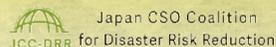




Lessons from Hagibis:

Learning to Cope with Intensifying Disasters
in the Age of *New Normal*



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TABLE OF CONTENTS

Abbreviations	02
List of Figures	02
Introduction	02
Lesson 1: Comprehensive news updates helped early evacuation	04
Broadcasting Disaster News: The Case of NHK	05
Recent ways of broadcasting emergency alerts and updates in NHK	06
Applying Lessons from Recent Disasters	07
Lessons from typhoon Hagibis:	08
Collecting weather updates from all corners of the country: The case of Weather News Inc.	09
Lesson 2: Effective operation of the flood protection structures is essential	10
Dam operation	11
1. Conflicting purposes of dam	11
2. Emergency discharge operation	12
Inland urban flooding in Tokyo and Kawasaki	12
Lesson 3: More attention is required towards people with special needs	14
The case of Tateyama: About the city	14
The Aging Population	15
Effects of Disasters	15
Improved preparedness	15
Assistance for most vulnerable	16
External Communication	16
Current Needs: Roofing	16
Lesson 4: Shortage of volunteers has seriously affected the early recovery process	17
Effect on the reconstruction work	18
Self Defense Force reserves called up for extra hands	19
Lesson 5: More space for disaster waste management is required	20
Way Forward	22
Documents Consulted	23
Persons Consulted	24

Abbreviations

JMA	Japan Meteorological Agency
NHK	Nippon Hoso Kyokai or Japan Broadcasting Corporation
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
GEJE	Great East Japan Earthquake
WNI	Weather News Inc.
VC	Volunteer Center
Shakyo	“ <i>Shakai Fukushi Kyogikai</i> ” meaning Social Welfare Council
SDF	Self Defense Force
CBDRR	Community Based Disaster Risk Resilience

List of Figures

Figure 1: Map showing the course of the typhoon and the affected prefectures	03
Figure 2: How the news of an upcoming disaster is passed on from JMA to the public	04
Figure 3: River monitoring system through smart phone app.	05
Figure 4: Result of a survey on how evacuees decided to evacuate during the 2018 flood	07
Figure 5: Results of a survey conducted by Weathernews on October 13th from midnight to 6 PM about the rainfall and flooding situation in the affected areas. 19,931 people took part in this survey and shared the real updates.	09
Figure 6: Comparison of elevation and distance of some rivers around the world	10
Figure 7. Dam operation during Typhoon Hagibis	11
Figure 8: Planned dam operation and emergency discharge operation	12
Figure 9: Tamagawa river basin (Green) and inundated areas (Blue)	13
Figure 10: gate operation	13
Figure 11: Location of Tateyama city in Chiba prefecture	14
Figure 12: Map from an organization called “Chamin” showing the need of volunteers in the affected prefectures as of 10:55 AM on October 14th, 2019	17

Introduction

Between October 6 until 13, 2019, an extremely strong and large tropical cyclone, Typhoon Hagibis (meaning “*speed*” in Tagalog; also known as Reiwa 1 East Japan Typhoon or Japan Typhoon Number 19 of 2019), caused widespread destruction across its path. It was the strongest typhoon to strike mainland Japan in decades, and one of the largest typhoons ever recorded in terms of its diameter. It was also the costliest Pacific typhoon recorded in history, causing a total of 15 billion US dollars in financial damage¹.

Typhoon Hagibis came only a month after another strong typhoon, Faxai (Reiwa 1 Bōsō Peninsula Typhoon), took a similar path,² also causing heavy damage in several prefectures around the capital

region. The Japan Meteorological Agency (JMA) issued a rare, highest-level warning of extreme rain in 7 prefectures, including Saitama and Shizuoka, urging residents to evacuate or move to higher floors in the “nearest sturdy building” in order to avoid imminent danger. Less than an hour after the typhoon made landfall, the agency added five more prefectures to the extreme-rain warning list. JMA had warned that Hagibis could rival typhoon Ida of 1958³, which killed more than 1,200 people in Shizuoka Prefecture and the Tokyo region.

Japan’s multi-hazard preparedness is globally recognized. During typhoon Hagibis, Japan’s advanced technology made it possible to forecast the risks in

¹ Wikipedia: [https://en.wikipedia.org/wiki/Typhoon_Hagibis_\(2019\)](https://en.wikipedia.org/wiki/Typhoon_Hagibis_(2019))
² Typhoon Faxai: [https://en.wikipedia.org/wiki/Typhoon_Faxai_\(2019\)](https://en.wikipedia.org/wiki/Typhoon_Faxai_(2019))

³ Typhoon Ida: [https://en.wikipedia.org/wiki/Typhoon_Ida_\(1958\)](https://en.wikipedia.org/wiki/Typhoon_Ida_(1958))

detail, and the media efficiently circulated the latest updates in a timely fashion. Strong infrastructure, such as embankments and dams, protected many areas from devastating floods. However, there were also some areas that could have been handled better. As with previous disasters, Japan's aging population continues to be a matter of concern, and calls for revision of many policies. The vastness of the affected area was too

large for the number of spontaneous volunteers who came forward to help. And because of the scale of the disaster, the management facilities of the disaster waste were overwhelmed and had to shut down temporarily in many areas, which delayed the cleaning activity. This report examines some of these issues, and summarizes the lessons that can contribute to better preparedness for future disasters.



▲ Figure 1: Map showing the course of the typhoon and the affected prefectures
Source: AFP, October 14th

Meteorological data:

Category: Super typhoon 5 (maximum) on JMA scale
Maximum windspeed: 260 km/h (160 mph)
Maximum rainfall: 1001.5 mm in Hakone, Kanagawa (till 21:20, October 13th)

Damages:

Dyke failure in 140 places in 71 rivers
(7 rivers managed by national government, 64 managed by prefectural government)

Number of evacuees: over 230,000

Casualty: 98 deaths confirmed, 7 still missing (source: Wikipedia)
(almost 80% elderly, 30% died in vehicles)

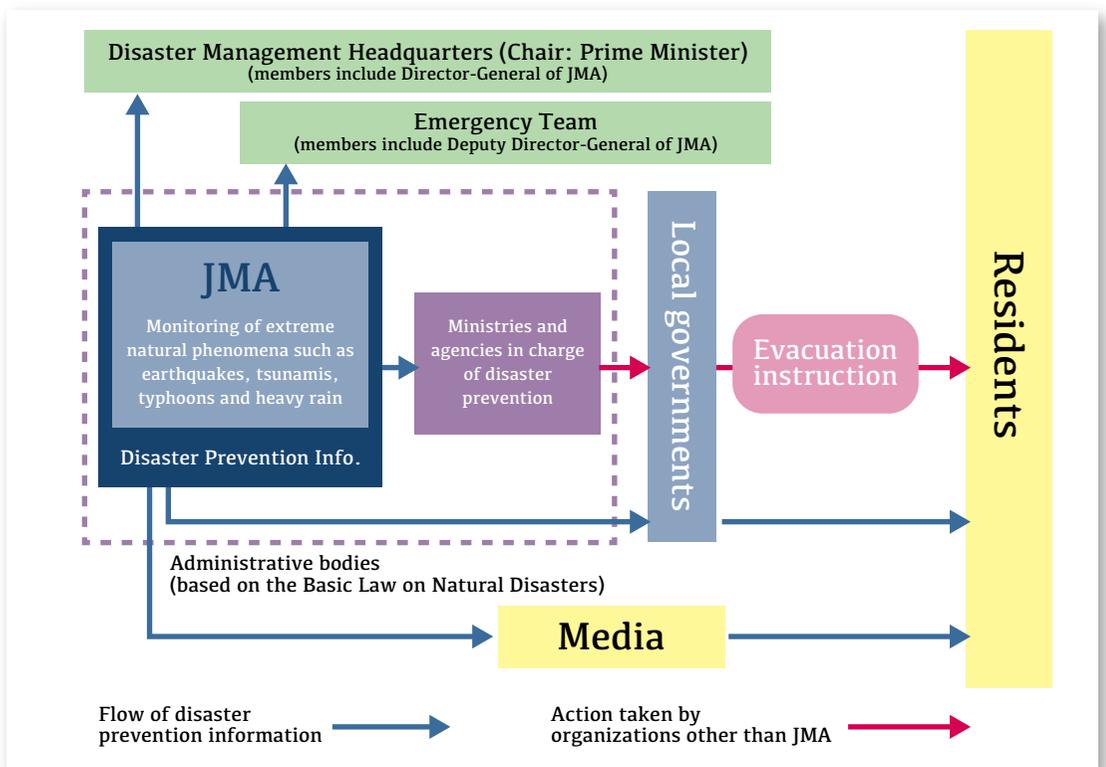
Inundated houses: Over 80,000
Damage of Agriculture: Over 2.7 billion USD

Lesson 1

Comprehensive news updates helped early evacuation

In case of climate disasters, when forecasting is possible, media plays an important role in circulating the latest updates throughout the country and helps early evacuation. The internet has accelerated and facilitated access to the weather forecasts. Before the internet, Japan Meteorological Agency (JMA), the official monitoring body for extreme

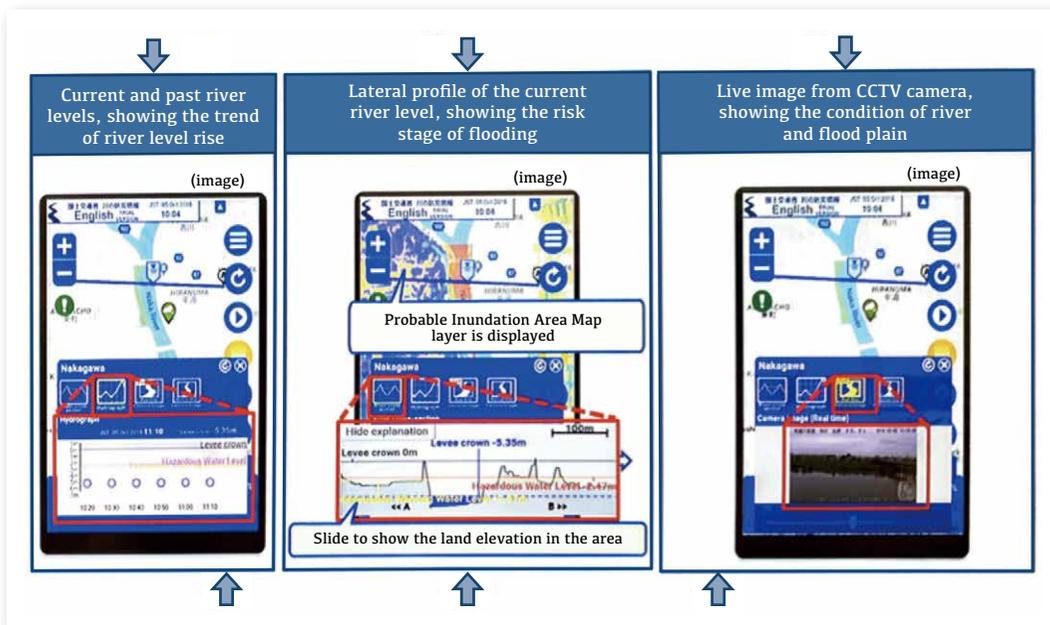
natural phenomenon, informed the media, mostly television (TV), radio and newspaper journalists, about upcoming hazards (Figure 2), who then circulated the news. With the advent of the internet, it is now possible to get the latest updates directly from JMA's website without waiting for the news to be published or broadcasted.



▲ Figure 2: How the news of an upcoming disaster is passed on from JMA to the public
Source: JMA website (<http://www.jma.go.jp/jma/en/Background/mission.html>)

However, the number of people who rely on radio or TV news during disasters is still quite significant⁴. The reason for this is that the radio and TV news are presented in a manner that is understood by most people. For example, a rain forecast of 200 mm/hour may not convey the right image of the danger, but with images and clips from similar rains in the past, and with verbal explanations from the announcer, this information becomes much more comprehensive. Similarly, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has a very sophisticated water level monitoring system for the rivers, and the latest updates from this system can be accessed through a smart

phone App (Figure 3). However, unless the information is presented in simple language, detailing the expected action to be taken by the receiver, the objective is not accomplished. Previous disaster lessons have revealed that weather information alone does not always lead to the proper action necessary to save lives. Therefore, the right interpretation and explanation of the technical information becomes essential to ensure the proper circulation of a forecast. This, possibly, is the reason why a large part of the population depends on radio and TV, especially Nippon Hoso Kyokai (NHK) or Japan Broadcasting Corporation, at the wake of a disaster.



▲ Figure 3: River monitoring system through smart phone app. (Source: MLIT)

Broadcasting Disaster News: The Case of NHK

Japan Broadcasting Corporation or *Nippon Hoso Kyokai* (NHK) has 4 broadcasting channels on TV, 3 channels on radio, data broadcasting and a website. There are 54 stations of NHK all over the country: the Headquarter in Tokyo, 7 base stations in the major cities, regional broadcasting stations at each prefecture and some branch stations. Viewing of NHK programs costs each household a fixed monthly subscription fee.

It is therefore expected that in times of disaster, NHK should be the most reliable and accurate source of information presented in a way that is understandable to all of its viewers. NHK is also obligated by law (Article 15 of the Basic Act on Disaster Management) to broadcast timely disaster updates.

In terms of equipment NHK has 750 robot cameras for automatic recording, all of which can be operated from Tokyo. In case the Tokyo Headquarters suffers damage, some of these cameras can be operated from

⁴ From Ministry of Internal Affairs data: <https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h29/html/nc152220.html>

Osaka. There are 15 helicopters stationed in 12 bases all over the country, 2 of them being in Tokyo. These helicopters can reach from almost one end of the country to the other. The helicopters are equipped with extremely sophisticated cameras that can shoot from a great distance from a running helicopter. All the camera operators, helicopter pilots and live news reporters go through a very intense training process, so that they can report the latest situation accurately while ensuring their own safety. Recently NHK has started using drones as well to collect live footage from places where helicopters cannot enter. However, drones have the risk of falling, which is why NHK has been extremely careful about the cases where they are used.

Recent ways of broadcasting emergency alerts and updates in NHK⁵

As mentioned above, NHK broadcasts its news through multiple media, especially during disasters, including radio announcements, website updates and notifications through smartphone app. Through a very informative conversation with Mr. Takatoshi Hashitsume, the Director of Disaster and Safety Information Center of NHK's News Department, it was found that the following methods are also being used to broadcast emergency alerts and updates:

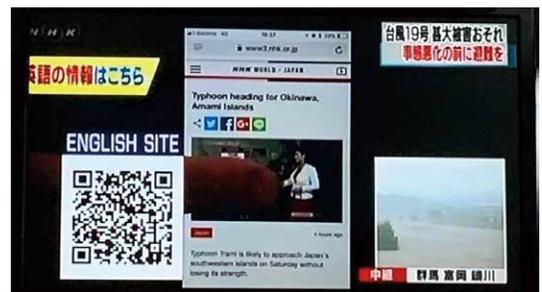
- 1 Data broadcasting through digital television: The “d” button of digital television sets can lead to a screen where the latest news can be seen in texts, images and video footages.
- 2 L-shaped Live Updates: In case of any emergency the screen changes like Picture 1, where live updates are shown in the L-shaped or inverse-L shaped notification corners.
- 3 QR Codes: QR codes for English websites, which contained the most updated information in English, were shown on screen (Picture 2) for foreign nationals during typhoon Hagibis:

4 L-Alert: Sometimes there is not enough time to prepare the script for a proper evacuation warning, to constantly announce updates on an emergency. NHK and the local residents' associations have set up a platform (address: <https://www.fmcc.or.jp/commons/>) to share the most updated information with each other directly. This helps the viewers get the most updated situation on any area at the shortest possible time.

5 Automatic text notification for evacuation: If a postal code is registered in the television set, the screen will automatically show text alert when that area gets an evacuation order (Picture 3). This facility has already started in 6 prefectures and will start soon in the others.



▲ Picture 1: Example of L-shaped Live Updates (Author's compilation, picture source NHK website)



▲ Picture 2: Example of QR code shown on live screen



▲ Picture 3: Example of automatic text notification (Source: NHK)

⁵ This part was developed based on a detailed interview with Mr. Takatoshi Hashitsume, the Director of Disaster and Safety Information Center of NHK's News Department, and the documents provided by him.

6 Emergency alert through cell phone company for foreigners: Apart from the above, NHK has collaborated with NTT Docomo to send the URL of NHK World’s English website to cell phones that are from outside Japan, through SMS. During typhoon Hagibis as many as 100,000 cell phone users received this emergency SMS, and thus could view English updates through NHK World’s website.

7 “You have got to evacuate!” call: NHK in collaboration with Yahoo and a cell phone company has started a service called “Nigenakya”, meaning “You have got to evacuate”. In this service, a user registers another location other than his/ her own for notifications (for example, for parents or family who live far away), and if there is a risk of a disaster in that location, the user gets a notification that tells him/ her to call the family member in that location.

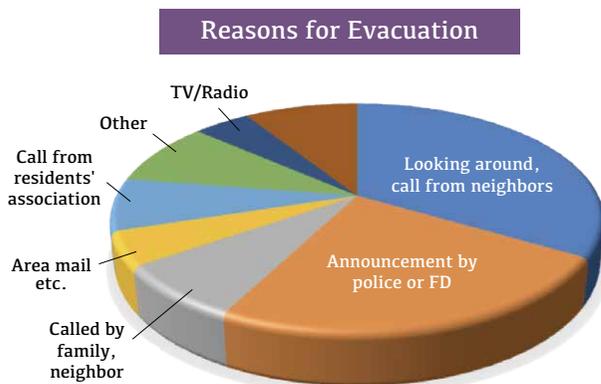
Picture 4: Poster of “You’ve got to evacuate!” call (Source: NHK)



Applying Lessons from Recent Disasters

1 Strengthening the local stations for disaster reporting: After the western Japan floods of 2018, some of the policies regarding broadcasting of evacuation announcements were revised. It was found from a survey conducted at evacuation centers in Hiroshima, Okayama and Ehime, that only 4.5% people decided to evacuate after hearing the announcement in TV.

From this experience it was decided that the local stations will take charge of announcing the warnings in case of disasters, and therefore strengthening of capacity of the local stations will be done accordingly.



▲ Figure 4: Result of a survey on how evacuees decided to evacuate during the 2018 flood (Source: NHK)

Looking around, by watching the water level or the environment getting worse	33.5%
Hearing announcement by the police or fire department	24.1%
Called / warned by family relatives	7.7%
Announcement from residents' association	7.4%
TV / Radio	4.5%

▲ Table 1: Result of a survey on how the evacuees decided to evacuate during the western Japan floods of 2018 (number of respondents: 310 from all four prefectures) (Source: NHK Disaster and Safety Information Center, News Department, NHK)

2 Way of reading/ announcing evacuation orders: In case of the Great East Japan Earthquake (GEJE), tsunami evacuation warnings were announced 21 times within the 30 minutes before they actually hit the coast. It was later found that the voice of the announcer remained proper and composed, thus people may not have felt the sense of urgency. In case of typhoon Hagibis, this was kept in mind, and the evacuation orders were read very strongly, in an out-of-the-normal way, so that the urgency of the situation would be apparent.

3 Camera angles: Sometimes, based on how the image was recorded, the coastline can appear much more normal than it actually is. This may have been one of the reasons why some people in Tohoku thought they still had time after the GEJE, or thought they did not have to evacuate at all. After that the NHK authorities ensure that images are taken in a way that represent the real danger. The screen announcement policies were revised, and in case of tsunamis, the live camera footage is shown in a small inset, with the more specific data covering the rest of the screen.

Sometimes the opposite is done to avoid worries among the viewers. When a reporter reports from too close to a dangerous area (such as near a swollen ocean in the strong winds of a typhoon), the viewers may worry about the safety of the reporter, as the ocean may seem much closer depending on the camera angle. NHK takes care that the angle represents the right distance, so that the viewer can focus on what is being shown without worrying about the safety of the reporter.

4 Mentioning specific names of areas: In 2016 a typhoon approached the north directly, without affecting any other region. When the evacuation announcements were made from Tokyo, it did not convey enough urgency. It was found out later that it may have helped if they mentioned the specific names of the areas that were going to be hit. If the announcement was done by one of the local announcers, or officials of JMA, it would have also had more of an impact.

5 Showing an example from the past: Instead of conveying only technical information, such as saying “windspeed of 60 meter/second”, an example from the past of a similar case ensures better understanding. JMA compared typhoon Hagibis with super

typhoon Ida of 1958 (maximum windspeed 75 m/s according to Wikipedia). Short video clips of that typhoon were shown to convey the possible upcoming danger, helping to prompt the early evacuation process.

Lessons from typhoon Hagibis:

According to Mr. Hashitsume, the following can be summarized as lessons from typhoon Hagibis for their future policies:

1 Understanding Hazard Maps: It has been repeatedly proven that the hazard maps are very accurate in predicting the risk of all the affected areas during recent climate disasters. Unfortunately it still seems that very few people have seen or understood the Hazard Maps of their area of residence. NHK is trying to think of ways it could bridge this awareness gap.

2 More information and explanation on breaking of levees: Much of the flood was caused by breaking of levees. If it is possible to get the information on a probable breach in any area, it could help in saving many lives, reflects the Director of Disaster and Safety Information Center of the News Department.

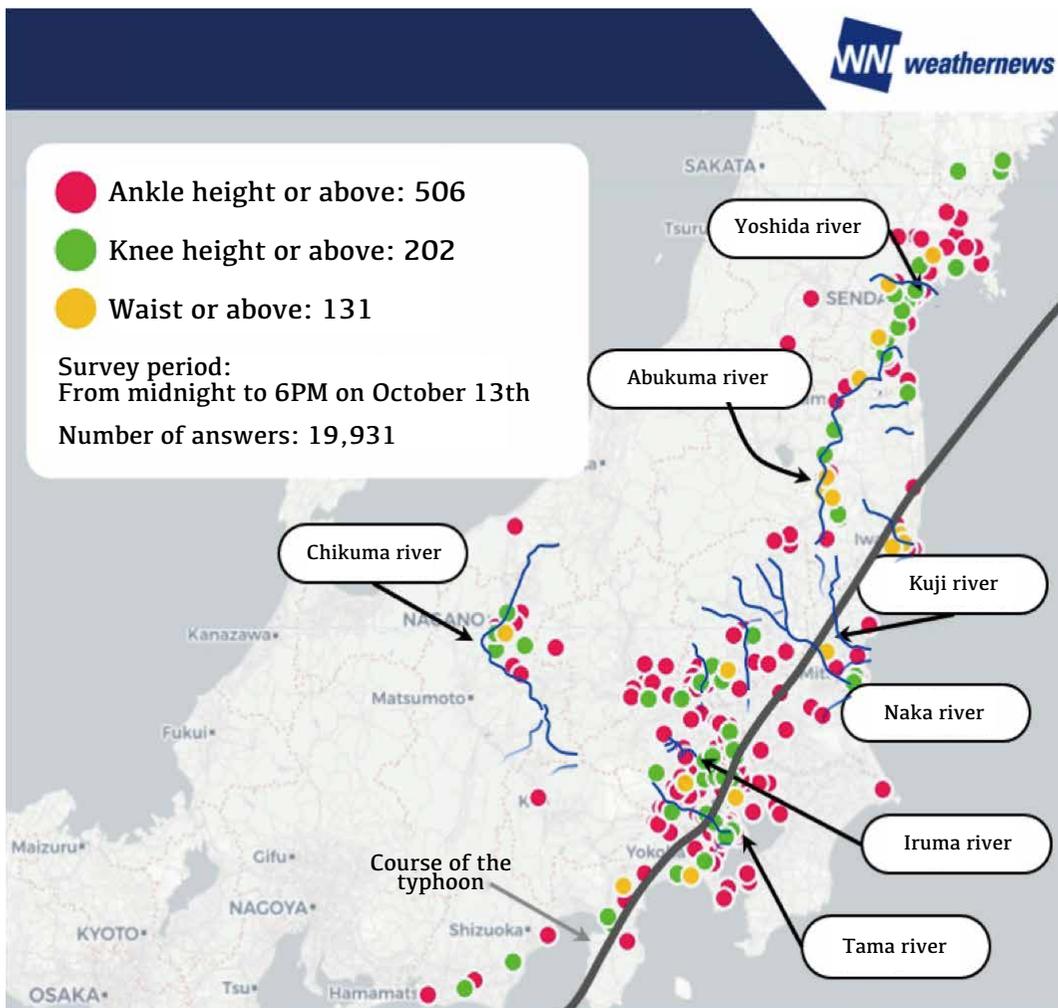
3 Announcing emergency water release of dams: Understanding the right timing of emergency water release of the flood protection dams can be a very difficult decision even for expert engineers. However, the safety of the areas near the downstream of the dams depends on this information. During typhoon Hagibis, there was confusion about the emergency water release from Shiroyama dam in Kanagawa prefecture. Research is needed on how to predict the timing most accurately, and how to share the information with the concerned people in advance to ensure their safety without causing any confusion or panic.

Collecting weather updates from all corners of the country: The case of Weather News Inc.

Weathernews Inc. (WNI) is a weather news provider for transport companies, but in the recent years it has become more popular for its weather information sharing platform. It collects weather updates from its users, who are located all over the country, in a language that is more comprehensible to the common people. Such as, saying “ankle height” instead of saying “20 cm” in case of rainfall, or expressing the speed of strong wind by using Japanese sound expres-

sions rather than mentioning the speed. This platform has become very popular among the users, as it gives them an opportunity to share what is really happening around them, and also helps them find out about the real situation of a certain area at any given time. It was found that the data provided by the users match almost exactly with that of JMA.

NHK also has a similar service called “Scoop Box” (<https://scoopbox.nhk.or.jp/>), where it invites and collects images and videos directly from its viewers. With the increase of smart phone users, the number of updates posted in the Scoop Box has increased very drastically in the recent years.



▲ Figure 5: Results of a survey conducted by Weathernews on October 13th from midnight to 6 PM about the rainfall and flooding situation in the affected areas. 19,931 people took part in this survey and shared the real updates. Source: Weathernews website (<https://weathernews.jp/s/news/typh1919/>)

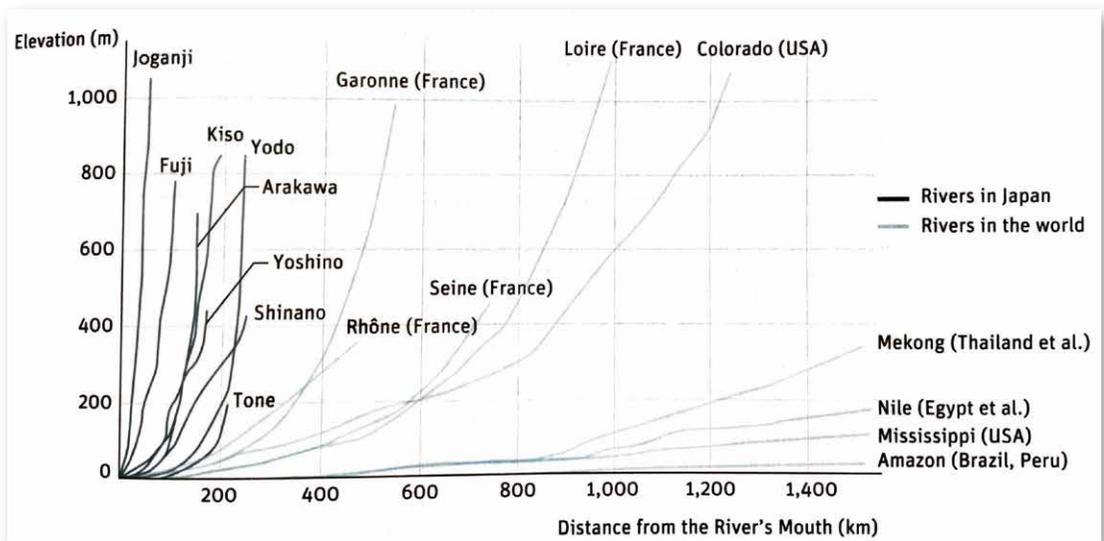
Lesson 2

Effective operation of the flood protection structures is essential

Japan has a large percentage of mountainous terrain within its small land area compared to most other countries of the world. This makes each river's watershed area small and its overall length short. Almost all the rivers run a short distance while the height difference from the upper to lower stream is significant⁶ (Figure 1). These relatively steep rivers have fast water velocity, and this causes sudden change in water levels downstream after heavy rainfall.

Japan has invested a good deal in infrastructure for flood protection over the last century, especially after the 1958 super typhoon Ida. Most of these infrastructures were designed with the consideration of sudden water level change due to heavy rain as explained above, but because of the change in rainfall pattern,

there were many cases of breakage of the embankments over the last few years, which caused severe floods in the nearby settlements. In case of typhoon Hagibis, there were breaches of levees in 140 areas along 71 rivers, since it was one of the largest typhoons in history affecting a very wide area. It is, however, true that without the embankments, dams and reservoirs, the damage would have been far worse (see Dam Operation). Flood damage could have been much worse if the operation of the infrastructure was not carried out as designed. On the contrary, optimizing operation could reduce damage beyond effects designed originally. Typhoon Hagibis has revealed some issues with the operation of both megastructures such as dams, and small structures such as drainage gates, and this chapter will talk about some of those issues.



▲ Figure 6: Comparison of elevation and distance of some rivers around the world (Source: National Institute for Land and Infrastructure Management 2004)

⁶ MLIT website: http://www.mlit.go.jp/river/pamphlet_jirei/kasen/gaiyou/panf/gaiyou2005/pdf/c1.pdf

Dam operation

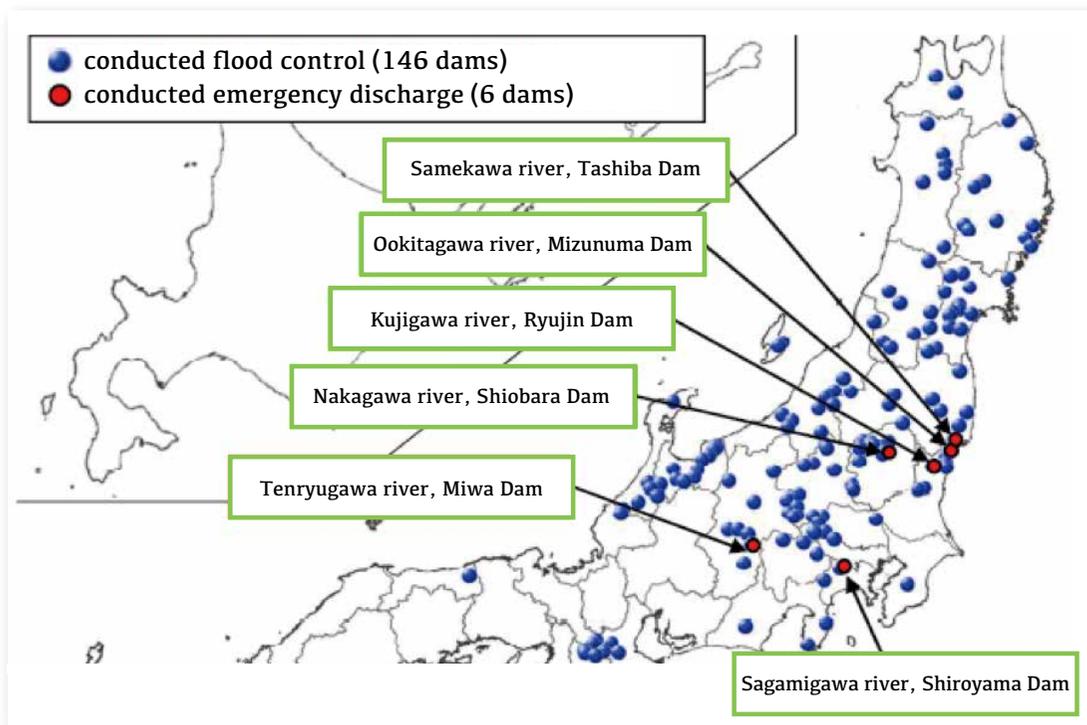
During typhoon Hagibis dams controlled the flooding and substantially mitigated the damage. For example, Miharu dam in Abukumagawa River stored 17.9 million m³ of floodwater and decreased water level by 80 cm in Koriyama city, Fukushima Prefecture, shortening inundation period. In Aganogawa River, Fukushima Prefecture, Okawa dam could secure 5.9 million m³ for flood storage before flooding under collaboration with water users and stored 24 million m³ of floodwater. In downstream Kitakata city was protected by lowering water level by 2.1 meter with the improvement works of river channel.

To manage increasing flood risks, flexible dam operation is needed to use capacities secured by water users with more accurate flood prediction. Also, dam operators and local governments need to strengthen the measures of mitigating flood damage downstream where flooding beyond planned scale may occur.

Conflicting purposes of dam

Since most dams in Japan controlling floods were constructed for multi-purpose use, the entire capacity of dam reservoirs cannot be used to store floodwater. The other users of the facility, such as users of irrigation, water supply, and hydropower generation also share the costs of the construction, and the operation and maintenance of the dams have to accommodate their rights and requirements even in cases of emergency. A multi-purpose dam is undoubtedly a more efficient investment than single-purpose dams, since the flood protection operations only take place in cases of heavy rain, but this gives the other users rights to claim the reservoir water even during emergencies.

During typhoon Hagibis, users at 33 dams agreed to the advance discharge of water without any compensation. Stored water was discharged beforehand, and additional capacities were secured by lowering the water levels of the reservoirs. The government is examining measures where the other users would allow discharging some water from the dam reservoir, which includes their share, to secure enough capacity during emergency in exchange of a compensation.

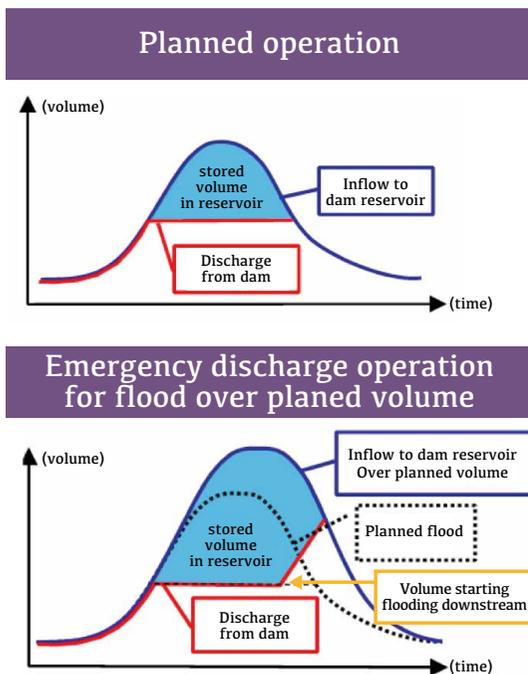


▲ Figure 7: Dam operation during Typhoon Hagibis (Source: MLIT)

Emergency discharge operation

During typhoon Hagibis 146 dams controlled the flood volume, among which 34 dams used over 60% of their capacities. Six dams conducted emergency discharge operation, since the reservoirs became full and unable to store further floodwater (Figure 7).

When flood volume flowing into a dam reservoir is expected to exceed the limit and reach the maximum water level, operators gradually increase discharge volume to the amount equal to the inflow (Figure 8). This operation is required not to destroy a dam body by the overflowing floodwater. Flood volumes downstream rapidly increase following emergency discharge operation, and this may cause flooding near the downstream area. The flood protection facilities of embankments, weirs, etc. are constructed to carry planned flood volumes. Since the discharge volume is equal to or smaller than the inflow volume, this operation does not worsen flooding situation in downstream. In the event of floods that exceed the reservoir capacity, dams can reduce water levels downstream before transitioning to emergency discharge operation.



▲ Figure 8: Planned dam operation and emergency discharge operation
(Source: MLIT)

In 2018, flooding caused inundation damage and casualties in the downstream of rivers with dams that conducted emergency discharge operation in Ehime Prefecture. Unfortunately sharing information about the emergency discharge did not necessarily lead to evacuation of residents, and eventually inundation occurred and several people died. Since emergency discharge operation may threaten human lives, information sharing needs to be strengthened to ensure timely evacuation. In case of typhoon Hagibis the media played an important role in sharing these information. There were confusions about the timing of the emergency discharge in case of Shiroyama Dam in Sagami-gawa, but in the end it did not cause any fatality.

Monitoring inflow volume of dam reservoirs is also a challenge, particularly in developing countries. Dam operators can only measure the water level of dam reservoirs and inflowing rivers, not directly the water volume. Without proper monitoring equipment and survey data, emergency discharge operation is quite difficult, which means, there may be a risk that the dam will release more than the inflow volume, causing flooding near the downstream.

Inland urban flooding in Tokyo and Kawasaki

During typhoon Hagibis, inland urban flooding occurred in many areas along the Tama river. The affected areas include the high-end residential areas such as Denenchofu of Ota ward in Tokyo and Musashikosugi in Kawasaki City. About 2000 houses were inundated and some 1000 houses were damaged (Table 1). In Musashikosugi residents of a prestigious high-rise apartment could not use basic facilities such as electricity, water, sewerage, and elevator for a week since the electric facilities underground were inundated. Floodwater from the river inundated 40 houses over an area of 70 ha near the Futakotamagawa station in Setagaya ward of Tokyo, where the government has not been able to construct embankments because of disagreement from the local communities.

Incorrect operation of the drainage systems also made the damage larger (Figure 10). When the water level reached a critical level, the Ota Ward office closed a drainage gate that connects Denenchofu to the Tama river, to protect the residential area from inflowing floodwater. However, the Setagaya Ward Office could not close the other gate, and the water soon flowed in, flooding many areas of Setagaya Ward and the low-lying areas of Denenchofu. Similarly, in Kawasaki city, the government could not close five gates, and the water from the Tama River flowed in flooding the residential areas. Kawasaki and Setagaya governments explained that the gate operators could not access these gates because of inundation and traffic jams.

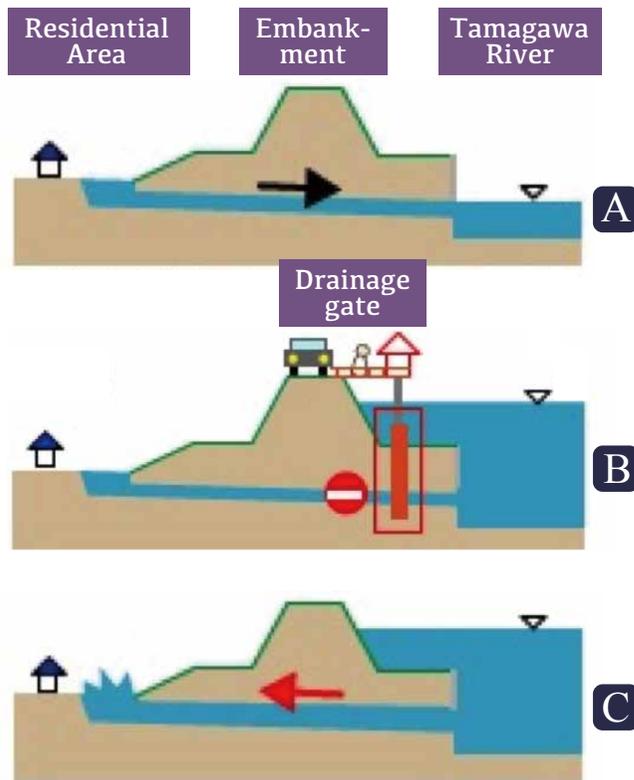
	damage (houses)	inundation (houses)	evacuee (persons)	death toll (person)
Ota Ward	292	470	11,791	0
Setagaya Ward	90	414	5,376	0
Komae City	3	280	3,966	0
Kawasaki City	608	907	33,150	1

▲ Table 2: Damage in Tamagawa River basin

Source: <https://www.bousai.metro.tokyo.lg.jp/taisaku/saigai/1006952/1007129.html>
https://www.pref.kanagawa.jp/docs/j8g/r1_tyhoon/documents/dai2_kaigishiryu.pdf



▲ Figure 9: Tamagawa river basin (Green) and inundated areas (Blue)
 (Source: MLIT)



▲ Figure 10: gate operation (Source: Modified from MLIT)

A	Normal time
	Water is discharging into the Tama river through drainage systems.
B	Operation at Flooding
	The gate is closed to protect residential area from floodwater flowing to the residential areas.
C	This time
	The gate was not closed, and floodwater inundated the residential areas.

Societal change make operation difficult at the local level. Historically, local communities have operated these facilities to protect their own communities. Because of modernization and urbanization, local governments have taken over such role. In urban areas, the cost of damage can be enormous because of assets of houses and commercial facilities. Unless detail operating regulations and trained operators are secured at all facilities, even simple ones like drainage gates cannot function properly to prevent damages from floods.

Lesson 3

More attention is required towards people with special needs

In Japan, like most other countries, people with special needs, such as the elderly or the disabled, are highly vulnerable to disasters. Evacuation centers and community resources struggle to provide assistance to these populations. In 2004, 9 people of Sanjo city in Niigata prefecture lost their lives during a flood, 7 of whom were elderly. This incident highlighted the need for evacuation measures that would ensure that none of the people in need of assistance were left behind. The city started listing people with special needs in 2005, and updated the list every six months with the help of the community leaders. The number soon reached near 5000, and it was found that the communities did not have enough able people to take care of all of them⁷. This incident represents the overall situation of Japan today where in the number of people who need care is quickly increasing, but the people who can provide assistance are on the decline. After typhoon Hagibis CWS Japan responded in Tateyama City of Chiba prefecture, and saw a very alarming picture of this situation.

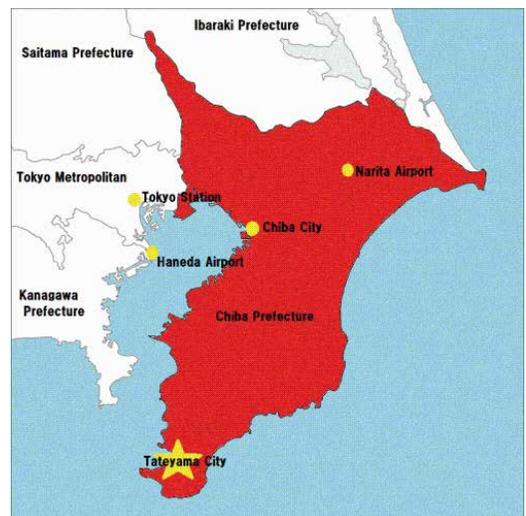
The case of Tateyama: About the city

Tateyama, a city located in Chiba prefecture, has a long history of disasters and recovery. The city was severely impacted by the 1923 Kanto Earthquake and has since, due to its vulnerable location, been regularly impacted by typhoons – most recently in 2019 by Typhoon Faxai (September 2019) and Typhoon Hagibis. Tateyama has been on a trajectory of declining population for decades. Historically, the town held

one of the biggest annual summer festivals, and was known as a vibrant fishing community. With climate change and tidal shifts, the fishing commercial business has significantly reduced, and today is practically non-existent. As a result, the city lacks its own commercial epicenter, with one interviewee noting, “welfare is the biggest industry in town.”

Total population	46,347
Number of households	22,880
Elderly population	18,100 (39.1% of total population) Note: In 2007 it was 28.5%
Elderlies who live alone	2,567
Percentage of elderlies with Care insurance	19.9%

▲ Table 3: Population Data of Tateyama (as of April 2019).
(Source: The city office.)



▲ Figure 11: Location of Tateyama city in Chiba prefecture
Source: Tateyama city website (<https://www.city.tateyama.chiba.jp/en/page100005.html>)

⁷ World Bank 2019. “Learning from Japan’s Experience in Integrated Urban Flood Risk Management: A Series of Knowledge Notes.” World Bank, Washington, D.C.



▲ Picture 5: Damages from a tornado in Chiba just before the landfall of Hagibis.
(Source: Getty image, via The New York Times, October 12, 2019)

The Aging Population

The city's population, like many in Japan, is ageing (Table 1). As the fishing commerce disappeared, children were no longer asked to take over their family's businesses. There is no University in the area, means that young people who do grow up here leave and do not return. About 10 years ago, the primary school closed in the area due to lack of children. The ratio of ageing people has steadily increased, but is now estimated to be 65% of the population.

Effects of Disasters

Disasters such as Typhoon Hagibis accelerate the declining population trend. Those whose houses are damaged due to the disaster often leave and do not return, having long-term, generational impacts. A typical story is one that happened to an 80-year-old grandfather living alone in the community, with his children living in Tokyo. His house was significantly damaged during the typhoon and he could not repair it himself, nor could he wait in it until repairs were made by the limited construction companies that exist. He moved to be closer to his family in Tokyo, but is alone, without a community; life is difficult for him there. In summer the whole family would return to this town on the sea

to celebrate, but now that he is no longer there, that tradition has also disappeared. This is a typical situation for the elderly residents there, wherein the disaster results in a spiral of negativity: the community loses its vitality, the elderly lose their community and young people lose a home to which they can return.

Some community members continue to work to resume the vibrancy of the village.. Although it is a physical struggle to rebuild and remove the debris, people like Mr. Takemasa Yashiro and his NPO Osekkai are committed to reviving the community. "This is our life; I don't want to see the village disappear."

Improved preparedness

Although the response to typhoon Hagibis was slow and largely considered ineffective (see below), certain preparedness improvements were noted between typhoon Faxai and typhoon Hagibis. For example, people bought mobile batteries and the municipality office brought in generators in anticipation of typhoon Hagibis. Convenience stores stocked up on disaster management goods, and people noted that there was less panic. Although the disaster management plan was in place, it hadn't been operationalized until Faxai. The response to typhoon Hagibis was more smooth as a result of having practiced the plan only a month prior.



▲ Picture 6: An elderly person being rescued after the typhoon in Kawagoe city
(Source: The New York Times, October 12, 2019)

Assistance for most vulnerable

Evacuation centers struggled to meet the needs of the elderly and disabled. Calls were made to increase care support functions and medical staff inside these centers, with social welfare people managing them so they could be closer to the problems. An evacuation plan still does not exist for the elderly, but a mutual support mechanism has been suggested wherein volunteers with cars can help evacuate the elderly.



External Communication

External communication of the problems inside Chiba was inadequate, resulting in slow support for the communities. Local residents were left to communicate the challenges and impacts to garner support through social media. Eventually issues were covered by the media, but this delay highlights the need for pre-work with media to ensure that communication about the needs are disseminated early and widespread.

Current Needs: Roofing

The roofs of many houses were damaged because of the strong wind. Some managed to cover the frames temporarily with plastic sheets, with the help of volunteers, NPOs and the Self Defense Force (SDF). Many people continue to live under open roofs barely covered by a layer of these plastic sheets even during winter, and hence the most prominent need right now is to repair the roofs. The sheets easily blow off, and many people will have to wait for years until proper roofing is put onto their houses. The money people receive for insurance is limited and the government support scheme depends on the level of the damage. It is a lengthy process to get an assessment, quotation and then actual repair and construction. There are limited people to do the assessments and even fewer who can do repairs. People are then forced to wait under the plastic sheets, as their houses experience even more damage due to rain and wind. Some are in denial about the mold behind the walls and stay in these harsh conditions because they have nowhere else to go. It has become essential to research and develop alternate methods of repairing roofs after disasters, because the work is quite risky and tough for volunteers, who do not have any training on this and are often very short in number.

▼ Picture 7: A resident in Chiba cleaning the debris from his house after the typhoon
(Source: Getty image, October 12, 2019)

▲ Picture 8: Damaged roof of a house covered with plastic sheets in Tateyama, Chiba

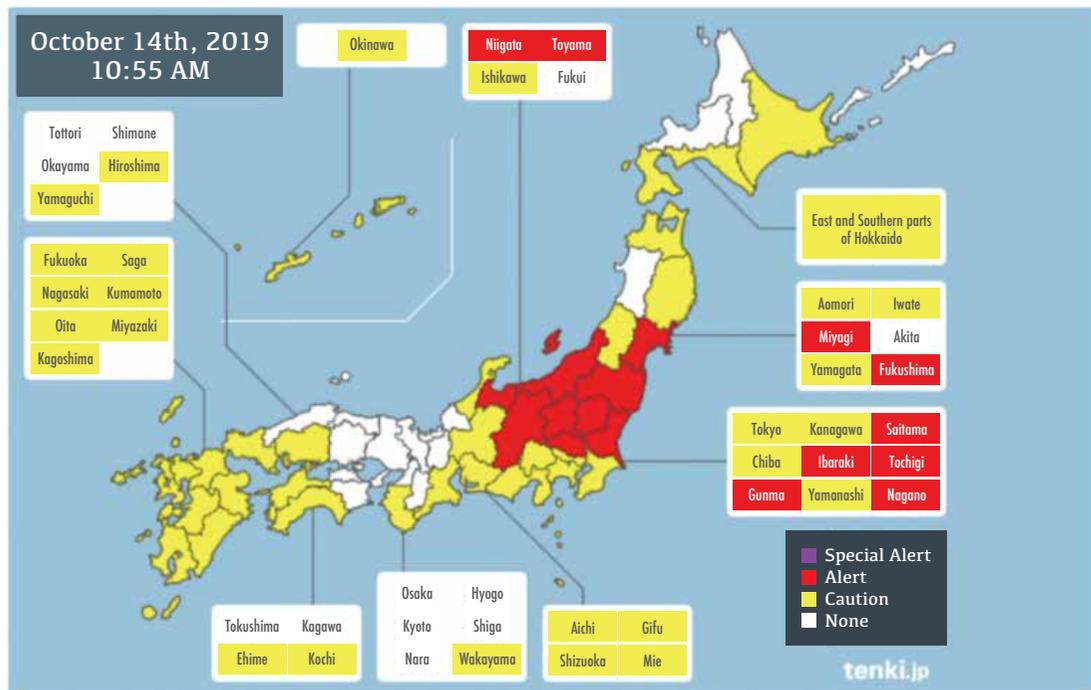
Lesson 4

Shortage of volunteers has seriously affected the early recovery process

In Japan, disaster volunteers are generally spontaneous. Typically, they volunteer through the Social Welfare Council (Shakai Fukushi Kyogikai or Shakyo in Japanese) or other organizations that manage volunteers. Their work consists mainly of cleaning and in helping repair houses. There are some local residents' associations where local volunteers can help before and during the disasters with the evacuation, but more often people from unaffected areas travel to those affected, using their weekends and paid leaves, to help through the Vol-

unteer Center (VC) or the Social Welfare Council stationed in those areas.

The areas affected by Typhoon Hagibis were so vast and the damage so extreme, that a large number of volunteers were required. By the end of October, Social Welfare Councils in 110 municipalities of as many as 14 prefectures had opened volunteer centers. According to the data published through their website on January 26th, 2020, there were 196,740 volunteers who registered through them since after



▲ Figure 12: Map from an organization called “Chamin” showing the need of volunteers in the affected prefectures as of 10:55 AM on October 14th, 2019

Source: Website of Chamin (<https://chamin.com/taiфу19-boranteia/>)

the disaster in mid-October, but in most areas they were insufficient to handle the need. In places like Tateyama city of Chiba prefecture, for example, the number of volunteers was minimal, throughout the three months. Some reasons for this include:

- The volunteers use their own weekends and paid leaves to travel to the affected areas, hence they tend to travel to areas that are not too far. While the number of volunteers increases significantly over weekends, the increase is usually seen in areas directly connected to a large station.

- The heavy torrential rains after the typhoon made the damages worse in many areas, and has likely raised the safety concern of many potential volunteers.

- The number significantly decreased in the cold areas of the Tohoku region since the end of November, possibly because of the winter.

The government started showing concern about the declining number of volunteers since the beginning of November. It encouraged people to offer their help more often, and also asked business groups to take steps so that companies will allow their employees to take leave to help with the effort⁸.

With the increase of disasters, it has become crucial to take the volunteer work force very seriously. Volunteers from various backgrounds, such as construction, medicine, nursing and care, education, are needed to recover after any disaster. In other developed countries, volunteers are trained locally so that there is always a certain number of helping hands during any kind of emergency. Depending entirely on people's kindness to offer their time and labor for free is no more enough for a disaster-prone country like Japan.

Effect on the reconstruction work

The lack of hands affected the construction industry equally. A large part of the work the volunteers help with involves cleaning, as has been mentioned above, but cleaning is only the beginning of recovery and reconstruction. Over 80,000 houses across 14 prefectures were inundated, most of which suffered several levels of damage. The repairing of these houses is a significant amount of job, and the current work force in the construction industry is nowhere close to enough to handle all of it. Besides, because of the scale of typhoon Hagibis, where levees broke in 140 areas along 71 rivers, repair and reconstruction work of the infrastructure is getting priority. "We are absolutely short of workers," said Yoshiaki Suzuki, presi-



▲▲ Picture 9&10: Students of Motomiya High School in Fukushima prefecture helping the residents clean up after the typhoon.

Source: Website of Nippon.com October 17, 2019 (<https://www.nippon.com/en/news/yjj2019101700653/high-schoolers-help-relief-efforts-after-typhoon-hagibis.html>)

⁸ The Japan Times, "Government seeks more volunteers to help in typhoon-affected areas", November 2, 2019



▲ Picture 11: Canadian rugby players volunteer to clean a road in Kamaishi, Iwate, following the cancellation of their Rugby World Cup match against Namibia due to Typhoon Hagibis.
(Source: Kyodo News, October 14, 2019)

dent of the six-man construction firm Suzuki Kenzai Kogyo in Tateyama city of Chiba prefecture. “Our top priority is to restore lifelines, repair roads and cover damaged roofs with blue plastic sheets,” Suzuki said. “There’s no time for removing the heaps of rubble caused by the last two typhoons”.

Self Defense Force reserves called up for extra hands

Following the severe shortage of volunteers and construction workers, the Defense Ministry has called up the ready reserves and reserves of the Self-Defense Forces for the disaster-relief mission, in consideration of the extensive damage and expected prolonged recovery efforts. In addition to 31,000 active SDF personnel, the ministry called up more than 260 SDF ready reserves and reserves to engage in work to remove debris and mud and to provide public hygiene support in prefectures including Miyagi, Fukushima, Tochigi and Nagano⁹. The number of personnel in certain regions will be boosted by up to 1,000 people, by drawing on reserves, depending on the situations in the disaster areas. The decision marks the first time that such reserves have been mobilized since the aftermath of the March 2011 earthquake and tsunami.

As of the end of March 2019 there were about 34,000 SDF reserves, including some 2,400 women. They consist of former SDF personnel and other civilians who have undergone specified education and training, who are usually working for private-sector companies. The number of SDF ready reserves, made up of former SDF personnel in principle, stood at about 4,300. The prime minister’s approval is required to mobilize SDF ready reserves and reserves. The government pays some benefits to employers when SDF ready reserves and reserves are called up for missions. With the frequency of large-scale disasters increasing, the possibility of deploying the ready reserve and reserve of the Self Defense Force will increase. According to the Defense Minister, the government is now considering ways to win the support of employers to secure reserve personnel for future disasters.

⁹ The Japan Times, “Japan calls up SDF reserves for first time since 3/11 for Typhoon Hagibis disaster relief”; October 28, 2019

Lesson 5

More space for disaster waste management is required

The waste disposal capacities of municipalities hit by Typhoon Hagibis in mid-October soon reached their limits, causing a serious problem in the affected areas. The amount of waste from the typhoon, including bedding and furniture, has been large. The garbage incineration plants in some areas were damaged by flooding during the typhoon, and the ones that were open, quickly became full.

The Nagano Environmental Energy Center in the city of severely affected Nagano prefecture had to stop



▼ Picture 12: Residents and volunteers at the trash collection point in Marumori town in Japan's Miyagi prefecture on Oct 19, one week after Typhoon Hagibis struck.

Source: The Straits Times, October 20, 2019 (<https://www.straitstimes.com/asia/east-asia/marumori-hard-hit-by-typhoon-cleans-up>)



¹⁰ The Japan Times, "Japanese waste disposal plants in areas rocked by Typhoon Hagibis overwhelmed by debris", November 2nd, 2019



▲ Picture 13: Workers at the trash collection point in Marumori town in Japan's Miyagi prefecture on Oct 19, 2019
Source: The Straits Times, October 20, 2019 (<https://www.straitstimes.com/asia/east-asia/marumori-hard-hit-by-typhoon-cleans-up>)

accepting disaster waste temporarily on October 28th, as the amount temporarily stored at a facility on its premises reached 98 percent of its capacity¹⁰. The center can handle up to 405 tons of waste a day, but the average daily amount brought there stood at 567 tons between October 15, 2 days after Hagibis tore through the area, and October 26.

In Fukushima Prefecture, where 61 temporary waste storage facilities are scattered among 22 municipalities, large amounts of waste remained on the streets in heavily hit areas even after a month, keeping local government officials and Self-Defense Forces personnel busy with collection. In the flooded town of Marumori in neighboring Miyagi Prefecture, some temporary waste storage facilities became full, and the authority decided to check identification to prevent residents of other municipalities from bringing their waste to facilities in the town.

The amount of debris that went beyond the management capacity of so many prefectures speaks of the scale of the typhoon. At the same time, it also shows that some areas are not prepared enough to handle debris from large scale disasters. Unless the damaged furniture and bedding are cleaned up, the cleaning and sanitizing of the building structures cannot start. A one-week delay of this process means a one-week

of extra stay in an evacuation center, or worse, a one week of extra stay in a damaged, damp house. The authorities that had to shut down their facility temporarily because of the overwhelming volume of debris and waste, had all reopened after different lengths time, and almost all the collected debris was cleaned up by the beginning of January, 2020¹¹, but the delay in the cleaning process caused by the lack of capacity of the facilities significantly delayed the recovery process of many affected areas.

Typhoons and earthquakes of similar scale may happen in future. With the changing climate the frequency of these disasters may even increase. Allocation of multiple back up spaces and facilities for collection of debris and disaster waste needs to be done to prevent this from happening in future.

¹¹ Website of Ministry of the Environment: http://kouikishori.env.go.jp/archive/r01_typhoon19/ (accessed on January 30, 2020)

Way Forward

In today's world, typhoons and floods are the most frequent and damaging natural hazard. Between 1998 and 2017, floods led to economic damages exceeding USD 600 billion, affected more than 2 billion people, and resulted in around 142,000 fatalities worldwide¹². Compounded by rapid urbanization and climate change, these losses will likely increase, especially in developing countries, where populations are rapidly growing in flood-risk zones. Japan's approaches towards mitigating water-disaster risks, including large investments on infrastructure, offer a rich knowledge opportunity for other countries. Even the measures that could not protect the people as expected during typhoon Hagibis stand as lessons for countries that wish to take up similar measures. The problems Japan currently faces with protecting its aging population, will be the case for several developing countries over the next decade or so. It can therefore set some good examples by revising some of the preparedness policies to ensure the safety of the elderly during disasters.

Similarly, Japan has a lot of scope to learn from other countries regarding aspects like volunteer management and Community Based Disaster Risk Resilience (CBDRR). Investing on structural measures alone cannot protect the people anymore, especially in today's changing climate, where large-scale disasters will become more frequent events compared to the last century. Experts on structural measures of flood protection have repeatedly emphasized the importance of a balance of both structural and non-structural measures. Practices like CBDRR should gain more focus in the overall preparedness plan. These measures are usually low-cost and easily adaptable, but they require consistent engagement. Therefore, strong policies are needed to ensure their proper implementation.

¹² Source: Wallemarq P., Below R., McLean D. (2018), UNISDR and CRED report: "Economic Losses, Poverty and Disasters (1998-2017)"

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