Integrated Flood Risk Management for Urbanized River Basins in Japan

Akira TERAKAWA

ICHARM Public Works Research Institute (PWRI) Tsukuba, Japan International Centre for Water Hazard and Risk Management



under the auspices of UNESCO

Background: Birth of ICHARM

- IDNDR 1990-1999 & ISDR 2000-, MDGs, WSSD, Hyogo Framework of Action 2005 etc.
- ICHARM was proposed by the Japanese Government and approved at UNESCO 33rd General Conference, October 2005
- Agreements signed by UNESCO, G of Japan & PWRI on March 3, 2006
- ICHARM was established on March 6, 2006
 - A UNESCO Category II Global Center hosted by Public Works Research Institute (PWRI), Tsukuba, Japan

List of existing IHP UNESCO centers

Centre	Abbreviation	Location (Country)
International Research and Training Centre on Erosion and Sedimentation	IRTCES	Beijing (China)
International Research and Training Centre on Urban Drainage	IRTCUD	Belgrade (Serbia and Montenegro)
Water Centre for the Humid Tropics of Latin America and the Caribbean	CATHALAC	Panama (Panama)
Regional Humid Tropics Hydrology and Water Resources Centre	нтс	Kuala Lumpur (Malaysia)
Regional Centre for Training and Water Studies of Arid and Semiarid Zones	RCTWS	Cairo (Egypt)
Regional Centre on Urban Water Management	RCUWM	Tehran (Iran)
UNESCO-IHE Institute for Water Education	UNESCO-IHE	Delft (Netherlands)
International Centre on Qanats and Historic Hydraulic Structures	ICQHS	Yadz (Iran)
IHP-HELP Centre for Water Law, Policy and Science		Dundee (UK)
Regional Water Centre for Arid and Semi-arid Zones of Latin America and the Caribbean	CAZALAC	La Serena (Chile)
International Centre for Water Hazard and Risk Management	ICHARM	Tsukuba (Japan)
European Regional Centre for Ecohydrology		Lodz (Poland)

Public Works Research Institute (PWRI)

History

 1927: Established
 1979: Relocated to Tsukuba
 (Area:126ha, Staff: 550)

 2001: Re-organized into two institutes

 (PWRI and NILIM)

 2006: Merged with Civil Engineering Research Institute of Hokkaido

Staff : 489 (including 345 researchers)
12 research groups with 34 research teams
Budget (FY 2008): 13 bil. JPY (120 mil. USD)

Missions of ICHARM

The mission of ICHARM is to function as an international center for providing and assisting the implementation of the most practicable strategies to prevent and mitigate water related disasters (floods, droughts, sediment-related disasters, tsunamis, storm surges, water contamination, etc.) in the world.

% Focus on flood related disasters at the initial stage

Research

- Local studies (Identification of the real needs of the people in diverse localities) → Diagnosis & Prescription
 - Disaster (Flood) Preparedness Indices
- Flood Alert System using satellite information (with JAXA, IFNet/GFAS/IFAS etc.)
- Risk analysis and adaptation measures to global warming
 - JMA/MRI GCM (20km mesh) →
 - Drawing a Global flood risk map,
 - Estimating Adaptation cost (structural & non-structural)
- Flood Hazard Mapping
 - methodologies to map in remote localities with poor data
 - effective and beneficial use of HMs in various conditions



Concept of IFAS (Integrated Flood Analysis System)

-Toward Prompt Implementation of Flood Forecasting / Warning Systems with the Sense of Ownership of local users in Developing Countries -



Capacity Building

- Training courses
 - Flood hazard mapping course started in 2004
 - River and Dam engineering course started in 1969
- Follow up program for ex-trainees
- Master course on Flood Disaster
 Management with National Graduate
 Institute for Policy Studies (GRIPS) started
 in 2007

Flood Hazard Mapping Training Course









Following up Seminar of FHM training course

(Jan. 30-Feb. 1, 2008 Guanzou, China)



Water-related Risk Management Course

A master's degree program by GRIPS* and ICHARM/PWRI

Objective :

to develop trainee's capacity to practically manage the problems and issues concerning water-ralated disasters

Duration : 1yr from October to September Language : in English Course Program :

Lectures



Disaster Management Policy, Basic Subjects (Hydrology, Hydraulics), Integrated Flood Risk Management, Hazard mapping and Evacuation Planning, Sustainable Reservoir Development and Management, Control Measures for Landslide and Debris Flow, Introduction to International Cooperation

Hands-on Training session Individual study

*GRIPS : Graduate Research Institute for Policy Studies (<u>www.grips.ac.jp</u>)

International Flood Initiative (IFI) http://www.ifi-home.info

Mission

Promote an integrated approach to flood management

by reducing the risk of social, environmental and economic effects that result in and from floods and increasing the benefits from floods and the use of flood plains

Implementation

UNESCO, WMO, UNU, UN-ISDR, IAHS, IAHR •••

Secretariat : ICHARM



Asia-Pacific Water Forum (APWF) http://www.apwf.org

- Launched during the WWF4 in Mexico
- to contribute to sustainable water management in order to achieve the targets of the MDGs in Asia-Pacific region
- 1st Asia Pacific Water Summit was held in Beppu, Japan on December 3 – 4, 2007

3 Priority themes

- Water Financing
- Water-related Disaster Management
- Water for Development and Ecosystem
- ICHARM served as the leading agency for the theme of water related disaster management

Function of ICHARM as a APWF Knowledge Hub

http://www.apwf-knowledgehubs.net

- Providing training courses mainly for practical engineers in charge of flood risk management
 - Flood Hazard Mapping Training Course (5 weeks, total 16 trainees from 8 countries)
 - Disaster Management Policy Program Water related risk management course (1year, master course, 10 students)
- Following up activities for ex-trainees
 - Follow up seminars
 - Help desk site
- Conducting Joint research projects for collaboratively finding solution to local challenges and capacity building
 - Personal exchange with related organizations
 - International recruitment of fixed term researchers

Network of Asian River Basin Organizations (NARBO)

http://www.narbo.jp

- Established in February 2004 based on the agreement at the 3rd World Water Forum in 2003
- To help achieve Integrated Water Resources management (IWRM) in river basins throughout Asia
- Secretariat : Japan Water Agency (JWA) and Asian Development Bank (ADB)
- 65 organizations from 12 countries (Bangladesh, Cambodia, India, Indonesia, Japan, Korea, Lao, Malaysia, Philippines, Sli Lanka, Thailand, Vietnam) are participating as of February 2008
- ICHARM joined as an international knowledge partner in the field of water related disaster management

I am going to talk about

- Concept of Flood Risk Management
- River Basin Approach for Managing Flood Risk for Urbanized River Basin
 - Comprehensive Flood Disaster Prevention Measures

- Designated Urban River Inundation Prevention Act



Various Natural Disasters over the World



Geographic Conditions of Japan

70% of land is covered with forests and mostly mountaneous

■ 50% of popuration and 75% of assets are concentrated in flood plains (10% of land)

Heavy rainfall occur 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)



Fukuoka Flood in 1999

(Source : MLIT)



Tokai Flood in 2000

(Source : MLIT)

(Dyke Break of the Shinkawa river 12th Sep. in Nishibiwajima town)



Inundated situation of Sanjo City, Niigata Prefecture after downpour in July 2004. 421 mm/day of rainfall was recorded at Tochio Observatory. (Source : MLIT)

In the case of downpour in Fukui Prefecture in July 2004, 283mm/day was recorded at Miyama Observatory.



Amendment of the River Law

(River Bureau, MLITT)



Scheme for River Planning

Basic River Management Policy

Social Infrastructure Council

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

River Improvement 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.

Process Chain of Natural Disasters



Flood Risk Management to cut Process Chain of Flood Disasters



Flood Risk Management

Flood risk management involves assessing and controlling the risk of flood and minimizing damages with the least cost.

By preventing flood risk (active safety measures) By mitigating damages by flooding (passive safety measures)

- 1) Understanding the risk of flood damage to life and properties in advance
- 2) Preventing and avoiding the risks
- 3) Mitigating damages caused by flooding
- 4) Preventing the expansion of damages



Measures for Excessive Flood

Measures for mitigating damages during a flood exceeding a design level include:

- Providing substantial disaster information
- Maintaining and improving the functions of facilities for preventing disasters
- Sharing disaster information in the daily life
- Strengthening local flood fighting capacities

Basic concept of adaptation strategies (River Bureau, MLITT)

Climate	change due to global warming is expected to induce the following
phenom	ena in coastal and low-lying areas.
-More fre	quent heavy rains and more intense typhoons
	Frequent and serious flood and sediment disasters
-Sea leve	I rise and more intense typhoons
	Frequent and serious high tides and coastal erosions
-Wider ra	inge of variation of rainfall intensity and change of river flow regime
	Frequent and serious droughts

Basic concept for Future ideal society

Combining mitigation and adaptation aiming at "Water -disaster adaptation society"

Basic direction of climate change adaptation strategies

1. <u>Adaptation measures to achieve "Zero casualty" should be considered</u> because "Zero damage" from disasters is difficult.

2. In a nerve center like the Tokyo metropolitan area, intensive efforts should be made such as preventing from ceasing national function

Variability of disaster external force



(River Bureau, MLITT)

Possible impacts of global climate change to water-related disasters (River Bureau, MLITT)

Large volumes of greenhouse gas emissions cause CO₂ concentration in the air to rise and increase heat absorption, resulting in temperature rise. Thus, global warming occurs.



Concept of adaptation measures to Climate Change



(ii) Adaptation measures centering around risk management

Adaptation measures to cope with increasing risks due to climate change (River Bureau, MLITT)



Adaptation measures to cope with increasing risks due to climate change (River Bureau, MLITT)



Adaptation measures to cope with increasing risks due to climate change (River Bureau, MLITT)

Share real-time information

- Provision of rainfall amounts and water levels real-time via cellular phone, the Internet or local disaster prevention radio
- · Flood forecasting through real-time simulation





Information provision via cellular phone or personal computer



Delivery of an image to a TV screen



Floodwater prediction through real-time simulation

Extensive Housing Land Development has been in Progress in the Heights and Hilly Zones of the Suburban Areas in the Three Major Metropolitan Regions.

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



Effect of urbanization on flood runoff



Widening of river channel is difficult in the highly urbanized area

Tsurumi River



Source: "Tsurumi River and Renewal of Its Basin – Suggestions toward Formulation of Master Plan for Development of Tsurumi River Basin Water Resources" Naka River and Ayase River



Source: Brochure "For Prptecing 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.

Comprehensive Flood Disaster Prevention Measures



River Improvement - 1

River Channel Improvement (Embankment, dredging etc.)

Tsurumi River



Before improvement

How the neighborhood of Shiotsuru Bridge has changed after river dredging.



After improvement

River Improvement - 2

Construction of Retarding Basin and Diversion Tunnel

Multipurpose Retarding Basin for Tsurumi River











Multi-purpose Retarding Basin for Tsurumi River





When it looks like a flood is going to cause the river to overflow, water from the river can flow over the overflow type levee into the retarding basin.



2 Floodwater is temporarily stored in the retarding basin.



B When the water level of the river drops, the sewage gate is used to allow water to gradually flow back into the river.









注意事項

- この駐車場は遊水地の中にあり、大雨が降ると鶴見川の水が流入して浸水します。危険になると駐車場を閉鎖します。遊難放送をしますので、指示に従って速やかに車を移動してください。移動しない車はレッカー車で移動する場合があり、その際には費用を請求します。車を移動しなかったことによる損害についてはその責を負いません。
- 2. 新横浜公園利用者以外の駐車は、ご遠慮ください。
- 3. 他の駐車の妨げにならないように白線内に駐車してください。
- 駐車券は、出場の際必要ですので折り曲けずに大切に保管してくたさい。また、駐車券を紛失した場合は、相応の料金を申し受けます。
- 5. 駐車場内での事故破損、火災、盗難等については一切の貴を負いま せん。
- 6. 競技大会がPM9:00に終了する場合の駐車場からの出場は、PM 12:00までにお願いします。
- 停止中のエンジン空ふかしは、大気(空気)を汚し、また、騒音の原 因となりますのでおやめください。
- 8. 場内美化のため、コミは各自お持ち帰りください。

(新機構公論 新定議理者) 横浜市スポーツ振興事業団・横浜マリノス・管理JV 共同事業体

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.





Example of general storm water detention pond

Storm water detention ponds covered with bluish green screens Construction of Storm Water Detention Pond

Aerial view of a group of storm water detention ponds





Example of Use as Multipurpose Facilities



Kirigaoka Regulating Pond (Tsurumi River)

Construction of Rainwater Storage Facilities



Shinkashi River

Construction of Permeable Pavements and Infiltration Inlets

Permeable pavement



Permeable tile pavement



Tokyo Metropolis

Construction of Permeable Pavement and Infiltration Inlet



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.

Damage Reduction Measures - 2

Official Announcement of Flooded Areas or Flood Hazard Areas

Flood Hazard Areas of Shinkashi River Basin



Construction of high-standard levees ("super levees")

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.



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



areas.





Designated Urban River Inundation Prevention Act(2003)

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

Summary

Integrated Approach **River basin approach** Process chain of flood disasters **Disaster management cycle** Consideration of excessive event Adaptation to possible climate change effect Hydrological impact assessment and prevention/compensation/mitigation measures

END

Thank you for your attention

http://www.icharm.pwri.go.jp