capacity of local communities.

These efforts, which are represented by the Sendai Regional Disaster Prevention Plan, contribute to the achievement of global Target E: “local disaster risk reduction strategies.”

3.2.3 Priority 3: Investing in disaster risk reduction for resilience

Priority 3 maintains that investment in hard measures such as improving the seismic resistance of vital facilities, together with soft measures, such as systematization for business continuity, will serve to protect lives, assets, and ecosystems from disasters and will promote swift post-disaster recovery and reconstruction. Compared to post-disaster investment, this kind of pre-event investment in disaster risk reduction is seen to be more cost-effective. Its active promotion is desirable, also from the perspective of strengthening a city's disaster-response capabilities.

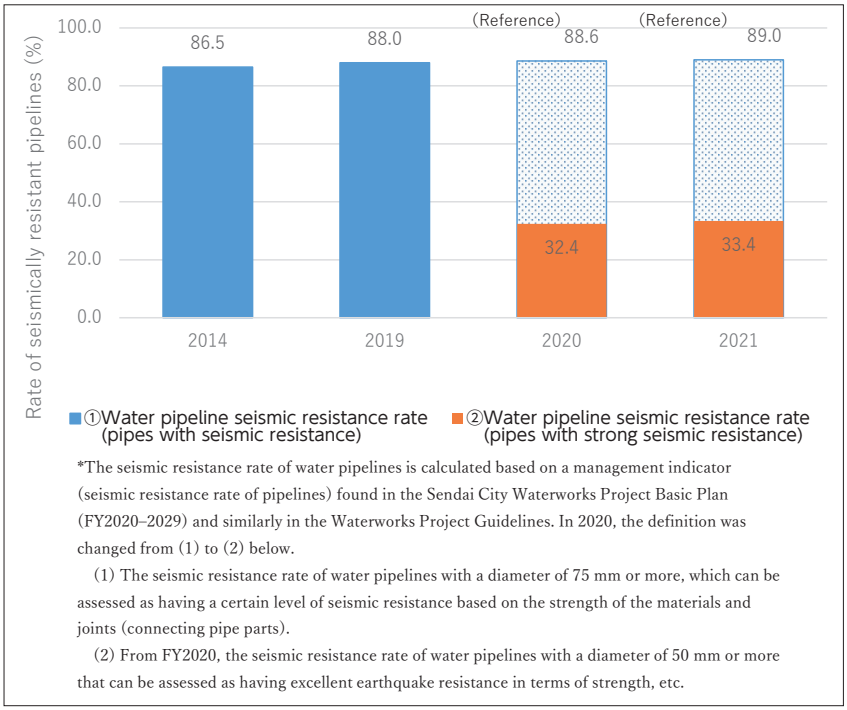
Key initiatives undertaken by Sendai are as follows.

(1) Disaster countermeasures for critical infrastructure

The Great East Japan Earthquake and subsequent tsunami cut off water supply to about half the total number of households in Sendai, while all households in the city were left without city gas and electricity (which is supplied by private power companies). The sewage system was also affected, with the coastal treatment facility completely destroyed by the tsunami, (see p.23: Restoration of the Minami-Gamo Wastewater Treatment Plant), however, downward flow was able to be maintained due to a natural downward flow system design that takes advantage of the difference in the elevation of the land.

For increased safety and peace of mind, backup functions such as improving the seismic resistance of pipelines and facilities, the creation of dual water supply systems, and the introduction of equipment that will receive gas supply under emergency conditions are being boosted one step further. Measures to formulate a business continuity plan (BCP) focusing on recovery and reconstruction are also being taken.

Diagram: Figures showing increases to seismic resistance of critical infrastructure (water pipelines)



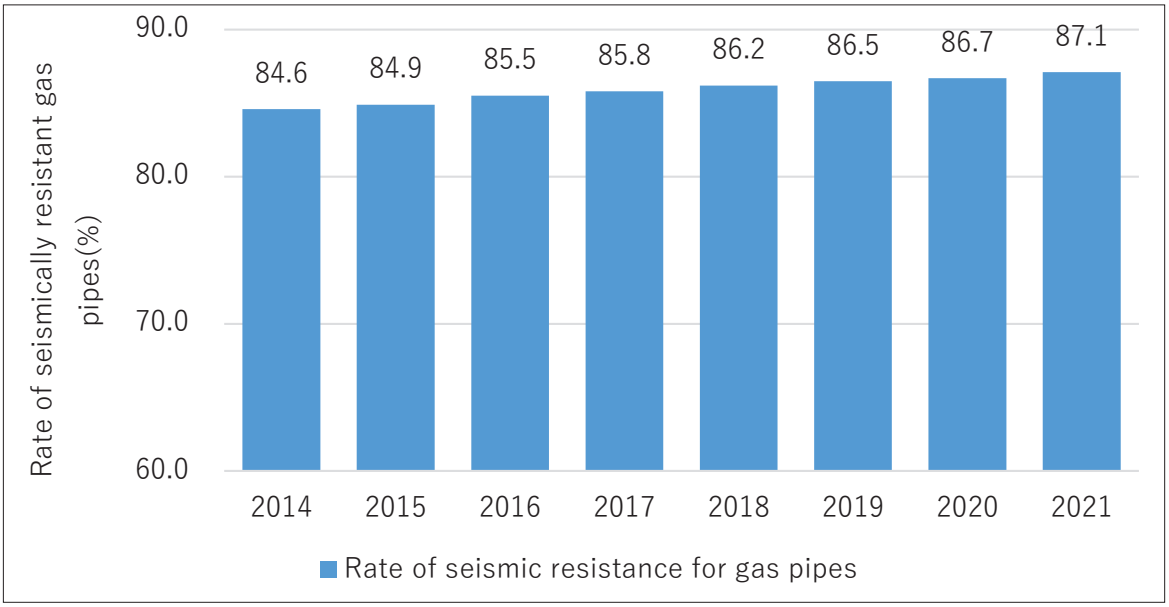
*The seismic resistance rate of water pipelines is calculated based on a management indicator (seismic resistance rate of pipelines) found in the Sendai City Waterworks Project Basic Plan (FY2020–2029) and similarly in the Waterworks Project Guidelines. In 2020, the definition was changed from (1) to (2) below.

(1) The seismic resistance rate of water pipelines with a diameter of 75 mm or more, which can be assessed as having a certain level of seismic resistance based on the strength of the materials and joints (connecting pipe parts).

(2) From FY2020, the seismic resistance rate of water pipelines with a diameter of 50 mm or more that can be assessed as having excellent earthquake resistance in terms of strength, etc.

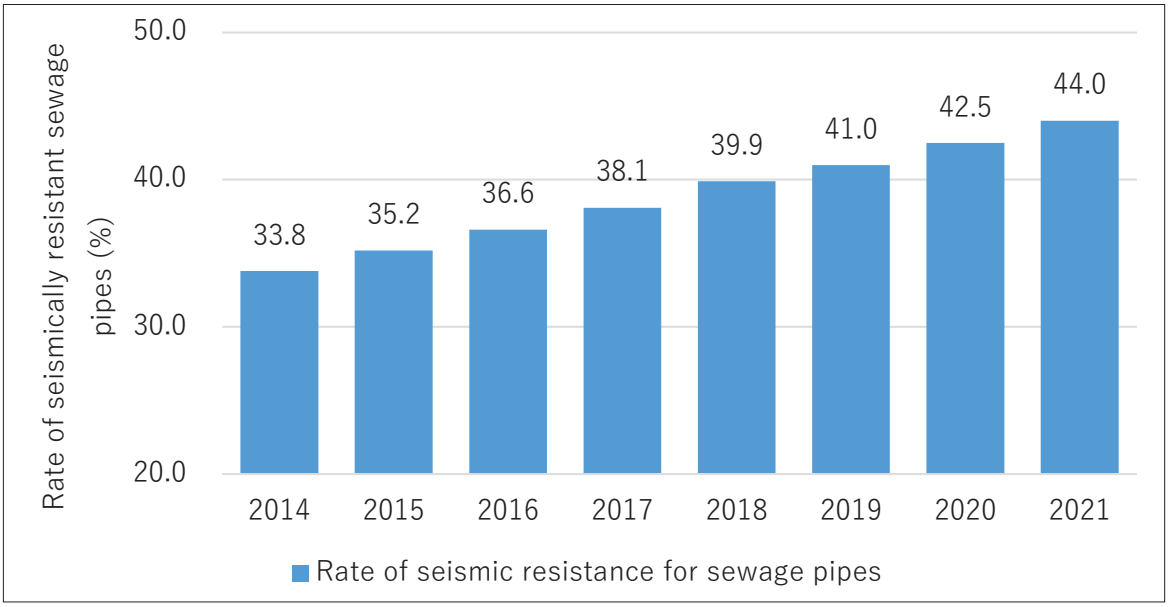
(Source of data: Sendai City Waterworks Bureau)

Diagram: Figures for improved seismic resistance of critical infrastructure (gas pipes)



(Source of data: Sendai City Gas Bureau)

Diagram: Figures for improved seismic resistance of critical infrastructure (sewage pipes)



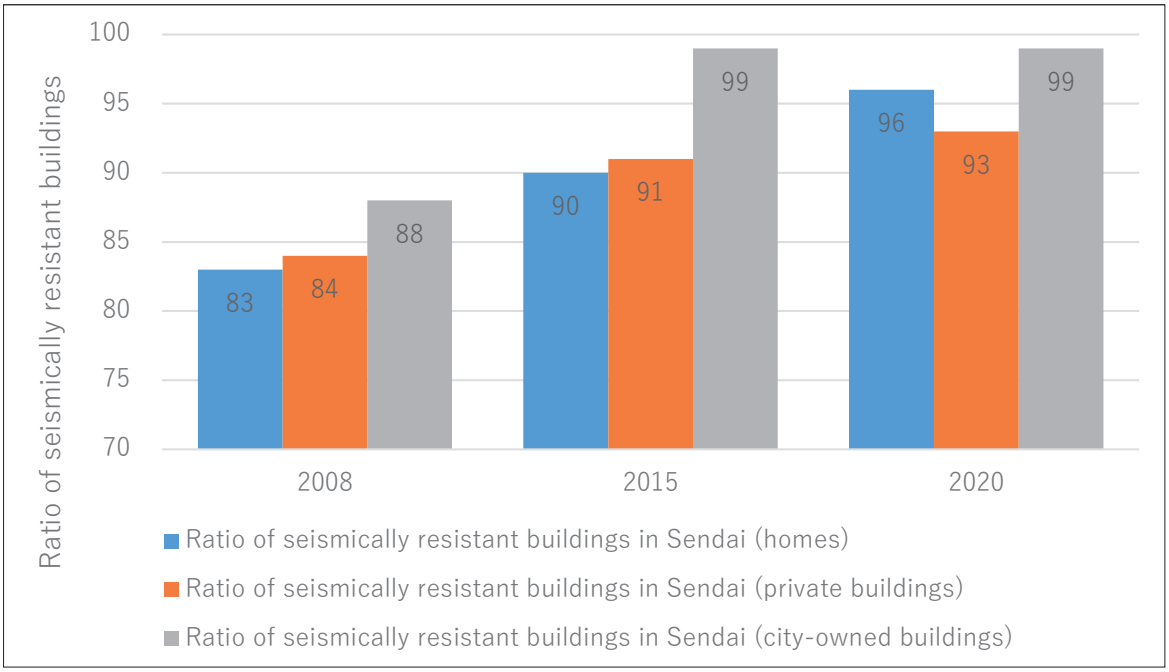
(Source of data: Sendai City Construction Bureau)

(2) Seismic resistance of wooden houses and condominiums

Wooden houses constructed before 1981 suffered severe damage during the 1995 Great Hanshin earthquake, resulting in the loss of many lives. This led to improvements to the seismic resistance of city-owned buildings.

With regard to detached wooden houses and condominiums, since FY2004, Sendai has been offering seismic resistance evaluations, subsidies for renovations, and advice based on the assessment findings. Under this system, in the period until FY2021, a total of 2,398 wooden houses and two condominiums were upgraded to be earthquake resistant.

Diagram: Figures for improved seismic resistance of city buildings



(Source of data: Sendai City Urban Planning Bureau)

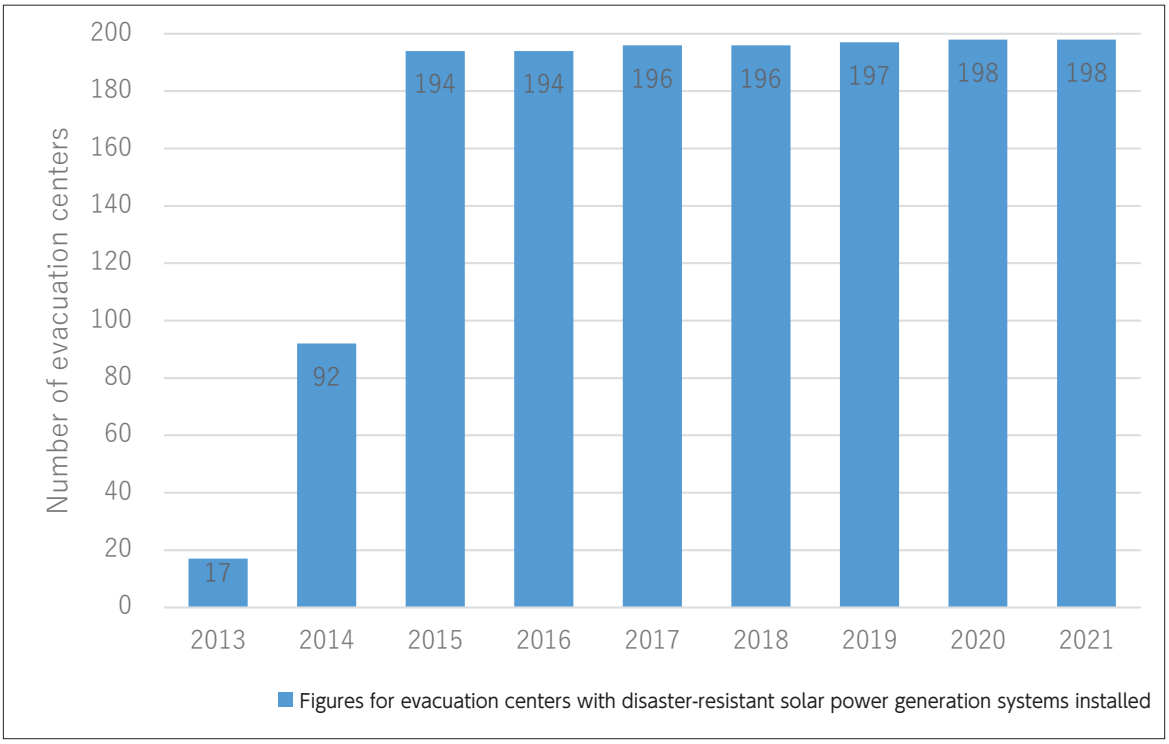
(3) Disaster-resistant solar power generation systems

During the Great East Japan Earthquake, disruptions to electricity and other sources of power caused a variety of problems in initial response, affecting the operation of evacuation centers and the like. Based on this experience, systems combining solar power generation and storage batteries has been installed in approximately 200 designated evacuation centers (elementary and junior high schools, etc.) throughout the city.

This initiative works to secure an independent source of power in the event of a disaster and to decarbonize the city during normal times. In the event of a power outage, electricity can be sourced by using solar power in the daytime and switching to storage batteries at night, allowing for the use of communication devices such as disaster prevention radios and TV, lighting, and other needs.

Working in cooperation with corporations and universities, initiatives working for the introduction of an energy management system offering remote monitoring and control of disaster-resistant solar power systems are also underway.

Diagram: Figures for evacuation centers where disaster-resistant solar power generation systems have been installed



(Source of data: Sendai City Environmental Bureau)

(4) Green Infrastructure in the City of Trees

Documents such as the Sendai City Basic Plan 2021–2030, which functions as the city's guideline for community development, and the Sendai City Green Basic Plan 2021–2030, which defines measures related to greenery, an important resource in Sendai City's community development, present a vision of sustainable community development that takes advantage of the city's favorable environment.

Working with these plans, the city's intention is to reduce the risk of flooding by enhancing green infrastructure working in alignment with the numerous processes of nature to build the foundations of human life. This include the utilization of green spaces and planted spaces in the city center to facilitate the filtering of rainwater into the ground.

In coastal areas, a key activity has been the planting of trees by citizens to restore the coastal disaster-prevention forests that were destroyed by the tsunami (see p.20: Furusato no Mori Forest Regeneration Project). This works to both preserve the coastal ecosystem and to enhance the effectiveness of multiple defenses against future tsunamis (see p. 24).

(5) Furusato no Mori Regeneration Project

The Great East Japan Earthquake caused extensive damage to green areas, including coastal disaster-prevention forests, in Sendai's eastern coastal areas.

The regeneration of green areas involves not only the planting of trees, but also a significant investment of time and energy in other activities including looking after the growth of the trees, their conservation, and so forth.

Consequently, Sendai City has partnered with citizens, NPOs, companies, and other organizations since 2014 on activities to plant and look after trees.

This project is a symbol of the reconstruction of Sendai, the City of Trees. In recognition of the city's efforts to restore the lush green landscape of its eastern area and make it attractive to visitors once again, it was awarded the Grand Prize (Minister of Land, Infrastructure, Transport and Tourism Award) in the 1st Green Infrastructure Award in 2021.

Tree planting and tending in action

IRIDeS evaluation of initiatives relating to Priority 3

Disaster countermeasures for critical infrastructure, improved seismic resistance for wooden houses and condominiums, and cooperation between the public and private sectors contribute to the resilience of the country. The promotion of green infrastructure and disaster-resistant solar power systems helps create an environmentally sustainable society that cares for the environment.

Investment in disaster risk reduction prior to the event reduces the damage caused by disasters and contributes to significant reductions in global Target A: "mortality rate," Target B: "number of affected people," Target C: "direct disaster economic loss," and Target D: "damage to critical infrastructure and disruption of basic services."

3.2.4 Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

Priority 4 sees the key to disaster risk reduction in enhancing the disaster response capabilities of all stakeholders, both in terms of hard and soft measures taken. In particular, the process of recovery and reconstruction that happens after a disaster is seen as a critical opportunity to "Build Back Better," incorporating experiences and lessons learned from the disaster and strengthening the disaster response capacity of the entire city.

Key initiatives undertaken by Sendai are as follows.

(1) Disaster risk reduction through the synergy of self-help, mutual aid, and public assistance

Since the establishment of Citizen Disaster Prevention Day in 1979, comprehensive disaster preparedness drills have been carried out on an annual basis in various locations throughout the city working in collaboration with a range of stakeholders such as local residents and neighborhood associations. From 2012 onward, this has also incorporated evacuation center management, based on the experience of the Great East Japan Earthquake.

Each local community organizes community-led drills and trainings based on scenarios for earthquakes, flooding, and other risks arising from the particular characteristics of the geographical area. These include tsunami evacuation drills for the city's eastern coastal regions, and training for responding to people who would be left stranded in the central parts of the city if public transportation services were suspended (see p.31). Local neighborhoods are preparing for the occurrence of a large-scale disaster through a combination of self-help, mutual aid, and public assistance.

NOTE: Registration System for People Requiring Assistance in Times of Disaster: protecting community members who need assistance

An information registration system for persons requiring assistance in the event of disaster was launched in FY2012 and is used to create a local evacuation support system. Through the system, information is provided to local organizations on people who need assistance in areas such guidance on evacuation or the confirmation of personal safety.

Registration is through the request of persons in need of support. As of March 2022, 10,055 people have registered.

Assistance drill in community

(2) Restoration of the Minami-Gamo Wastewater Treatment Plant

The Minami-Gamo Wastewater Treatment Plant used to treat about 70% of Sendai's sewage. The tsunami of over 10 meters in height that hit the plant after the 2011 earthquake caused catastrophic damage resulting in the shutdown of sewage treatment functions. Buildings suffered structural damage, machinery and electrical facilities were engulfed by the tsunami or swept away, power transmission towers collapsed.

As the plant is indispensable as infrastructure supporting the everyday lives of Sendai residents, discussions were held on how to implement its quick recovery concurrently with other tasks: the disposal of debris that had washed into the plant and the restoration of vital lifelines. In September 2011, a restoration policy that extended beyond the plant's previous functions was decided upon. After a design phase of approximately one year, the plant was constructed in a shortened timeframe of around three years—a process that would normally take ten years—with the entire system going into operation in 2015.

NOTE: Enhanced disaster prevention and environmental features at the Minami-Gamo Wastewater Treatment Plant

The plant's primary and final sedimentation tanks are a two-tray system, while the reaction tank is installed underground in the interests of compactness. The plant is elevated so as to be able to withstand tsunamis of Tokyo Peil* (T. P.) + 10.4 meters in height,* and doors in the building are a watertight design, enabling the plant to resist a tsunami of the scale of the wave that hit Sendai after the Great East Japan Earthquake.

A discharge line has been secured to allow the treatment and discharging of the minimum amount of wastewater without the use of a pump in the event of a blackout. The plant is equipped with a solar power generation system. A small-scale hydroelectric power generation system, useful to reduce power consumption, has also been newly installed, making the facility one that embodies the "Build Back Better" approach.

Policy related to the construction of facilities that can generate biogas from sludge was announced in 2022. Used for power generation and convert it into energy by the private sector, the aim is both to reduce greenhouse gas emissions and achieve economic efficiency through the sale of the gas.

*T.P. (Tokyo Peil) refers to the average sea level of Tokyo Bay, which sets the standard for sea level height in Japan.

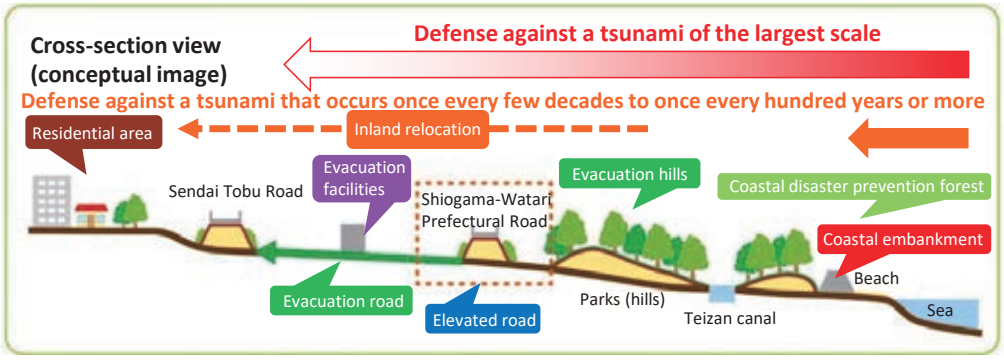
Exterior of the facility

(3) Multiple layer defenses against tsunamis

After the Great East Japan Earthquake, group relocations of populations living in the eastern coastal area were organized (see p. 24: Relocation to inland areas (project to promote group relocations for disaster prevention)). Meanwhile, projects to build coastal embankments and elevated roads were completed by 2019.

Such initiatives reduce the impact of a tsunami. Meanwhile, initiatives such as drills for residents using evacuation facilities assist in building multiple defenses that protect both human lives and urban functions.

Diagram: Multiple layer defenses against tsunamis



(4) Relocation to inland areas (project to promote group relocations for disaster prevention)

Even with multiple defenses in place, an area (of approximately 1,210 hectares) where the estimated flooding due to tsunami would exceed 2 meters was designated a disaster risk area in December 2011, and 1,540 local households were encouraged to relocate to safer regions in the west of the city.

The development of the relocation site and the purchase of land were completed by 2016.

New homes in the collective relocation site

(5) Utilization of disaster prevention collective relocation sites

In the aim of creating new appeal and value for the land (collective relocation site) that was purchased by Sendai City under the project to promote collective relocations for disaster risk reduction, land is being leased out to motivated citizens and businesses that have been selected through an

open-call process. It is being used in a self-directed way according to the free ideas of the private sector.

As of June 2021, land utilization has been decided in relation to 35 subdivisions and 18 businesses. Ventures such as a tourist orchard, a dog run, and a complex (with hot springs, restaurants etc.) are creating new life in the area.


Examples of the new site in use

(6) Restoration of cultivated agricultural areas in the east of the city

The eastern part of Sendai was severely damaged by the tsunami. Drainage pump stations were destroyed and farmland subsided, for example. To support the resumption of commercial agriculture in this area, damaged land is being restored while concurrently undergoing conversion into large-sized plots in order to improve productivity.

Under the initiative of national and prefectural governments, cultivated land is being upgraded through conversion into large-sized plots. City government first promoted consensus building among local residents, with the project commencing in stages from 2013 and 2,000 hectares converted by FY2020.

Commercial farming resumed in 2014 on farmlands whose production base was successfully put in order. Improvements to profitability are being sought through efforts such as the incorporation of commercial farming organizations and the consolidation of agricultural land.

Commercial farming resumed after the restoration of agricultural land

(7) Supporting disaster-stricken areas based on the experience and lessons learned from the Great East Japan Earthquake

Experience and knowledge gained from the Great East Japan Earthquake allows Sendai to provide recovery and reconstruction support to other affected areas by dispatching personnel or providing relief supplies, for example.

After the 2016 Kumamoto earthquake, staff members who had been involved in the operation of the Disaster Response Headquarters at the time of the Great East Japan Earthquake were send to Kumamoto to act in the capacity of advisors, offering counsel and recommendations based on their experiences. This was presented as a positive example in a report by the Ministry of Internal Affairs and Communications on methods for dispatching support staff.

In addition, while providing support tailored to the situation so as to minimize the time required for the recovery and reconstruction of disaster-stricken areas, new insights and challenges arising from the situation are reflected in the Sendai City Disaster Support Plan (formulated in 2018), a document that stipulates the details of the organizational structure and operations for support from the Sendai to other cities.

NOTE: Information on support personnel dispatched after the Great East Japan Earthquake (actual personnel numbers, with some duplication)

- **July 2012: Torrential rains in northern Kyushu**
  - ・Taketa, Oita Prefecture: disaster response support, disaster victim certification administrative support, health activities support (12 people)
  - ・Yame & Yanagawa, Fukuoka Prefecture: disaster response support, disaster certification administrative support (10 people)
- **April 2016: Kumamoto earthquakes**
  - ・Kumamoto, Kumamoto Prefecture: disaster victim certification administrative support, evacuation center management support etc. (269 people)
- **2016: Typhoon Lionrock (known in Japan as 2016 Typhoon No. 10)**
  - ・Iwate Prefecture: emergency firefighting support team (231 people)
- **2018: Torrential rains in Western Japan**
  - ・Soja, Okayama Prefecture: disaster victim certification administrative support, etc. (103 people)
  - ・Uwajima, Ehime Prefecture: water supply restoration support (21 people)
  - ・Kaita, Hiroshima Prefecture: health support for victims (15 people)
- **September 2018: Hokkaido Eastern Iburi earthquake**
  - ・Shiraoi, etc.: dispatching an advance team (2 people)
  - ・Sapporo: Disaster assessment advice for sewage pipes (2 people)
  - ・Abira: health consultations (15 people)
- **June 2019: Yamagata offshore earthquake**
  - ・Yamagata Prefectural Office: local liaison headquarters personnel (4 people)
  - ・Tsuruoka, Yamagata Prefecture: disaster victim certification administrative support (2 people)
- **2019: Typhoon Faxai (known in Japan as Reiwa 1 Boso Peninsula Typhoon or Typhoon #15)**
  - ・Minamiboso, Chiba Prefecture: disaster victim certification administrative support (6 people)
- **2019: Typhoon Hagibis East Japan Typhoon (known in Japan as Reiwa 1 East Japan Typhoon or Typhoon No. 19)**
  - ・Miyagi Prefecture: emergency firefighting support team etc. (336 people)
  - ・Osaki, Marumori, Osato, Miyagi Prefecture: support for water supply activities (191 people)
  - ・Fukushima Prefectural Office, etc.: support for restoration of sewage facilities (2 people)
  - ・Iwaki, Soma, etc., Fukushima Prefecture: emergency water supply support (12 people)
- **2021: Fukushima Prefecture offshore earthquake**
  - ・Marumori, Yamamoto, Shiogama, Miyagi Prefecture: emergency water supply support, support for restoration of sewage facilities (34 people)

IRIDeS evaluation of initiatives related to Priority 4

Hard measures such as the speedy emergency measures seen in the restoration of the Minami-Gamo Wastewater Treatment Plant, the creation of multiple defenses in preparation for a tsunami, and land use policy related to disaster prevention collective relocation, together with soft measures that promote disaster risk reduction through the synergy of self-help, mutual aid, and public assistance both serve to strengthen the advance preparations that are part of the recovery and reconstruction process.

Seen to make significant reductions in Target A: “mortality rate,” Target B: “number of affected people,” Target C: “direct disaster economic loss,” and Target D: “damage to critical infrastructure and disruption of basic services,” these efforts assist in the reduction of disaster risk.

3.2.5 Stakeholder responsibilities

In the promotion of the Sendai Framework for Disaster Risk Reduction, all stakeholders, including citizens, local organizations, academic institutions, and private sectors, are required to fulfill their respective roles and responsibilities. In addition, multiple perspectives should also be reflected, including disaster risk reduction measures from the perspective of gender.

Key initiatives undertaken by Sendai are as follows.

(1) Sendai Symposium for Disaster Risk Reduction and the Future

To ensure that the efforts of citizens at the Third UN World Conference on Disaster Risk Reduction are not a one-time event, the Sendai Symposium for Disaster Risk Reduction and the Future, has been held every year since 2014 as an event open to citizen participation.

Citizens, private sectors, NPOs, educational research institutions, and a variety of other stakeholders come together in an event where they can learn and think about disaster risk reduction through exhibitions, presentations, and experiential content.

Diagram: The theme of each session, together with visitor numbers

Year held	Theme	Venue	Number of attendees
2016	One Year After the UN World Conference on Disaster Risk Reduction Contributing to the future of disaster risk reduction from Sendai and Tohoku	Sendai International Center	Approx. 2,500
2017	Communicating, sharing, and handing down experiences	Sendai International Center	Approx. 1,600
2018	Protecting lives, putting down roots in the community Corporate disaster risk reduction initiatives	El Park Sendai	127
Mar., 2019	The leading role of multi-stakeholders We know and we act Toward a future of disaster risk reduction	Sendai International Center	Approx. 3,500
Nov., 2019 ※Held in conjunction with World Bosai Forum	Delivering our disaster preparedness To the world, to the future	Sendai International Center	Approx. 3,700
2020	Nine Years after the Great East Japan Earthquake Past progress, future thoughts	El Park Sendai	None *Video distribution
2021 *Held for 2 days	Ten Years after the Great East Japan Earthquake For an even better future	Sendai International Center	Approx. 4,300

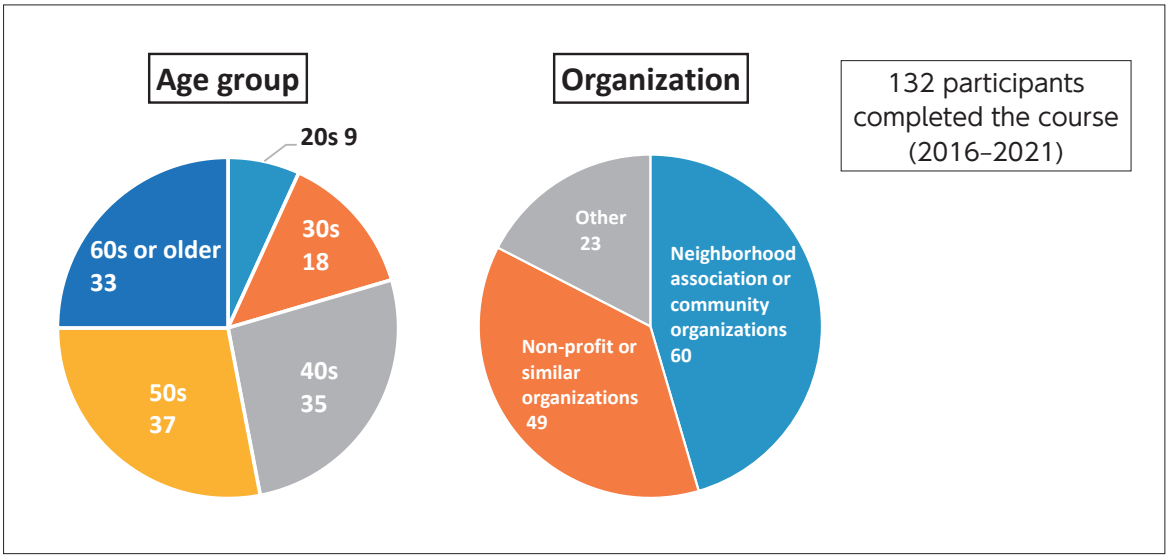
(Source of data: Sendai City City Planning Policy Bureau)

(2) Promotion of local disaster risk reduction from a gender equality perspective (women and disaster risk reduction community development)

In the aftermath of the Great East Japan Earthquake, there were many instances where women found themselves unable to demonstrate full leadership in the management of evacuation centers or the process of reconstruction.

It is important to create an environment in which women can play an active role as leaders in building disaster-resilient communities together. Since 2016, Sendai has run Decision-making and Taking Action, a training program to build human resources for local community development. In order to have various people, including women, participating in local disaster risk reduction during normal times, in 2014, the city created and ran a workshop program in collaboration with citizens to consider issues related to the management of evacuation centers.

Diagram: Numbers of participants who have completed the Decision-making and Taking Action training program



(Source of data: Sendai City Community Affairs Bureau)

(3) BOSAI-TECH Innovation Creation Promotion Initiative

Since 2019, Sendai has been working under the theme of disaster risk reduction and technology (BOSAI–TECH) with the aim of revitalizing local industry through the creation of disaster risk reduction-related ventures, an example of which is experiments with technologies such as drones (see p.11: Tsunami Evacuation Information Drone).

The Sendai BOSAI–TECH Innovation Platform was established in February 2022. Participants include companies, organizations, and human resources active in the fields of disaster risk reduction, technology, and business. The platform is an arena for the ongoing creation of new solutions to various disaster risk reduction issues through a collaboration of industry, academia, government, and finance. As of December 2022, the platform has more than 140 members, including other municipalities in Japan and also domestic

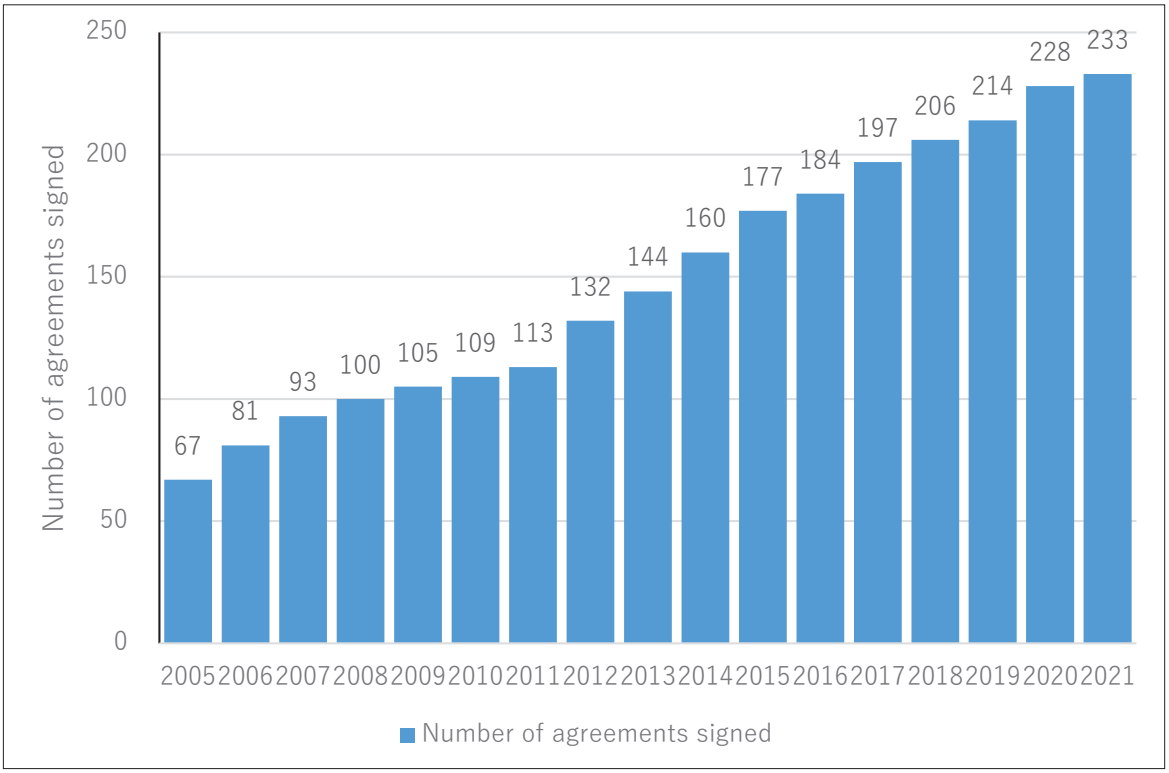
and foreign companies. It supports the creation of new ventures by member companies and has plans to expand within the city, the country, and internationally as well.

(4) Cooperation with local governments, companies, research institutes, etc.

Preparedness for the occurrence of a large-scale disaster has been in place since before the Great East Japan Earthquake. Under agreements for mutual support concluded between municipalities, local governments have supported each other by dispatching personnel or providing supplies in times of disaster. Sendai also had agreements in place with private companies for a range of emergency measures including public relations activities and the supply of food and other goods, and has partnered with research institutes on joint research projects that are playing a part in disaster risk reduction. In the wake of the Great East Japan Earthquake, Sendai received a variety of support from all over the country thanks to these agreements.

Based on the lessons learned from the Great East Japan Earthquake, the city is also working to have private facilities made available for tsunami evacuation and as shelter for stranded commuters (see p. 24: Multiple defenses against tsunamis), building a solid support and cooperative system through collaboration with various stakeholders.

Diagram: Figures for signed support agreements



(Source of data: Sendai City Crisis Management Bureau)

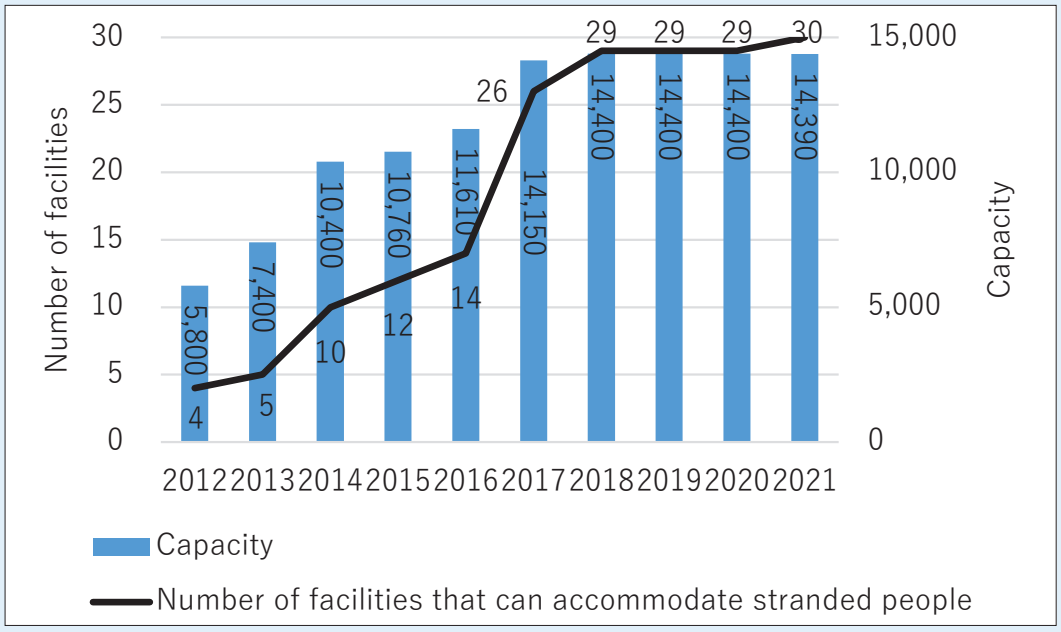
NOTE: Strategies taken in collaboration with companies to respond to stranded commuters

After the Great East Japan Earthquake, more than 10,000 people, including tourists, found themselves unable to return home due to the suspension of public transport services and caused great confusions as they streamed into the nearest evacuation shelters.

Learning from this, the city has secured temporary accommodation for stranded commuters in the vicinity of transportation hubs such as Sendai Station through the cooperative efforts of transportation operators, hotels, commercial facilities, universities, and others.

In the aim of preventing confusion in the event of a disaster, concerned parties in the areas around JR Sendai and JR Nagamachi stations have worked together to set up a liaison council for responding to people who have been stranded and are unable to return home. The council has drawn up a set of guidelines for responding to stranded people, a clear demonstration of the efforts toward mutual assistance made by business operators in the station areas.

Diagram: Temporary accommodation for stranded people and figures for the number of people accommodated



(Source of data: Sendai City Crisis Management Bureau)

IRIDeS evaluation of initiatives taken by stakeholders

Opportunities such as the running of the Sendai Symposium for Disaster Risk Reduction and the Future, the promotion of women's leadership, and promoting the creation of innovation in BOSAI–TECH are participated in by diverse stakeholders from industry, government, academia, and the citizens of Sendai, and are all initiatives that will help mainstream disaster risk reduction.

BOSAI-TECH, an initiation that shares and rolls out disaster risk reduction technology both in Japan and overseas, is a contribution to global Target F: “enhance international cooperation.” The running of the Sendai Symposium for Disaster Risk Reduction and the Future and the promotion of women's leadership are important initiatives that address all of Targets A to G.

3.2.6 International cooperation and global partnerships

The Sendai Framework for Disaster Risk Reduction calls for countries and international organizations to play a central role in providing ongoing support to developing countries and other countries vulnerable to disaster damage. At more local levels such as that of local government, it is necessary to utilize different networks to enhance access to knowledge and the sharing of information.

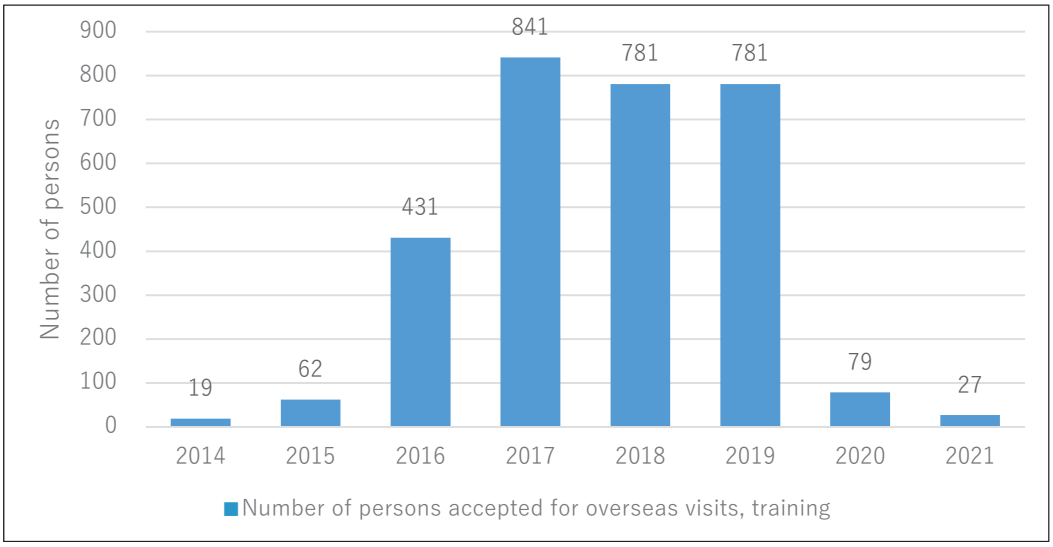
Key initiatives undertaken by Sendai are as follows.

(1) Widespread information sharing through international conferences and hosting visits

Since the Great East Japan Earthquake, Sendai has played a role as a disaster-stricken area to make a contribution to disaster risk reduction around the world. The city shares information on the current state of reconstruction and on experiences of and lessons learned in the earthquake. In particular, with the hosting of the Third UN World Conference on Disaster Risk Reduction and the adoption of the Sendai Framework for Disaster Risk Reduction, Sendai has actively participated in international conferences hosted by organizations such as the United Nations Office for Disaster Risk Reduction (UNDRR), disseminating information on initiatives taken by the city. Examples include the Global Platform for Disaster Risk Reduction and the Asia Ministerial Conference on Disaster Risk Reduction. Additionally, the city has been communicating widely both in Japan and overseas using pamphlets, newsletters, and the Internet, on the topics of reconstruction efforts and lessons learned from the earthquake.

In addition to giving presentations at conferences both in Japan and overseas, the city enthusiastically hosts visits from companies, people involved in disaster risk reduction in Japan and overseas, and other organizations such as the Training Center for Gender & Disaster Risk Reduction, sponsored by the Japan International Cooperation Agency (JICA). Since 2020, such visits have declined in number due to the impact of Covid-19, although information is still being disseminated via the Internet.

Diagram: Number of persons accepted for overseas visits, training



(Source of data: Sendai City City Planning Policy Bureau)

NOTE: Recognition as a Disaster Risk Reduction Role Model City by the United Nations Organization for Disaster Risk Reduction (UNDRR)

From 2011–2020, the United Nations Organization for Disaster Risk Reduction (UNDRR) ran a campaign for global risk reduction called Making Cities Resilient. Under the campaign, Sendai was ranked as a Role Model City for advanced disaster risk reduction, coming 35th in the world (the first such case in Japan was Hyogo Prefecture).

Approximately 1,400 cities participated in the campaign. Of them, those that have implemented initiatives that serve as models for disaster risk reduction in other countries around the world were officially recognized by the UNDRR. Sendai's efforts toward disaster risk reduction, which commenced prior to the earthquake, and its work on disaster mitigation at the community level, carried out in cooperation with citizens in reconstruction projects, and human capacity building that supports the taking of action for mitigation, were all highly evaluated.

The above campaign ended in 2020. Meanwhile, Sendai has become the first Japanese municipality to participate in the follow-up initiative: Making Cities Resilient 2030.

Sendai also takes part in Sendai Framework Voluntary Commitments, a UNDRR portal website where organizations from all countries can voluntarily inform others about actions they have taken toward implementing the Sendai Framework. Efforts presented on the portal feature training programs to develop women's leadership (see p.29: Promotion of local disaster risk reduction from a gender equality perspective (women and disaster risk reduction community development)).

(2) Cooperation in hosting the World Bosai Forum / IDRC in Sendai

The World Bosai Forum is an international conference that has been held regularly in Sendai since 2017 under an agreement between IRIDeS and the International Disaster and Risk Conference (IDRC Davos) held in Switzerland. While IDRC Davos focuses on experts in the field, the World Bosai Forum is distinctive for having programs in which a wide range of citizens are welcome to participate.

A member of the executive committee, Sendai City offers its support in holding the conference. Presenting the Sendai Symposium for Disaster Risk Reduction and the Future (see p. 28) concurrently, the city is attempting to create synergies in providing Sendai citizens opportunities for exchange with international experts, as it also encourages them to come into contact with the world's most advanced disaster risk reduction knowhow.

A panel at the World Bosai Forum

IRIDeS evaluation of international cooperation

Sendai's proactive stance in hosting companies and people in charge of disaster management both in Japan and overseas, including announcing its hopes to host the Third UN World Conference on Disaster Risk Reduction in 2015, represents an important effort to share its experiences and lessons from the Great East Japan Earthquake with the world.

In terms of their promotion of international cooperation and strengthening of global partnerships, these initiatives are contributions to global Target F: "enhance international cooperation."

3.3 Analysis findings for data related to the seven global targets

3.3.1 Global target assessment indicators

Required data and assessment indicators for the seven global targets have been organized in accordance with UNDRR guide on assessment indicators (*).

Targets aimed at reductions (Targets A to D) were quantitatively assessed based on data related to disaster damage and other factors. Meanwhile, as the indicators outlined in the UNDRR guide are used to monitor initiatives taken at the national level, for targets aimed at increases (Targets E to G), we decided to study trends in changes in the implementation of initiatives taken by Sendai City that are related to the indicators.

(*)Sendai Framework for Disaster Risk Reduction guide on assessment indicators

Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction: Collection of Technical Notes on Data and Methodology (UNISDR, 2017)

Diagram: Assessable global targets and assessment indicators

Global Target		Index	
A	Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015	A-1 (combined)	Disaster mortality and missing people per 100,000
		A-2	Disaster mortality per 100,000
		A-3	Missing people by disaster per 100,000
B	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015	B-1 (combined)	Number of people directly affected by disasters per 100,000
		B-2	Number of people who were injured by or fell sick due to a disaster per 100,000
		B-3	Number of people whose residence was damaged
		B-4	Number of people whose residence was completely destroyed
		B-5	Number of people whose foundation for life was either damaged or lost
C	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030	C-1 (combined)	Direct economic loss caused by disasters compared to GDP
		C-2	Direct agricultural loss caused by disasters
		C-3	Direct economic loss of other production facilities that were either damaged or completely destroyed by disasters
		C-4	Direct economic loss of housing sector due to disasters
		C-5	Direct economic loss from critical infrastructure either being damaged or completely destroyed by disasters
		C-6	Direct economic loss from cultural heritage either being damaged or completely destroyed by disasters
D	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030	D-1 (combined)	Damage to critical infrastructure caused by disasters
		D-2	Number of health facilities either completely destroyed or damaged by disasters
		D-3	Number of educational facilities either completely destroyed or damaged by disasters
		D-4	Number of other critical infrastructure departments and facilities either completely destroyed or damaged by disasters
		D-5 (combined)	Number of disruptions to basic services caused by disasters
		D-6	Number of disruptions to educational services caused by disasters
		D-7	Number of disruptions to health services caused by disasters
		D-8	Number of disruptions to other basic services caused by disasters
E	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020	E-1~2	Sendai City's Relevant Initiatives and Current Status
F	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030	F-1~8	
G	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030	G-1~6	

3.3.2 Disasters assessed in this report

This report is based on the assessment of disasters that occurred between 2005 and 2021. Major disasters outlined below.

Small-scale disasters other than those listed below were also part of the assessment.

(1) Earthquakes

The 2011 Great East Japan Earthquake is one of the most serious earthquakes to have struck Sendai. At around 2:46 p.m. on March 11th, 2011, an earthquake occurred with an epicenter off the coast of Sanriku (38°06.2'N, 142°51.6'E). The maximum magnitude recorded in Japan was 9.0, while the maximum seismic intensity (on the Japanese scale) in the city limits was 6+, recorded in Miyagino Ward. The earthquake triggered a tsunami who height reached an estimated 7.1 meters at Sendai Port. The largest aftershock was recorded on April 7th with a magnitude of 7.2 and a seismic intensity of 6+ in Miyagino Ward.

Other major disasters that have occurred in Sendai are as follows.

Diagram: Main earthquakes occurring within the assessment period

Date	Earthquake	Overview of earthquake
June 14th, 2008	Iwate-Miyagi Nairiku earthquake	Magnitude: 7.2 Maximum seismic intensity in city: 5+
February 27th, 2010	Earthquake with epicenter off the coast of central Chile	Magnitude: 8.6 Tsunami warning issued for Miyagi Prefecture (major tsunami)
March 11th, 2011	Great East Japan Earthquake	Magnitude: 9.0 Maximum seismic intensity in city: 6+ Tsunami warning issued for Miyagi Prefecture (major tsunami)
August 30th, 2012	Earthquake with epicenter off the coast of Miyagi Prefecture	Magnitude: 5.6 Maximum seismic intensity in city: 5+
November 22nd, 2016	Earthquake with epicenter off the coast of Fukushima Prefecture	Magnitude: 7.4 Maximum seismic intensity in city: 4 Tsunami warning issued for Miyagi Prefecture
February 13th, 2021	Earthquake with epicenter off the coast of Fukushima Prefecture	Magnitude: 7.3 Maximum seismic intensity in city: 5+
March 20th, 2021	Earthquake with epicenter off the coast of Miyagi Prefecture	Tsunami warning issued for Miyagi Prefecture Magnitude: 6.9 Maximum seismic intensity in city: 5+
May 1st, 2021	Earthquake with epicenter off the coast of Miyagi Prefecture	Maximum seismic intensity in city : 5- Magnitude: 6.8

Source of data: Sendai City website listing of past major disasters experienced in Sendai, Sendai Regional Disaster Prevention Plan (General Edition)

(2) Storm and flood damage

In recent years, Sendai has been experiencing increasingly severe weather conditions, including brief torrential rainstorms. Disaster patterns are also changing, with an increase in urban flooding and landslides occurring in built-up areas. Major disasters that have occurred in Sendai are as follows.

Table: Major storm and flood damage occurring within the assessment period

Date	Type of damage	Cause of disaster	Weather records for Sendai area
September 20th–21st, 2011	flood and storm damage	Typhoon Roke (2011 Typhoon No. 15 in Japan)	Total rainfall: 318.0mm (20th–21st) Max. rainfall/hr: 51.0mm Max. instantaneous wind speed: 23.2m/s
June 19th–20th, 2012	flood and storm damage	Typhoon Guchol (2012 Typhoon No. 4 in Japan)	Total rainfall: 134.5mm (19th–20th) Max. rainfall/hr: 31.0mm Max. instantaneous wind speed: 22.3m/s
September 30th, 2012	flood and storm damage	Typhoon Jelawat (2012 Typhoon No. 17 in Japan)	Total rainfall: 26.5mm (30th–1st) Max. rainfall/hr: 11.5mm Max. instantaneous wind speed: 26.3m/s
September 10th–11th, 2015	flood damage	Tropical Storm Etau (2015 Typhoon No. 18 in Japan)	Total rainfall: 271.5mm (10th–11th) Max. rainfall/hr: 50.0mm
October 12th–13th, 2019	flood and storm damage	Typhoon Hagibis East Japan Typhoon (Reiwa 1 East Japan Typhoon or Typhoon No. 19 in Japan)	Total rainfall: 383.5mm (11th–13th) Max. rainfall/hr: 63.5 mm Max. instantaneous wind speed: 30.4m/s

Source of data: Sendai City website listing of past major disasters experienced in Sendai, Sendai Regional Disaster Prevention Plan (General Edition)

3.3.3 Collection and analysis of disaster damage data

After discussions between Sendai City and IRIDeS, city government agreed to release data and documents on disaster damage that was related to assessment indicators.

Data was collected from the relevant government departments, then aggregated using an assessment formula in accordance with the UNDRR guide for assessment indicators.

Diagram: Data related to assessment indicators

Type of damage	Name of data/document	Government department	Related assessment indicators
Deaths, etc.	Ledger of disaster-related condolence money payments	Health and Welfare Bureau	A-2、A-3
Negative Injuries, etc.	Emergency transportation data	Fire Bureau	B-2
Building	List of issued certificates of disaster	Finance Bureau	B-3、B-4、B-5、C-3、C-4、C-5
Agriculture	Damage survey reports; reports on damage to crops, etc.; damage reports	Economic Affairs Bureau	B-5、C-2
Medical facilities	Fukushima earthquake damage report	Health and Welfare Bureau	C-5、D-2、D-7
Educational facilities	Response forms on damage to educational facilities, school closures, etc.	Education Bureau	C-5、D-3、D-6
Cultural properties	List of subsidized projects for disaster-related restoration of cultural properties	Education Bureau	C-6
Sewage facilities	List of post-disaster assessment of sewage facilities	Construction Bureau	C-5、D-4、D-8

Diagram: Documents related to assessment indicators (collections of records, etc.)

Type of damage	Name of data/document	Government department	Related assessment indicators
Medical facility	Records of the Great East Japan Earthquake (*)	-	C-5、D-2、D-7
Gas facility	Great East Japan Earthquake: Records of Restoration	Gas Bureau	C-5、D-4、D-8
Waterworks facility	Great East Japan Earthquake: Records of the Restoration of Sendai City Waterworks	Waterworks Bureau	
General damage	Major disasters Experienced by Sendai in the Past (data on Sendai City website)	Crisis Management Bureau	C-5、D-4、D-8
	Great East Japan Earthquake Sendai City: Collection of Earthquake Records	Community Development Policy Bureau	B-5、C-2、D-4、D-8
	Great East Japan Earthquake Sendai City: Collection of Records after Five Years of Reconstruction	Community Development Policy Bureau	B-5、C-2、D-4、D-8

(*) Issued by the Sendai City Medical Association

3.3.4 Assessment findings from the monitoring of indicators

(1) Assessment findings for Targets A to D

Each indicator was compared and assessed according to average values for the assessment period (2005–2014/2015–2021). It was found that targets were achieved for almost all assessment indicators. In addition, the assessment revealed a target achievement of greater than 90% for the majority of assessment indicators.

The assessment period of the Framework was taken into account, and the monitoring and assessment were conducted working solely with disasters that actually occurred during the parameters of the period. When factors such as the frequency of disasters and the interval of time between the occurrence of earthquakes are taken into consideration, it should be noted that there are limitations to direct assessment in the first and second halves of the time period.

Diagram: Monitoring and assessment results for Targets A to D [All disasters]

Global Target		Assessment Result (All Disasters)		Progress
Assessment Index		Annual Average (2005–2014)	Annual Average (2015–2021)	○: Achieved ／: Not achieved
A Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015				
A-1 (combined	Disaster mortality and missing people per 100,000	5.22 /100,000	0.03 /100,000	○ -99%
A-2	Disaster mortality per 100,000	4.99 /100,000	0.03 /100,000	○ -99%
A-3	Missing people by disaster per 100,000	0.24 /100,000	0.00 /100,000	○ -100%
B Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015				
B-1 (combined	Number of people directly affected by disasters per 100,000	7,899 /100,000	508 /100,000	○ -94%
B-2	Number of people who were injured by or fell sick due to a disaster per 100,000	22 /100,000	1 /100,000	○ -97%
B-3	Number of people whose residence was damaged	48,061	2,946	○ -94%
B-4	Number of people whose residence was completely destroyed	6,340	2	○ -100%
B-5	Number of people whose foundation for life was either damaged or lost	28,060	2,599	○ -91%
C Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030				
C-1 (combined	Direct economic loss caused by disasters compared to GDP	2.98 %	0.05 %	○ -98%
C-2	Direct agricultural loss caused by disasters	7,369 million yen	439 million yen	○ -94%
C-3	Direct economic loss of other production facilities that were either damaged or completely destroyed by disasters	11,342 million yen	11 million yen	○ -100%
C-4	Direct economic loss of housing sector due to disasters	99,109 million yen	10 million yen	○ -100%
C-5	Direct economic loss from critical infrastructure either being damaged or completely destroyed by disasters	12,007 million yen	1,966 million yen	○ -84%
C-6	Direct economic loss from cultural heritage either being damaged or completely destroyed by disasters	17 million yen	0 million yen	○ -100%
D Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030				
D-1 (combined	Damage to critical infrastructure caused by disasters	137 cases/100,000	5 cases/100,000	○ -96%
D-2	Number of health facilities either completely destroyed or damaged by disasters	39 cases	15 cases	○ -62%
D-3	Number of educational facilities either completely destroyed or damaged by disasters	27 cases	20 cases	○ -26%
D-4	Number of other critical infrastructure departments and facilities either completely destroyed or damaged by disasters	1,364 cases	19 cases	○ -99%
D-5 (combined	Number of disruptions to basic services caused by disasters	5,742 cases/100,000	12 cases/100,000	○ -100%
D-6	Number of disruptions to educational services caused by disasters	20 cases	29 cases	／ 45%
D-7	Number of disruptions to health services caused by disasters	19 cases	4 cases	○ -77%
D-8	Number of disruptions to other basic services caused by disasters	60,078 cases	99 cases	○ -100%

*D-6 “Number of disruptions in educational services due to disasters” represents the total number of schools that were closed, but does not take into consideration the length of time of the closures. (Includes temporary closures due to heavy rain.)

1) Earthquakes and tsunamis

Damage from earthquakes and tsunamis has been on a downward trend since the Great East Japan Earthquake. All assessment indicators targets were achieved.

Diagram: Monitoring and assessment results for targets A to D: Earthquakes and tsunamis

Global Target / Assessment Index			Assessment Result (All Disasters) Annual Average (2005–2014)	Annual Average (2015–2021)	Progress ○: Achieved ／: Not achieved	
A	Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015					
	A-1 (combined	Disaster mortality and missing people per 100,000	5.22 /100,000	0.00 /100,000	○	-100%
	A-2	Disaster mortality per 100,000	4.99 /100,000	0.00 /100,000	○	-100%
	A-3	Missing people by disaster per 100,000	0.24 /100,000	0.00 /100,000	○	-100%
B	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015					
	B-1 (combined	Number of people directly affected by disasters per 100,000	7,895 /100,000	309 /100,000	○	-96%
	B-2	Number of people who were injured by or fell sick due to a disaster per 100,000	22 /100,000	1 /100,000	○	-97%
	B-3	Number of people whose residence was damaged	48,061	2,381	○	-95%
	B-4	Number of people whose residence was completely destroyed	6,340	0	○	-100%
	B-5	Number of people whose foundation for life was either damaged or lost	28,019	1,000	○	-96%
C	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030					
	C-1 (combined	Direct economic loss caused by disasters compared to GDP	2.98 %	0.03 %	○	-99%
	C-2	Direct agricultural loss caused by disasters	7,347 million yen	60 million yen	○	-99%
	C-3	Direct economic loss of other production facilities that were either damaged or completely destroyed by disasters	11,342 million yen	3 million yen	○	-100%
	C-4	Direct economic loss of housing sector due to disasters	99,109 million yen	0 million yen	○	-100%
	C-5	Direct economic loss from critical infrastructure either being damaged or completely destroyed by disasters	12,005 million yen	1,652 million yen	○	-86%
	C-6	Direct economic loss from cultural heritage either being damaged or completely destroyed by disasters	17 million yen	0 million yen	○	-100%
D	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030					
	D-1 (combined	Damage to critical infrastructure caused by disasters	137 cases/100,000	4 cases/100,000	○	-97%
	D-2	Number of health facilities either completely destroyed or damaged by disasters	39 cases	15 cases	○	-62%
	D-3	Number of educational facilities either completely destroyed or damaged by disasters	27 cases	19 cases	○	-31%
	D-4	Number of other critical infrastructure departments and facilities either completely destroyed or damaged by disasters	1,363 cases	6 cases	○	-100%
	D-5 (combined	Number of disruptions to basic services caused by disasters	5,742 cases/100,000	1 cases/100,000	○	-100%
	D-6	Number of disruptions to educational services caused by disasters	20 cases	0 cases	○	-98%
	D-7	Number of disruptions to health services caused by disasters	19 cases	4 cases	○	-77%
	D-8	Number of disruptions to other basic services caused by disasters	60,078 cases	12 cases	○	-100%

2) Storm and flood damage

Although storm and flood damage is small in scale compared to that caused by earthquakes and tsunamis, this investigation revealed an increase in damage in recent years. Looking specifically at individual indicators, while there was no significant difference in human damage (deaths, injuries, etc.) between the first half and the second halves of the assessment period, property damage (damage to homes/businesses, etc.), damage related to agriculture and fisheries, and damage to social infrastructure (economic losses, disruptions to services, etc.) were shown to be on the rise, especially in recent years.

Diagram: Monitoring and assessment results for targets A to D (Storm and flood damage)

Global Target / Assessment Index			Assessment Result (All Disasters) Annual Average (2005–2014)	Assessment Result (All Disasters) Annual Average (2015–2021)	Progress (○: Achieved ／: Not achieved)	
A	Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015					
	A-1 (combined	Disaster mortality and missing people per 100,000	0.00 /100,000	0.03 /100,000	／	Increased
	A-2	Disaster mortality per 100,000	0.00 /100,000	0.03 /100,000	／	Increased
	A-3	Missing people by disaster per 100,000	0.00 /100,000	0.00 /100,000	○	–
B	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015					
	B-1 (combined	Number of people directly affected by disasters per 100,000	4 /100,000	200 /100,000	／	4988%
	B-2	Number of people who were injured by or fell sick due to a disaster per 100,000	0 /100,000	0 /100,000	○	–
	B-3	Number of people whose residence was damaged	0	565	／	Increased
	B-4	Number of people whose residence was completely destroyed	0	2	／	Increased
	B-5	Number of people whose foundation for life was either damaged or lost	41	1,599	／	3772%
C	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030					
	C-1 (combined	Direct economic loss caused by disasters compared to GDP	0.00 %	0.01 %	／	2712%
	C-2	Direct agricultural loss caused by disasters	22 million yen	379 million yen	／	1651%
	C-3	Direct economic loss of other production facilities that were either damaged or completely destroyed by disasters	0 million yen	9 million yen	／	Increased
	C-4	Direct economic loss of housing sector due to disasters	0 million yen	10 million yen	／	Increased
	C-5	Direct economic loss from critical infrastructure either being damaged or completely destroyed by disasters	1 million yen	314 million yen	／	21751%
	C-6	Direct economic loss from cultural heritage either being damaged or completely destroyed by disasters	0 million yen	0 million yen	○	–
D	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030					
	D-1 (combined	Damage to critical infrastructure caused by disasters	0 cases/100,000	1 cases/100,000	／	7267%
	D-2	Number of health facilities either completely destroyed or damaged by disasters	0 cases	0 cases	○	–
	D-3	Number of educational facilities either completely destroyed or damaged by disasters	0 cases	1 cases	／	Increased
	D-4	Number of other critical infrastructure departments and facilities either completely destroyed or damaged by disasters	0 cases	13 cases	／	6614%
	D-5 (combined	Number of disruptions to basic services caused by disasters	0 cases/100,000	11 cases/100,000	／	Increased
	D-6	Number of disruptions to educational services caused by disasters	0 cases	28 cases	／	Increased
	D-7	Number of disruptions to health services caused by disasters	0 cases	0 cases	○	–
	D-8	Number of disruptions to other basic services caused by disasters	0 cases	87 cases	／	Increased

(2) Assessment findings for Targets E to G

Among the various initiatives described in 3.2. Progress and results in implementing initiatives related to the four priorities for action, annual figures were examined for initiatives that are highly relevant to the assessment indicators. All such initiatives are on an upward trend and can be considered to have achieved the relevant targets.

Details of the assessment are as follows.

Diagram: Assessment findings for initiatives related to Targets E to G

	Global Target	Progress
	Relevant initiatives by Sendai City and their situation	○: Achieved ／: Not achieved
E	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020	
	Number of evacuation centers with localized operation manuals completed	○
F	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030	
	Figures for participants in training programs, etc.	○
G	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030	
	Sendai City Crisis Management Bureau Twitter account, number of followers	○

1) Initiatives related to Target E (local disaster risk reduction strategies)

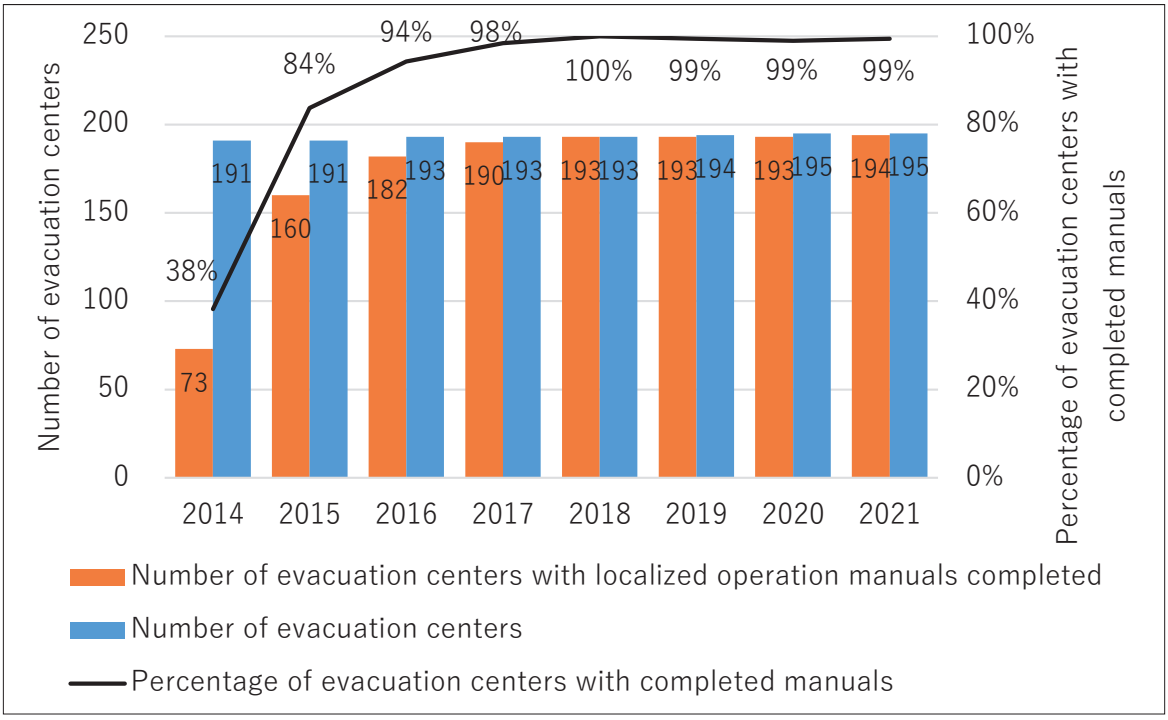
Sendai City's disaster risk reduction strategies include the Sendai Regional Disaster Prevention Plan (see p. 13) and the Sendai City National Resilience Regional Plan (see p. 13), in addition to the Sendai City Earthquake Disaster Reconstruction Plan, which is designed to comprehensively address various initiatives for recovery from the Great East Japan Earthquake.

These plans function as both local disaster risk reduction strategies (corresponding to assessment indicator E-1) in line with with Japan's national strategy, and also as disaster risk reduction strategies (corresponding to assessment indicator E-2) in line with the Sendai Framework for Disaster Risk Reduction. As such, initiatives related to Target E can be considered to be in implementation.

We focused on the number of evacuation shelters for which localized operation manuals have been completed (see p.15) and the relationships of evacuation shelters as an initiative that can be quantitatively assessed in terms of disaster risk reduction strategies, and examined annual figures, looking at fluctuations over time.

The preparation of localized manuals has sped up since 2014, reaching an achievement rate of 100% of evacuation centers in 2018. Since then, there has been a slight increase in the number of designated evacuation centers, however, the achievement rate has remained at a high level.

Diagram: Figures for evacuation centers with localized operation manuals completed (duplicated)



(Source of data: Sendai City Community Affairs Bureau)

2) Initiatives related to Target F (international cooperation)

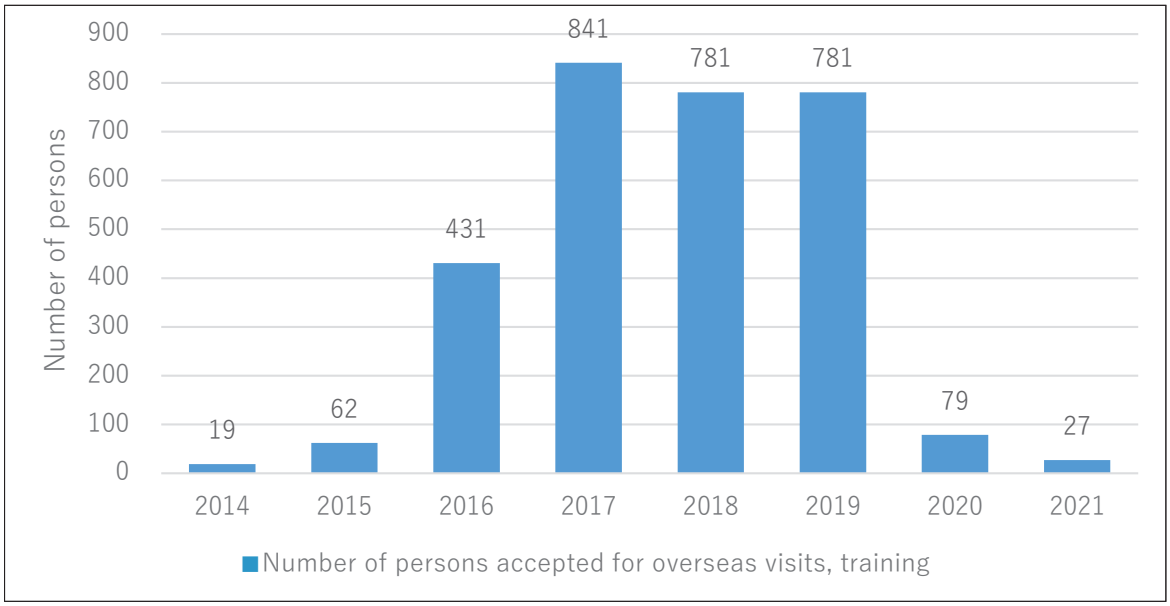
Sendai's efforts to disseminate information by hosting international conferences and inspection tours (see p.33) are examples of the city's work for international cooperation. Of these, we studied figures for the number of international visitors accepted for inspection tours and trainings, an initiative that can be quantitatively assessed.

Figures saw a striking increase after the Third UN World Conference on Disaster Risk Reduction held in 2015, with participants in 2017 reaching a record hight of 841 persons.

Training programs and the like have taken on wide-ranging themes, including reconstruction, disaster risk reduction, women's leadership, and collaboration with citizens. Programs are presented not only by government officials, but by people from various walks of life, thus serving to spread the concept of citizen-led community disaster risk reduction. Many of the trainees come from countries that, like Japan, are prone to natural disasters. Sendai's experience with earthquakes and efforts towards disaster risk reduction are considered to be useful references.

Since 2020, however, figures have decreased because of immigration restrictions due to the Covid-19 pandemic.

Diagram: Number of persons accepted for overseas visits, training (duplicated)



(Source of data: Sendai City City Planning Policy Bureau)

3) Initiatives related to Target G (Early warning/disaster risk information)

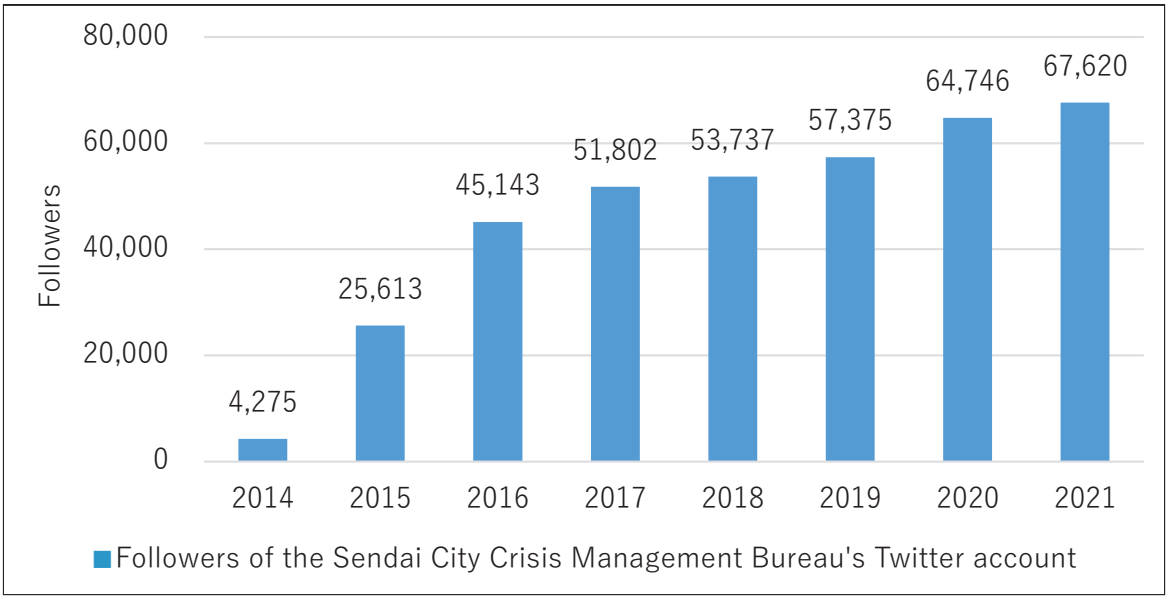
Information (early warning/disaster risk information) related to disaster conditions and evacuation or safety is important to minimize damage.

Sendai's efforts related to early warning and disaster risk information include disseminating disaster risk information (see p. 9). Working in collaboration with telecommunications carriers and the media, Sendai City is providing information in a form that is approachable for large numbers of citizens through emergency alert emails and TV or radio news: an initiative related to Target G that is being implemented.

In addition, Sendai City itself disseminates information through means including the Internet. One quantifiable initiative is is the follower count for social media, which has taken off in recent years. Looking at the Sendai City Crisis Management Bureau Twitter account, we observed fluctuations in annual figures.

The content of the tweets includes information on natural disasters such as tsunamis and floods, information on Covid-19 infections, and the announcement of disaster preparedness drills, and similar events. The account's follower account has been increasing each year.

Diagram: Followers of the Sendai City Crisis Management Bureau's Twitter account (duplicated)



(Source of data: Sendai City Crisis Management Bureau)

3.4 Summary (Assessment at the midterm point of the Sendai Framework for Disaster Risk Reduction)

Among the Framework's seven global targets, disaster damage for targets aimed at reduction (Targets A to D) showed a downward trend from the first half (2005–2014) to the second half (2015–2021) of the assessment period. This assessment has revealed that these targets have been achieved for all assessment indicators.

Observed according to type of disaster, damage caused by earthquakes and tsunamis has been on a downward trend since its peak in 2011 with the Great East Japan Earthquake. Although no tsunami damage has been recorded since the Great East Japan Earthquake, Sendai has been hit by multiple earthquakes of a magnitude 7 class, however, the damage has been minimized. Initiatives related to the four priorities for action are thought to play a vital role in achieving the reduction targets (Targets A to D).

In terms of targets aimed at increase (Targets E to G), steady progress can be observed when data is organized on a quantitative basis for the following initiatives, which are related to the four priorities for action: the progress of Sendai City's disaster risk reduction strategies, the development of evacuation center management manuals, figures for numbers of people accepted for overseas inspections and training, and changes in figures over time for early warnings and access to disaster risk information.

Based on the above, this assessment reveals that that global targets are in the process of being achieved at the midterm point of the Sendai Framework for Disaster Risk Reduction.

Diagram: State of progress in implementing global targets at the midterm point of Sendai Framework for Disaster Risk Reduction

○:Being achieved ／:Unachieved

Global targets		Assessment	(reference) Storm and water damage
A	Reduce the average per 100,000 mortality rate for disasters	○	／
B	Reduce the average per 100,000 of people affected by distasters	○	／
C	Reduce direct disaster economic loss caused by disasters	○	／
D	Reduce disaster damage to critical infrastructure and disruption of basic services, among them health and education facilities	○	／
E	Increase the number of countries with national and local disaster risk reduction strategies	○	—
F	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the Framework	○	—
G	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments	○	—

Further initiatives must be promoted in order to ensure the achievement of the global targets related to the Framework's goal. Themes to tackle in the future have been compiled as follows.

- When observed by type of disaster, an increase in storm and flood damage can be noted in recent years. Particularly noticeable is the increase in property damage (damage to houses and businesses, etc.) and damage related to agriculture, forestry and fisheries. One characteristic of storm and flood damage to property is the tendency for localized damage, in contrast to the large-scale, city-wide damage that occurs with earthquakes and tsunamis. This calls for the concentrated and effective promotion of countermeasures.
- With regard to the hosting of overseas visitors on inspection tours and trainings, there is a need to restore the number of visitors to pre-pandemic levels, and to promote initiatives that further increase these numbers, while keeping an eye on the trends in Covid-19 case numbers. Self-assessment is also possible in other cities in Japan and overseas by applying the aggregation methods and formulas used for Framework's global targets. Dissemination of information in Japan and internationally, and encouraging similar initiatives is also desirable as a contribution to the promotion of the Sendai Framework for Disaster Risk Reduction.
- In terms of access to early warnings and disaster risk information, it is necessary to deliver information to more citizens and improve the effectiveness of evacuations.
- To gain an understanding of the effects of disaster risk reduction measures, together with the state of progress in implementing the Sendai Framework for Disaster Risk Reduction, it is effective to investigate documents other than those containing data of disaster damage, such as collections of records. In the future, the ongoing collection of statistical data and the collection and maintenance of records from times of disaster is desirable.

4 Implementation of midterm assessment by citizens

(summary of outcomes from the Special Edition Course/workshop that was part of the Sendai Framework for Disaster Risk Reduction Course)

In November 2022, Special Edition: Let's Put our Heads Together! Our Past and Our Future, was offered as part of the Sendai Framework for Disaster Risk Reduction Course (see p.12), which is run jointly by Sendai City and IRIDeS. Participating Sendai residents reflected on their own activities in their capacity as individual stakeholders.

In the course, Sendai City and IRIDeS reported on their progress in carrying out the midterm assessment, while course participants reflected on the activities that have taken place thus far, modelling the process after the four priorities for action, while also discussing future initiatives.

During the discussions, many opinions were expressed regarding the creation of mechanisms in the community to support those who require support and special care, such as the elderly, people with disabilities, patients with intractable diseases, and sexual minorities. Considering such a diversification of needs, it is important for stakeholders such as governments, local communities, and companies to continue to work together and work toward inclusive modes of disaster risk reduction.

The outline of the Special Edition course is as follows.

Course Outline

- Date: Saturday, November 26th, 2022
- Organizer: IRIDeS, Sendai City
- Venue: TKP Garden City Sendai (in Sendai)
- Participants: About 30 people comprising those working on local disaster risk reduction, corporate SDGs managers, high school students, etc.

Seminar and workshop

Diagram: Reflection on activities by participants and action they hope to take in the future (excerpt)

Priorities for action	Currently working on:	Hope to work on in the future:
1 Understanding disaster risk	・Preparation of pamphlets on disaster risk reduction and pamphlets to lessen the isolation of the elderly and foreigners in the community	・Passing down information about disasters to younger generation, which has no experience ・Pursuing understanding of disaster risk reduction among people with intractable diseases
2 Disaster risk governance to manage disaster risk	・Establishing independent disaster risk reduction organizations; running of drills and study groups	・Ensuring that all people, including sexual minorities, can feel safe in evacuation centers
3 Investing in disaster risk reduction for resilience	・Support activities for persons with disabilities in disasters run by persons with disabilities	・The sustainable use, conservation, and restoration of forests
4 Enhancing disaster preparedness for effective response and to “Build Back Better”	・Checked stockpiles in disaster risk reduction warehouse ・Participated in local disaster preparedness drills and checked hazard maps	・Communicating the importance of evacuation drills and encourage more people to participate in them

5 Future outlook

5.1 Continuation of initiatives related to the priorities for action

Findings of the assessment revealed that diverse Sendai City initiatives related to the priorities for action have contributed to the successful implementation of the Sendai Framework for Disaster Risk Reduction. These include community development that is sustainable and resilient to disasters, human capacity building that nurtures local disaster risk reduction leaders, and international contributions through the dissemination of experiences and lessons learned.

While continuing these efforts, our intention is to restore pre-pandemic levels of international visitors for inspections and training, which had to be restricted due to the spread of Covid-19, while also working for the spread of a disaster-aware culture—which is to say, the knowledge and skills required for overcoming disasters (see p.8: Handing down experiences and lesson learned)—widely throughout Japan and other countries of the world.

5.2 Responding to revisions to disaster risks such as local earthquakes

Over the duration of the assessment period, figures for damage have declined, but this is partly due to comparisons that have been made with the Great East Japan Earthquake, which was a major disaster. As there is no guarantee that a disaster of similar magnitude or one of a scale greater than has been experienced in the past will not occur, we must consider how to respond to new disasters, in recognition that disasters will continue to occur in the future.

In 2022, Miyagi Prefecture announced a tsunami inundation scenario based on the occurrence of a tsunami of maximum intensity on a par with the tsunami that accompanied the Great East Japan Earthquake, but under even more adverse conditions. Furthermore, Miyagi Prefecture is considering new damage scenarios for multiple earthquakes and tsunamis, including an earthquake directly below the city with a epicenter on the Nagamachi-Rifu Fault, which is expected to result in serious damage centering on Sendai.

Estimates show that it is possible to reduce damage caused by even the most powerful earthquake or tsunami by taking measures such as promoting seismic resistance and encouraging early evacuation in the event of a tsunami. Based on such a review of disaster scenarios, Sendai City intends to promote further disaster risk reduction measures.

5.3 Promotion of effective disaster risk reduction measures

In regard to increases in storm and flood damage, concerns that climate change will produce increasingly severe and frequent disasters mean that further measures against heavy rain events are required.

On the national level, relevant laws and regulations were revised in 2021. In addition to flood control by personnel managing rivers and sewage systems, measures are being taken to increase the effectiveness of basin-wide comprehensive disaster risk reduction through the collaborative efforts of

stakeholders such as the national government, local government, private sectors, and residents. Sendai City is also working to improve both hard and soft measures and intends to invest in more effective disaster risk reduction measures based on the assessment findings. The city's major initiatives are as follows.

(1) Flood control measures for the Sendai Station area

Increasing urbanization in the area around Sendai Station has resulted in a shortage of rainwater drainage facilities, producing an increased risk of flood damage in heavy rainfall events.

The city is currently working on the maintenance of its stormwater main lines. After the completion of scheduled maintenance in 2026, it will be able to avoid flood damage caused by heavy rains of up to 52 mm per hour, a volume that is anticipated to fall at a frequency of once in ten years.

Flooding damage in front of Sendai Station Typhoon Hagibis East Japan Typhoon

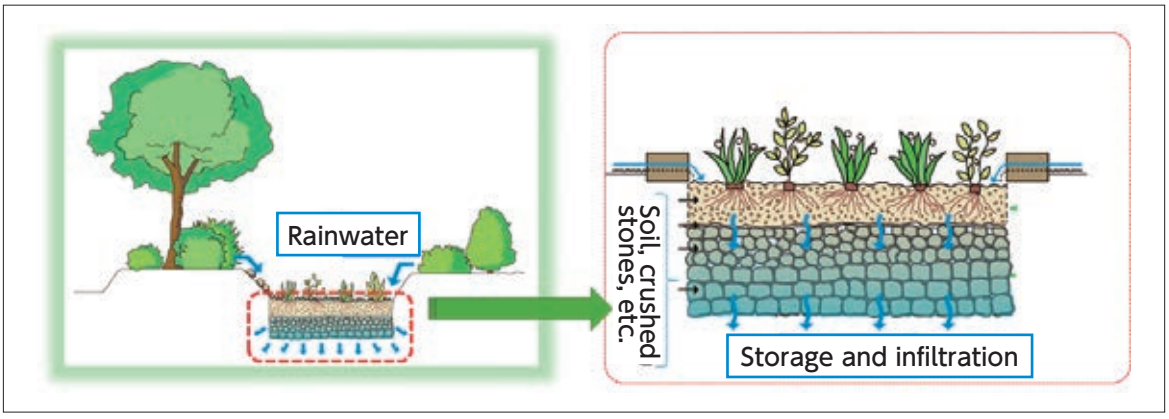
Digging work with shield machine

(2) The provision of a rain garden in the city center

As part of the utilization of green infrastructure (see p. 20), a rain garden will be set up in Aobayama Park in the center of the city in 2023.

The rain garden is a planted space that functions to temporarily store rainwater, allowing it to slowly seep into the ground in order to control the amount of runoff into rivers and waterways. It is also expected to be effective in mitigating an urban heat island effect. This will also be the main venue for the 40th National Urban Greenery Fair Sendai, a national-scale greening event that is also scheduled for 2023. This rain garden will function as a model case, with plans for further rollout and popularization in the city.

Diagram: The functioning of the rain garden



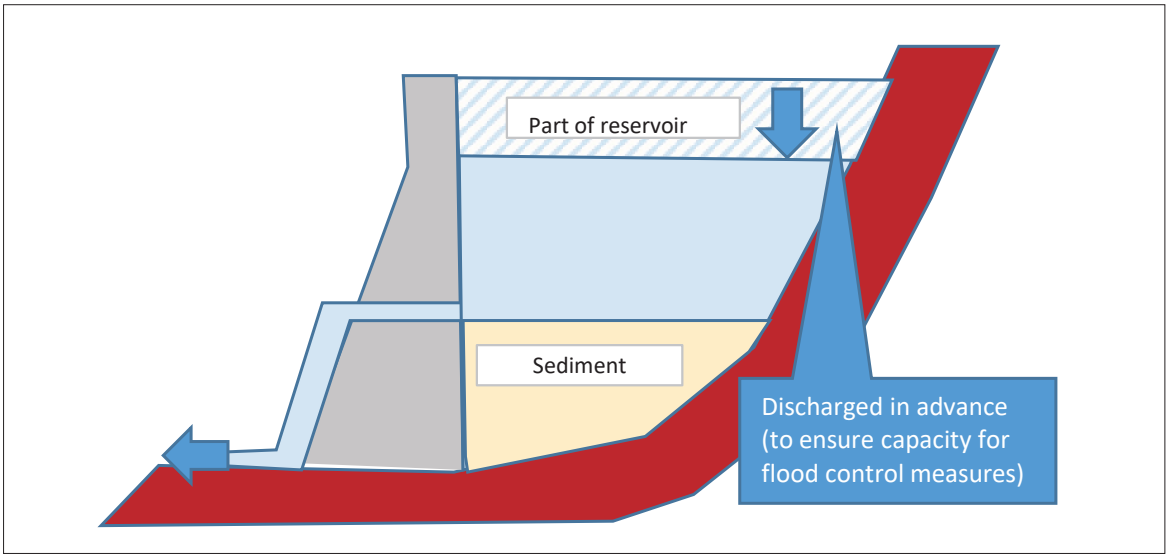
(3) Disaster risk reduction measures for agricultural facilities

Agricultural reservoirs that meet certain conditions, such as those that were damaged by the torrential rains that fell primarily in western Japan in 2018 and that could result in loss of human life if they were to burst, have been reselected by prefectures as priority reservoirs for disaster risk reduction.

In Sendai, priority reservoirs for disaster risk reduction will have surveillance systems with cameras and water level gauges installed. Meanwhile, large-capacity reservoirs (agricultural irrigation dams) will have their flood control functions reniforced in the event that heavy rains are predicted, including the option of drawdown to lower the water level.

In addition, the service life of facilities such as drainage channels is being systematically extended in order to prevent damage to agricultural land and residential areas.

Diagram: Image (cross section) of pre-event drawdown at an agricultural irrigation dam



(4) Creating mechanisms to enhance the effectiveness of evacuation (evacuation support for people requiring special care, etc.)

Since 2015, a succession of damage caused by storm and flood events around Japan has focused attention on challenges related to damage to facilities for senior citizens and the evacuation of elderly people. Relevant laws and regulations were revised, and in 2017, it became obligatory for owners of facilities for people requiring special care (medical facilities, social welfare facilities, etc.) that are located in dangerous areas to create evacuation guarantee plans and perform drills.

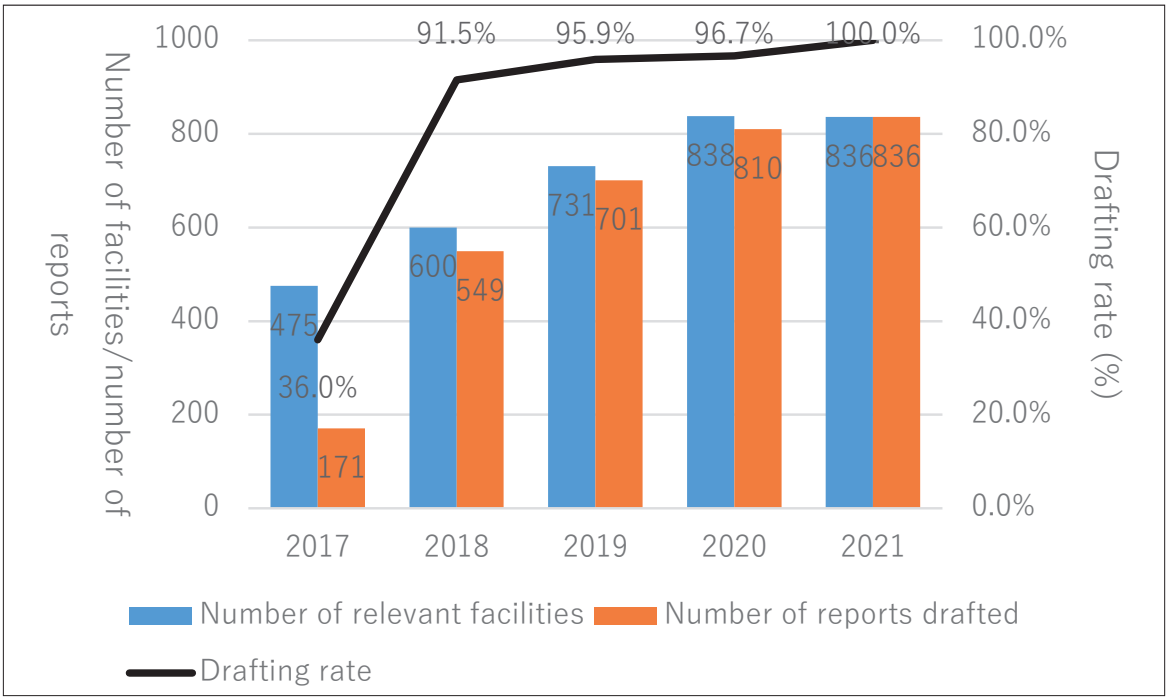
Sendai City offers support for the preparation of evacuation guarantee plans for relevant facilities, and also conveys information when evacuations are called for.

The Sendai Evacuation Information Phone Service was launched in 2021. Through the service, evacuation information is distributed to landline phones in pre-registered households where mobile phones and smartphones are not used. In addition, each citizen is encouraged to create a personal evacuation plan known as My Timeline, a plan for the purposes of organizing the actions one should take to evacuate, together with their timing, tailored to one's own

family structure and living environment.

Going forward, Sendai City will continue to work steadily on initiatives such as drills conducted in coordination with local communities through multi-layered disaster risk reduction achieved through a synergy of self-help, mutual assistance, and public assistance (see p. 22).

Diagram: Figures and percentages for the drafting of evacuation guarantee plans



(Source of data: Sendai City Crisis Management Bureau)

(5) Wider participation and themes to be incorporated in the Sendai Symposium for Disaster Risk Reduction and the Future

The Sendai Symposium for Disaster Risk Reduction and the Future (see p. 28), is a forum in which a diverse range of stakeholders participate to learn and think about disaster risk reduction from various angles, not only reconstruction after the Great East Japan Earthquake, but also climate change and environmental problems.

As we move into the second half of the Sendai Framework for Disaster Risk Reduction (see p.49), the symposium will continue, but with a wider range of themes so as to involve more people, in line with opinions expressed in Sendai Framework for Disaster Risk Reduction Course, Special Edition (see p.49).

Activities during the Sendai Symposium for Disaster Risk Reduction and the Future

5.4 Future Efforts at the International Research Institute of Disaster Science, Tohoku University (IRIDeS)

Carried out in accordance with the UNDRR assessment manual, this project represents the first example, conducted at the municipal level, of the monitoring of the progress of implementation of Sendai Framework for Risk Reduction. The process of disaster damage statistics collection that was employed in this study can serve as a reference for other local governments to collect statistics in a similar fashion. In light of this study, major future initiatives to be implemented by IRIDeS are as follows.

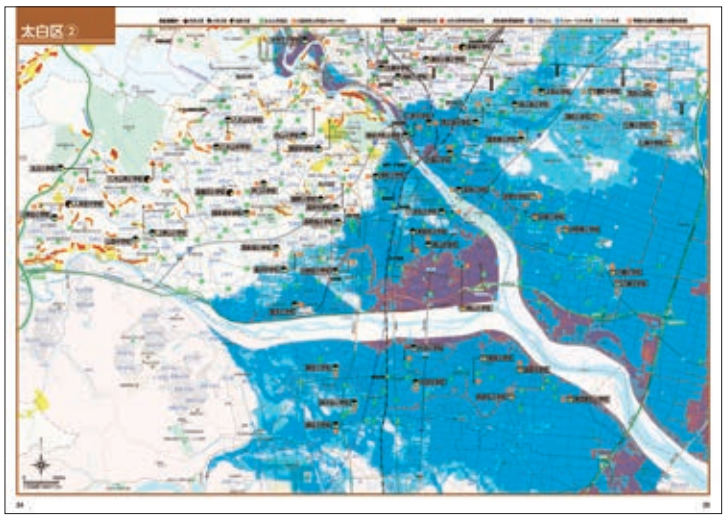
(1) Assessment using damage estimates and indicators in the event of planned-scale and estimated maximum-scale flood damage

The infrequency of low-probability disasters makes highly accurate quantitative predictions of the scale of damage difficult. In other words, data on actual damage in disasters that occur infrequently is extremely valuable. In Sendai, quantitative records of the damage caused by the Great East Japan Earthquake, a mega-earthquake with a low probability of occurrence, and the accompanying tsunami were produced. This made possible the monitoring of the progress of implementation of the Sendai Framework for Disaster Risk Reduction based on indicators. In other words, it can be said that we have been able to use indicators to quantitatively evaluate the scale of damage caused by low-probability earthquakes and tsunamis.

On the other hand, regarding storm and flood damage, which has become more severe in recent years, during the Framework assessment period, Sendai has not encountered a disaster of the scale of a probability of once in 100 years or once in 1,000 years. In order to promote evidence-based policy planning in the future, it is important to have quantitative estimates of the anticipated damage even with storm and flood damage, whose probability of occurrence is low, and to reflect this in policy planning that will contribute to damage mitigation.

The collection of basic data (hazard data, etc.) for the purposes of estimating damage in the event of planned-scale and estimated maximum-scale flood damage, and conducting quantitative assessments based on damage estimates and indicators were beyond the scope of this study, but are hoped to lead to the development of highly effective measures.

Diagram: An example of a hazard map showing assumed maximum scale flood damage



(2) Realizing disaster risk reduction that leaves no one behind

The SDGs adopted at the UN Summit in September 2015 pledge to "leave no one behind." In the field of disaster risk reduction, the realization of this kind of disaster risk reduction means that every last person must be saved, without leaving behind the vulnerable and those requiring special care, including the elderly, people with disabilities, and foreigners, who are in weak positions in the face of disasters. To this end, it is important for all parties concerned, not only at the national level but also at the local government, district, and individual level, to take ownership of disaster risk reduction. At times when disaster strikes, it should be possible to mutually support all people in the community, including the vulnerable and people requiring special care, and to reduce the human loss to zero.

The relationship of disaster damage with attributes such as gender ratios, age, having a disability, or being a foreigner was beyond the scope of this study, however a more detailed analysis focused on attributes is required. We believe that an appropriate assessment of community vulnerability is a prerequisite to making a reality of disaster risk reduction that leaves no one behind.

It is difficult to claim that vulnerability assessment focusing on social attributes has been conducted at a sufficient level in our work with disaster damage statistics data. Such initiatives should be developed as good practice, not only in Japan, but also in other countries and municipalities. Through the United Nations Development Programme (UNDP) and UNDRR, with which IRIDeS enjoys close collaborative relationships, we will promote the active dissemination of research results for the achievement of SDGs and the Sendai Framework for Disaster Risk Reduction.

5.5 Toward the standardization of disaster statistics

Identification of the locations and departments in charge of data held by Sendai City that is useful for disaster statistical analysis has made ongoing monitoring possible. In addition, assessment methods such as formulas used to assess global targets and aggregation methods can be put to use by other local governments, and it is expected that such initiatives will spread on a local government basis.

The visualization of the results of disaster risk reduction measures that has been carried out to date represents an important opportunity for Sendai City's self-reflection on its efforts, and serves to support the promotion of the Sendai Framework for Disaster Risk Reduction. To gain a picture of long-term changes in disaster risk—issues such as the frequency of disasters, the interval between earthquakes, and the impact of climate change, for example—more local governments need to work on continuous monitoring. Working in collaboration, Sendai City and IRIDeS will cooperate with the Japanese government, the UNDRR, and other related organizations to promote its application in other cities.

It should be noted that damage data held by a local government was not created with the monitoring of the Sendai Framework for Disaster Risk Reduction in mind. Standards and other factors can differ. Also, the occurrence of a large-scale disaster tends to impact on assessment findings too greatly when compared to large-scale units such as "the country" or "the world," so care must be taken in applying such data in other regions.

Monitoring the costs required for disaster risk reduction measures, in addition to monitoring damage-related data, makes it possible to demonstrate the cost-effectiveness of investment in disaster risk reduction. As some initiatives, such as flood control projects at the national or prefectural level, are conducted inter-municipality, the calculation of figures per municipality will be an ongoing challenge.

6 Conclusion

As both the host city of the Third UN World Conference on Disaster Risk Reduction and also as a safe and secure disaster-resilient and environmentally friendly city, Sendai considers it its responsibility to further strengthen its disaster risk reduction capabilities in the second half of the Sendai Framework for Disaster Risk Reduction, based on the findings of the midterm assessment. The city will strengthen ties it has cultivated with Sendai citizens, community organizations, and a range of stakeholders both inside and outside Japan, and promote initiatives that will enable it to overcome future disasters, as it also hands down experiences and lessons learned from the Great East Japan Earthquake.

Additionally to this, IRIDeS sees its responsibilities as including the building of comprehensive knowledge obtained through integrated arts-sciences research. Scholarship that serves to builds social systems that allows people and society to make wise responses to increasingly complex disaster cycles, overcome hardships, and make use of lessons learned will be used to create academic value, systematized as "practical research on disaster risk reduction."

Looking to the future, we hereby reiterate our determination to continue working together to enhance local disaster risk reduction capabilities and to contribute to disaster risk reduction around the world.

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