Research Paper

DISATER MANAGEMENT IN JAPAN AND EFFECTIVE USAGE OF METEOROLOGICAL INFORMATION WITH A PROMPT REPORT OF TYPHOON HAGIBIS

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ABSTRACT

Typhoon Hagibis (T1919) hit area of Japan and 100 casualties and missing people were reported. The course, intensity, land timing were correctly forecasted in numerical weather models and lots of information issued almost properly, however, one of the severest typhoons in decades brought huge damages. Even if emergency warnings and evacuation directions were issued, most people did not evacuate. Evacuation in night-time was danger and earlier evacuations in comparison with day-time that recommended. In March of 2019, the guideline for evacuation was updated and risk levels of warning were categorized from Level 1 to Level 5.

Keywords*: Typhoon Hagibis, Evacuation, Disaster Risk Reduction.*

1. Introduction

Typhoon Hagibis (T1919) landed Japan around 7pm Japan Standard Time (JST) of 12th of October, 2019, went across Kanto/Tohoku area and passed to Pacific sea in early morning of 13th. It brought huge damage, mainly in Kanto/Tohoku area, according to the disaster report No. 35 (issued at 11th of November) (CAO, 2019), number of casualties were 95 (32 in Fukushima prefecture and 12 in Chiba prefecture) and 5 were still missing. The number of completely collapsed houses were 1,981, inundation house were 27,861 (above floor level) and 32,821 (below floor level) in 12th November 521,540 houses had electric failures at midnight, suspension of water supply were 166,149 at 12th of October, airplane cancellations at Haneda airport were 1796 (domestic) and 337 (international) at 12th and 813(domestic), 198 (international) at 13th. Washouts of embankment were 12 points of 7 rivers controlled by country and 129 points of 23 rivers controlled by prefectures. Damage of crops were 19.52 billion, agricultural facilities were 157.8 billion, forestry was 65.6 billion and fishery was 11.5 billion Japanese Yen (each statistical data is reported at 11th of November from ministries).

Forecasts of numerical weather prediction models from numerical weather prediction centers, i.e. ECMWF, JMA-GSM and so on, had forecasted its course, land timing and location correctly from the beginning of the week (7th of October). Japan Meteorological Agency (JMA) announced that the typhoon brought huge damage to Japan firstly 3 days at 9th (Wednesday) and media/public continuously informed fore-

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casts/warns precisely and frequently. On 12th (Saturday), Hagibis brought strong rain mainly in front of its trajectory and orographically at slopes faced to east and south in Kanto/Tohoku area heavy rain was recorded. At Hakono (JMA AWS station in Kanagawa prefecture) recorded 942.5mm precipitation in 24 hours until 21:00 of 12th, total precipitation was 1001.5mm, and it exceeded 3 times of monthly precipitation in October (334.3mm) (CAO, 2019).

JMA warned dangerous weather events in 3 types of information, i.e. advisory, warning. JMA issued extreme warning for Shizuoka, Kanagawa, Tokyo, Saitama, Yamanashi and Nagano at 15:30JST (JMA1, 2019) for Ibaragi, Tochigi, Niigata, Fukushima and Miyagi at 19:50JST of 12th (JMA2, 2019) and for Iwate at 0:40JST of 13th. The extreme warning were issued for 13 prefectures finally. Recently, JMA shared not only meteorological but met-related analysis/forecasting data, for example, landslide index, flood risk and inundation risk shown in Fig. 1. For the typhoon Hagibis, these information were timely issued and correctly reflected actual condition well.
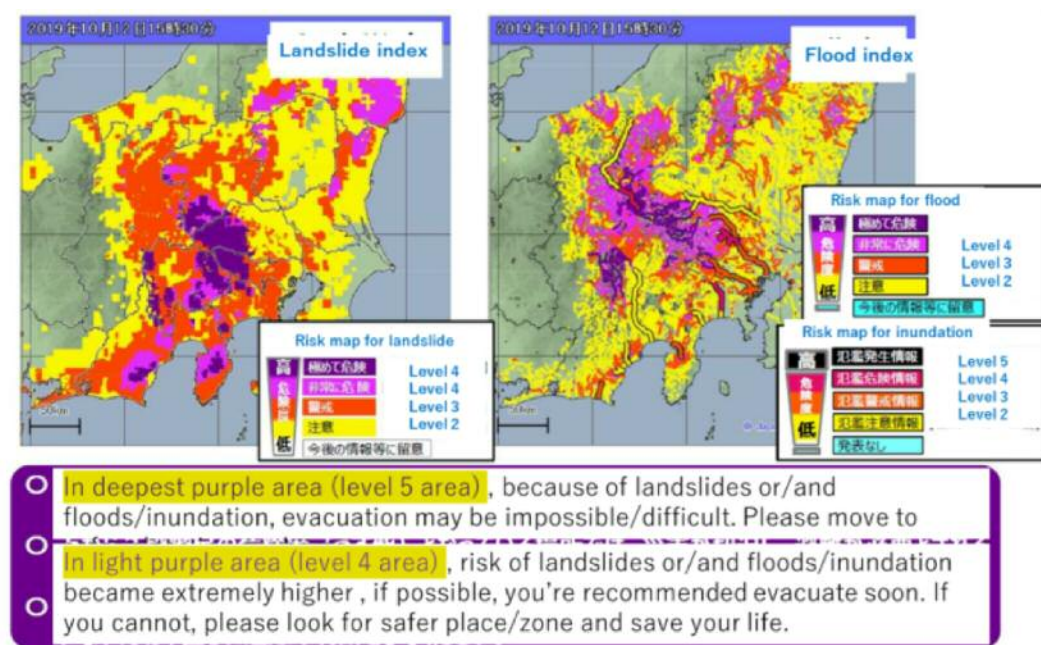
Fig. 1. An example of Risk indexes for Hagibis
(captured from a JMA extreme warning report (JMA1, 2019) and translated).

JMA also managed multi language information web site for inhabitants and tourists in Japan, and information for weather warning, weather forecast, composite radar image, real-time risk map for landslide/inundation/flood, tsunami warning, earthquake information and volcano warning are shared. The web page address in Vietnamese is following (https://www.data.jma.go.jp/).

2. Evacuation during the disaster

For the typhoon Hagibis, weather forecasts were correct and directions for evacuation were issued from local municipal offices mostly earlier, however, 95 casualties were recorded by the typhoon.

In 2018, western Japan experienced heavy rain disaster in July and 237 casualties were recorded (JMA3, 2019). In Okayama, Mabi-town located confluence area of Oda-river and Takahashi-river, one forth (1/4) of the town was inundated and the deepest depth of water exceeded to 4.8m (casualties of the Kurashiki-city

was 51). The flood occurred night-time and some people could not evacuate higher place/higher floor and during evacuation some was flown by water.

Table 1. Damage of heavy rain disaster in July 2018

List	Casualties	Missing	Heavily injured	Injured	Completely collapsed	Partly collapsed	Inundation houses
Okayama	66	3	9	152	4,828	4,433	7,112
Hiroshima	115	5	61	85	1,150	5,721	8,957
Ehime	31		33	2	625	3,315	2,679
Whole Japan	237	8	123	309	6,767	15,234	28,469

In Hiroshima, lots of landslides occurred in fragile and steep slopes. This area was developed as residential area near to the city central, however, the soil contained sands and relatively fragile for rains. In this area, landslide disaster happened in early morning of 20th August, 2014 and 74 casualties (73 was killed by landslides) reported. Nevertheless, landslides brought many casualties in 2018.

According to "the census for evacuation consciousness during a heavy rain event in July 2018" (Edo, 2019), 79.8 percent people (695 of totally 871) understood dangerous of heavy rain when they heard a comment "never experienced heavy rain in the extreme warning issued by JMA. 42.8% people collected in the context of disaster and rain, 37.7% did nothing, 22.8% confirmed their evacuation route, 19.1% checked stock of foods, 15.2% prepared evacuation goods. However, the ratio of evacuated people was 3.6% and 71.5% people judged they did not need to evacuate. The heavy rain started around noon of 6th of July and lasted until the morning of 7th and the heaviest rain (30 to 40mm per hour) were recorded at 6pm and 7pm. People had felt unusual heavy rain and 35.5% people evacuated from 0pm to 6pm, 38.7% evacuated during from 6pm to midnight of 6th. On the other hand, a small town Sakamachi, 45% people (48 of totally 107) evacuated to shelters or relatives houses during the disaster.

Table 2. Evacuation activity at Hiroshima during heavy rain in 2018. (Referred from "A census for evacuation consciousness during a heavy rain event in July 2018")

List	Evacuated	Consider evacuation but not evacuated	Judged evacuation unnecessary
Number	31	217	623
Ratio	3.6%	24.9%	71.5%

Mostly every year, such disasters occur and lots of papers pointed that "Normalcy Bias" brought such damages frequently. People always tend to think "someone except me encountered with an accident/disaster" and "I have never encountered with an accident/disaster for long time, at this time it would be all right for me". During the highest risk level, TV noted, "If you cannot evacuate, move to upper floor or move to opposite side from slope/river. Please choose possible way to survive", repetitively.

According to the TV interview after the disaster (5:30pm news of NHK on 16th October) (MLIT, 2019; Nippon, 2019), a woman lived in Fukushima (28 casualties recorded) said "after washout, the water level rose very fast, in 20 to 30 minutes up to few meters." Some old people could not evacuate to upper floor, some lived in plain houses and some people could not aware it, because river water rose at mid night. Nn Nagano and Tochigi, when some people tried to evacuate to evacuation facilities, their cars were flown by flooded water. In Kanagawa, after rain

became weaker, on the way, some people tried to back to their home. The road collapsed with their car when they were passing riverside road which had become fragile. Previous disasters revealed that night time evacuation is more dangerous because people could not know information, heavy rain disturbs people to see road, river, mountain and to hear sounds from surroundings. As a consequence, an earlier evacuation in daytime is a good way to protect people from natural disasters.

3. Frame of Disaster Risk Reduction (DRR)

In Japan, disaster management frame is prepared in central government and preparedness frame of DRR is escalated as shown in Fig. 2.

Correspondence and activities of DRR consist from "real-time phase" and "day-to-day preparatory phase". In "a real-time phase", Local Meteorological Offices (LMOs) operate real-time dissemination network of warnings and websites dedicated to the respective local gov-

ernments in order to share and exchange the information and potential risks (the number of local governments was about 1700 in July 2015). Collaboration with the prefectural governments, LMOs share real-time warning and information services on floods of specific rivers and sediment disaster and briefing/advice to prefectural governments and municipalities. LMOs implement telephone meetings/advices about countermeasures in hazardous conditions.

In "a day-to-day preparatory phase", LMOs improve operation of services through the investigation of utilizations by local governments and the public after the severe events. Clarification of warning criteria for the impact-based warnings was coordinated and the criteria was shared with local authorities and the public, through JMA Websites. In 2013, coordination of criteria for emergency warnings introduced, which was regulated in the Act to strengthen collaborations in catastrophic events.
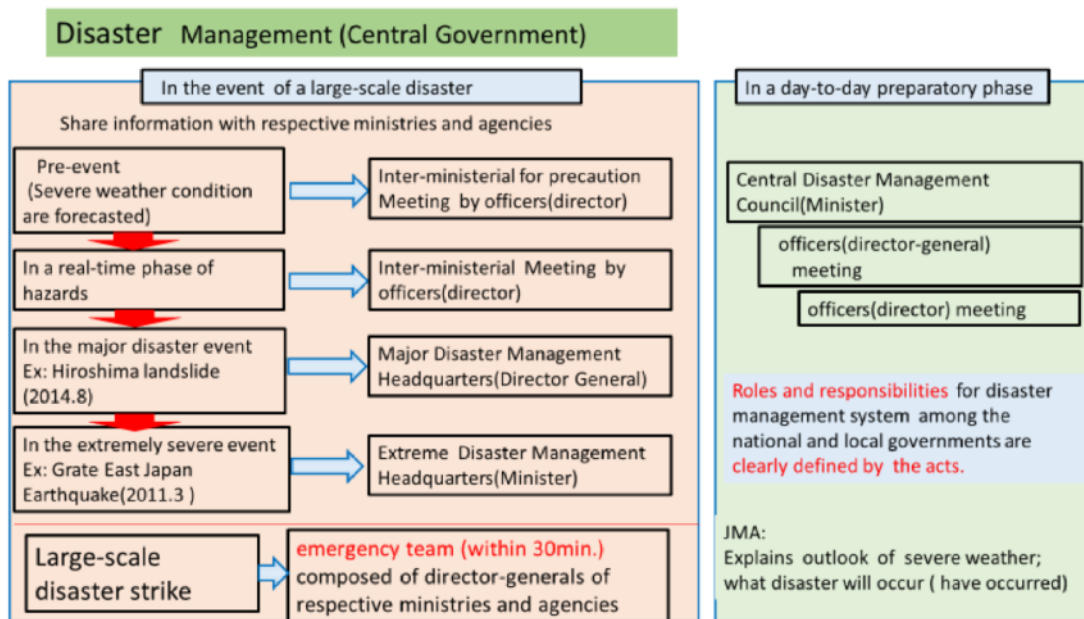

Fig. 2. Disaster management frame in central government (Hatori, 2015)

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In prefectures and municipalities level, LMOs support or exchange meteorological information with 47 prefecture governments and around 1,700 municipalities in cities, towns, villages. Regarding DRR information, LMOs issue daily weather forecasts 24/7 basis and when severe events are forecasted, bulletins for severe weather for example typhoon is successively issued. When these events start, meteorological warning is issued from each local LMO and escalated from "advisory", "warning" and then "emergency warning". Responses of municipal offices and residences are shared on JMA web site, for example as the "To-do List when Advisory, Warning or Emergency Warning is Issued" shown in Fig. 3.

Weather Warning/Advisory type								Municipal responses	Resident responses
	Heavy rain		Storm	Storm surge	High waves	Heavy snow	Snowstorm		
	Landslides	Inundation							
Emergency Warning (Significant likelihood of catastrophe)	Landslide Alert Information	Heavy rain Emergency Warning (risk of landslides*)	Heavy rain Emergency Warning (risk of inundation)	Storm Emergency Warning	Storm surge Emergency Warning	High wave Emergency Warning	Heavy snow Emergency Warning	Snowstorm Emergency Warning	• Immediately urge residents to take all possible steps for self-protection • Alert residents to the issuance of an Emergency Warning and highlight the exceptionally dangerous situation • Urge residents to evacuate • Issue evacuation advisories and orders to areas as necessary • Prepare for emergency response • Issue evacuation preparedness information to trigger evacuation of people requiring assistance • Establish evacuation centers • Disseminate Warnings to residents	• Take immediate action for self protection (head to an evacuation center, or if it is dangerous to go outside, evacuate to a safer place within the building) • Start voluntary and early evacuation or follow evacuation advisories/orders • For Storm Warnings, evacuate to a safe place • Report abnormalities to municipalities and other authorities • Stay away from hazardous places • Prepare for evacuation
Warning (Chance of catastrophe)	**	Heavy rain Warning (risk of landslides*)	Heavy rain Warning (Inundation)	Storm Warning	Storm surge Warning	High wave Warning	Heavy snow Warning	Snowstorm Warning		
Advisory (Possible development of serious adverse conditions)		Heavy rain Advisory		Gale Advisory	Storm surge Advisory	High waves Advisory	Heavy snow Advisory	Snowstorm Advisory	• Patrol areas requiring caution • Advise residents to pay attention • Monitor weather bulletins and information on rainfall conditions • Prepare to call out relevant officials	• Check emergency supplies • Check evacuation routes and centers • Check windows and storm shutters • Monitor weather bulletins on TV, radio and JMA's website

* The term "landslides" here refers to debris flows and concentrated slope failures.
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Fig. 3. The To-do List when Advisory, Warning and Emergency Warning is Issued

Weather forecasts have been improved more closely and easier to the public. For example the number of forecast/warning area was increased from prefecture level around 90 in 1953 to 1,800 blocks/municipality level in 2012. For people understanding, information includes images and illustrations help us to understand the situation objectively. On the "extreme warning for heavy rain of Hagibis", the warning included "weather chart", "typhoon trajectory", "precipitation/wind distribution map of AWSs', "composite radar image", "risk index for flood/landslide/inundation" for visual usage on medias and municipal offices. Warning mentioned the similarity of historical events and media explained risks of the event using video/photo archives of historical disasters.
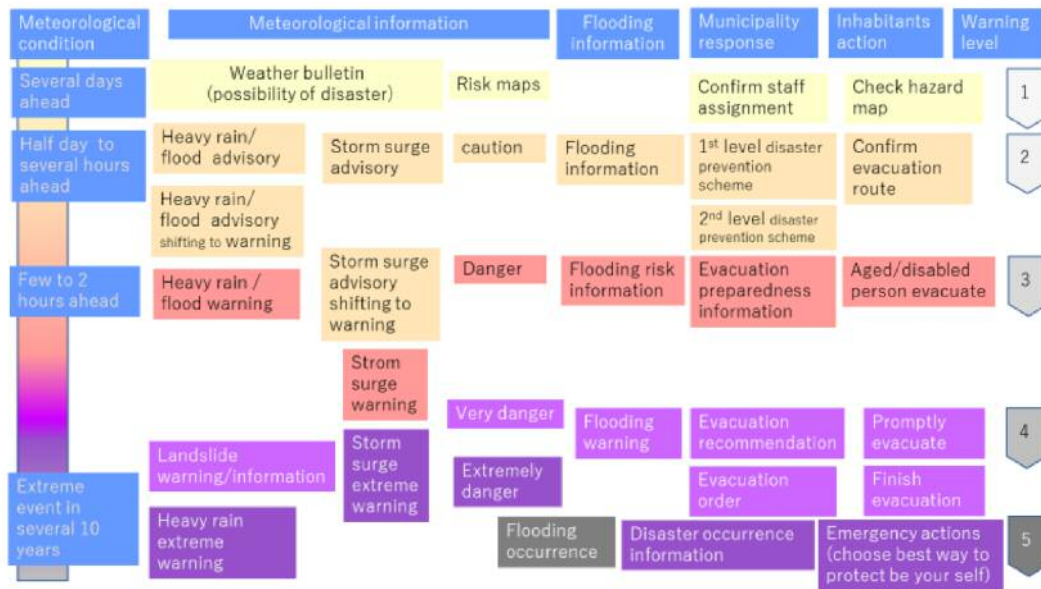
Fig. 4. Risk category of disaster information and response (Based on JMA web site: https://www.jma.go.jp/jma/)

In March of 2019, the guideline for evacuation was updated from cabinet offices, and the updated guideline, risk level of warning was categorized from Level 1 to Level 5. Meteorological condition, meteorological information, municipality response and residence response are mentioned along risk category Level 1, 2, 3, 4 and 5 shown in Fig. 4.

4. Conclusion

The Japan Meteorological Agency issued a warning 5 - the highest on the country's five-level disaster warning scale - after recording record rainfall during the 19th typhoon, internationally known as the Hagibis. This was an unprecedented level of warning in Japan for decades. The areas covered by the warning were the capital of Tokyo and six provinces including Kanagawa, Saitama, Gunma, Shizuoka, Yamanashi and Nagano. The Japan Meteorological Agency called for people living in these areas, especially those near rivers, seas and mountains, to take urgent measures to protect their lives. In the event of a move to an evacuation point where danger was encountered, it must be quickly sought to shelter in tall, well-ground houses nearby. Because natural disasters can occur at any time, Japanese have the habit of hoarding from normal living. Vietnam also needs to learn from Japan about how to respond and cope with different types of natural disasters including tropical storms.

Acknowledgement

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