Application of Science & Engineering-Based Comprehensive Flood Management Planning Method to Chao Phraya River Basin

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Outline

1. Japanese Flood Management System
   Concept / Legal Framework / Planning Method & Process to Secure Implementation

2. Application of the Planning Method to Chao Phraya River Basin

3. Conclusion
1. Japanese Flood Management System
Japan, a Flood-Prone Country

Flood Water Levels in Central Tokyo

Assets
- Area below flood water level: Approx. 75%
- Other Area: Approx. 25%

Population
- Area below flood water level: Approx. 50%
- Other Area: Approx. 50%

Area
- Area below flood water level: Approx. 10%
- Other Area: Approx. 90%

Source: Japan Rivers, Learning to Live with River, CIA The World Fact Book

Flood Water Levels in Central Tokyo

- Sumida Riv.
- Arakawa Riv.
- Edo Riv.

Railway
- National Route 6

Elevation (m)
Characteristics of the Flood Management in Japan

• Focus on the preventive stage
• Holistic approach from preventive stage to emergency response and recovery
• A basin-based comprehensive flood risk management plan, according to the characteristics of each basin
• Appropriate combination of "hard (structural)" and "soft (non-structural)" measures
Comprehensive Flood Management

- Conservation of natural land
- Restriction and control of earth filling
- Reservoirs
- Rainwater storage and infiltration
- Urbanization control
- River improvement
- Permeable pavement
- Seepage pits
- Rainwater tanks
- Multipurpose retarding basin
- Water-proof buildings
- Evacuation warning systems
- Drainage pump station
- Underground river
- Hazard & Risk mapping
- River measures
- Basin measures
- Damage alleviation measures
Effect of investment for Flood Management in Japan

Water-related Disasters Statistics in Japan

*Number of fatalities exclude those who dead by tsunami
How is implementation of the measures secured?
In cases where there is a prefectural river council:

- Items decided:
  ○ Basic policies concerning overall conservation and use of the rivers in the river system
  ○ Items which should be the foundations for improvement of the river
  - Items concerning the design flood and its allotment to the river course and to flood regulation facilities
  - Items concerning the design flood discharge and design flood level at major points, river width related to the design transverse profile, and the flow rate necessary to maintain the normal functions of the flowing water.

- Items decided:
  ○ Items concerning goals of the River Management Plan
  ○ Items concerning the execution of improvement of the river
  - Outline of the purposes, kinds, and locations of execution of river works, of functions of river management facilities provided by executing the said river works.
  - Purposes, kinds, and locations of execution of river works

**Measures necessary to reflect opinions**

**Infrastructure Council or Prefectural River Councils**

**Finalize Academic Persons**

**Draft Opinion**

**Infrastructure Council or Prefectural River Councils**

**Finalize Local Residents**

**Finalize Governors or Mayors**

**Full Measures**

**Prioritization Implementation Process**

**Framework of Flood Management Planning under “River Law”**
2. Application of the Planning Method to Chao Phraya River Basin
Planning Process

Chao Phraya Flood in 2011

Planning Team
Thailand : RID, DWR, WFMC
Japan : JICA supported by MLIT

Academic & Scientific Support
• IMPAC-T (Thai and Japanese Universities)
• ICHARM (UNESCO Centre)

Workshops

Other related Agencies
Thai Academia

Masterplan proposal
Chao Phraya River Basin Master plan

Goal:

To promote sustainable economic growth by way of reducing flood risk and exploiting floodwater as water resources through proper Flood Management.
Flood Management Policy

i. to integrate all of the activities implemented by respective organizations concerned in the whole river basin;

ii. to maintain a harmonious balance between flood control and water utilization;

iii. to control inundation;

iv. At the planning stage of countermeasures, to seek best mix of structural and non-structural countermeasures;

v. At the ordinary operation stage, to set the proper operation rules for flood control facilities and land use regulations with due consideration for extreme events; and

vi. At the emergency stage, to fulfill the responsibility of each individual, community, private firm, NGO and governmental organization.
iii. To control inundation

Why?

Inundation cannot be eliminated.

Avoidance of unexpected inundation

Minimization of damage

Securing farmers’ income

After all projects’ completion
Maximum Inundation Area: 20,000 km²
Support from farmers’ experience and knowledge collected by JICA Agricultural Study

Characteristics of “Controlled Inundation Areas”

Precise topographical data from LiDAR topographical survey
Controlled Inundation Area

Five Categories

Type FS: Flooded, but inundation is relatively shallow and Short.

Type FL: Flooded, and inundation is deeper and Longer.

Type W: Flooding comes from both the upper river basin and the West hilly area.

Type M: Marsh area, where floodwater stays throughout a flood season.

Type H: Close to the Hilly area, where inundation is shallow and short.

- Land use regulation
- Mitigation and adaption measures
- Facilities to control inundation
<Controlled Inundation>
Areas to be protected
(The Royal Thai Government)

Raising surrounding roads and road embankments (already started)
iv. Best mix of structural and non-structural countermeasures

● Structural measures

Embankments, dams (reservoirs), floodways, weirs, etc.

Best combination?

● Non-structural measures

✓ Flood Management Information System

Draft Basic Plan finalized.

✓ Agricultural intervention in controlled inundation areas

Guideline being prepared.

✓ Characteristics of controlled inundation areas

✓ Land use regulation, evacuation drill, etc.
“Full” Projects to be studied

proposed by SCWRM and WFMC

Countermeasures:
1) Operation Efficiency of Existing Dam (C7)
2) Construction of new dams (C2)
3) Improvement of retarding/retention areas (C4)
4) East/West Diversion Channels (C6)
5) Outer Ring Road Diversion Channel (C6)
6) River Channel Improvement Works (C5)
6-2) Ayutthaya bypass Channel (C5)
6-3) River Improvement in Tha Chin River (C5)

Other Countermeasures:
1) Flood forecasting system
2) Reforesting at upstream of river basin (C1)
3) Land use control for flood area (C3)
4) Road raising around economic zone and dyke raising along Chao Phraya River and Pa Sak River (by BMA, DOH & DOR)
Combination of Measures to secure the cost-effectiveness.
Combination of Measures to secure the cost-effectiveness.
## Inundation Area & Safeness

### Retention & Inundation Area (km\(^2\))

<table>
<thead>
<tr>
<th>Item</th>
<th>2011 Flood</th>
<th>“Full” Projects</th>
<th>Proposed Combination 1</th>
<th>Proposed Combination 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper NS</td>
<td>Lower NS</td>
<td>Upper NS</td>
<td>Lower NS</td>
</tr>
<tr>
<td>Low-lying Area</td>
<td>3,400</td>
<td>500</td>
<td>3,400</td>
<td>500</td>
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<tr>
<td>Retention Area</td>
<td>900</td>
<td>1,000</td>
<td>900</td>
<td>1,000</td>
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<tr>
<td>Uncontrolled Inundation Area</td>
<td>500</td>
<td>10,800</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Controlled Inundation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Economic Zone Inundation</td>
<td>-</td>
<td>4,800</td>
<td>-</td>
<td>500</td>
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<td>(5,600km(^2))</td>
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<tr>
<td>Total</td>
<td>4,800</td>
<td>17,100</td>
<td>4,500</td>
<td>14,800</td>
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<td>Grand Total</td>
<td>21,900</td>
<td>19,300</td>
<td>19,800</td>
<td>19,800</td>
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</tbody>
</table>

*Considering inland flood caused by local rainfall

**Notes:**
- “Controlled Inundation” indicates areas where the flooding can be managed.
- “Full” Projects assume full use of available infrastructure.
- Proposed Combinations 1 and 2 show alternative approaches to managing inundation areas.
Planning Process to implementation

- Strong Commitment of Responsible Local Entities from the Early Stage of Planning
  - Information sharing
  - Improvement through discussion
- Chao Phraya Flood in 2011
- Planning Team
  - Thailand: RID, DWR, WFMC
  - Japan: JICA supported by MLIT
- Academic & Scientific Support
  - IMPAC-T (Thai and Japanese Universities)
  - ICHARM (UNESCO Centre)
- Workshops
  - Workshops
- Other related Agencies
  - Thai Academia
  - Consensus building with Residents / other concerned entities
- Masterplan Proposal
- Implementation?
- Needed for Smooth Implementation

- Process Design
- Governmental System for Implementation
3. Conclusion
1. **Japanese Flood Management System**
   - Japan’s stable economic growth sustained by flood management works based on long-term and Medium-term plans prescribed in “River Law”.
   - Planning method and process: crucial to secure implementation.
     - Appropriate combination of structural and non-structural measures based on basin characteristics, derived from scientific & engineering-based analyses.
     - Consensus building process with local governments, academia, local residents
     - Prioritization of measures in consideration of effects, balances of upstream/downstream and left/right bank.

2. **Application of the Planning Method to Chao Phraya River Basin**
   - Concept: “appropriately control inundation to minimize damage”, deduced from the study of characteristics of the basin with Scientific & engineering-based methods, local people’s experience and knowledge.
   - Proposal of the best combination of hard and soft measures according to scientific and engineering-based analyses of hydraulic effects and investment efficiency
   - Challenges:
     - Consensus building process with local residents
     - Governmental system including legislation to secure implementation