

Report
on
Rebuilding Flood-Conscious Societies
in Small and Medium River Basins

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Council for Social Infrastructure Development

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1. Introduction - Accelerate Rebuilding Flood-Conscious Societies

In August 2016, a series of typhoons caused torrential rainfall, bringing about levee breaches at MLIT-managed rivers in Hokkaido, and inundation around Prefecture managed rivers in the Tohoku region. Residents at a nursing home were especially affected, due to the evacuation order being given too late along the Omoto-gawa River, managed by Iwate Prefecture.

(MLIT: Ministry of Land, Infrastructure, Transport and Tourism)

Three typhoons hit Hokkaido in one year and one typhoon landed on the Pacific coast in Tohoku, the first time such a series of events have been recorded by the Japan Meteorological Agency since 1951. Unprecedented crises due to climate change already seem to have arrived. We are concerned that the frequency and magnitude of flooding have been growing more severe for some time. Previously unheard-of events will happen again and again in the future.

Our flood management policy encounters the same issues that our society faces. Rivers severely affected by typhoons are tributaries of Class A River basins managed by the MLIT and small and medium river basins managed by prefectural governments. These have not yet been improved. Moreover, they will be affected by serious population decline.

After the Kanto-Tohoku Torrential Rain in September 2015, the Council for Social Infrastructure Development recommended that we keep in mind the inevitability of large-scale floods that exceed the limited capacity of facilities and that our whole society must always be prepared for them.

Based on this recommendation, the MLIT embarked on a new policy: *Rebuilding Flood-Conscious Societies* in MLIT-managed river basins nationwide, and expanded it to Prefecture-managed river basins.

The disaster affecting small and medium river basins in 2016 underlined the need to accelerate policy promotion and fully cover Prefecture-managed river basins. All possible measures should be implemented without any hesitation, to gain an advantage before the next flooding season.

Through intensive promotion, we should set targets to eradicate human loss due to delayed evacuations and to ensure the social functioning of local communities.

The basic policies are:

- 1) Saving all human life by sharing risk information with local communities, including nursing homes and other facilities
- 2) Protecting core facilities through prioritized and intensified investment in efficient and effective projects, including existing facilities, to support socio-economic activities
- 3) Integrating all stakeholders to promote the policy of “no human loss” and the “the continuity of local communities” through a mutual support network

Adding to the 2015 report, the recommendations should be institutionalized swiftly, and realize Policy Vision on rebuilding *Flood-Conscious Societies* in order to save precious human lives and reduce disaster damage to regional socio-economies as far as possible.

2. Typhoons in the Hokkaido and Tohoku regions in August 2016

2.1 Outline of Torrential Rains

In August 2016, Typhoon No. 7 (Chanthu), No.11 (Kompasu) and No.9 (Mindulle) hit Hokkaido, and the powerful Typhoon No. 10 (Lionrock) landed on the Pacific coast in Iwate Prefecture. The succession of typhoons caused intensive rainfalls in the Hokkaido and Tohoku regions. That month's precipitation was greatest at 89 of 225 stations in Hokkaido exceeding the average by 2 to 4 times in a wide area of Pacific coast in Eastern Hokkaido. Record-breaking precipitation was observed at 8 sites for a 24-hour period, and at 19 sites for a 72-hour period in Hokkaido and Tohoku.

Intensive Rainfall Caused by Typhoon No.10

Although typhoon No.10 did not land in Hokkaido, a continuing inflow of hot and humid air caused over 300 mm of rain, especially on the right side of the Tokachi River basin.

In the Tokachi River basin, 505 mm of cumulative rainfall was recorded from August 29th to 31st on the upper Tottabetsu. The mean rainfall exceeded its design rainfall at the upstream basin of Natai-bashi. Flood discharge surpassed the design flood discharge stipulated in the Satsunai river improvement basic policy.

In addition, on the Sorachi River in the Ishikari River basin, nearly double of the maximum experienced rainfall was observed, for instance 292mm of rainfall during a 12-hour period at the Kushinai observatory. And at the Kanayama Dam in the upstream area, the largest inflow was recorded since the Dam had come into operation.

In the Tohoku region, concentrated torrential rains broke the record in the coastal area of Iwate Prefecture. On the Omoto River, managed by Iwate Prefecture, a record-high 66mm hourly rainfall was observed at Iwaizumi, and maximum flood discharge was close to the design flood discharge at Akashika.

Intensive Rainfall Caused by a Series of Typhoons

Typhoons No. 7, 11 and 9 landed in Hokkaido one after another on August 17th, 21st and 23rd. Moreover, another typhoon, No. 10, approached Hokkaido a week later. These typhoons brought record heavy rains.

On the Tokoro River, the cumulative rainfall from August 17th in the whole river basin was at a record-high level. Due to typhoon No. 11, the water rose again after having dropped temporarily. Flood discharge at Kitami exceeded the designed flood discharge in the river improvement basic policy. The high water level continued due to rainfall brought by typhoons No. 9 and 10.

2.2 Outline of Disaster Damage

In Hokkaido, four levee breaches and five inundations occurred on the MLIT-managed sections. Five levee breaches and 73 inundations occurred on Hokkaido-managed sections. These caused 3 deaths, 2 missing persons, 13 injuries, 30 completely destroyed houses, 1,019 partially destroyed houses, and 927 flooded houses.

In the Tohoku region, flooding occurred on 20 rivers in 12 river basins managed by Iwate, Aomori and Miyagi Prefectures. In Iwate Prefecture, extensive damaged occurred, including 20 deaths, 3 mission persons, 4 injuries, 472 completely destroyed houses 2,359 partially destroyed houses, and 1,466 flooded houses.

(1) In Hokkaido

Damage in MLIT-Managed River Basins

- A levee breach on the Hokkaido-managing Tottabetsu River caused a flood covering 50 hectares along the Satsunai River.
- On the Sorachi River of Ishikari River basin, a levee breach in the upstream triggered another breach in the downstream. These caused 130 hectares of inundation and damage to 183 houses, a food processing factory, and other properties.
- Four overflows on the Tokoro River and a levee breach on the upper Shibamyamazawa River caused 504 hectares of inundation and soil erosion on farmlands.

Damage in Hokkaido-Managed River Basins

- On the Pekerebetu River and Pankeshintoku River of the Tokachi River basin, rising riverbeds due to sediments caused riverbank erosion to wash houses away. The channel expanded and washed out the backfilling of a bridge abutment.

Damage to Transportation

- Many bridges on National Highways No. 38 and 274 collapsed, closing off traffic connections in the Hidaka Mountains and temporarily isolating the Tokachi region. The Railway network in Eastern Hokkaido was also paralyzed due to collapsed bridges and other damage.

Damage to Agriculture

- Damage to agriculture amounted to 38,927 hectares of farmland and JPY 54.3

billion in total. Half of the damage was to potato and carrot crops that supply 83% and 92% respectively of the national market. This caused prices to soar nationwide.

- Affected not only by flood damage but by also soil erosion, it took a long time for local agricultural industries to recover, which deeply affected economy.

(2) Outline of Damage in Iwate Prefecture.

Prefecture-managed River Basins

- Along the Kuji and Akka Rivers, floodwater and driftwood blocked the channel at bridges and washed away houses along the riverbank.
- On the Omoto River, a great deal of debris and driftwood, combined with intensive rainfall caused the inundation over an area of 340 hectares, affecting 844 houses.

Damage to Transportation

- Flooding stopped many national and regional roads near rivers, stranding over 1,000 people.

Damage to a Nursing Home

- On the Omoto River, the narrow valley flooded when intensive rainfall caused the water to rise rapidly. Human suffering due to the slowness of evacuation occurred at a nursing home.

2.3 Features of the Disasters

The disastrous flooding caused levee breaches and inundation due to overtopping or erosion of both MLIT-managed and Prefecture-managed rivers. Specific features of the disaster were:

- Extensive human suffering due to delay in evacuation at a nursing home, which was caused by inappropriate information distribution and rapidly rising water in the mountainous area
- Inundation of narrow valleys in mountainous areas, which caused damage to nursing homes, factories, houses, and other property
- Channel blockages by debris and driftwoods at bridges in small and medium rivers
- Traffic disruptions on the road and rail networks due to channel blockage at bridges and the erosion of roads, which caused logistics failures and stranded communities.
- Soaring prices of farm products nationwide because of damage to agriculture production of high-rate market share.

In addition, the Kitagawa River in the Gokase River basin in Miyazaki Prefecture was hit by flooding caused by Typhoon No.16 (Malakas) in September 2016. The discharge was on the same scale as that which had occurred in 1997, but the damage was dramatically smaller because of the flood risk reduction project that was implemented after 1997, including building open levees and land heightening.

3. Small and Medium River Basins under Changing Climate and Declining Populations

The rivers affected by the series of typhoons were tributaries of Class A Rivers managed by the MLIT and small and medium river basins managed by prefectural governments.

These small and medium river basins are prone to flooding due a to relatively small discharge capacity against intensive and frequent torrential rainfall caused by climate change. In addition, communities along the rivers have less anti-disaster capacity because of declining and aging populations in this remote mountainous area. These communities are vulnerable to natural disasters, including flooding.

(1) The Situation of Small and Medium River Basins

Small and medium rivers generally have a small catchment area, steep riverbed slopes and short channels. The channels normally have a trench-shape or single cross section between levees, and typically allow the run-off water to rise quickly when there is intense rainfall. Large-scale flooding upstream often outflows from the channel, making the valley a whole single channel. Landslides produce debris and driftwood which may block channels and add to the rise in water level.

River improvement has been carried out in downstream areas of large-scale rivers which have concentrated populations and assets which can suffer damage caused by flooding. Therefore, small and medium rivers, which have more scattered populations and assets, rarely have a river improvement plan, and their improvement is at a low level.

Prefecture-managed rivers extend to about 113,000 km (77,500 km of class-A rivers and 35,900 km of class-B rivers), which is much longer than the approximately 10,600 km of MLIT-managed rivers. These remain with insufficient water level observation and river surveys.

(2) Responses to Climate Change

Regarding climate change adaptation and water-related disasters, the Council for Social Infrastructure Development discussed countermeasures and presented a report in August 2015. It suggested taking flexible approaches, taking into account various influences through:

- Arranging procedures of river improvement to reduce damage if flooding occurs
- Designing levees to prolong time before they breach after overtopping
- Taking a step-by-step approach to deal with higher external forces

The 5th IPCC assessment report assumed that extreme precipitation will occur more intensively and frequently in mid-latitude areas by the end of the 21st century. This means that small and medium rivers will suffer from quick and large floods more frequently, causing more severe damage.

Based on the 2015 report, in small and medium river basins, structural and non-structural measures should be implemented flexibly and swiftly to save human lives and minimize damage.

(3) Responses to Population Decline

Small and medium rivers flow through mountainous areas. These areas will have difficulty in resilience against natural disasters because a low birthrate, a declining population and aging communities will affect proper operations during floods such as sluiceway controls, flood fighting activities, evacuations and other operations.

The National Spatial Strategy (endorsed by the Cabinet in 2015), made the following recommendations for mountainous areas where there are many small and medium scale rivers:

- Promote the development of “small hubs” where services and other functions are concentrated.
- Develop multi-functioning communities to create jobs, operate farmlands, and prevent disasters.
- Improve safety through land use control in high-risk zones, while taking into account local conditions.

In accordance with this policy for flood control in small and medium river basins, river administrators and all stakeholders should share flood risk information, raise awareness of risk reduction and promote structural measures to protect important local hubs and take non-structural measures to enable appropriate evacuation behavior.

4. Key Activities Based on the Report of December 2015

Based on the report of December 2015, the MLIT formulated a new policy: *Rebuilding Flood-Conscious Societies* and established committees to share flood risk reduction targets among river administrators, municipalities and all stakeholders in each MLIT-managed river basin in order to promote structural and non-structural measures integrally.

Flood Risk Reduction Committee

The Flood Risk Reduction Committee had been established in 127 out of a total of 129 areas (98%) by the end of November 2016 and is sharing current flood risk information and countermeasures. 123 committees (93%) have discussed swift and smooth evacuation, appropriate flood fighting operations, drainage after inundation, the operation of facilities, and other matters, and have compiled a *Local Action Plan* detailing practical 5-year activities for all stakeholders.

Non-structural Measures

Regarding non-structural measures, the MLIT introduced a *Time-series Disaster Operation Plan* which focuses on the issuance of evacuation advisories. 611 out of 730 municipalities (84%) had already installed the plan as of the end of November 2016.

In addition, the MLIT designated house collapse hazard zones where flood waters might destroy houses, and announced them in 69 of 109 MLIT-managed river basins as of the end of November 2016.

Moreover, the MLIT improved the web-site *Disaster Information on Rivers* to provide live views of rivers and probable inundation zones, adding to the ongoing distribution of information on river water levels, radar rainfall data and flood warnings. On-site information is also provided to GPS-equipped smartphone users. Since September 2016, the MLIT has operated an active information delivery service for the Kinu River in the Tone River basin (Joso, Ibaraki Prefecture) and the Hiji River (Ohsu, Ehime Prefecture). There are plans to expand the service area.

In addition, the MLIT has created a video program entitled "*Lessons for Mayors in Flood Fighting Operations*" in order to help mayors understand flood management and disaster information management.

Structural Measures

River administrators are promoting conventional flood disaster preventive measures such as heightening levees, excavating riverbeds and preventing seepage, on 1,200 km

of prioritized river sections.

In parallel, river administrators have adopted new crisis-management structural measures which prolong the time before levees are breached in cases of over-topping. These measures have been introduced at 1,800 km of temporary levees which are risky but not prioritized due to up and downstream balance and other factors.

As mentioned above, under the policy “*Rebuilding Flood-Conscious Societies*”, the MLIT and other river administrators are promoting structural and non-structural measures nationwide mainly to confirm effects in some regions.

On the Tokoro River, where in August 2016 Typhoon No.11 (Kompasu) flooded 215 hectares, the municipality completed a smooth evacuation with nobody left behind through earlier evacuation advisories depending on the time-series disaster operation plan and a hot-line from the MLIT, as discussed by the Tokoro River Flood Risk Reduction Committee.

The MLIT and local committees are publishing such good practices through websites and social media. It is recommended that river administrators, municipalities, residents, and private sectors collaborate to promote disaster risk reduction and follow up the policy.

The time-series disaster operations and the hot-line are proving to be effective in MLIT-managed rivers and being adapted to prefecture-managed rivers. It is recommended to develop approaches that meet local needs and conditions in small and medium river basins.

5. Key Challenges to be addressed

Focusing on issues highlighted by the recent series of typhoons, considering the current situation in small and medium river basins affected by climate change and population decline, reviewing the new policy of rebuilding flood-conscious societies, the key challenges to be addressed are as follows:

Structural and Non-structural Measures in Cooperation with Related Organizations

- As Flood Risk Reduction Committees are working effectively in MLIT-managed river basins, similar approaches are required in Prefecture-managed rivers.

Information Sharing for Appropriate Evacuation

- Errors in communicating to mayors hamper appropriate issuance of evacuation advisories.
- On rivers not designated as water level warning river, no information to assist in issuing evacuation advisories is provided.
- Designation of water level warning rivers, to provide local flood risk information, has not been promoted.
- Flooding information is not fully understood by nursing home administrators. Practical evacuation plans have not been prepared. Evacuation drills are not being carried out. As a result, early evacuation of the physically disabled has not been prepared.

Functional Maintenance of River Facilities

- Due to a low birthrate, an aging and declining population, and changing communities, it is becoming difficult to secure operators for sluiceways. River facilities operations will be difficult in the future.

Land use in Accordance with Disaster Risk

- In the recent flooding, a nursing home and several newly-built factories along the river were damaged. From the viewpoint of security against flooding, the land use is not appropriate.

Flood Control in Small and Medium River Basins

- Due to up-and-downstream balance, financial constraints, and other factors, the current level of improvement is not high. The frequency of intensive rainfalls is increasing. Floods exceeding the capacity of facilities capacity occur in many areas.

- Roads, railways, farmlands, and other property have suffered extensive damage. Recovery and reconstruction take too long and socio-economic effects extend beyond the damaged areas.

Support for Municipalities

- Prefecture-managed rivers are numerous and long. Municipalities have decreased their number of employees and lack experience. When serious situations occur, disaster response will be problematic in such areas as information management. In addition, when there is damage in municipalities, it will be impossible to carry out disaster recovery quickly.
- Due to declining and aging membership of flood fighting teams, local institutional systems have been weakened. Local disaster resilience has suffered.

6. Measures Needed in Small and Medium River Basins

6.1 Basic Policy

Based on major damage caused by the typhoons, the current situation in small and medium river basins affected by climate change and declining populations, as well as actions taken so far and issues still to be addressed, with a strong determination never again to experience such painful damage, we should endeavor to:

- ensure evacuation in order to save all human lives, and eliminate human loss due to delays in evacuation
- have administrators protect core facilities so as to minimize socio-economic impacts, and ensure the continuity of communities

We should make efforts to expand and fulfill the policy of “Recreating Flood-Conscious Societies through the following:

- Ensuring steady-going evacuations to save all human lives, including those of nursing home residents, through risk information sharing in local communities
- Protecting core facilities crucial for local socio-economies through prioritized and intensified investment in efficient and effective projects, including improvement of existing facilities, for socio-economic activities
- Integrating all stakeholders in order to eradicate human losses and to ensure local community continuity

Focus of This Report

The rivers damaged by the series of typhoons were tributaries of Class A Rivers managed by the MLIT and small and medium river basins managed by Prefectures, where river improvements had been somewhat delayed. Some urbanized rivers had been covered by the Climate Change Adaptation Policy since 2009. Therefore, this report focuses on small and medium rivers running through areas with low-density population and property.

Flood risk information sharing

To promote flood control in each region, firstly, river administrators should provide flood risk information such as the location of probable inundation zones at normal times, and a real-time water information system to enable emergency responses such as evacuation advisories.

However, water level observation is insufficient in small and medium river basins. Even in such regions, river administrators should install simplified water gauges,

conduct river surveys, simulate probable inundations, and share as much information with communities as possible. Roadside indicators of past water depth are also an effective way to raise residents' awareness in their daily lives.

In addition, administrators in charge of disaster management, social welfare, and medical care should properly understand the shared information, consider countermeasures and implement them in normal times before flooding occurs.

Steady-going Evacuation of Nursing Homes

In the nursing home affected on this occasion, the manager did not understand the flood risks, thus exacerbating the damage. River administrators and other stakeholders should raise the awareness of the management of every facility.

Because nursing care recipients require considerable time for evacuation, the facility managers should prepare practical evacuation plans and carry out evacuation drills in cooperation with local communities. Preparation on a daily basis is recommended in order to ensure smooth evacuations.

Prioritization and Implementation of River Improvement

River improvement has been promoted intensively in urban areas located downstream. The flooding hit small and medium river basins where river improvement had been delayed due to concerns about up-and-downstream balance and financial constraints. River administrators should invest in these areas to ensure a balance of safety between upstream and downstream.

Therefore, river administrators should prioritize and concentrate on projects that secure lives and property efficiently, utilize natural topography as much as possible, select localized countermeasures such as ring levees and land heightening, and revitalize existing facilities for maximum retarding functions.

River administrators should also promote structural measures that assist swift and smooth evacuations. It is important to build evacuation centers and routes with local communities and to stop water flows using continuous embankments and natural hills.

Land Use

In this flooding disaster, a narrow valley was inundated, and a nursing home and newly built factories were damaged. For better land use, river administrators should actively provide flood risk information and each community should review the locations of nursing homes, taking into account flood risks and daily needs. If a community decides to build a nursing home in a probable inundation zone, it is necessary to

consider how to act in case of emergency. It is also important to consider using new nursing homes as evacuation centers and community communication sites.

Cooperation among Relevant Administrators and Support for Municipalities

As recommended in the 2015 report, frequent floods exceeding the capacity of present facilities have recently occurred; climate change may exacerbate the situation. It is very difficult to deal with this only through conventional measures. River administrators and all stakeholders in river basins should take measures together.

Because of climate change and declining populations in particular, municipalities will face further difficulties in emergency response, flood fighting and disaster recovery due to both of financial and institutional limitations.

To a build safe and secure society, the MLIT and municipalities should fulfill their respective roles and fully cooperate in dealing with the issues. It is urgent to enhance interdependence among all stakeholders, and establish institutional support for municipalities, and for the MLIT to actively provide flood risk information, utilizing the Flood Risk Reduction Committee.

6.2 Measures to be taken

Based on the basic policies, the following measures should be implemented in small and medium river basins:

6.2.1 Structural and Non-structural Measures in Cooperation with Relevant Organizations

(1) Flood Risk Reduction Committee to Rebuild Flood-Conscious Societies

Prefecture-managed river basins require an institutional framework to share flood risk information and risk reduction targets during normal times, and to promote structural and non-structural measures integrally and systematically.

It is recommended that river administrators and local mayors establish a Flood Risk Reduction Committee, as well as a cooperative mechanism in order for a wide range of stakeholders to carry out continuous and effective actions.

6.2.2 Steady-going Evacuations through Flood Risk Information Sharing

(1) Support for Issuing Evacuation Advisories

1) Review by Flood Risk Reduction Committees

To ensure appropriate evacuation advisories by municipalities, Flood Risk Reduction Committees should review and recommend criteria and a time-series

disaster operation plan.

2) Hot-line between River Administrators and Mayors

To ensure appropriate evacuation advisories at Prefecture-managed river basins, river administrators and mayors should establish a hot-line in order to share river information directly. Furthermore, it is recommended that they compile guidelines for confirming run-off features and local conditions.

(2) Flood risk Information Sharing

1) Promotion of water level warning river scheme

It is recommended to promote the water level warning river scheme by clarifying designating criteria. Even before designation, in the absence of flood simulations, flood risk information should be shared in a simple manner, utilizing data on previous inundation areas and water depths.

2) Water Level Monitoring for Evacuation

It is recommended to develop simplified and inexpensive water level gauges and a monitoring network to increase the number of water level observatories in small and medium river basins.

3) Flood Risk Information Sharing (out of the designated scheme)

Without designation of a water level warning river scheme, the Flood Risk Management Act doesn't enforce the disclosure of probable inundation zones. However, municipalities and river administrators should investigate past flood records and utilize them as flood risk information.

4) Rainfall Information (out of the designated scheme)

Rivers not included in the water level warning scheme have a short run-off time. Municipalities should utilize rainfall information for issuing evacuation advisories so as to gain lead times for evacuation.

(3) Steady-going Evacuations of Nursing Homes

1) Awareness-raising among Facility Management

River administrators and other stakeholders should hold briefing sessions for nursing homes to provide disaster information and evacuation information. To deepen the understanding of administrators and staff, it is recommended that they

prepare practical evacuation plans and carry out evacuation drills in cooperation with local communities.

2) Practical Evacuation Planning

It is recommended to ensure an evacuation system for nursing homes through the practical evacuation plans and evacuation drills. In model districts, all relevant stakeholders should make up practical evacuation plans and share lessons learned nationwide. In addition, municipalities should check the effectiveness and sustainability of their plans, utilizing inspection manuals.

6.2.3 Functional Maintenance of River Facilities

(1) Functional Maintenance of River Facilities

1) Reliable Operation of Sluiceways and Sluiceways

Due to a low birthrate, an aging and declining population, and change in communities, it has become difficult to secure operators for river facilities. River administrators should install operation-free sluice gates and outsource maintenance to local organizations in order to promote more reliable operations.

2) Sophistication of river management

River administrators should sophisticate river management using the state-of-the-art ICT technology, such as land and underwater laser surveys using drones.

6.2.4 Appropriate Land Use

(1) Appropriate Land Use

1) Flood risk Information for Appropriate Land Use

River administrators should encourage land use in low-risk areas by distributing flood risk information in cooperation with the relevant agencies.

2) Designation of Disaster Hazard Zones

River administrators should encourage municipalities to designate flood hazard zones where inundation can be allowed, and building ring levees in cooperation with the relevant agencies.

6.2.5 Prioritization of Flood Management Measures

(1) Flood Management in Low-density Areas

1) Prioritization Based on Local Conditions

To improve safety in areas where populations and properties are widely spread out, and considering financial constraints, it is recommended that administrators intensively protect core facilities, such as those concerned with disaster management and public services.

River Administrators should proceed with efficient localized measures against flooding, such as ring levees and residential land heightening with the understanding of local residents gained through flood risk information sharing.

Flood Risk Reduction Committees should discuss evacuation centers and routes in order to develop them collaboratively among the relevant stakeholders. For example, gravel excavated from rivers may be used in land reclamation. Also, continuous embankments and natural hills are useful for stopping floodwater flow.

2) Run-off Control in Rural areas

It is recommended that administrators promote run-off control in rural areas, not only in urbanized areas. To maximize water storage capacity, reservoirs and paddy fields should maintain their retarding functions with the consensus of the owners.

3) Countermeasures against Driftwood and Debris

Driftwood captured by bridges in narrow sections of small and medium rivers, dams up the upstream water. River administrators should share the risk with the communities and take responsibility for preventing such occurrences with relevant stakeholders. Debris from slope collapses also raises the water level in small and medium rivers. River administrators should research debris flow on riverbeds. It is recommended that they prevent problems caused by sediment in upstream basins.

(2) Flood Management in the Upstream of Main Stream and Tributaries

1) Safety Improvement Upstream and Downstream Balance

River administrators should discuss and promote structural and non-structural measures for keeping an upstream and downstream balance.

2) Review of River Improvement Plans

River administrators should review present river improvement plans through assessment of the effects of recent heavy rainfalls.

3) Flood Control in the Upstream

River improvement should be promoted in small and medium river basins, where improvement level is currently relatively low, to increase total safety level of the whole river basins.

River administrators should promote pinpoint (smaller) projects which have less impact on the downstream, and revitalize existing facilities by enhancing the flood control functions of reservoirs or revising operational rules in accordance with downstream river improvement. Especially in river basins damaged recently, dam operators should consider temporary operational rules.

In Prefecture-managed river basins, it is recommended to install new technical support for the MLIT to carry out difficult projects, such as dam upgrades, instead of the actual administrators.

(3) Protection of Facilities Influential on the Socio-economy

1) Collaboration with Core Facility Administrators

In order to minimize the socio-economic impact of floods, river administrators and administrators of important facilities should collaboratively enhance measures for disaster risk reduction. River administrators should promote river improvement and the administrators of core facilities should maintain the functions of their facilities by themselves. For this purpose, river administrators should share flood risk information with the administrators through the Flood Risk Reduction Committee.

6.2.6 Supporting Municipalities in Disaster Recovery and Flood Fighting

(1) Support in Quick Recovery

1) Technical Support for Disaster Recovery

River administrators should enhance collaboration with municipalities in capacity development through training, drills, and equipment provision.

The Technical Emergency Force (TEC-FORCE), in addition to damage investigation, should support municipalities with a number of disaster recovery works such as recovery planning, financial support applications and procurement work.

In Prefecture-managed river basins, especially, it is recommended that administrators install new technical support system which enables the MLIT (central government) to conduct urgent and difficult works for the quickest recovery instead of prefectures.

(2) Support in Disaster Information Management

1) Warning Stage

As large-scale and devastating disasters cause confusion and delay emergency response, preparatory work is important. However, disaster simulation and information management require advanced technical skills. River administrators should support municipalities in the warning stage before disasters occur.

In addition, river administrators should prepare time-series disaster operational plans to simulate disaster response in Prefecture-managed river basins.

2) Human Resource Training for Flood Response

Because large-scale and devastating disasters cause damage also to MLIT-managed rivers, MLIT staff may not be able to support municipalities. Municipalities should rely on specialists with experience of TEC-FORCE and disaster damage assessment or on those licensed in river management. It is recommended that municipalities promote better human resource utilization through training programs and by listing professional careers.

(3) Support for Flood Fighting Operations

1) Involvement of the Private Sector

Because flood fighting teams suffer from personnel and financial shortages, river administrators should support flood fighting operations such as sandbag piling, river monitoring and evacuation guidance, involving private sector actors such as civil contractors.

7. Conclusion

This report summarizes the measures to be implemented toward “Rebuilding Flood-Conscious Societies” in small and medium river basins, in terms of both structural and non-structural measures, based on the social situation in areas around the rivers.

In particular, the following measures should be promoted promptly, in order not to repeat past disasters in the next flooding season:

- Steady going evacuation at nursing homes in order to avoid repeating the tragedy of the last flood
- Flood Risk Reduction Committee to promote risk reduction sharing good practices
- Technical assistance for disaster recovery requested by many stakeholders

In parallel, measures having a deep impact, such as flood control and land use planning, should be discussed with careful consideration from a long-term perspective.

Currently, based on the report of December 2015, “*Rebuilding Flood-Conscious Societies*” is ongoing, mainly in MLIT-managed river basins. This policy is also effective in small and medium river basins, and is expected to be implemented nationwide. We hope to establish a safe and secure society with no further delay.