Integrated Flood Management for Urbanized River Basins in Japan

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I am going to talk about

- Scheme for River Management in Japan
- Integrated Flood Risk Management Measures in Urbanized River Basins
Geographic Conditions of Japan

- 70% of land is covered with forests and mostly mountaneous
- 50% of population and 75% of assets are concentrated in flood plains (10% of land)
- Heavy rainfall occurs during rainy season in June-July and in the typhoon season in August-October
- Rivers are short and steep, causing sharp hydrograph
- The ratio of maximum/minimum discharge is extremely high (about 100 for Tone River)
Inhabitable area / National land area

(Prepared by MLIT)
Population in flood plain / Total population

<table>
<thead>
<tr>
<th>Country</th>
<th>%</th>
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<tbody>
<tr>
<td>England</td>
<td>7</td>
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<tr>
<td>France</td>
<td>7</td>
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<tr>
<td>USA</td>
<td>9</td>
</tr>
<tr>
<td>Germany</td>
<td>17</td>
</tr>
<tr>
<td>Japan</td>
<td>51</td>
</tr>
<tr>
<td>Netherlands</td>
<td>64</td>
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(Prepared by MLIT)
Amendment of the River Law

(River Bureau, MLIT)

- Introduction of integrated river system management
- Enhancement of water-use regulations
- Improvement and conservation of river environment
- Introduction of plans reflecting public opinions

Process of amendment of the River Law:
- Birth of modern river administration system
- Establishment of systematic framework for flood control and water use
  - Introduction of integrated river system management system
  - Enactment of water-use regulations
- Establishment of comprehensive river administration system for flood control, water use, and environmental conservation
  - Improvement and conservation of river environment
  - Introduction of river improvement planning system designed to incorporate the opinions of local residents
Tasks of River Administrator

- Flood management
- River water use management
- River environment management

Activities of River Administration Offices

- Observe rainfall, river water level, river water quality
- Research the environment of river and river basin
- Study river improvement and environment
- Plan, design and construct river structures
- Patrol to observe problems of structures, illegal acts
- Administrate use of river area
New scheme for river management

Old System

Basic Plan of Work Operation

Draw up the basic plan draft of works operation

Determination of the basic plan of works operation

Reflection

Class A river system

River Council

Main contents of river works

Contents ⇒ Basic Policy, Design Flood, Design Flood Discharge etc.

New System

Basic River Management Policy

Draw up the draft plan

Determination and publication of the plan

Social capital improvement Council

(Class A river system)

Prefectures’ River Council

(Class B river system)

The case that the prefecture has its River Council

New scheme for river management

Contents ⇒ Goal of River Development

Contents of River Works and River Maintenance

Original plan

Draw up the draft plan

Determination and publication of the plan

Reflection

Academic expert

Prefectures’ River Council

Governor of a local authority

(River Bureau, MLIT)
Scheme for River Planning

Basic River Management Policy

- Basic policy on flood control measures, water use and environment conservation
- Unregulated peak discharge on target level
- Design flood discharge

River Basin Implementation Plan (for 20 ~ 30 years)

- Persons experiences or academic standing
- Reflection of local opinions through public hearing
- Governor of local government

- Flood control facilities (Dam, Retarding Basin)
- Embankment, bank heightening, river widening, dredging, bank protection, pumping station, etc.
Tama River Implementation Plan

<table>
<thead>
<tr>
<th>Seminars (8 times) and river basin commission meetings (5 times) for 2 years</th>
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<tbody>
<tr>
<td>with the participation of citizens, local governments, literates and river managers</td>
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<td>for consensus building among various stakeholders</td>
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<tr>
<td>before establishing the plan in 2002</td>
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(1) River improvement for disaster prevention or mitigation for flood and high tide, including measures to cope with excessive event

(2) Appropriate usage of river water including maintaining the basic function of rivers

(3) Preservation and restoration of river environment and enhancement of education for citizens for historical, cultural and ecological value of Tama river
The Tsurumi River basin in Kanagawa Prefecture has seen a much higher population growth rate than the national average.
Urbanization rate of 10% in 1958

Urbanization rate of 60% in 1975

Urbanization rate of 84.3% in 1997

Flooding of September 1976

Developments of Heights and Hilly Zones: Tsurumi River (through Tokyo metropolis and Kanagawa Prefecture)

Extensive Housing Land Development has been in Progress in the Heights and Hilly Zones of the Suburban Areas in the Three Major Metropolitan Regions.
Effect of urbanization on flood runoff
Reduction of Water Retention and Retarding Functions of River Basin Results in Increase in Peak Discharge.

After 80% development in future
Actual conditions as of 1975
As of 1958
Undeveloped river basin

(Flood discharge at Ochiai Bridge)
Rainfall depth considered

Source: Interim Report (June 1977) of Tsurumi River Basin Flood Disaster Prevention Planning Committee
Widening of river channel is difficult in the highly urbanized area

Tsurumi River

Naka River and Ayase River


Source: Brochure “For Protecting Our Town from Flood Disasters”
Comprehensive Flood Disaster Prevention Measures

**Basin Council**

consisted of the representatives of the regional development bureau of MLIT, river related departments and the urban, housing and land department of the prefectural and municipal governments concerned, to discuss the implementation scenario of the comprehensive measures for the river basin.

**Basin improvement plan**

The Council studies and selects concrete measures appropriate to the characteristics of the particular basin and make up a basin improvement plan.
Basin Improvement Plan

Retention areas
- Maintenance of controlled urbanization districts
- Conservation of nature
- Construction of reservoirs and regulating basins
- Installation of permeable pavements and seepage sumps

Detention areas
- Preservation of urbanization control zones
- Control of landfill
- Promotion of conditions favorable to agricultural activities

Low-lying areas
- Development of drainage facilities
- Construction of storage facilities
- Encouragement of use of flood-proof buildings
River Improvement - 1

River Channel Improvement (Embankment, dredging etc.)

Tsurumi River

How the neighborhood of Shiotsuru Bridge has changed after river dredging.
River Improvement - 2

Construction of Retarding Basin and Diversion Tunnel

Multipurpose Retarding Basin for Tsurumi River
With the basin divided into three zones, namely, Water Retention Zone, Retarding Zone and Low-lying Zone, basin improvement measures appropriate to the characteristics of the respective zones have been implemented.
Construction of Storm Water Detention Pond

Aerial view of a group of storm water detention ponds

Example of general storm water detention pond

Storm water detention ponds covered with bluish green screens
Example of Use as Multipurpose Facilities

In normal times

Kirigaoka Regulating Pond (Tsurumi River)

In flood times
Construction of Rainwater Storage Facilities

School ground storage

Shinkashi River
Basin Measures - 4

Construction of Permeable Pavements and Infiltration Inlets

Permeable pavement

Permeable tile pavement

Tokyo Metropolis
Construction of Permeable Pavement and Infiltration Inlet

Storm water infiltration facilities
Damage Reduction Measures - 1

Encouraging Construction of Waterproof Buildings

Tsurumi River

▲ Constructed in a multipurpose retarding basin for the Tsurumi River, this building has adopted a piloti type structure to permit the use of the retarding basin during floods.

▲ Located near the Tsurumi River, the building, learning from past experience, adopts a piloti type structure to protect it from flood damage.
Official Announcement of Flooded Areas or Flood Hazard Areas

Flood Hazard Areas of Shinkashi River Basin
High-standard levees

A high-standard levee is an embankment designed as part of a community to prevent destructive damage resulting from a levee break caused by a flood greater than the design flood.

Levee height

Area to be integrated with a high-standard levee as part of a community

About 30 times as high as a conventional levee

Ara River (Komatsukawa area)

High-standard levee projects are integrated with urban redevelopment projects to make efficient use of limited space in built-up areas.
Flood Hazard Map

Example of Fujimi City, Saitama Prefecture

Evacuation direction

Evacuation area
Lessons learned

- **Preventive measures** are often more efficient than proactive measures.
- **Involvement of various stakeholders** in the planning process, consequently saves time and cost.
- **Excessive event** should be taken into account for minimizing losses.
- **Hydrological impact assessment** due to basin development should be assessed and appropriate measures be taken for preventing or mitigating the negative impacts.
Thank you for your attention

http://www.icharm.pwri.go.jp
Integrated risk management considering the total balance of proactive and reactive measures is important.
Comprehensive Flood Disaster Prevention Measures

① River Improvement

- Improvement of river channel (construction of dikes, dredging, etc.)
- Construction of retarding basin, diversion tunnel, etc.

② Basin Improvement Measures

- Water retention area
- Retarding area
- Low-lying area

- Preservation of urbanization controlled area
- Conservation of non-urbanized areas
- Construction of storm water detention pond, etc.
- Construction of storm water storage facilities
- Provision of permeable pavements, infiltration inlets, etc.

- Preservation of urbanization controlled areas
- Restrictions on banking
- Improvement of farming environment

- Construction/improvement of inner basin drainage facilities
- Construction of storm water storage facilities
- Encouraging construction of waterproof buildings

③ Flood Damage Reduction Measures

- Establishment of flood warning and evacuation system
- Enhancement of flood defense system
- Official announcement of flooded areas and flood hazard areas
- Encouraging construction of waterproof buildings
- Publicity activities directed toward community residents

River Administrators (Central, prefectural and municipal governments)

Local Governments in River Basins (Prefectural and municipal governments)

River Administrators and Local Governments in River Basins
The purpose of the Act is to prevent inundation damage in a designated urban river basin (where severe inundation disaster has occurred or is likely to occur and also where conventional measures such as channel improvement is difficult due to urbanization).

Drawing a comprehensive river basin inundation mitigation plan
Constructing storm water retention and infiltration as river management activities and other necessary measures
Permission of Actions hampering storm water retention and infiltration function of the basin (Article 9-22)

Change of land shape for housing area development

Land pavement due to change of agricultural land to parking area

Construction of golf course

etc.

Storm water does not infiltrate into underground by housing land development, etc., and flows into rivers at the same time, causing flood damage

needs a permission from prefectural Governor