Challenges in flood control operation and dissemination of information - Lessons from the record-breaking heavy rain in July 2018, Japan

Défis liés aux opérations de lutte contre les inondations et à la diffusion des informations - Leçons tirées des fortes pluies record de juillet 2018 au Japon

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Abstract. In July 2018, a record-breaking heavy rain hit western part of Japan, leaving severe damages. 213 dams under the jurisdiction of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) were engaged in flood control operation, and greatly contributed to the reduction of flood damages. Meanwhile, in case of 8 dams, the amount of rainfall was so huge that the emergency spillway gate operation by discharging equal to inflow volume was obliged to execute which caused severe flood damages in some of the downstream areas. In December 2018, Special Panel set up by MLIT finalized a report urging enhancement of flood control capability of dams and dissemination of related information, in preparation for the risk of extreme rainfall which may increase under changing climate condition. This paper briefly introduces the report, outlining the flood control activities at the 2018 flood event as well as the contents of the proposal.

Résumé. En juillet 2018, une forte pluie record a frappé l'ouest du Japon, causant de graves dommages. 213 barrages sous la juridiction du Ministère des Terres, des Infrastructures, des Transports et du Tourisme (MLIT) ont été engagés dans des opérations de lutte contre les inondations, et ont largement contribué à la réduction des dommages dus aux inondations. Pendant ce temps, dans le cas de 8 barrages, la quantité de pluie était si énorme que l'opération d'urgence de la vanne de déversement en déchargeant

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un volume d'entrée égal a été obligée de s'exécuter, ce qui a causé de graves dommages dus aux inondations dans certaines des zones en aval. En décembre 2018, un groupe spécial mis en place par le MLIT a finalisé un rapport appelant à l'amélioration de la capacité de contrôle des crues des barrages et à la diffusion des informations connexes, en prévision du risque de précipitations extrêmes qui peuvent augmenter dans des conditions climatiques changeantes. Ce document présente brièvement le rapport, décrivant les activités de lutte contre les crues lors de la crue de 2018 ainsi que le contenu de la proposition.

1 Introduction

In July 2018, a record-breaking heavy rain hit western part of Japan, and gave the worst damage in recent 30 years as a flood and sediment disaster. This disaster also brought challenges in the field of flood control operation of dams and dissemination of related information to the municipalities and residents concerned. This paper outlines the disaster, flood control activities and proposals of the special panel set up by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

As a background information, Japan geographically consists of a series of narrow islands. In addition to this feature, mountains at the backbone of islands divide the terrain into many small independent river basins. Typhoons and rainy fronts bring floods, whose hydrographs are generally very sharp and short. However, stagnant rainy fronts, with back-building phenomenon, sometimes bring extremely large and long-running floods, like this disaster in July 2018.

Major rivers developed low-lying alluvial plains in the downstream, where most of the population and economic activities locate. This is why reduction of flood disasters is of vital importance for the Japanese people.

Disaster Countermeasure Basic Act of Japan stipulates the responsibilities of the central government, prefectural government, municipalities, designated public institutions and residents for disaster management. Mayor of a municipality is directly responsible for protection of its residents, and in charge of issuing an evacuation advice/order in case of emergency. Based on the River Law, River Administrator is in charge of reduction of flood disasters. River Law stipulates that River Administrator for Class A rivers is the Minister of MLIT, and that for Class B rivers is the Governor of Prefecture.

2 Outline of the Heavy Rain Disaster in July 2018

In July 2018, stagnant rainy front and Typhoon No.7 brought a record-breaking heavy rain to Japan. Figure 1 shows the total amount of rainfall in 11 days. Many of the rain-gauge stations in western part of Japan had new record high precipitation in 24, 48 and 72 hours duration [1]. This heavy rain caused serious flood and sediment disasters as described in Table 1. The casualties reached 245, which was the worst of this type of disaster in recent 30 years. Hereinafter, this heavy rain and flood is referred to as the July 2018 flood event.

Table 1. Damages by the heavy rain in July 2018 (all over Japan).

Human loss		Damaged houses		Inundated houses (above floor level)
dead	missing	totally collapsed	half collapsed	
237	8	6,767	11,243	7,173

Source: Fire Defense Agency (as of 9th January 2019).

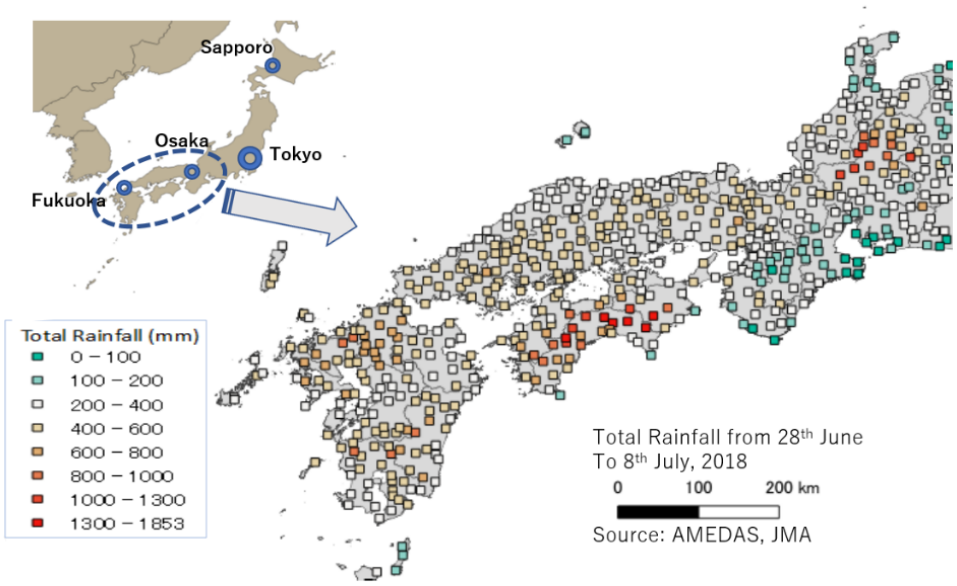

Fig. 1. Total amount of rainfall in the July 2018 flood event.

3 Flood Control Operation of Dams in the July 2018 Flood Event

There are approximately 2,700 dams in Japan, whose height is equal to or higher than 15 meters. Major owners are agricultural organizations, power companies, central/local governments and JWA (Japan Water Agency). In view of purposes of existing dams, the majority is for water use including irrigation and hydro power. Dams with flood control function are basically under the jurisdiction of MLIT. There are 558 dams of this kind all over Japan, which consists of 100 dams directly managed by MLIT, 23 dams managed by JWA and 435 dams managed by prefectural governments.

As shown in Figure 2, among these 558 dams, a total of 213 dams, which correspond to approximately 40% of these dams and locate mainly in Western Japan, were engaged in flood control operation in this flood event, and greatly contributed to the reduction of flood damages.

However, in case of 8 dams which are indicated as red dots in Fig. 2, the amount of rainfall was so huge that the flood control capacity was predicted to be used up, then the dam operating officer was obliged to execute emergency spillway gate operation in which the discharge from the dam was increased up to the incoming flood flow. MLIT has a special rule for this operation and call it “Disaster reducing operation for an extraordinary flood”, which hereinafter is referred to as DRO/EF, along with a detailed procedure for warning in the downstream river section and communication with the authorities concerned such as municipal offices and police. These procedures were observed, and evacuation notices were issued by municipal mayors, though, in some of the downstream areas of the said 8 dams experienced severe inundation, as well as human losses.

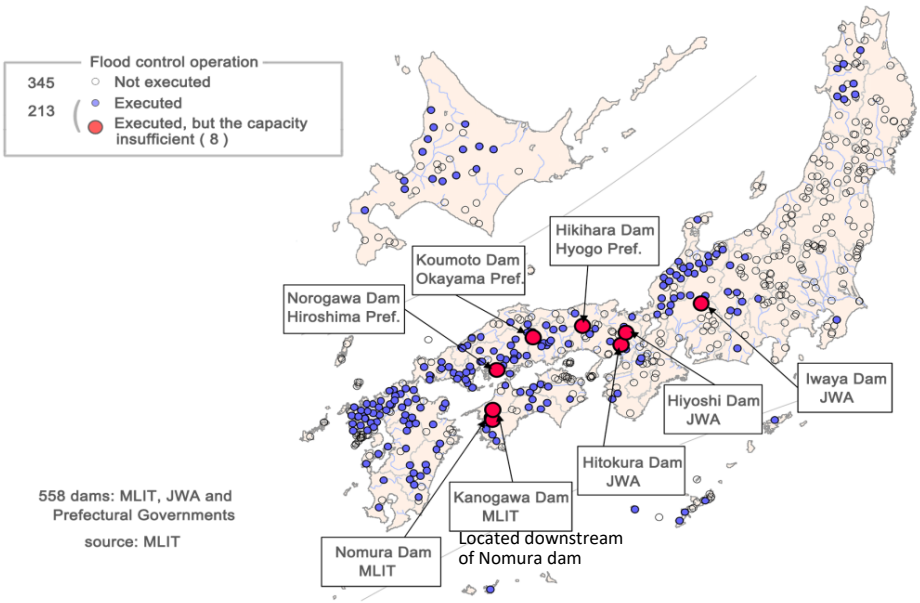

Fig. 2. Situation of flood control of dams in Japan in the July 2018 flood event.

4 A Case Example of Flood Control Operation – Nomura Dam

Nomura Dam is a multi-purpose dam built by the then MoC (Ministry of Construction) in 1981, on the Hiji River located in the north-west part of the Shikoku Island. Overview of the river and the dam is described in Figure 3. There is the other multi-purpose dam, Kanogawa Dam, which was built by the then MoC in 1958, and now undergoes a dam upgrade project to enhance flood control capability.

According to the initial flood control rule of Nomura Dam, the peak discharge of the target flood is 1,300 m^3/s, and the operator starts flood control operation when the incoming flood discharge reaches 500 m^3/s, and gradually increases the outflow discharge up to 1,000 m^3/s. After the severe flood damage in July 1995, this operation rule was revised in 1996 in consideration of the uncompleted river improvement works in the downstream of dams. This new rule aims at more effective flood control for medium/small scale floods, and the flood control operation starts when the incoming flood discharge reaches 300 m^3/s.

Figure 4 shows the rainfall, discharge hydrograph and flood control operation in this flood event. Based on the forecast of large amount of rainfall, preliminary release of the reservoir water was executed, thus 6.0 million m^3 of flood control capacity including additional 2.5 million m^3 was secured before the main flood [2].

The rain continued to fall during the whole day of the 6th June, and very heavy rainfall was recorded since 2:00 AM in the 7th June. Maximum 48-hour rainfall in the catchment area was 419 mm, while that of the flood control plan is 340 mm. At 3:37 AM in the 7th June, the dam operating officer identified that DRO/EF will be necessary around at 6:20 AM, and reported this information to the municipal office. At 5:15 AM the dam operating officer started warning of DRO/EF in the downstream of the dam. At 5:18 AM the Mayor issued the evacuation order, and the firefighting team urged the residents along the river to evacuate. At 6:20 AM DRO/EF started, and inundation was estimated to start from around 6:40 AM. The maximum flood discharge into the dam was 1,942 m^3/s, the largest inflow on its record.

Unfortunately, there were 650 inundated houses and five casualties in the downstream of the dam.

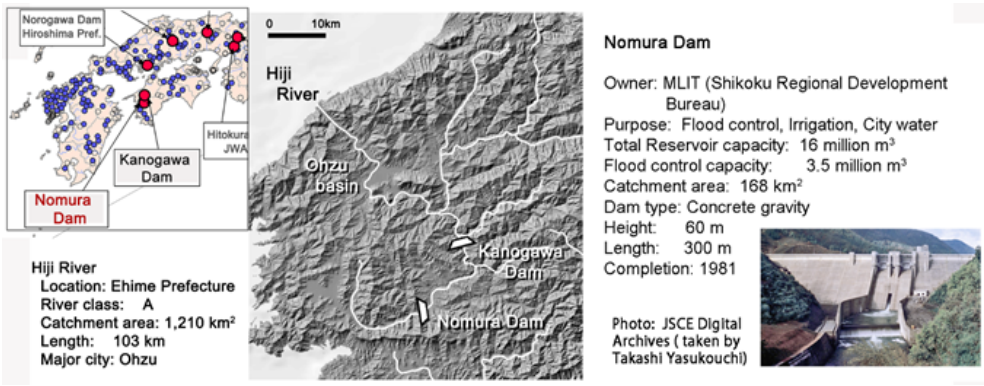

Fig. 3. Outline of the Hiji River and Nomura Dam.

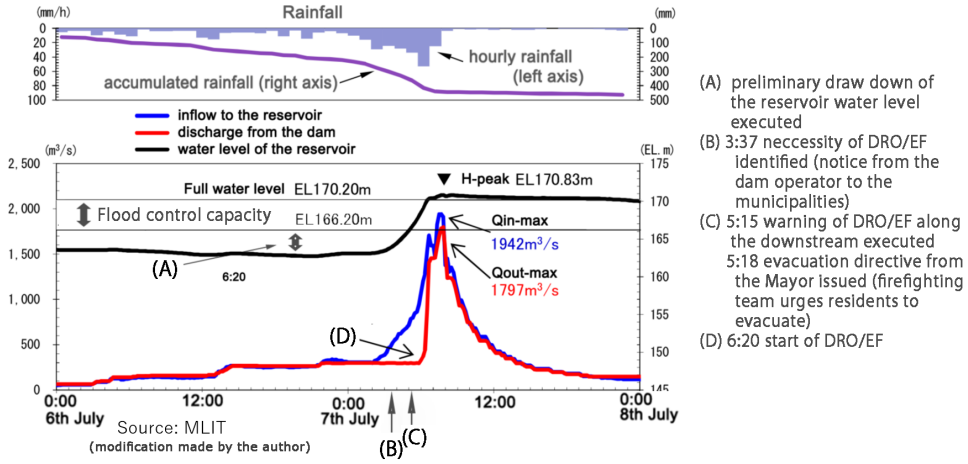

Fig. 4. Flood control operation of Nomura Dam in the July 2018 flood event.

5 Issues Identified in Flood Control Operation and Related Information

For many decades in Japan, central and local governments have made a lot of efforts to reduce flood damages by implementing river improvement works, dam construction and other measures. However, in this flood event, two major issues became clear. One is that some of the dams have used up their flood control capacity and failed to fully control the flood peak, due to extraordinarily large and lengthy rainfall. The other one is that information pertaining to the operation of dams including DRO/EF has not effectively lead to the evacuation activities of the residents.

In view of the growing concern that the climate change would increase the possibility of extreme floods exceeding the flood control capability of existing dams, these issues must be dealt with successfully and quickly. To address these issues, MLIT set up a special panel of experts in September 2018. Table 2 shows the member of the panel.

Table 2. Members of the special panel on flood control function of dams.

Name	*Affiliation*
Tetsuya SUMI	(Chairperson) Professor, Disaster Prevention Research Institute, Kyoto University
Takaaki KATO	Associate Professor, Institute of Industrial Science, University of Tokyo
Takashi SASAKI	Senior Researcher for water environment, National Institute for Land and Infrastructure Management, MLIT
Naoya SEKIYA	Associate Professor, Interfaculty Initiative in Information Studies, University of Tokyo
Eiichi NAKAKITA	Professor, Disaster Prevention Research Institute, Kyoto University
Ryo MORIWAKI	Professor, Graduate School of Science and Engineering, Ehime University
Katsuya YAMORI	Professor, Disaster Prevention Research Institute, Kyoto University

The panel identified more detailed issues as follows.
As for the first issue,

- Is there a better way to secure more flood control capacity by preliminary release of water from the reservoir?
- Is there a better way to execute flood control more effectively by increasing the amount of discharge during the normal flood control operation before the start of DRO/EF?
- Is there a better way to execute flood control more effectively by utilizing weather/rainfall prediction?
- As for the second issue,
- Isn't it necessary to raise the shared awareness of the residents by providing risk information such as possible inundation level, not only at a time of flood but also in normal times?
- Isn't it necessary to improve the content and method of information service so that the information would reach the residents more effectively and lead to the activities required?
- Isn't it necessary to improve the way of communication between the dam operating office and municipalities concerned so that it would directly support the decision of mayors?

6 Summary of the Proposal by the Special Panel

In December 2018, the panel finalized a proposal based on these three basic principles [3]:

- To promote both structural measures such as upgrading of existing dams, and non-structural measures such as enhancement of information service, in an integrated manner
- To promote basin-wide and comprehensive measures including river improvement work in the downstream of dams, management of sedimentation in reservoirs, and effectively utilization of water use capacity for flood control
- To encourage self-motivated evacuation activities through shared understanding of the information provided by dam operating offices, municipalities and meteorological agencies.

The proposal covers two fields: matters related to more effective flood control by dams and ones related to more effective dissemination of information which leads to self-motivated evacuation activities. The proposal also categorizes its detailed proposal items into (A) immediate action needed, (B) quick start needed and (C) promotion of research/development and its application needed. Below are the summarized contents of the proposal.

(A) Immediate action needed

These items below, which are viable at this stage, must be executed immediately.

(A)-1 Enhancement of flood control capability through more effective operation and other measures

(A)-1-1 Review of operation rule of dams

This is to clarify what hampers the preliminary release of water, and how the unfinished river improvement work in the downstream affects the flood control operation.

(A)-1-2 Promotion of preliminary release of water (utilization of water use capacity) through coordination with stakeholders

It is essential to have the understanding and cooperation of the users of the water use capacity in advance.

(A)-1-3 Promotion of proper maintenance and measures for longer operational life of dams, including restoring lost capacity by reservoir sedimentation

Measures against drift woods during floods, and systematic repair and renewal of mechanical equipment such as outlet gates are also important.

(A)-2 Promotion of self-motivated evacuation activities

(A)-2-1 Preparation of a flood hazard map in the downstream of the dam

Area, depth and speed of inundation at a time of the maximum probable rainfall must be estimated. Installation of additional observation equipment including a special type of water level gauge and monitoring camera, which is simple, low-cost and available at a time of flood, is also needed.

(A)-2-2 Promotion of explanation of information concerning function and operation of dams to the residents

It is important that the residents have precise understanding of flood control procedure of dams, including limitation of its capability. To this end, an explanatory campaign must be organized jointly by a dam owner and municipalities concerned.

(A)-2-3 Execution of an evacuation drill with the participation of residents, based on possible dam operation at a time of extraordinary flood

Through this drill, it is expected that the residents have a clear image of flood control operation, starting from the preliminary release, normal flood control, and DRO/EF.

(A)-2-4 Improvement of measures for information service concerning dam operation to the residents and provision of information to mass media

Internet website, cable TV, and community wireless system are effective for dissemination of real-time information to the residents. It is also important that dam operating offices provide easy-to-understand information to mass media during flood time, based on the efforts in normal times which lead to full understanding of dam operation.

(A)-2-5 Development of an information tool for residents, useful in an acute situation

For example, a specially customized website with local information will be effective for the residents to make a decision to evacuate. These tools must be well-recognized among the residents through local gatherings in normal times.

(A)-2-6 Improvement of contents and method of warning along the river before starting DRO/EF

This warning, which is so far made by means of siren sound and announcement through loudspeakers, must be improved so that the residents clearly understand its eminent and life-threatening situation.

(A)-2-7 Improvement of warning facilities and other measures

Renovation of siren, loudspeakers and other facilities, which convey warning message of DRO/EF, must be done. Also, the target stretch of the river for warning must be reviewed if necessary.

(A)-3 Facilitation of proper issuance of evacuation advice/order by municipal mayors

(A)-3-1 Participation of dam operating officers in the special administrative association for flood disaster reduction formed by the Flood Prevention Law.

This association consists of MLIT, prefectural governors, municipal mayors and other organizations concerned, and aims at minimizing damages at a time of extraordinary flood exceeding the flood control plan.

(A)-3-2 Holding of a top-level seminar to support proper judgement of evacuation advice/order

This seminar is expected to lead to better coordination between the information on dam operation and disaster risk reduction activities of mayors including issuance of evacuation advice/order.

(A)-3-3 Strengthening of communication network to support proper judgement of evacuation advice/order

A member of the dam operating office is dispatched as a liaison officer to the municipal headquarter for disaster management, if necessary.

(A)-3-4 Preparation of a timeline action plan focusing of evacuation advice/order triggered by DRO/EF

A drill involving dam operating offices, municipalities and the residents is also expected.

(A)-4 Improvement of facilities to assure more stable operation of dams

(A)-4-1 Promotion of water resistance of discharge warning facilities

This is important in view of the increase of occurrence of extraordinary floods exceeding the planned level.

(A)-4-2 Securing of emergency power source for dam operation during power outage

Utilization of hydropower generation for dam operating offices is also recommended.

(B) Quick start needed

These items, which are viable at this stage and take a considerable time for their accomplishment, must be undertaken quickly.

(B)-1 Enhancement of flood control capability through more effective operation and other measures

(B)-1-1 Enhancement of flood control function by utilization of water use capacity volume

There is a case in a multi-purpose dam that a part of water use capacity is reserved for future demand and has not been used for flood control. Such capacity may be provisionally utilized for flood control function. Besides, a part of the capacity of a single-purpose dams for water use may be utilized for flood control function through coordination with stakeholders.

(B)-1-2 Promotion of river improvement work in the downstream for more effective flood control function

In case discharge from the dam is restricted due to insufficient flood carrying capacity in the downstream river section, improvement of its capacity of the river contributes to enhancement of flood control function by increasing discharge from the dam.

(B)-1-3 Promotion of dam upgrading projects for enhancing preliminary release of water

When discharge capability of a dam at low water level is increased through the upgrading work such as installing bottom outlets, this will lead to the enhancement of flood control function by enabling larger amount of preliminary release of water.

(B)-1-4 Promotion of dam upgrading projects to enhance flood control function

Securing more flood control capacity by raising a dam height contributes to more effective flood control capability. In addition, to complete the project in a shorter period, the process of dam upgrading work and its related works must be fully examined.

(B)-1-5 Amendment of operation rule made capable by the above efforts

The dam operation rule can be amended for more effective flood control function, according to the accomplishment of the measures stated above. All the stakeholders including water users, municipalities and residents concerned must be involved in this process.

(B)-2 Promotion of self-motivated evacuation activities

(B)-2-1 Provision of information related to dam operation and disaster management from the viewpoint of universal design, and review of wording for easier understanding

It is important for the residents to understand the seriousness of the situation in an intuitive way. This also holds true for both domestic and foreign visitors.

(B)-2-2 Enhancement of provision of information related to dam operation by utilizing push-type delivery tool

This will be useful in the event of DRO/EF with the cooperation of local authorities.

(B)-2-3 Provision of a probable flood area map in the downstream of dams and its application

It is also important to place sign boards on-site showing the probable flood depth.

(B)-2-4 Holding of regular meetings with residents concerning operation of dams

It is also advisable to involve the municipalities concerned, and to utilize various tools for the better understanding of residents.

(B)-2-5 Holding of drills related to flood control operation and evacuation activities on regular basis with the participation of residents

Collaboration with municipalities concerned is also important.

(B)-3 Facilitation of proper issuance of evacuation advice/order by municipal mayors

(B)-3-1 Holding of regular seminars for municipal mayors to support their issuance of evacuation advice/order

It is important to have hand-on type of seminars, like a role-playing game.

(B)-3-2 Enhancement of timeline schedule focusing on issuance of evacuation advice in coordination with flood control function of dams

This must be reviewed and improved based on the efforts mentioned above.

(C) Promotion of research/development activities and their applications

These matters listed below, in which execution we find difficulties at this stage, must be tackled in medium- and long-term prospect with research and development activities.

(C)-1 Further strengthening of flood control function

(C)-1-1 Improvement of accuracy for prediction of rainfall and inflow to the reservoir a few days in advance, which contributes to more effective release of water before the main flood

It is also important to make a study on backup methodology by utilizing several reservoir capacities for water use.

(C)-1-2 Improvement of accuracy for prediction of rainfall and inflow to the reservoir several hours in advance, which contributes to more effective flood control operation against the main flood

This is useful for minimizing the flood damage in case the incoming flood is predicted to exceed the planned level. It is also important to minimize the flood damage risk in case of wrong prediction.

(C)-1-3 Formation of the social environment in which advanced rainfall prediction be well utilized for sophisticated flood control operation

This includes the social acceptance of consequences of prediction failures, risk distribution and others.

(C)-1-4 Development of technology for strengthening flood control function of dams

It is important to develop technologies such as drilling of a dam body, which enable renovation work of an existing dam during its normal operation, as well as those for effective maintenance of dams and their related facilities. Innovative technologies such as utilization of artificial intelligence for rainfall and flood prediction must be introduced.

(C)-1-5 Adaptation to the possible increase of climate change impacts

Increase of frequency of a heavy rain and change of rainfall pattern must be considered.

(C)-2 Further promotion of self-motivated evacuation of residents

(C)-2-1 Technological Development of dissemination tool for dam-related information

In case inundation occurs in the downstream of dams, people perceive this event not in the same way as it happens in a natural river, since the dam controls the flow. From this viewpoint, it is important to develop information tool which enables more direct reach to the residents.

(C)-2-2 Development of adequate land use in view of flood risk management

From a long-term perspective, it is recommended to guide the land use to areas less prone to be inundated, through disclosure of flood risk information.

In the wrap-up of the report, the panel shows the basic recognition for future actions as follows. Climate change brings slow but steady increase of flood risk through increase of heavy rainfall events, and change in rainfall pattern. This is not a mere estimation but what has become visible for us already. In the face of this threat, we must fully mobilize the potentiality of dams by improvement of operation and upgrading of their facilities, along with comprehensive and basin-wide measures including river improvement work in the downstream.

On the other hand, we know that there is a limitation in flood control capabilities of dams, and that extraordinary large floods, which could not be fully dealt with by structural measures, will hit the society someday. This must be properly and commonly perceived by all stakeholders, and we must be prepared for this by building up a society fully conscious of flood risk.

In view of flood risk management related to dams, cooperation among river administrators, dam operating officers, municipalities, water users and residents concerned is essential. For this purpose, proper information service, which leads to proper activities required, is of vital importance.

7 Recent developments after the Special Panel in 2018

After the special panel, preliminary release operation has been remarkably increased in Japan as shown in Table 3. These dams are mainly located in the Western Japan since their owners have understand the importance to upgrade their operation rule to manage increasing flood impacts after the flood in 2018. On the contrary, there was little sense of crisis in the dams in the Eastern Japan, and the introduction of preliminary release was not progressing.

Table 3. Number of dams which has started the preliminary release operation.

Dam types	As of July 2018	As of Aug. 2019
Dams with flood control function (MLIT, Prefectural Government and JWA)	27	51
Dams for water use (Hydropower, Irrigation, Municipal water etc.)	6	7

The typhoon Hagibis, which struck Japan in October 2019, passed through the Kanto and Tohoku regions, and caused extensive heavy rainfall and flooding to these regions. Flood control operations were carried out at 146 dams out of 558 dams under the jurisdiction of MLIT installed in these areas. These dams had a great effect on lowering the river water level downstream. On the other hand, an emergency spillway release operation (DRO/EF) was also carried out at the six dams (Miwa, Shiroyama, Shiobara, Ryujin, Mizunuma, Takashiba) as shown in Figure 5 due to rainfall and flooding that exceeded the dam flood control capacity. Even though some dams preliminary releases were conducted to increase storage capacity for flood control, the rainfall caused by the typhoon this time greatly exceeded the prepared one.

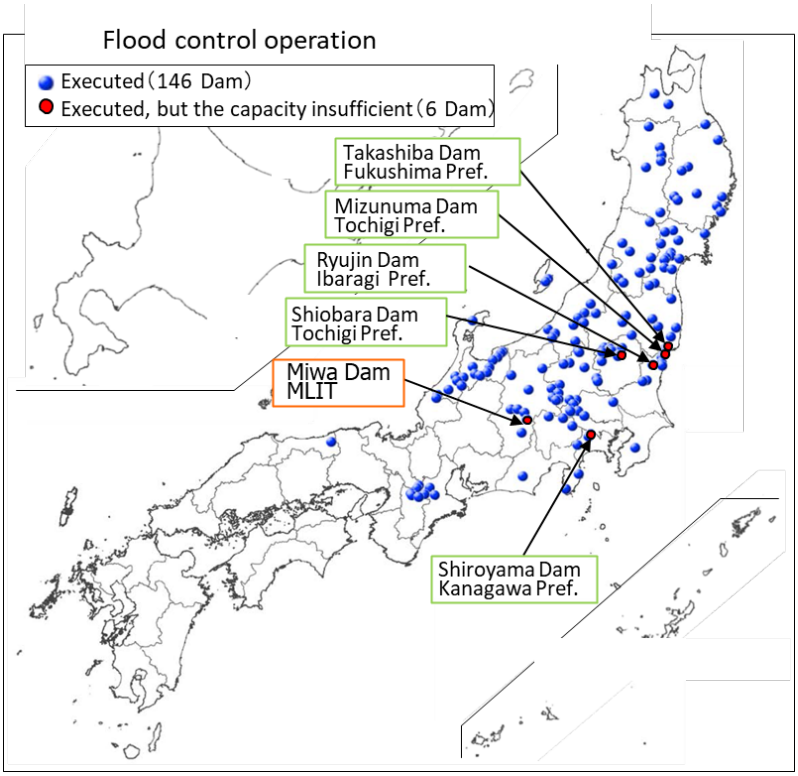

Fig. 5. Situation of flood control of dams in the Typhoon Hagibis.

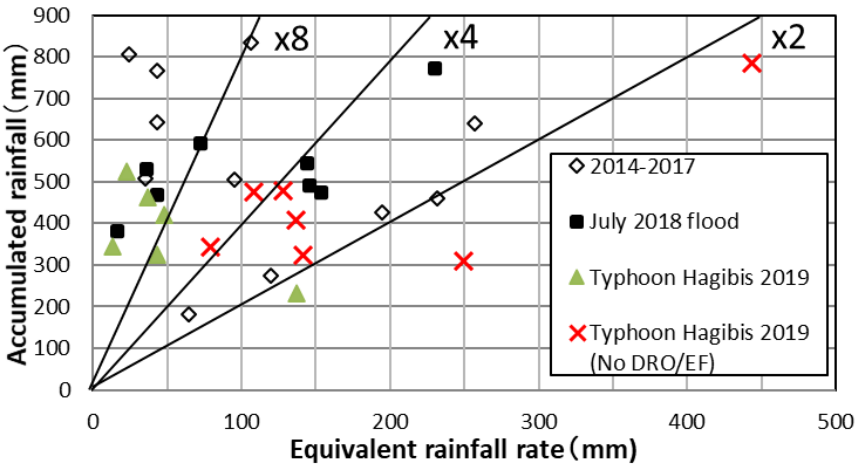

Fig. 6. Examples of the Disaster reducing operation for an extraordinary flood (DRO/EF) and Relationship between Equivalent Rainfall Rate (ERR) and actual accumulated rainfall.

In recent years, the number of dams that perform DRO/EF during such extreme floods has increased. Figure 6 shows the relationship between the Equivalent Rainfall Rate (ERR) which is defined as the flood control capacity of these dams divided by the catchment area and the actual accumulated rainfall. From these results, it can be seen that dams that have undergone DRO/EF are relatively small, with the ERR of less than 100 mm, and that many of them have actual accumulated rainfall that is more than four times the ERR. On the contrary, if it is 100 mm or more, many dams may withstand the flood. This suggests that if the ERR of the dam is small, it is recommended to preliminary release the water so that it is 100 mm or more. Additionally, these dams are listed for high priority to be upgraded.

In December 2019, the Cabinet drew up a basic policy to strengthen the flood control function of existing dams including hydropower, agricultural and municipal water dams. In April 2020, the new guideline has been released to prepare agreements among all dam users, for the purpose of smooth execution of preliminary release of the reservoir by using three days rainfall prediction before the flood events. Real operation under this guideline has started in 2020 flood season to review the effectiveness and issues to be improved.

8 Conclusions

The heavy rain which hit western part of Japan in July 2018 brought serious damages including more than 200 casualties. In this flood event, 213 dams under the jurisdiction of MLIT were engaged in flood control operation, contributing greatly to the reduction of flood damages. However, in case of 8 dams, the amount of rainfall was so huge that the dam operating officer was obliged to execute emergency spillway gate operation. Some of the downstream areas experienced severe inundation, as well as human damage. This paper outlines the flood disaster and flood control operation of dams, and gives detailed description of flood control operation of Nomura dam.

This flood disaster has demonstrated two major issues related to dam operation: reduction of damage for an extreme flood and dissemination of information for preparedness actions. In view of these issues and growing concern for climate change, MLIT set up a special panel of experts on flood control function of dams in September 2018.The panel finalized a proposal based on these three principles: promotion of both structural and non-structural measures, promotion of basin-wide and comprehensive measures, and encouragement of

self-motivated evacuation activities. The proposal covers two fields: matters related to more effective flood control by dams and matters related to more effective dissemination of information. The proposal also categorizes its detailed proposal items into (A) immediate action needed, (B) quick start needed and (C) promotion of research/development and its application needed.

The major part of the itemized proposals is shown below (category A-1 and A-2).

(A)-1 Enhancement of flood control capability through more effective operation and other measures

(A)-1-1 Review of operation rule of dams

(A)-1-2 Promotion of preliminary release of water (utilization of water use capacity) through coordination with stakeholders

(A)-1-3 Promotion of proper maintenance and measures for longer operational life of dams, including restoring lost capacity by sediment

(A)-2 Promotion of self-motivated evacuation activities

(A)-2-1 Preparation of a flood hazard map in the downstream of the dam

(A)-2-2 Promotion of explanation of information concerning function and operation of dams to the residents

(A)-2-3 Execution of an evacuation drill with the participation of residents, based on possible dam operation at a time of extraordinary flood

(A)-2-4 Improvement of measures for information service concerning dam operation to the residents and provision of information to mass media

(A)-2-5 Development of an information tool for residents, useful in an acute situation

(A)-2-6 Improvement of contents and method of warning along the river before starting DRO/EF

(A)-2-7 Improvement of warning facilities and other measures

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