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THE 14TH CONFERENCE ON PUBLIC WORKS RESEARCH AND DEVELOPMENT IN ASIA

Proceedings

December 2005

National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure and Transport
Government of Japan

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The 14th Conference on Public Works Research and Development in Asia

Proceedings

December 2005

Synopsis:
This proceedings summarizes the reports of the session on subject of common interest, symposium papers, lecture notes, etc. on the 14th Conference on Public Works Research and Development in Asia held mainly at the National Institute for Land and Infrastructure Management (NILIM) in Tsukuba and the Sendai International Center in Sendai from October 17, 2005 to October 28, 2005.

Keywords:
Risk Management and Mitigation for Flood and Sediment Related Disasters
Flood, Sediment and Tsunami Related Disasters in Asia
Conference on Public Works Research and Development in Asia
National Institute for Land and Infrastructure Management

FOREWORD

The 14th Conference on Public Works Research and Development in Asia was held at the National Institute for Land and Infrastructure Management (NILIM), Ministry of Land, Infrastructure and Transport (MLIT) in Tsukuba, Ibaraki Prefecture and at the Sendai International Center in Sendai, Miyagi Prefecture from Monday, October 17 to Friday, October 28, 2005.

The conference has been held every year since 1992 aiming to encourage government officials responsible for research and development of civil engineering technology in Asian countries to meet together to exchange their views and to develop their research network.

Representatives of 8(eight) countries such as Cambodia, India, Korea, Lao PDR, the Philippines, Thailand, Vietnam and Japan attended the 14th conference. In line with the subjects of "Risk Management and Mitigation for Flood and Sediment Related Disasters," they presented their papers and discussed the related problems. The conference was a great success.

This report summarized the participants' presentation papers, documents provided for discussion, records of lectures and related information. We hope this report will be of good use for you. In conclusion, we would like to extend our deepest gratitude to people and organizations concerned, especially, the Japan International Cooperation Agency (JICA), the Public Works Research Institute (PWRI) and the Tohoku Regional Bureau of MLIT for the support of and cooperation with the conference

NILIM Conference Secretariat

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I OBJECTIVE

The importance of appropriate infrastructure management has been increasing year after year along with the progress of the economic growth in Asian countries. The implementation of proper public works, with careful attention to the environmental issues, will contribute to the sustainable development in respective Asian countries, and provide people with comfortable circumstances in harmony with the nature.

Taking into consideration of the said situation, the National Institute for Land and Infrastructure Management (NILIM) holds the Conference on Public Works Research and Development in Asia with the support of the Japan International Cooperation Agency (JICA) from 2001 succeeded to the former Public Works Research Institute. The participants of the conference are government officials in Asian countries and responsible for research and development of infrastructure management.

The objectives of the conference are to find common problems on research and development in the field of civil engineering technology and to search seeds for possible joint research through exchanging information and discussion on the present and future infrastructure status of each country. The participants also try to form a continuous research network among Asian countries and properly contribute to the improvement of infrastructure management.

Ⅱ SCHEDULE

No.	DATE		FUNCTIONS	ACCOMMODATIONS
1	2005/ Oct.16	Sun	Arrival in Japan (Overseas Participants)	Tsukuba
2	Oct.17	Mon	JICA Orientation Opening Ceremony Introduction of NILIM Observation Tour 1986 Kokai River Embankment Destruction Part Kokai River Hakojima Retarding Basin Welcome Party	Tsukuba
3	Oct.18	Tue	Keynote Lecture "Disaster Management Perspective - From Engineering to Citizen's Participation" Tour of Research Laboratories in NILIM & PWRI Individual Studies	Tsukuba
4	Oct.19	Wed	Session on Subject of Common Interest "Risk Management and Mitigation for Flood and Sediment Related Disasters"	Tsukuba
5	Oct.20	Thu	Session on Mitigation Measures and Risk Management against Flood and Coastal Disaster Lecture on Flood Disaster Lecture on Coastal Disaster General Discussion Session on Risk Management and Mitigation for Sediment-related Disasters Lecture on Procedure for Setting Area for Restriction on Land Use in order to Reduce Risk due to Sediment-related Disasters Lecture on Development of Warning and Evacuation System against Sediment-related Disasters Lecture on Debris Flows Detection Sensors Lecture on Development of the Landslide Displacement Detection sensor Using Optical Fiber General Discussion	Tsukuba
6	Oct.21	Fri	Special Session on Flood Forecasting and Warnig Discussion on Flood Forecasting and Warning Move from Tsukuba to Tokyo Courtesy Call on Minister of Land, Infrastructure and Transport	Tokyo
7	Oct.22	Sat	Day off	Tokyo
8	Oct.23	Sun	Day off	Tokyo

No.	DATE		FUNCTIONS	ACCOMMODATIONS
9	Oct.24	Mon	Study Tour: Kanda River/Loop 7 Undreground Regulation Pond Works Tsurumi River Multipurpose Retarding Basin Slope Failure Prevention Works in Yokohama Large Hydro-Geo Flume in PARI Intelligent Wave Basin for Maritime Environments in PARI Airplane Loading Test Systems in NILIM Yokosuka Office	Tokyo
10	Oct.25	Tue	Lecture "The World Water Forum" Move from Tokyo to Ichinoseki-city	Ichinoseki (Tohoku Region)
11	Oct.26	Wed	Study Tour: Ishibuchi Dam Isawa Dam Chusonji-Temple Ichinoseki Retarading Basin Satetsu-River Disaster Restoration Site	Sendai
12	Oct.27	Thu	The 14th International Symposium on National Land Development and Civil Engineering in Asia "Flood, Sediment and Tsunami Related Diasters in Asia" Symposium Reception	Sendai
13	Oct.28	Fri	General Discussion Closing Ceremony JICA Evaluation Move to Tokyo	Tokyo
14	Oct.29	Sat	Departure from Japan (Overseas Participants)	

Ⅲ PROGRAM

October 16 (Sun)	**Arrival in Japan**

Accommodation: Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki, 305-0031, Japan
TEL. +81-29-852-1112, FAX +81-29-852-5623

October 17 (Mon)	**Venue: NILIM**

Morning JICA Orientation
13:00-13:30 Opening Ceremony of "The 14th Conference on Public Works Research and Development in Asia"
13:30-14:00 Summary on NILIM
14:00-17:00 Observation Tour
- 14:30-15:00 1986 Kokai River Embankment Destruction Part
- 15:30-16:00 Kokai River Hakojima Retarding Basin
  - Shimodate River Office, Kanto Regional Development Bureau, Ministry of Land, Infrastructure and Transport (MLIT)

18:00-19:30 Welcome Party
(Venue: Jupiter-East Room, 3F, Okura Frontier Hotel Tsukuba)
Host NILIM Director General
Guests Director General of Geographical Survey Institute
Chief Executive of Public Works Research Institute
Chief Executive of Building Research Institute
Director General of JICA Tsukuba

Accommodations: Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki, 305-0031, Japan
TEL. +81-29-852-1112, FAX +81-29-852-5623

October 18 (Tue)	**Venue: 8F International Conference Room, NILIM**

10:00-12:00 Keynote Lecture"Disaster Mitigation Perspective – From Engineering to Citizen's Participation"
Dr. Yujiro OGAWA
Professor, College of Environment and Disaster Research, Fuji Tokoha University

Disaster Mitigation by Civil Engineering Approach have played great roll to save human lives from past disasters. Adding to this approach Citizen's Participation Approach will become much important in future by citizen's capacity building such as identifying regional risks and autonomous actions to be taken in disasters.

12:00-13:00 Lunch
13:00-15:00 Tour of Research Laboratories in NILIM & RWRI
- 13:05-13:35 UNESCO-PWRI Centre & Current Meter Calibration Channel
- 13:40-14:00 River Model Test Yard
- 14:05-14:25 Coastal Hydraulics Laboratory
- 14:30-15:00 Smart Communication & Advanced Cruise-assist Highway Systems

15:15-17:00 Individual Studies
(Preparations for the presentation on Oct.19)

Accommodations: Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki, 305-0031, Japan
TEL. +81-29-852-1112, FAX +81-29-852-5623

October 19 (Wed)	Venue: 8F International Conference Room, NILIM

(M.C.: Mr. Minoru KURIKI, Director, River Department, NILIM)

09:30-09:45 Conference Report

Mr. Jun INOMATA,
Director, Planning and Research Administration Dept., NILIM

This is to show the outline and history of the Conference on Public Works Research and Development in Asia

09:45-15:30 Session on Subject of Common Interest
"Risk Management and Mitigation for Flood and Sediment Related Disasters"

09:45-10:15	Japan	Mr. Tsuneyoshi MOCHIZUKI
10:15-10:45	Cambodia	Dr. Bunna YIT
10:45-11:00	Break	
11:00-11:30	India	Mr. Janak Jerambhai SIYANI
11:30-12:00	Laos	Mr. Keophilavanh APHAYLATH
12:00-13:30	Lunch	
13:30-14:00	Philippines	Ms. Rebecca Trazo GARSUTA
14:00-14:30	Thailand	Mr. Akkapong BOONMASH
14:30-14:45	Break	
14:45-15:15	Vietnam	Mr. NGUYEN Xuan Hien

15:15-15:30 Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO

Dr. Tadahiko SAKAMOTO,
Chief Executive, Public Works Research Institute

Accommodations: Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki, 305-0031, Japan
TEL. +81-29-852-1112, FAX +81-29-852-5623

October 20 (Thu)	Venue: 8F International Conference Room, NILIM

10:00-12:00 Session on Mitigation Measures and Risk Management against Flood and Coastal Disaster

10:00-11:30 Lecture/Discussion "Mitigation Measures and Risk Management against Flood and Coastal Disaster"

Dr. Tadashi SUETSUGI
Head, River Division, River Dept. NILIM
Mr. Tetsuya NAKAMURA
Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM
Mr. Fuminori KATO
Senior Researcher, Coast Division, River Dept. NILIM

【Flood disaster】

- *Present status of flood disaster in urban area*
- *The characteristics of flooding due to dyke-break and measures against overtopping of flood*
- *Risk management techniques*
- *The aspect of flood disasters in 2004*
- *Measures against flooding in urban area*

【Coastal disaster】

- *Recent coastal disaster*
- *Measures against coastal disaster*

11:30-12:00 General Discussion

Chairman: Dr. Tadashi SUETSUGI
Head, River Division, River Dept. NILIM

Secretary: Mr. Yoshito KIKUMORI
Senior Researcher, River Division,
River Dept. NILIM

12:00-13:00 Lunch

13:00-15:00 Session on Risk Management and Mitigation for Sediment-related Disasters

13:00-13:20 Lecture "Procedure for Setting Area for Restriction on Land Use in order to Reduce Risk due to Sediment-related Disasters"
Dr. Hideaki MIZUNO
Senior Researcher,
Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM

Restriction on land use is one of measures to reduce risk due to sediment-related disasters. The lecturer is going to give an explanation on the method for setting area, where land use is limited.

13:20-13:40 Lecture "Development of Warning and Evacuation System against Sediment-related Disasters"
Mr. Nobutomo OSANAI
Head, Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM

With respect to the development of a warning and evacuation system against sediment-related disasters, it is well known that sediment-related information plays a very important role in realizing a timely warning and a speedy evacuation. To best utilize this kind of information, a risk management system should be established first that enables a quick grasp of the actual damage conditions and a swift collection/delivery/transmission of disaster-related information.

In this lecture, we introduce the basic method of setting of standard rainfalls for warning and evacuation which is commonly adopted in Japan. This method is intended to forecast the occurrence of a debris flow using rainfall indexes which are obtained by combining a rainfall intensity and a total rainfall.

13:40-14:00 Lecture "Debris Flows Detection Sensors"
Mr. Jun'ichi KURIHARA
Team Leader,
Volcano and Debris Flow Research Team,
Erosion and Sediment Control Research Group,
Public Works Research Institute

It is important to establish warning and evacuation system to protect people's lives from debris flow disasters. In Japan, many types detection sensors have been installed such as wire sensors. In this paper, sensors which are used in Japan will be presented, and it will be introduced to establish the *objective trigger level setting method of vibration sensor.*

14:00-14:20 Lecture "Development of the Landslide Displacement Detection Sensor Using Optical Fiber"
Mr. Kazunori FUJISAWA
Team Leader, Landslide Research Team,
Erosion and Sediment Control Research Group,
Public Works Research Institute

14:20-15:00 General Discussion
Chairman: Dr. Hideaki MIZUNO
Senior Researcher,
Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM
Secretary: Mr. Taro UCHIDA
Researcher,
Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM

Accommodations: Okura Frontier Hotel Tsukuba
1-1364-1, Azuma, Tsukuba, Ibaraki, 305-0031, Japan
TEL. +81-29-852-1112, FAX +81-29-852-5623

October 21 (Fri) Venue: 8F International Conference Room, NILIM, and MLIT

09:00-12:00 Special Session on Flood Forecasting and Warning

09:00-12:00 Discussion on Flood Forecasting and Warning
Chairman: Mr. Junichi YOSHITANI
Team Leader,
Risk Management Research Team, Secretariat for Preparatory Activities of UNESCO-PWRI Centre,
Public Works Research Institute
Secretary: Dr. Merabtene TAREK
Specialist,
Risk Management Research Team, Secretariat for Preparatory Activities of UNESCO-PWRI Centre,
Public Works Research Institute
This session is organized to initiate active collaboration platform to share good practices and discuss future visions on research and development in flood mitigation and risk management.

12:00-13:30 Lunch

13:30-16:00 Move to Tokyo

16:30-17:00 Courtesy Call to the Minister of Land, Infrastructure and Transport (at Ministry of Land, Infrastructure and Transport: MLIT)

Accommodations: Hotel Century Southern Tower (Shibuya)
2-2-1 Yoyogi, Shibuya-ku, Tokyo 151-8583 Japan
TEL. +81-3-5354-0111, FAX: 81-3-5354-0100

October 22 (Sat) Day Off

Accommodations: Hotel Century Southern Tower (Shibuya)

2-2-1 Yoyogi, Shibuya-ku, Tokyo 151-8583 Japan

TEL. +81-3-5354-0111, FAX: 81-3-5354-0100

October 23 (Sun) **Day Off**

Accommodations: Hotel Century Southern Tower (Shibuya)

2-2-1 Yoyogi, Shibuya-ku, Tokyo 151-8583 Japan

TEL. +81-3-5354-0111, FAX: 81-3-5354-0100

October 24 (Mon) **Tokyo& Kanagawa Area observation sites**

08:30-09:15	Move from Hotel
09:15-10:00	Kanda River/Loop 7 Underground Regulation Pond Works
10:00-11:00	Move
11:00-11:45	Tsurumi River Multipurpose Retarding Basin
11:45-12:15	Move
12:15-13:30	Lunch
13:30-14:00	Move
14:00-14:30	Slope Failure Prevention Works in Yokohama
14:30-15:30	Move
15:30-16:40	NILIM Yokosuka Office & Port and Airport Research Institute
15:30-15:45	Large Hydro-Geo Flume
15:45-16:00	Intelligent Wave Basin for Maritime Environments
16:05-16:20	Airplane Loading Test Systems
16:40-18:30	Move to Hotel

Accommodations: Hotel Century Southern Tower (Shibuya)

2-2-1 Yoyogi, Shibuya-ku, Tokyo 151-8583 Japan

TEL. +81-3-5354-0111, FAX: 81-3-5354-0100

October 25 (Tue) **Venue: JICA Headquarters**

10:00-12:00	Lecture "The World Water Forum" Mr. Hideaki ODA Secretary General, Japan Water Forum *Water problems in the world and international measure situations such as a world water forum for solving them are explained.*
12:00-15:00	Lunch & Move to Tokyo Station
15:16-17:47	Leaving from Tokyo Station to Ichinoseki Station by JR Train YAMABIKO No.57
18:00	Arrival at Hotel

Accommodations: Kura Hotel Ichinoseki
2-1 Otemachi Ichinoseki Iwate 021-0864, Japan
TEL. +81-191-31-1111, FAX +81-191-31-1112

October 26 (Wed) **Tour in Tohoku District**

08:30	Hotel Departure
08:30-09:20	Move
09:20-09:40	Ishibuchi Dam
09:45-10:35	Isawa Dam
10:40-11:20	Move
11:20-12:20	Chusonji-Temple
12:20-13:10	Move/Lunch
13:10-14:30	Ichinoseki Retarding Basin
14:30-15:05	Move
15:05-16:00	Satetsu-River Disaster Restoration Site

16:00-17:30 Move to Hotel

Accommodations: Hotel JAL City Sendai
1-2-12 Kakyoin, Aoba-ku, Sendai-shi, Miyagi 980-0013, Japan
TEL. +81-22-711-2580, FAX +81-22-221-5533

October 27 (Thu) **Venue: Sendai International Center**

The 14th International Symposium on National Land Development and Civil Engineering in Asia

"Flood, Sediment and Tsunami Related Disasters in Asia"

（M.C.: Mr. Kiyoshi MINAMI, Research Coordinator for Evaluation Planning and Research Administration Dept., NILIM）

(13:00-13:10 Group Photo only for persons concerned)

13:10-13:20 Opening Address Mr. Tsuneyoshi MOCHIZUKI
Director General, NILIM

Address Mr. Masato SEIJI
Vice Minister for Engineering Affairs,
Ministry of Land, Infrastructure and Transport

Address Representative of Overseas Participants

13:20- 14:20 Keynote Speech "Global Disaster – Lessons from the 2004 Sumatora Earthquake and Indian Ocean Tsunami"
Prof. Fumihiko IMAMURA
Professor, Disaster Control Research Center, Graduate School of Engineering, TOHOKU UNIVERSITY

The earthquake of M9.0 took place on December 26, 2004, followed by the oceanic tsunami affecting all coast in the Indian Ocean. The number of casualties in the ocean exceeds 200,000. We carried out the field survey and numerical analysis to clarify the mechanism of the source and damage in the suffered areas. The video and satellite information are also compiled to have the lesson

14:20-14:30 Case of Japan
Mr. Tsuneyoshi MOCHIZUKI
Director General, NILIM

14:30-14:45 Case of Tohoku District
Mr. Masaharu SHINOHARA
Director, River Department, Tohoku Regional Bureau

14:45-15:00 Case of Korea
Dr. Chang Wan KIM
Research Fellow, Korea Institute of Construction Technology

15:00-15:15 Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO
Mr. Akira TERAKAWA
Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute

15:15-15:35 Break

15:35-16:55 Panel Discussion
(M.C.:Mr. Ryosuke TSUNAKI, Director, Research Center for Disaster Risk Management)

(PANELISTS)

1. Prof. Fumihiko IMAMURA Professor, Disaster Control Research Center, Graduate School of Engineering, TOHOKU UNIVERSITY

2. Mr. Tsuneyoshi MOCHIZUKI	Director General, NILIM
3. Mr. Masaharu SHINOHARA	Director, River Department, Tohoku Regional Bureau, MLIT
4. Dr. Bunna YIT	Director, Public Works Research Center, Ministry of Public Works and Transport, Kingdom of Cambodia
5. Mr. Janak Jerambhai SIYANI	Chief Engineer (R&B) & Add Secretary, Roads & Buildings Department, Government of Gujarat, India
6. Dr. Chang Wan KIM	Research Fellow, Water Resources Research Department, Korea Institute of Construction Technology, Republic of Korea
7. Mr. Keophilavanh APHAYLATH	Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic
8. Ms. Rebecca Trazo GARSUTA	Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH), Republic of the Philippines
9. Mr. Akkapong BOONMASH	Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Kingdom of Thailand
10. Mr. NGUYEN Xuan Hien	Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development, Socialist Republic of Viet Nam

16:55-17:00 Closing Address
Mr. Norio MORINAGA
Director General, Tohoku Regional Bureau, MLIT

17:30-19:00 Reception
Host Vice Minister for Engineering Affairs, MLIT

Accommodations: Hotel JAL City Sendai
1-2-12 Kakyoin, Aoba-ku, Sendai-shi, Miyagi 980-0013, Japan
TEL. +81-22-711-2580, FAX +81-22-221-5533

October 28 (Fri) **Venue: Hotel JAL City Sendai**

09:30-10:30 General Discussion
Chair: Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM
10:30-11:00 Closing Ceremony of "The 14th Conference on Public Works Research and Development in Asia"
11:00-11:30 Break
11:30-12:30 JICA Evaluation
13:30 Move to Tokyo

Accommodations: JICA Tokyo

October 29 (Sat) **Return to Home Country**

The 14th Conference on Public Works Research and Development in Asia

No.	Country	Title	Name	Office/Position
1	Cambodia	Dr.	Bunna YIT	Director, Public Works Research Center, Ministry of Public Works and Transport
2	India	Mr.	Janak Jerambhai SIYANI	Chief Engineer (R&B) & Add. Secretary, Roads & Buildings Department, Government of Gujarat
3	Korea	Dr.	Chang Wan KIM *Only Tohoku District	Reseach Fellow, Water Resources Research Department, Korea Institute of Construction Technology
4	Laos	Mr.	Keophilavanh APHAYLATH	Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction
5	Philippines	Ms.	Rebecca Trazo GARSUTA	Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH)
6	Thailand	Mr.	Akkapong BOONMASH	Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives
7	Vietnam	Mr.	NGUYEN Xuan Hien	Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development
8	Japan	Mr.	Tsuneyoshi MOCHIZUKI	Director General, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport

The 14th Conference on Public Works Research and Development in Asia

Session on Subject of Common Interest

- Risk Management and Mitigation for Flood and Sediment Related Disasters -

MINUTES

1. **Date and Venue** 09:00 – 15:30 Wednesday 19 October 2005
International Conference Room, NILIM

2. **Participants**

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambhai SIYANI
Laos	Mr. Keophilavanti APHAYLATH
Philippines	Ms. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. Nguyen Xuan Hien
Japan	Mr. Tsuneyoshi MOCHIZUKI Director General, NILIM Mr. Kazuhiro NISHIKAWA Executive Director for Research Affairs, NILIM, Mr. Jun INOMATA Director, Planning & Research Admin. Dept., NILIM Dr. Ryosuke TSUNAKI Director, Research Center for Disaster Risk Management, NILIM Mr. Minoru KURIKI Director, River Department, NILIM Mr. Kazunori WADA Research Coordinator for Watershed Management, River Dept., NILIM Mr. Kiyoshi MINAMI Research Coordinator for Evaluations, Planning & Research Admin. Dept., NILIM Dr. Tadahiko SAKAMOTO Chief Executive, PWRI Mr. Akira TERAKAWA Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, PWRI Mr. Junichi YOSHITANI Team Leader, Risk Management Team, ICHARM Centre, PWRI Dr. Tarek MERABTENE Specialist Researcher, Risk Management Team, PWRI

3. **Opening of Session on Issues of Common Interest**

The session on subject of common interest convened in Tsukuba on October 19 (Wed.) from 0930 – 1530, on the issue of “Risk Management and Mitigation for Flood and Sediment Related Disasters” in Asia, and were moderated by Mr. Minoru KURIKI, Director of NILIM’s River Department. Attendee nations included the Kingdom of Cambodia, India, the Lao People’s Democratic Republic, the Republic of the Philippines, the Kingdom of Thailand, the Socialist Republic of Viet Nam, and Japan.

Prior to the country reports, an introductory presentation by Director of the Planning and Research Administration Department Mr. Jun INOMATA provided a broad overview of the conference, including history, objectives, and the broadening base of participating countries.

4. **Summaries of the Country Reports**:

Country Report for Japan by Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM

Japan's disaster legislation has evolved from focus on specific types of damage to emergency response and post-disaster reconstruction. In terms of sediment flow and flood disasters, infrastructure improvements combined with the concentration of population and assets has resulted in a reduction in total area inundated with relatively unchanged damages. Recent human tolls of elderly disaster victims have put new focus on improving information dissemination. Community disaster measures and preparedness are most important and effectively introduced through drills and education.

Future challenges lie in effectively mixing and matching non-structural and structural responses, local community involvement, and defining roles and responsibilities for all levels of government and community.

After Mr. Mochizuki's presentation, views on a comprehensive tsunami prediction system and communities' preparedness were exchanged.

Country Report for the Kingdom of Cambodia by Dr. Bunna YIT:

Cambodia's primary flooding concern is with the Mekong River, whose basin is shared by several countries. The area suffered its worst recent flood in 2000, which inflicted major damage on primary roads. To make embankments along the river, which are used as roads, more resistant to erosion, Cambodia is trying surface vegetation, bitumen sprays, stone riprap, gabion or concrete slope protection measures.

The Ministry of Water Resources and Management provides information on critical river levels to The National Committee for Disaster Management (NCDM), which in turn, informs provincial, district and commune authorities. Public information is disseminated by TV and radio (Ministry of Information) while the Army and Police are responsible with commune for evacuation of people and animals to safe areas.

Country Report for India by Mr. Janak Jerambhai SIYANI:

Gujarat (western India) suffers from earthquakes, cyclones, sediment flows, and draught. Floods are the most frequent and often most devastating disasters experienced in India, affecting an average of 18.6 million hectares annually. In terms of rainfall, nearly 75% of annual precipitation comes between June and September, yielding flash floods within five to seven hours. The problems from these floods are compounded by the simultaneous occurrence with high coastal tides flowing into the low lying flood inundation plains, severe sediment congestion from upstream erosion, and drainage blockages. India implements both structural and non-structural flood disaster measures.

Zoning is applied to areas highly susceptible to floods to minimize damage. In some areas, raised platforms are constructed to provide shelter areas and preserve core public utilities. Forecasting and warning is handled by the Central Water Commission, recent focus has been on multi-hazard disaster management.

After Mr. Siyani's presentation, questions on Gujurat State Disaster Management Authority (GSDMA), including its structure and responsibility, were raised,

Country Report for the Lao People's Democratic Republic by Mr. Keophilavanh APHAYLATH:

In Laos, the majority of the population lives in lowlands along the Mekong. Some 76% of the workforce is involved in agriculture and a little over 20% of the national economy comes from international aid. Floods are the primary natural disaster, directly affecting 63% of the population. Limited access and communication systems constrain disaster response. There were 22 floods over the 30 years from 1966 to 1995, among which four (1966, 1971, 1978 and 1995) were large. The government offices involved in floods are the Ministry of Agriculture with the lead role, the National Disaster Management Committee (NDMC), the National Disaster Management Office (NDMO) as the secretariat for international partners, and the Meteorological Office.

The size of the Mekong basin makes international cooperation through the Mekong River Commission(MRC) imperative. Since the 1970's, MRC has used a Stream Synthesis and Reservoir Regulation (SSARR) model developed by the US Army Corps of Engineers, with forecasting accuracy between 10–14%. There is a considerable body of traditional knowledge used by farmers to counter flooding effects. Laos is working to establish an integrated National Flood Management Action Plans but requires further international help and better inter-ministerial coordination.

After Mr. Aphaylath's presentation, discussions on causalities caused by floods, relocation of villages were held.

Country Report for the Republic of the Philippines by Ms. Rebecca Trazo GARSUTA:

The Department of Public Works and Highways(DPWH) is the national agency responsible for public works projects including flood control. Flood management infrastructure is a priority under the DPWH's Medium Term Philippine Development Plan. The Department currently works with a decreasing annual budget. Disaster response is handled by the National Disaster Coordinating Council under the Civil Defense Office of the Department of National Defense.

The most serious disasters in the Philippines generally derive from typhoons. With international assistance, DPWH commenced a massive flood response program using both structural and non-structural approaches in 1985. Structural measures include dikes, retention ponds, sediment basins, sabo dams, channeling, and improvement of drainage facilities. Non-structural measures includes forecasting and warning systems and communications equipment as part of warning networks..

After Ms. Garsuta's presentation discussions were held on the number of annual casualties, hazard maps, and community based programs against flood disasters.

Country Report for the Kingdom of Thailand by Mr. Akkapong BOONMASH:

Flood control in Thailand is primarily handled by the Royal Irrigation Department, the Ministry of Agriculture. In particular, it is now working on an Integrated Plan for Flood Mitigation in the Chao Phraya River Basin, which includes preservation of the present natural retarding effect to minimize the increase in flood damage in the future through control and guidance on basin development in areas where flood damage is expected. Suitable measures to assure the safety level against floods in Bangkok and other urban areas will be introduced, and the safety level in agricultural areas will be enhanced.

After Mr. Boonmash's presentation questions were raised on the demarcation of responsibility on flooding of the Chao Phraya River.

Country Report for the Socialist Republic of Viet Nam by Mr. NGUYEN Xuan Hien:

Although floods occur in Vietnam annually, water levels rise slowly, thus usually providing communities with sufficient time to implement safety measures. A series of riparian measures combined with new seed and farming techniques have already doubled or in some areas tripled Vietnam's rice production. Nonetheless, there are still many measures needed, because floods in Vietnam arrive slowly but tend to stay for long periods.

Floods have both positive and negative aspects, and Vietnam has a philosophy of living in harmony with floods.

After Mr. Nguyen’s presentation, discussions on the cause of death during floods and on the term “living with floods” were held.

ICHARM Announcement by Dr. SAKAMOTO:

The world has need of an international center that allows countries to share information on flooding, control measures, and effective technology transfers.

ICHARM will be established as a Category II international Center under the auspices of UNESCO in JFY 2005, and will work in collaboration with other UNESCO-IHP agencies. Sponsored by the PWRI, it has the primary objective of collecting and applying a broad scope of knowledge and experience related to overcoming water-related disasters and helping the sustainable, integrated management of river basins. Additionally, it will serve a second goal of capacity building, and third of research.

Among the earliest available courses is Flood Hazard Mapping, to take place for four weeks for five years (2004-2008), to be provided to 16 trainees from eight Asian nations.

Secretariat Affairs:

It was decided that Mr. Mochizuki, would chair the General Discussion on October 28 where the conclusion of the Conference and minutes of the Common Interest Issue discussed on October 19 and Specific Subject Issues on October 20 and 21 will be summarized.

The 14th Conference on Public Works Research and Development in Asia

Discussion on Specific Subject

- Session on Mitigation Measures and Risk Management against Flood and Coastal Disasters-

MINUTES

1. **Date and Venue** 10:00-12:00 Thursday 20 October 2005
International Conference Room, NILIM

2. **Participants**

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambhai SIYANI
Lao PDR	Mr. Keophilavanh APHAYLATH
The Philippines	Ms. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. NGUYEN Xuan Hien
Japan	Dr. Tadashi SUETSUGI Head, River Division, River Department, NILIM Mr. Tetsuya NAKAMURA Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM Mr. Fuminori KATO Senior Researcher, Coast Division, River Department, NILIM Mr. Yoshito KIKUMORI Senior Researcher, River Division, River Department, NILIM

3. **Discussion Minutes**

The primary focal points of the keynote presentation on Mitigation Measures and Risk Management against Flood and Coastal Disasters were: (1) Flood Disasters and Countermeasures; (2) Countermeasures for Urban Floods, and (3) Coastal Disasters and Countermeasures. The discussion raised the following questions from the overseas participants. The Japanese representatives provided additional information and/or further explanations.

(1) Flood Disasters and Countermeasures

(a) Countermeasures against infiltration into dikes (Cambodia)

Both floods and rain can cause water infiltration into dikes. The basic concepts behind countermeasures against water infiltration are to prevent water from entering the dyke body and to drain infiltrated water from the body. To drain infiltrated water, it is most effective to equip drainage at the toe of backside slopes. The gentle slope of dyke makes the body stable; however, it also increases surface susceptible to rainwater infiltration. Therefore, the gradient design for slopes must consider both stability of dyke body and prevention of water infiltration.

(2) Countermeasures for Urban Floods

(a) Rain Forecasts (Vietnam)

In Japan, three organizations work to predict precipitation levels. First and primary is the Japan Meteorological Agency which provides official forecasts. The Agency provides information to the pubic through the mass media. Secondly, private concerns also forecast rain for on limited areas. These services are useful when weather information on specific areas is needed. Lastly, river administrators also forecast rainfall levels. Using radar rain-gauge system, they predict rain as part of their work in river management.

In respect to precipitation, the use of past precipitation records enable reasonably accurate forecasts for the approximately three hours ahead.

Japan Meteorological Agency computers manage comprehensive data on various factors such as air pressure and temperature. Such data management allows the Agency to conduct mid and long term rain forecasts.

(b) Rain Storage Facilities (The Philippines)

Generally speaking, rainwater reservoirs are built in schoolyards. However, urban areas often lack enough space needed for such reservoirs. To facilitate the underground permeation of rainwater, several measures are taken, including construction of permeable pavements or underground spillways, are taken. During non-flood season, underground reservoirs are also used to cope with emergencies such as fires and earthquakes.

(c) Rainwater Infiltration Facilities (India)

Normally speaking, gravel is the main material for construction of rainwater infiltration facilities. Pipes for rainwater drainage installations are connected to tanks of infiltration facilities. The base of the tanks is made of gravel. It is important to select gravel of appropriate size since when dirt and/or particle are jammed between gravels, it is difficult for rainwater to permeate. At the same time, the facilities must be maintained. The price of gravel is not expensive so much, however, maintenance cost of facilities is rather higher.

(3) Coastal Disaster and its Countermeasures

(a) Tsunami Alert (The Philippines)

The Japanese Tsunami Alert System covers the Pacific. Due to its broad coverage, it predicted the occurrence of the last year’s Indian Ocean Tsunami. It can provide precise Tsunami alerts near Japan area. The current challenge is how the receivers can make an effective use of the prediction.

(b) Cost of Building Coastal Dyke and the Height of Dyke (Vietnam)

Differing from river dykes, coastal dykes are surfaced with concrete or asphalt, which makes their construction more costly. The dike height is determined by sea level and wave height. Sea level and wave height referred for dyke construction is usually based on the highest sea level that occurred in the past and the biggest wave that occurs in 30 to 50 years, respectively.

The 14th Conference on Public Works Research and Development in Asia

Discussion on Specific Subject

- Session on Risk Management and Mitigation for Sediment-Related Disasters -

MINUTES

1. **Date and Venue**: 13:00-15:00 Thursday 20 October 2005
   International Conference Room, NILIM

2. **Participants**:

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambhai SIYANI
Lao PDR	Mr. Keophilavah APHAYATH
The Philippines	Mr. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. NGYUEN Xuan Hien
Japan	Mr. Jun'ichi KURIHARA Team Leader, Volcano and Debris Flow Research Team, Erosion and Sediment Control Research Group, PWRI Mr. Kazunori FUJISAWA Team Leader, Landslide Research Team, Erosion and Sediment Control Research Group, PWRI Dr. Nobutomo OSANAI (Head, Erosion & Sediment Control Division, Research Center for Disaster Risk Management, NILIM Dr. Hideaki MIZUNO Senior Researcher, Erosion & Sediment Control Division, Research Center for Disaster Risk Management, NILIM Mr. Taketoshi SHIMIZU Research Engineer, Erosion and Sediment Control Disivion, Research Center for Disaster Risk Management, NILIM

3. Discussion Minutes

The "Risk Management and Mitigation for Sediment-related Disasters" session focused on the initiative to "identify, assess and monitor risks, and enhance early warning." This topic was among the five action priorities in the "Hyogo Framework for Action 2005-2015, Building the Resilience of Nations and Communities to Disaster" adopted at the World Conference on Disaster Reduction (WCDR) held 2005 in Kobe City, Hyogo Prefecture. The discussions considered the following two aspects of sediment-related disasters:

a. Risk Evaluation, and,
b. Early Warning Systems.

To begin, a National Institute for Land and Infrastructure (NILIM) representative presented background on sediment-related disasters in Asia and on the Hyogo Framework as the Session Outline(1). This was followed by a presentation on Risk Evaluation, with emphasis on the Application to Past Disasters of a Method of Setting the Range of Debris Flow Damage to Houses (2). This outlined methods of determining special hazard zones and to determine the range of debris flow damage to houses.

The presentation continued on the following three aspects of (b) Early Warning Systems.

(3) Warning and Evacuation System against Sediment-related Disasters
(4) Debris Flow Detection Sensors
(5) Development & Actual Utilization of the Landslide Displacement Detection Sensors Using Optical Fibers

Q and A followed each presentation.

(1) Outline of the Session

First, the session was outlined. Some specific content was:

Of all of Asia's hydro-meteorological disasters, 9% are sediment-related. There is an average of 71 deaths per disaster, with average damages of $2.28 Million. Effective counter measures are crucially needed.

The Five Priorities for Action set out in the "Hyogo Framework for Action 2005-2015" adopted at the WCDR held in Kobe City, Hyogo Prefecture in 2005, are:

a. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
b. Identify, assess and monitor disaster risks and enhance early warning
c. Use knowledge, innovation and education to build a culture of safety and resilience at all levels
d. Reduce the underlying risk factors
e. Strengthen disaster preparedness for effective response at all levels

(2) Application to Past Disasters of Methods of Setting Range of Debris Flow Damage to Houses

A method to calculate stream factors where there is the potential for debris flows was introduced. One means of mitigating sediment disaster risks lies in restricting land utilization. He outlined methods of zoning new land developments (in the potential range of debris flow damage) in Japan.

(3) Warning and Evacuation Systems for Sediment-related Disasters

The role played by prompt dissemination of warnings is significant in ensuring safe evacuations in sediment-related disasters. The presentation outlined how improvements of the risk management system to enable data collections are required to promptly and efficiently communicate warning information on sediment-related disasters.

Methods typically applied in Japan to design warning and evacuation systems for sediment disasters were introduced. The primary response was to predict debris flows based on combining rainfall intensity and cumulative rainfall.

(4) Debris Flow Detection Sensors

The presentation emphasized the importance of detecting of debris flows to lessen the death toll in sediment related disasters. Additionally, the various detection sensors for debris flows actually used in the field in Japan were outlined, along with a detailed introduction on a new method to set vibration sensor trigger levels.

(5) Development and Actual Utilization of the Landslide Displacement Detection Sensor Using Optical Fibers

This presentation introduced the development of using optical fiber to monitor ground fluctuation caused by landslides; this has the advantages of ability to measure broad expanses and resilience to lighting. A case examining actual field use of the device in a real world land slide was examined.

(6) Comprehensive Discussion (Q and A)

Q. A formula to calculate velocity of debris flow was provided. How do you verify its accuracy? Also, will it be improved in the future? (The Philippines)

A. To enhance the estimation accuracy of velocity and depth of debris flows, detailed topographic data is crucial.

Q. From what perspective or what factors govern the classification of Japanese sediment-related disasters such as debris flow, landslide, and slope failure? (The Philippines)

A. Although the term "landslide" is commonly used throughout the world, Japan categorizes these into the three separate types. Landslides are separate based on its cause: groundwater up-rise. All three are categorized according to their different movement patterns.

Q. How is the volume of debris flows calculated? How do you evaluate the changes of rainfall to predict debris flows? (Cambodia)

A. We conduct field surveys to survey deposit volume in mountain streams and the volume of earth and sand subject to move in a sediment flow, and calculate the potential debris flow volume comparing those two numbers. We then assess where debris flows occur according to the estimated volume of rainfall as it happens.

Q. How is the number of days with rainfall determined, when predicting debris flows caused by precipitation? (Cambodia)

A. Although normally be determined considering geological conditions, we also use statistics from which we can estimate if a debris flow will occur. Not only the antecedent rainfall, but also half-life period used when calculating working rainfall is designated with statistics.

Q. What is the reason for applying 25m as the value at a standard distance (d') in the formula to calculate vibration sensor trigger level to detect debris flows? (Cambodia)

A. Although installed in mountain areas, the vibration sensors must be on level ground. From the past experiences, the average distance has been approximately 25m.

Q. How do you determine the installation sites of the landslide displacement dictation sensors using optical fiber? (Cambodia)

A. Deformation by landslide generally appears in roads and retaining walls. When those cracks are discovered, a field survey at the upper slope is conducted and the installation location of the system is determined after confirming the condition of the cracks on the slope.

The 14th Conference on Public Works Research and Development in Asia
- Special Session on Flood Forecasting and Warning -

MINUTES

1. **Date and Venue** 09:00-11:30 Friday 21 October 2005
International Conference Room, NILIM

2. **Participants**

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambehai SIYANI
Lao PDR	Mr. Keophilavanh APHYLATH
The Philippines	Ms. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. Nguyen Xuan HIEN
Japan	Mr. Akira KITAGAWA Executive Coordinator for International Affairs, PWRI. Mr. Akira TERAKAWA Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, PWRI Mr. Junichi YOSHITANI Team Leader, Risk Management Team, ICHARM Centre, PWRI Mr. Yoshio SUWA Dr. Tarek MERABTENE Specialist Researcher, Risk Management Team, PWRI

3. **Discussion Minutes**

(1) Opening Address, Mr. Junichi Yoshitani

At the opening address Mr. Yoshitani have presented the current issues in flood forecasting and warning and put emphasis on future directions in flood disasters mitigation that is 1) to seek the best combination of structural and non-structural alternatives; 2) to seek the effective scheme of involving people in decision process; 3) to seek appropriate role and responsibilities sharing between national government, local government, municipalities, and individuals. There are two different impacts to reduce Loss of lives and Economic loss. While economic loss can be reduce by promoting structural measures loss of lives requires more holistic proactive and reactive actions involving Individual actions, Community actions and Government actions. The public response to flood warning is less than 30% percent, this ratio is even smaller in developing countries where people would prefer to stay in prone area to watch their property.

(2) Summary of country and session reports, Mr. Yoshio Suwa, PWRI

In his presentation, Mr. Suwa emphasized the need to clarify the problems that our society is facing during disasters. For instance, during the Nigata flood in 2004 death of old people occurred and during Typhoon 23 a bus was inundated, along other examples of recent floods in Japan were presented. Among the most important concern during the evaluation of the effectiveness of our current warning system is to analyze the real causes of death for each flood disasters. Other concern put forward for discussion is the evaluation of flood forecasting and warning system during an actual flood for instance the response of agencies and the population to the flood warning and/or Alert.

(3) Flood Forecasting and Warning in India, Mr. Janak Jerambehai Siyani

The flood of 26 July 2005 in Mumbai City was the worst ever recorded event. During the flood the forecasting system could not predict the highly localized phenomena. Despite the issuing of flood warning, the death toll was unprecedented high and reached 736 in Mumbai and more than 1000 death in Maharashtra State. During the flood about 150,000 people were stranded in their offices and schools and many people died drown inside their cars. The coincidence of high tide and heavy rain worsened the situation. The state government had released Rs.5 billion for emergency relief.

(4) Cambodia Case Study, Dr. Bunna Yit

For flood forecasting 8 hydrologic stations are available. Ministry of Public Works and Transport with The National Committee for Disaster Management has approved some action to (1) collect disaster information along the affected or damaged road and hydro-structure, (2) inspect and survey critical section and ready to warn the road user and people when the flood water reach the freeboard design level. Many sections of road in the flood basin are considering as evacuate place for the animals and people from the villages nearby. MPWT shall and ready to warn the transporters of possibility to disrupt traffic or minimize the loading traffic by heavy truck for high risk and high safety. Boats are also valuable mean for rescue activities during flood.

(5) Lao PDR Case Study, Mr. Keophilavanh Aphaylath

Flood forecasting in Lao PDR is coordinated with the Mekong River Commission. The real-time information (water level and rainfall data) includes data from five key hydrological and meteorological stations in Thailand, and five key hydrological and meteorological stations in Lao PDR to transmitted by radio or facsimile to the MRC Secretariat daily at 17 00 hours or, during peak periods twice daily, at 11 00 and 17 00 hours. Normally, the forecast is issued five days in advance. The death toll in Lao PDR is very small or none existing but economic damages to agriculture in particular is still very high.

(6) The Philippines Case Study Ms. Rebecca Trazo Garsuta

The Disaster mitigation program in the Philippines include both proactive and reactive responses are adopted. As proactive measures communities undertake exercise and evacuation drills along many awareness campaign and volunteer team actions. As damage mitigation measure the local community issue guideline on safety measures (such as suspension of school classes) as well as to issue local ordinance to use calamity fund. Much legislation for water disaster mitigation are continuously formulated by the Government.

(6) Thailand Case Study, Mr. Akkapong Boonmash

Flooding in Thailand occur in average 10 times/year. the inundated lands is about 32% of the total. Every year more than 100 people die due to flood and more 800 thousands people are affected. The average damage is as high as 4,094 million Baht. Disaster preparedness in Thailand is conducted as part of the country's civil defense management, which is comprised of three levels National Level (the Department of Disaster Prevention and Mitigation (DPM) is the principal government agency responsible for formulating policy on disaster management and prevention), Provincial Level (the Provincial Governor is designated as Director of Provincial Civil Defence) and Local Level (the Mayor is concurrently the Municipal Civil Defense)

(7) Vietnam Case Study, Mr. Nguyen Xuan Hien

The flood forecasting is not easy, in the Mekong delta we have tried to carry out the long-term flood forecasting (month, season), medium-term flood forecasting (10-15 days) and short-term flood forecasting (3 to 7 days). The result show that short-term flood forecasting is enough accuracy and the others are only for reference. In Vietnam we found that most of the death people were children. As a response the government establishes the child care houses during the flood season. We have reduced number of the death people (2000 flood: 448 2001 flood: 412, 2002 flood:170, 2003 flood: 85, 2004 flood: 42).

(8) Discussions outcomes, Mr. Tarek Merabtene

- While governments have the responsibility to develop flood forecasting and warning systems, it's the responsibility of the Citizens to take proactive measures to safe their lives. For instance Refusal of early evacuate by citizens have proved to increase difficulties to mobilize enough facilities such helicopters and boats for rescue.
- The issue of why people do not respond to warning is still questionable. In many areas poverty is one of the reasons but other reasons have to be identified by undertaking case basis analysis.
- In Japan recent problems such death of old people put forward the issue of evacuation system and evacuation order and directive for old people.
- Disaster from small river scale where no flood forecasting and warning system exist should be carefully considered.
- Traffic control during flood is new issue under discussion.
- Good example: Kochi Prefecture. Community flood fighting > smooth communication and support between individual.
- Thus, Evacuation System are as important as warning system. For instance inability to evacuate due to social conditions.
- Analyses of the real cause of death for every flood disaster is recognized to be a very important issue.
- For instance the cause of death in Mekong Delta during flood is questionable acknowledging that the rising speed of water level is not so rapid to impede evacuation.
- Learning from the different Mechanism of the flow information of warning.
- In major rural area the main limitation for effective warning is the lack Information Perception. For instance farmers have a very poor or absent knowledge to understand forecasting and warning information.
- There is an emerging need to establish accurate database for global analysis
- Since many private boat are made of timber and people tend also to rescue their animals case of drawn boats are witnessed. Other cause of death is sudden biting by wild animals such as snakes.
- Strengthen the international collaboration for support and exchange data, information, knowledge and experiences on flood forecasting and warning are very importance and indispensable.
- Efficient of Measurement station was bought forward by the case of Mumbai flood where 2 meteorological stations recorded different precipitation. Even with higher resolution system it is difficult to forecast a case such as of the localized rain in Mumbai.
- Cause of death: absence of high spot, Submergence of occupied vehicles
- Preparation of manuals in local languages
- People in remote area are not connected to media and human communication is important.
- Moving animals to safe place is also a major issue of local and rural areas during flood.
- The FFWS are limited in many of our regions due to limited rain gauges.

The 14th Conference on Public Works Research and Development in Asia

The 14th International Symposium on National Land and Development and Civil Engineering in Asia
- Flood, Sediment and Tsunami Related Disasters in Asia" -

MINUTES

1. **Date and Venue** 13:10 – 17:00 Thursday 27 October 2005
Sendai International Center Conference Room

2. **Participants**

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambhai SIYANI
Korea	Dr. Chang Wan KIM
Laos PDR	Mr. Keophilavanh APHAYLATH
Rep. of Philippines	Ms. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. NGUYEN Xuan Hien
Japan	Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM
	And many more

3. **Addresses**

A. Host Nation Opening Address by Mr. Tsuneyoshi MOCHIZUKI, Director General, National Institute for Land and Infrastructure Management (NILIM)

Our world has recently seen several major disasters, many water related. In the Century of Water, Asian nations are working to improve water utilities, sewage and irrigation systems, and to develop water resources and disaster prevention. In Japan, water disaster mitigation has a long history, and today, Japan now has comprehensive Basic Laws on Disaster Measures. Advances in communications allow agencies involved in disaster management to stay informed on a real time basis, and help keep the general public better informed. High Risk Areas are being equipped with Hazard Maps marking both danger zones and evacuation refuges. Integrated response is key, and in Japan as throughout Asia, much important work remains to be done and vulnerability remains high. Today's conference allows the exchange of views with Asian nations with similar concerns, so that we can all better understand each other's problems and responses, and can help resolve these problems through mutual cooperation.

B. Guest Address presented by Mr. Michio TANAHASHI in lieu of Mr. Masato SEIJI, Vice Minister for Engineering Affairs, Ministry of Land, Infrastructure and Transport (MLIT).

Today's Conference brings experts from seven Asian states to Tohoku, where the Regional Bureau has done much on behalf of today's proceedings. MLIT's mission is to "Provide both Hard and Soft Infrastructure for Peoples' Lives Filled with Vitality" and, "Ensure a Beautiful, Attractive National Domain, for Diverse, Unique Communities." We try to enhance the quality of government services, lower costs, and ensure quicker response, by seeing things through the eyes of the ordinary citizen. "Building a Nation Resilient to Disasters" is a major policy pillar for our MLIT. Civil Engineering is key to achieving these ends, and we must further research and develop social capital and infrastructure requirements suitable for the social, natural, and economic conditions of each nation. Each achievement in each nation lends to greater advancement and progress for all.

C. Overseas Participants' Representative Address by Mr. NGUYEN Xuan Hien of Viet Nam, representing international attendees

The international attendees would like to express our heartfelt thanks to the Government of Japan, the JICA, and to the Ministry of Land, Infrastructure and Transport for the opportunity to study Japanese technology on disaster mitigation including the site survey program, dam construction, meteorology, and related laws. We know we are all susceptible to disasters, but if we work together, sharing data, information, knowledge, and skills, we will achieve what we aim for. We would like to commit ourselves for more dedicated service in our specific fields to prevent further disasters in the future.

4. **Keynote Address**

Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami

Prof. Fumihiko IMAMURA, Disaster Control Research Center, Graduate School of Engineering at Tohoku University

The 2004 Sumatra Tsunami was one of the three largest known. Since 1992, there have been 22 major tsunami in the Pacific and Indian Oceans. Essentially, a tsunami is generated by disturbance of the seabed, causing waves to travel across open waters amplified by shoaling and refraction. As the wave reaches shallower waters, the climb in energy density increases both wave height and force. A review of the 1993 Hokkaido tsunami experience underscores how secondary disasters such as fire and landslides can widen devastation. The 1998 Papua New Guinea tsunami resulted in a booklet being made to disseminate the age old wisdom of tsunami awareness, which had dissipated with modernization. The death toll was aggravated when modern residents failed to realize they should run for height cover.

Specific details were given on the seabed deformation that resulted in the 2004 tsunami. Advanced modeling and simulations demonstrated the force and strike zones and angles which hit Banda Aceh and Khao Lak area of Thailand, as well as a derailed train swept by the tsunami in Sri Lanka. Satellite imagery clearly demonstrated the damage swath. At Kahawa, a single two story residence withstood the tsunami strike, and further studies may yield valuable data on resilient designs. There is some evidence indicating that heavy greenery serves to break the wave forces.

A major aspect in reducing the rate of fatalities appears to be in three factors: self help, public or government help, and good neighbor actions or mutual help. In Japan, reminders of past losses are amplified with Hazard Maps and GIS modeling to identify high risk zones.

5. **Special Reports**

A. Japan (Mr. T. Mochizuki, Director General, NILIM) Disaster Reduction and Risk Management Approach to Flood, Landslide, and Tsunami Problems in Japan

Japan is part of Asia, the part the world most affected by flood disasters. The geologically active Japanese archipelago is a land of steep slopes with swift short rivers. Population is concentrated in heavily urbanized low lying coastal flood plains. Flood damages in recent years have been characterized by lower death and injury tolls, with lower total area inundated. These are the results of improved communications, evacuation logistics, and better infrastructure. However, these drops have also been accompanied by almost no change in the overall monetary value of damages, as the value of the flooded areas has continued to rise.

Japan uses the Flux Difference Splitting (FDS) Method to analyze the combined effect of flood and inundation flows. Flood Hazard Maps have proved an effective, way to reach residents in high risk areas. Japan defines sediment disasters into four types: (1) debris flows or sediment carried by swiftly moving streams, (2) rock falls or sudden cliff collapses, (3) volcanic pyroclastic flows, and (4) landslides, extensive, slow slope failures. The Japanese disaster prevention scheme consists of four phases: Response, Recovery, Mitigation, and Preparedness. Future risk management initiatives concentrate in three areas: (1) Seeking the best combination of structural and nonstructural measures for each river basin, (2) Seeking effective means to involve the public in the decision making process, and (3) Seeking appropriate responsibility sharing between the national, local, and municipal governments and individuals.

B. Regional Report (Mr. M. Shinohara, Director of the River Department, Tohoku Regional Bureau) Disaster Reduction and Crisis Control for Flood, Landslide and Tsunami Disasters in the Tohoku Region

Tohoku constitutes about 18% of Japan's land surface and is home to 8% of the population. Straddling two oceans, floods occur western coasts along the Sea of Japan due to fronts, and along the eastern Pacific coast due to typhoons; it is also hit by tsunami. At the northern end of the main island of the Japanese archipelago, Tohoku is also susceptible to floods from snow melt. Tohoku is now establishing three flood control basins, and four discharge channels. A project similar to the US Tennessee Valley Authority (TVA) program has been established for five dams on the Kitakami River, it is called the KVA. The program incorporates flood controls, irrigation, and power generation. New innovations include integration of structural and non—structural measures including, providing river disaster prevention information on Internet or mobile phone sites, images of river water levels provided to the public media, and support for Hazard Maps.

C. Country Report for Korea (Dr. Chang Wan KIM, Research Fellow, Korea Institute of Construction Technology) Typhoon Rusa and Super Typhoon Maemi: Impacts and Aftermath

Recently, two major typhoons, Rusa in 2002 and Super Typhoon Maemi in 2003, imposed a heavy toll on Korean society. Typhoon Rusa was one of the worst tropical storms in the last 45 years, Super Typhoon Maemi was the strongest since records were first taken 100 years ago. Rusa made landfall in August with sustained winds of 120 km/hr, and gusts of 150 km/hr. Super Typhoon Maemi, a Category 5, attained maximum speeds of 280 km, but made landfall on 12 September with maximum sustained winds of 140 km/hr, gusting to 175 km/hr. Typhoon Rusa was a "wet typhoon" with a 200 year record breaking precipitation with ten times greater than average damages, and five times the previous records. Super Typhoon Maemi was a "dry" typhoon with strong wind force. Maemi struck the Busan harbor with such intensity that it not only tossed shipping containers and fishing boats into the air but also toppled eleven giant container-lifting cranes, each weighing some 900 tons.

One problem with both typhoons was that forecasts and severe weather warnings came too late for disaster management teams to react well. The climate is rapidly changing but government policy is only slowly adjusting. Korea is now developing its first Korean geosynchronous multi-functional satellite (COMeS) program to provide real-time meteorological observation data with higher time, spatial and spectral resolution data than currently available. For more rapid and precise forecasts of rainfall and streamflow, Korea is installing hydrological radar and automated flow measurements.

D. Akira TERAKAWA, Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute (PWRI), Outline of the ICHARM

The International Centre for Water Hazard and Risk Management, a.k.a, ICHARM, will operate under the auspices of UNESCO from PWRI facilities located in Tsukuba, Japan. The need for ICHARM is evident from the (77%) share of water disasters in natural disasters, which account for 61% of all disasters vis-à-vis 39% technical disasters. Floods and storm rains account for the overwhelming majority of water disasters with 10 or more deaths or 100 or more victims. Of these, nearly 1/3 occurs in Asia.

ICHARM will be located with the PWRI facilities in Tsukuba. Established in 1927, PWRI today has almost 220 staff involved in 14 prime research themes. Of the nine research teams, three (Water Environment, Hydraulic Engineering, and Erosion and Sediment Control) work with water related disasters. PWRI will be able to offer ICHARM involvement in its already world wide international cooperative research programs. The objective of ICHARM is to help prevent or mitigate water-related disasters throughout the world, through the synergy of accumulated knowledge and experience and via the international sharing of valuable information with the global UNESCO-IHP network.

Q&A:

Q. Please outline the foreign researcher program.

A. One researcher has been selected to start work in October, and we expect to add another four within the fiscal year.

6. PANEL DISCUSSIONS

MC: (Mr. Tsunaki, Director, Research Center for Disaster Risk Management, NILIM) Asia perpetually suffers from water related disasters, with coastal areas are often hit by tsunami. The Indian Ocean Tsunami has made us all more aware of water related disasters. Let us hear first from our neighbors who have not yet introduced conditions in their countries.

A. Cambodia (Dr. Bunna YIT) Risk Management & Mitigation for Flood Sediment Disasters.

Three fourths of Cambodia’s 12 million people live in the central plains. Since Mekong flood disasters have far reaching impacts, there are eight hydro-meteorology stations set along the river’s banks. River levels rise steeply during the June to November rainy season. Floods in 2000 were especially damaging, including to the road network which obstructed rescue and recovery efforts. Many trunk routes align the river banks, with double service as dykes.

Q&A:

Q. Do you have any plans to clear sediment gridlock during the dry season?

A. This is currently impossible because we do not have the funds. But this is a problem that is not unique to Cambodia and should be tackled through an international framework.

B. India (Mr. Janak Jerambhai SIYANI) Risk Management & Mitigation for Flood Disasters

India is studying both structural and non-structural methods of risk management. Structural means include dams, embankments, flood walls, natural detention basins, et al, but most importantly, multipurpose reservoir projects. Non-structural measures for mitigation of flood disasters include flood plain management measures such as zoning, flood forecasting and warning systems, public health measures, flood insurance, et cetera. Flood warning systems move information from the national centers to public media, and from district and tauka levels to villages. The pre-disaster risk management cycle moves in tandem with post disaster recovery work.

Q&A:

Q. You noted that land use policies should be more stringent; does India have a land use control law for low lying areas?

A. Land use laws and rules are common in the urban areas but are poorly enforced. Without enforcement, the wrong use will only make future problems worse.

Q. Warning systems are important. Does your warning system serve only local residents or does it also provide for tourists or visitors?

A. I think that the issue is the low lying areas of urban centers, where poor people are concentrated. Outsiders tend to stay on higher ground, so we don’t see that they have much problem.

C. Laos PDR (Mr. Keophilavanh APHAYLATH)

The overwhelming majority of the 5.5 million people in land-locked Laos PDR live in the lowlands along the banks of the Mekong. Overseas aid makes up a little over 20% of the nation’s GDP. Although still reliant on agriculture, much of the land cannot be tilled due to still remaining anti-personnel cluster bombs. The primary natural disasters are floods and droughts. Much work in risk management is done with the cooperation or under the auspices of the Mekong River Commission. Focus is on better procedures to assess flood behavior and restrict damage. Survey data collected by the Department of Irrigation is being transferred to GIS format. The Streamflow Synthesis and Reservoir Regulation flood forecasting model developed by the US Army Engineers in the 1970's is still being used, although plans call for model amplification or substitution. Laos is now studying long term investment in infrastructure to include dykes, reservoirs and the widening and deepening of natural drains.

Q&A:

Q. You noted Government policies. Who actually is responsible for issuing warnings?

A. Early warning is handled by the Mekong River Commission; there is no system for tributaries of the Mekong. However, our floods are not flash floods but river levels rise slowly enough for the population to evacuate safely without hurry.

D. Rep. of the Philippines (Ms. Rebecca Trazo GARSUTA) Risk Management and Mitigation for Flood and Sediment Related Disasters

Most natural disasters in the Philippines are due to destructive typhoons and heavy monsoon rains. The National Disaster Coordinating Council is the fulcrum of the country's disaster mitigation programs—it focuses on providing non-structural measures. Because the cost of annual damages totals 2% of the national budget, and nearly double the flood funding allocated to the Department of Public Works and Highways, serious measures are supported via ODA funds including help from JICA. Structural disaster mitigation includes conventional public works such as dikes, retention ponds, sedimentation basins, sabo dams, channeling, and drainage improvements. Non-structural programs include capacity building workshops for disaster response teams, and means for proper, effective dissemination of information. Both structural and non-structural mitigation measures must be employed to allow the full benefits of projects. Non-structural measures also imbue the local population with a sense of ownership. Particularly, a JICA sponsored pamphlet for a local community done in the local dialect and adaptation of Hazard Maps as non-structural measures used in Japan have been beneficial.

Q&A:

Q. You are using the Hazard Maps as non-structural measures. I believe NGO's have a major role in outlining the Hazard Maps. If so, can you describe what types of NGO's are used? Also, how do you measure the efficiency of these measures?

A. There is considerable local participation from the preparation stage of the Hazard Maps. The Government merely assists to finalize plans. NGO's, private, church or business-based, represent the many different stakeholders, and help integrate different sectors of society. Schools help disseminate information. As for effectiveness, post-project results in Ormoc City yielded much lower death tolls in a flood that came two years later after a devastating flood, indeed there were zero casualties.

E. Thailand (Mr. Akkapong BOONMASH)

Located in the tropical monsoon zone of SE Asia, Thailand enjoys relatively uniform temperatures in all regions, conditions generally favorable for year-round crop production. The primary disaster prevention and mitigation measures come under the Integrated Plan for Flood Mitigation in Chao Phraya River Basin. Here, the main causes of flooding are the low flow capacities of river channels. For example, dike breaching and overtopping occur at nearly all reaches of the Chao Phraya River. To cope with flooding, the government has implemented several programs including a river improvement and drainage system improvement called "monkey cheek project" in the river delta. The Monkey Cheek Project is drainage work from upper area southwards through the canal to a large storage canal near the shore line. When the sea level is lower than water in the canal, the water in these storage canals is drained through gravity flow. The basic concepts of the master plan includes, preservation of the present natural retarding effect to minimize future flood damage through controls and guidance on basin development in areas where flood damage is expected.

Q&A:

C. This is not a question, but a comment. Your annual average of 1470 mm is lower than that of Japan.

Q. Does Thailand have any structural measure or flood protection plans for the Chao Phraya?

A. Yes, we have to improve the river by heightening the levees, then we will improve the retarding basin.

Q. I lived in Bangkok from 1993 to 1995. You noted an annual death toll of about 120 persons, but the flooding rises very slowly. Can you give us more information on these deaths?

A. The data is for the entire country of Thailand, not just Bangkok.

F. Vietnam (Mr. NGUYEN Xuan Hien)

The Mekong River Delta is located in Vietnam where an annual 1.2 to 1.8 million hectares are inundated for period of three to six months. A combination of advanced water management programs, new rice seed, and flood infrastructure has resulted in multiple rice crops each year. However, Vietnam considered floods to have positive effects as well as negative, bearing silt to enrich the fields, and generally cleansing the land. Vietnam therefore follows a policy of partially “adapting to living with floods.”

Q&A: None

G. Dr. IMAMURA

I would like to comment on Hazard Maps. These are mandatory but not well used by residents. I believe it is important to make community participation in forming these maps more enjoyable. We have sponsored contests for students, for example.

H. Mr. MOCHIZUKI

Information exchange between agencies responsible for disaster response does not always go well. One problem is doubtless cutback in the civil servant workforce, but another is the diversity of available information. One possible solution is the use of IT to provide exactly the same screen readouts to all parties. Such systems would have to be adjusted for different disasters.

I. Mr. SHINOHARA

Q. Since Vietnam is at the delta of the Mekong River, it must be fairly easy for Vietnam to predict coming floods.

A. (Mr. Nyugen) The Mekong River flows through six countries, but the River Commission only includes four. The upstream waters are in China, not a River Commission member. We are aware that China plans to build a total of five hydropower plants, two of which are complete. Cooperation is crucial.

J. Dr. KIM

Structural measures are important in Asia, but in Europe, they have focused on living with floods. The paradigm change seems to be moving toward a greater focus on non-structural measures like forecasting, Hazard Maps, and demolishing concrete surfaces.

K. Mr. MOCHIZUKI

Q. Dr. KIM, you had a bar graph showing damage levels and costs. What has been the result of bureaucrats or media who have viewed your graph?

A. (Dr. Kim) Many people have reacted to the graph as merely showing unusual conditions and not as precursors of a period of aberrant weather conditions. Another aspect is that private landowners are opposed to publishing of Hazard Maps because such maps can bring down property values.

Q: As you know, typhoons often pass by Japan en route to Korea. Perhaps we should work harder to anticipate paths, and provide the information to our respective citizens.

A: Yes, as I noted, our forecasting center did not adequately anticipate these major typhoons, and information from the Japan Meteorological Agency would be most helpful.

L. Ms. GARSUTA

I was very impressed with Dr. Imamura's presentation on the tsunami. Certainly, global research is going to be very important in the future. With Japan's help, as a leader in tsunami research, the ICHARM project will help lay the necessary foundations at a propitious time.

6. **Closing Address**

The closing address was provided by Mr. Shinichiro TANAKA, of the MLIT Tohoku Regional Bureau. He noted that the symposium considered the theme of Disasters, a topic immediate and central to the Tohoku Regional Bureau. We consider it meaningful to have had the opportunity to have heard from many areas on disaster conditions and measures, and we hope to use much of what we have heard today in our future applications.

The 14th Conference on Public Works Research and Development in Asia

General Discussion

MINUTES

1. **Date and Venue** 09:30-10:00 Friday 28 October 2005
Hotel JAL City Sendai

2. **Participants**

Cambodia	Dr. Bunna YIT
India	Mr. Janak Jerambhai SIYANI
Korea	Dr. Chang Wan KIM
Laos	Mr. Keophilavanti APHAYLATH
Philippines	Ms. Rebecca Trazo GARSUTA
Thailand	Mr. Akkapong BOONMASH
Vietnam	Mr. Nguyen Xuan Hien
Japan	Mr. Tsuneyoshi MOCHIZUKI Director General, NILIM Mr. Kazuhiro NISHIKAWA Executive Director for Research Affairs, NILIM, Mr. Jun INOMATA Director, Planning & Research Admin. Dept., NILIM Mr. Minoru KURIKI Director, River Department, NILIM Dr. Ryosuke TSUNAKI Director, Research Center for Disaster Risk Management, NILIM Mr. Kiyoshi MINAMI Research Coordinator for Evaluations, Planning & Research Admin. Dept., NILIM
	〔Secretary General〕 Mr. Junzo INOUE Head, International Research Division, Planning and Research Administration Department, NILIM Mr. Soichiro YASUKAWA Senior Researcher, the same as above Ms. Yoriko IIBA Assistant Head, the same as above Ms. Akiko ISOGAI Chief, International Section, the same as above

3. **General Discussions**

As agreed in the Session on Subject of Common Interest on October 19, Mr. Mochizuki chaired this session.

Conference Secretariat personnel reported on the contents of the previous sessions.

(1) **Report on Session on Subject of Common Interest**

M. KURIKI, Director of River Department, NILIM

Mr. Kuriki presented the minutes of the October 19 Session on Subject of Common Interest (Risk Management and Mitigation for Flood and Sediment Related Disasters) to the assembly. The majority of the minutes had been vetted by participants prior to the session.

A minor addition was made to the last sentence in the Country Report for Cambodia noting that “Public information is disseminated by TV and radio (Ministry of Information) while the Army and Police are responsible ’with commune’ for evacuation of people and animals to safe areas.”

Laos requested to correct his name from “Mr. Keophilavanti” to “Mr. Keophilavanh.”

From the report for Philippines, the word of the final sentence “causalities” be changed to “casualties.”

The minutes were approved pending the above changes.

(2) **Report on Specific Subject Session**

R. TSUNAKI, Director of Research Center for Disaster Risk Management, NILIM

The minutes for the three Specific Subject sessions were introduced by Dr. Tsunaki.

In the third minutes on the Special Session on Flood Forecasting and Warning on Oct. 21, there were some additions and corrections.

Cambodia requested to correct his name from “Dr. Bunna Yet” to “Dr. Bunna Yit.”

The Philippines requested to change the phrase in parentheses at the third sentence from “(such suspension of schools)” to “(such as suspension of school classes).”

The minutes were approved pending the above changes.

(3) **Conclusion**

J. INOMATA, Director of Planning & Research Administration Department, NILIM

The conference secretariat, Mr. Inomata presented a draft of conclusion of the 14th Conference on Public Works Research & Development in Asia.

Laos proposed to add a few words of thanks to the Japanese Government to give them this chance to come and attend the conference. Although Japan, the chairperson Mr. Mochizuki, expressed his gratitude to Laos for his compliments, he advised to make the conclusion just only the content of the conference itself and Laos agreed.

Cambodia suggested to add “and in sharing information on forecasting data and natural disasters” at the last part of the first sentence of the agreement.

Vietnam also suggested to add “and non-structure measures” at the last part of the second sentence of the agreement.

The conclusion was adopted with the above changes.

(4) **Proposal for Future Conferences**

K. NISHIKAWA, Executive Director for Research Affairs, NILIM

Mr. Nishikawa presented a proposal for the enhanced operations of future conferences. His proposal included the following:

(a)Establishment of a Research Information Network

(b) NILIM requests in support of future conferences: Following the return of participants to their respective nations, they are requested to provide the conference information to the institutes or organizations concerned including Japanese Embassy and JICA offices.

The participants agreed the proposal and then the chairperson moved to close the general discussion and proceed to the closing ceremony.

CONCLUSIONS

THE 14TH Conference on Public Works Research and Development in Asia

The Conference on Public Works Research and Development in Asia has been carried out since February of 1993 with the support of Japan International Cooperation Agency (JICA), for the following purpose; 1) to exchange information of mutual understanding, 2) to discuss technological issues, and 3) to establish human network.

The 14th Conference on Public Works Research and Development in Asia was held mainly in Tsukuba and in Sendai from October 17 to 28 in 2005. The participants included executives and senior civil engineers of government agencies responsible for research and development and policy making relevant to public works in the following countries; Cambodia, India, Korea, Laos, Philippines, Thailand, Vietnam and Japan.

The 14th conference took up "Risk Management and Mitigation for Flood and Sediment Related Disasters" as the subject of common interest among nations. Under the subject, the participants had discussions to enhance mutual understanding and to learn advanced technologies, as well as site visits related to new technologies and practices. In addition, the participants joined "The 14th International Symposium on National Land and Development and Civil Engineering in Asia" and a panel discussion on the "Flood, Sediment and Tsunami Related Disasters in Asia" followed by a key note speech and introduction of several cases.

The conference, through the discussions, site visits and the symposium, concluded the following agreements;

- The participants recognize the role and need for further improvement in “Risk Management and Mitigation for Flood and Sediment Related Disasters” as well as the importance in conducting research to facilitate them and in sharing information on forecasting data and natural disasters.
- The participants recognize that each country should learn from insights and experiences of countries in Asia, to enhance and support the infrastructure development and non-structural measures.
- The participants recognize the needs to cooperate with each other and continue the conference in the future.

Disaster Reduction and Risk Management Approach to Flood, Landslide, and Tsunami Problems in Japan

Tsuneyoshi MOCHIZUKI

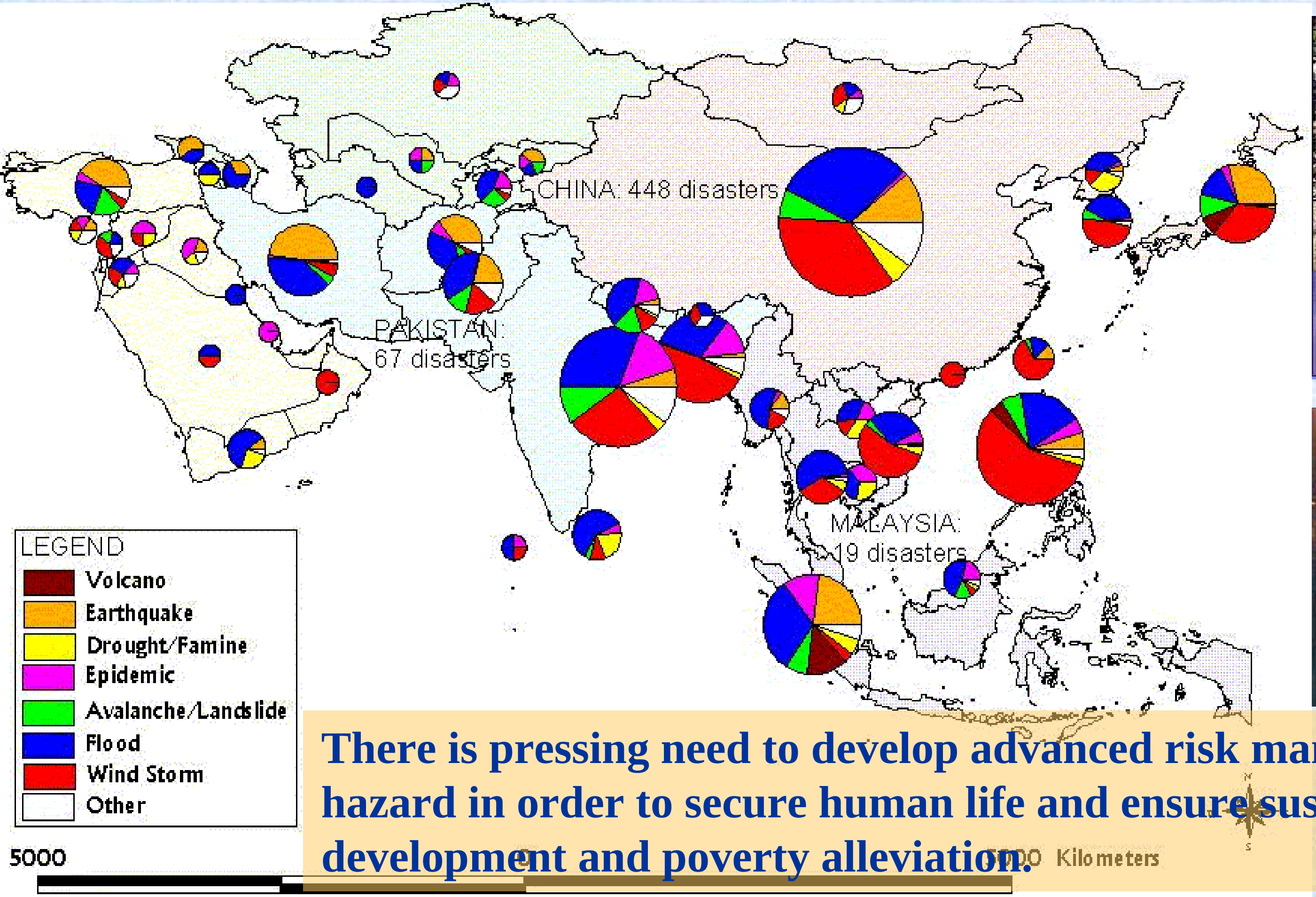
Director General

National Institute for Land and Infrastructure Management

19 Oct. 2005

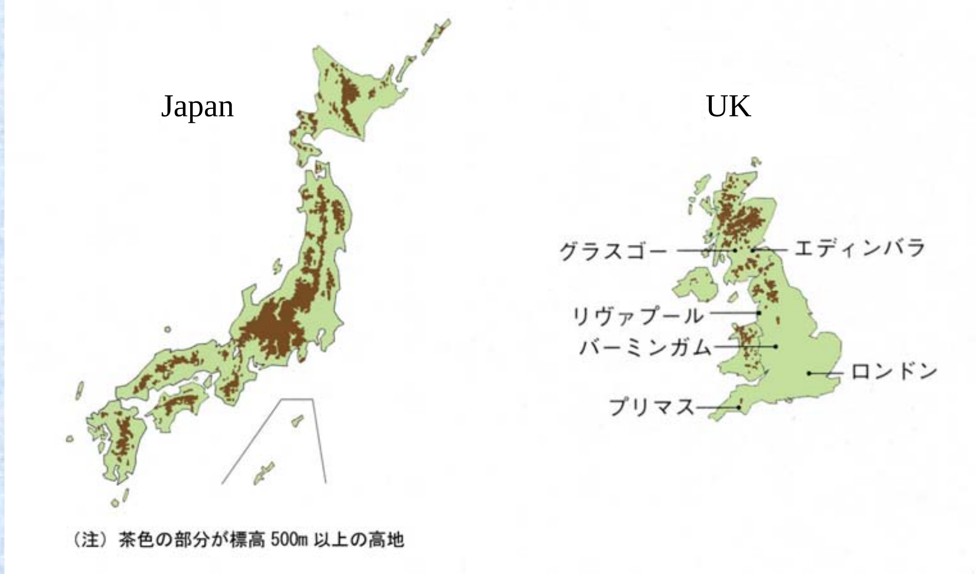

Asia Most Affected by Flood Disasters

People outlook to disasters! Can it make a difference

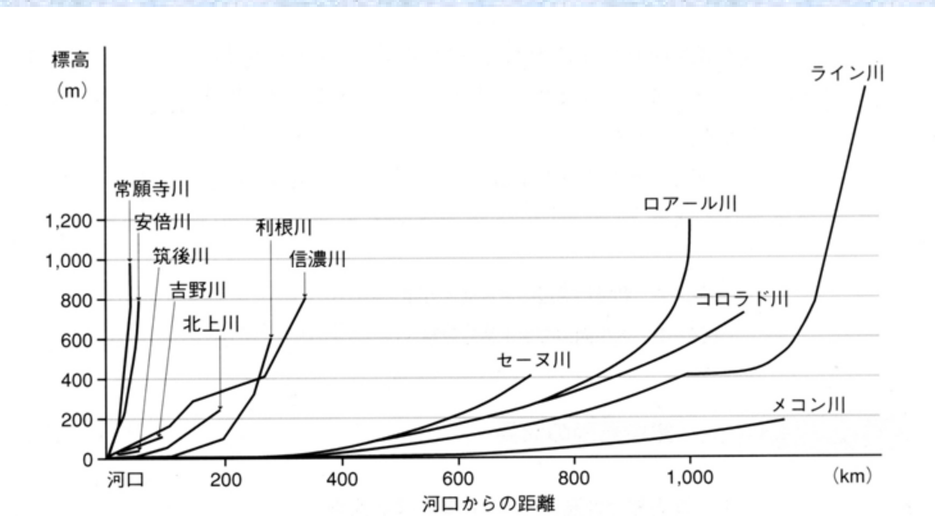


There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.

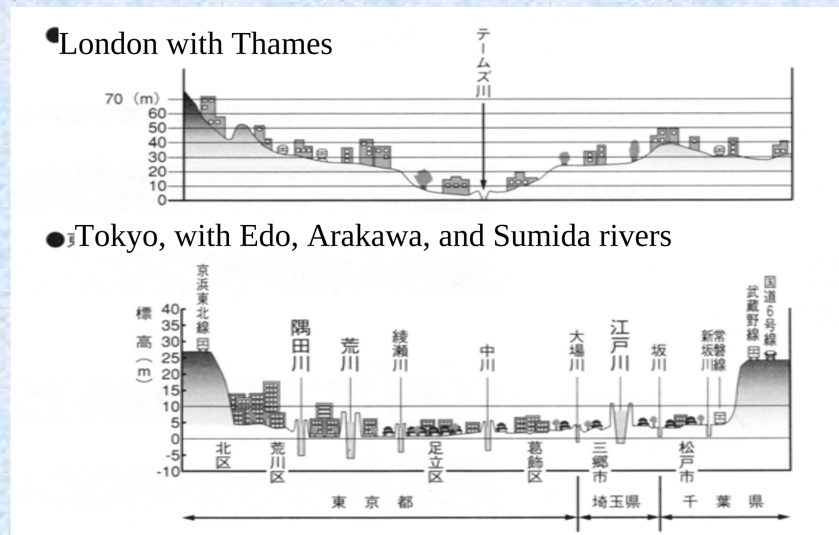
Geographical Features of Japan



Smaller area of level ground (as compared with UK)

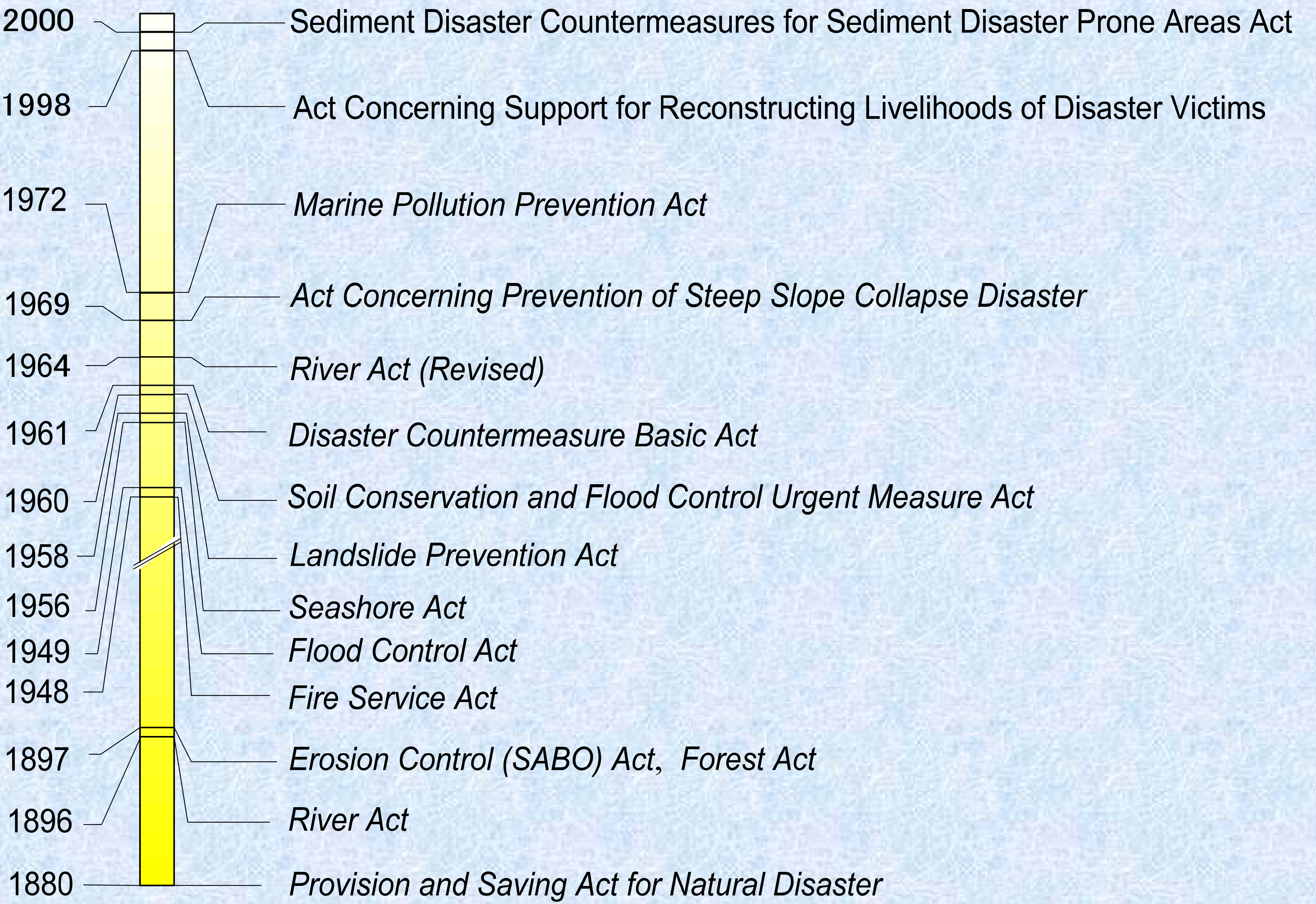


Steeply sloping rivers (in terms of longitudinal slope)



Concentration of population and properties in flood plains
(The ground levels in Tokyo and London)

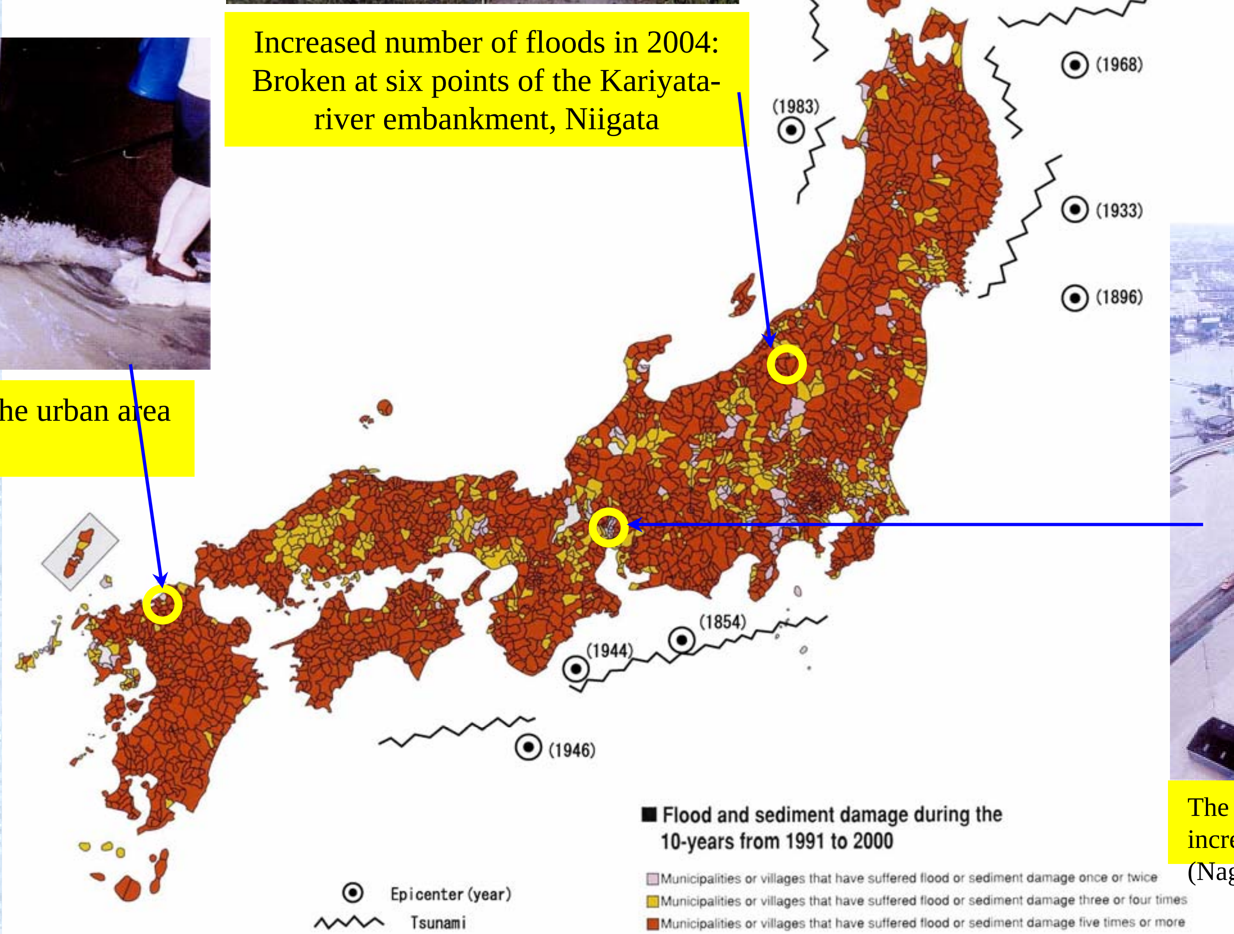
The History of Legislation about Disaster Control



Characteristics of Recent Flood Damages

Increased number of floods in 2004: Broken at six points of the Kariyata-river embankment, Niigata

Underground flood in the urban area (Fukuoka)



The urban flood disaster caused increased damage cost (Nagoya)

Overview and Characteristics of Flood Disasters

- The numbers of missing and dead and damaged houses have been reduced.

←Improvement of flood control system and weather information

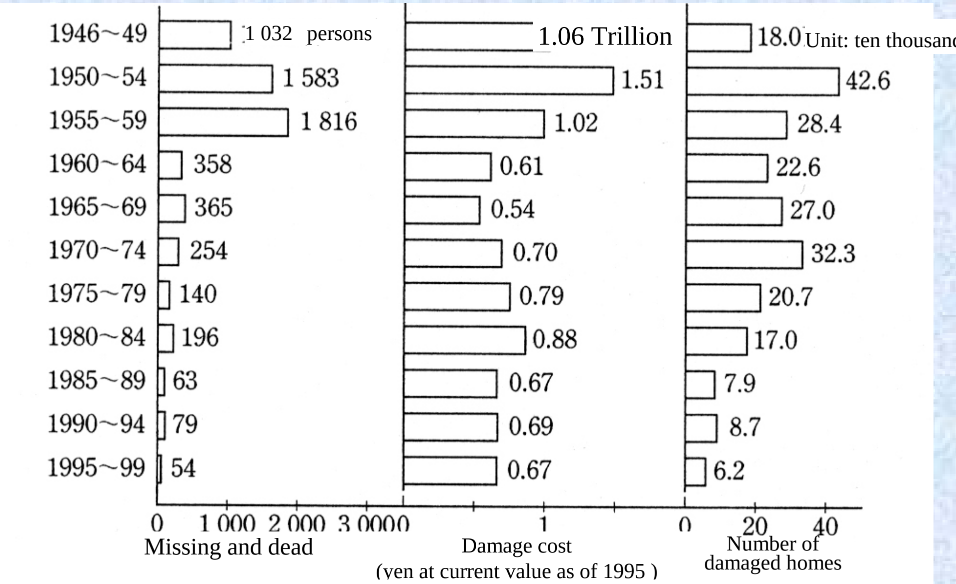
Rate of completed embankment: 38%(1976) →56%(2002)

The number of warning increased six-fold after the introduction of AMeDAS (in early 1970s).

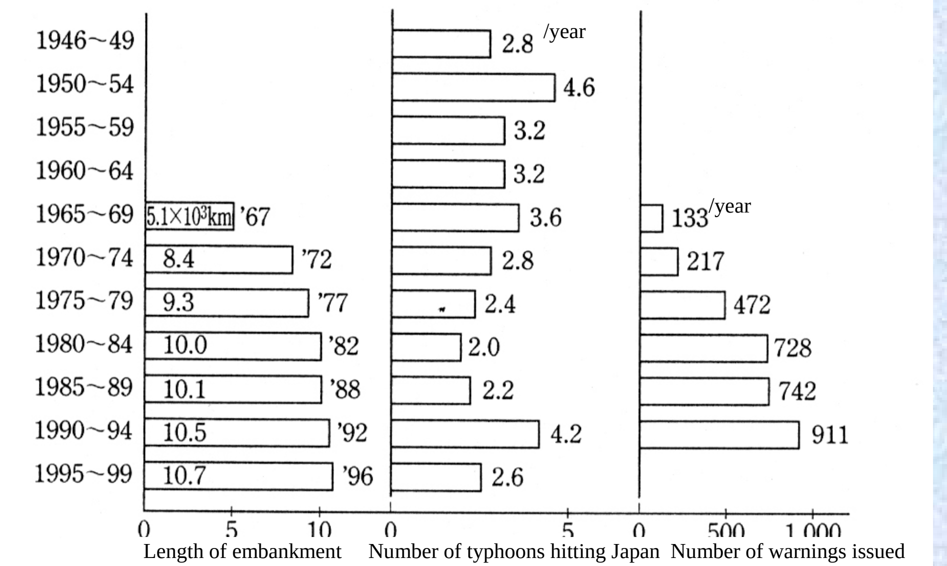
- The monetary amount of damages has remained flat.

←The area of submerged surface has decreased, but it tends to concentrate large and midsized cities.

∗ The disaster victims realized that lifeline disruption has a large impact (accounting for 1% of the damages)



(1) Year-to-year changes in damages from flood disasters



(2) Factors contributing to flood disaster prevention

Lessons from and Mitigation Measures against Flood Disasters

Water running over or passing through the embankment. → Develop and improve embankment systems

Delay in collection and distribution of information → Put rain and water gauge systems in place, and improve the information transmission systems.

No guidelines on issuing evacuation advisories, or delay in issuing. → Establish the warning water levels allowing for the rising rate of flood water level.

Improve the information transmission systems

Increased the number of elderly victims

Outline of Flood Disaster Prevention Legal System

- The Basic Disaster Prevention Planning (Revised 2002）
- The Urban River Inundation Prevention Act (2003)
- The Flood-Fighting Act (Partially revised 2005)

○The central and prefectural governments establish the assumed inundation areas, and every municipal government defines the procedures of distributing the flood information and the evacuation shelters as part of its local disaster preparedness program.

○Basin Flood Prevention Plan

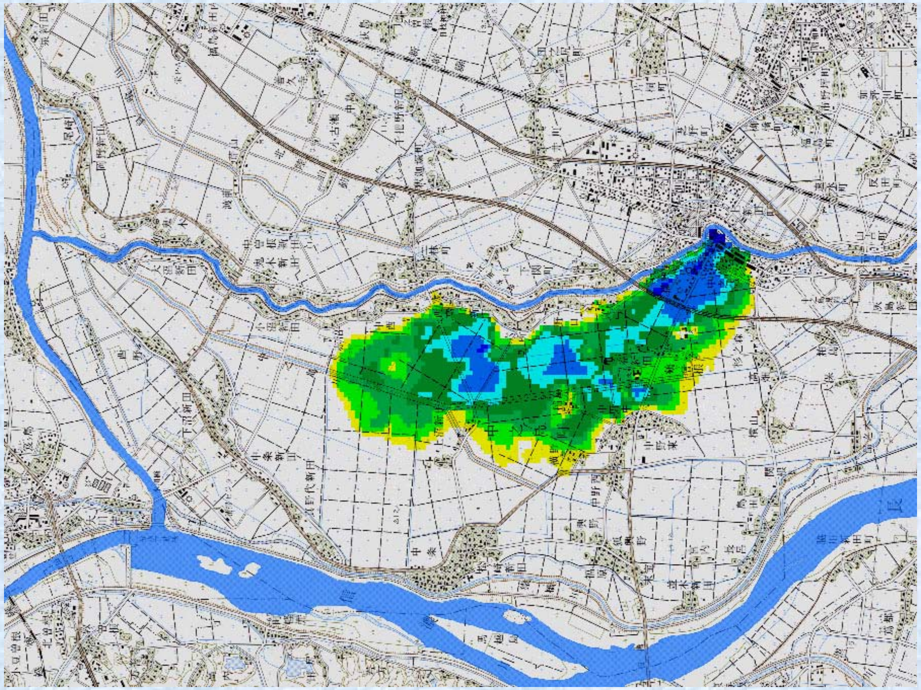
○The flood evacuation plan to be published by underground space administration

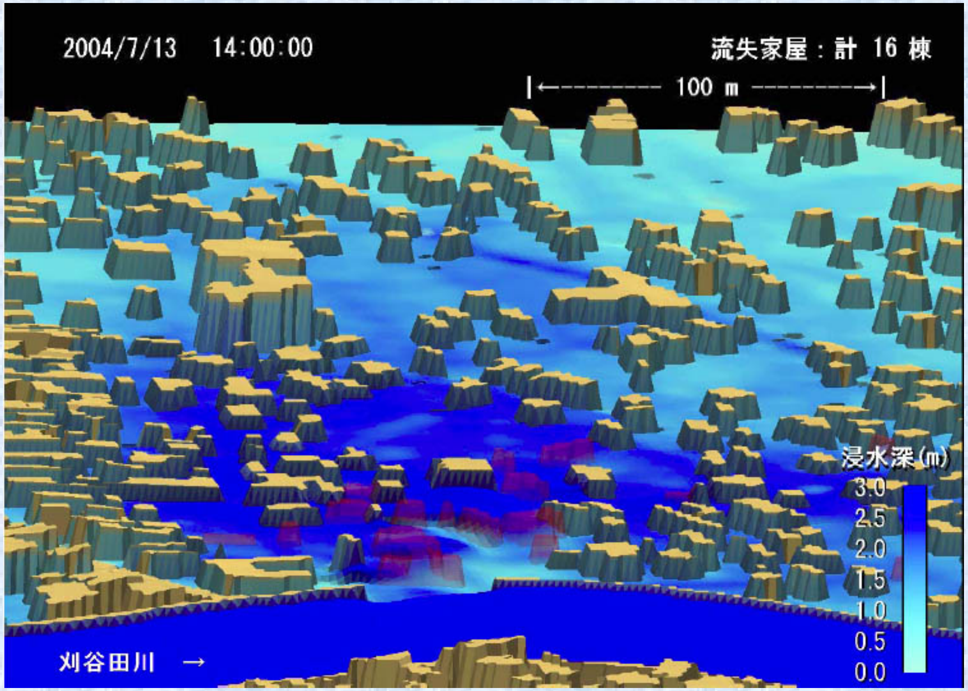
○Post-dike break inundation forecasting by the ministry of Land, Infrastructure and Transport and the Meteorological Agency

○Flood prevention activities that the designated public-interest corporations and nonprofit organizations have to take.

Enhancement of Flood Simulation Technology

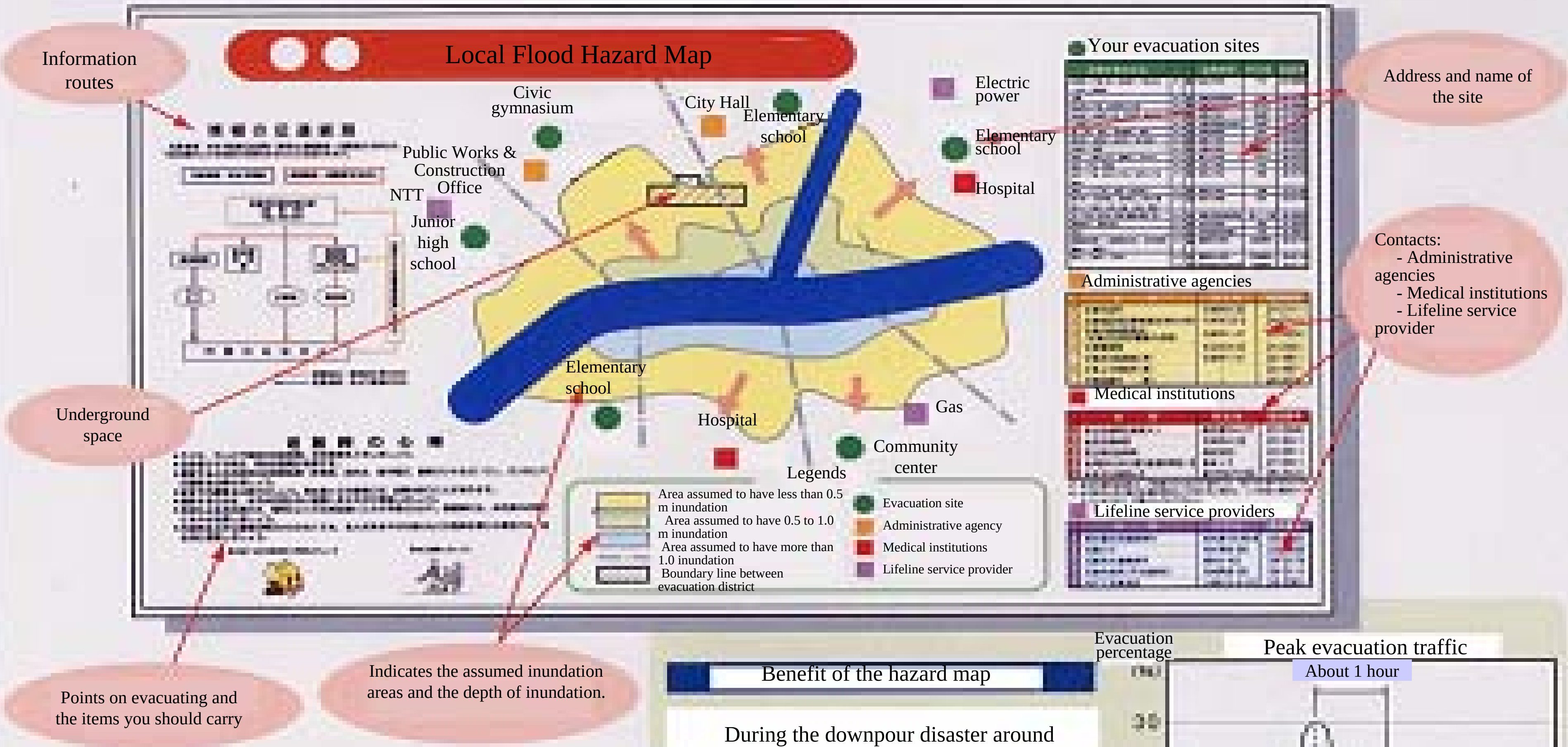
Analysis of the flood and inundation flows in combination by using the Flux Difference Splitting (FDS) Method will reveal the behaviors of inundation flow in the vicinity of the dike break spot and contribute to mitigation of damages.





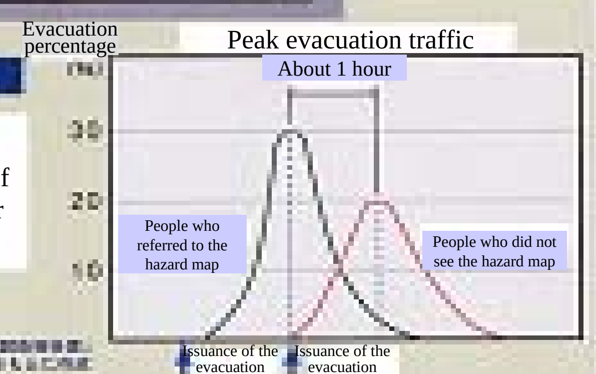
Disaster Risk Management Activities
– Flood Hazard Map -

The Flood Hazard Map indicates the assumed inundation areas and evacuation sites intelligibly, which will assist people to take speedy and reasonable evacuation activities in a disaster as well as raise their awareness about disaster preparedness.



Benefit of the hazard map

During the downpour disaster around Koriyama, Fukushima, in the late August of 1998, the hazard map proved helpful in for earlier evacuation.



Disaster Risk Management Activities
– Disaster Drills and Education -

■Training seminars for mayors

As the chief with final responsibility of disaster risk management, the local mayors have to make smart and rational judgments during a disaster. They get together regularly to take the disaster training seminar of role-playing simulation.

■Training seminars for river disaster prevention officers

Local officers for disaster prevention get together to to take the disaster training seminars of role-playing simulation for the purpose of improving their disaster risk management capabilities.

■Flood fighting training

To avert the worst-case scenario of levee break, it is necessary to reinforce the embankment in advance by flood control construction. Flood fighting workers get together to take field exercises.

■Disaster preparedness education

From the standpoint that the self-help and mutual assistance are fundamental to disaster preparedness, the administrative officers have offered disaster education to the local residents and children.

Characteristics of Sediment Disasters

Debris flow:

A mixture of earth, rocks and water moves downstream at 20 to 40 km per hour, resulting in destruction of farms and homes.

Sakurajima, Kagoshima (Sept., 1986)

Landslide:

A heap of earth on a slope moves downward slowly. It occurs in an extensive slope area at a time and carries a huge volume of earth, causing vast destruction.

Nagano (Sept., 1986)

Rock fall:

A cliff may fall suddenly during sever rainfall or earthquake. Many of the victims might fail to escape and be killed.

Minamata, Kumamoto (Sept., 1997)

Volcanic disaster:

Volcanic disaster are caused by lava flow,volcanic mudflows and pyroclastic flows and so on.

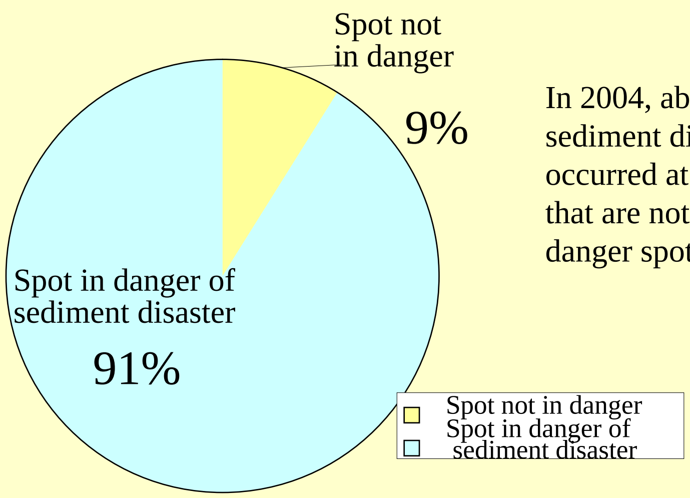
Izu-Oshima, Tokyo (1986)

Avalanche:

A large mass of snow falls down the side of a mountain, causing an extensive coverage of damage.

Obanazawa, Yamagata (1986)

Lessons from and Mitigation Measures against Sediment Disasters



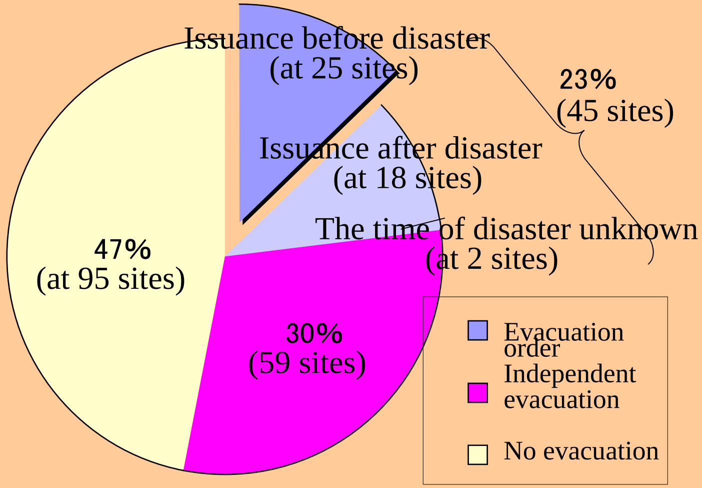
In 2004, about 10% of sediment disasters occurred at those spots that are not recognized as danger spots.

Improve the accuracy of identifying the danger spots.

Install check dams that can trap the logs more efficiently.

In the Niigata Chuetsu Earthquake, a river was blocked at several spots.

Review and revise the manual for responding to a large-scale waterway blockage.



Evacuation order was issued before occurrence of sediment disaster only at 10% of the relevant sites.

Develop the objective guidelines for issuing evacuation orders.

Responses to Sediment Disaster induced by Earthquake

One Recent Case of Debris Flow and Landslide disasters (Chuetsu Earthquake, Niigata) pref.)

EARTHQUAKE

Slope failures and landslides

River channel blockage

Emergency survey

Emergency survey

On-site emergency task force

Emergency measures

Emergency drainage

Removing the sediment blocking the river channels with heavy machinery

Transportation of materials by helicopter

Disaster Risk Management Activities

－Lifesaving of Persons from a Car Trapped under Sediment (Chuetsu, Niigata)－

The experts from PWRI were monitoring without a break until a boy was rescued successfully.
(the upper left corner on the photo)
Photo credit: Asahi Shimbun.

Course of events

Oct., 23, 2004, a large-scale slope failure occurred in Myoken-cho, Nagaoka, when the earthquake attacked the Chuetsu region,

Around 15:00, Oct., 26, a car was found trapped under sediment.

In the night of Oct., 26, the Niigata Governor asked MLIT, through the Cabinet Office, to dispatch the experts to the disaster site.

Around 12:00, Oct., 27, the experts from PWRI arrived at the site via helicopter.

・The expert from P.W.R.I checked if the site conditions allow the rescue party to start their operations.
→Operations started.
・The team determined and advised which rocks could be moved or not.
・The team continued mo[illegible]ring the operations for the safety of the rescue party .

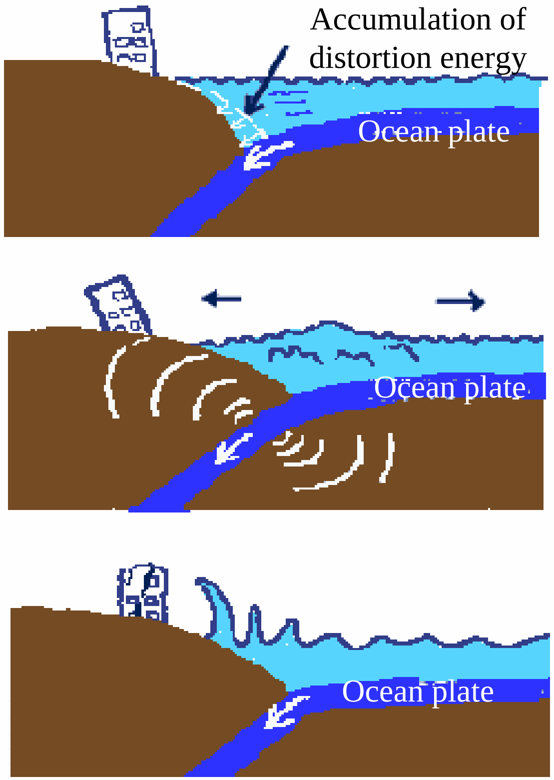
Around 14:30,Oct.,27,a boy was rescued！

The full view of the slope failure site. This disaster attacked across a 200 m long portion of the road.

The rescue operation in progress, which was carefully carried out under the continuous aftershocks.

Overview and Characteristics of Tsunami Disaster

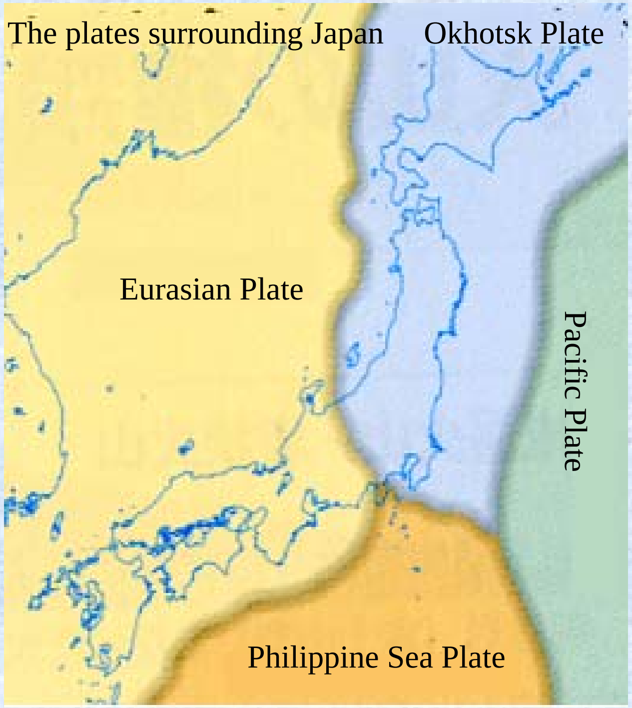
Formation of Tsunami



The distortion increases as the edge of the continental plate is dragged downward, which increases the distortion.

When the distortion reaches its limit, the end of the plate is broken away and the remaining part of the plate edge springs back up .

Upon entering shallow coastal waters, tsunami suddenly grows in height.



Data source: the Meteorological Agency

Lessons from and Mitigation Measures against Tsunami Disasters

Floating objects in coastal waters

Recovery of transportation infrastructures

Response to up flow

Disaster Risk Management Activities

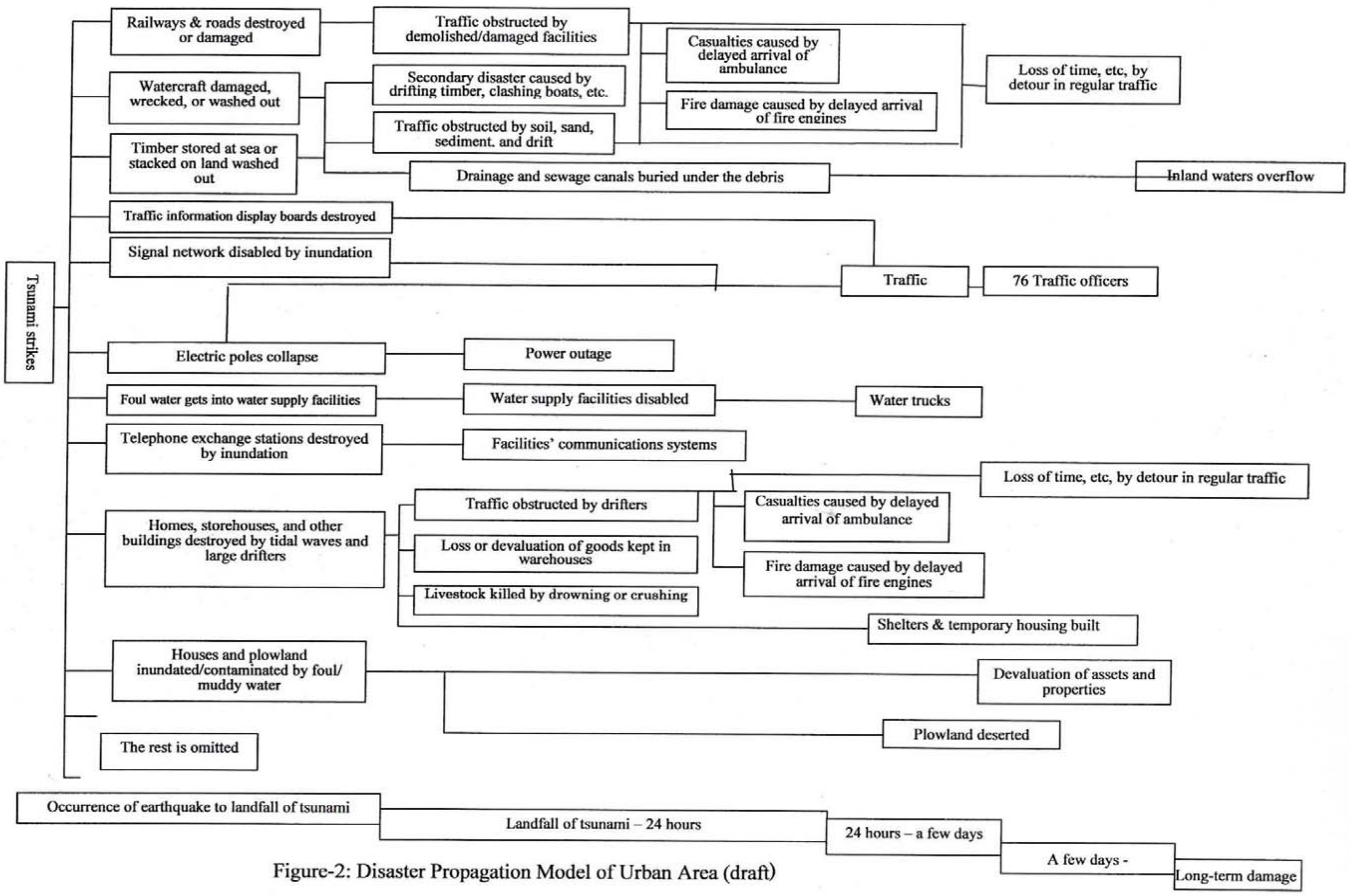


Figure-2: Disaster Propagation Model of Urban Area (draft)

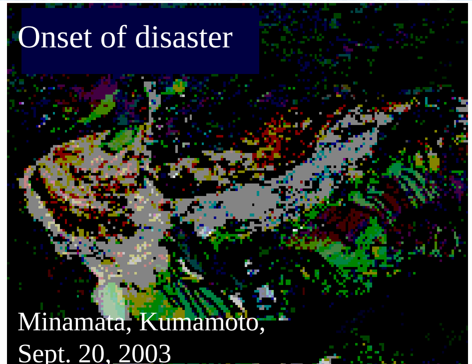
Japan's Disaster Prevention Scheme

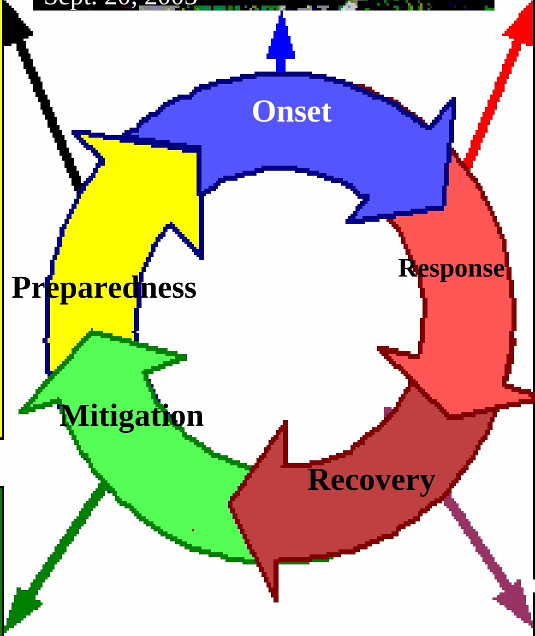
- The Japanese disaster prevention scheme consists of the four phases: Response, Recovery, Mitigation, and Preparedness.
- As part of the designated administrative system, the Ministry of Land, Infrastructure and Transport has worked on development of the anti-disaster operation plan and taken the response, recovery, and mitigation measures.

Well-planned systematic government administration of disaster prevention

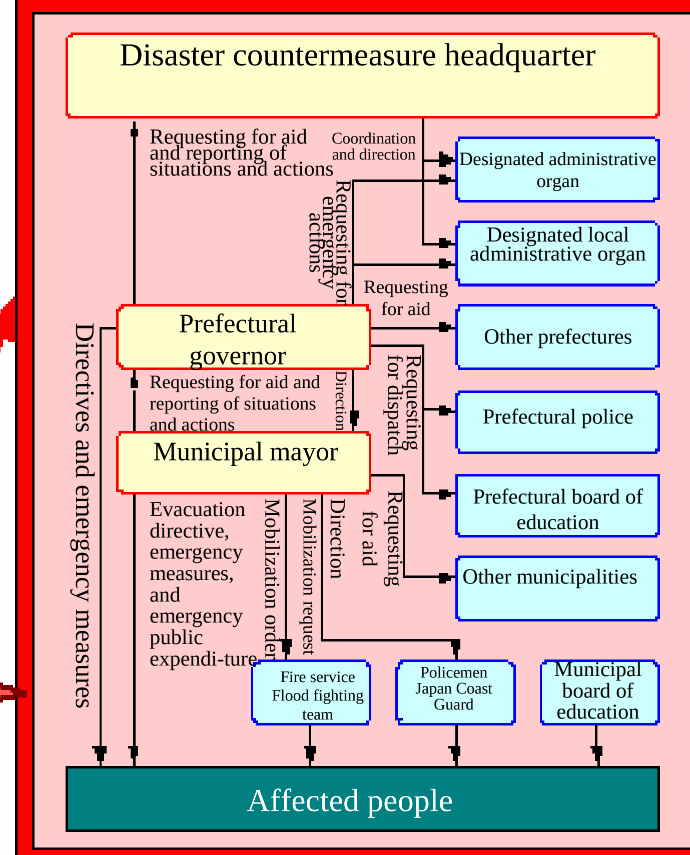
Central Disaster Management Council	Basic Disaster Prevention Planning
Designated administrative organs and public corporations	Disaster Prevention Activities Plan
Prefectural Disaster Management Councils	Basic Disaster Prevention Plan at prefecture level
Municipal Disaster Management Council	Basic Disaster Prevention Plan at municipality level

Definition of alarming areas, development of disaster prevention organization, and conduct of disaster drills,etc.





Division of roles in the emergency responses



Construction or improvement of the preventive structures

(Facilities of river management, flood prevention, coastal protection, etc.)

Financial support to the affected people and conduct of disaster restoration activities

Our Challenges for the Future

Future Directions

- To seek the best combination of structural and nonstructural alternatives for each river basin

- To seek effective scheme of involving people in decision process

- To seek appropriate role and responsibility sharing between the national gov, local gov., municipality and individuals.

COUNTRY REPORT OF CAMBODIA

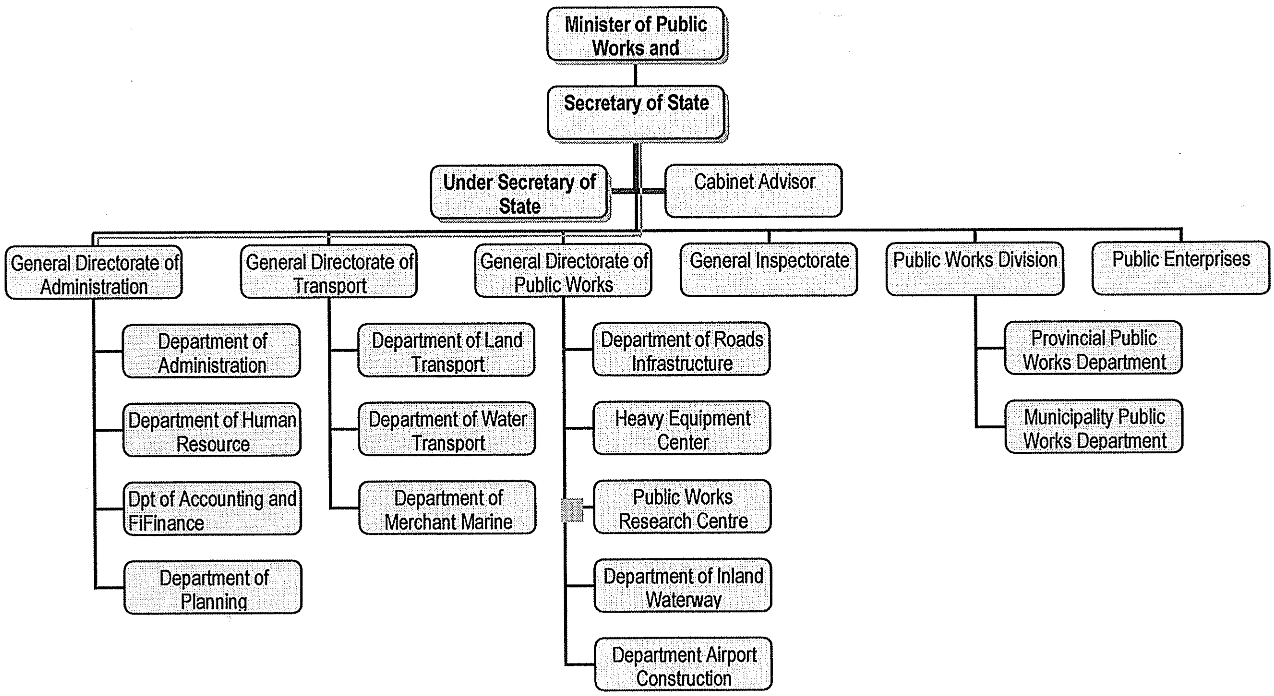
RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT DISASTER

JICA EXECUTIVES'SEMINAR
ON PUBLIC WORKS AND MANAGEMENT
JFY 2005

Prepared by Yit Bunna,
Director of the Public Works Research Centre,
Ministry of Public Works and Transport.
The Kingdom of Cambodia

Organization Data

The Ministry of Public Works and Transport (MPWT) is response for all transport infrastructure in country – roads, railways, ports and inland waterway, exclude air transport. Through a number of departments and enterprises MPWT is also responsible for the operations of, amongst others, the national railways, the river transport company, and the international port of Sihanoukville (sea) and Phnom Penh (inland waterway). MPWT's total staff is about 9,500.



Apart of General Directorate of Public Works, the Public Works Research (ex. Technical Department) - PWRC is responsible at drafting and regulating technical standards/regulation for public works and researching technology related. PWRC has several units which are Mapping, Road, Bridge, Environment and erosion protection, Traffic safety, Data Information planning system Offices, and Structural Inspection Bureau. 60 Engineering and technician staffs work in it with 3 deputy directors and director.

Personal Data

As Director and Civil Engineer background speciality, working in the field project planning and management in the Public Works Research Centre of the Ministry of Public Works and Transport during the last 25 years (since 1980). Recent works concentrated with road rehabilitation of southern part zone. With the Building and Public Works laboratory, the PWRC study on enrichment of bearing capacity of material using as sub-grade, sub-base and base course in road are assisted the rehabilitation of Cambodian road network more efficiency. Stabilization of silt clay is becoming common practice wherein southern part of country is poor of road material since the application of design study in 1994.

Lead the study of the embankment protection by using local material and local grass and enrichment of environment protection that are ongoing now in the MPWT where more than 40%

of the road networks situated in the Basin of Mekong River which flooded every year. The design road standard responding to the flooded region had been established in 2002 and had been recommended to implement to where they need.

Manage the rehabilitation of roads (southern part of country) in the Flood Rehabilitation Project and the reconstruction of 105 km of National road 1 section: Ferry Neak Loeung to Bavet Border with Vietnam to become Asian Highway Standard class 3. The scope of this reconstruction has been including rehabilitation of 5 bridges and construction of 5 new bridges (2 prestressed bridges with length 120m each), cross-drain, road furniture and others. As the highway cross the flooded area, around 4000 m of high embankment were protected by grouted riprap.

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1. INTRODUCTION

The Royal Kingdom of Cambodia extends over an area of 181,035 sq. km in the western part of the Indochina peninsula. It is located completely within the tropics with its southernmost point slightly more than 10° to 15° north of the equator between 102° to 108° east longitude. International borders are shared with Thailand and the Lao People's Democratic Republic on the west and on the north, and the Socialist Republic of Vietnam on the east and south-east. The country is bounded on the south-west by the gulf of Thailand and has a coastline of 435 km. Cambodia extends approximately 560 km from north to south and 440 km from east to west (see Fig. 1 – Map of Cambodia).

The geographically dominant features of Cambodian landscape are the large almost flat Central Plains in which lies the centrally located Tonle Sap (Great Lake) connecting with the Mekong basin and the Mekong River which traverses the country from north to south. Surrounding the Central Plains which cover three quarters of the country's area are the densely forested and sparsely populated highlands. The Central Plains, formed largely of alluvial sediment from the Mekong, Tonle Sap and Bassac rivers, are contained on three sides by the forest highlands of the Elephant and Cardamom Mountains to the west and south-west, the Dangrek Mountains to the north, and the high Chhlong - Rattanakiri plateau to the east.

The distribution of precipitation varies of the country. Average annual rainfall in Cambodia varies from 1,500 mm or less in the central plain, 1,500 to 2,500 mm in the surrounding mountains. Over most of South West coastal region, average annual rainfall in excess of 3,000 mm. The East of the Mekong River is generally between 1,800 mm and 3,000 mm. The peak of the rainy season takes place in September, and the rainfall duration the wet season (from May to October) amount to 83% of the rainfall. In the dry season, rainfall is scarcely observed especially from December to March.

The population of Cambodia is unevenly distributed, with relatively high densities in the provinces of the central plains and low densities in the provinces of the surrounding highlands. These densities range from a few to 180 persons per square kilometre depending on the provinces. The overall density of the country is 59.1 persons per square kilometre. The population is concentrated in the central plain, in the vicinity of the Great Lake of the Tonle Sap and the rivers.

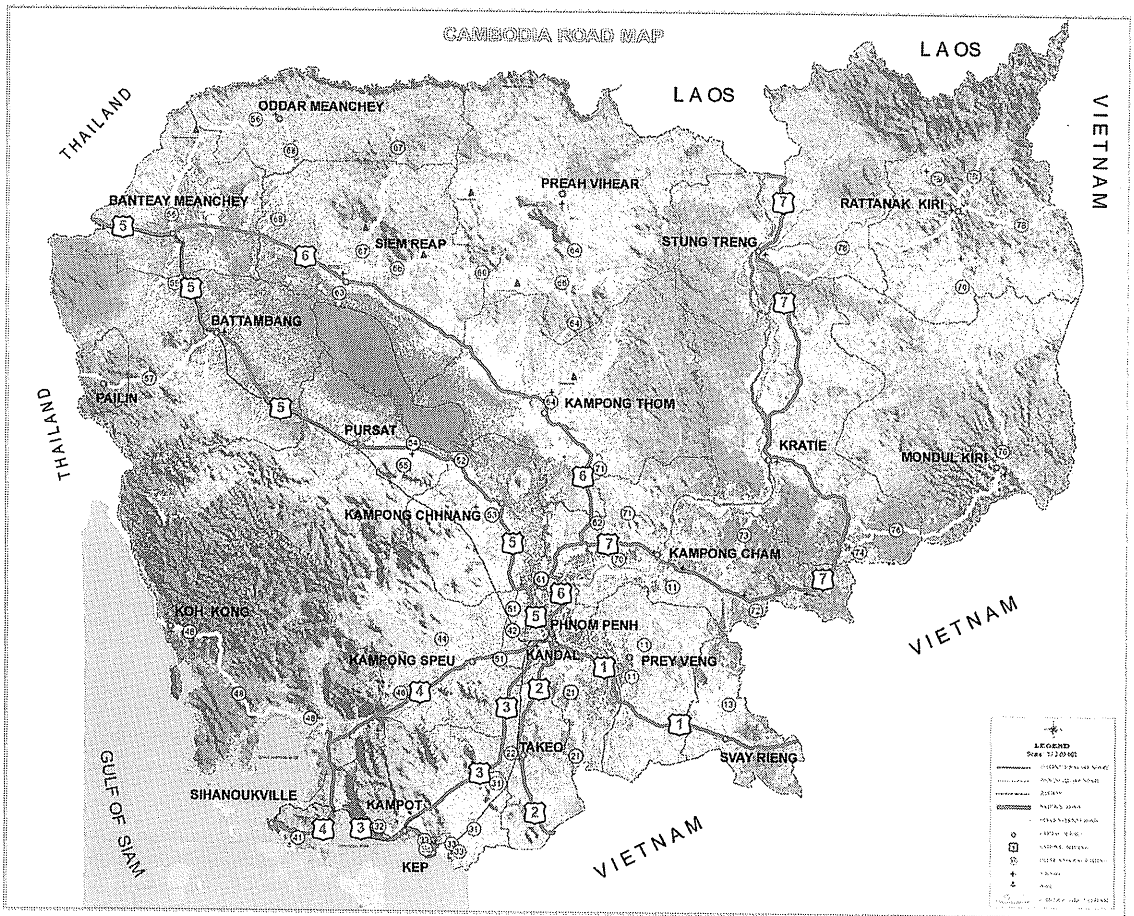


Figure 1. Map of Cambodia.

2. MEKONG FLOOD DISASTER

Apart of the lower Mekong Basin, the natural flood is critical to the sustenance over 9 million people living the plain area where the Great Mekong flow across. In recent years, there has been a marked increase in the severity of floods and droughts in country. The floods have caused severe human suffering, major disruption of social and economic life activities and serious damage to infrastructure.

2.1 The 2000 Mekong Flood Disaster

The 2000 floods in Cambodia resulted in extreme inundation of the floodplains of the Mekong, Bassac and Tonle Sap rivers. In August-September 1996 the Mekong River inundated the central plain of country and caused extensive damage to infrastructure, lasted less than two weeks, the 2000 flood started in the middle of July and continued until mid November. In 1996, the Mekong River was above emergency level for about 10 days, in 2000, the river has been well above emergency level for all of September and well into October. The record high levels of the river systems and the unusually long floods, combined with the residual impact of the 1996 floods, have seriously damaged Cambodia's infrastructure and caused the people extensive suffering as a result of displacement, food shortage, interruption of economic livelihood, and disease.

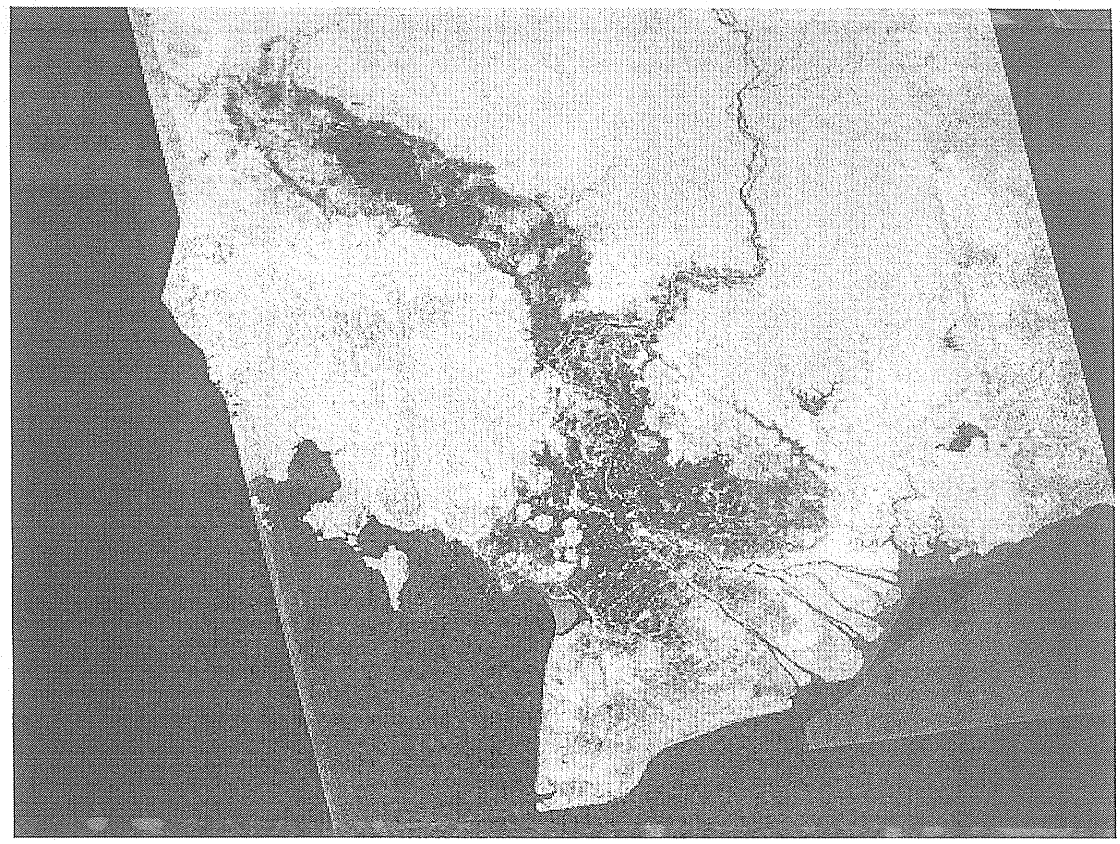


Figure 2. Satellite Photo of Sap and Mekong River Basin

About 78% of the Kandal province was inundated; over 279,000 ha of land were flooded, causing widespread damage to crops and homes. Over 59% of Takeo province was also inundated, and extensive damage was recorded in Kompong Chhnang, Battambang, Siem Reap, Kompong Thom and Kompong Cham provinces as well.

Province	**Area,ha**	**Number of Hectare inundated**			
		Dry season (Mar 16-19)	Peak flood (Sep23 – Oct 5)	Post-flood (Oct19-29)	Extensive flood area
Stung Treng	1,201,513	19,308	41,961	41,427	23,002
Kratie	1,197,280	24,544	71,434	55,645	48,406
Kompong Cham	947,392	25,458	251,388	236,882	225,930
Prey Veng	476749	11,560	263,138	278,052	266,492
Kandal	356,784	27,798	255,655	279,360	251,562
Takeo	349,174	3,263	188,498	205,528	202,265
Kompong Speu	696,470	290	471	1,706	1,470
Kompong Chhnang	528,421	14,544	185,470	185,060	170,926
Pursat	1,158,839	287	142,628	154,667	154,380
Battambang	1,245,111	2,709	310,783	324,651	321,942
Siem Reap	1,196,390	6,744	229,995	231,316	252,795
Kompong Thom	1,244,673	12,273	341,865	349,621	337,348
					2,195,135

The flood has had serious impact on human life and economic activity, because of unprecedented water levels, and their unusually long duration. About 347 people died and about 3.4 million people affected, 84,710 families were evacuated, and 7,000 houses were destroyed. The long duration of the floods meant a loss of income and drawn down of saving for many people, especially the poor and landless. The northern dike protection city Phnom Penh was in serious danger of failing for almost a month and is in a poor state after-back down of flood. It is affected also to 1,000 schools, 158 health centers in 12 provinces with serious damaged.

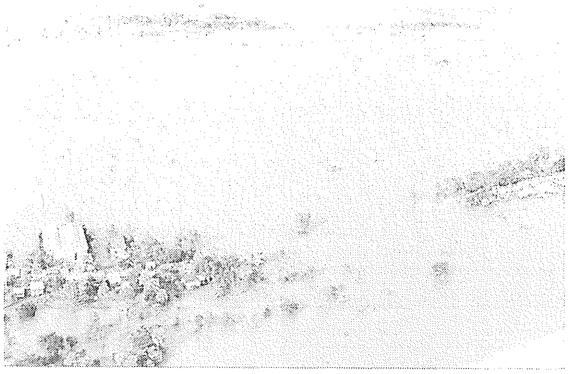
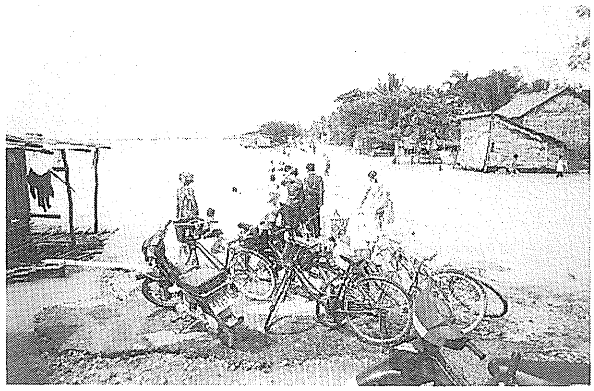



Figure 3. Disaster by the Power of Mekong in year 2000

The social impact from the worst flood 2000 has been reported by NCDM as the most economic loss among the annual cycle flood in Cambodia. The estimate cost of damage for all sectors is about USD 156,655,456.00. The impact by sector in value is estimated as follow:

- Agriculture damage cost USD 66,550, 153
- Social not estimated
- Education USD 15,200,000.00
- Health USD 693,000.00
- Rural Development USD 10,876,384.00
- Water resource USD 16,714,734.00
- Public works and Transport USD 46,621,385.00

2.2 Flood and Road Infrastructure Disaster

2.2.1 Critical level of Mekong

All the stations along the Mekong River from upper province (Stung Treng) to lower part border with Vietnam (province Kandal) had been recorded and warning all of people and authorities to take measure against or evacuation animal and people from the critical location where the inundation was serious. On 21 September 2000 at the station measured in front of the palace Royal Palace was reached 11.20 m (critical level to alert was 10.18 m). This record surpassed the level water in 1961 and 1996.

2.2.2 Disaster situation of road infrastructure.

Severe flooding of the year 2000 has caused major damage to part of the primary road network mainly in the north-eastern, southern, and western part of the country. Although much of the western and southern parts of the country are still under water until November which habitual the flood receded after October, It is estimated that about 1,800 km of national roads and about of

820 km of secondary, provincial town, and riverbank roads has been serious damage. About 3,025 m of bridges have been destroyed and badly damaged. Of the road impact, 57 percent of the laterite roads and almost 100 percent of earth-fill road around the Mekong and Sap River were damaged to various degrees and 60 percent were washed out by flood.

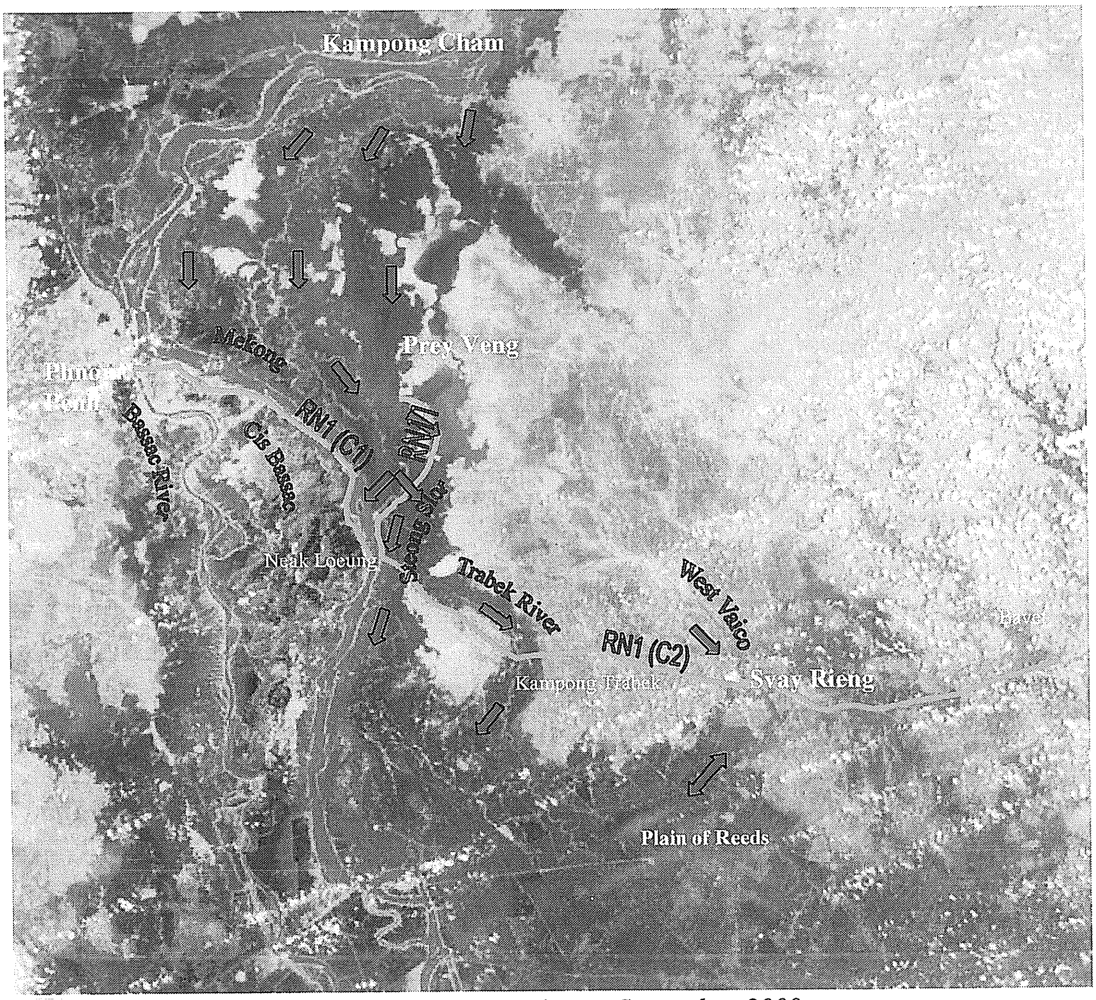


Figure 4. *Inundation of Southern Part during September 2000*

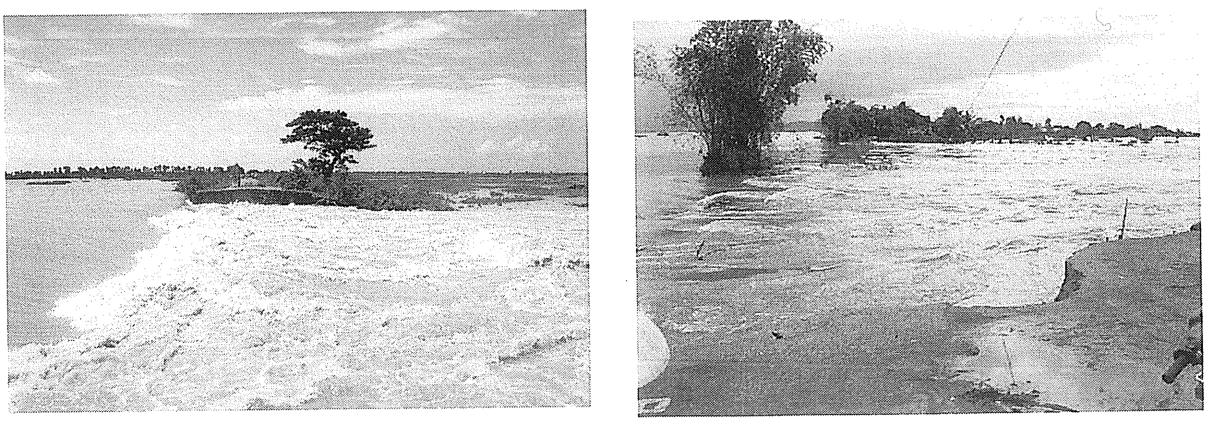


Figure 4a. *Road washed out by Flood*

3. FLOOD MITIGATION IN ROAD INFRASTRUCTURE

3.1 Hydraulic Mechanisms of Flood Damage (Embankment Overtopping, Erosion and Breaching)

River flows and floods are classified as 'open channel hydraulics', that is the water surface is free to the atmosphere. In open channel flow 'specific energy' remains constant, unless there is some destruction or loss of energy. This means that as water flows past a constriction it must accelerate with a corresponding reduction in depth so that the specific energy is preserved. A road embankment when it is overtopped behaves like a weir. A weir is always a 'critical depth' hydraulic control. Water at some point on the weir passes through critical depth to accelerate from subcritical flow upstream to supercritical flow downstream. Under most conditions the flow will become subcritical again downstream at a hydraulic jump, or depending on conditions, a flow disturbance. Because the elevation of the water surface downstream of a weir is usually less than it is upstream there must be a reduction in specific energy. This explains the hydraulic jump or flow disturbance; where the energy is dissipated through turbulence, heat generation, and erosion of the channel. When the flow is over a wide weir like a road embankment into a reservoir like the flooded area downstream of RN11, the hydraulic jump forms on the downstream slope of the weir.

These changes in flow conditions are the mechanism for erosion and breaching of the RN11 embankment, Figure 5. The faster water moves the greater its sediment carrying capacity. Flow will entrain sediment from the channel bed until it satisfies its potential sediment transport capacity. So water accelerating over the upstream slope of an unprotected road embankment and then flowing even more rapidly over the downstream face will quickly scour soil particles and erode the slopes. This is compounded by the hydraulic jump, which dissipates energy by turbulence and further scouring of the embankment slope.

Figure 5. Mechanism of Erosion and Embankment

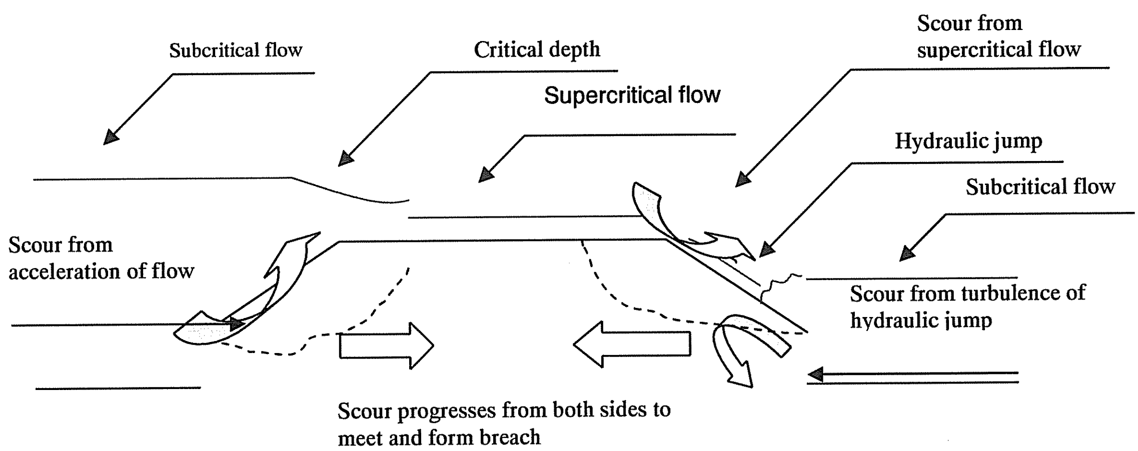
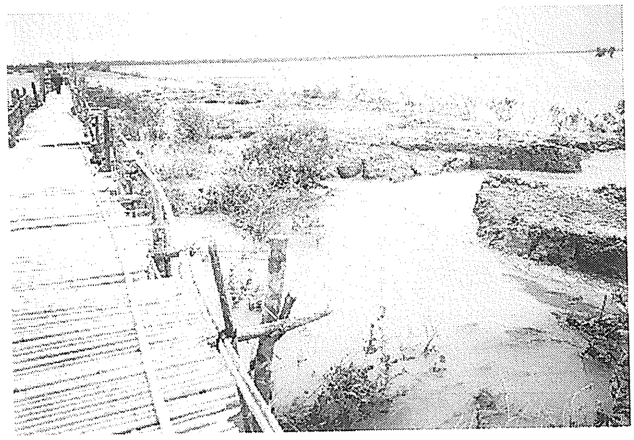


Figure 5a

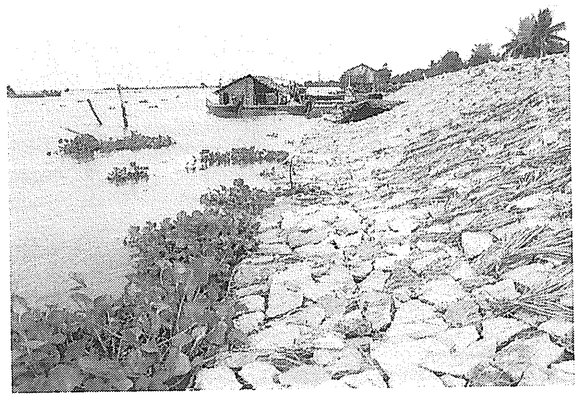


An embankment breach results when overtopping flow continues at sufficient volume for sufficient time. Under such conditions the erosion from upstream and downstream eventually meets and this opens a channel that quickly widens and deepens because of the force of the flow. The breach will eventually stabilise as water levels drop.

An embankment can be made more resistant to erosion from overtopping by slope protection. Basically slope protection helps the underlying fill resist greater flow velocities. Slope protection may variously include vegetation, bitumen sprays, or revetments in stone, gabions or concrete. A sealed road will be more resistant to breaching than a gravel road. Kerbs or edge beams will also significantly improve protection against erosion.

Figure 5b

Floodway, built for overtopping flown water

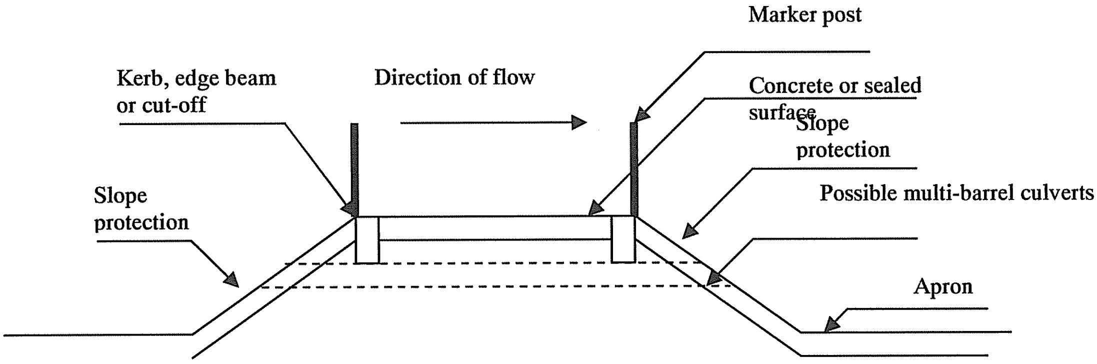


Embankment protection by gabion mattress

A more economical solution is to allow the floodwater to overtop the embankment at discrete location designed to act as 'spillways' or 'floodways'. This would mean there would be sections of low embankment that would flood first. The disadvantages of this include slowing traffic flow, and when the water becomes deep, interrupt of traffic flow.

The features of a typical floodway are shown in Figure 5.1. These can include: a concrete or sealed road surface; edge beams, kerbs or cut-offs; slope protection; downstream scour protection apron; depth boards and marker posts for safety; optional culverts to allow cross flow before the floodway becomes submerged. Obviously the more of these features that are incorporated, the greater will be the cost of the floodway.

Figure 5.1 Typical Features of a Floodway



Ultimately the decision on whether or not to use floodways is a choice between risk and economy, bearing in mind that even a rudimentary floodway, which may fail in an extreme flood, will significantly reduce the risk and consequent cost of more extensive damage to the road.

3.2. Road Design (Embankment) Level

Most of the roads infrastructure had not been design to meet high water level as in year 2000. It has widely reported that the 2000 flood was 1 in 70 years or 1.4% probability of occurrence event (source from Ministry of Water Resources and Meteorology –MOWRAM). All primary roads infrastructure that conduct the main communication of the socio-economic network of Cambodia are lying in the plain area, around the principal rivers and considering as dike protection during the flood season. The low road- embankment designed from the past were overtopped and breached and some structures could not resist the huge intensity of flood and damaged occur the receded water in October. The reconsideration design level for the structure and road should be accommodating against the mechanism destructive of the flood.

However, the Ministry of Public Works and Transport still consider for the minimum design levels for the vertical alignment on predicted flood levels such that the edge of the finished shoulder would be at least at the elevation of the 1 in 10 year or 10% probability of current event, or no less than the 1 in 50 year or 2% probability of occurrence event.

The 1 in 10 year and 1 in 50 year flood levels were estimated from the annual series for peak river stage at Phnom Penh, correlated to the shorter record for the stage gauge at Neak Loeung or at any station close to the area of road will be considered and upon systematic field measurements and levelling of the 1996 flood.

4. RISK MANAGEMENT IN ROAD INFRASTRUCTURE

4.1 General Response to the Flood

The National Committee for Disaster Management NCDM, under the chairmanship of the Prime Minister had been directing and coordinating relief efforts from the start. The focus has been primarily distributing food, blankets and medicines and providing shelter for this placement. Close coordination has taken place through regular meeting between the government, the funding community (co-chair by the United National Development Program and World Food Program (WFP)) and the Cambodian Red Cross. Line ministries have been charged with damage assessment. Priority is given to the restoration of road communications through the national road network where affected by the flood.

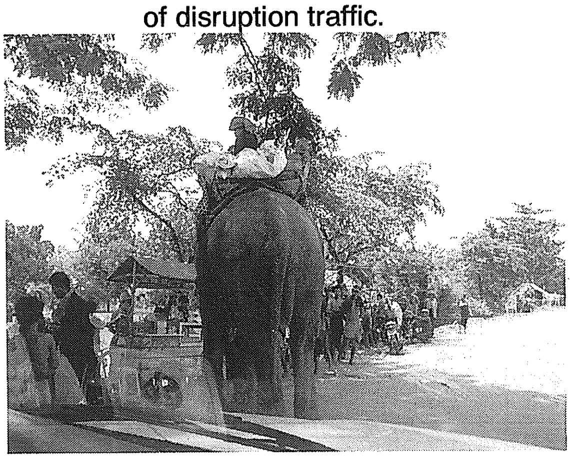
Apart of working effort of NCDM, the government set up a coordinating relief core group that joined by international community as International Federation of the Red Cross and UN Disaster Management Team to close work on emergency relief assistance, food security, health and water sanitation, small scale infrastructure, and data collection and dissemination.

4.2 Improvement Plan

Against the Periodical flood and probability risk to the transport communication, MPWT has improved some action plan as follow:

- **Collection disaster information**. The built update data of disaster flood on road infrastructure and it is the first step to plan of recovery communication access after the power of Mekong recede it action and will useful for recommendation in the rehabilitation phase.
- **Inspection and survey**. It is habitually done 2 times a year: before and after the rainy season (flood time). During the flood time the routine patrol for the critical section and where the flood reach the freeboard design level is important to inform and prevent the people of evacuation to safe area.

- **Evacuation**. Many section of road in the flood basin are considering as evacuate place for the animals and people from the villages nearby. At the critical level of Mekong, MPWT shall arrange and warn the transporters and road users of possibility of disruption traffic.



- **Upgrading the safety of inland waterway transport.** Traditional mode transport as handmade boat, wooden vessel had been playing the first mean to access anywhere at any direction during the flood period. However the life-safety is under-satisfaction and risk in use but emergency needed. It is request to train the users on how to safe themselves across the inundated plain and river. The information of river-way and it expansion should be access to all local and intercity vessel.
- **Public Warning information**. At the critical level of Mekong, MPWT shall arrange and warn the transporters and road users of possibility of disruption traffic or reduce it by the tentative section which road will soft and possibility in critical situation. It is not only for the security of the road communication in flood areas, MPWT staff will and keep inform people along the road about water level information which dispatch by MOWRAM, NCDM and by Television and radio broadcasting.
- **Education and Training**. Provincial Rescue group with participation of people in the flood area will be the trainers to people in the remote areas how to be on-time evacuate their families and animal to high land.

COUNTRY REPORT OF INDIA

Risk Management and Mitigation for Flood

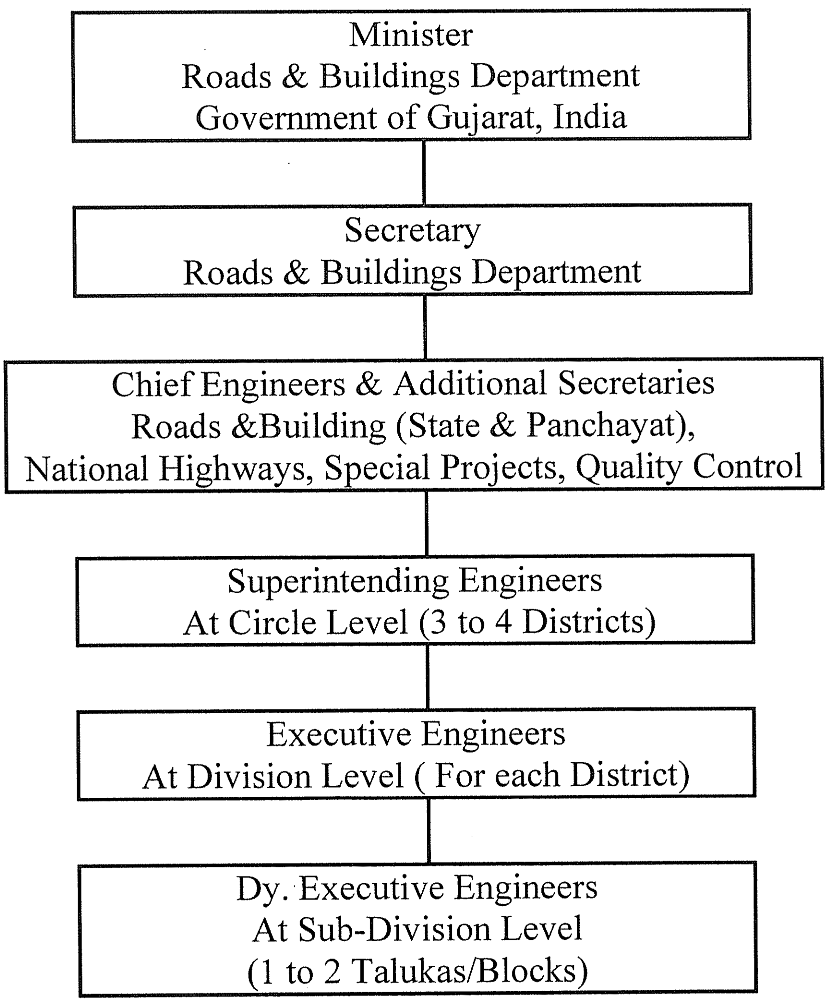
JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

YEAR 2005

Prepared by Mr. J.J.Siyani
Chief Engineer & Additional Secretary,
Roads & Buildings Department, Government of Gujarat,
India

1. Organization Data:

The author is working as Chief Engineer (R&B) and Additional Secretary in the Road & Buildings Department of Government of Gujarat. The Roads & Buildings Department has annual budget (Plan & Non-plan) is Approx. Rs.18 Billion. He looks after the construction & maintenance of Roads, Bridges and Government Buildings. Six circle offices and three specialized circle offices of mechanical, electrical and designs are reporting to him. Executive Engineers are reporting to circle and Dy. Executive Engineers are reporting to the Executive Engineers. Gujarat state is situated in the western part of India. Geographical location of the state is highly vulnerable to natural disaster like Earthquake, Cyclone, Flood and Tsunami. Therefore, role of the Roads & Building Department is very crucial for management of public infrastructure and life line structures. The organizational setup of Roads & Building Department is as under:



2. Personal Data:

(I) Recent Work:

Presently, I am holding the post of Chief Engineer & Additional Secretary in the Roads & Building Department Government of Gujarat, India. The core functions and responsibilities are as below:

- Development and maintenance of Highway network & Government buildings in Gujarat State (Network comprises of 18,768 Kms & buildings being 10,497 in numbers)
- Rehabilitation & Repair works for Buildings damaged in the earthquake
- Retrofitting of Buildings in earthquake zone IV& V
- Immediate Restoration work for Flood affected roads & buildings
- Permanent Restoration work for Flood affected roads & buildings
- Matters related with State Legislative Assembly
- Caring Administrative matters

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3. Risk Management and Mitigation for Flood Disaster

Abstract

This country report "Risk Management and Mitigation for Flood Disaster" highlights the present scenario of flood disasters in India. This report states structural and non-structural measures for mitigation of flood disasters. During recent flood occurrence in Gujarat and Maharashtra (Western Indian states) suffered loss of lives and large scale damage to the property. Administrative mechanism to mitigate flood disaster has been addressed briefly in this report.

Introduction

Most part of the Indian landmass is prone to several natural disaster like flood, cyclone, earthquake, tsunami and landslides. Severe floods occur almost every year in one part of the country or the other causing loss of life, large scale damage to property and untold misery to millions of people. Indian subcontinent has major river basins such as Ganges, Brahmputra, Narmada, Godavari, Krishana, Cauveri, basins in North West Region etc. Every year country faces flood disasters in those basins and also experiences flash flood in localized area due to heavy rain and cloud bursting. Recent flood in the Gujarat and Maharashtra, put further challenges to disaster mitigation and risk management. Photographs of these recent floods are presented in Plate 1 & Plate 2. River floods caused primarily due to the peculiarities of the rainfall in the country. These flood are the most frequent and often the most devastating disaster in India. About 40 million hectares of the land in the country are subjected to floods and an average 18.6 million hectares of the land are affected annually.

Flood mitigation methods include both structural and non-structural. The structural measures like dams, embankment, flood walls, channel improvement, drainage improvement, diversion of flood waters have been widely used in the country. Non-structural measures are aimed at modifying the susceptibility to flood damage as well as modifying loss burden. These consist of flood forecasting and warning, disaster relief, flood plain management measures like flood plain zoning and flood proofing including disaster preparedness.

In this regard, institutional mechanisms has been evolved for multi hazard disaster management. Ministry of Home Affairs have initiated National Disaster Risk Management Programme in all the flood prone States. Assistance is being provided to the States to draw up disaster management plans at the State, District, Block/Taluka and Village Level. Awareness generation campaigns to sensitize all stakeholder on the need for flood preparedness and mitigation measures are being undertaken.

3.1 Present Status of Flood Disaster

Nearly 75 per cent of the total rainfall is concentrated over a short monsoon season of four months (June to September). As a results the rivers witness a heavy discharge during these months, leading to widespread floods. The problem of flood is compounded by sediment deposition, drainage congestion and the sychronisation of river floods with sea tides in the coastal plains.

The rivers originating in the Himalayas carry a large amount of sediment, causing erosion of the banks in the upper reaches and over-topping in the lower segments. The most flood prone area are the Brahmaputra, Ganga and Meghana basin in the Indo-Gangetic-Brahmaputra plains in north and northeast India, which carry 60 per cent of the nation's total river flow. The Ganga-Brahmputra-Meghna basin is one of the largest in the world. About 47 percent of India's population resides in the Basin. The other flood prone areas are the northwest region of the west-flowing rivers like the Narmada & Tapti and Central India and the Deccan plateau with major east-flowing rivers like the Mahanadi, Krishna and Cauvery.

Around 40 million hectares of the land in the country are subjected to floods and an average of 18.6 million hectares of land are affected annually. The annual average cropped area affected is approximately 3.7 million hectare.

The annual average flood damage based on the data from 1953-1994 is as follows:

- Land area affected ---- 7.56million hectare.
- Population affected ---- 32.03 million
- Human lives lost ---- 1,504
- Livestock lost ---- 96,713
- House damaged ---- 11,683
- Crop damaged ---- Rs. 4.6 billion
- Public utilities damaged ---- Rs. 3.77 billion

3.2 Structural Measures for mitigation of flood disaster

The general approach to tackle the problem of floods in the past has been in the form of physical measure with view to prevent the flood waters from reaching potential damage centers. The approach has its ancient origin and tradition in country, because flood protection embankment have been extensively constructed in the Godavari, Krishna and Cuavery Deltas in South India and also in some areas of Indo-Gangetic plain.

The main thrust of the flood protection programme undertaken in the country so far in the form of structural measures may be grouped into the following:

- Dams and Reservoirs
- Embankments, Flood walls, sea walls
- Natural detention basin
- Channel improvement
- Drainage improvement
- Diversion of floodwaters.

A number of multipurpose reservoirs like Narmada, Ukai, Bhakra, Hirakund, etc constructed under the programme of water resources development provided flood control benefits through durable regulation.

3.3 Non-structural measures for Flood Disaster Mitigation

The non-structural measures of flood disaster mitigation aims at reducing damage, as well as modifying loss burden, this consists of:

- Flood plain management measures like flood plain zoning and flood proofing including disaster preparedness.
- Flood forecasting and warning
- Disaster Relief
- Flood fighting including public health measures
- Flood insurances etc.

Flood Plain Management and Zoning

Flood Plain Management is aimed at regulation of land use in the flood plains in order to restrict the damage due to floods. Areas likely to be affected by floods of different magnitude/frequencies are identified and to develop those areas in such a fashion that the resulting damage is minimum in case the floods do occur. Flood plain zoning, aims at disseminating information on a wider basis so as to regulate indiscriminate and unplanned development in flood plains. All developmental activities in flood plain must be compatible with the flood risk involved.

Flood Proofing

Flood proofing measures which help greatly in mitigation of distress to the population in flood prone area were also taken up in a few places. One of these measures consist of providing raised platform for flood shelter for and cattle and raising the public utility installation above flood levels. A programme of raising of a few flood prone village above pre-determined flood level and connecting them to nearby road or high land was taken up mainly in Uttar Pradesh and some places in West Bengal & Assam.

Flood Forecasting and Warning

Flood forecasting and warning in India was commenced in small way in the year 1958 with the establishment of a unit in the Central Water Commission (CWC), New Delhi for the flood forecasting of the river Yamuna at Delhi. This has now grown to cover most of the flood prone interstate river basin in the country. This organization is presently responsible for issuing flood forecasts at 157 stations of which 132 stations are for water stage forecast and 25 for inflow forecast. Hydrological and hydrometeorological data from nearly 100 hydrological and 600 hydrometeorological stations, respectively in these rivers being collected, analyzed and forecasts issued for the benefit of State Governments and Union Territories. The various Flood forecasting stations are using different forecasting method, based on availability of hydrological and hydro-meteorological data, basin characteristics, computational facilities available at forecasting centers, warning time required and purpose of forecast.

3.4 Political Administration and Planning for mitigation of flood disaster.

Central Water Commission (CWC) carry outs flood forecasting activities throughout country. The final forecasts are then communicated to the concerned administrative and engineering authorities of the State and other agencies connected with flood protection and management work on telephone or by special messenger/ telegram/ wireless depending upon local factors like vulnerability of the area and availability of communication facilities etc.

On receipt of the flood forecast the above agencies disseminate flood warning to the official concerned at Central & State Governments and people likely to be affected and take necessary measures like strengthening of the flood protection and mitigation works and evacuation of the people to safer places etc., before they are engulfed by floods. As a pre-monsoon arrangement, the relief materials are already stocked at appropriate places and distribution measures are initiated to mitigate the miseries.

Recently Ministry of Home affairs Government of India has constituted a Committee to develop Model Building Bye Laws and review of City, Town and Country Planning Act and the Zoning Regulation. It states about identification of flood prone areas in river plains using the Flood Atlas of India prepared by CWC and reproduction of larger scale state wise maps in the Vulnerability Atlas of India. Also, for areas flooded under heavy intensity rains, inundation in depression, back flow in drains, inadequate drainage, failure of protection work etc. Wherein recommendation were made on Land use zoning for Flood Safety. It states preparation of flood contour maps and regulation for land use zoning.

3.5 Conclusions

Flood is one of the devastating natural disaster, which occurs more frequently. For developing country like India, careful planning is essential to mitigate this disaster, so that loss of life can be avoided and property damages can be minimized. A judicious mix of structural and non-structural measures has to be the basis for formulation of flood management strategy which must also be economically, socially and environmentally acceptable.

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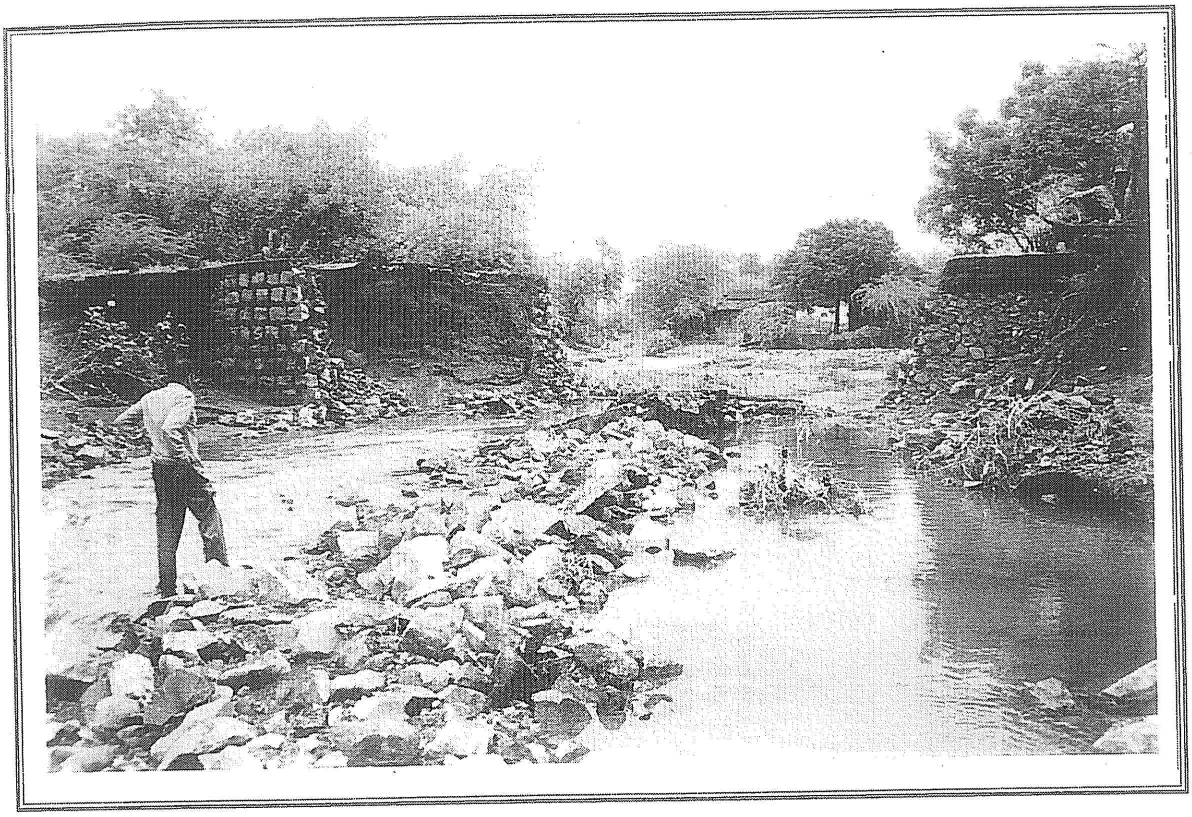
REFERENCES

1. Disaster Management Plan (Flood Memorandum-2005), Flood Control Cell, Narmada, Water Resources, Water Supply & Kalpsar Department. Government of Gujarat, 2005.

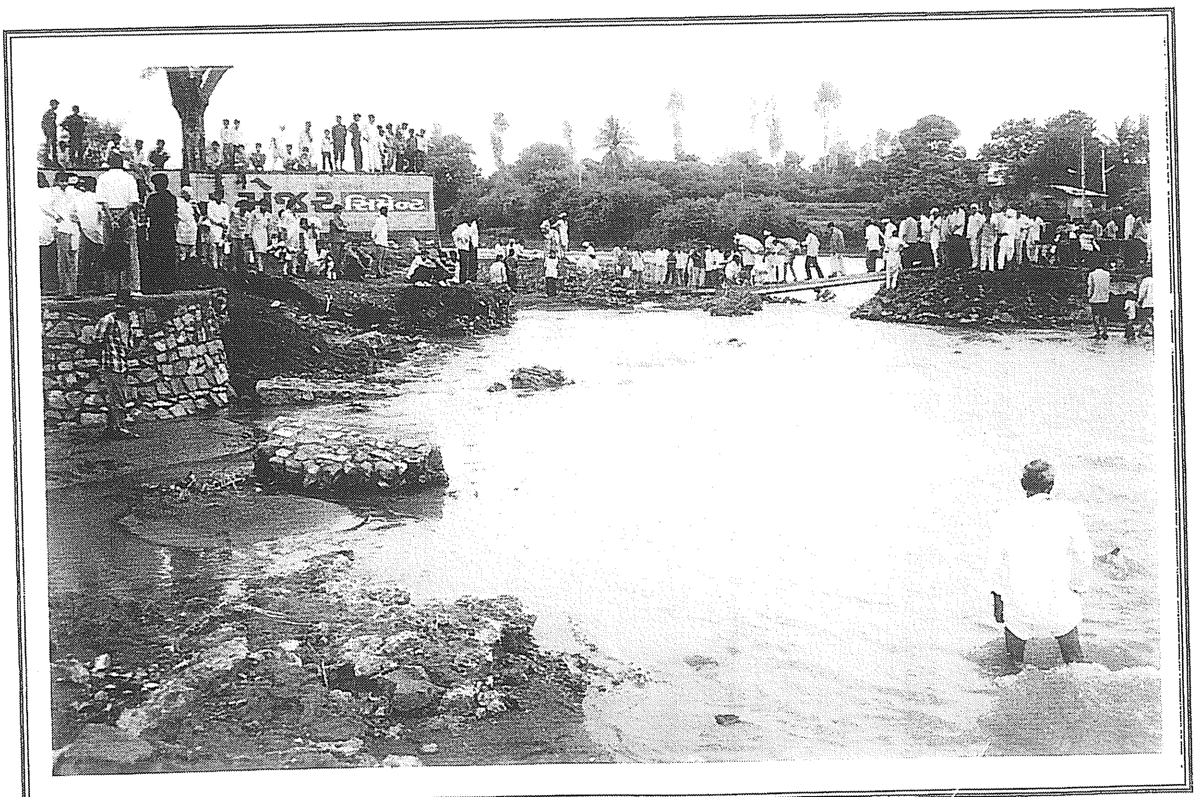
2. Proposed Amendment in Town and Country Planning Legislation, Regulations for Land Use Zoning by Committee of Experts constituted by Ministry of Home Affairs, Government of India, September, 2004.

3. Guidelines for Flood Disaster Risk Management Programme prepared by GSDMA &UNDP, Government of Gujarat, September, 2004.

4. Flood Control Operation Policy for Ukai Multi-Purpose Reservoir, Mr. B.J.Parmar, Former Secretary & Mr.B.M.Rao, Chief Engineer (North Gujarat) & Additional Secretary, Narmada, Water Resources and Water Supply Department, Government of Gujarat.



Khambha - Una Road, Km. 19/0 to 19/2



Chalala - Khambha - Nageshwari Road, Km. 34/0

Plate 1: Photographs of Gujarat Flood, Year 2005

Plate 2: Photographs of Maharashtra Flood, Year 2005

COUNTRY REPORT OF LAO PDR

RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT RELATED DISASTERS

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
JGY 2005

PREPARED BY KEOPHILAVANH APHAYLATH
DIRECTOR GENERAL OF URBAN RESEARCH INSTITUTE
LAO PEOPLE'S DEMOCRATIC REPUBLIC

I. ORGANIZATION DATA

1. Name of Organization:

Urban Research Institute (URI)

2. Summary of Organization

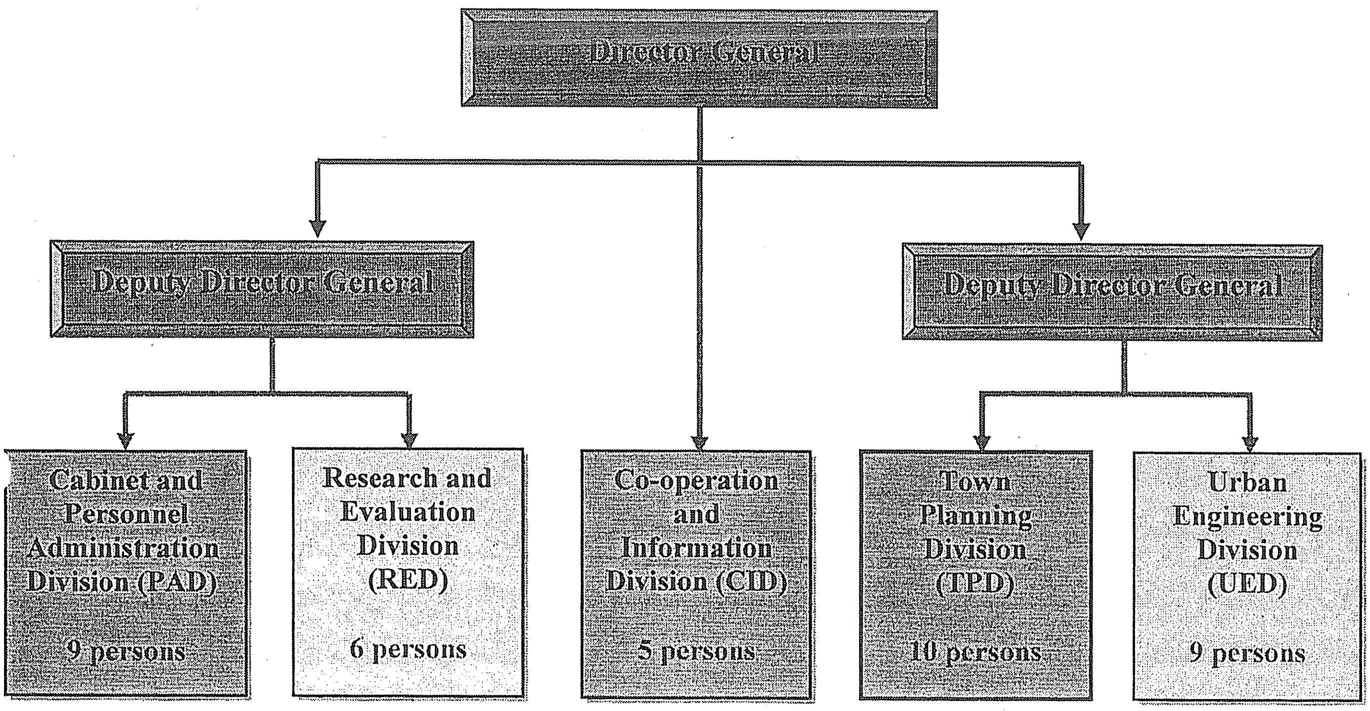
The Urban Research Institute "URI ", a legal, technical organization which is included in the organization of MCTPC, having the same status as the other Departments. Its role is to assist the Minister in terms of research, technique and technology of urban planning and others fields as assigned by MCTPC

The major mandates are as bellow:

- Urban Planning
- Survey and Research
- Training

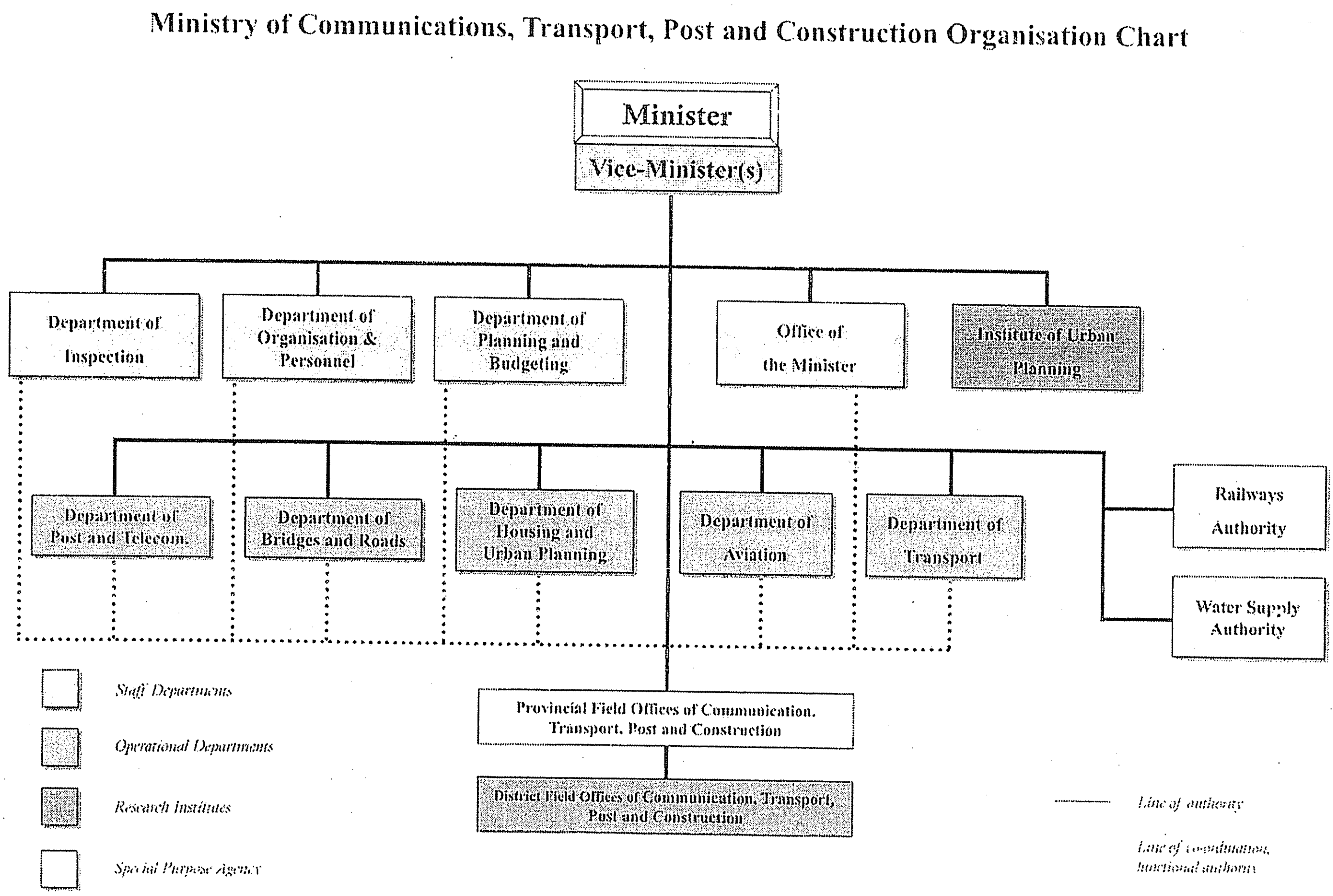
3. Organization Chart

Urban Research Institute Organization Chart



4. Organization's Position in Government

Ministry of Communication, Transportation, Post and Construction Organization Chart



II. PERSONAL DATA

2.1 Recent work for the past three years

Present Position: Director General, Urban Research Institute (URI)
Vice President of Lao engineer and architect association

1. / experiences:
   - Land use planning and urban regulation
   - Urban Disaster Study (Road accident)
   - Local Consul on Road Safety for ADB-ASEAN.
   - Urban Sanitation Study (WSP-EAP World Bank)
   - Small Town's Management Models study for water Supply and Sanitation in Lao PDR
   - Visiting Lecturer at National Political and Public Administration Institute (Urbanization and Urban Planning).
   - Trainer of Urban Disaster Management and Urban Environmental Management.
   - Fire risk assessment in Vientiane Lao PDR.

2. / Publications:
   - Initiative of Small Towns on Water Supply and Sanitation in Lao PDR
   - Guidelines for Urban Planning and Urban Regulation
   - Guidelines for Urban Environmental Management in Lao PDR.

2.2 Contact Address:

Ministry of communication, transport, post and construction.
Urban research institute, Dongpalane road, Bane Phonesinouane, Vientiane Capital city, Lao PDR.
Tel. office: (856-21)412285, Mobile: (856-20) 5520422, Fax: (856-21)416527
Email: aphaylath @yahoo.com

III. RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT RELATED DISASTERS.

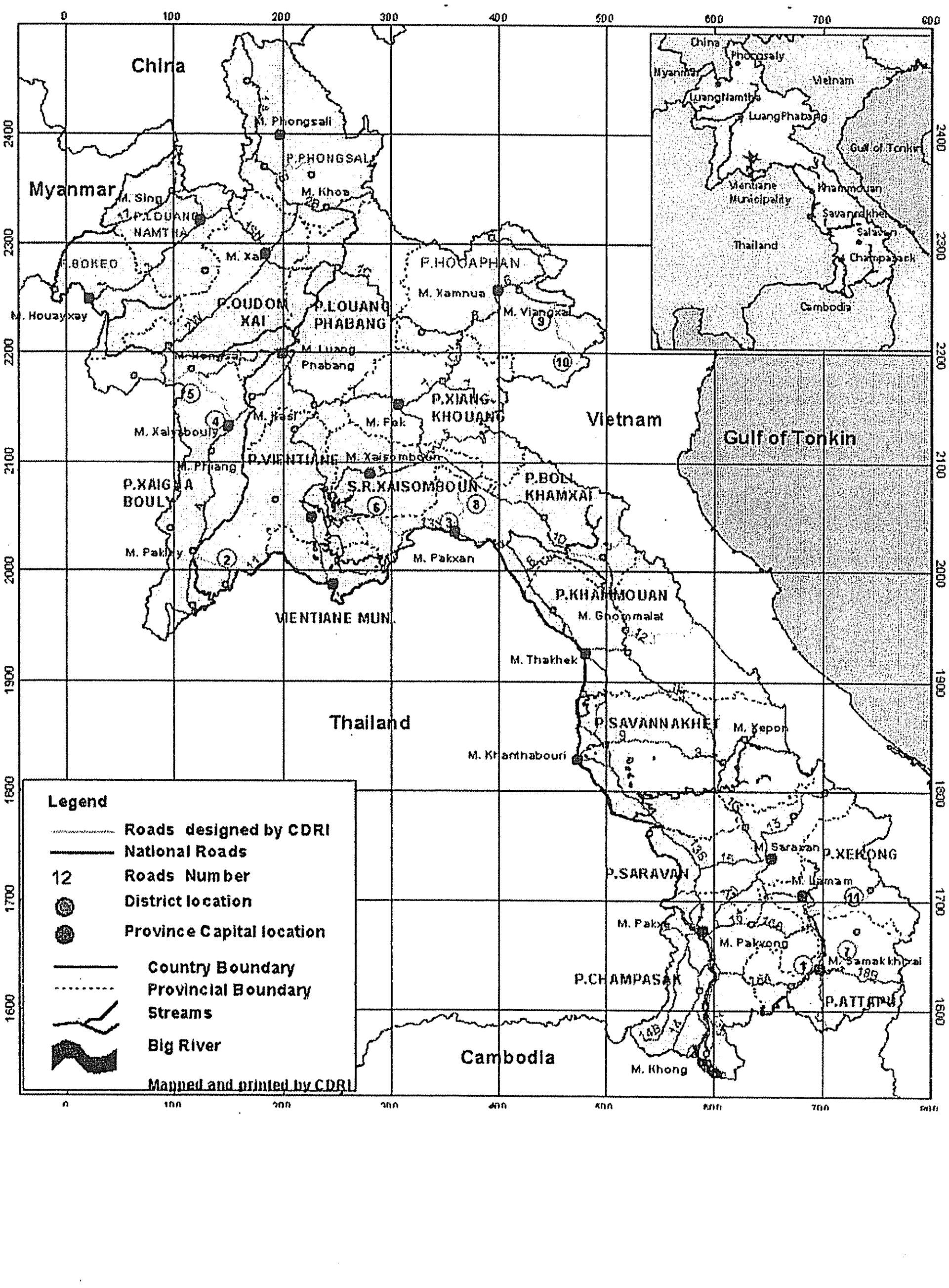
3.1 Current situation and problem

The Lao Peoples Democratic Republic is a land- locked country, sharing borders with China, Myanmar, Thailand, Vietnam and Cambodia. It is the least developed country in the region, with majority of its population living in lowland areas along the Mekong River. The percentage of arable land is low, not all of which can be used due to the lethal anti-personnel cluster bombs that continue to plague the eastern part of the country. The country still relies largely on agriculture: around 76% of its workforce is in agriculture, contributing 51% to its economic revenue. The national economy heavily relies on overseas development aid, which accounts for 20.5% of its GDP.

Country profile: Lao PDR

Mid-2002 population:	5.5 million
Annual population growth rate:	2.3%
Urban population:	25%
Annual urban population growth rate:	4.9%
Population below poverty line (1999):	46.1%
GDP per capita (PPP US $):	1700 (2000 est.)
GDP by sector (1998):	51% agriculture, 22% industry, 27% services
Climate: Tropical monsoon	
Total area: 236,800 km2	
Land use (1993): 3% arable land, of which18% is irrigated	

Sources: UN ESCAP (2002), UNDP (2001), the world Fact book 2001



3.2 Disaster problem in Laos

Hazards:
Floods and drought are considered the main natural hazards to which the country is expected. Floods mostly occur in the alluvial plains of Mekong and its tributaries during the May-September monsoon season. Thirteen major floods have occurred over the past 35 years. The area most affected (central and southern regions) accounts for the zone of greatest economic activity in the country, where 63% of the country's population live. Typhoons that enter the country from Vietnam can compound the rainfall pattern and cause additional flooding. An issue of concern for the future is the siltation in the lower Mekong River basin.

The areas most prone to drought are the western provinces and some of the higher elevations of the southern provinces. Drought affects about 20% of the country's population, adversely affecting agricultural production. Other potentially disastrous event fire (both urban and forest fire), agricultural pests and epidemics. During 1997-2000 more than 500 cases of fires were reported.

Since past decade the changing of the nature, climate and environment in region and in country with contributing of human intentional or unintentional made factors in degradation of environment, opening more spaces, over logging, continuation of slash and burn cultivation practices, weakness on enforcement of using chemical peptizes and fertilizers and other are made people more vulnerable and increasing losses. For example: flash flood and land slide occurred in Houaphanh, Louangprabang and Vientiane provinces which were never seen before in Laos. The flush flood and land slide in July 2001 in Vangvieng and Kasy districts of Vientiane province destroyed 8 houses, all cultivation area, cut of national road for some time impacted to more then 200 families in 4 villages.

Vulnerability:
Majority of the country's population does not have the capacity to cope with disasters due to poverty. Most inhabit the floodplains, making them vulnerable to the annual flooding. Its high population growth rate puts additional strain on environmental condition. Difficulties in access and communication are a major constraint in the country's development and in response to disasters particularly. Only a limited part of the country can be reached by "all weather" roads, and large parts become inaccessible in times of disaster.

3.3 Flood Background

Flooding of the Mekong River and its tributaries are recurrent events and cause each year in varying degrees damage to agricultural production, rural infrastructure and human settlements, and results in losses in livestock and human lives. The floods occur during the monsoon period from August till November and are caused by the typhoons originating in the South China Sea.

The 1995 and 1996 floods were exceptionally serious. An analysis of flood levels of the Mekong River over the past thirty five years shows that only in 1961 and 1966 similar flood levels were reached. The floods of recent years show an upward cycle and 1994, 1995 and 1996 levels have been well above average. The damage to agricultural production has been substantial and exceptional, in particular in 1995 and 1996.

Historic Flood Pattern: During the last 30 years (1966 to 1995), 22 notable floods have occurred with an average frequency of once in 1.4 years (Table 1). Of these 22 historic floods, only four were large, covering the whole country (1966, 1971, 1978 and 1995), giving an average frequency of once in every 7.5 years. The 1966 flood is recalled as one of the most disastrous and probably the longest. It caused unprecedented water levels in the Mekong, inundation of large areas and extensive damage. Agriculture and agricultural infrastructure suffered the worst damage. The Laotian flood pattern is also distinct from that of Thailand or Cambodia since floods in Laos tend to be more 'flashy' and frequent than in Thailand, due to relatively high rainfall in the Lao mountains and the lack of regulation on its tributaries.

In Laos, flooding by the Mekong River in 1994 damaged about 28 000 ha of cropped land. The floods of 1995 and 1996 were the worst since 1966, seriously affecting the agricultural areas along the Mekong and its tributaries in the Prefecture of Vientiane, and in the provinces of Vientiane, Bolikhamxay, Khammouane, Savannakhet and Champassak. An estimated 87 300 ha were inundated in 1995 and 76 000 ha in 1996. Considerable damage was caused to irrigation and other infrastructure, as well as to about 260 ha of fish ponds.

Flooding in the Vientiane Plain, 1995.
Persons affected: 153 398, Households affected: 26 603, Villages affected: 427

Table1

Land use	Damage	Percentage
Transplanted area	42,337 ha	41.14%
Stream, swamp, bamboo, grassland	10,140 ha	9.85%
Clear forest, hill and pasture area	31,354 ha	30.47%
Residential and other areas	19,081 ha	18.54%
Total flood area	102,912 ha	100%

	Rice crop	Other crops
Total area	61,142 ha	17,167 ha
Flood affected	34,471 ha	7,866 ha
Damaged	30,962 ha	4,313 ha

3.4 Latest events

The table below illustrates the extent of damage to planted rice paddies in the 5 most affected provinces. In areas where the irrigation systems remain intact, the next crop can be planted now and harvested in three months' time. What remains to be identified are those areas where farmers have no access to irrigation during the dry months and will have to wait to plant in June/July and to harvest the following November. Irrigated fields account for approximately 25% of the total planted area. A joint WFP and National Disaster Management Office (NDMO) assessment team also identified damage to water gates, irrigation canals, electricity lines and dams in 31 irrigation schemes.

Table 2

Province	No of districts	Planted areas flooded (ha)	Planted areas damaged (ha)	Families affected
Borikhamxy	4	3,708	2,864	3,236
Khammouane	9	23,657	22,027	29,389
Savannakhet	15	24,903	18,457	15,599
Saravanne	4	4,347	2,125	2,383
Champasack	8	22,730	17,270	20,993

Source: Ministry of Agriculture.

3.5 Flood Management and Mitigation in Lao.PDR

The Lao Government, in close cooperation with the UN system, international aid agencies and the LRC/Federation, are in the process of carrying out a comprehensive needs and damage assessment to establish immediate relief and medium to longer term requirements. It is anticipated that this assessment will be completed within the next two to three weeks when it will be possible to give a clearer overall picture of the situation and likelihood of external assistance required. In the meantime the Lao Government, with the support of its partners, has the situation under control.

So far the Government has not declared emergency and local government authorities, supported by Lao Red Cross (LRC) branches and other organizations, are coping well with the effects of local flooding.

The Ministry of Agriculture is playing the lead role of coordinating flood operations, on behalf of the National Disaster Management Committee (NDMC), with the support of other key government ministries such as health, labor and social welfare, transport and the meteorological office; in close consultation with its international partners. The National Disaster Management Office (NDMO) acts as the secretariat, and is the information clearing house and focal point. The LRC is an active member of the NDMC and is seen as an important partner for emergency response. A key coordination meeting took place on 23 August to share information with government, international aid organizations, and key donors about the flood situation and discuss the practical aspects of carrying out the comprehensive needs and damage assessment described above.

The Meteorological Office and the Ministry of Agriculture have emphasized the need for preparedness planning in the event that the second flood peak, anticipated in mid September, exceeds the first resulting in flooding on a par with 1966.

The Water Administration Division (WAD) is one of the divisions under the Department of Roads, Ministry of Communication, Transport, Post and Construction. The main task are operating and managing hydrological stations along the Mekong River and its main tributaries, setting up of short-term and long- term plans of river engineering works such as river bank protection, flood control in an urban area, river port improvement, and aids to navigation and river morphology.

The Urban Research Institute (URI) is one of the ranking as Department of Ministry of Communication, Transport, Post and Construction. The Main task is elaborated the land-use planning measures that are aimed at "keeping people away from the flood waters". Land-use measures on the floodplain aim to ensure that the vulnerability of a particular land-use activity is consistent with the flood hazard on that area of land, the objective is to keep people and vulnerable activities out of the most hazardous areas of the flood plain. The second task is to propose the structural measures to the urban and rural development projects that are aimed at "keeping flood water away from the people". Typical structural measures include flood mitigation dams, embankments and flood detention basins. Development a building controls regulation for urban and settlement areas, aimed at reducing flood damage to the building.

Ministry of Health has a task to alert the population to the threat of disease caused from flood. As expected, the flood waters have contaminated wells and tests by the Ministry of Health revealed a high level of contamination from e coli and cholera bacteria

3.6 Research / Survey

Flood management options

For sustainable agricultural development of the alluvial plains of the Mekong River, a national strategy and action plan is prerequisite to achieve a national and regional preparedness to recurrent floods.

The flood events have revealed considerable weaknesses in the way flood calamities are being addressed. Information on the extent of the flood-affected areas and the extent of the damages are still not well known and collected data show conflicting information. The unprepared ness and lack of procedures to assess the extent and damage caused by floods damage has effected the allocation and mobilization of emergency assistance and the readiness of local institutes and agencies to offer effective support.

The experience of the Mekong River Commission (MRC) and FAO TC Project have been instrumental in a better understanding of the dynamics of the floods, in developing procedures to better assess flood behavior and in defining various answers to prevent and restrict the damage caused by floods. As a result, several short-, medium- and long-term solutions can be recommended to overcome the effects of the floods and to address in a more sustainable way the recurrent effects of floods.

Options in flood mitigation

The solutions to overcome the effect of the floods can be found at different levels and in different sectors, and involves cooperation and coordination at international, national, provincial and field levels and can be classified as follows:

Flood surveys and management plans

At national level a better understanding is required of the flood behavior and the various options to manage and regulate more effectively excess waters. Such national flood management plans and strategies will include:

- an assessment and classification of areas effected by regular flooding;
- a monitoring system to assess on a continuous basis the areas each year effected by floods; and
- an overall flood control management plan to manage recurrent and exceptional floods and to have in place emergency measures to reduce and overcome the damage of exceptional floods.

Methodology: The survey was carried out by Department of Irrigation (DOI) field teams which visited 28 districts in six provinces. In each district/village/area visited, the areas flooded in 1995 and 1996 were recorded in the field on aerial photographs at a scale of 1:30 000 through interviews with district staff, farmers and local residents. In addition, field data were collected in questionnaires to determine the exact dates and duration of flood(s), the level and depth of flooding, and the highest historic flood level reached in the are. Flood plain mapping comprised transfer of information on flooded areas, depths and duration from aerial photographs to the 1:50 000 topographical maps. Since the contour interval on the 1:50 000 maps used for mapping is 10 m, the delineation of flooded areas on the map was approximate and was carried out by interpolation of levels between two consecutive contours.

GIS mapping

Survey data were transferred to the existing maps of 1:50 000 scale. In order to improve the quality of the surveys and to develop thematic maps to allow a more versatile use, the survey data were to be produced in a geographical information system (GIS). The GIS facilities available at other government institutions and accessible to the Irrigation Department were reviewed, and a method to elaborate the analogue maps into a GIS-system was proposed to further enhance the interpretation of flood data and to provide possibilities for better spatial analysis. The necessary hardware was purchased for the

Irrigation Department and special GIS training organized. The analogue maps were digitized and transferred into the GIS system.

Remote sensing of flooding

The flood surveys have obvious shortcomings, as they are time consuming, have a restricted validity and data become available long after emergencies have been solved. There is an obvious need for faster ways to obtain reliable information on the extent of any flooding event.

Aerial photography and photogrammetry - based on new coverage - is time consuming and expensive and takes time to mobilize. In order to assess the viability of derivation of flood data by satellite and contour data the potential of using Radarsat imagery for more precise hypsographic data has been investigated. Although efforts of the project to obtain and process Radarsat images for the 1997 flood have not been successful, ample attention is given to further assess the viability of the method.

Flood monitoring and flood forecasting

The size of the Mekong Basin makes international cooperation imperative and any flood monitoring and forecasting needs to be made in close cooperation with the five countries sharing the Mekong Basin through the MRC.

At present, flood forecasting is carried out only during the monsoon season using the Streamflow Synthesis and Reservoir Regulation (SSARR) model that MRC has been using since early 1970s. It was developed by the US Army Corps of Engineers and it has been reviewed in an earlier consultancy report. Essentially, it consists of three sub-models, namely, riverflow synthesis, river routing and reservoir routing and it operates from synoptic data received from 41 rainfall and 35 water level stations located in the LMB. The model has served a useful purpose for some 25 years with a forecasting accuracy of 10%–15% but requires urgent updating using the median concepts of river modelling.

Mathematical simulation models can be very useful in evaluating the effects of reservoirs and their operation on the Mekong River floods. In general, flood forecasting models are of great help in improving the operation of reservoirs and avoiding unnecessary spilling of water. Mathematical models can also lead to an improved understanding of the flood phenomena and provide insight into the causes of flooding. In this manner, more appropriate measures can be taken to reduce flood damage.

Several models are presently commercially available in flood forecasting and management models, and several have been proposed to replace the existing SSARR model. The replacement of the existing model will provide an unique opportunity for the MRC staff in Bangkok and the DOI staff in each MRC country to be trained in the use of the selected state-of-the-art flood forecasting and management model. Transfer of technology is essential to the MRC countries at the turn of the century. Further details on model upgrading or replacement are included in studies undertaken by Delft Hydraulics and hopefully will lead to concise proposals and resources to assist the MRC in this important task.

Flood control works and investments

A more permanent option to reduce the destructive effects of floods is desirable. Therefore, long term investment in various types of flood control works are required, which may include:

- gates preventing back up of high flood waters;
- reservoirs and retention dikes to protect urban areas and agricultural lands;
- widening and deepening of tributaries and natural drains;
- diversion channels; and
- retention ponds and retarding basins.

The benefits of the flood protection works need to be further evaluated in terms of increased crop production and in reducing the areas subject to regular flooding, and also the negative environmental effects in relation to the ecological value of wetlands and the increased risks of flood hazards in adjacent areas.

Investments in gates and protection dikes will provide long-term solutions for more durable protection of agricultural lands and infrastructure. In addition to local investment studies, a flood management plan will be required to assess the effectiveness of flood investment works and to provide a basis for identifying and prioritizing essential investments for rehabilitation and construction of flood control and other water management infrastructure.

The flood control works carried out under EU financing in the Vientiane Prefecture may serve as an example of the beneficial effects of flood control: farming and social patterns changed - houses previously built on stilts or located on higher ground are now constructed at ground level and cropping has changed from mainly flood resistant rice to rice and other crops (vegetables, tree and other crops). However risks have become more significant as any dike breach will result in considerable losses, especially as the area is surrounded by a dike, making drainage more difficult.

Protection works are needed all along the Mekong River to protect the low lying agricultural areas that are inundated by each flood. Furthermore, an important additional benefit of flood protection works is the potential for retention of water for irrigation in the dry season. The DOI has built several flood protection structures such as flood dikes and flood control gates along the Mekong and some of its tributaries, but their overall effect on the annual loss of paddy and other crops appears to be negligible so far. Therefore, a flood protection project in Laos deserves top priority.

At the request of DOI the project carried out an assessment of eight pilot projects for flood mitigation and management as well as investigations for a pilot project for the construction of flood control works in Bolikhamxai Province. These included the assessment of the extent of the works and the areas which will profit from a better protection against regular flooding and from storage of water for irrigation in the dry season. The results of the preliminary studies are presented in Paper 20

Reservoir management

The various storage reservoirs established or planned in the country for hydropower development (see Table 3) will provide valid options to reduce high discharges caused by excessive rainfall of short duration. This, however, requires an optimization of hydropower generation and flood absorption through reservoir management modelling.

Operating rules for optimum power generation may not be commensurate with those of flood control. The former requires the reservoir to be full in order to operate penstocks with the maximum head available and the latter requires the reservoir to be appropriately drawn down for flood absorption. Although the existence of the reservoir is most likely beneficial to flood control, operation needs to consider both management aspects. This can only be achieved with the development of a thorough knowledge of the flood system through simulation of various scenarios by means of a hydrodynamic flood simulation model. The need for the development of this understanding is felt both in the Ministry of Industry and Handicrafts (MIH - Electricité du Laos) and in the Ministry of Agriculture and Forestry (MAF - Department of Irrigation). There appears to be a clear willingness to co-operate on this issue.

TABLE 3: Planned hydropower reservoirs in Laos

River Basin	Province (s)	Number of existing Schemes	Existing Active Storage (MCM)	Number of Planned Schemes	Planned Active Storage (MCM)
Nam Ngum	Vientiane	1	4,700	3	NA
Nam Lik	Vientiane	0	0	2	NA
Nam Theun	Bolikhamxai Khammouane Savannakhet	1	NA	7	5,687
Se Kong/Selabam/ Paksong	Savannakhet Champassak	2	NA	18	9,828
Nam Dong Xeset	L. Prabang Saravane	1 1	NA NA	NA	NA
Total		**6**	**4,700**	**30**	**15,515**

MCM: Million Cubic Metre;
NA: Not Available;
Note: Information is not complete.

Local preparedness in flood control

Considerable traditional local knowledge exists on the behavior of floods. Farmers faced with regular flooding have developed various practices and techniques to overcome such recurrent floods which affect large areas in the lower flood plains of the Mekong River and its tributaries. By making an inventory of this local knowledge and stimulating communities to propose their own solutions in terms of local infrastructure works, more cost effective and sustainable solutions can be found to improve protection against floods and to provide agricultural alternatives to recover from production losses due to flooding.

Where needed technical and financial assistance can be provided to assist the local communities in the realization of flood mitigation measures. At district and village level, communities should be encouraged in the implementation of self-help flood control projects making use of the considerable local knowledge and traditional technologies.

Furthermore, to compensate recurrent losses. farmers need to be encouraged to diversify agricultural production and to extend their production basis to irrigated crops during the dry season.

Irrigation provides an optimal means to stabilize and broaden the production basis of the small holder farmer and constitutes an alternative against the vagaries of the monsoon season. However, public irrigation development has been problematic in Laos and many of the medium and large scale irrigation schemes have proved uneconomic and not sustainable.

Irrigation in the dry season

An attractive solution to reduce the negative impacts on agricultural production due to floods is the promotion of dry season irrigation. Such a solution can be found in small community irrigation projects and in particular in the introduction of simple, low-cost irrigation technologies. Pump units driven by small combustion or electric motors or operated by hand or foot can now be made available at prices acceptable to small farmers and would provide a very attractive tool to expand and diversify agricultural production. Water can be pumped either from perennial rivers (Mekong and tributaries), seasonal ponds and water-filled depressions or from traditional open wells which could be improved or developed by simple borehole drilling techniques.

National Flood Management Action Plan

The implementation of the various options which are available for flood management and mitigation as outlined above are not likely to be feasible without an integrated approach which ensures that at all levels coordination exists in planning appropriate flood mitigation measures which are related to monitoring, investments and preparedness.

Flood Management Unit

To define flood mitigation measures, to monitor annual floods and to improve national and local preparedness for floods, the National Flood Management Unit has to be reinforced and inter-ministerial capacity increased to effectively coordinate and implement national actions in flood management.

3.7 Government Measures

Past experience:

In dealing with disaster problem in Laos especially with flood in the past much more depended to the perceiving to problem of Authority in organization and community themselves. The Government has paying more attention on disasters to disadvantage groups of people who had been victims of natural disasters with emphasized on relief and mitigation after disaster struck. For example: supplied of water, seeds, rice, medicines, chemical peptizes, distribution of relief goods, building of weir and embankment, irrigation and other. Since 1993 government has allocated annual budget for those activities from 500 to 1000ml kips for emergency relief to victims of disaster in country. In implementing those activities, other government agencies and privates, international organizations, friend countries, inter NGOs were also participated and contributed with their resources which could held mitigate with foods and shelters to victims, allowing for victims disaster to recover and return live cycle to normalcy after disaster struck. Nevertheless we had mentioned that managing disaster we still weren't proactively dealing with arising problems, beside that the lacking of necessary regulation, codes in implementing and procedures in coordination are also require for carefully study to understand real courses of problem and design from the strategy, priority, concept and select appropriated measures for realization in new term.

Disaster management policy, planning and practice:

Prime Minister's Decree No. 158 (1999) created the National Disaster Management Committee and other provincial and district DMCs, and provided basis for the development of a disaster management policy. NDMC Decree 97 (2000) assigned the roles and responsibilities of sectors within NDMC.

The National Policy on Disaster Management formulated adopts an all-hazards and people-centered approach to disaster management, and recognizes that disaster risk and vulnerability reduction are essential to sustainable development planning. The National Plan for the period 2001-2020 has been formulated, while provincial disaster management plans, which mirror the national plans but are made specific to the risk, hazard and vulnerabilities of the particular province, are under development.

Priorities for action are capacity building of disaster management personnel from national to community levels, early warning systems for floods and drought, public awareness, among other preparedness, prevention and mitigation, and response and recovery activities identified.

Opportunities and Lessons learned:

- Representatives of several sectors in the NDMC are still not clear about their roles and responsibilities
- Weak cooperation and collaboration between sectors
- Need to improve early warning information and its dissemination to the grass roots level
- Public awareness and education especially on the consequences of floods and drought
- Appropriate solutions (e.g. relocation of village, disaster risk reduction strategies, and new or adapted cultivation techniques) are needed.
- Integrating Disaster Management concept into other projects of urban and rural development with focused on flood, drought, fire , land management, bank erosion, water management. Protection of environment, forest and other natural resources.
- Appropriate legislation should be drafted that provides financial resources for disaster preparedness and mitigation.

Source: NDMO presentation, workshop on Policy, Legal and Institutional Arrangements and Planning for Disaster Management, 2004 Vientiane Lao PDR.

References

AusAid, Flood Forecasting on the Mekong River in the Lao PDR. (Prepared by Janice Green), May 1996.

ESCAP/UNDP, *Proceedings of the Expert Group Meeting on Comprehensive Flood Loss Prevention and Management*, Bangkok 17–21 October 1988, United Nations, New York, 1988.

Geijer, J., Guidelines for field data collection and flood plain mapping, Latham J., *Report on the implementation of remote sensing and GIS components*, Project TCP/LAO/6613, FAORAP, Bangkok, November 1996.

Hasan, M.R., Preparation of a comprehensive flood loss prevention and management plan for agriculture sector in Laos (TCPLAO/6613): Report on hydrology and field data collection, (Field Document 1), FAO, Rome, June 1996.

Hasan, M.R., Preparation of a comprehensive flood loss prevention and management plan for agriculture sector in Laos (TCPLAO/6613): *Report on flood plain mapping and flood loss prevention and management, (Field Document 2)*, FAO, Rome, May 1997.

Hasan, M.R., Preparation of a comprehensive flood loss prevention and management plan for agriculture sector in Laos (TCPLAO/6613): *Report on Data Collection for Proposed Flood Protection Works. (Field Document 3)*, FAO, Rome, September 1997.

Hoogeveen, J., Report on developing a GIS in Laos, Project TCP/LAO/6613, FAO, Rome, May 1997.

Jeggle, T., *Disaster Awareness, Preparedness and Management: A Review of Current Perceptions and Capacities*, UNDP, Vientiane, 1996.

Microtec GIS Service and Training, Report on the Conduct of the Training Programme in the Use of ArcView GIS software, Project TCP/LAO/6613, FAO, Vientiane, December 1997.

Mekong River Commission, *Priority action package for Mekong hydrology*, Unpublished Report, MRC. Bangkok, April 1997.

Muir, T., Hydropower Potential of Laos PDR, Paper Presented to Donors'Meeting in Bangkok, 1995.

Stephens, T.F., Report on Proposed Pilot Project for Flood Prevention and Management, TCP/LAO/6613, Rome, January 1998.

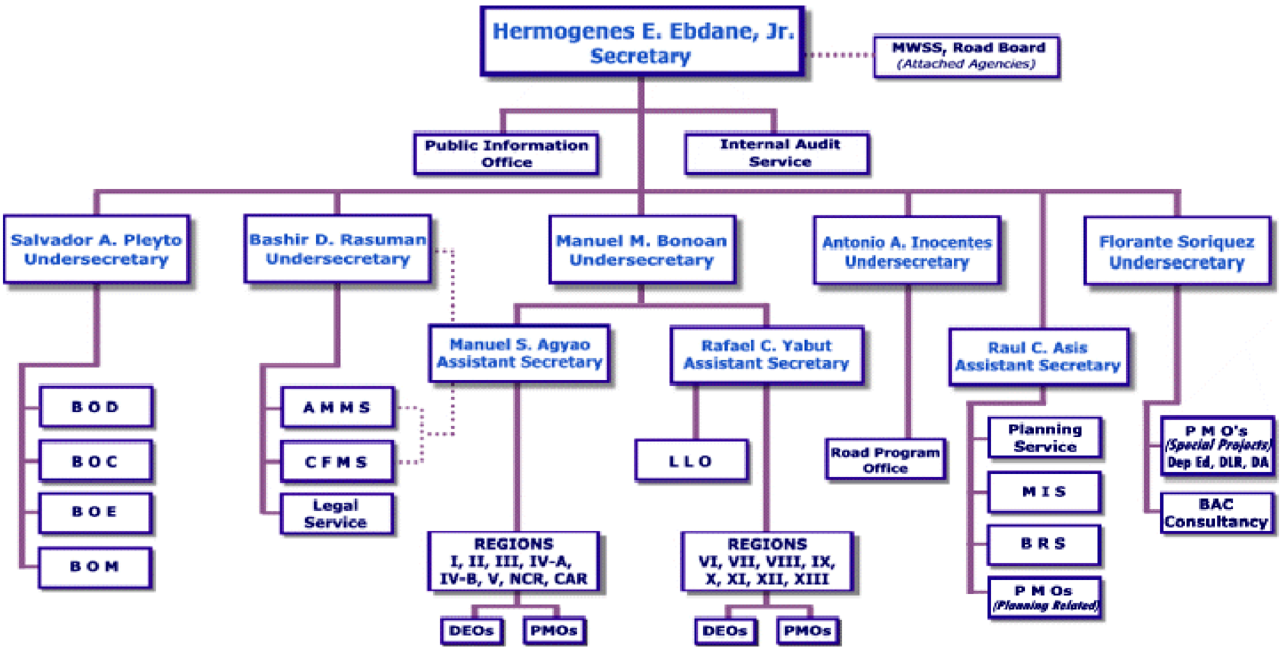
Verwey, A. Delft Hydraulics, Flood Forecasting and River Modelling for the Mekong Basin, Consultancy Report TCP/LAO/6613, FAO, October 1997.

1. ORGANIZATION

1.1 Name of Organization – Department of Public Works and Highways

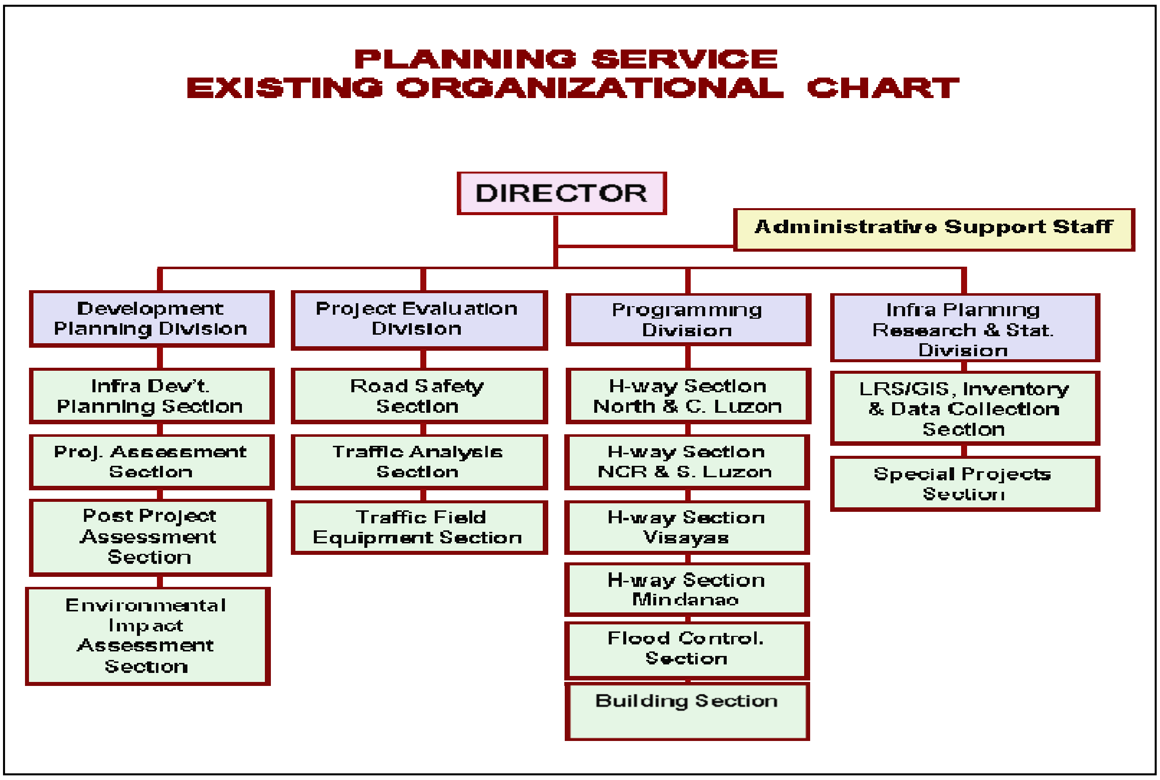
The Department of Public Works and Highways (DPWH) is the engineering arm of the government mandated in the planning, design, construction and maintenance of public works and highways including flood control facilities and structures. DPWH is headed by the Secretary supported by five (5) Undersecretaries and three (3) Assistant Secretaries. It has five (5) Bureaus, and five (5) Services, Project Management Offices handling foreign-assisted projects, Regional Offices and District Engineering Offices.

1.2 DPWH Organizational Chart



BRS - Bureau of Research and Standards	**CAR** - Cordillera Administrative Region
MIS - Monitoring and Information Service	**NCR** - National Capital Region
LLO - Legislative Liaison Office	**DEOs** - District Engineering Office
BOD - Bureau of Design	**RESs** - Regional Equipment Services
BOC - Bureau of Construction	**RB** - Road Board
BOM - Bureau of Maintenance	**IROW** - Infrastructure Right-of-Way
BOE - Bureau of Equipment	
CFMS - Comptrollership & Financial Management Service	
AMMS - Administrative & Manpower Management Service	

Planning Service (PS) is one of the five (5) Services. PS is responsible in the formulation of policies, strategies, standards and guidelines for the implementation of infrastructure projects, formulation of long and medium term plans and programs of the department; in-charged in data collection and analysis, programming funds and conducts post-evaluation of projects. It is also responsible in the management and maintenance of data including the Geographic Information System (GIS).



Planning Service has four (4) Divisions namely: Infrastructure Planning, Research and Statistics Division (25 staff), Development Planning Division (32 staff), Project Evaluation Division (23 staff) and Programming Division (41 staff).

1.3 Organization Position in Government

DPWH role in national development is vital being in-charge in infrastructure development of national highways and bridges and development of major river basins. The yearly budget of the department from 2000 to 2005 is as follows:

Year	Total Budget of DPWH
2000	54.11
2001	45.82
2002	47.99
2003	43.79
2004	47.19
2005	42.79

2. PERSONAL DATA

2.1 Recent Work

As Chief of the Development Planning Division, Planning Service, my recent work includes the following:

- Drafted polices, guidelines and methodologies of development planning of infrastructure projects including flood control facilities/ structures;
- Formulated long and medium term plans and programs for national highways, bridges and major flood control projects consistent with the national development goals and objectives
- Worked as counterpart staff in the conduct of Master Plan Studies and Feasibility Studies funded under foreign assistance;
- Prepared project proposals and packaged infrastructure projects for foreign funding; and
- Undertaken post evaluation analysis of selected major infrastructure projects.

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3. Risk Management and Mitigation Flood and Sediment Related Disasters

3.1 Current Situation and Problem

The Philippines being in the Pacific Ring of Fire and the asia-pacific Typhoon Belt has had many painful yet triumphant experiences when it comes to natural disasters. The inherent flexibility, resourcefulness and sense of brotherhood among Filipinos have shed light over what has seemed to be overwhelming odds as a result of many calamities.

Although the Philippines may have been noted in the world for the eruption of Mt. Pinatubo, the highly active volcanic activity of majestic Mt. Mayon and the uniqueness of Taal, the smallest lake volcano in the world, most disasters in the Philippines are due to the after effects of destructive typhoons and unusually heavy monsoons.

The Philippine government has institutionalized its disaster preparedness and mitigation program through the establishment of the National Disaster Coordinating Council under the Office of Civil Defense of the Department of National Defense. The National Disaster Coordinating Council takes the lead in promoting disaster preparedness as a non-structural component of the two-pronged disaster management approach being employed by the Philippine government, the other being the structural component.

From the damage figure of the OCD, and the NDCC, the large number of typhoons that hit the Philippine Area of Responsibility (PAR) undoubtedly took the heaviest toll on lives and property. This strikes a heavy blow on the Philippine economy, especially since the Philippines is basically an agricultural economy. Even the damage brought by the eruption of Mt. Pinatubo brought the greatest damage upon the onslaught of lahar. Damage caused by lahar far exceeded that of the volcanic eruption itself, burying entire communities under volcanic debris. It is regretful that an average of 900 persons are killed and an estimated cost of approximately P800 billion are lost due to typhoons and associated flooding events.

The loss of human lives, damage to agricultural crops and private and public properties, and the disruption of business operations deplete economic development and hinder the delivery of basic social services. The equivalent cost of flood and sediment-related damages amounts to 2% of the national budget and almost double the budgetary allocation of the Department of Public works and Highways for flood control.

As such, serious efforts towards the mitigation of floods have been undertaken by the DPWH with the help of ODA agencies such as the JICA, OECF/JBIC, ADB, WB etc.

3.2 Government Measures

Policies and Strategies

A major component of the Medium-Term Philippine Development Plan is the infrastructure development program of the DPWH. It emphasizes the need for the DPWH to implement flood mitigation and water resources management projects.

Most if not all weather-related disasters in the Philippines are due directly or indirectly to tropical cyclones. During the months of July to September, the presence of tropical cyclones northeast of the Philippines may intensify the southeast flow, bringing considerable rain and resulting to inland flooding and inundation of major river basins. With 421 principal river basins with drainage areas varying from 41 to 27,280 square kilometers, the hydrological profile of the Philippines makes it imperative to address the problem of flooding by prioritizing the development of water resources and river management programs for 18 major river basins and other noted key cities and urban centers like Ormoc City and Iloilo.

Following the two-pronged approach to disaster mitigation, that is: (1) Structural Mitigation; and (2) Non-Structural Mitigation, the DPWH has embarked, in partnership and with the support of international ODA agencies on a massive flood control program which began since 1985.

Structural Mitigation

Employing proven engineering interventions such as dikes, levees, retention ponds, sedimentation basins, sabo, channeling, river walls and revetments, floodways, pumping stations, floodgates and improvement of drainage facilities are the most conventional approaches made to counteract the negative effects of disasters, particularly floods.

These structures are designed to preserve and enhance the retention and detention capabilities of river basins and are constructed to withstand flooding up to a pre-determined magnitude.

Consequent maintenance activities for the above-mentioned facilities are also included within the definition of structural measures. Although these engineering works are very effective in arresting floods, an integrated approach to disaster mitigation that combines structural measures with disaster preparedness is most ideal.

Non-Structural Mitigation

Because structural flood mitigation measures can only withstand forces up to a level of flood for which it was designed, adequate non-structural support as a comprehensive approach to flood and sediment disaster mitigation necessitates the establishment of an effective flood monitoring, information and warning system. This entails an elaborate system of gauges and communication equipment strategically located along the length of a river system providing an effective warning and information dissemination network. In addition, capability building workshops for disaster response teams as well as providing them with the necessary equipment to effectively respond to disaster emergencies greatly minimizes threats to both life and property. The basic tool here is information and how it can effectively and promptly be disseminated.

Strategic Objectives

The following are the strategic objectives set by the DPWH:

1) Mitigate flooding to tolerable levels in Metro Manila and Major River Basins with the additional construction/installation of adequate flood control facilities such as dikes, river walls, levees, cut-off channels, diversion floodways, revetments and installation of pumping stations, dredging and related works in all flood and sediment prone areas that need protection as determined by the national land use plan.

2) Strengthen the Flood Control and Sabo Engineering Center to conduct basic and applied research and development, feasibility studies, preliminary engineering and implementation of sabo engineering projects.

3) Conduct comprehensive flood plain management strategy with the installation of flood forecasting and warning and flood monitoring systems in all major river basins.

4) Pursue proper operation and maintenance of flood control and drainage facilities including an effective garbage collection and disposal, "Bantay-Estero/Ilog Brigades" and regulation/rules in coordination with other concerned government agencies and Local Government Units.

5) Relocate informal settlers living along banks of rivers/creeks in coordination with other concerned government agencies.

6) Conduct studies, preliminary engineering and implementation of sabo projects for prevention/mitigation of sediment-related disasters, debris and lahar flow/landslide on affected national roads and river bed deformation in seriously threatened/affected areas.

7) Study and formulate guidelines leading to sustainable development/land use in sediment-related disaster-prone areas.

8) Implement comprehensive measures consisting of structural construction, warning/evacuation and livelihood programs in coordination with other concerned government agencies and local government units.

3.3 Government Projects for Flood Disasters

Ormoc City Flood Mitigation Projects

The tragic flash flood on November 5, 1991 that killed almost 8,000 persons emphasized not only the need for a comprehensive watershed management program but also the development of an effective drainage system and provision of river control structures.

The national and local governments carried out rehabilitation works right after the typhoon. However, the efforts have been limited to the reconstruction of bridges and dikes. Major improvement works of the two biggest rivers in Ormoc City, Anilao and Malbasag Rivers, were left unattended, mainly due to fund limitations.

Upon the request of the Philippine government, JICA conducted the "Study on Flood Control for Rivers in Selected Urban Centers" including Ormoc City and environs. After the completion of the study, the GOP sought financial grant assistance which gave way to the implementation of the "Flood Mitigation Project in Ormoc City".

The flood control of Ormoc City is funded through the Japan International Cooperation Agency. The total grant aid acquired from the Government of Japan by the GOP for Flood Mitigation Projects in Ormoc City amounted to P317 million for Phase I and P612 million for Phase II.

Project works for Phase I include:

Construction of 4 New Bridges:
1) Alegria Bridge (3 Span PC Type)
2) Osmeña Bridge (3 Span PC Type)
3) Malbasag Bridge (2 Span PC Type)
4) Carlos Tan Bridge (2 Span PC Type)

Construction of 3 New Slit Dams:
1) Anilao Slit Dam (3x77m, 16 slits)
2) Biliboy Slit Dam (8x81m, 12 Slits)
3) Malbasag Slit Dam (3x97m, 13 Slits)

Local efforts by the Philippine government in cooperation with the private sector promises a bright future for what are now polluted rivers in Philippine urban and industrial centers. Pollution combined with the degradation of river systems due to heavy siltation and waste mismanagement have greatly contributed to the susceptibility of this rivers to inundation, affecting the economic and social facets of the community that live along its banks. The effort of collaborating with private sector partners in river management through a Flood Mitigation Committee (FMC) as what has been established in Ormoc City is being replicated locally in many parts of the Philippines. This resulted to an unprecedented awareness of the value of "Living with Nature". Supported by local PMO's, residents of communities and funded by local government units in partnership with private sector benefactors can make a big difference. For this effort, both short-term and mid-term plans have been laid out. The FMC in Ormoc for instance, engages in regular clean-up and beautification activities to help maintain the pleasant, safe and effective condition of Malbasag and Anilao Rivers, turning the once dreadful reminder of a misfortunate tragedy into a monument of triumph of environmentally concerned people, faithfully practicing non-structural preventive and maintenance measures to prevent similar flood and sediment-related disasters from once again happening in Ormoc City.

Central Luzon Flood Control Projects

The great plains of Central Luzon have been vastly devastated time and again first by the great eruption of Mt. Pinatubo and the onslaught of lahar sediments to the perennial flooding of the great plains of Pangasinan due to the insufficient carrying and retention capacity of the Agno River. The DPWH with the support of ODA agencies such as the JBIC and the JICA have conducted studies and implemented long-term mitigation measures, both structural and non-structural benefiting the provinces of Pampanga, Tarlac and Pangasinan.

The Agno Flood Control Projects

Frequently experiencing typhoons, over-banking of the Agno River had caused damaging floods in the Pangasinan Plain. It has been estimated that a total of 180,000 to 200,000 hectares of productive land are prone to flooding in the provinces of Pangasinan and Tarlac. The population in this flood-prone area was conservatively estimated to be around 700,000 persons. In 1972, the largest flood ever recorded in the area, Agno River inundated almost the entire flood plain with damages estimated to have reached at least P2 billion.

Phase I: Agno & Allied River Urgent Rehabilitation Project (JBIC, 1995-2003)
This phase generally involved the design and construction of the Bugallon cut-off channel and the construction of the Bugallon Bridge. It also included revetment works for Lower Agno and upper Sinocalan Rivers and dike rehabilitation at Guelew, Bocboc, Naguelguel and Urbiztondo. Dike heightening works were also provided for portions of Cabayaoasan and Bugallon.

Phase II: Agno River Flood Control Project (JBIC, 1998-2006)

This phase of the project was intended to improve the capacity of the river channel with the construction of a floodway and development of the Poponto Retarding Basin, a closure dike at the floodway entrance, diversion and floodway control weirs, heightening and construction of new dikes, revetments, groins and bridges. Notable in this phase is the emphasis on the social development aspect of flood control, again reiterating the importance of complementing engineering interventions with disaster preparedness and social preparation in terms of coping with and mitigating economic shocks brought about by perennial disruptive flooding. The social development component include the construction of evacuation mound dikes and evacuation centers, improvement of evacuation system and routes, capability building for disaster response teams and provision of effective monitoring, forecasting and warning facilities.

The Pampanga Delta Development Project (OECF, 1990-2003)

The project is located in the delta area of Pampanga River basin from Sulipan/Calumpit to Manila Bay, around 45 kilometers northwest of Manila. In order to reduce flood damages in the downstream areas and reduce the level of flood in Candaba Swamp, a trunk floodway for the conveyance of flood water from the entire Pampanga River Basin was implemented. This was done by dredging low water channels, confining channels with parallel dikes and constructing related structures along the following rivers: Pampanga River from Sulipan to Manila Bay (22.7 kms); Labangan Floodway from Calumpit to Manila Bay (16.9 kms); and the New Bagbag Channel (4.8 kms) connecting the Pampanga River Basin to the Labangan Floodway.

3.4 Projects for Sediment-Related Disasters

The Pinatubo Hazard Urgent Mitigation Project

The flood and lahar control projects implemented in the Pinatubo devastated areas were meant to stabilize and normalize the social and economic sectors of the lahar ravaged communities of Pampanga.

The projects include the following:

Phase I: Urgent Works for the Sacobia-Bamban
River Stretch (OECF, 1997-2001)

- Bamban River improvement at downstream stretch from San Francisco Bridge to Rio-Chico River confluence.
- Training works from Bamban to San Francisco Bridge including the construction of the Maskup Consolidation Dam
- Restoration of Highway Route 3 including the construction of Bamban Centennial Bridge and Mabalacat Bridge.

Phase II: Urgent Works for the Pasig-Potrero River Stretch (JBIC, 2000-2005)

- Rehabilitation and improvement of the southwest corner of the Megadike
- Widening of the Gapan-San Fernando-Olongapo Road/Gugu Bridge/Gugu Right Dike and Culverts
- Baluyot Channel Improvement

- Construction of San Fernando-Sto. Tomas-Minalin Tail Dike and Evacuation Roads and Channelization of Gugu Creek
- Dredging in the delta areas/pilot channel dredging and Third River
- Excavation and bank fortification of downstream channels passing Sasmuan Restoration of Mancatian Bridge including access roads along the Angeles-Porac roads

4. OBSERVATIONS AND PROACTIVE ACTION

The aggradations of riverbeds often occur due to sedimentation, causing flood disasters. To prevent severe floods, sediment should be controlled in the mountain area by Sabo works. Large scale sedimentation often occur due to slope failures, landslides and surface erosion especially in hilly and mountainous areas where, sadly, more often have been denuded by improper utilization of resources, over-exploitation and unregulated and unmonitored human community encroachments.

Aggravated by rainfall, loosened sediments flow down through river system, with a great volume deposited at the bottom of riverbeds causing diminished carrying capacities and insufficient flow of river systems. In the case of volcanic sediment disasters as in the Mt. Pinatubo eruption of June 1991, the deposited pyroclastic materials have brought the Central

Luzon plains face to face with sediment flow at its most vicious form – Lahar. With large amounts of rainfall, lossened sediments from the slopes of Pinatubo flows down in the form of mud causing destruction to lives and property along its path. Massive lahar flow from the slopes of Pinatubo has buried homes, infrastructure – even entire towns. In the end, there were at least 77,000 hectares of farmlands buried under 1 to 12 feet of sediment. Official records indicated a total of 932 persons dead, 41,979 houses totally destroyed and 70,257 homes severely damaged as a direct result of lahar onslaught. Total damages to infrastructure, agriculture, trade and industry and natural resources immediately after the initial lahar flows only already reached an estimated P10.4 billion (USD366 million).

In view of the limited expertise and resources to cope with floods and associated events such as debris/sediment flow disasters, the DPWH established a new organization, the PMO-FCSEC (Project Management Office-Flood Control and Sabo Engineering Center) in January 2000. The PMO-FCSEC was organized in cooperation with JICA and the University of the Philippines. Its main objective is to enhance the flood control and sabo engineering capabilities of the DPWH. The improvement of flood control programs through the enhancement of technological know-how was since then undertaken by the PMO-FCSEC. The completed and most recent projects of the PMO-FCSEC include the new hydraulic laboratory building in Napindan, Taguig, and Metro Manila. Technical standards for planning and design of structures concerning flood control and sabo (erosion and sediment movement control works) has also been published. The technical standard is the first among the outputs envisioned under Project ENCA. Project ENCA is a project-type technical cooperation program of the JICA being implemented by the PMO-FCSEC.

At present, the DPWH realizes the need for a comprehensive approach to either solving or mitigating the effects of flooding and sediment-related events. Thus, all its efforts have been concerted in attaining full convergence of both reactive and pro-active disaster mitigation efforts as reflected in its past project programming and the projects it envisions in the future. Both structural and non-structural mitigation measures must go hand in hand if full benefits of project benefits are envisioned to be felt by the communities targeted by every project. Not only does non-structural measures prepare communities and equip them with the necessary gadgets and capabilities to cope with such elements, non-structural measures also imbibe a sense of ownership to projects by the local people.

This sense of ownership enhances not only their self-worth but also their willingness to fully cooperate with the project proponents ensuring effective implementation and sustainable disaster mitigation efforts.

COUNTRY REPORT OF THAILAND

Risk Management and Mitigation

For Flood and Sediment Related Disasters

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

JFY 2005

Prepared by Akkapong Boonmash

Director of Improvement and Maintenance Division

Office of Hydrology and Water Management

Royal Irrigation Department (RID)

THAILAND

COUNTRY REPORT

1. Organization Data

(1) Name of Organization : Royal Irrigation Department

(2) Summary of Organization

The Royal Irrigation Department has been entrusted with the duty to provide the water such as to store and conserve , to regulate , to distribute , to release or allocate water for agriculture, energy, domestic consumption, industry and also including prevention of damage causing by water , and inland navigation within irrigation area.

2.1 Vision

The Royal Irrigation Department attempted to development and water management for crop production , quality of life promotion and sustainable country development.

2.2 Mission

- Main development for water resource development according to potential basin.
- Water management for water user sectors with adequacy and sustainability
- Strengthening participatory irrigation management every Level with equilibratory environment and optimum utilities.
- Flood control and flood mitigation.

2.3 Administration

Head Office of RID is located in 811 Samsen rd. Dusit, Bangkok, the capital of Thailand . RID consists of 5 division 10 offices and 16 regional offices.

Most divisions are located in Bangkok and the others are located in Pak-kret district , Nonthaburi province.

Each regional irrigation office is equilibrium to division, which operates and maintains irrigation project in the each region. The regional irrigation offices serves for most activities which water plays a major role especially for agriculture.

2.4 Budget

RID is run by Royal Thai Government Budget. And now, there are some grants and loans from the developed counties to support irrigation development and water resource development in Thailand such as JICA, JBIC, ADB and so on.

RID has been allocated about 53 % of the budget of Ministry of Agriculture and Cooperatives. It was approximately 27,660 million baht in 2005.

(3) Organization Chart

Improvement and Maintenance Division responsible for formulation criteria and standard of irrigation project maintenance, budget allocation for operation and maintenance irrigation project and flood prevention. There are 26 officials and 17 employees.

Office of Hydrology and water Management (see Figure 0-1) responsible for policy making and planning of implementation plan in hydrology and water management of the department, formulation of hydrological criteria for the operation of irrigation projects, investigation and compilation of data on hydrology, meteorology, sediment and water quality in natural water researches, studies and experiments on crop irrigation water requirements for suitable planing of water resources development and water distribution of particular areas, planning, implementation and development for almost efficiency of water for cast. There are 227 officials and 539 employees.

(4) Organization's Position in government

The Royal Irrigation Department (see Figure 0-2) under umbrella of the Ministry of Agriculture and cooperatives (MOAC) (see Figure 0-3) to administration the agriculture, water resources provision, irrigation, promotion and development of farmers and cooperative system, including manufacturing process and agricultural products. The Ministry of Agriculture and cooperative (MOAC) was one of the twenty ministry of the Royal Thai Government.(see Figure 0-4)

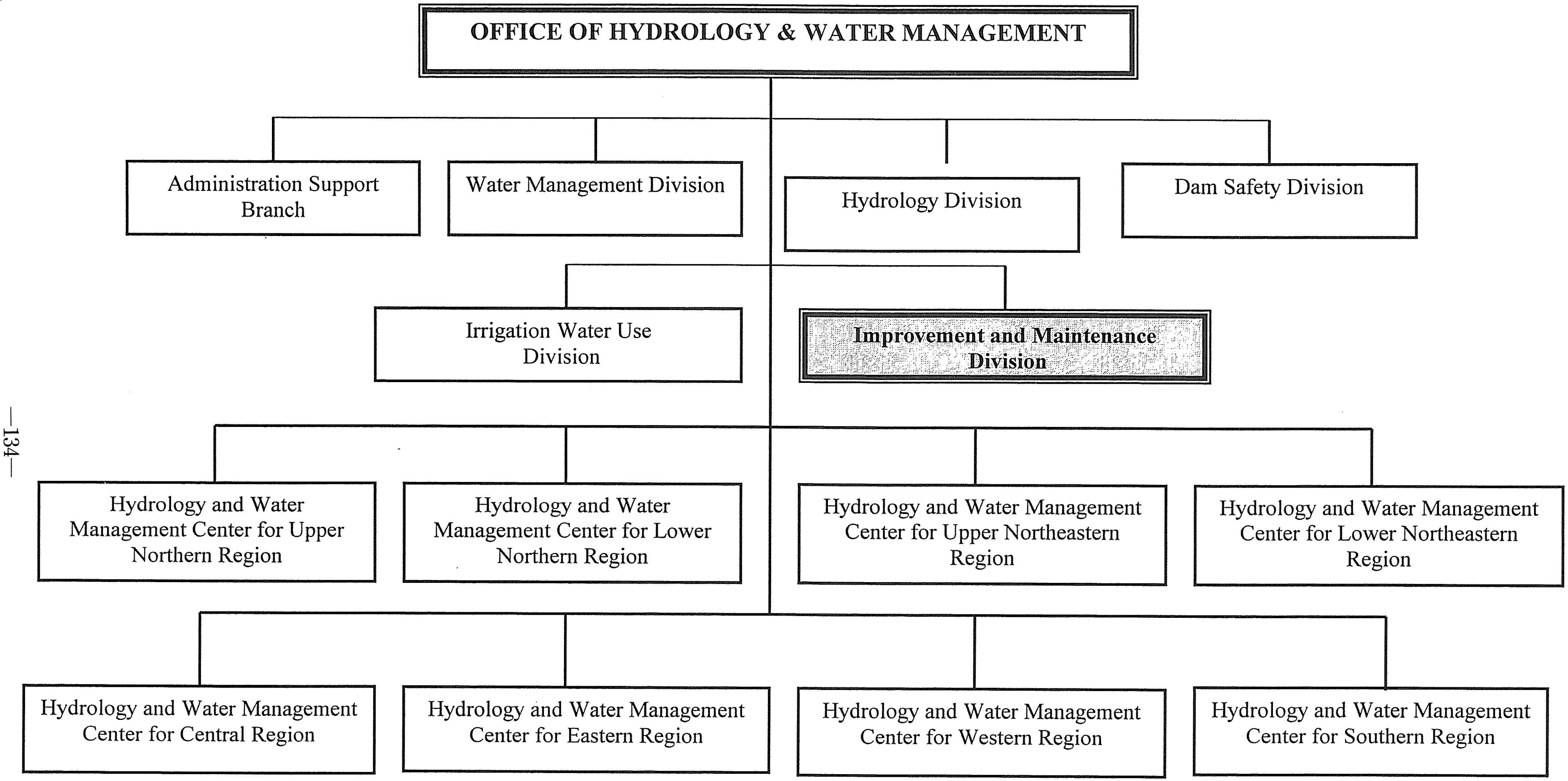

Figure 0-1 : Organization Chart of Office of Hydrology & Water Management

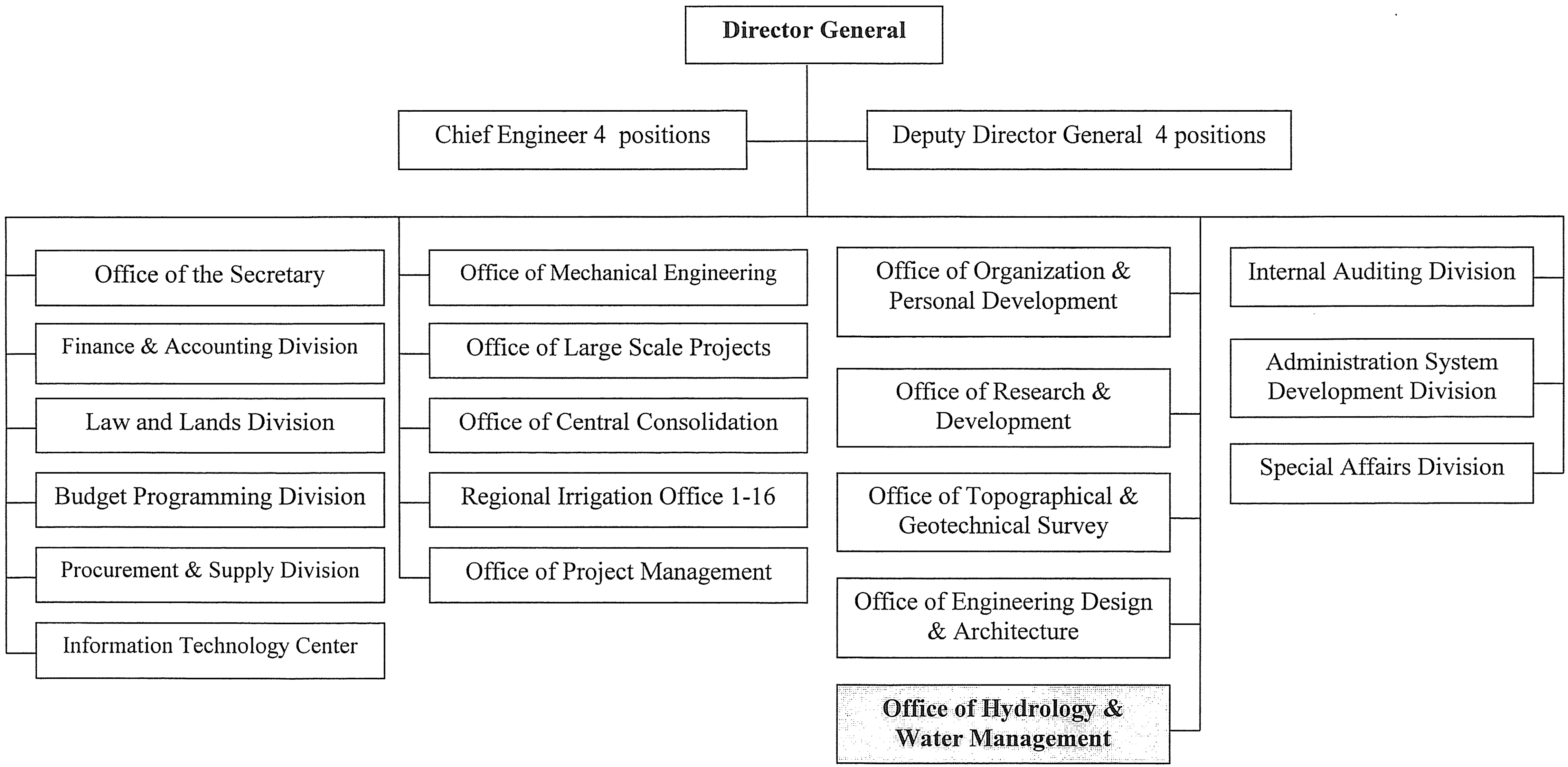

Figure 0-2 : Organization chart of Royal Irrigation Department

Ministry of Agriculture and Cooperative

Organization Chart

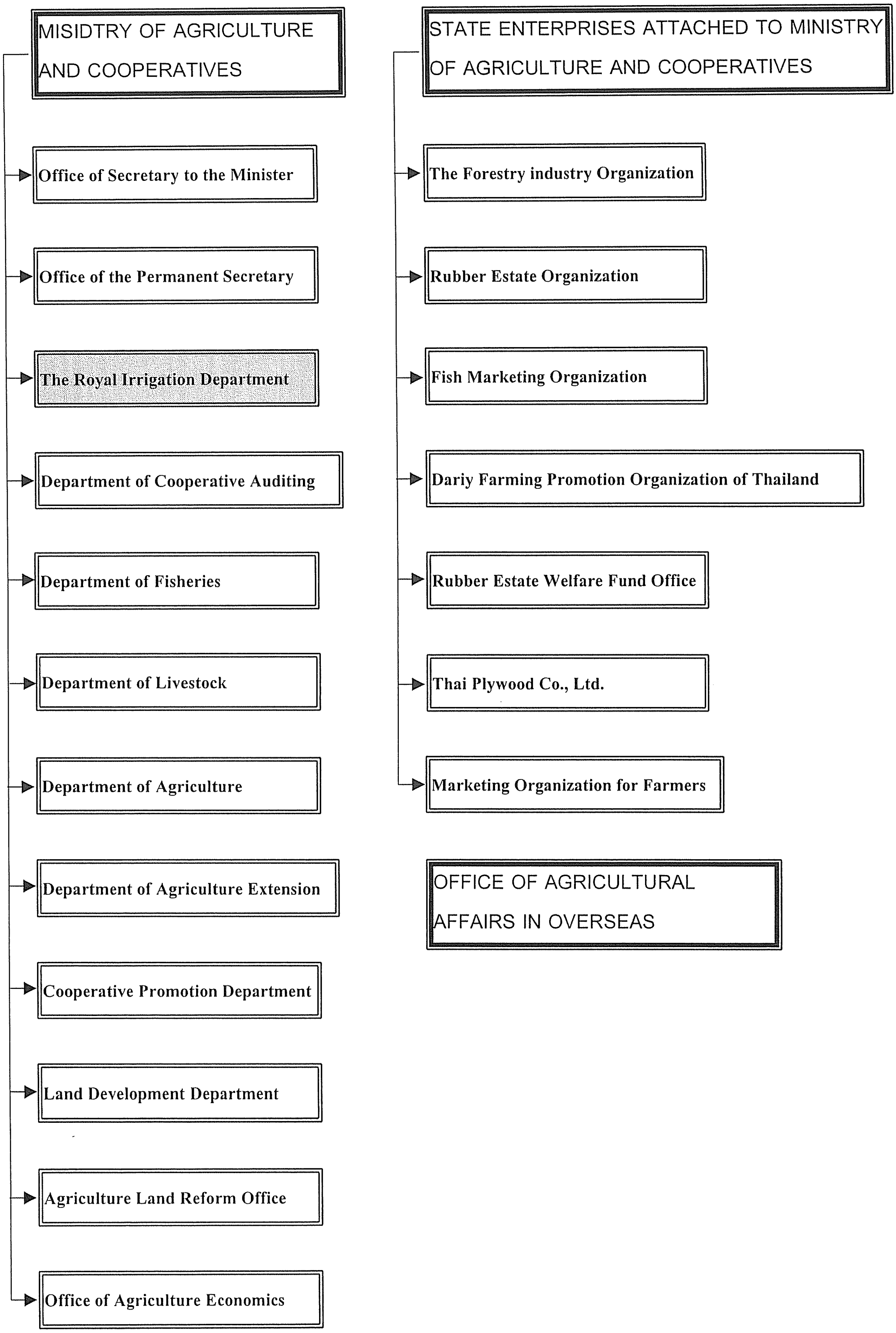

Figure 0-3: Organization Chart Ministry of Agriculture Cooperative

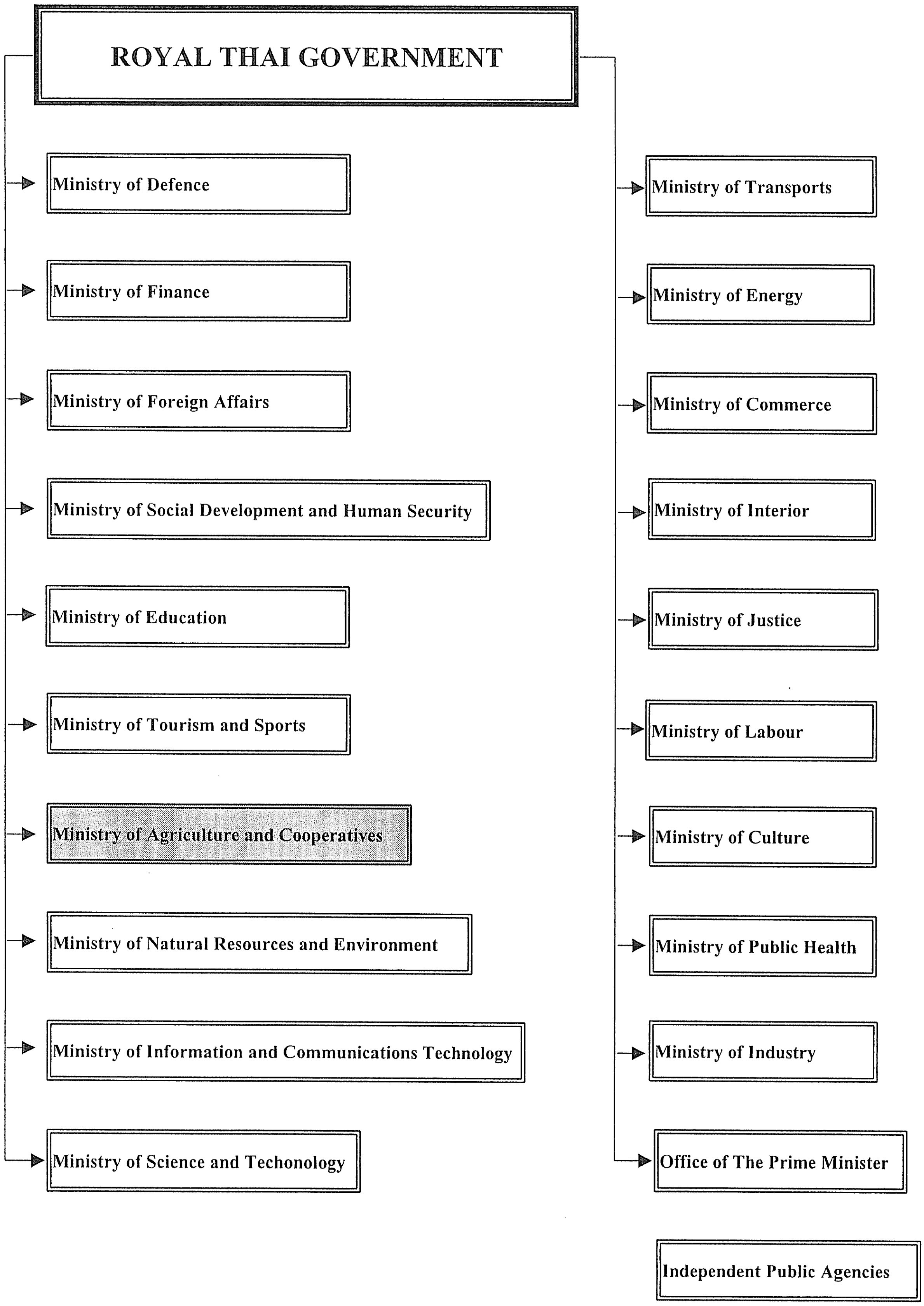

Figure 0-4: Organization Chart Royal Thai Government

2. Personal Data

(1) Recent Work

In 1998 – 2002 I worked as chief of Improvement Project Planing Section responsible for feasibility study and plan on improve the existing irrigation project for cultivation and flood prevention . From 2002 – 2005 I worked as the Director of improvement and Maintenance Division responsible for formulation criteria and standard of irrigation project maintenance , budget allocation for Operation and maintenance irrigation project and flood prevention, Besides , I work as a committee of the projects committee for the feasibility study on rehabilitation projects which are conducted by consultant companies ,for improving irrigation efficiency.

(2) Contact Address

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3. Integrated Plan For Flood Mitigation In Chao Phraya River Basin

3.1 River Basin Condition

3.1.1 General Features of Past Major Floods

The Chao Praya river basin has experienced so many flood , and the 1983 and 1995 floods were the most serious (see Fig. A-1). As seen in Fig. A-2 , flood inundate wide areas that have natural retarding functions along the river course. The inundation area is broadly divided into four (4) areas: Upper Central Plain, Nakhon Sawan Area, Higher Delta, and Lower Delta. The inundation in 1995 nearly exceeded 16 billion m^3 which was almost equal to the total active capacity of the Bhumibol and Sirikit dams (refer to Fig. A-2) . However , the extensive inundation considerably relieved the urban areas located downstream , like Bangkok, from a catastrophic disaster.

3.1.2 Main cause of Flood

The main causes of flooding are the low flow capacities of river channels. The present river channel capacities are between 3,000 and 4,000 m^3/s in the stretch near Nakhon Sawan, about 3,600 m^3/s at Bangkok.

In the 1995 flood, dike breaching and overtopping occurred at almost every reach of the Chao Phraya River, its tributaries and distributaries. The estimated flow capacity near Bangkok was about 3,600 m^3/s , which corresponds to about a 3 - year return period discharge if confined in the river channel without inundation. Besides, it is pointed out that several activities such as land use in flood risk areas, development of upstream, operation of flow control facilities such as dams, and coordination among agencies concerned on flood management are related with the increase in flood damage.

3.1.3 Flood Damage Condition

Under the foregoing circumstances , flood damage is very severe in the whole basin. According to the flood damage analysis, flood damage in the 1995 flood amounts to about 72 billion baht under the future land use condition, as shown in Fig. A-2

3.1.4 Ongoing Flood Mitigation Project by Agencies Concerned

To cope with the flooding problem, the agencies responsible for flood mitigation and drainage works have made serious efforts under the following projects:

- Heightening of flooding barrier at Bangkok Metropolitan Area by MBA

- Provision of polder system together with the improvement of drainage system by PWD
- River improvement (completed) and drainage system improvement called " monkey cheek project" in delta area by RID
- Loop – cut at Bangkok Port and construction of multipurpose dams by RID

3.1.5 Major Issues considered for Flood Mitigation

Under this situation, the major issues on flood mitigation are emphasized with the following points:

- Increase of flood damage due to basin development in the future.
- Reduction of safety level against floods at Bangkok due to protection works for Pathum Thani and Nonthaburi.
- Continuation of Low safety level against floods in agricultural areas.

3.2 MASTER PLAN STUDY

3.2.1 Basic Concept of Master Plan Formulation

Considering the major issues on flood mitigation in Chao Phraya river basin , the basic concepts of master plan formulation are as follows:

- Preservation of the present natural retarding effect to minimize the increase of flood damage in the future through control and guidance on basin development in areas where flood damage is expected. (This concept is the current global concept of flood mitigation , and is the "monkey cheek" concept being practiced in Thailand.)
- Introduction of suitable measure to assure the safety level against floods at Bangkok and other urban areas and to enhance the safety level in agricultural areas.

3.2.2 Measures of the master Plan

The Master Plan is formulated with 2018 as the target year. In general ,several measures consisting of structural and nonstructural ones are considered to cope with the flooding problems, as shown in Fig. A-3 As discussed below, specific measures are required to deal with the above-said issues in the Chao Phraya river basin.

3.2.2.1 Preservation of Present Natural Retarding Effect and Minimization of Increase of Flood Damage

To maintain the present natural retarding effect and to minimize the increase of flood damage , nonstructural mesaures, especially land use control and guidance , are essential. For the realization of land use control and guidance, flood risk maps are provided, so that all agencies concerned can prepare the development plan based on these maps considering the influence of development . Also ,people who are going to develop the land are forewarned through publication of the flood risk maps.

3.2.2.2 Assurance of Safety Level against Flood at Bangkok and Urban Areas

To assure the safety level of urban areas against floods, nonstructural measures such as the modification of reservoir operation rule, flood forecasting, flood fighing and land use control and guidance are considered , while ring levee with drainage system improvement is applied as the structural measure.

To assure the safety level of a 100-year return period at Bangkok, the following alternatives are proposed in combination with the ring levee provided by PWD, as show in fig. A-4:

- Alternative 1, Partial protection of Pathum Thani and Nonthaburi
- Alternative 2-1 , Heightening of Flood Barrier
- Alternative 2-2 , Diversion Channel

3.2.2.3 Enhancement of Safety Level against Flood in Agricultural Areas

To enhance the safety level against flood in agricultural areas , nonstructural measures including the modification of reservoir operation rule, flood forecasting, flood fighting, land use control and guidance, etc., are proposed. On the other hand , the following structural measures are proposed for flood mitigation in agricultural areas: (a) river improvement ; and (b) distribution and drainage systems improvement .

The protection level of agricultural areas in the downstream of Chainat could be enhanced to a 10-year return period by a combination of the above measures.

3.2.2.4 Institutional Arrangement for Implementation of Measures

In principle, the existing agencies concerned will handle these measures under their own responsibilities. To smoothly implement these measures , however , it is necessary to set up a new organization , the River Basin committee , as the coordination agency among the agencies concerned , because such an organization does not existion at present in the Thai government.

3.2.3 Economic evaluation of the master Plan

In this study, the Master plan is formulated by applying such measures as summarized in Fig.A-3. For the protection of urban areas, three (3) alternative measures are proposed as aforementioned. The cost, benefit and economic viability of the measures including these alternative which can be evaluated in monetary term are shown below. (the cost and benefit for ring levee are not included, because the project undertaken by PWD is considered as the premise for this study):

Alternative	Project component	Cost (mil.baht)	Economic Benefit (mil.Baht)	Economic Viability		
				EIRR*	B-C	B/C
Alt.1	Modification of Dam Operation Rule; Distribution and drainage systems improvement ; river improvement and others , but with partial protection of pathum thani and Nonthaburi	6,907 as initial cost and 464 as annual cost	3,268/year	21.1%	5,875 (mil.B)	2.4
Alt.2-1	Alternative 1 plus Heightening of Flood barrier and full protection of Phatum Thani, Nonthaburi and Bangkok	8,400 as initial cost and 476 as annual cost	4,838/year	24.0%	9,014	2.9
Alt.2-2	Alternative 1 plus Flood Diversion , Upgrading of river improvement, and Full protection of Phatum Thani, Nonthaburi and Bangkok	39,896 as initial cost and 671 as annual cost	6,300/year	12.0%	1,427	1.1

- **component of dam operation rule is not included**

The project will bring about many intangible benefits as the atabilization of people ' s living condition, decrease of waterborn diseases, increase of work opportunities, and so on . Among the alternatives, the division channel can be used for water resources development purposes.

3.3 FEASIBILITY STUDY

Considering significance and urgency, the following priority projects were selected for the Feasibility Study from among those proposed it the Master Plan study:

- Nonstructural Measures: Land use control and guidance based on the flood risk map, modification of reservoir operation rule, and institutional and organizational arrangement .
- Structural Measures: River Improvement (Stage l) for protection of agricultural areas .

3.3.1 Nonstructural Measures

3.3.1.1 Study on the Modification of Reservoir Operation Rule

In the feasibility study, the objective dams were narrowed down to the Bhumiblo, Sirikit and Pasak under the condition that the Kok – Ing - Nan diversion project will still not be in operation. This is because the completion year of the Kok – Ing – Nan water diversion project is assumed to be 2012, while the target year of the Feasibility Study is 2005.

In the Feasibility Study, the modification of reservoir operation rule of these three dams was ezamined under the following principles:

- The discharges from the Bhumibol and Sirikit reservoirs are minimized, while flood damage is observed in the downstream area.
- In the case of Pasak reservoir, the upper rule curve is set up to secure flood mitigation function by maintaining a vacant capacity when the flood peak is observed.

To identify the suitable operation rule curve in accordance with the above principle, several cases of rule curves were set up and, through simulation, the most effective operation rule was selected from the flood mitigation viewpoint.

The project benefit and cost for the modification of reservoir operation rule are estimated as follows:

Item	Average Annual Economic Benefit (million Baht)	Annual Maintenance Cost (million Baht)
Total for three dams	1,038	80

3.3.1.2 Study on Land Use Control and Guidance

Effective land use control and guidance are essential for flood mitigation, as pointed out in the master plan study. The area where land use control and guidance should be considered was identified based on the three kinds of flood risk map. With such maps, land use control and guidance could be realized through the following:

- Recognition of the flood risk map by the agencies concerned, and publication of the flood risk map to caution on land use in the flood risk area.
- Preparation of land use plan based on the flood risk map so as to minimize the increase of flood damage in the future and to preserve the natural retarding effect.
- Advice and coordination on the provision of public facilities such as toads and airports for the preservation of the present retarding effect, when such public facilities are provided in the flood risk area.

3.3.1.3 Study on Institutional Arrangement

In the master plan, several measures for flood mitigation are proposed, and the possibility of realizing these measures within the present institutional framework has been examined. To solve the present issues, further institutional arrangement has also required:

- Setting up of strategy of integrated flood mitigation.
- Nomination and coordination of agencies concerned.
- Flood disaster management, especially on flood fighting.
- Other functions to enhance the flood mitigation capability, including the role of a flood information center.

3.3.2 Structural Measure (River Improvement)

In the feasibility study, the possibility of river improvement in the midstream of the Chao Phraya river system from the Chao Phraya Dam to Pathum Thani was further examined to clarify the possible improvement scales and stretches. Through hydraulic analysis and preliminary designing, the major features of river improvement were proposed, as mentioned below.

3.3.2.1 Project Scale

The project design scale is set at a 3- year return period. The river improvement will then upgrade the safety level of all the problem areas in the midstream to the 3- year level, at least, but will not increase flood damage in the Bangkok metropolitan area.

3.3.2.2 Improvement Works

The proposed dike alignments are drawn, following the existing dikes or roads to minimize land acquisition. The total length of dike improvement is estimated at 67 km, and 13 regulators are proposed at the intersections of the existing/proposed dikes and khlongs. The total financial cost is estimated at 1,425 million baht, while the annual benefit is estimated at 221 million baht/year.

3.3.3 Project Evaluation

3.3.3.1 Economic and Financial Considerations

The economic evaluation has been made only for project components that can be evaluated in monetary term based on the economic cost and benefit; namely, the modification of reservoir operation rule and the river improvement. The results of the evaluation are as shown below.

Item	(1) River Improvement	(2) Modification of Reservoir Operation Rule
EIRR (%)	12.5	-
B – C (million Baht)	28	5,693
B/C	1.0	13.3

As identified from these figures, the economic viability of river improvement is not so high, but the EIRR value is over 12 % which is regarded as the minimum of project viability. In the case of modification of reservoir operation, EIRR is not a suitable index to identify the economic viability. This is because the project will bring about constant benefit and cost from the beginning, so that EIRR is not obtainable. Therefore, only B – C were used to evaluate economic viability of this project component.

Judging from the figures, the modification of reservoir operation rule will bring about a high economic return.

Also, these project components will bring about many intangible benefits such as the stabilization of people's living condition, decrease of waterborne diseases, increase of work opportunities, and so on.

As for the financial point of view, the source of the cost is assumed to be the government budget, which will be fulfilled by increase of government income resulting from the increase of productivity in the river basin due to flood damage mitigation.

3.3.3.2 Environmental Impact Assessment

As discussed earlier, the environmental impact assessment (EIA) is necessary only for the river improvement. The EIA has concluded that the river improvement will not cause a serious environmental impact in the project area.

3.4 CONCLUSION AND RECOMMENDATION

3.4.1 Conclusion

The Master Plan integrated flood damage mitigation in the Chao Phraya River Basin has been formulated in accordance with the "Monkey Cheek" concept for preservation of the present retarding effect and, also, with the introduction of suitable flood mitigation measures. To realize the Master Plan, several projects have been selected for urgent implementation. For some of the projects, their feasibility have been examined and confirmed and, for the others, further studies have been undertaken.

3.4.2 Recommendation

(1) Justification of the Master Plan

The Master Plan of integrated flood mitigation in the Chao Phraya river basin has been formulated. Since the realization of the Master Plan river is essential for the future development of the basin and the whole country as well, it should be justified as a part of Thailand's National Development Plan.

(2) Strengthening of the Present Organization and Set up of a River Basin Committee

The Master Plan is composed of several project components, most of which are to be undertaken by the agencies concerned within their scopes of responsibility. For the realization of the Master Plan, however, it is recommended that the present organization be strengthened to successfully implement the project components.

For coordination to realize the Master Plan, it is indispensable to promptly set up the River Basin Committee as proposed in the Water Resources Act that is presently under consideration on the national level. Thus, it is also recommended that the setup of the River Basin Committee be expedited.

In case the prompt setting up of the River Basin Committee is difficult under the current movement to restructure the existing organization, it is suggested that an ad-hoc committee be set up by the existing agencies concerned, as a tentative solution, to cope with the flood mitigation issues caused by lack of coordination.

(3) Selection of Alternative Measures

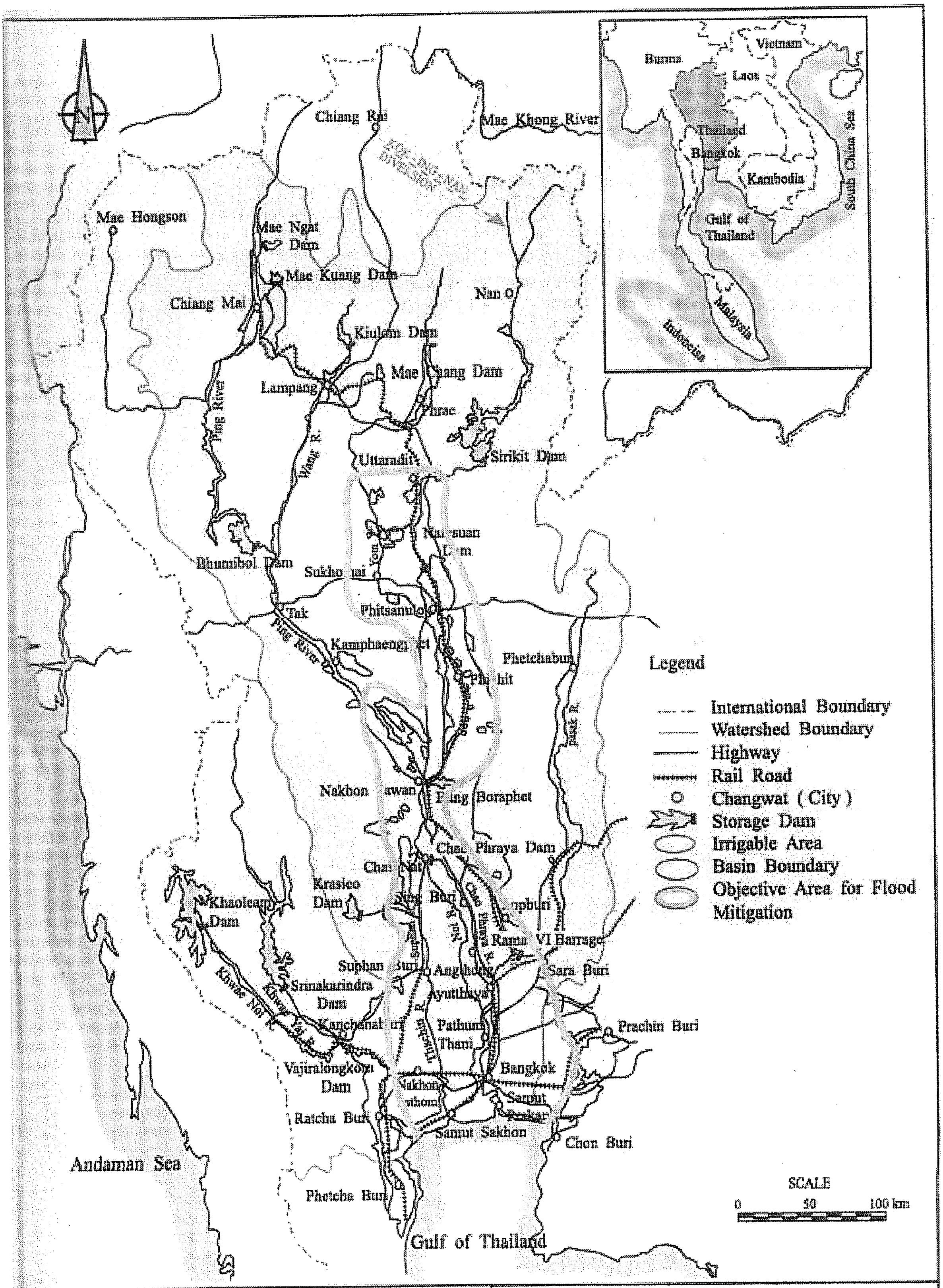
In the Master Plan, alternative measures (Alternative 1, 2-1 and 2-2) have been proposed to assure the safety level of protection for urban areas in the downstream, especially Pathum Thani, Nontaburi and Bangkok. Since t has been difficult to select the most suitable alternative due to significant issues involved, it is recommended that further discussions be made as early as possible to select the most acceptable for all concerned. In the discussion for realization of the stuffy results, it is necessary for all concerned in the Thai side to recognize that further stubby shall be done before construction of diversion channel. Also, social and environmental assessment for the heightening of flood barrier in Bangkok shall be conducted in detail before construction.

(4) Implementation of Priority Projects

In the framework of the Master Plan, four (4) priority projects have been selected; namely, modification of reservoir operation rule, land use control and guidance, institutional and organizational arrangement, and river improvement. Since all of these priority projects are essential to promote the flood mitigation in the Chao Phraya river basin from the technical, social and environmental points of view, it is recommended that these projects be promoted to the next stage of implementation as early as possible.

(5) Further Study on Flood Mitigation in Agricultural Areas

As the measures for flood mitigation in agricultural areas, river improvement works and drainage system and distribution system improvement have been proposed. The process of system improvement was introduced in the Master Plan study, and only the river improvement works were covered in the feasibility study. To mitigate the flood damage in agricultural areas, however, it is also necessary to promote the distribution and drainage system improvements n parallel with the improvement works. Thus, it is recommended that a further study on these system improvement works should be undertaken as early as possible.



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	GENERAL MAP
CTI ENGINEERING CO., LTD. AND INA CORPORATION	

Fig A-0 GENERAL MAP

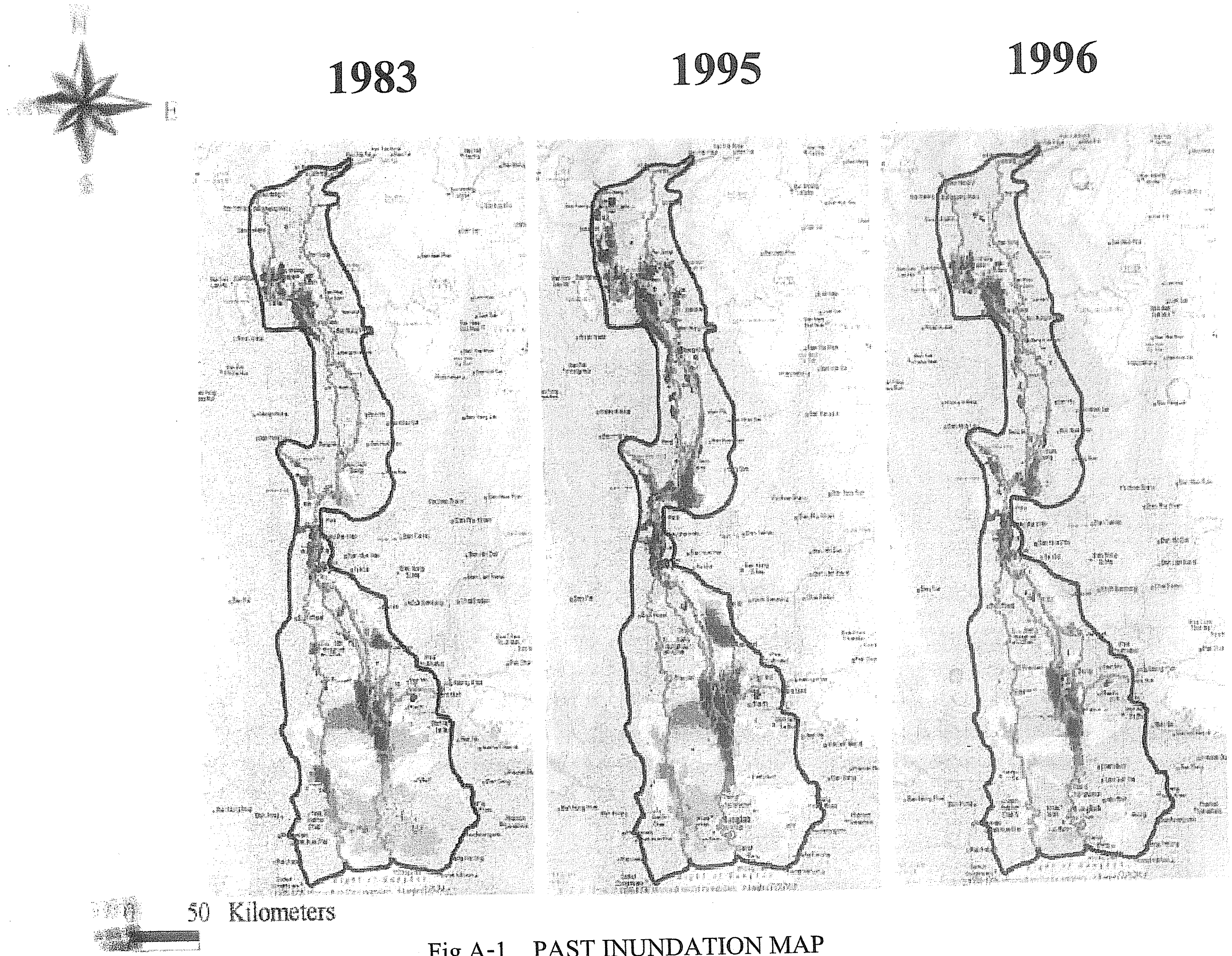
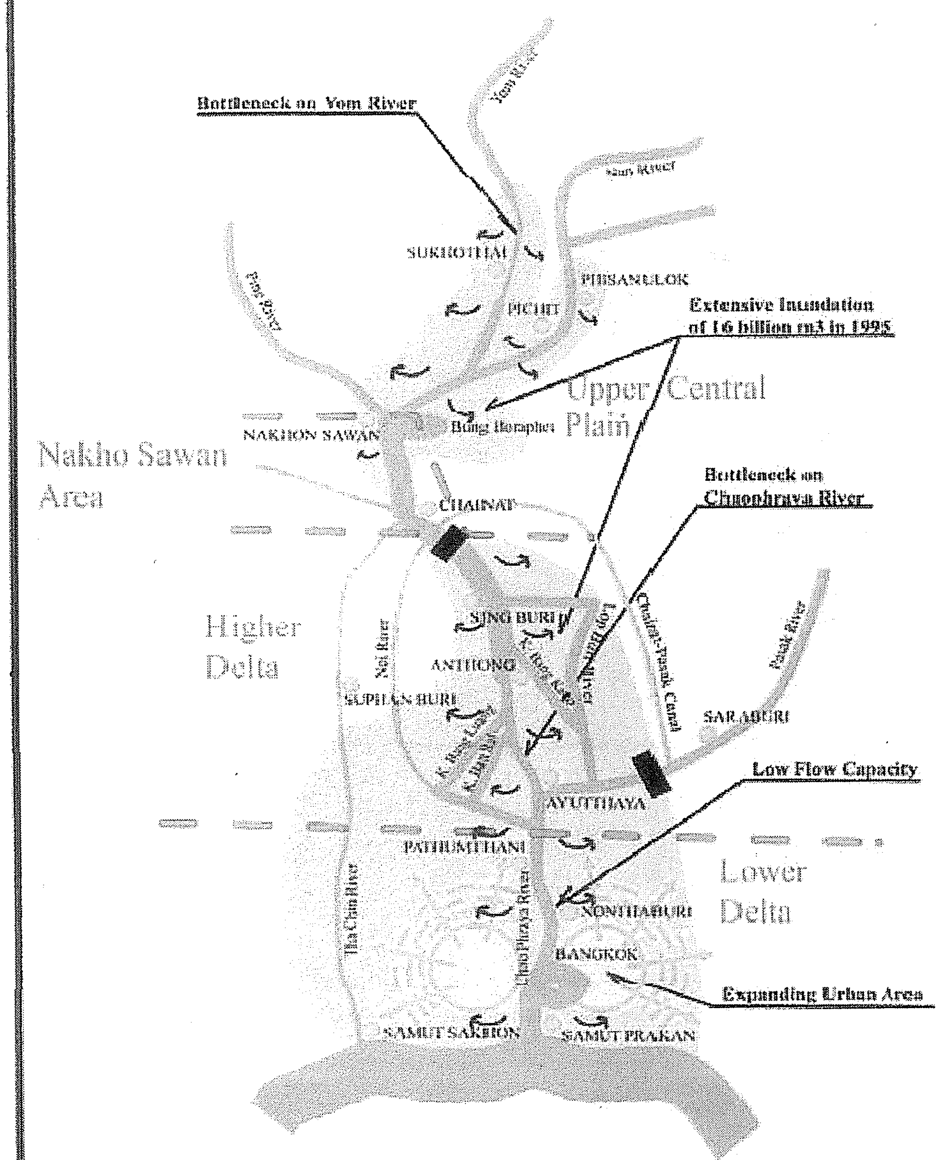


Fig A-1 PAST INUNDATION MAP



River and Flooding Condition

Area	River	Stretch	Flow Capacity (m^3/s)	Inundation Volume in 1995
Upper Central Plain	Nan	Phisanulok to Chao Phraya River	1,000 to 2,000	5 billion m^3
	Yom	Suknothai to Nan River	50 to 1,100	
Nakhon Sawan Area	Chao Phraya	Nakhon Sawan to Chainat	2,500 to 4,500	1 billion m^3
Higher Delta	Chao Phraya	Chainat to Ayutthaya	4,200 to 1,300	7 billion m^3
Lower Delta	Chao Phraya	below Ayutthaya	2,900 to 3,200	3 billion m^3
	Chao Phraya	BMA Flood Barrier *	3,600	

* : On-going Project

Flood Damage in 1995 Flood

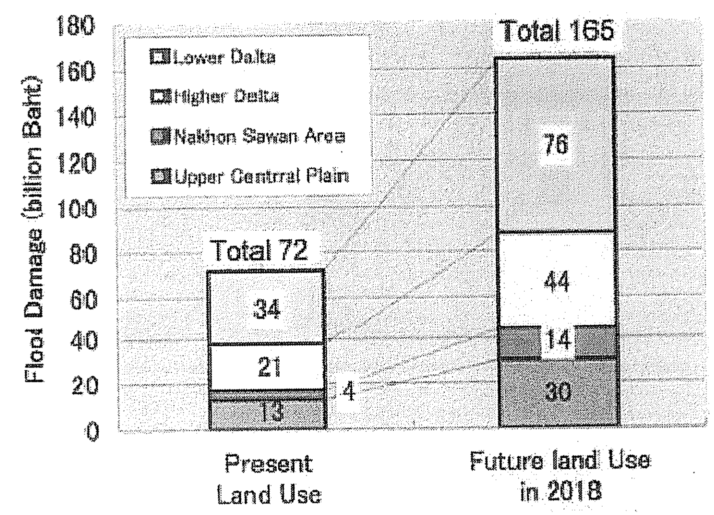


Fig A-2 PRESENT FLOODING SITUATION

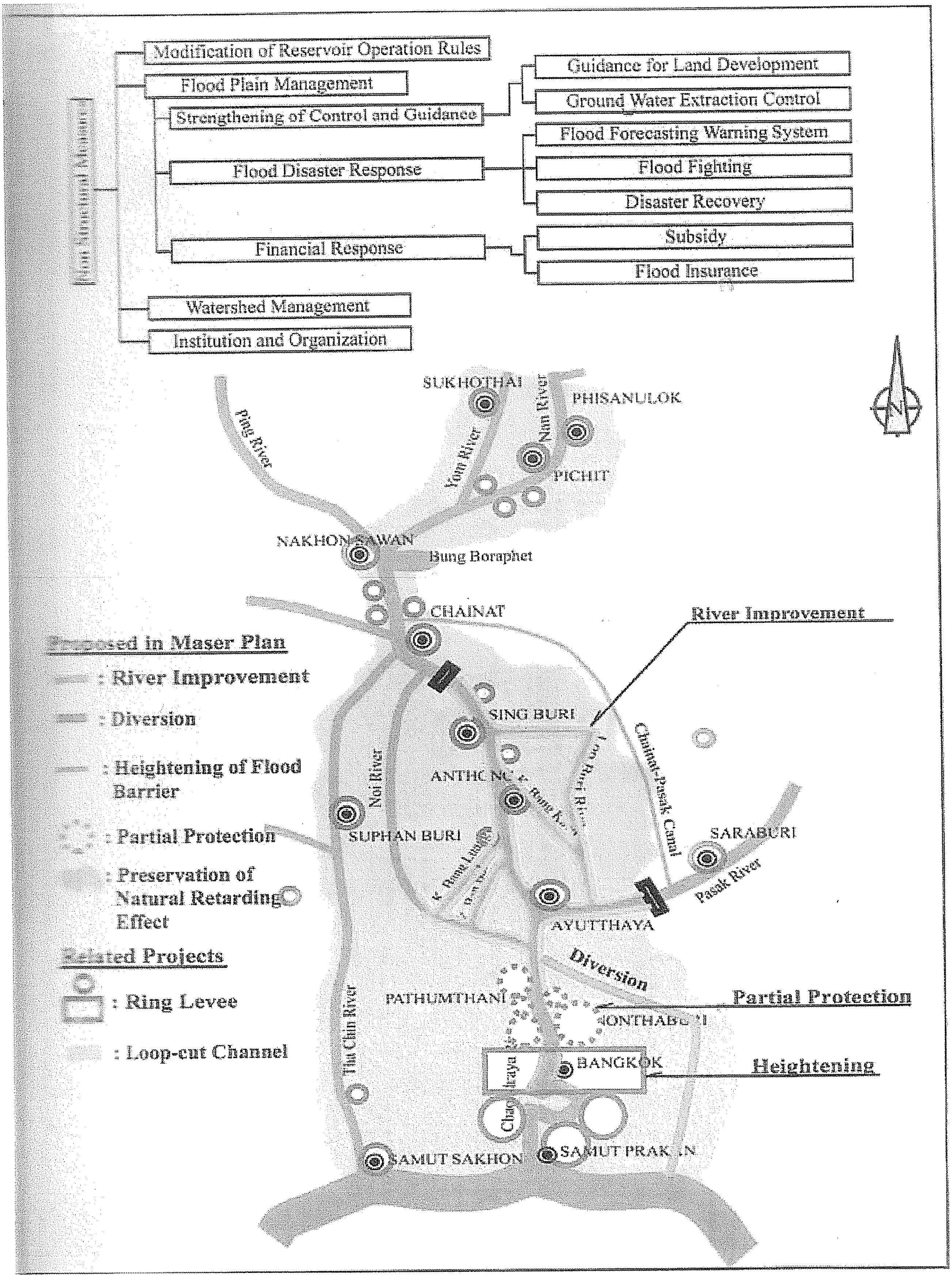


Fig A-3　MAJOR PROPOSED MEASURES

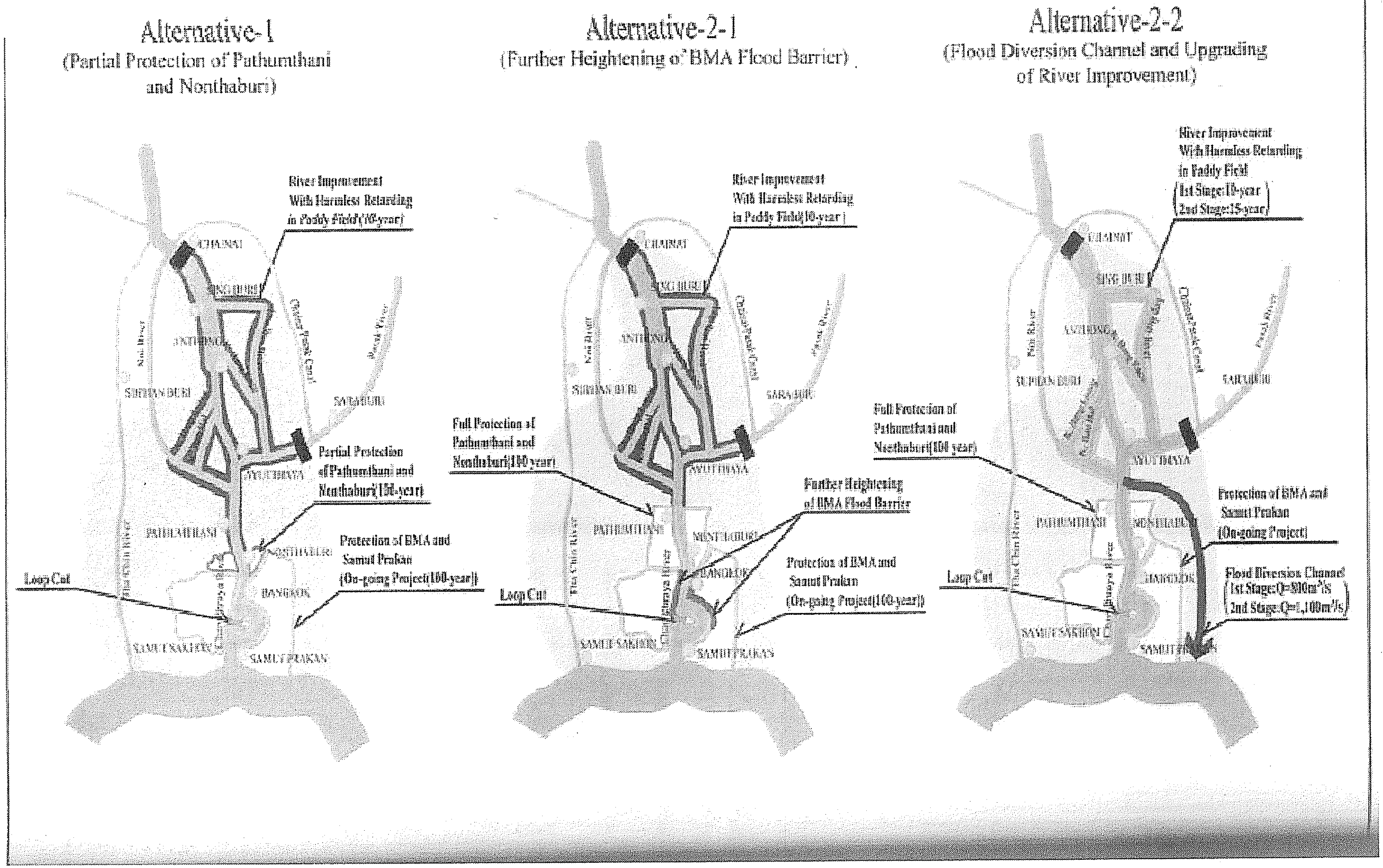


Fig A-4 ALTERNATIVES

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
(MARD)

COUNTRY REPORT OF VIETNAM

RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT DISASTERS IN THE MEKONG DELTA

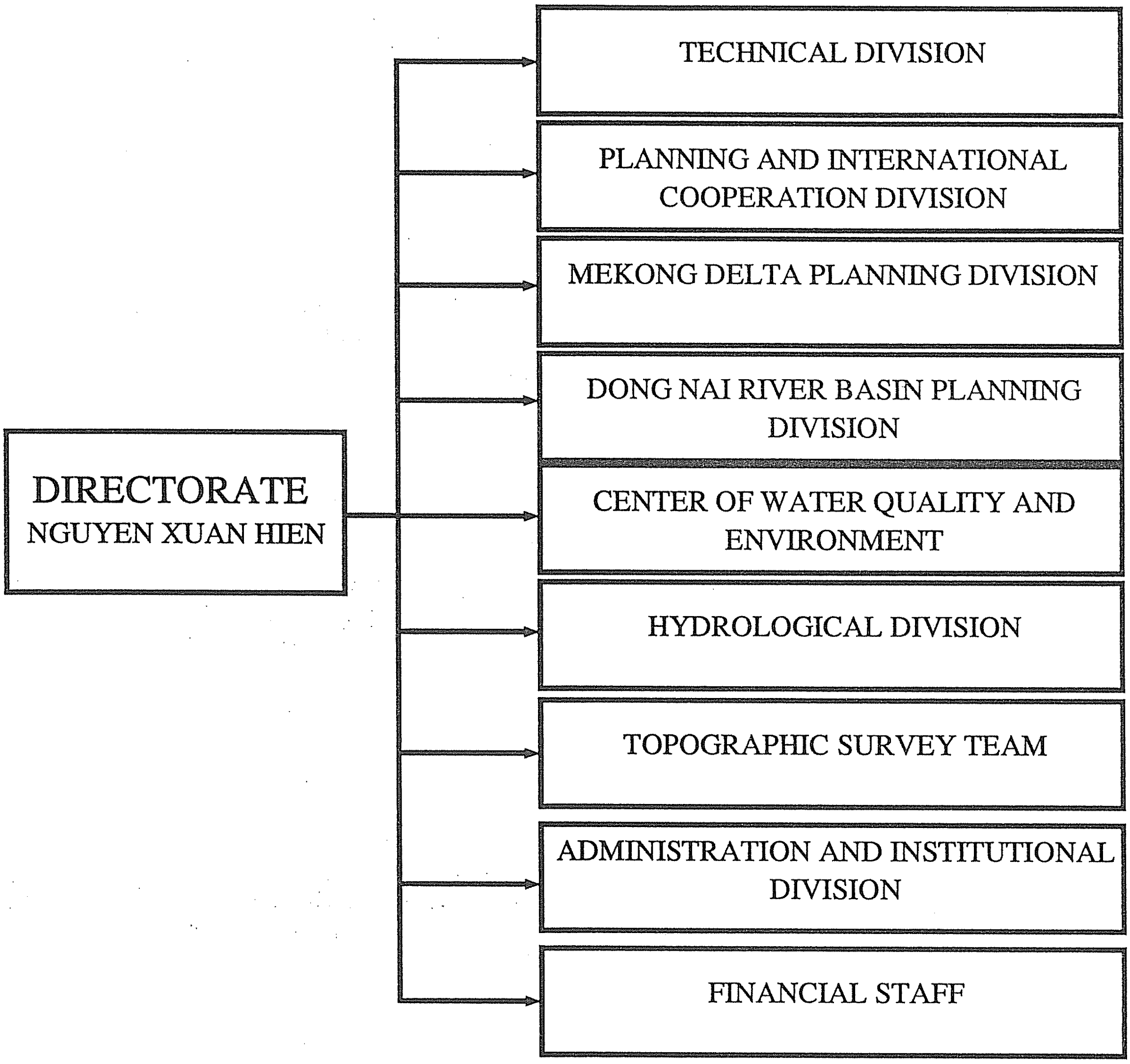
JICA EXECUTIVES' SEMINAR
ON PUBLIC WORKS AND MANAGEMENT
JFY 2005

Prepared by: NGUYEN XUAN HIEN

Position: Deputy director
Organization: Sub-Institute for Water Resources Planning
Country: Vietnam

HO CHI MINH CITY, AUGUST, 2005

SUB-INSTITUTE FOR WATER RESOURCES PLANNING (SIWRP)



SIWRP belongs to the Ministry of Agriculture and Rural Development

- **Capacity**
  - *A staff of doctors, masters and engineers graduated in Vietnam and oversea, a staff of skilled workers.*
  - *Capacity in cooperation with many Vietnamese and International agencies on water resources/river basin management and development.*
  - *Specific software for hydrology, hydraulics, GIS, ARCVIEW, economic, optimal analysis and environmental impact assessment (EIA).*

- **Function**
  - *Integrated water resources planning for the river basins;*
  - *Participating regional, provincial and sectoral master plans relating to water resources development;*
  - *Implementing studies on water control projects;*
  - *Researching water resources subjects and programs;*
  - *Surveying hydrology, topography and geology;*
  - *Setting up water quality monitoring networks;*
  - *Implementing environmental impact assessment (EIA);*
  - *Consulting water resources development strategy.*

- **Responsibility area:**
  - *The Mekong delta and Dong Nai river basin, including 22 cities and provinces, 88,000 km^2;*
  - *The Mekong delta: 39,400 km^2, occupying 50% total food production of Viet Nam;*
  - *The Dong Nai river basin and surrounding areas: 48,500 km^2, occupying 50% total industrial production of Viet Nam.*

- **Personal Data**

I was the senior hydraulic modeller in SIWRP and have extensive experience having worked with the hydraulic model for many years. I have applied the hydraulic models for simulation of the hydraulic and salinity intrusion on many water resources projects in the Mekong Delta. In addition of modelling experience, I also have many years of experience in water resources planning and management.

From 2002 to now: Deputy Director of Sub-Institute for Water Resources Planning. I'm responsible for the technical issues of all the water control Projects in the Mekong Delta as follows:

The Water Resources Planning Project for the Cai Lon and Cai Be river Basins in the Mekong Delta from 2002 to 2004.
The Integrated Water Resources Planning Project for the Mekong Delta from 2002 to 2005.
The Flood Control Dike System Planning Project for the Mekong Delta from 2002 to 2005.
The Water Resources Planning Project for the Diversification Crops in the Coastal Areas of the Mekong Delta from 2002 to 2005.
Manager of the Detail Water Resources Planning Project for the Ca Mau Peninsular, Mekong Delta from 2003 to 2006.

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271/3 An Duong Vuong Street, 5th District, Ho Chi Minh City, Vietnam
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CONTENT

I. INTRODUCTION

A large area in Northern part of the Vietnamese Mekong Delta is flooded annually. The flooded area is approximately from 1.2 million hectares to 1.8 million hectares in high flood years and flooding lasts from 3 to 6 months with water depth between 0.5 to 5.0 meter. Flooding has serious negative impacts on production and on the lives of the people.

Recognizing the special important role of food production in the Mekong Delta, the Communist Party of Vietnam (CPV) and the Government of Vietnam (GOV) have invested to exploit the abundant potential of the Mekong Delta over the past two decades. The construction of a series of hydraulic works in order to divert freshwater, drain acid water, prevent saline water and drain inundated water and numerous kilometers of dikes for protecting Summer-Autumn rice against floods in combination with application of new rice-seed and advanced agricultural technique have created premises and conditions for changing seasonal–crop structure; have increased rice production of Mekong Delta from single rice production with low yield to double and triple rice production with high yield, from 4.7 million tons of rice product in 1976 to 13 million tons of rice product in 1995 and 17 million tons of rice product in 2000, playing an important role to national food security strategy.

However, a lots of problems related to floods still remain which we do not have enough time, knowledge, experience or capital to tackle in order to develop more stable agriculture and aquaculture production of the Mekong Delta. At present, floods have become the most dangerous disaster, not only damaging people's properties and threatening people's lives, but also hindering progress of industrialization and modernization in the Mekong Delta.

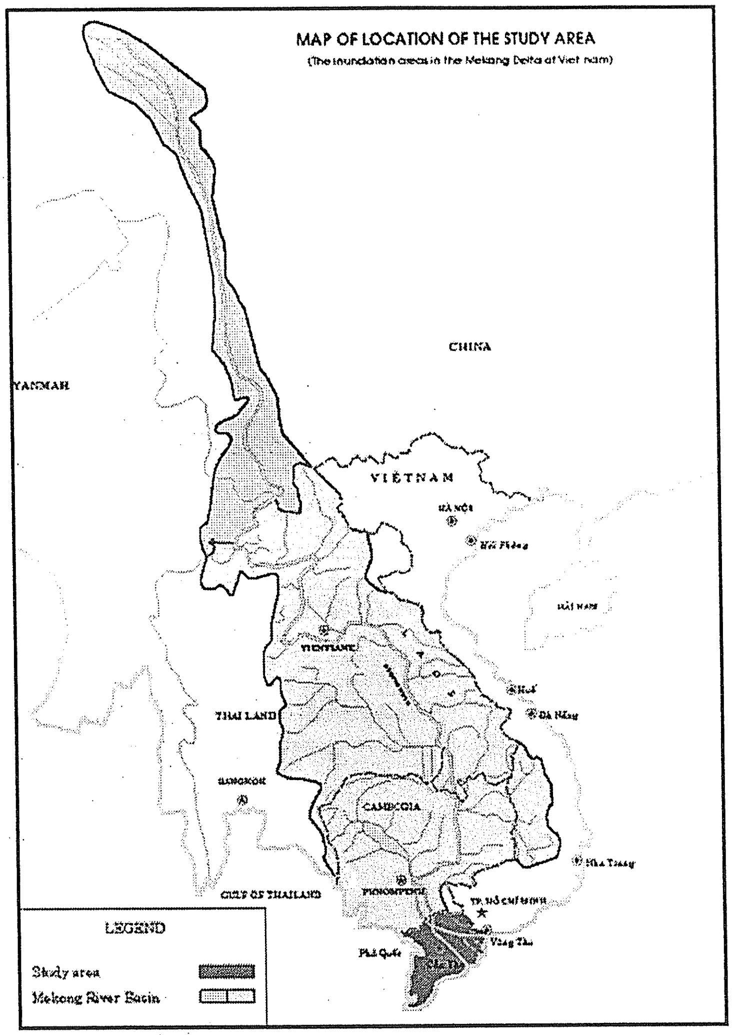
Nevertheless, floods also have positive effects, floods carry sediments to enrich the rice fields, increase aquaculture production, leach toxic ions from acidic soils and generally cleanse the land.

How to minimize the negative impacts and maximize the benefits of flood in the Mekong delta are the main mission of the flood management and mitigation.

II. RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT RELATED DISASTERS

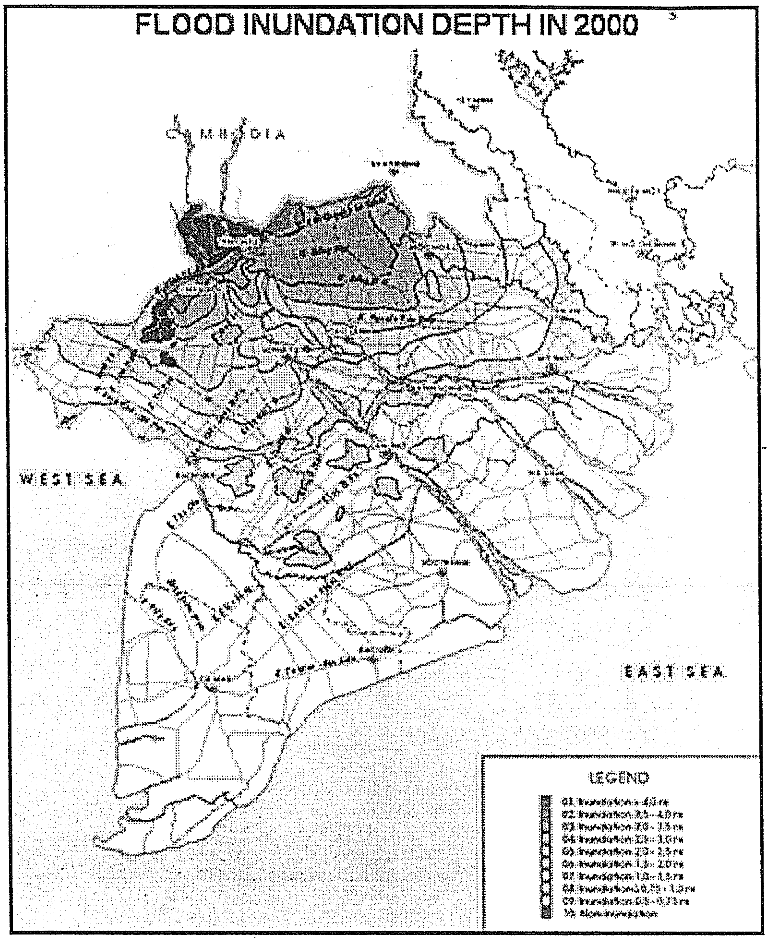
2.1. Characterization of the flood in the Mekong Delta

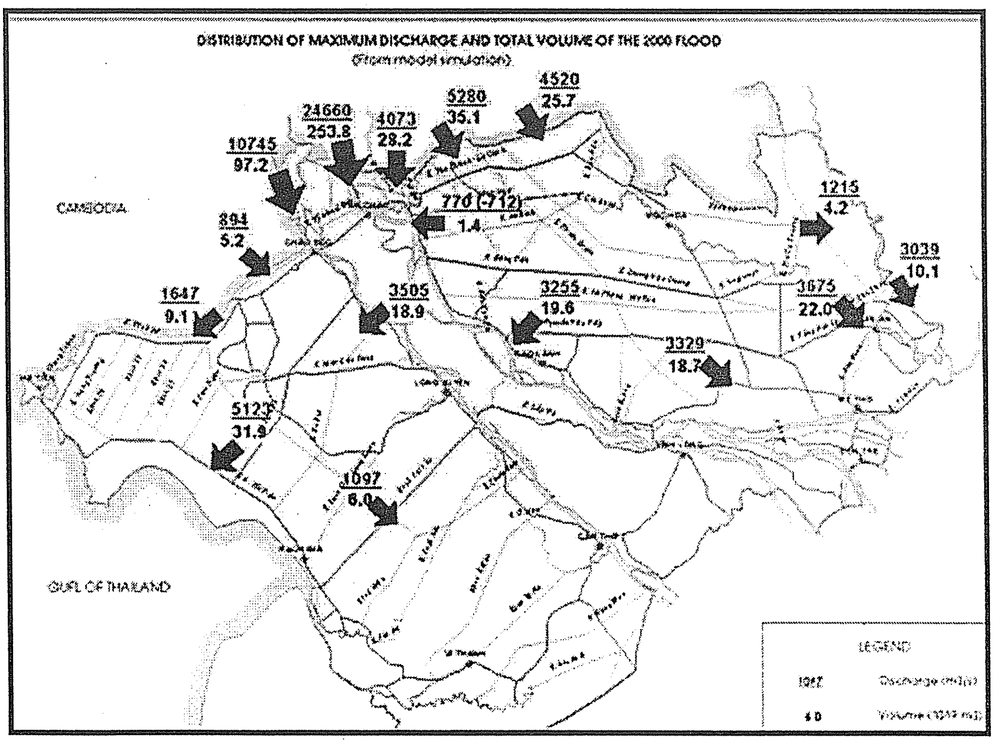
In the flood season the river system does not have sufficient capacity to discharge the total amount of water. Consequently, this results in storage and overland flow in flood plains in Cambodia and Vietnam. The flooding starts downstream of Kompong Cham in Cambodia, from Kompong Cham, flood is regulated by many large depressions.



- On the left side of the Mekong river, the Tongle Toch river from 9 km downstream of Kongpong Cham runs parallel with the main river and submerges a large low-lying area at Prey Veng, then reconnects to the Mekong river at Ban Nam.
- On the right side of the Mekong river, the Prek Dang Kom and Mul KomPul rivers submerge the area between the Mekong river and TonleSap river.
- The Great Lake, connected to the main river by the Tonle Sap, plays a very important role in flood water regulation. At elevation of +11 m, the lake has 12,000 Km^2 of water surface with a volume of 80 billion m^3. From May until September, Mekong water feeds into the Great Lake and drains back into the river from October until April next year. In the first haft of the flood season, maximum flow into the Great Lake can reach 11,000 m^3/s, and causes a reduction in the peak of the flood at downstream. Outflow from the Great Lake usually occurs in late September or early October. Highest outflow from the lake is about 10,000 to 12,000 m^3/s. The effect of the Great Lake in reduction of the flood peak is significant for early, fast and high flood. The flooding conditions become more serious if the second peak of flood occurs when the Great Lake is already full and starts to release water into the Mekong river.

- Downstream of Phnom Penh, about 80 to 85% of the total flow drains through the Mekong while only 15 to 20% through the Bassac. This distribution is changed at downstream in the Vietnamese Mekong Delta. About 1/3 of the discharge in the Mekong is transferred into the Bassac through the Vam Nao.
- Before entering the Vietnamese Mekong Delta, on the left side of the Mekong river, water flows in the Stung Slot river (or Tonle ProSat river) towards the South. Near the Cambodia-Vietnam border, water in the Mekong overflows the low river bank and drains into some canals connecting to the Stung Slot river.. It combines with flood water from upstream of the Stung Slot and submerges the large area along the border of the two countries. After that, most of the flood water flows into the Plain of Reeds through the low embankment of the So Ha canal. This is the main source of flooding and causing severe damages in the Plain of Reeds. The remain flows into the So Thuong river and back to the Mekong river.
- On the right of the Bassac river, flow from the Prek Thnot river from the Western side of the delta, it combines with flow from some canals which convey flood flow from the Bassac river forward downstream, parallel with the Bassac river then connect with the Chau Doc river in Vietnam. Near the border, the TaKeo river originates from the South-western hill zone of Cambodia. All flows of these tributaries connect together and submerge a large area at the border, the main part of flow crosses seven bridges on the Chau Doc-Tinh Bien road into the Long Xuyen quadrangle, a part flows through the Vinh Te canal to the Gulf of Thailand and the remain flows back to the Bassac river.
- Flood enters Vietnam following the Bassac and Mekong rivers and two large overland flows: on the left to the Plain of Reeds, on the right to the Long Xuyen Quadrangle. The inundation map and the distribution of inflow and outflow in the Vietnamese Mekong Delta in the 2000's flood season are shown in following figures.


FLOOD INUNDATION DEPTH IN 2000
CAMBODIA
WEST SEA
EAST SEA
LEGEND


DISTRIBUTION OF MAXIMUM DISCHARGE AND TOTAL VOLUME OF THE 2000 FLOOD
(From model simulation)
4520
25.7
5280
35.1
24660
253.8
4073
28.2
10745
97.2
770 (-712)
1.4
894
5.2
1215
4.2
3039
10.1
1647
9.1
3505
18.9
3255
19.6
3675
22.0
3329
18.7
5123
31.9
1097
6.0
CAMBODIA
GULF OF THAILAND
LEGEND

- In a high flood year, the total average discharge is about 45,000-55,000 m^3/s, of this, 75-80% flows through the main river and the other 25-30% or 10,000-15,000 m^3/s flows over the border. Of the over-flow floods, about 2,000-4,000m3/s flows to the Long Xuyen Quadrant, and about 8,000-12,000m3/s flows to Plain of Reeds. In the main river, a discharge of 23,000-25,000m^3/s sharing 82-86% flows through Tan Chau and a discharge of 7,000-9,000m3/s sharing 14-18% flows through Chau Doc. Total flood volume brought into the Mekong Delta of Vietnam is about 400-500 billion m^3 of which 80-85% is from the main river and the other is from the border over-flow floods. There is a difference in terms of water level between the Mekong river and the Bassac river. At the same time, the water level at Tan Chau is 40-60 cm higher than the water level at Chau Doc. So, water is always diverted from the Mekong river to the Bassac river through connected canals such as Tan Chau-Chau Doc, Vam Nao... of these, the Vam Nao canal is the largest canal. Due to this water diversion, water flows of the Mekong river and Bassac river at My Thuan-Can Tho are almost the same (51% and 49%). Most of the floods of the Mekong Delta in Vietnam flow into the South China Sea through the main rivers, and some flow into the Gulf of Thailand through the canal system.

2.2 Flood impacts on socio-economy and environment

Floods of the Mekong Delta in Vietnam have low transmission speed but cause deep and long-term inundation of large areas. This situation causes a lot of constraints to socio-economic development, agricultural production, settlement and development of infrastructure as well as to people's lives, transportation, education, and disease treatment. It can be said that floods limit land reclamation, rural development, and urbanization as well as the improvement of population education and modernization of society.

Annually, floods cause damages to property, loss of lives as well as river bank erosion, sedimentation and destroy infrastructure such as roads, bridges, sluices, schools, hospitals etc...

The 2000 flood was one of the most serious flood during the last 70 years, it made heavy damage in the Vietnamese Mekong delta. List of the 2000 flood damage in the Vietnamese Mekong delta is presented in the table bellow:

No	Item	Unit	Total
1	People death In which Children	People People	448 319
2	Property Inundated household Inundated infirmary Inundated road	 Unit Unit Km	 865,166 376 11,010
3	Water resources system Impaired canal, embankment erosion Impaired dike, embankment Impaired sluice	 m^3 Km Unit	 27,822,400 1,470 2,440
4	Agriculture and fishery production Loss rice area Submerged rice reduce of yield Loss and submerged fruit area Loss and submerged upland crop area Loss fishery area	 Ha Ha Ha Ha 	- 55,519 168,814 70,064 23,201 12,668
5	Education Flooded school Flooded class Absent pupil	 Unit Unit Pupil	 2,751 12,282 830,899

The estimated cost of the 2000 flood damage was 4,000 billion VND about US$ 275 million.

Generally, the more economic development the more damages occur. In recent years, the damages to agriculture have been reduced but the damages to infrastructure have been increased. In agricultural production, the damages to rice and upland crops have been reduced but damages of fruit trees has been increased.

Floods of the Mekong Delta in Vietnam have brought some benefits. Floods bring abundant silt for farm sedimentation. Annually, the Mekong Delta in Vietnam is embanked by millions of tons of silt. And due to silt sedimentation, land stretches along the Mekong river and Bassac river are fertile, suitable for fruit trees, upland crops and paddy rice.

Water of the Mekong river and the Bassac river in the Mekong Delta of Vietnam contains lots of silt particles which come from the upper part. Concentrations of silt particles in these rivers is high in the flood season and low in the dry season. Silt concentration is reduced from upstream to downstream. At Tan Chau station, the average silt concentration is about $800g/m^3$ in the flood season, and a highest number of $1000g/m^3$ was recorded in August but an average silt concentration of only about $200g/m^3$ was recorded in the dry season. At the Chau Doc station, a number of about $200g$-$300g/m^3$ in term of average silt concentration was recorded in the flood season with the highest number of $400g/m^3$ of silt concentration being recorded. However, silt concentration of the Bassac river increased after the Vam Nao due to water diversion from the Mekong river.

Flood flows are good for environmental improvement and land reclamation. Floods can clean farm fields, dissolve toxic chemical, kill mice, and insect. Floods of the Mekong delta in Vietnam create float-water season in large areas and favorable environment for fresh-water fishery development. Fish and shrimp growth is closely related to the flood regime. Water species grow fast in the flood season due to the enlarged living environment. Generally, the more floods, the more fish. Annually, the Mekong river produces 35 million heads of fish with high value.

2.3 Objectives

The objectives of flood management and mitigation in the Mekong Delta are to create conditions for comprehensive socio-economic development of the Mekong Delta in Vietnam, to protect the ecological environment as well as to develop rural areas of the Mekong Delta in Vietnam in trend of industrialization and modernization. This means that flood control must not only overcome and mitigate damages caused by floods; protect and improve the living standard of the people; protect inhabited areas, urban areas, infrastructure; develop agriculture but also exploit benefit of floods in order to increase silt amounts, fisheries, watering down acid water, and cleaning farm fields in the inundation areas. Therefore, the strategy of flood management and mitigation in the Mekong delta is **"Adapt living with floods"**

- Due to "living with floods", the river, canal and structure system in the inundation areas of the Mekong Delta are responsible for not only supplying water, drainage, drainage of acid water but also drainage of floods. So that, the study of planning for transportation, inhabited areas and infrastructure must be considered in practical conditions in order to be suitable with flood management and mitigation. In view of water resource planning, flood management and mitigation must also pay attention to consider comprehensively the water supply, drainage protection of salinity intrusion, watering down acid water and land reclamation as a "planning of water resource utilization and conservation". Moreover, water resources planning must be combined with planning of transportation, construction, fishery and agriculture etc... in order to develop and construct the rural areas of the Mekong Delta in a trend of civilization and modernization. In the other word, ***flood management and mitigation should be based on comprehensive view to solve the multiple problems.***

- Flood protection for the Mekong Delta in Vietnam must be construction-measures and non-construction measures. Construction measures are the building of hydraulic works in order to initially control floods in accordance with objectives and purposes. Non-construction measures are measures in order to mitigate damages caused by floods such as long-term and short-term flood forecast for controlling floods; building of modern communications system in order to receive information immediately and orders as well as establishment of relief teams to respond to bad situations. Arrangement of production sectors; cultivation seasons must be suitable in order to avoid damages and to increase efficiency. A close combination between construction measures and non-construction measures will bring much higher benefits and decrease investment cost.

- Mathematical models for describing and forecasting hydrological regimes of the Mekong Delta are the main tools used to forecast the changes of water levels and discharges at different sites in the inundation areas of the Mekong Delta in accordance with different scenarios. However, the hydrological and hydraulic regimes of the Mekong Delta in Vietnam are very complex and depend on lots of factors, which are difficult to define, such as overflow plains, low-lying areas, and the distribution of flows in dense canal system. Flood simulation models for the Mekong Delta in Vietnam have been studied over 20 years, but these still contain some constraints. Hence, it needs to be continued to upgrade mathematical models as well as review and analyze the simulation results seriously and when designing constructions considering safety coefficients. The experiences in construction of hydraulic works in a large areas of Mekong Delta in Vietnam are step by step construction parallel with monitoring in order to change when it is necessary.

- Floods affect not only to the inundation areas but also the whole area of the Mekong Delta in Vietnam. Flood control constructions will change hydrological regimes and the environment of the whole Mekong Delta in Vietnam. So, environmental impacts of flood management and mitigation scenarios need to be assessed in order to find out the benefits and ways to mitigate negative impacts on the ecological environment.

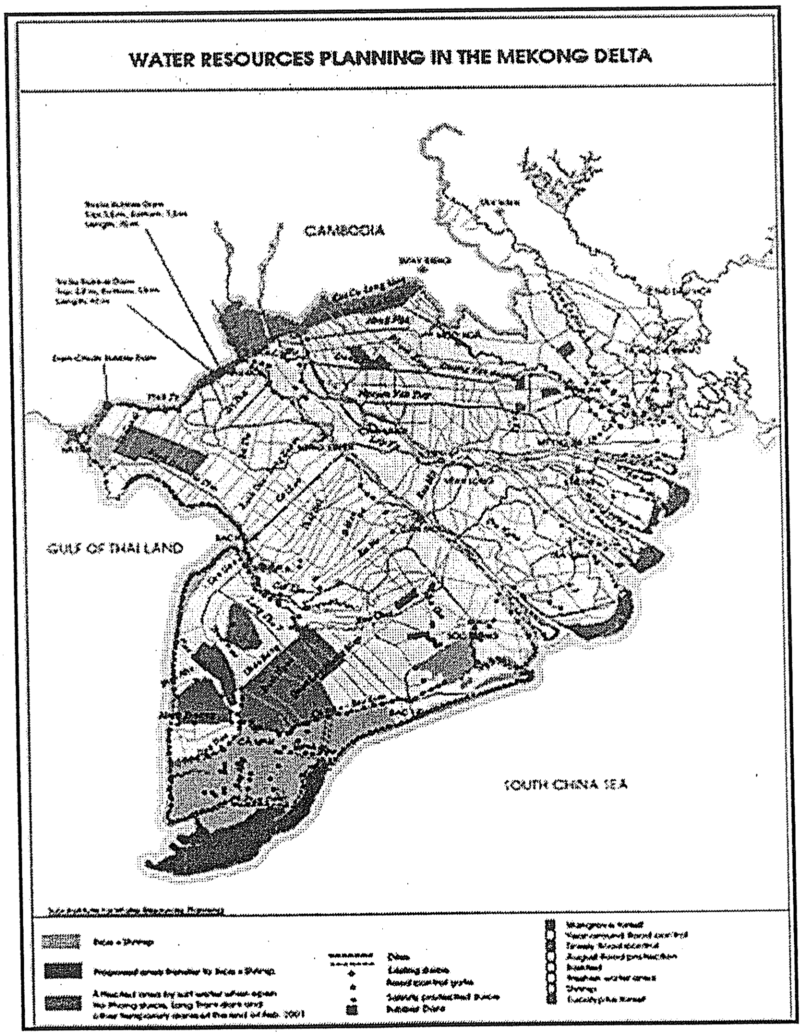
- Selection of flood management and mitigation scenarios must be based on objectives, economy, engineering, society and environment. Firstly, the given scenarios must be considered to the satisfaction of objectives. And these are the pivotal points for selection of scenarios.

- Economic efficiencies are also very important standards for selection of scenarios. But floods of the Mekong Delta affect lots of sectors such as the economy, the society and the environment. At present, economic assessments are evaluated in much more detail by many methods. However, besides valuable economic coefficiencies, there are lots of un-valuable economic coefficiencies such as indirect economic coefficiencies. Hence, flood management and mitigation in the Mekong Delta in Vietnam must be considered not only to economic impacts but also to social and environmental impacts.

2.4 Structural Measures

"Living with floods" does mot mean to let floods freely flow to inundation areas. It means that floods have to be controlled, limiting less silt floods from Cambodia to the Plain of Reeds and the Long Xuyen Quadrant and find out ways to bring floods to the Gulf of Thailand, to the Vam Co river as well as bring back to the Mekong river and the Bassac river in order to reduce the inundation depth and creation to take silt floods from the Mekong river and the Bassac rive to farm fields. Living with floods but controlling them in order to prevent or limit early season floods aiming at safely harvesting Summer-Autumn rice and prevent or limit late floods in order to fast ensure steady double rice production (Winter-Spring and Summer-Autumn). In the main flood period, let floods flow to farm fields in order to reduce water levels in the border areas. Moreover, living with floods but having control of them in order to exploit the benefits and limit the negative impacts of floods.

For the flood management and mitigation, based on the depth and duration of flood inundation and natural condition, the Vietnamese Mekong delta has divided into two areas, the deeply flooded areas and the shallow flooded areas. For each area, flood control measures will be applied with different levels. The flood management and mitigation for the Mekong delta is presented in the following figure.



The shallow flooded areas of the Vietnamese Mekong Delta such as the western area of Bassac river, the southern areas of Nguyen Van Tiep canal, the area between the Mekong river and Bassac river have rich agricultural potential and most of these areas cultivate double and triple crops per year. Hence, long-term orient is year around flood control planning for the shallow inundation for agricultural production in trend of civilization and modernization. It is noted that all shallow inundation areas are to be joined in flood drainage. So that, when building up year around flood control constructions in these areas, canals must be dredged in order to upgrade capacity of drainage of floods and avoiding increase of water levels for adjacent areas.

In the deeply flooded areas, the main strategy is to adapt to flooding conditions with restricted structural measures to stabilize existing double rice crops: winter-spring and summer-autumn. Existing embankments and dike will be reinforced to protect against early floods until august for safe harvesting of the summer-autumn crop. Drainage outlets will be enlarged to accelerate drainage capacity of the system. In order to protect the environment and the ecology in the inundation areas, it needs to build some ecological reservoirs as in the Tram Chim area of the Plain of Reeds and Long Xuyen Quadrangle.

For population protection, the rural population has been resettled into centers along roads at an elevation above flood level. Raised floors or pile houses have been built and public structures have been established in these population centers. In cities and urban centers, raised floor structures can be used or an enclosed dike to protect the whole communities can be built.

2.5 Non-Structural Measures

2.5.1 Preparedness Measures

Flood preparedness readiness in Vietnam is primarily responsibility of local authorities, with technical assistance and review by the regional offices based in Ho Chi Minh City. These arrangements have also been supported by national projects, primarily the MARD/UNDP programme improve communication systems and reporting during the response and recovery phases. With regard to flood warning arrangements, the Hydrometeorological Service of Vietnam informs provinces of mainstream water levels and expected flood effects, white the provincial authorities, primarily DARD, estimate local flooding affects from canals across the delta. Appropriate warnings are issued to districts, which in turn contact local authorities.

Community systems early warning have been greatly strengthened by the National Disaster Management Program undertaken by the Department of Dyke Management and Flood Protection of MARD, with support from UNDP. This program has improved communication links between Districts, Provinces, regional offices of ministries in Ho Chi Mink City, and national offices in Hanoi. There is now interconnectivity between all national and regional offices, provincial offices, district offices and some communities. Warning messages can be relayed more easily, and with more detail than before. This has been accompanied by a steadily building role of the Disaster Management Center, part of the government's Central Committee for Flood and Storm Control to provide continuous information about extent damage linked to water levels. The Vietnamese Government recognizes the importance of improving the early flood warning system in the Mekong delta, at least in the short to medium term.

2.5.2 Response Measures

Vietnam has a long history of emergency response operations, and activities are in general well defined. At the most local level, members of the Vietnam Fatherland Front and Women's Union are responsible for initial needs assessments, registrations, and delivery of relief supplies to families. They interact with District flood committees, who in turn report to provincial flood committee headed by MARD. The flow of information then goes to the Department of Dyke Management and Flood Protection, from where it is circulated to line ministries and sent to national levels. Response activities also include a number of activities to mitigate damage, such as the rapid deployment of military for dike control and early harvesting, and orders for early harvesting. The Vietnamese Red Cross cooperates closely with the local authorities to ensure basic provision of relief and access to safe sites.

Damage reports are collected by the districts, sent to provinces, which compile and send to the Department of Dyke Management and Flood Protection in a summary form. There does not appear to be any effort at this time to link damage and assessment information with geographical information system.

2.5.3 Recovery Measures

There appear to be three tiers of recovery operations.

- At community level, families must rebuild or repair homes, replant crops or restore businesses, and begin accessing social services such as schools and clinics. This process is greatly assisted by the mass organizations and districts.
- At the provincial level, where the bulk of public take place. The three priorities for are reported to be rehabilitating roads, repairing and re-dredging irrigation systems, and ensuring that communities are engaged with activities that are more in keeping with "living with floods". While line ministries have responsibilities for public improvements planning such as school or clinic repairs, the implementation and sitting decisions tend to be made by provincial committee.
- In the case of the 2000 floods, a large amount of international emergency assistance was provided for recovery activities. These funds were channeled through the Ministry of Planning and Investment, who in turn released funds to Provincial People's Committees. While in large part this was an efficient method for ensuring rapid recovery, there were certain problems posed with regard to sitting and sizing of rehabilitated improvements, such as embankments.

III. CONCLUSION AND RECOMMENDATION

Flood and inundation in the Mekong delta are strongly impacts to socio-economic development. Moreover, floods and inundation are very complicated, affected by many factors. Therefore, flood control measures should have to be implemented step by step in order to supplement justify practically.

It is recommended to develop capacity building for engineers concerning with flood management and mitigation and increase regularly data exchange between the riparian countries. Also close communication between the riparian countries is indispensable in flood management and mitigation.

It is recommended to establish early flood warning system in the Mekong Basin. In the short and medium term, non-structural measures, such as hydrological forecasting flood and warning system are cheaper and more practical. Although flood warning can not prevent flooding, but it can minimized the damage to property and lost of people's lives through timely and accurate flood forecasting in the Mekong Basin.

Mathematical models have now been used to simulate various alternatives for flood control in the Mekong delta. In the near future, effort will be made to improve models as essential tools in flood management and mitigation. A monitoring network is necessary to observe changes in flow regimes and to provide early identification of negative effects to the environment for studying mitigation measure.

Flooding in the Mekong Basin has both advantages and disadvantage, how can flood management and mitigation make full use of the advantage and limit disadvantage? Therefore, the international cooperation for support and exchange data, information, knowledge and experiences in flood management and mitigation is indispensable.

Outline of ICHARM

Dr. Tadahiko SAKAMOTO

Chief Executive

Public Works Research Institute (PWRI)

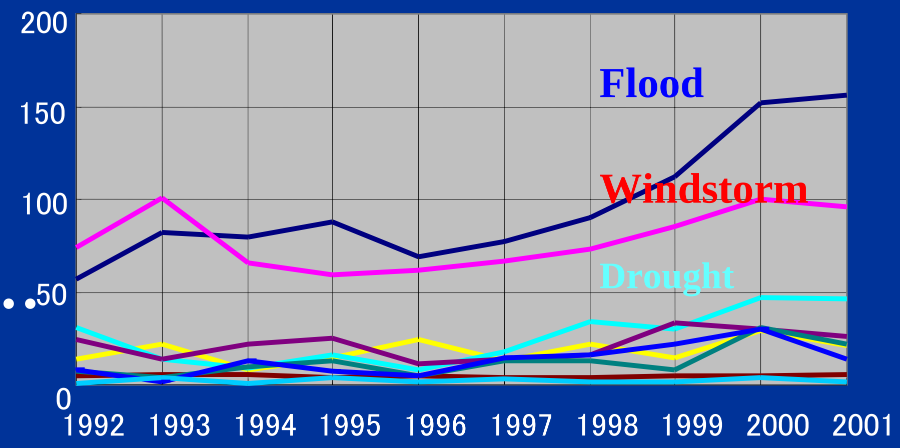
Tsukuba, Japan

Background

-Water hazards as a major challenge-

The number of water-related disasters is still increasing

Number of Events by types in the world



Source :EM-DAT, CERD, University of Louvain, Belgium

The water-related disasters will be …

- **aggravated by population growth, rapid urbanization, and concentration of human settlements and assets in flood areas;**
- **hampering sustainable development on a global scale**

Reduction of water hazards is vital to alleviating poverty

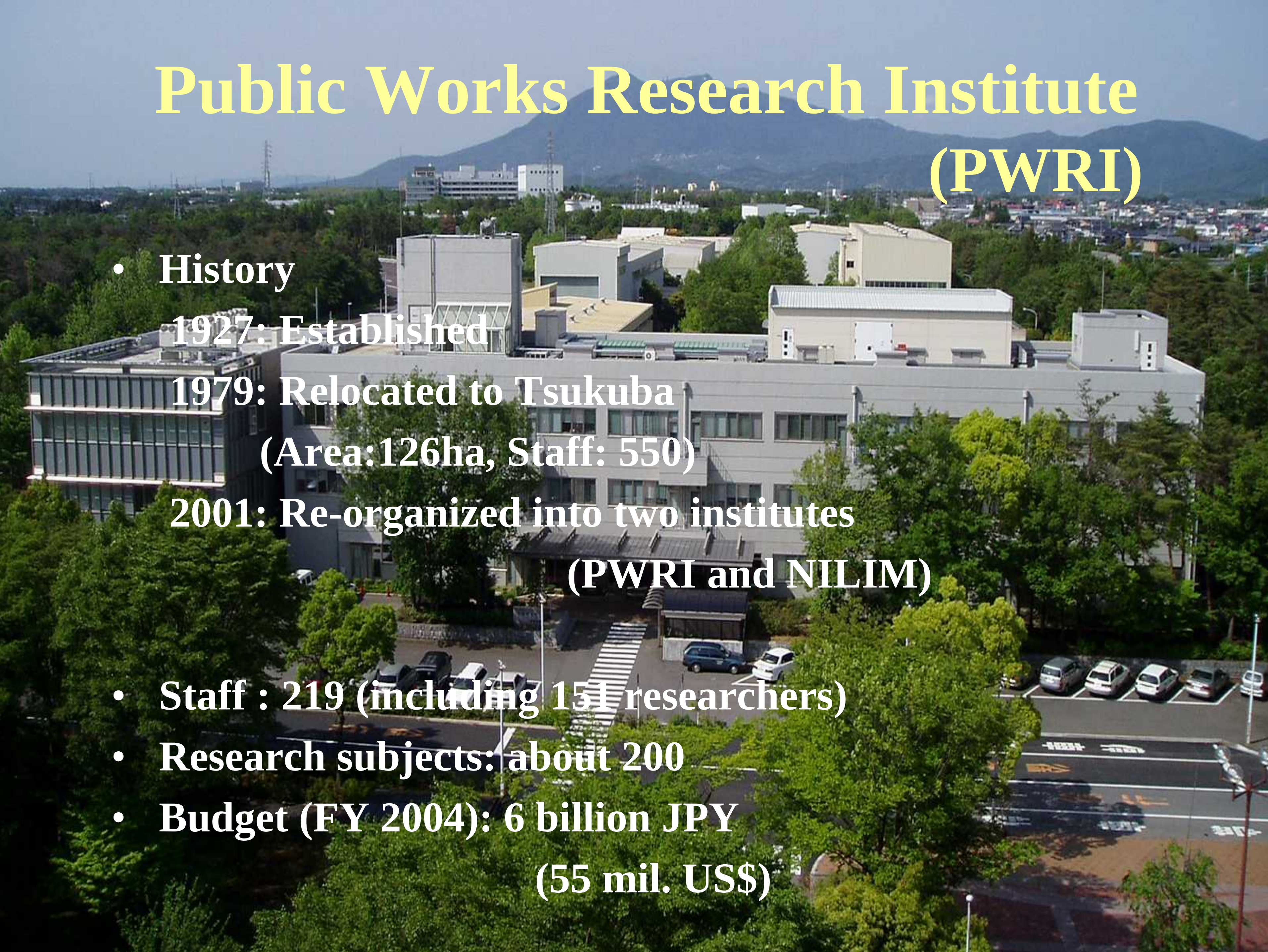
Background

-The Need to deal with water-related disasters-

2002 **World Summit on Sustainable Development (Johannesburg)**

2003 **3rd World Water Forum (Kyoto, Shiga & Osaka)**

⇨ **Necessity of improving risk management measures, technologies and capacity building relevant to water-related disasters**



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)

- Staff : 219 (including 151 researchers)
- Research subjects: about 200
- Budget (FY 2004): 6 billion JPY (55 mil. US$)

Objective of ICHARM

- **Accumulated knowledge and experience trying to overcome water-related disasters**
- **Global network of UNESCO-IHP for internationally sharing valuable information**

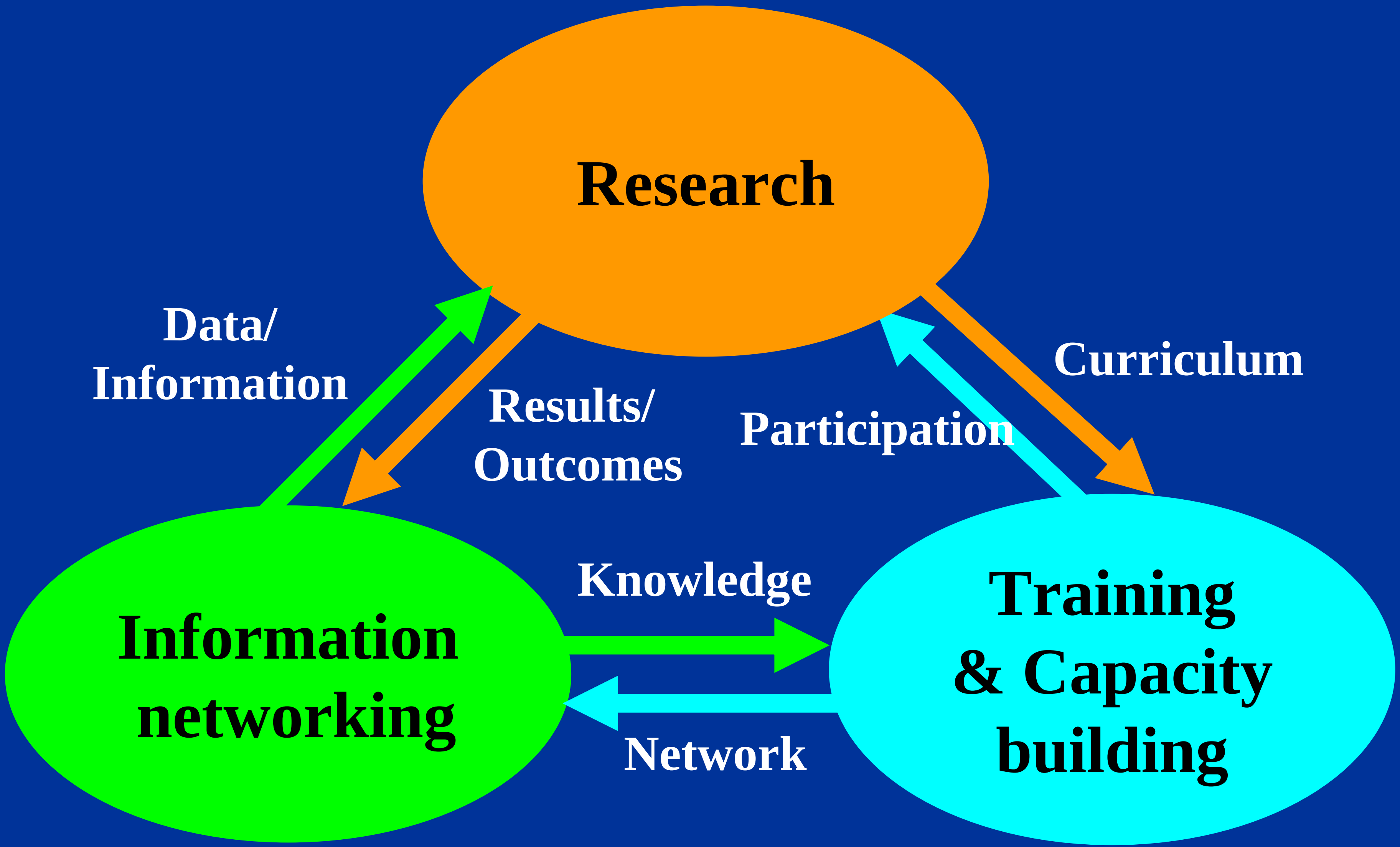
→ **Contribution to prevent or mitigate water-related disasters throughout the world**

Framework of ICHARM

- The new Centre will be established within PWRI as a global centre under the auspices of UNESCO (Category 2) in fiscal 2005

- The new Centre will be collaborating with UNESCO-IHP networks, relevant UN agencies and other key world institutes & organizations

Pillar Activities of ICHARM



Activities

- Research -

- **Contribution to international projects such as WWAP and IFI/P (UNESCO/WMO)**
- **Hydraulic / hydrological prediction, observation, modeling and analysis**
- **Risk assessment and risk management technologies for water-related hazards under various socio-economic, geographic and climatic conditions**

Activities

- Training and Capacity building -

Conducts JICA training courses, including
- River and dam engineering
- Flood Hazard Mapping

A new course on comprehensive tsunami disaster prevention is in preparation

Strengthen the follow-up activities to link the training course to concrete action for preventing or mitigating water related disasters

New training course on Flood Hazard Mapping

Objective

- Acquire professional knowledge necessary to produce flood hazard maps
- Enhance understanding of its effectiveness
- Seek application in his/her own country

Framework

- 4 weeks for 5 years (2004-2008)
- 16 trainees from 8 Asian countries
- Place: Tsukuba, Japan (PWRI & JICA)

Activities
- Information Networking -

Information networking will be synergized with research and training activities

in order to enhance integration and coordination:

Through the information network…

- **Research output will be widely disseminated**
- **Feedback from countries / regions will be reflected in the research projects**
- **Trainees will develop domestic links to their own countries/ regions**
- **Local needs for training items would be clarified**

Preparatory Activities

October 2003

32nd UNESCO General Conference

→ **Announcement of intention to set up the Centre by the representative of Japanese Government**

October 2003

RSC meeting in Southeast Asia & Pacific and in Latin America & Caribbean

→ **Resolutions strongly supporting the establishment of the Centre**

Preparatory Activities (cont'd)

January 2004

International technical workshop at PWRI

→ Experts from Asia, Africa, East & West Europe, and North & South America

→ Summary Report on directions of the Centre

International Symposium in Tokyo

April 2004

Proposal of the new Center was welcomed at UNESCO IHP Bureau Meeting

July 2004

A preparatory meeting of IFI/P hosted by PWRI

Preparatory Activities (cont'd)

September 2004

UNESCO IHP Intergovernmental Council

→ Resolution to support the proposal

January 2005

World Conference on Disaster Reduction

(Hyogo Japan, organized by ISDR)

→ Recognition of the role of ICHARM

→ Official launch of IFI


International Strategy
ISDR
for Disaster Reduction
Welcome to Hyogo
World Conference
18-22 January 2005, Kobe, Hyogo,

Dr. Sakamoto, CEO of PWRI, at the opening of the thematic session entitled ‘Research on Floods and Landslides and a new Initiative for Risk Reduction’

International Flood Initiative (IFI)

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 ･･･

Secretariat : ICHARM

Preparatory Activities (cont'd)

April 2005

UNESCO Executive Board

→ Draft decision was adopted to approve ICHARM at the General Conference

Preparatory Activities (cont'd)

October 2005

33rd UNESCO General Conference

→ **Proposal of the Japanese Government was accredited by 191 member countries**

Office Space of ICHARM

Research Staff 20
(in initial stage)

Office space
2,000m^2

Thank you for your attention

For more information :

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

DISASATER MANAGEMENT PERSPECTIVE

From Engineering to Citizen's Participation

Yujiro OGAWA

Dean of Environment and Disaster Research

Fuji Tokoha University

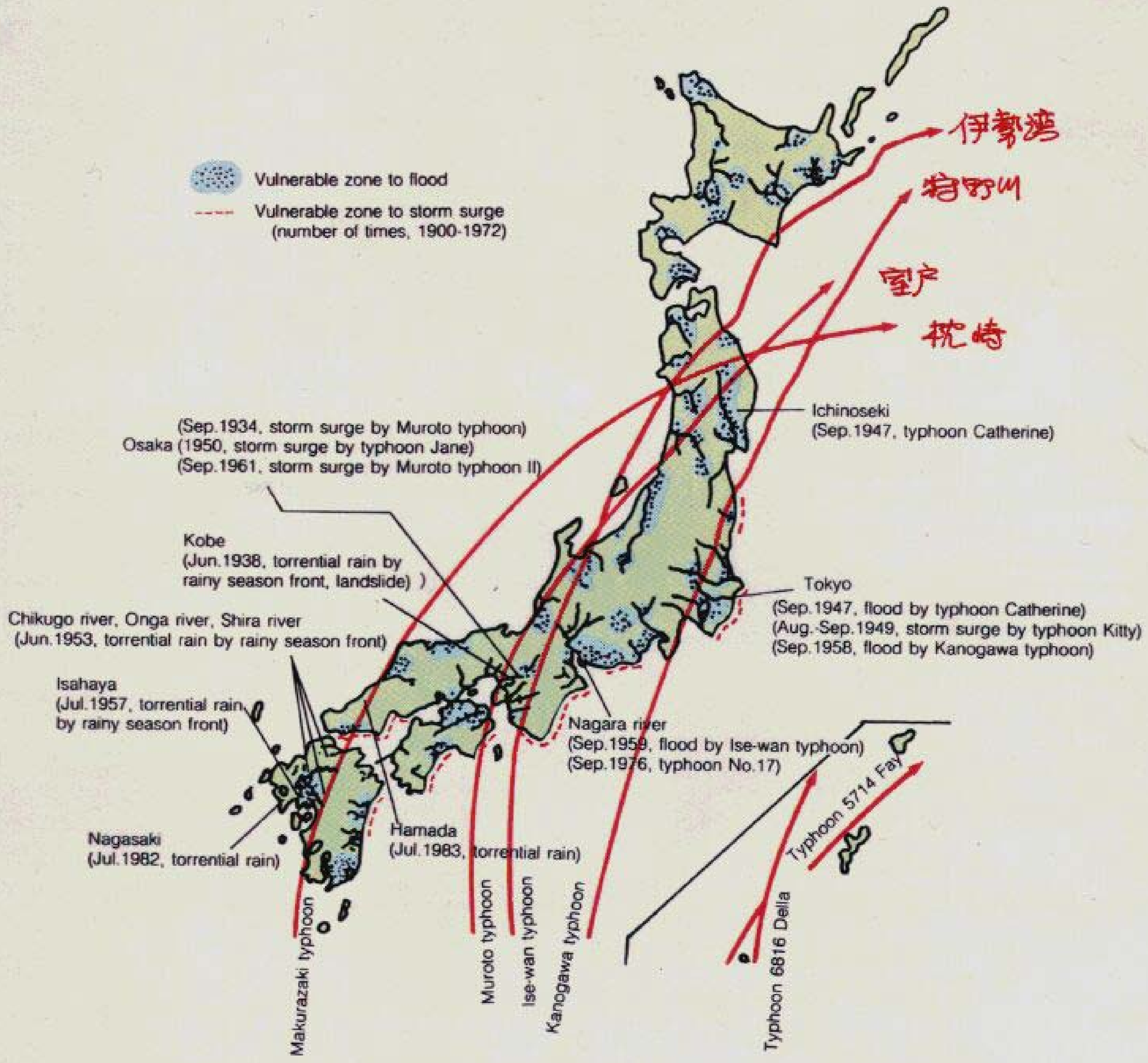
Major Flood in Japan

- Major Flood after WW2
- Big Damage in 1950' to 1960'
- Less Damage in Last 30 years
- Flood in Urban Area became Major Issue

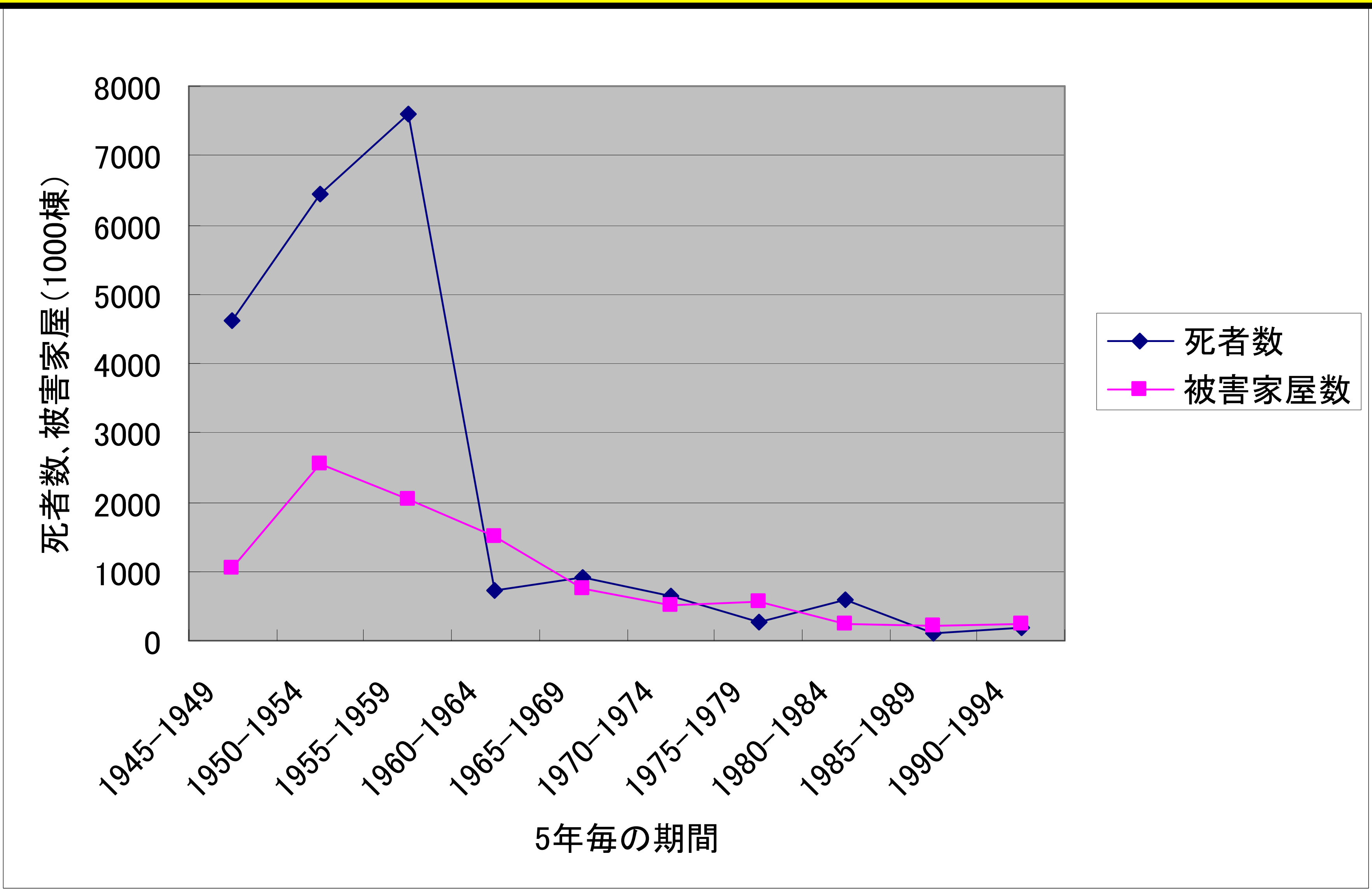
Major Flood Disaster in Japan

Name	Date	Death	Houses Damaged	Affected Area in Japan
枕崎台風	1945.9	1,700	361,321	九州～東北
カスリーン台風	1947.9	1,930	394,041	東海以北
アイオン台風	1948.9	838	138,052	四国～東北（特に岩手）
キティ台風	1949.8	160	161,263	中部～北海道
ジェーン台風	1950.9	508	222,736	四国以北（特に大阪）
大雨（前線）	1951.7	306	104,883	中部以西（特に京都）
ルース台風	1952.10	973	359,391	全国（特に山口）
大雨（前線）	1952.7	140	161,691	中国～東海
大雨（前線）	1953.6	1,013	489,298	九州～中国（特に熊本）
南紀豪雨	1953.7	1,124	97,368	全国
台風第13号	1953.9	478	582,273	全国（特に近畿）
台風第12号	1954.9	146	221,235	関東以西
洞爺丸台風	1954.9	1,761	311,075	全国
諫早台風	1957.7	992	79,376	九州（特に長崎）
狩野川台風	1958.9	1,269	538,458	近畿以北（特に静岡）
台風第７号・前線	1959.8	235	224,806	近畿～東海（特に甲信）
伊勢湾台風	1959.9	5,098	1,197,576	全国（九州を除く）
Ｓ36梅雨前線	1961.6	357	422,826	全国（北海道を除く）
第２室戸台風	1961.9	202	883,564	全国（特に近畿）
大雨（前線）	1962.7	102	91,999	九州・東海
台風第20号	1964.9	56	116,020	九州～東北
台風第24号・前線	1965.9	107	259,925	全国
台風第24・26号	1966.9	318	126,767	全国（特に山梨）
Ｓ42.7月豪雨	1967.7	371	305,201	九州北部～関東

Areas damaged by wind and water disasters in Japan



Death and Damage by Major Flood in Each 5 Years

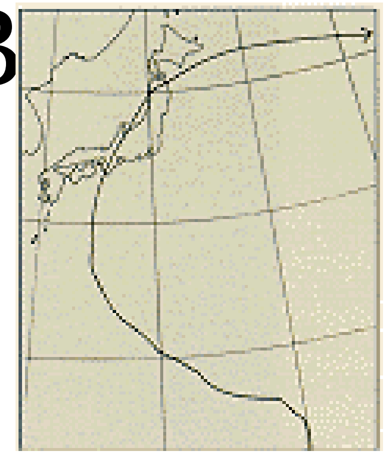


都市水害Urban Flood

- Flood in Urban Area
  - Ise Bay Typhoon（1959）
  - Nagasaki Flood　(1982)
  - Under Ground Shopping Mall in Fukuoka（1999）

- Private House Underground Flood in Tokyo(1999)

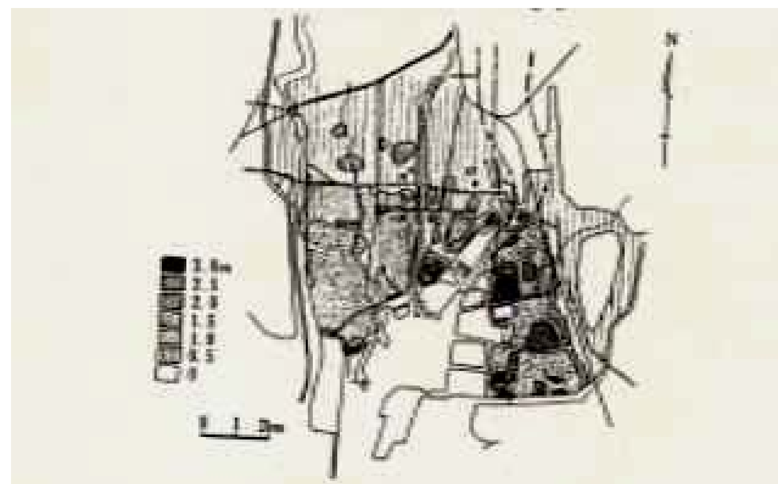
伊勢湾台風(Ise B



- **1959年9月**

死者	4,759人
行方不明者	282人
負傷者	38,921人
家屋全壊	36,135戸
家屋流失	4,703戸
家屋半壊	113,052戸
床上浸水	157,858戸
床下浸水	205,758戸
破堤	5,760カ所
田の流失	8,969ha
畑の流失	21,795ha
船舶流失	2,431隻

- 災害対策基本法の制定
- 災害危険地域
  - 地盤のかさ上げ
  - H2年に高床でも可



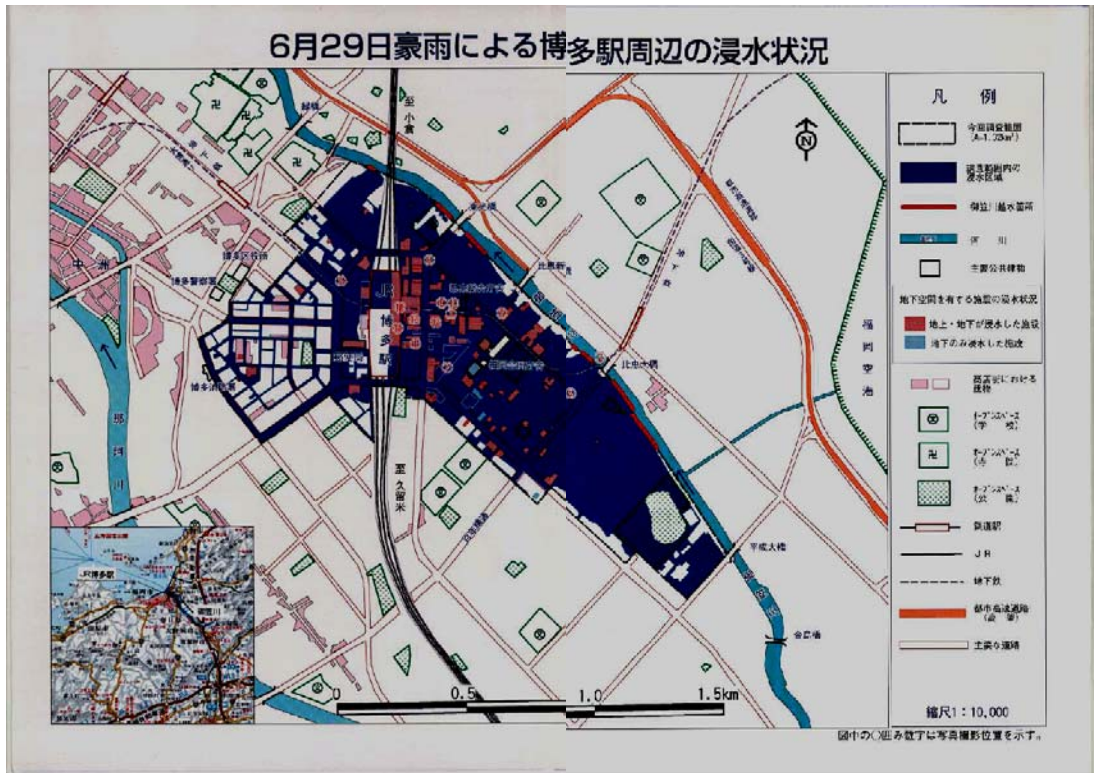
長崎水害(Nagasaki Flood)

- **Flooding to Underground Restaurant**
- **Flooding to Underground Parking**
- **Flooding to Hospital Underground Floor**
  - **Expensive Medical Equipments**
  - **Emergency Generators**

Flooding to Fukuoka Underground Shopping Mall

June 29,1999

JR Hakata Station
Low Level Land
1m Flood
Electricity of Undreground Shopping Mall
1 person death



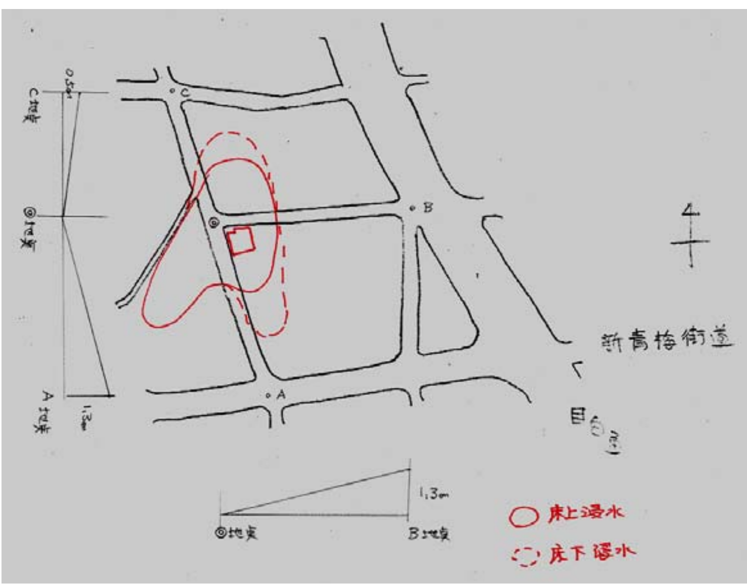
Flooding to Fukuoka Underground Shopping Mall

JR博多駅周辺は一時泥の海と化した
(JR博多駅博多口交通センター付近)

地下鉄博多駅出口より流れ込む濁流
(地下鉄博多駅15番出口)

Private House Basement Flood in Tokyo(1999)

- **July 21, 1999   Heavy Rain in Western Part of Tokyo**
- **Flooding to Private House Underground**
- **House Owner who go down to Underground Floor was killed**
- **Elevator for Private House**



Problems in case of t he Private House Basement

- Resident recognized that small flooding occurred in past several times
- Flooding from outside of underground floor
- Hole for air fan on the wall of basement
- Exit from Basement are only for outside and Elevator and no step for first floor
- No emergency exit from elevator

Lessons learned from Private house basement flooding

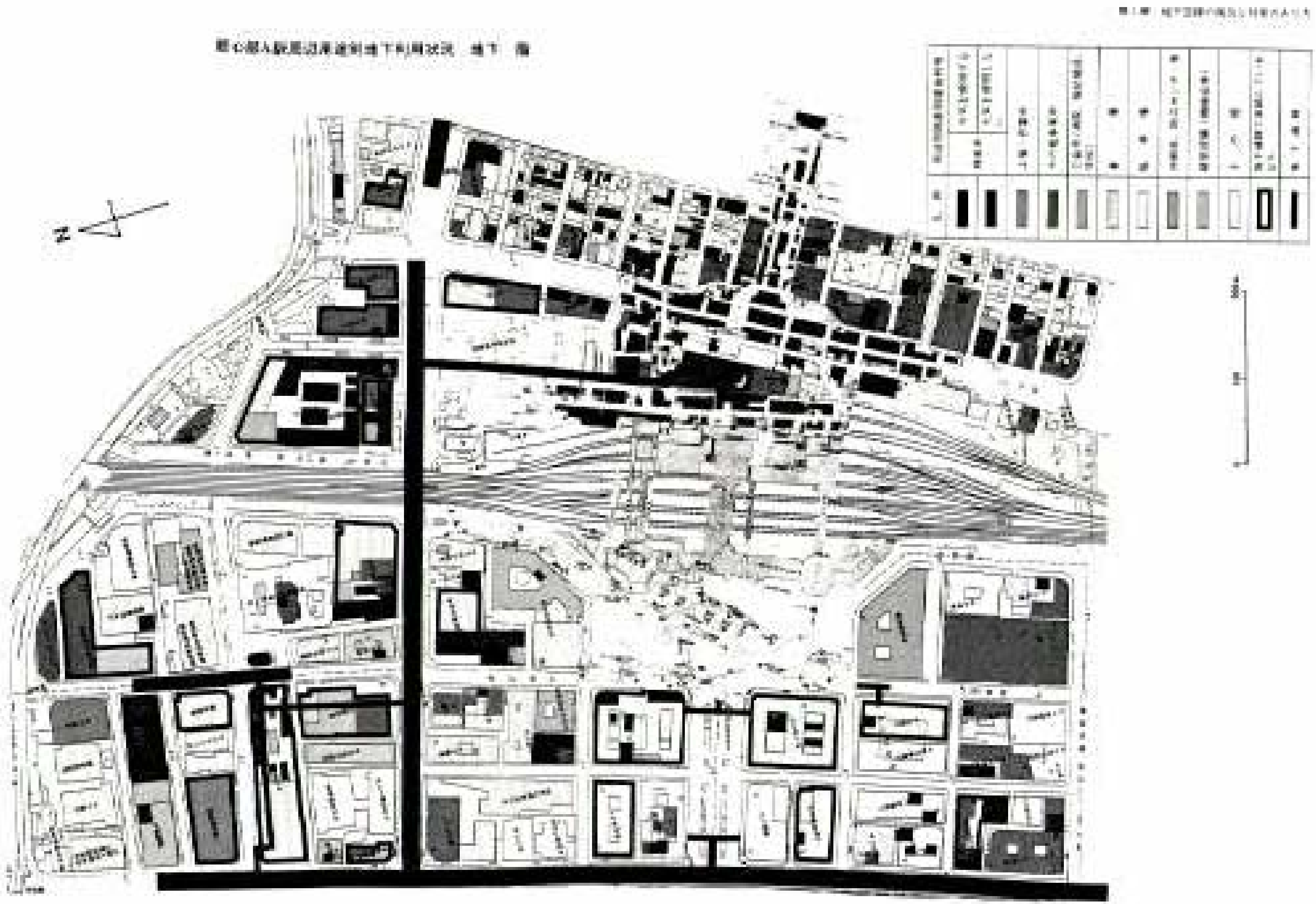
- Basement space for Private housing
- Water protection in Basement
- Evacuation Exit in Private House Basement

- Risk of Private House Basement
  - Residents should know the risk
  - Designer should know the risk
  - Risk should be transmitted to public

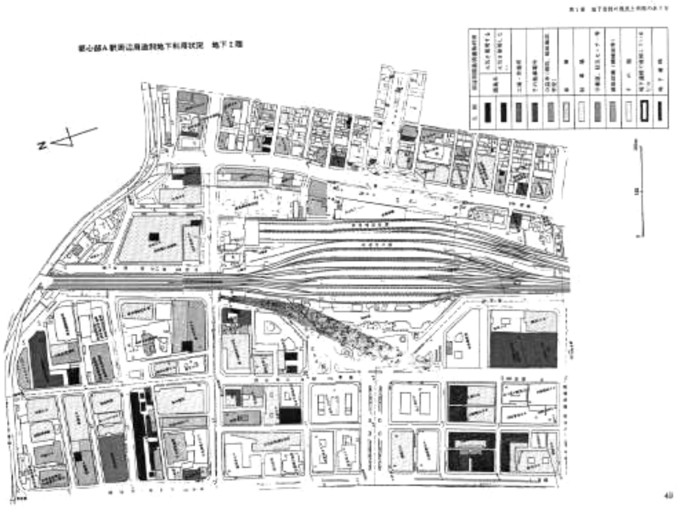
Urbanization and Urban Flood

Rapid Urbanization in 20 century
- Tsurumi River in Kanagawa Prefecture
  - Frequent flooding in urban area
- Depth of Subway in Tokyo
  - Asakusa line : Just under ground surface
  - Chiyoda line : 50m to 70m under surface

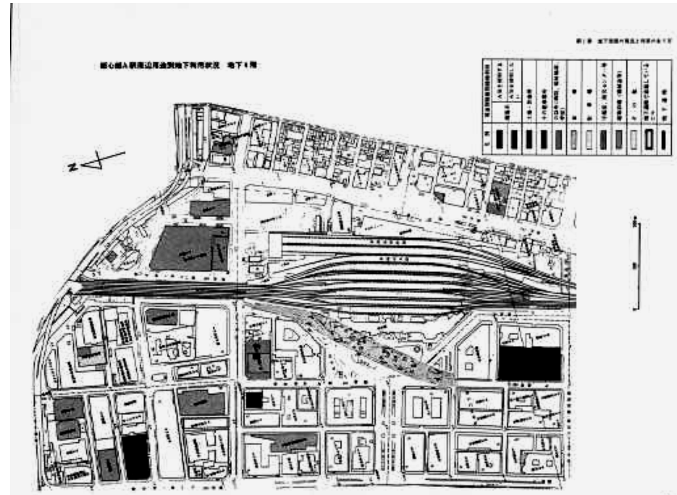
Use of Underground Space
- Underground Use in Marunouchi-aria



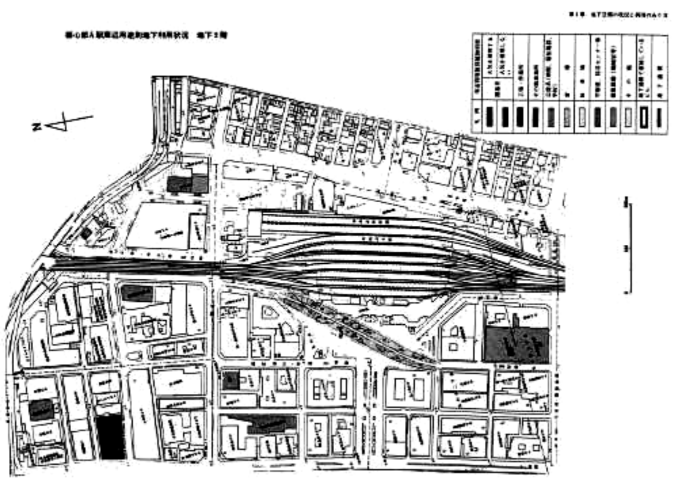
東京駅周辺地下1階



地下2階



地下3階



地下4階

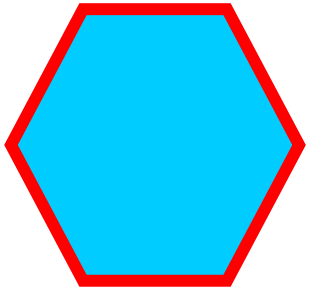
地下5階

Six approaches for Urban Flooding

Information Sheering

Citizen's Capacity Building for Flooding

Enforcement of Disaster Response



Countermeasures for protection of flooding

Evacuation System

Urban Planning for Disaster Mitigation

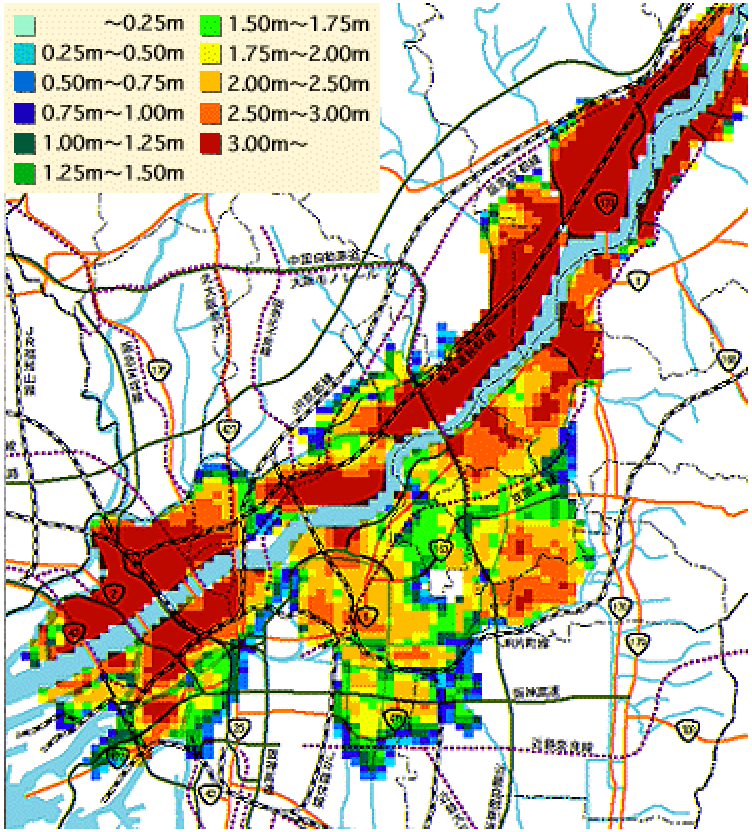
<u>Citizen’s Capacity Building for Flooding</u>

- **Information Dissemination**
- **Citizen’s Awareness**
- **Flood Information Sharing**
- **Disaster Education**
- **Volunteer Organization**

Hazard Map

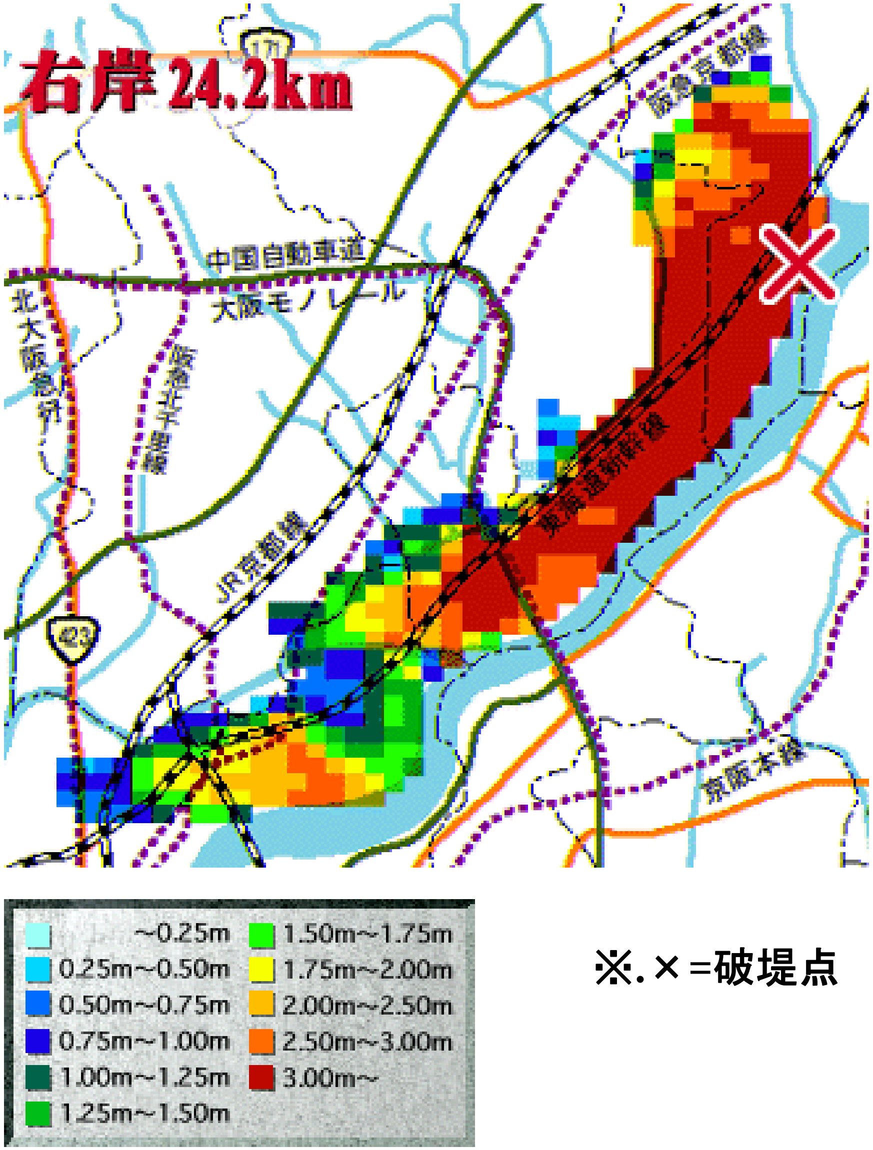
Flooding Simulation

Information Dissemination

- 

Yodo River in Osaka

We can see from Internet anytime


右岸24.2km
171
阪急京都線
中国自動車道
大阪モノレール
北大阪急行
阪急千里線
JR京都線
東海道新幹線
423
京阪本線
~0.25m
0.25m~0.50m
0.50m~0.75m
0.75m~1.00m
1.00m~1.25m
1.25m~1.50m
1.50m~1.75m
1.75m~2.00m
2.00m~2.50m
2.50m~3.00m
3.00m~


右岸
24.2km
17.2km
8km
9.2km
左岸

※.×=破堤点

Flooding Simulation

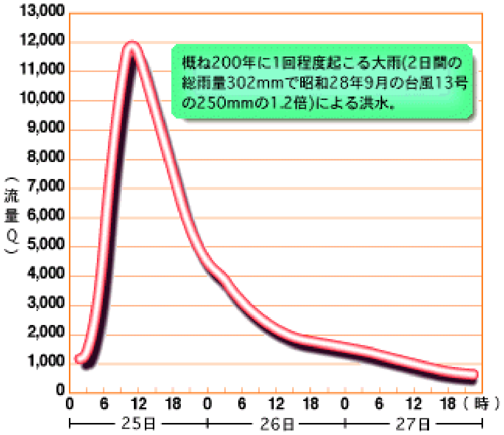
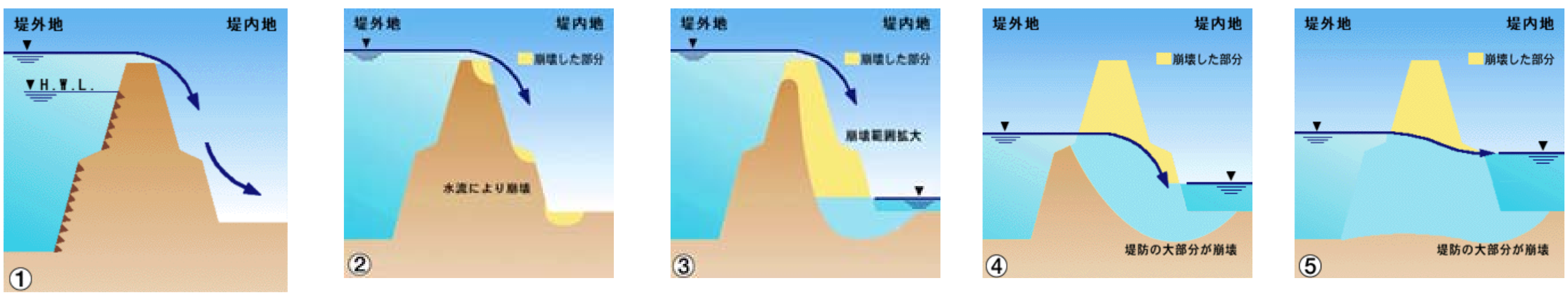


図-1 枚方地点計画流量ハイドログラフ



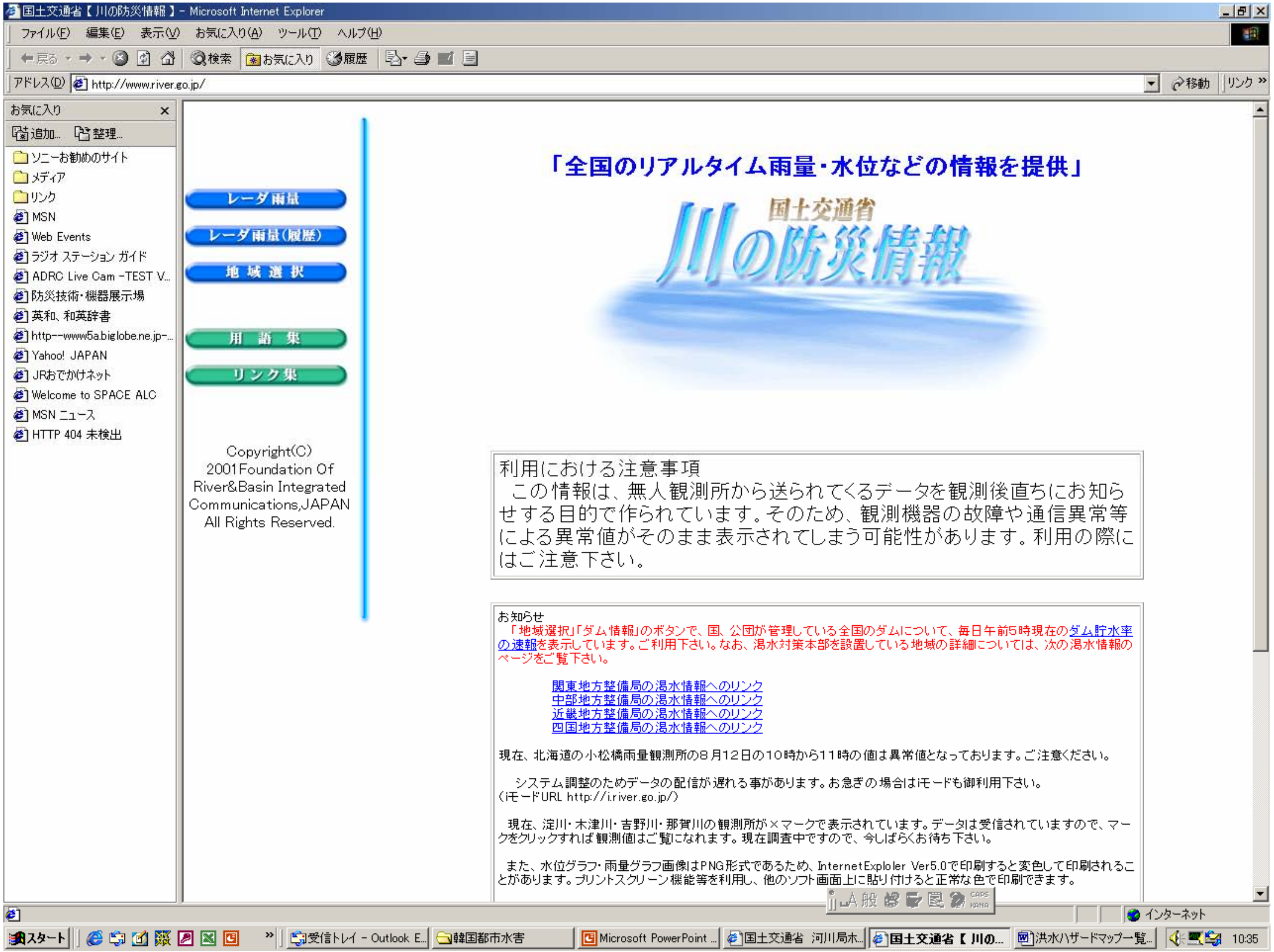
Information Sharing

- 防災関係機関相互
- 住民への情報提供
- 洪水警報
- マスコミとの連携

- 最近の情報公開の傾向
- 知らせることによる共同の防災への努力

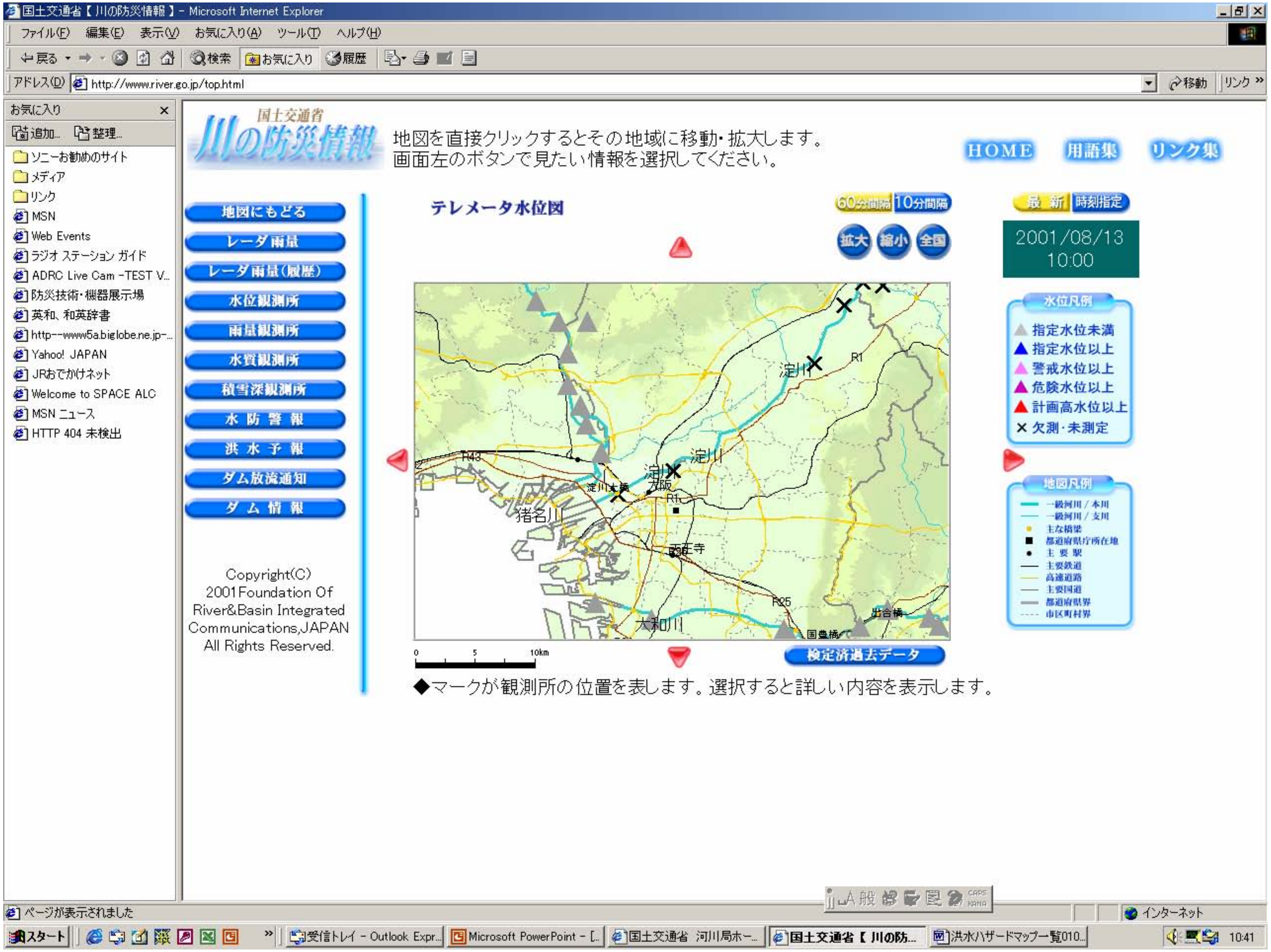
河川水位の常時公開

Information Sharing
“Real Time Water Level “

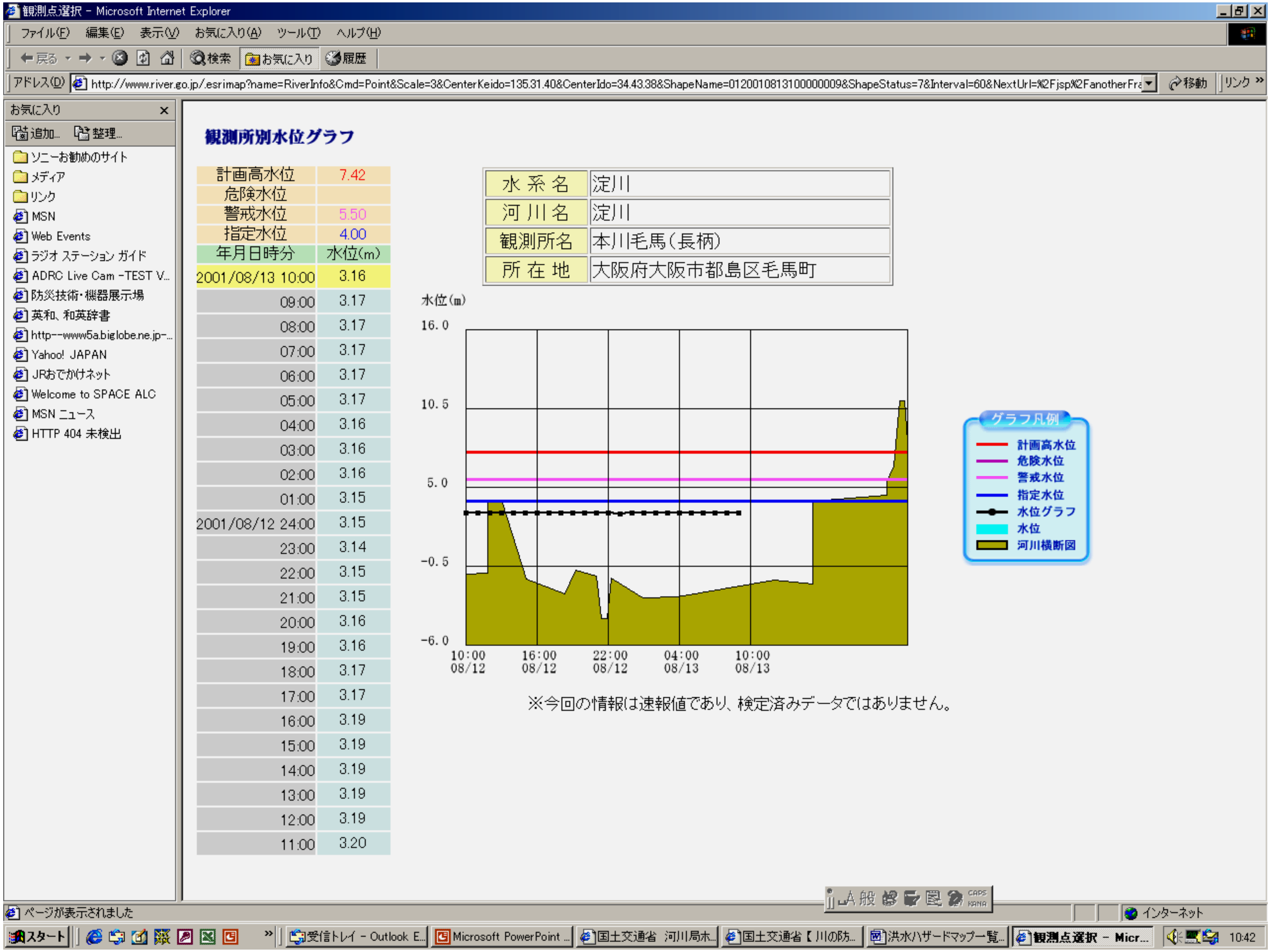


Select Region

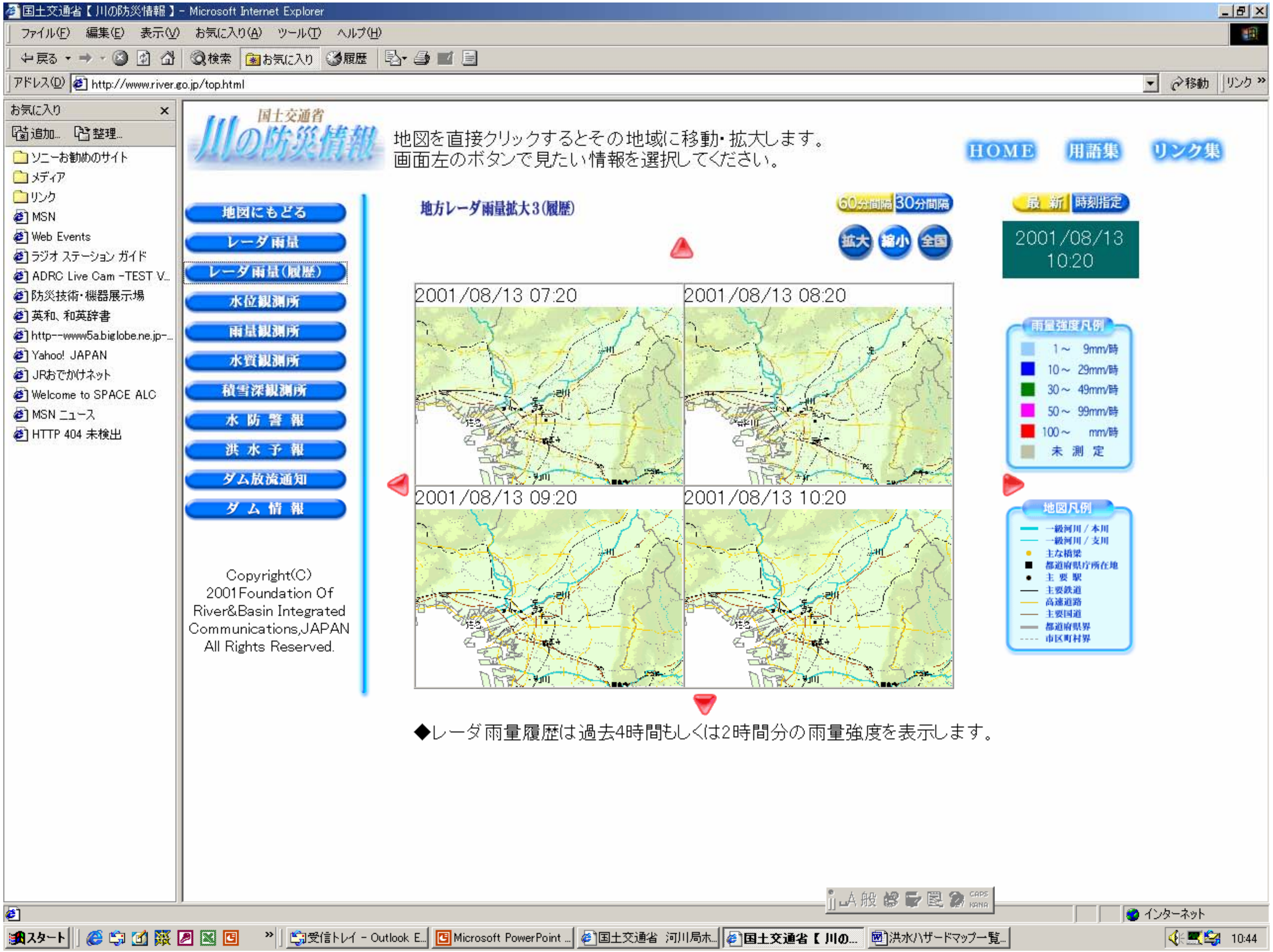
Select River



Real Time Water Level



Real Time Data of Precipitation



Capacity building of Residents

- How to upgrade Citizen’s Awareness?
- Citizen’s Participation Program
  - Named “Disaster Mitigation Town Watching”
  - Developed in 1994

Town Watching Workshop at Qui Nhon in Vietnam at 2004.7


2004 7 1


BẢN ĐỒ QUY HOẠCH
TRUNG TÂM XÃ PHƯỚC HOÀ
2004 7 1


2004 7 1


2004 7 1


2004 7 1


2004 7 1


2004 7 1


2004 7 1


2004 7 1

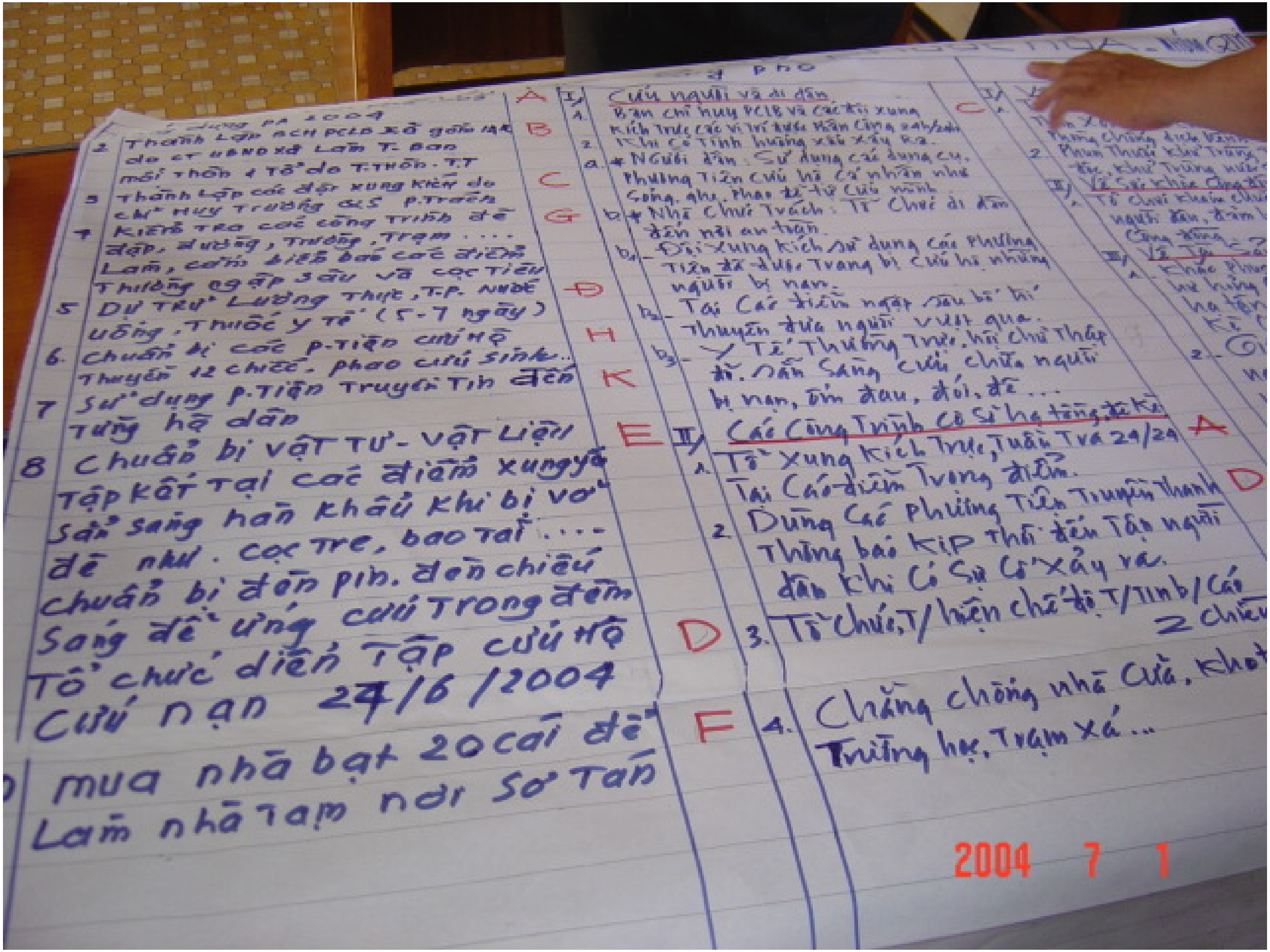

CỘNG SẢN VIỆT NAM QUANG VINH MUÔN NĂM
XÃ PHƯỚC HÒA
THỐNG NHẤT,
2004 7 1


Sơ họa thôn
TÂN GIẢN
Nhóm
Q. trị
Sông Gò Bồi
Trường tốt
Cầu tốt
Ngã tư tốt
Đường tràn
Tre làng
R. Lá
Rừng Lá
ghi chú
Xấu
Tốt
2004 7 1

SƠ ĐỒ VÙNG NGẬP LỤT
NHÓM I
BÌNH ĐỊNH
KHU DÂN CƯ
LÚA
LÚA
SÔNG GÒ BỒI
TL 640
(good)
(bad)
Điểm tốt
Điểm xấu
2004 7 1


SƠ HỌA HIỆN TRẠNG THÔN TÙNG GIẢNG
XÃ PHƯỚC HÒA - HUYỆN TUY PHƯỚC
B
XÃ PHƯỚC THẮNG
SÔNG GÒ BỐI
: ĐIỂM TỐT
: ĐIỂM XẤU
GHI CHÚ
2004 7 1


2004 7 1



Tháng PA 2004
A
2 Thành lập BCH PCLB xã gồm 14 do CT UBND xã làm T. Ban
B
mỗi thôn 1 tổ do T.Thôn - T.T
3 Thành lập các đội xung kích do chỉ huy trưởng QS P.Trách
C
4 Kiểm tra các công trình đê đập, đường, trường, trạm ....
G
Làm, cắm biển báo các điểm thường ngập sâu và cọc tiêu
5 Dự trữ lương thực, T.P. nước uống, thuốc y tế (5-7 ngày)
Đ
6. Chuẩn bị các p.tiện cứu hộ thuyền 12 chiếc. phao cứu sinh..
H
7 Sử dụng p.tiện truyền tin đến từng hộ dân
K
8 Chuẩn bị vật tư - vật liệu tập kết tại các điểm xung yếu sẵn sàng hàn khẩu khi bị vỡ đê như. cọc tre, bao tải ....
E
Chuẩn bị đèn pin. đèn chiếu sáng để ứng cứu trong đêm
Tổ chức diễn tập cứu hộ cứu nạn 24/6/2004
D
mua nhà bạt 20 cái để làm nhà tạm nơi sơ tán
F
I/ Cứu người và di dân
1. Ban chỉ huy PCLB và các đội xung kích trực các vị trí được phân công 24h/24h khi có tình huống xấu xảy ra.
C
2. a. * Người dân: Sử dụng các dụng cụ, phương tiện cứu hộ cá nhân như sõng, ghe, phao để tự cứu mình
b/ * Nhà chức trách: Tổ chức di dân đến nơi an toàn.
b1 - Đội xung kích sử dụng các phương tiện đã được trang bị cứu hộ những người bị nạn.
b2 - Tại các điểm ngập sâu bố trí thuyền đưa người vượt qua.
b3 - Y tế thường trực, hội chữ thập đỏ, sẵn sàng cứu chữa người bị nạn, ốm đau, đói, rét...
II/ Các công trình cơ sở hạ tầng, kiến trúc
A
1. Tổ xung kích trực, tuần tra 24/24 tại các điểm trọng điểm.
D
2. Dùng các phương tiện truyền thanh thông báo kịp thời đến tận người dân khi có sự cố xảy ra.
3. Tổ chức T/hiện chế độ T/Tinh/Các 2 chiều
4. Chằng chống nhà cửa, kho... trường học, trạm xá...
2004 7 1


2004 7 2


2004 7 2


PHƯƠNG ÁN PCLB XÃ PHƯỚC HÒA
2004 7 2

Workshop in Yokohama targeting Earthquake Problems


カメヤ
中村町三丁目


駐輪禁止

MEASURE
BRIGADES
INVOLVEMENT!
USE

AT LAST

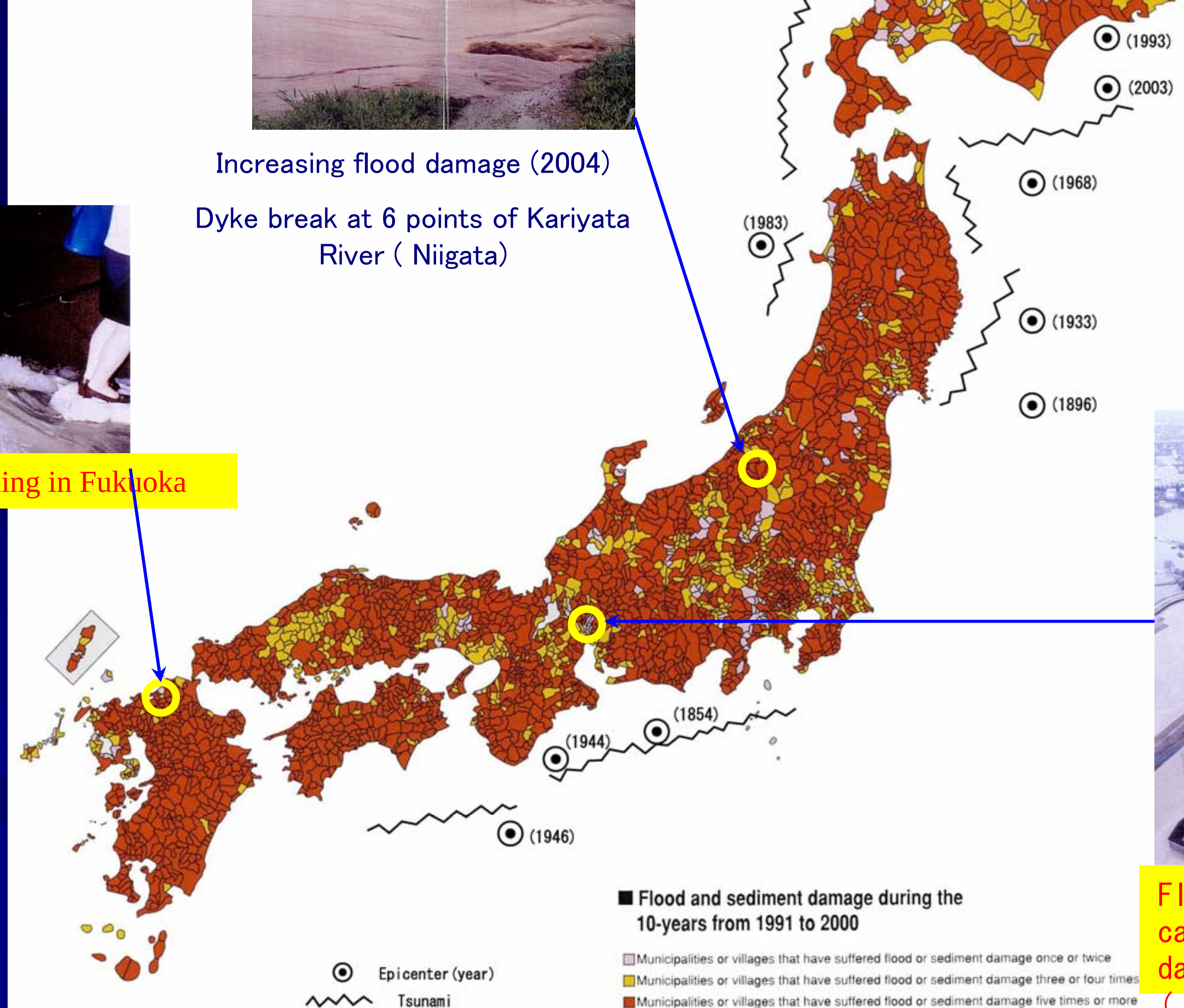
- Civil Engineering Approach have played great roll in Disaster Mitigation.
- Our build environment are and will be vulnerable for Natural Disaster.
- Citizen’s Participation Approach will become much important.
- Citizen’s Capacity Building Methodology such as “Town Watching” is just started.
- We need to expand Disaster Management by Holistic approach.

Present status of flood damage in Japan

Increasing flood damage (2004)

Dyke break at 6 points of Kariyata River (Niigata)

Underground space flooding in Fukuoka



Flood in Cities causes increased damage cost (Nagoya)

Flood damages and lessons taught from them

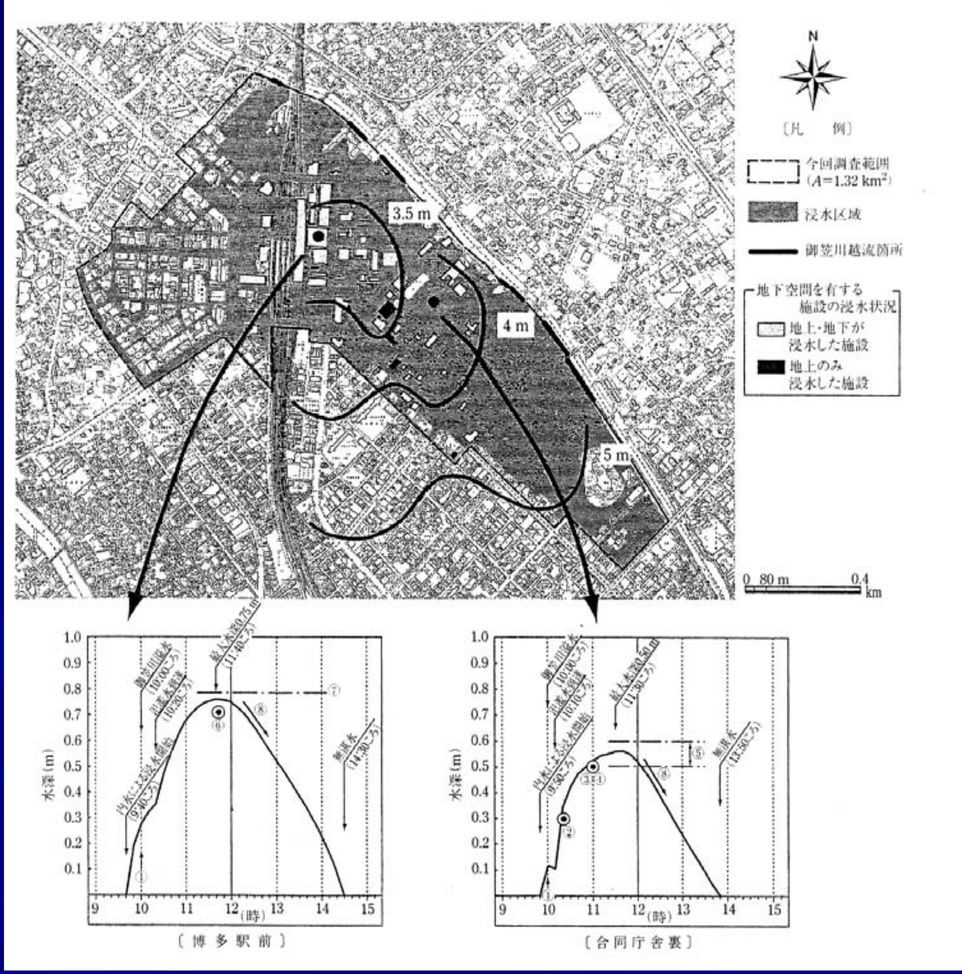
・Underground space flooding in Fukuoka（June,1999）

77mm/hr＞52mm/hr

Water from sewerage, Mikasa River and Sannoh diversion channel

→ Hakata St. (lower ground)

Inundation increase velocity: 10～20cm/10min.



・The extent of damage

Almost half of all the shops, except the underground shopping area, were inundated to more than 1m-deep.

Underground shopping area (Deitos)

Water came in through 20 points and 10 of them were gateways.

・Measures

Drainage through 13 drain outlets into underground reservoir（13,000m3）

種類	年　月	被災箇所：被災概要	最大雨量
地下鉄	1973.8	名古屋市営 名城線：平安通駅でホーム上 40 cm 浸水	80 mm/h
	1981.7	都営三田線：内幸町駅が内水	—
	1985.7	都営浅草線：西馬込駅が内水	68 mm/h
	1986.8	仙台市営：開業前に浸水	—
	1987.7	京阪電鉄：鴨川支川の水が浸入	78 mm/h
		都営浅草線：五反田駅	70 mm/h
		営団丸の内線：赤坂見附駅	—
	1999.6	福岡市営：博多駅	77 mm/h
	1999.8	営団半蔵門線：渋谷駅が内水	—
		営団銀座線：溜池山王駅が内水	—
	2000.9	名古屋市営：名城線：平安通駅でホーム上 90 cm 浸水	93 mm/h
		名古屋市営：桜通線：野並駅が浸水	—
		名古屋市営：鶴舞線：塩釜口駅が浸水	—
	2001.8	名古屋市営：桜通線：名古屋駅が浸水	—
	2003.7	福岡市営：博多駅	太宰府 104 mm/h
地下街	1970.11	八重洲：河川の水圧で工事用防水壁が壊れ，水が浸入	—
	1971.7	名古屋駅前ユニモール	30 mm/h
	1981.7	*新宿歌舞伎町サブナードが内水（最高 30 cm）で浸水*	—
	1982.8	名古屋市セントラルパークが内水	33 mm/h
	1999.6	博多駅，天神で浸水	77 mm/h
	2000.9	名古屋駅前ユニモールが若干浸水	—
		名古屋市セントラルパークが若干浸水	—
	2003.7	博多駅地下街で浸水	太宰府 104 mm/h

Lessons from the underground space flooding in Fukuoka

・Limit of drainage capacity through sewer

・Inner water increases as quick as flooding water.

・ Check boards and doors to the connecting passage to adjacent building

・Immediate evacuation is must if the water flows into narrow underground spaces.

・Underground reservoir of building is effective for drainage.

Underground space flooding

・Underground space flooding occurs when rainfall intensity exceeds 70mm/hr

・Just one water infall causes flooding←Caution needed for entrances and exits, connecting passages to the adjacent building

・Inundation hour : $T=3(A/B \cdot H)^{0.35}$

A/B＝<u>total floor area／total door width</u>

The smaller is the value above, the faster is the inundation pace.

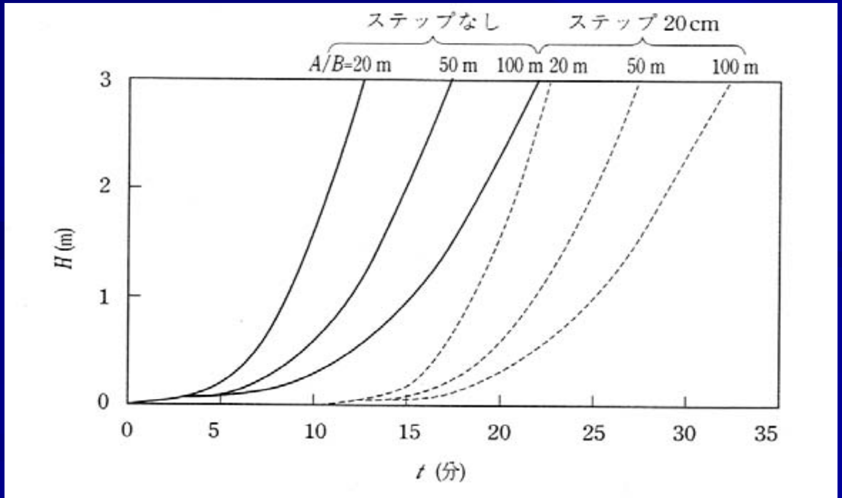
e.g.) 13min. at 20m (Fukuoka), 17min. at 50m (Tokyo)

・ Door becomes hard to be opened because of the water pressure regardless of whether it opens inward or outward

←set check boards and check doors at exits and entrances

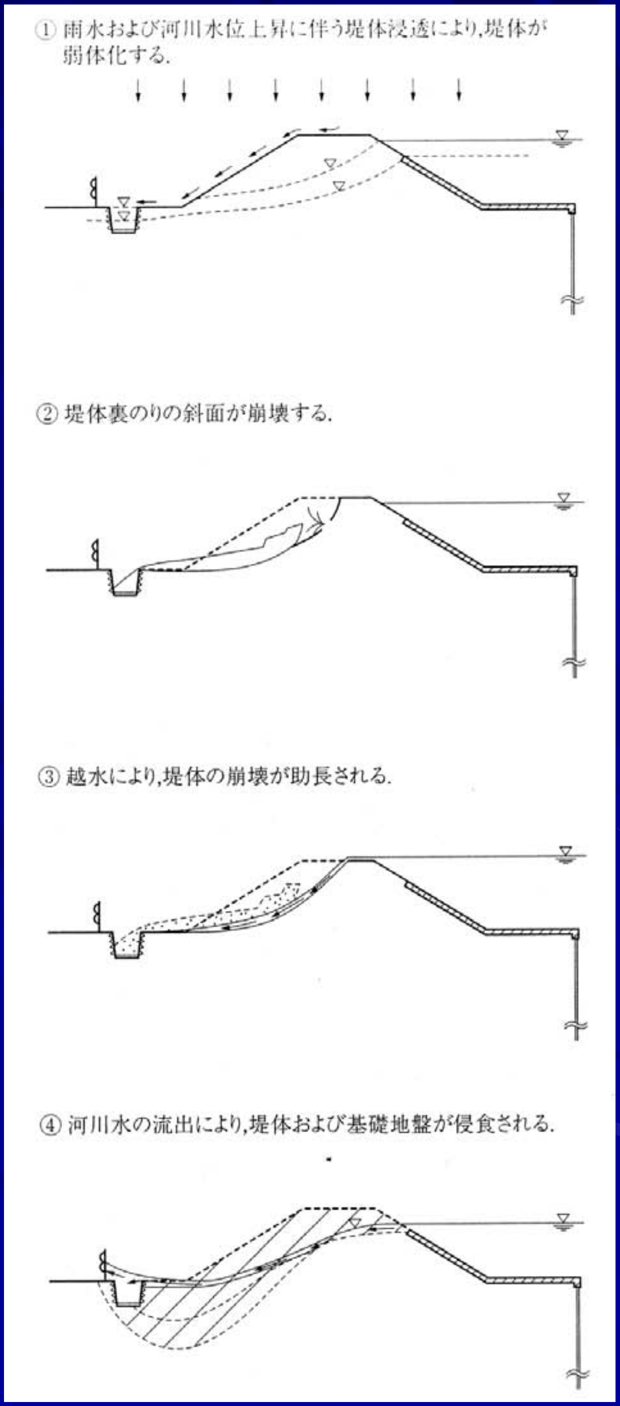
・Set inundation check equipments to air vents of subway

Immediate evacuation is needed when the flooding water reaches basements and underground buildings



Rain Storm Disaster in Tokai

- Sep. 2000 Dyke break of diversion channel of Shonai River (Shin River)
- conceivable cause of the dyke break is over-topping or infiltration
  eyewitness, slope scouring, erosion depth
- Water level exceeded design water level for 11 hours.
  infiltration→slope scouring→overtopping →dyke break



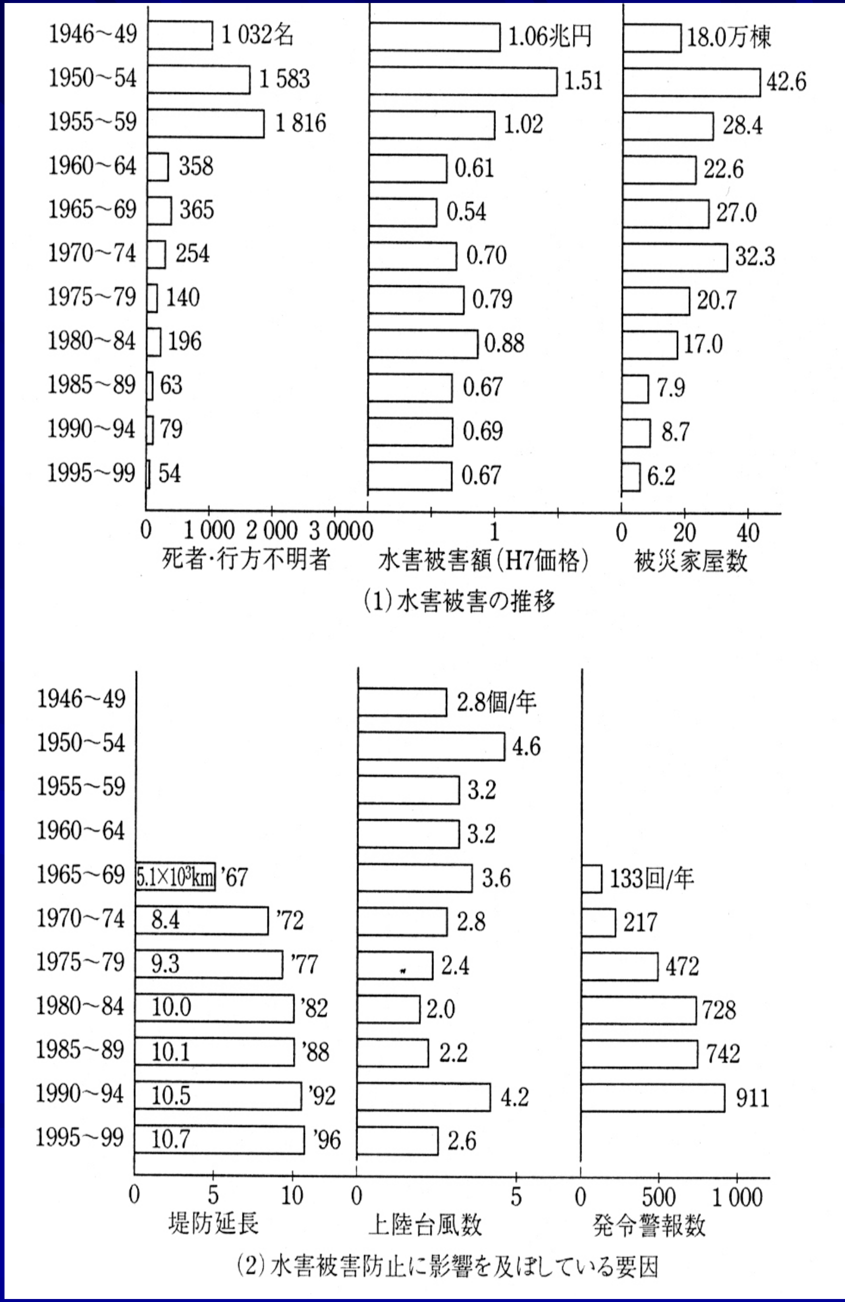
Flood Damage

・the number of dead and missing persons and the damaged houses are decreasing.

← River improvement
Weather information announcement

Installation rate of design height dyke
38%（1976）→ 56%（2002）
Development of AMEDAS（late 1960's）
6 times as many warnings as before

・Damage cost remains the same level.
←Inundated area is decreasing, but large and midsize cities are damaged.



Detailed contents of flood damage

- Death risk of dead and missing persons

  Man in his 40～50's died during his activity by the river side

  <u>Less death risk of aged person</u> ,

  compared with that of seismic and sand avalanches

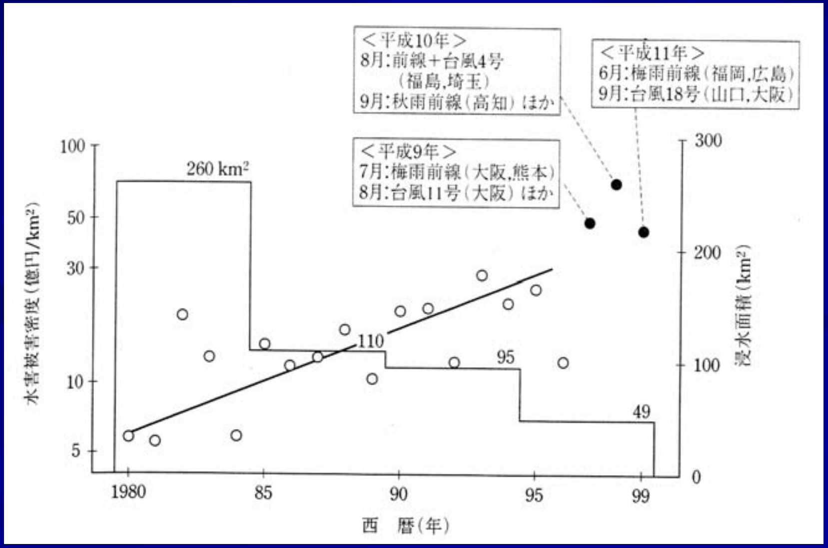
  ←caution needed for activities during floods

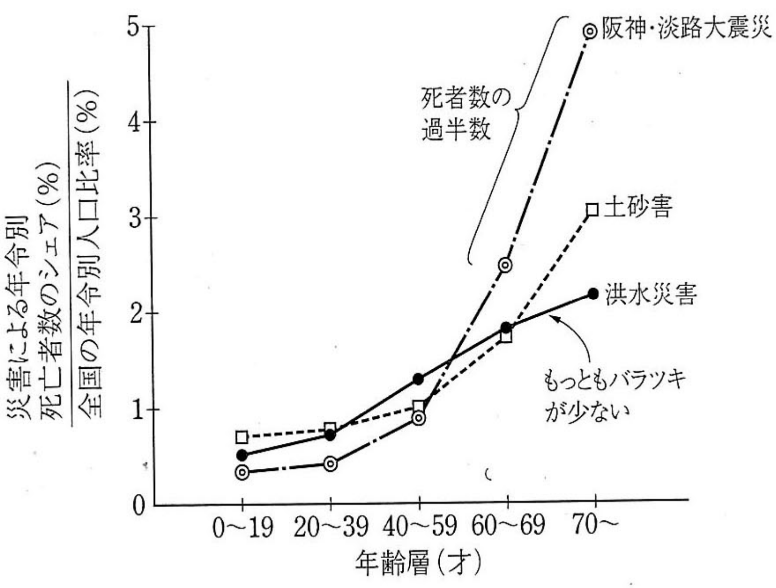
- Damaged house

  Many houses used to be totally destroyed or washed away, now 80% of the damaged houses are under floor flooding

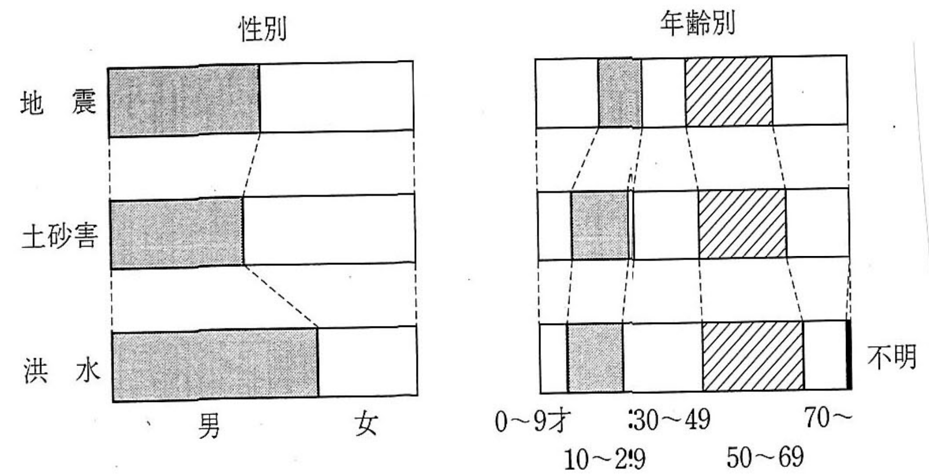
- Flood damage density tends to increase

  Higher increasing rate especially since 1997, about $60 million /km^2 was recorded in 1998





災害による年令別死亡者数のシェア(%)
全国の年令別人口比率(%)
5
4
3
2
1
0
阪神·淡路大震災
死者数の過半数
土砂害
洪水災害
もっともバラツキが少ない
0～19
20～39
40～59
60～69
70～
年齢層(才)



性別
地 震
土砂害
洪 水
男
女
年齢別
不明
0～9才
10～29
30～49
50～69
70～

Flood damage of the past 10 years

- 60 persons dead and missing
  40 victims by sand avalanches
- about 70,000 of damaged houses
  ¾ of them are under floor flooding.
- Total damage cost is about $6 billion
  70% flood damage cost by damages of public facilities
  60% of the total flood damage cost caused by inner-water and overtopping from no-levee section

Dyke break caused by Overtopping

▪ **state of overtopping**

Undulations on crown of the levee causes non-overtopping and overtopping section.
As overflow discharge increases, overtopping section becomes longer.

▪ **Process** overtopping → slope toe → levee body → dyke break
scouring collapse

↑

→ slope shoulder → deep overtopping depth
erosion

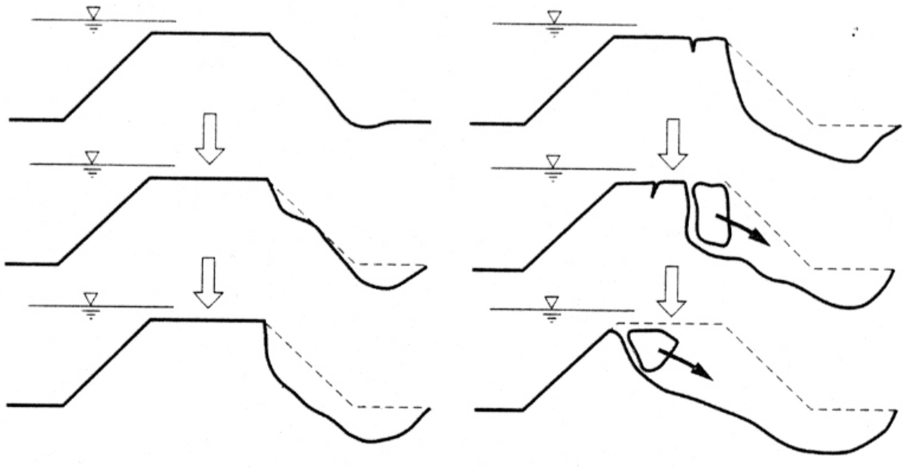
▪ **overtopping～ dyke break**

within 40min(40%)、more than 2 hr. (20%)

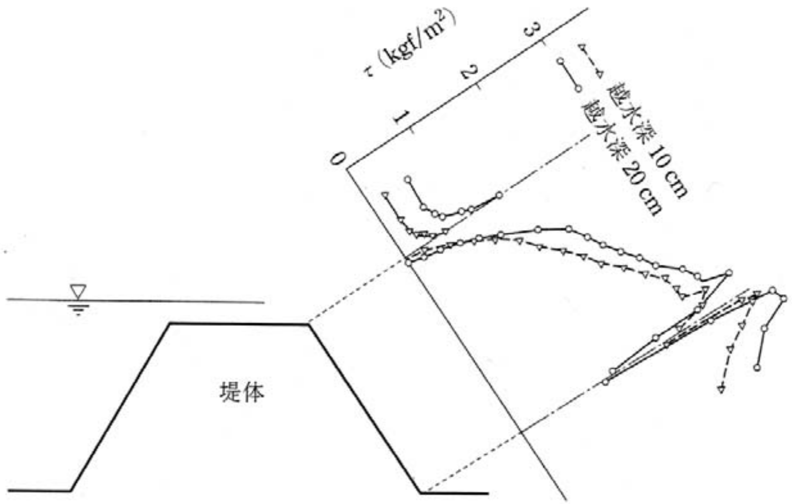
▪ **Forms of dyke break**

Dyke-break width is related to river width and it becomes wider at river confluence

Elevation at dyke-break section is deeper or as deep as the ground level.

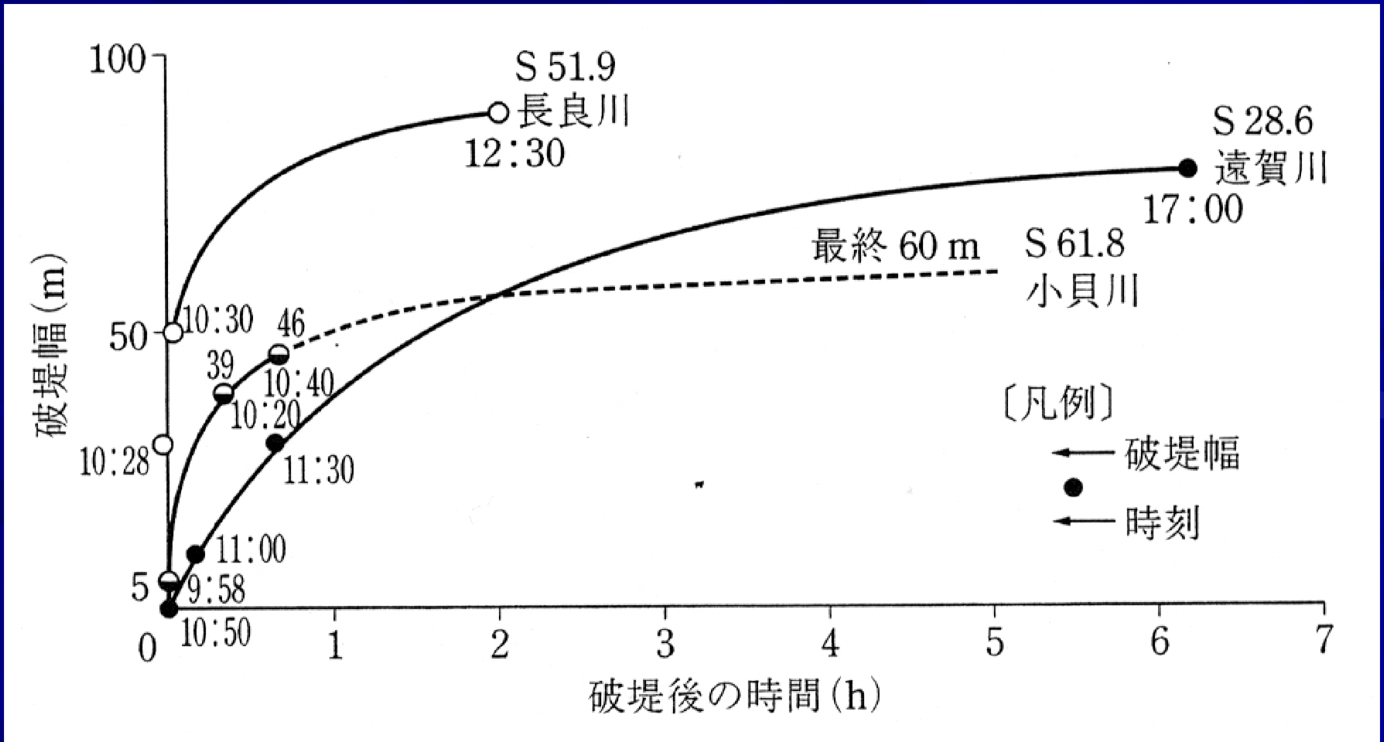


（a）裏のり・裏のり尻侵食過程　　（b）天端崩壊過程



Forms of dyke break

- dyke-break width
  levee body becomes fairly wet→ Overall width (Bb) of the dyke is broken in a short time
- ground level at dyke break section
  same level as the inland of the dyke, or deeper than that
- Planner shape
  mostly trapezoid　viewing from the river side



Flooding water propagation

・Embankment such as railroad or road has a great effect on flooding water propagation

・Flood water that flows into channels causes preceding floods
e.g. Dyke break of Kokai River (1986)

・Propagation velocity is about 1 km/hr
3～5 km/hr at steep slope floodplain

河川	破堤箇所	伝播速度	伝播地域（氾濫原勾配）
利根川	埼玉県東村(1947.9)	0.82 km/h 0.23 km/h	破堤箇所～埼玉県吉川町(1/6 800～1/3 700) 埼玉県三郷市～千葉県市川市
北上川	宮城県中田町(1947.9)	0.94 km/h	破堤箇所より 10 km 下流(1/4 000～1/3 000)
黒部川	富山県黒部市(1952.7) 富山県黒部市(1969.8)	2.7 km/h 4.5 km/h	破堤箇所～4 km 下流（1/120～1/90） 破堤箇所～1.5 km 下流（1/120）
長良川	岐阜県安八町(1976.9)	0.80 km/h	破堤箇所より 1.8 km 上流～旧森部輪中堤（1/4 000）
小貝川	茨城県石下町(1986.8)	0.60 km/h 0.90 km/h	破堤箇所～破堤箇所より 600 m 南地点 破堤箇所より 600 m 南地点～八間橋(1/2 000)
関川	新潟県新井市(1995.7)	1.30 km/h	破堤箇所～島田橋（1/200）

出典）末次（2004）：氾濫被害軽減のための氾濫原管理，水利科学

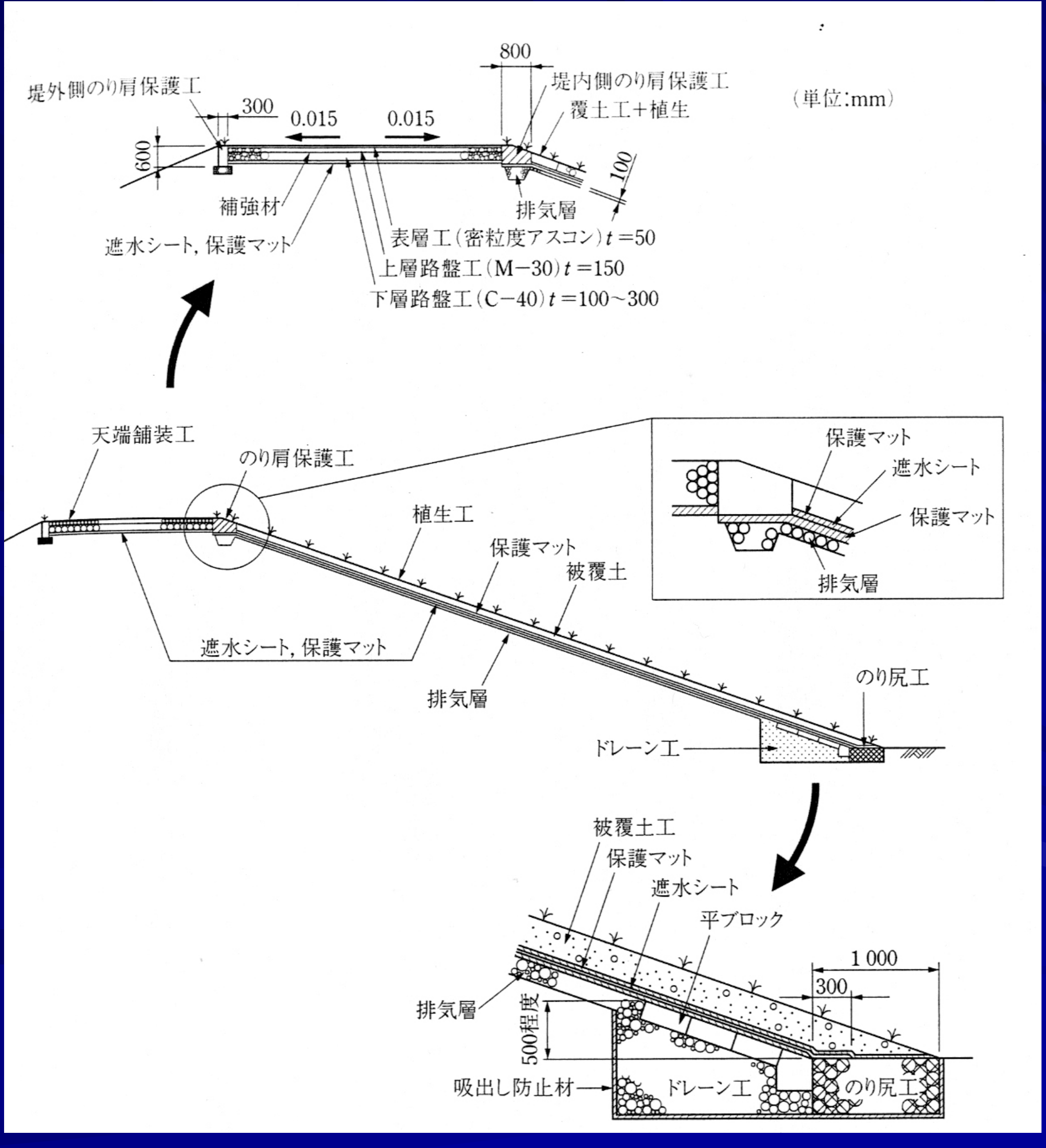
Countermeasures against dyke break caused by overtopping

・70-80% of dyke break is caused by overtopping (including medium or small rivers)

・Against overtopping, the significant protection methods are
1.levee-crown pavement / 2. back-slope coating/
3.slope-toe protection

・At high graded levee, 1. impermeable plastic sheet /
2. protection work for back slope
Naka River and Shin River

＊Levee-crown pavement can work effectively against overtopping in some cases.


800
堤外側のり肩保護工
堤内側のり肩保護工
（単位:mm）
300
0.015
0.015
覆土工＋植生
600
100
補強材
排気層
遮水シート，保護マット
表層工（密粒度アスコン）t＝50
上層路盤工（M−30）t＝150
下層路盤工（C−40）t＝100～300
天端舗装工
のり肩保護工
保護マット
遮水シート
保護マット
排気層
植生工
保護マット
被覆土
遮水シート，保護マット
排気層
のり尻工
ドレーン工
被覆土工
保護マット
遮水シート
平ブロック
1 000
300
排気層
500程度
吸出し防止材
ドレーン工
のり尻工

Measures for reducing flood

- Structural measures

  Overtopping→high graded levee、levee-crown pavement、smooth slope

  Infiltration→interception of rainwater from crown and slope, drain work

  Erosion→revetment, spur-dyke, vane work

- Non-structural measures

  secondary levee、flood control green zone、flood hazard map

  collecting and transmitting information, flood fighting activities, refuge action,flooding water control

Flooding water control

Induction of Measures	Diversion of flood water	Secondary levee	:Yoshida R. (Tributary of Naruse R.)
		Flood control green zone	:Ooi R., Kano R.
	flood water	Induced channel	:Kokai R. (Tributary of Tone R.) Agano R.
		Network of waterways	:Yanagawa City, Tributary of Nagara R.
		Pump or sluice gate	:Oohori R.(Tributary of Fuefuki R.)
	Local protection	Ring levee	:Nagara R. , OmonoR., Sakura R.
		Water-proofings	:Kanda R. basin, many other cases

Secondary Levee

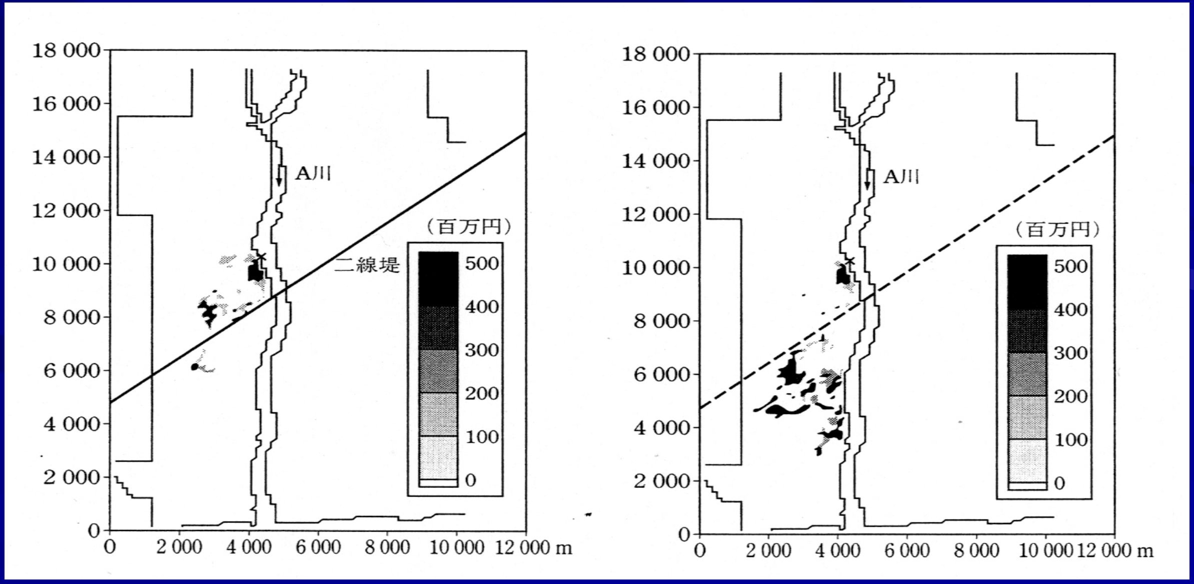
・Aim： to decrease total damage cost even though it causes increase of damage locally

・Tone R. mid basin：Tsujoh secondary levee
（Flood control capacity is equivalent to Watarase retarding basin)

・Ara R. basin: Sumida levee, Nihon levee
From 1590'～ to 1912', 3 times of dyke break at Sumida levee and 0 at Nihon levee.

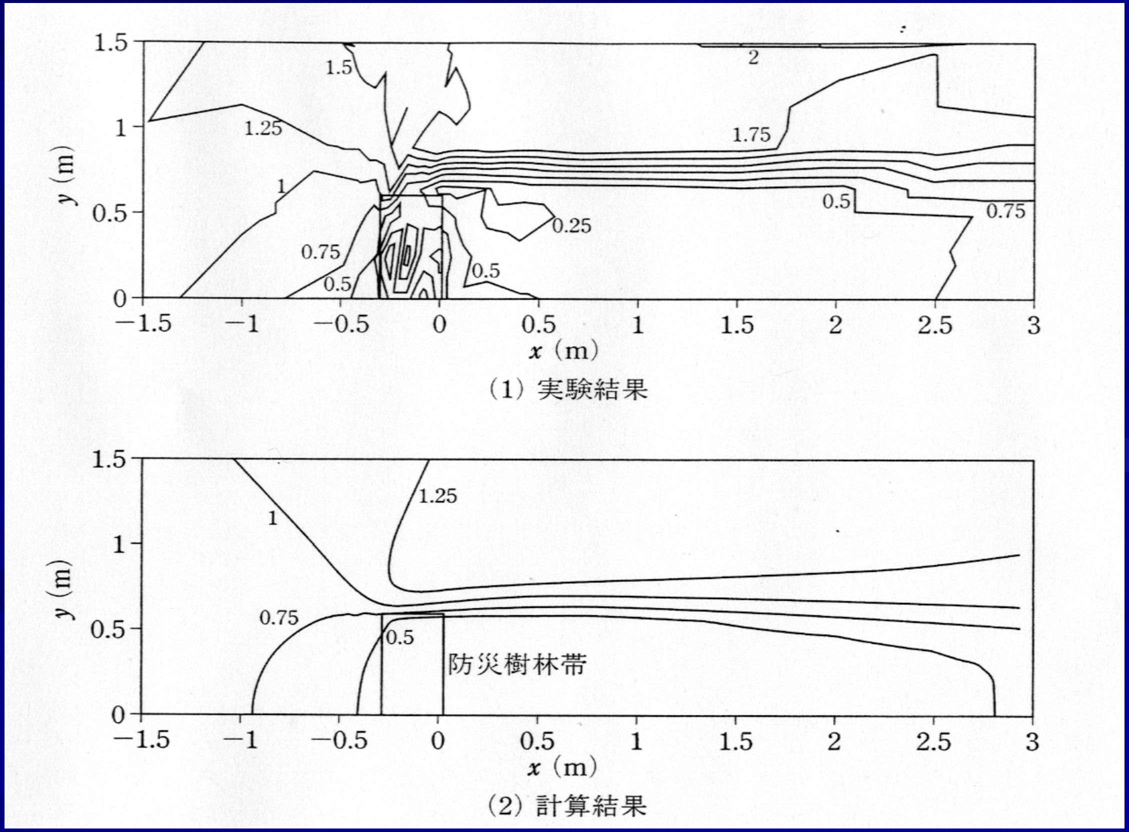
・Yoshida R. basin： Protect urban area around Kashimadai St. by making high leveled road and new bypass road as secondary levee.
Project for making City less vulnerable to floods

＊It is effective when floodplain slope is less than 1/1000, and the asset ratio of up and down stream of the secondary levee is more than triple.



Flood control green zone

- Aim：To protect houses from flooding water
- Ooi R. basin（boat-shaped house）, Kano R. basin
  green zone and embankment on the side of river
- Yosasa R. basin: The ratio of swept-away houses with green zone（shelter belt）is almost half of the houses with no green zone
  ←Green belt diverts the flooding flow and halve its flood force in the area that covers more than double width of green zone



Flood risk map
- Geomorphological map → Flood control geomorphological map, Land condition map
- Past inundated area map →Avoid map
  → Flood inundation frequency map
- Inundation predicted area map → Flood hazard map

・More than 1000 of flood risk map in total
・Not fully utilized
← Ingenuity is needed to avoid being dumped
by inserting beneficial information : community events, telephone number
Distribution right before the flood occurs : e.g.) Evacuation from Gokase R. in Nobeoka city
・ Publication of dynamic information
←Distribution map of propagation time: e.g.) Flood hazard map of Seki R. basin

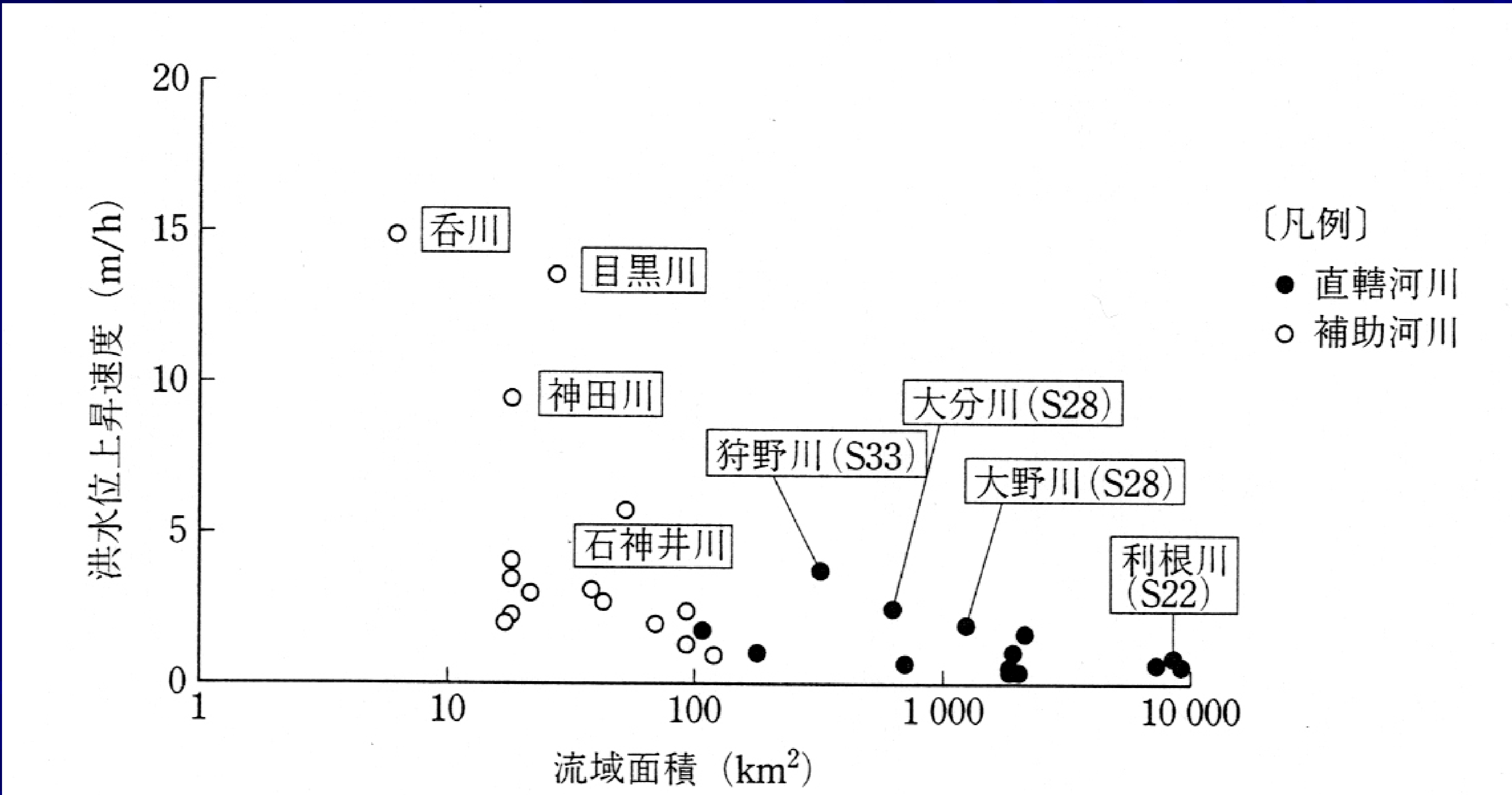

20
はんらんした水はどのくらいの速さでやってくるの?
この図は、関川、保倉川、矢代川の堤防が洪水によって壊れた時に、はんらんした水がどのくらいの速さで広がっていくのかを表したものです。
河川沿いの地区では30分で、はんらんした水がかなりの範囲に広がることが分かります。堤防の近くや低い土地にお住まいの方は十分注意してください。
また、主要道路の50cm以上冠水する区間もあわせて示してあります。
洪水到達時間並びに主要道路冠水状況図
はんらん水到達時間30分線
はんらん水到達時間１時間線
はんらん水到達時間２時間線
主 要 道 路
主要道路で50cm以上冠水する区間
はんらん時にヘリコプターが離発着可能な広場
八千浦中学校グラウンド
直江津中学校グラウンド
直江津高等学校浜野球場
春日中学校グラウンド
春日小学校グラウンド
小猿屋小学校グラウンド
水防ヘリポート
戸野目小学校グラウンド
城北中学校グラウンド
市営ソフトボール球場
市営陸上競技場
市営球場
陸上自衛隊高田駐屯地
上雲寺小学校グラウンド
和田小学校グラウンド

Evacuation system（Government side：normal times）

・ Designate different shelter for floods, and for earthquakes.
Conducting safety-level evaluation for inundation,
Distance from the river, Past inundation record
（shelter place, roads around the river）

・If it is difficult to designate public shelters,
Plains of valley bottom → private house for temporary shelter：Rumoi R.
Low-lying area → tall buildings for temporary shelter:Toyama city

・Water level criteria for alerting
Designate the critical water level from the time needed for evacuation and rising speed of flood water level,
If the water level criteria is too low, efforts are needed to set shorter time for evacuation.



洪水位上昇速度（m/h）
20
15
10
5
0
1
10
100
1 000
10 000
流域面積（km^2）
呑川
目黒川
神田川
石神井川
狩野川(S33)
大分川(S28)
大野川(S28)
利根川
(S22)
〔凡例〕
● 直轄河川
○ 補助河川

Evacuation system（Government side：on floods）

▪Collecting information
▪Sure transmission of information

▪Declaration of evacuation order through community wireless system for each house and speaker van,
Voice cannot reach through community wireless-system when heavily raining

▪Setting up shelters in early stage

▪Map distribution to refugee’s guide
＊Lending radio transmission to community leaders to collect and transmit information cooperation from taxi radio transmission, amateur radio transmission club
e.g.：Numazu city, Tsuruoka city, Kawasaki city

Evacuation activities

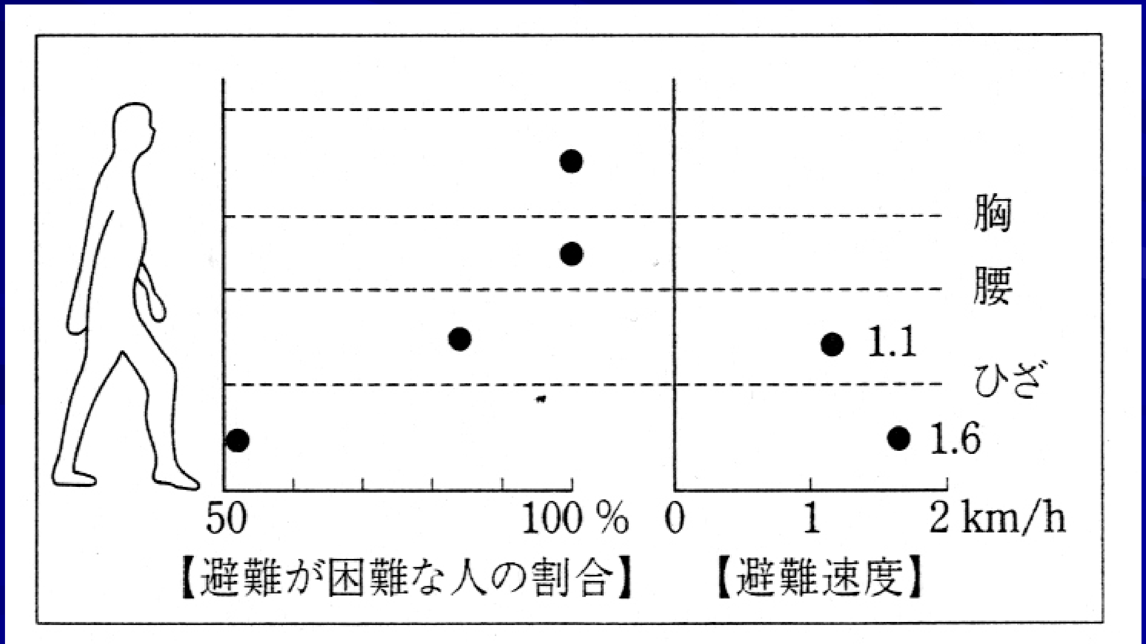
・Regardless of evacuation order,
only about 10 % of residents evacuate.
Slow in action
Evacuation order that stirs sense of urgency
of residents to evacuate in early stage
e.g.)Emergency declaration by the mayor
（Misumi town）

・How to evacuate？←Refugee's guide, Shelter map

・Precautions about evacuation should be known
to everyone

- Points to keep in mind during evacuation activities

- If inundation depth becomes higher than 50cm, it causes difficulties in walking;
  Walking speed in inundated area:
  The speed is 1.6km/hr with water below the knee
  and 1.1km/hr for water between knee and waist,
- In inundated area, people should use lope and rod for search,
  Caution is needed since there are many cases that people fall into water channels or side ditch during the evacuation activity;
  In case of evacuation using roads of the base of a mountain,
  caution is needed for sand avalanches,
- Babies should be evacuated in a baby basket,
  and elderly persons by using ladder.

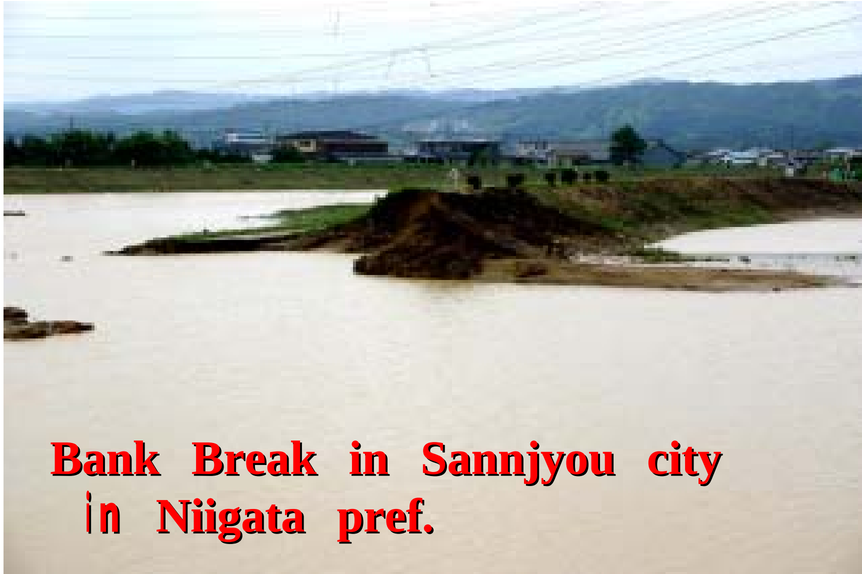


ASPECT OF RECENT FLOODS IN JAPAN

HEAD,FLOOD DISASTER PREVENTION DIVISION

TETSUYA NAKAMURA


NIIGATA
HUKUI
TOKYO
HYOGO
HIROSIMA
TAKAMATSU
MIYAZAKI
日本海
大韓民国
日本


Bank Break in Sannjyou city
in Niigata pref.


Bank Break in Nakanoshima
town in Niigata pref.


Flood in Sannjyou city




Flood damage in Sannjyou city

Bank break in central Hukui city

Pump Car for mud after flood

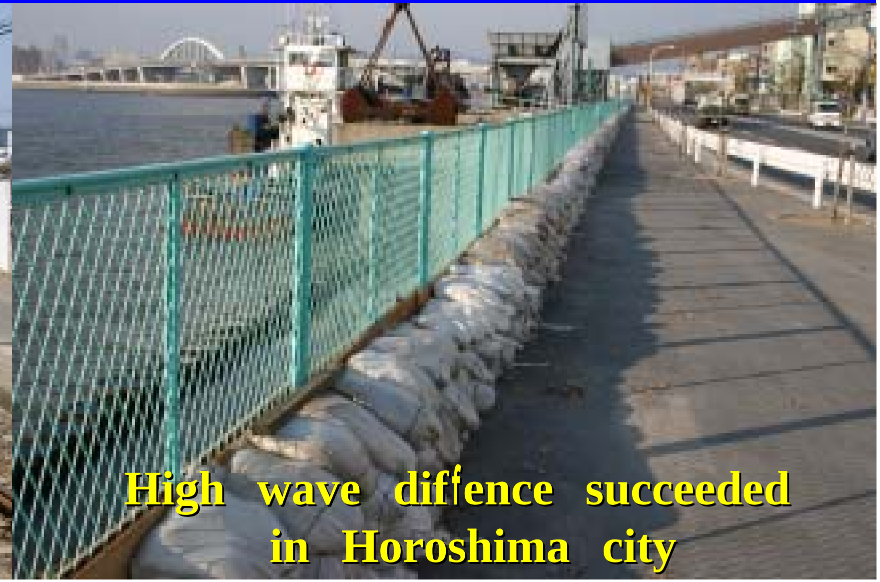
Flood in central Hukui city

Separated Disposal after flood

Effect of high wave in Takamatyu city

High wave in central Takamatsu city

High wave overflow from river in Takamatsu city



High wave diffence succeeded in Horoshima city

Upstream flood damage

Broken piers of rail way

Drift woods after flood

Entrance of underground spill way in TOKYO

Damage in basefloor in TOKYO

Damage of facility for drinking water in MIYAZAKI city

Innundated hospital

Flood fighting in MIYAZAKI city

●Inundation Damage Control Law for Specific Urban Rivers (No.77/Law/2003)

This law aims to promote inundation damage prevention measures in urban river basins where significant inundation damage has occurred or likely to occur and the progress of urbanization makes it difficult to prevent inundation damage by improving river channels and the like, by designating specific urban rivers and specific urban river basins and establishing measures to prevent inundation damage such as formulation of **countermeasure plans against river basin flood** with the objective of comprehensively promoting measures against inundation damage and **development of rainwater storage and infiltration facilities**.

Frequent occurrence of inundation damage in urban river basins in recent years

- Inundation damage has been frequently occurring in urban areas including the Tokai Flood Disaster of 2000.
- The urban heat island effect has been causing frequent localized torrential downpours, resulting in increasing risk of inundation damage.
- Such issues as reclamation of once established regulating reservoirs by housing land development are occurring in part of urban areas.

↓

- Although significant inundation damage occurred or may occur, prevention of inundation damage by improvement of river channels or a flood control dam is difficult due to progress of urbanization.

↓

Countermeasures against inundation damage by establishment of a new scheme is required in urban river basins

- Countermeasures against inundation damage with river administrator, sewage system administrators and municipalities in one body are effective

Hard side measures | **Soft side measures**

Countermeasures against inundation by river water

River Law

(Prevention measures against flood and others)

- Flood control measures by improvement of river channels/dams
- **Development of rainwater storage and infiltration facilities in the basin (River administrators)**

Flood Fighting Law

(Measures taken in the event of flood and other disasters)

- Designation of estimated inundation areas

(Targeting only inundation by river waters designated in terms of flood forecast)

New Law

- **Designation of specific urban rivers and specific urban river basins (The minister and prefectural governors)**
- **Formulation of "Countermeasure Plans against River Basin Floods" for comprehensive countermeasures against inundation damage (river administrator, sewage system administrator, prefectural governors and municipal chiefs)**
- **Designation of estimated urban flooded areas and estimated urban inundation area (targeting both river water and inland water)**
- **Designation of estimated urban flooded areas and estimated urban inundation area (targeting both river water and inland water)**
- **Obligation of notification of behaviors reclaiming existing regulating reservoirs and recommendation of required measures**
- **Conclusion of management agreement by municipalities**

Countermeasures against inundation by inland water

- **Obligation of equipping drainage facilities with water storage and infiltration functions (by ordinance)**
- **Cost burdening by other municipalities**
- Drainage and treatment of sewage

Sewage Water Law

- Development permission

City Planning Law

Outline of the Inundation Damage Control Law for Specific Urban Rivers
(No.77/Law/2003)

[Purpose of the Law]

This law aims to promote inundation damage prevention measures in urban river basins where significant inundation damage has occurred or likely to occur and the progress of urbanization makes it difficult to prevent inundation damage by improving river channels and the like, by designating such rivers as specific urban rivers and such areas as specific urban river basins respectively and establishing measures to prevent inundation damage such as formulation of countermeasure plans against river basin flood with the objective of comprehensively promoting measures against inundation damage and development of rainwater storage and infiltration facilities, for the purpose of protecting lives, bodies and properties of citizens; and thereby contribute to the securing of the public welfare.

1. Designation of specific urban rivers and specific urban river basin (Article 3)

[Requirements for designation of specific urban rivers]

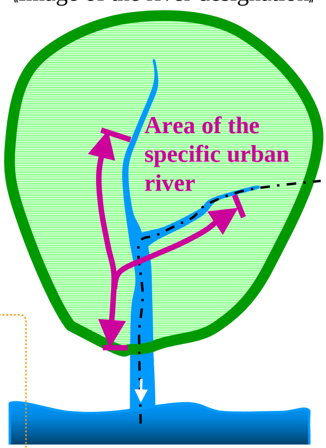
- Occurrence or possibility of occurrence of significant inundation damage.
- Difficulty of inundation damage control by improvement of river channels or flood control dam due to progress of urbanization.

[Designation of specific urban river basins]

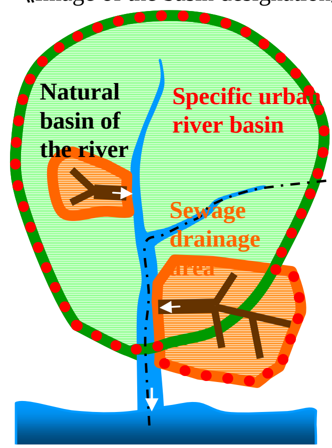
- Basins of specific urban rivers and the sewage drainage areas will be designated in combination.

*There are 30-40 rivers estimated to be designated as specific urban rivers Kanda River in all over Japan including the Kanda River (Tokyo), the Tsurumi River (Kanagawa/Tokyo), the Shin River (Aichi), the Neya River (Osaka).

《Image of the river designation》



《Image of the basin designation》



2. Formulation of countermeasure plans for river basin floods (Article 4)

- To be formulated jointly by the river administrator, the sewage system administrator, the prefectural governor, and municipal chiefs

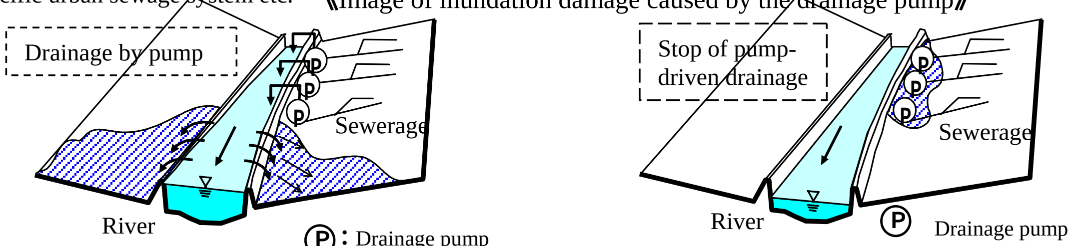
[Planned items]

- Basic policies for countermeasures against inundation damage
- The rainfall amount targeted for controlling urban floods or urban inundation.
- Matters concerning the improvement of the specific urban river
- **Matters concerning the development of rainwater storage and infiltration to be implemented by the river administrator**
- Matters concerning the improvement of sewage systems to drain the rainwater to rivers within the basin of the specific urban river in question
- Matters concerning the storage and infiltration of rainwater in the basin
- Matters concerning the operation control of the drainage pumps in the specific urban sewage system etc.

[Planning procedure]

- Hearing of opinions of citizens within the basin at a public hearing session and so on
- Hearing of opinions from men of learning and experience

《Image of inundation damage caused by the drainage pump》



Drainage of inland water to the river by drainage pumps will solve the inland water damage; however, it may cause inundation by the river water at the neck of the downstream river channel.

The drainage control may cause inland water damage in the periphery of the drainage pumps.

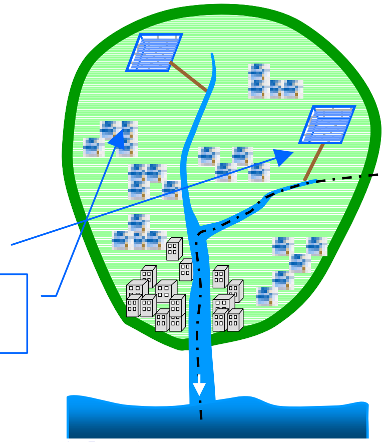
- Best effort duty of citizens and administrators within the specific urban river basin to store and infiltrate rainwater

3.Measures Based on Countermeasure Plans against River Basin Floods

(1) Development of rainwater storage and infiltration facilities by river administrator (Article 6)

・Development of rainwater storage and infiltration facilities in the specific urban river basin based on the countermeasure plans against river basin floods
・Such **facilities will be regarded as river management facilities in the River Law** and the like.

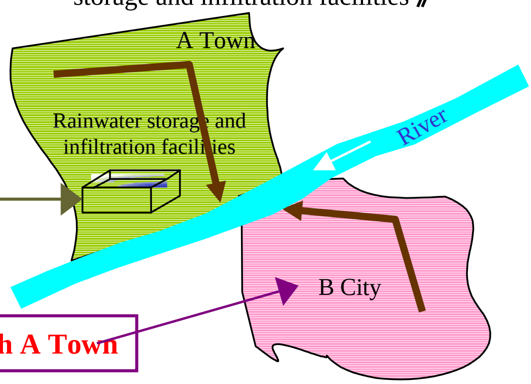
Development of rainwater storage and infiltration facilities in the basin



(2)Burden charge shared by other municipalities (Article 7)

•Municipalities that implement the projects including the sewage system specified in the countermeasure plans against river basin floods may burden the charge on other municipalities benefiting from the project implementation.

《Image of a broad-based case of rainwater storage and infiltration facilities》

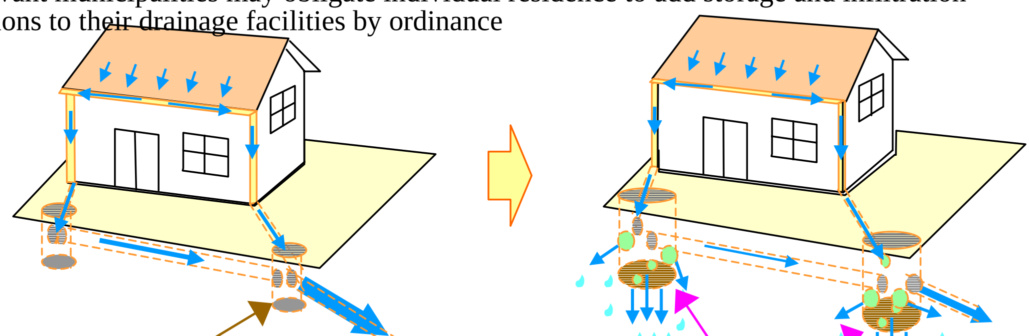


The rainwater storage and infiltration facilities are not installed by A Town and B City respectively; instead, **the storage required of B City is covered by the facilities of A** Town to secure the outflow discharge of both municipalities.

B City will share the cost burden with A Town

(3) Special exception concerning the technical requirements of the drainage facilities (Article 8)

•Relevant municipalities may obligate individual residence to add storage and infiltration functions to their drainage facilities by ordinance



Ordinary gully

Rainwater outflow will be reduced with the storage and infiltration functions added to the gully within a residence

4. Regulation for control of rainwater outflow in specific urban river basins

(1) Permission of behaviors hindering infiltration of rainwater (Articles 9-22)

○ Behaviors hindering infiltration exceeding a certain amount (estimated at 1,000m2) of rainwater (behaviors bringing about significant overflow increase) performed in lands other than housing land will require permission of the prefectural governor.

《Rainwater infiltration hindering behaviors falling under this category》

•Land transformation performed for housing land development

Example) Transformation of farmland to a parking area

•Land pavement

Example) Transformation of farmland to a parking lot

•Construction of a golf course and so on

○ In obtaining a permission, installation of rainwater storage and infiltration functions compliant with the technical requirements will be required

○ Behaviors that are likely to hinder the functions of rainwater storage and infiltration facilities installed associated with the permission will require the permission of the prefectural governor

Rainwater hindered from infiltrating into the underground by housing land development and the like will flow out into the river and so on at once and bring about inundation damage

(2)Notification of behaviors associated with the conservation and regulating reservoir (Articles 23-26)

•The prefectural governor will designate a flood control reservoir exceeding a certain capacity (estimated at 100m3) as a conservation and regulating reservoir

•Behaviors likely to hinder the functions of the conservation and regulating reservoir (such as reclamation) will be obliged to be notified to the prefectural governor.

•The prefectural governor will advise/ recommend required measures

Former flood control reservoir (of a capacity level of approximately 500m3)

Status after reclamation

(3)Management agreement associated with the conservation and regulating reservoir (Articles 27-31)

•Municipalities may manage conservation and regulating reservoirs with an agreement concluded with owners of the conservation and regulating reservoirs.

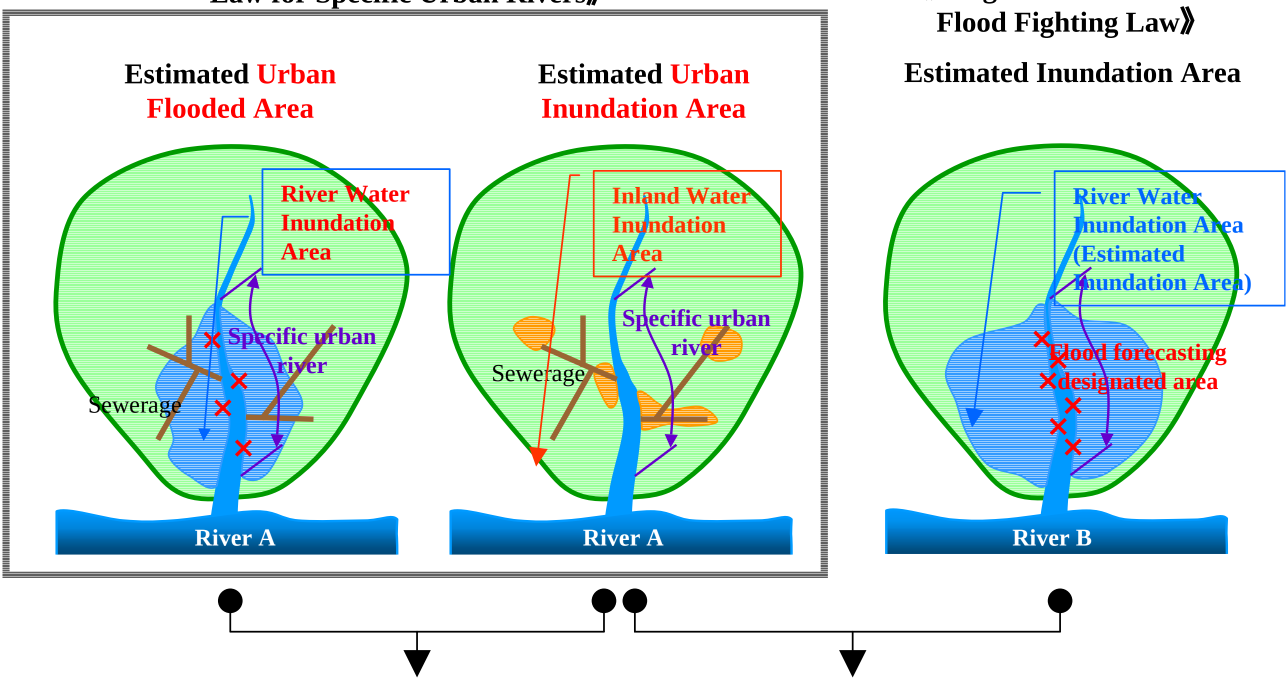
•The management agreement will be also effective on the of the conservation and regulating reservoir (effect on transferee).

5. Designation of estimated urban flooded areas and estimated urban inundation area (Articles 32 and 33)

・" Estimated Urban Flooded Areas" = Areas where inundation caused by urban flood (River flooding) is estimated
・" Estimated Urban Inundation Area" = Areas where urban inundation (inundation caused by inland water such as overflow stream or pooling) is estimated will be designated and announced
・The **municipal conference will establish information transfer methods about inundation and evacuation areas and information transfer methods to underground shopping areas and announce them to citizens**
・Best effort duties of underground shopping area administrators to prepare and announce plans on evacuation in the event of inundation etc.

《Designation Based on the Inundation Damage Control Law for Specific Urban Rivers》

《Disignation Based on the Flood Fighting Law》



A case where the specific urban river is not a flood forecasting designated river (such as the Kanda River and Neya River)

A case where the specific urban river is a flood forecasting designated river (such as the Tsurumi River and Shin River)

Date of enforcement

•A day designated by a government ordinance within one year after the promulgation date (May 15, 2004)

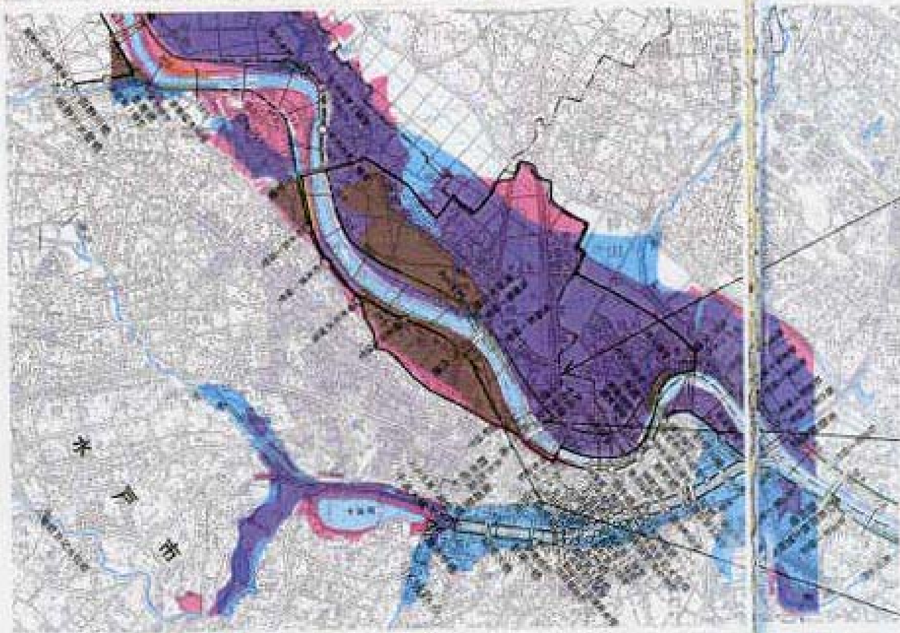
Countermeasures against urban flood

HEAD,FLOOD DISASTER PREVENTION DIVISION

TETSUYA NAKAMURA

Past Inundated Area Map

Past Inundated Area Map (Mito City)



Data on past inundation

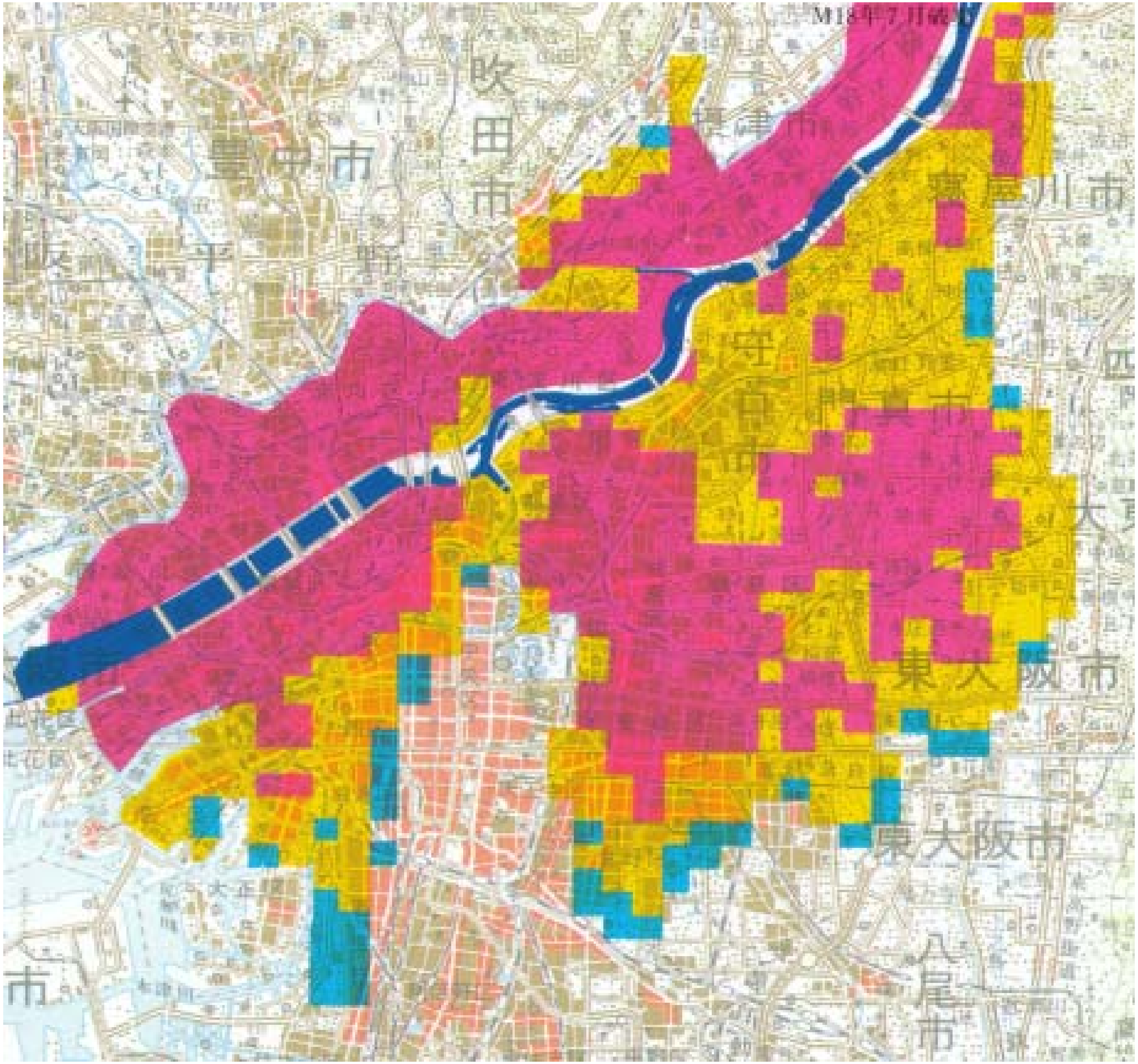
年月日	[illegible]	[illegible]			[illegible]				[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	床上	床下	計	(m)	
S36-6-28	[illegible]	48	362	水戸	56,555	1,789棟	6,456棟	8,245棟		
S57-9-10-14	台風[illegible]号	35	232	[illegible]	1,147	65棟	152棟	217棟		
S61-8-4-5	台風10号	49	313	[illegible]	3,618	2,775棟	624棟	3,399棟		

Predicted Inundation Area Map

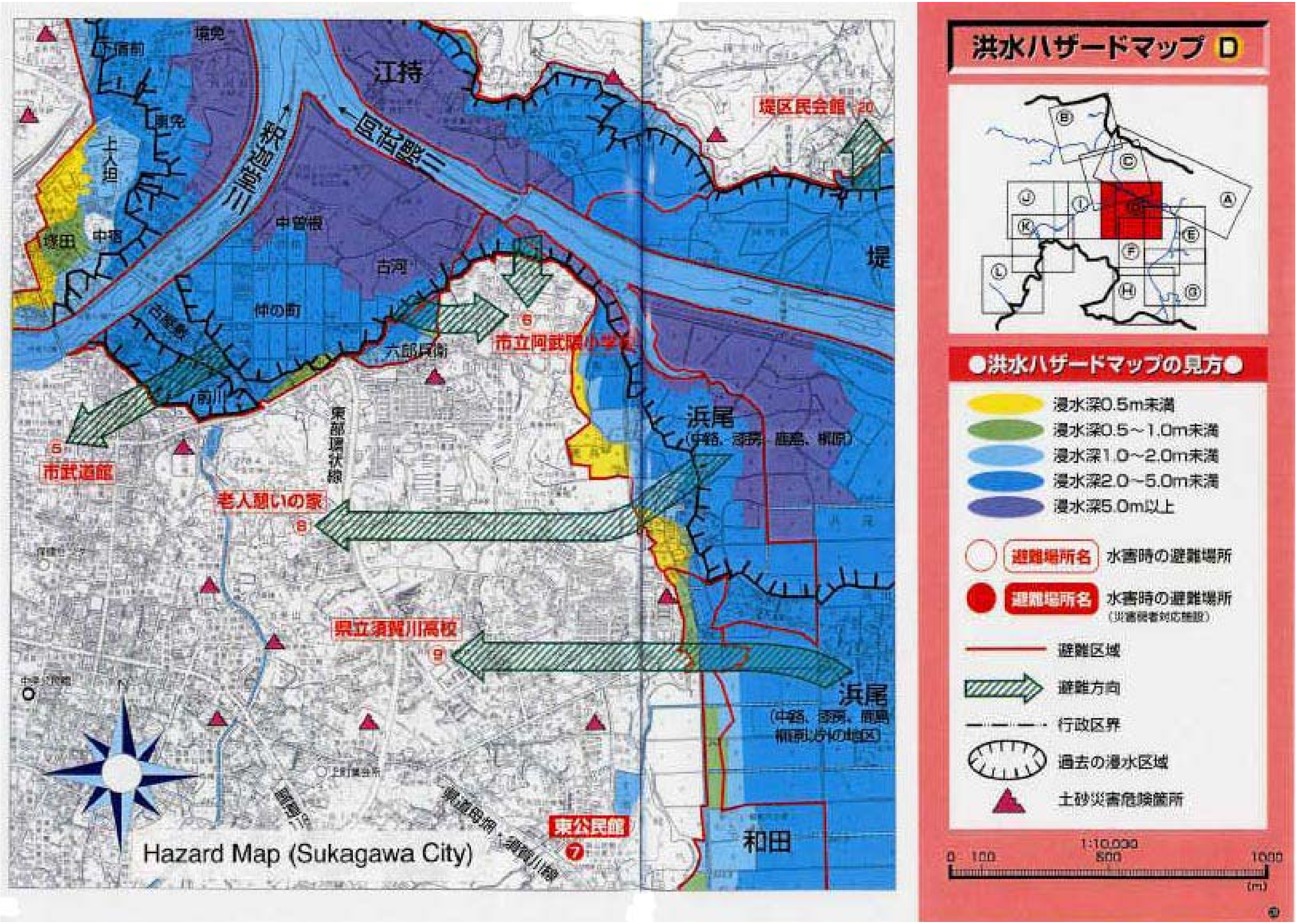
凡　例

- 浸水深が0.5m以下の区域
- 浸水深が0.5m~2.0m未満の区域
- 浸水深が2.0m以上の区域
- 過去の破堤箇所
- 対象としている河川区間

洪水氾濫危険区域内面積		29,000 ha
洪水氾濫危険区域内戸数	0.5m以下	68,000 戸
	0.5m~2.0m未満	354,000 戸
	2.0m以上	467,000 戸
	合　計	889,000 戸
洪水氾濫危険区域内人口		2,660,000 人

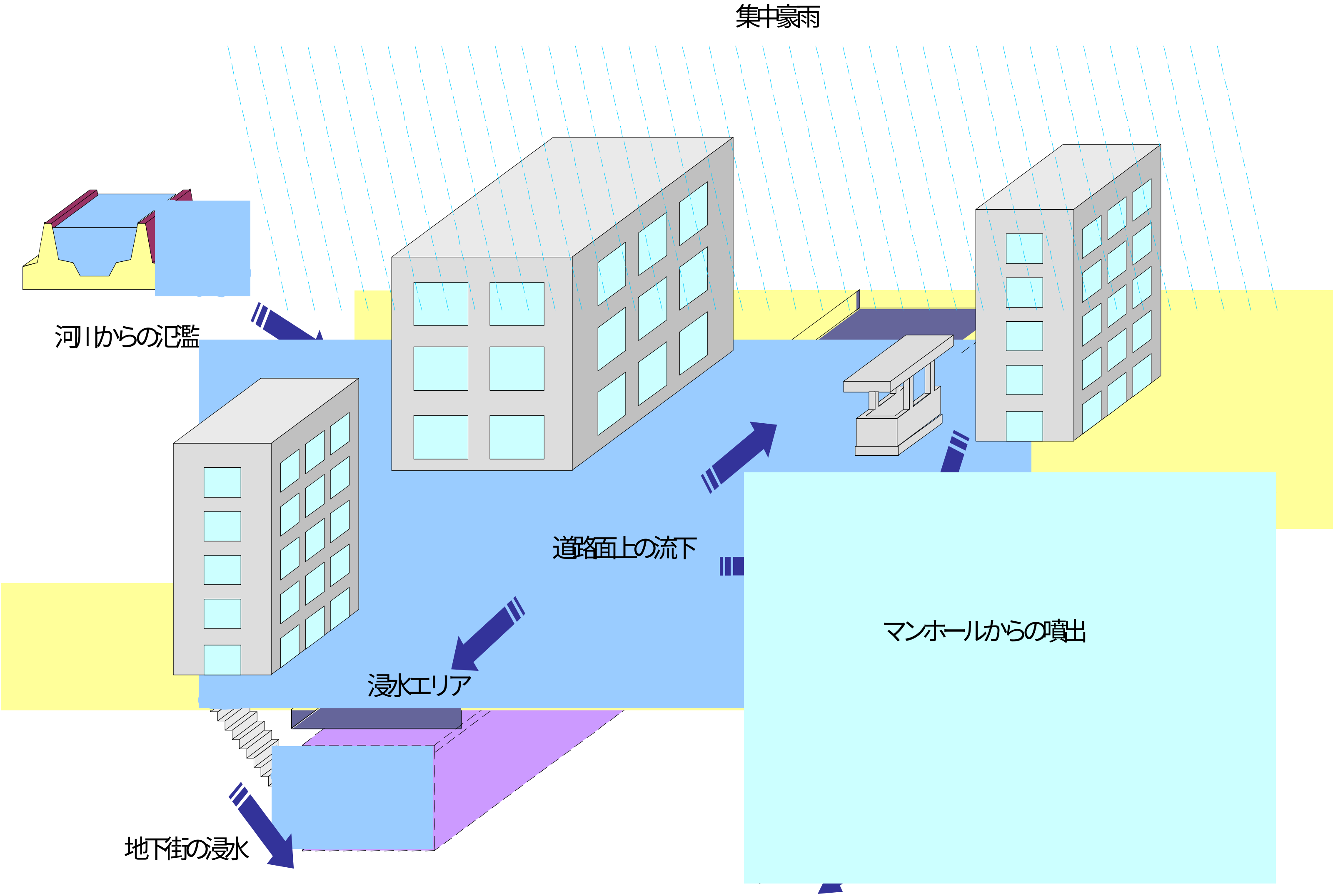


Hazard Map

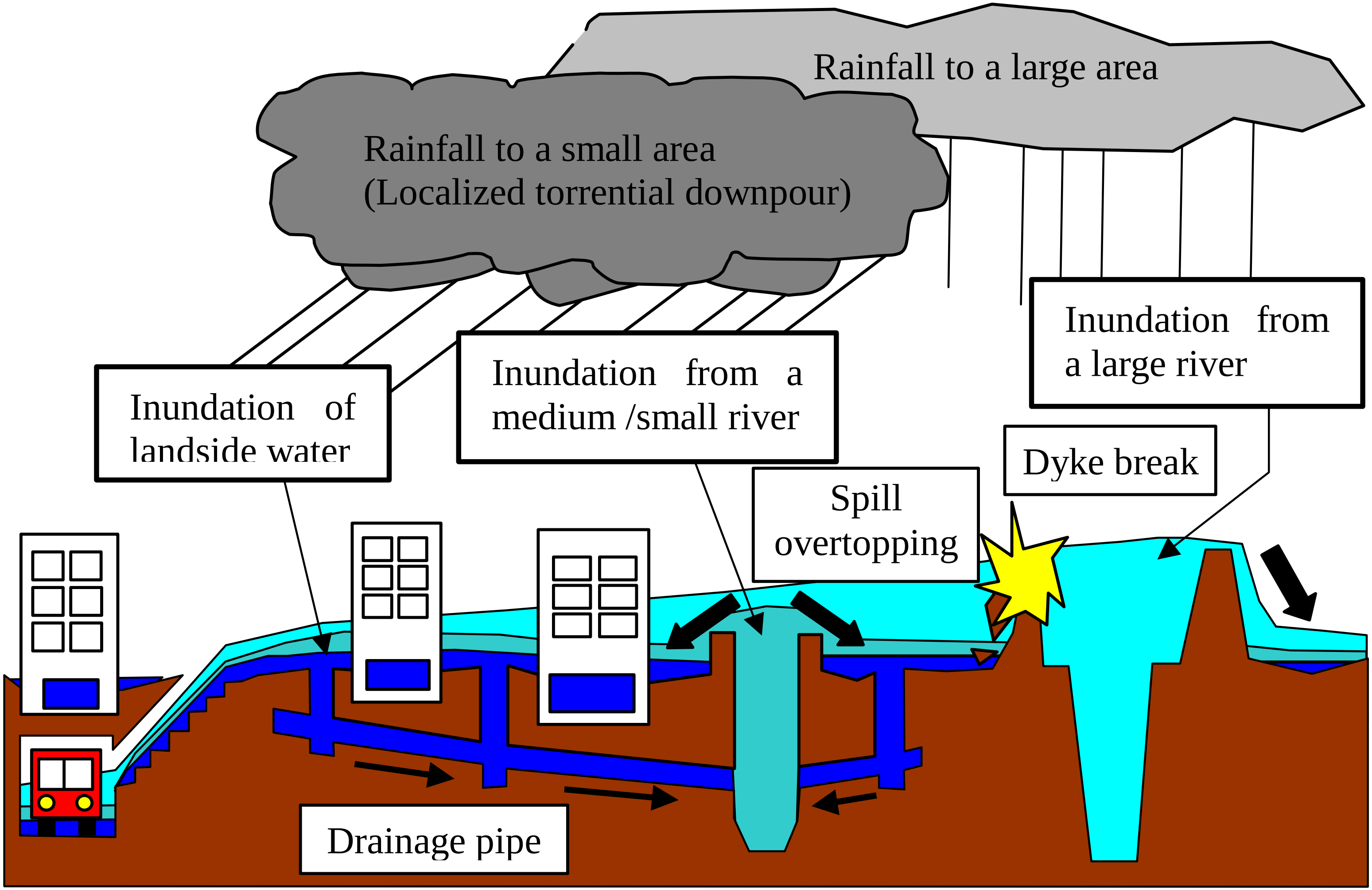


洪水ハザードマップ D
●洪水ハザードマップの見方●
浸水深0.5m未満
浸水深0.5～1.0m未満
浸水深1.0～2.0m未満
浸水深2.0～5.0m未満
浸水深5.0m以上
避難場所名 水害時の避難場所
避難場所名 水害時の避難場所
避難区域
避難方向
行政区界
過去の浸水区域
土砂災害危険箇所
1:10,000
0 100 500 1000
(m)
江持
堤区民会館 20
堤
市立阿武隈小学校 6
市武道館 6
老人憩いの家 8
県立須賀川高校 9
東公民館 7
浜尾
和田
Hazard Map (Sukagawa City)

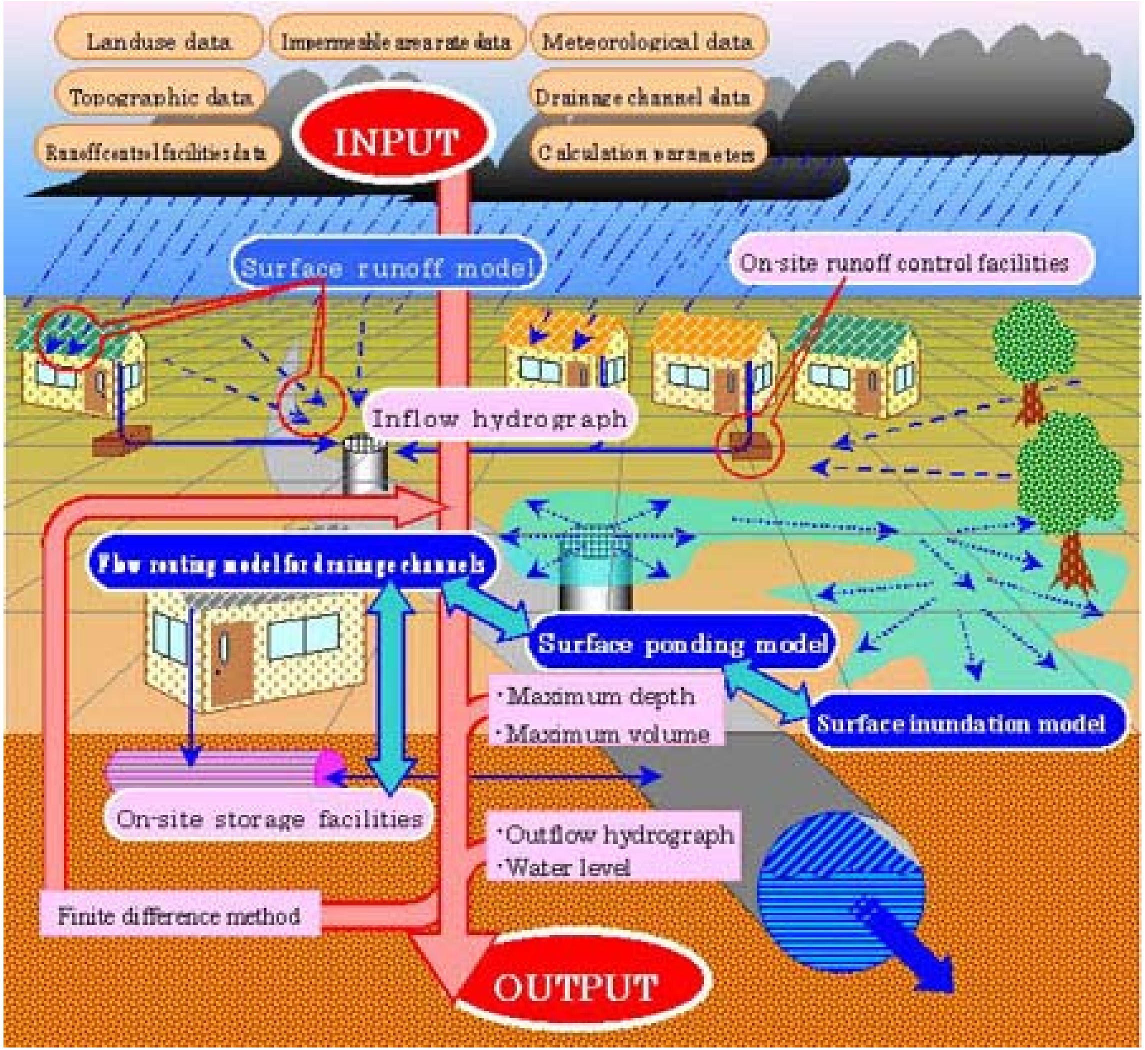
How urban inundation occurs?



Development of flood hazard simulation method considering both riverine flood and landside water inundation CONSISTENTLY.



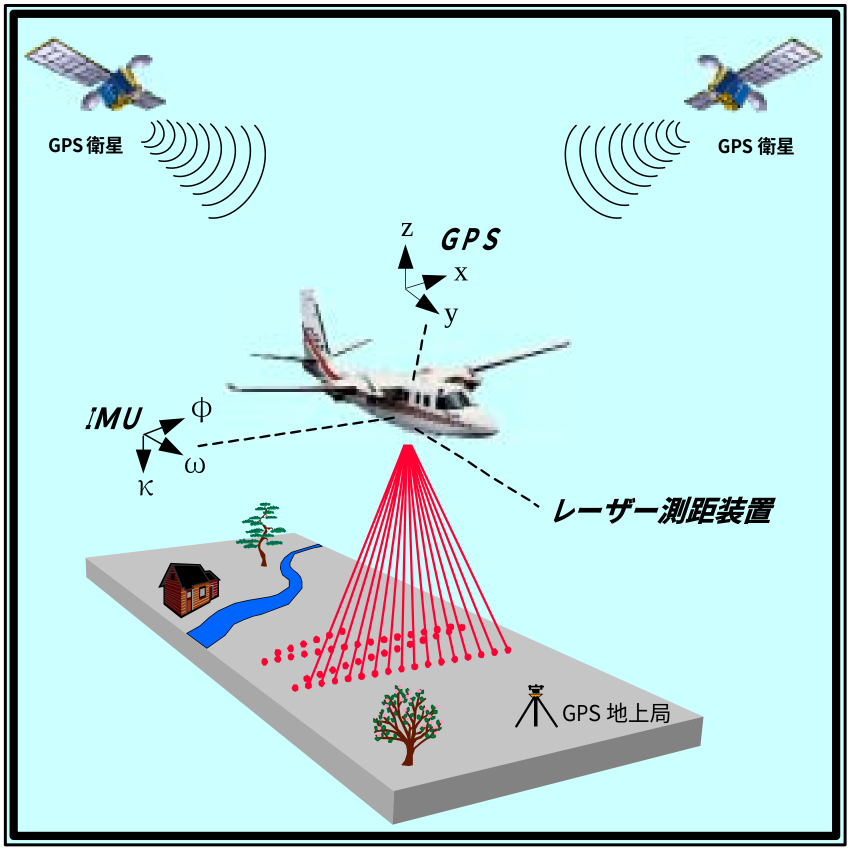
NILIM
(New Integrated Lowland Inundation Model)

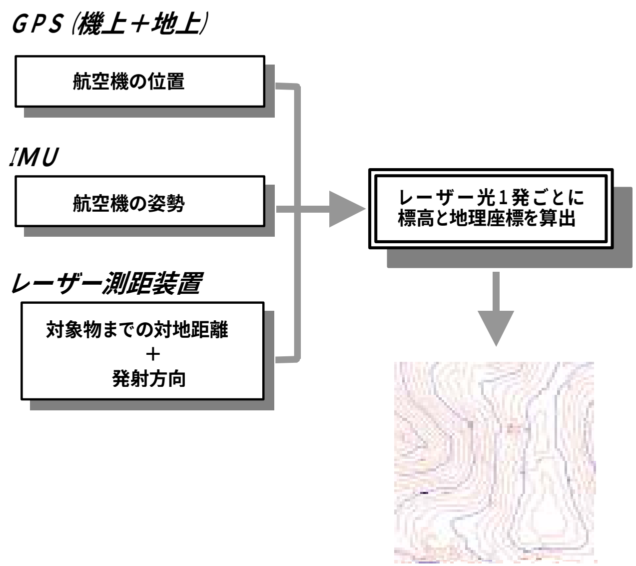


New challenges on flood simulation

Data Collection Using New Technology

Use of Laser Scanner for Ground Level Measurement

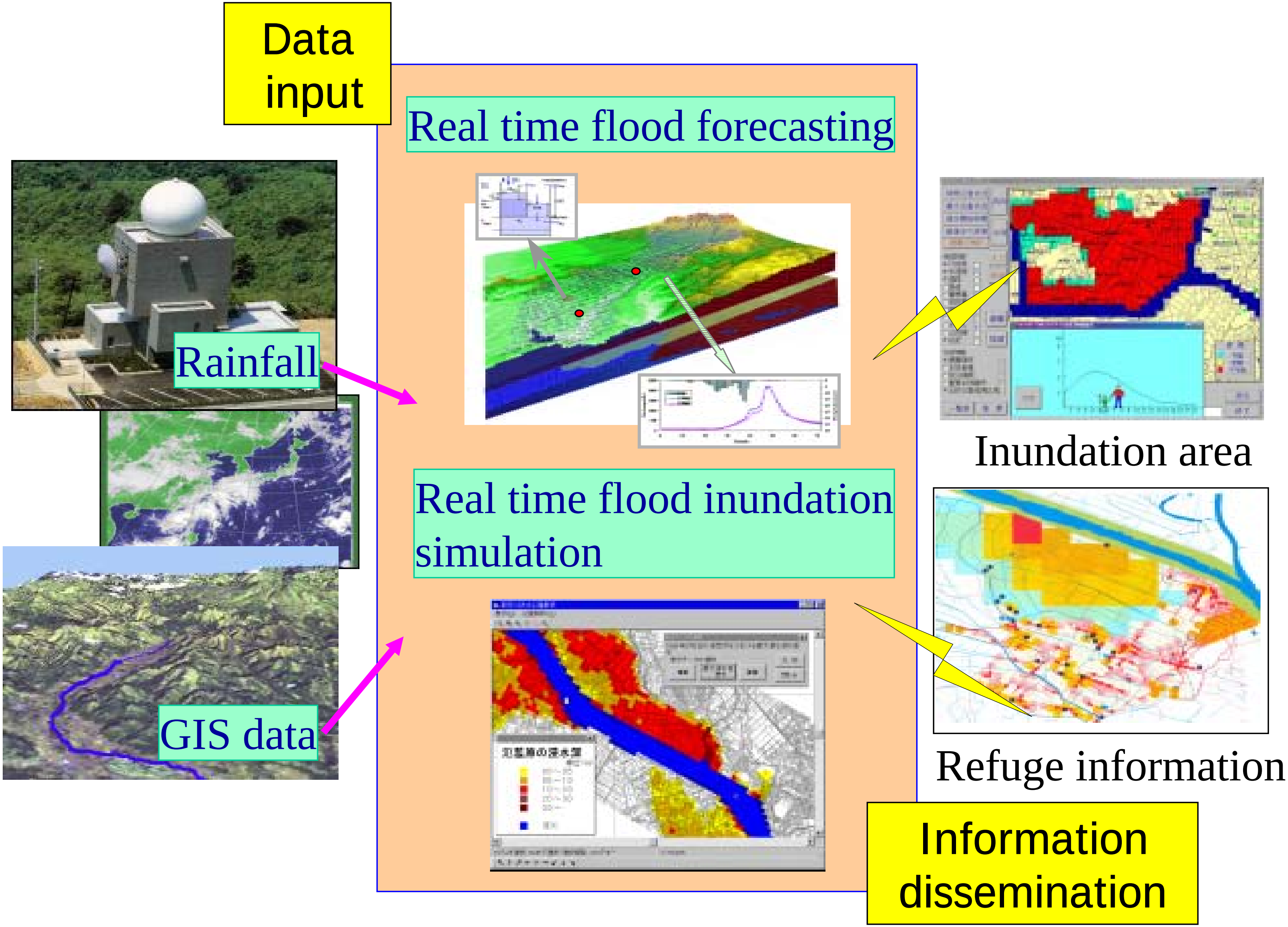




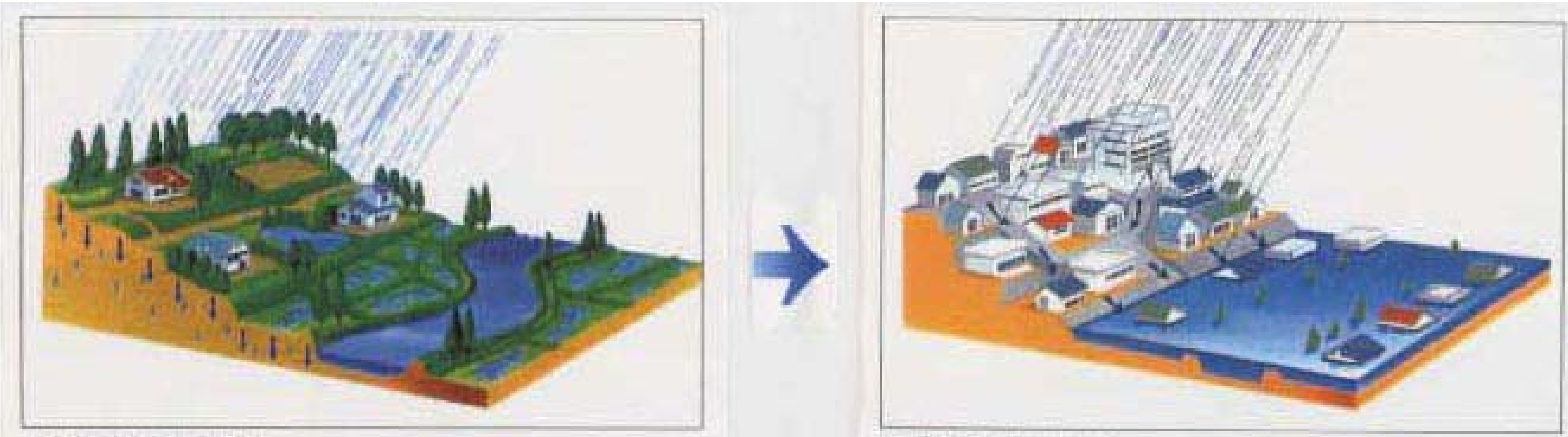
特徴

◆高い計測精度 (機械精度)
水平方向：対地高度の 1/1,000
垂直方向：±15cm

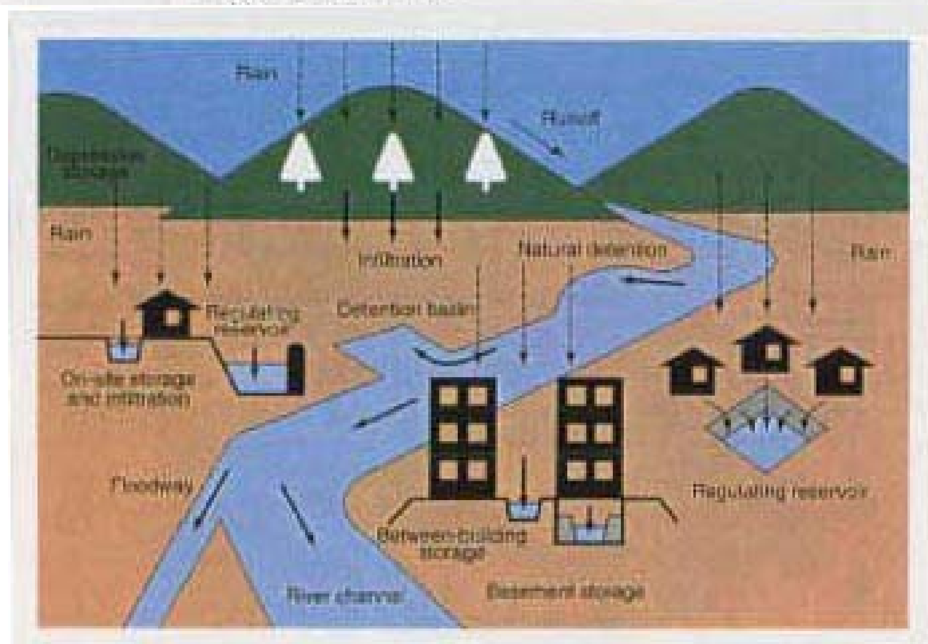
◆樹木の下の地表面の計測も可能
(条件あり)


Data input
Real time flood forecasting
Rainfall
Inundation area
Real time flood inundation simulation
GIS data
Refuge information
Information dissemination

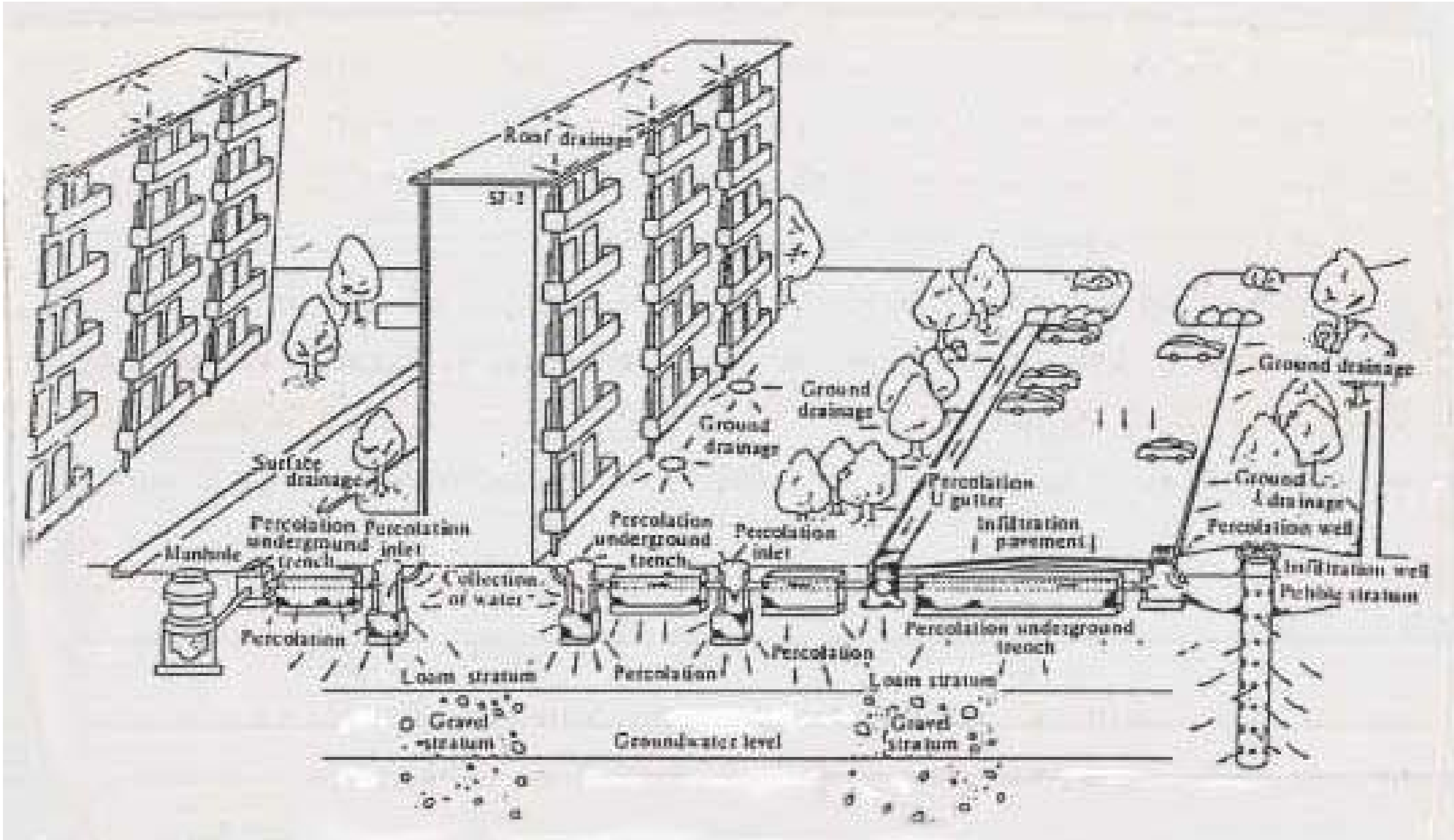
Conservation & Restoration of Natural Function of the Catchment



Measures with Facilities in the Basin



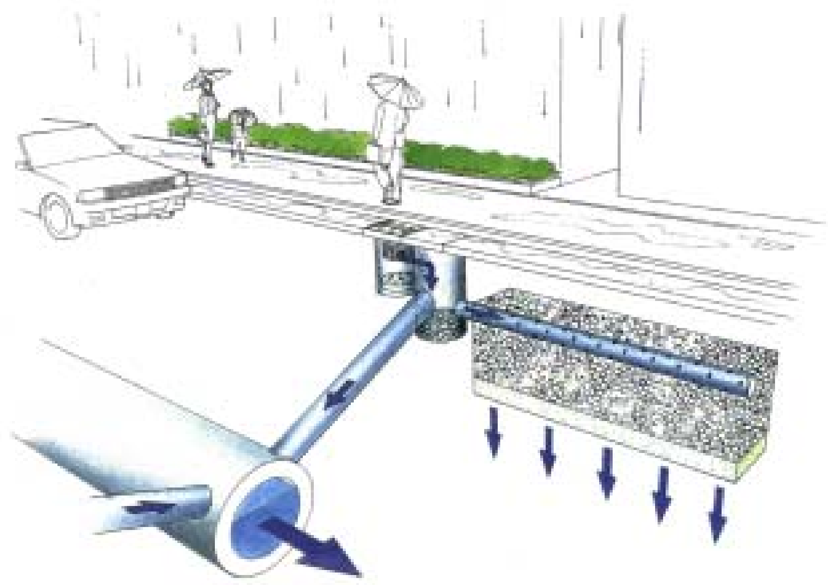
Combination of Rainwater Infiltration Facilities



Infiltration facilities

In urban areas, typically roads and sidewalks are paved with artificial materials such as asphalt and concrete. In this situation, infiltration facilities are effective structures that facilitate rainwater to infiltrate into the ground to reduce storm water runoff.

Infiltration inlet installed in front of a house



Infiltration inlet installed under roads

At ordinary times

In the event of a heavy rain, rainwater is detained to control flow into rivers.

Municipal Kumagaya Nishi Elementary School (Kumagaya City, Saitama Prefecture: Oshi River)

Tsurumi River Multipurpose Retarding Basin (Yokohama City, Kanagawa Prefecture)

Piloti Type

The underground structure of the building and the parking lot absorb water and let it drain gradually so that flooding and water invasion can be avoided.

Storage Plus Filtration

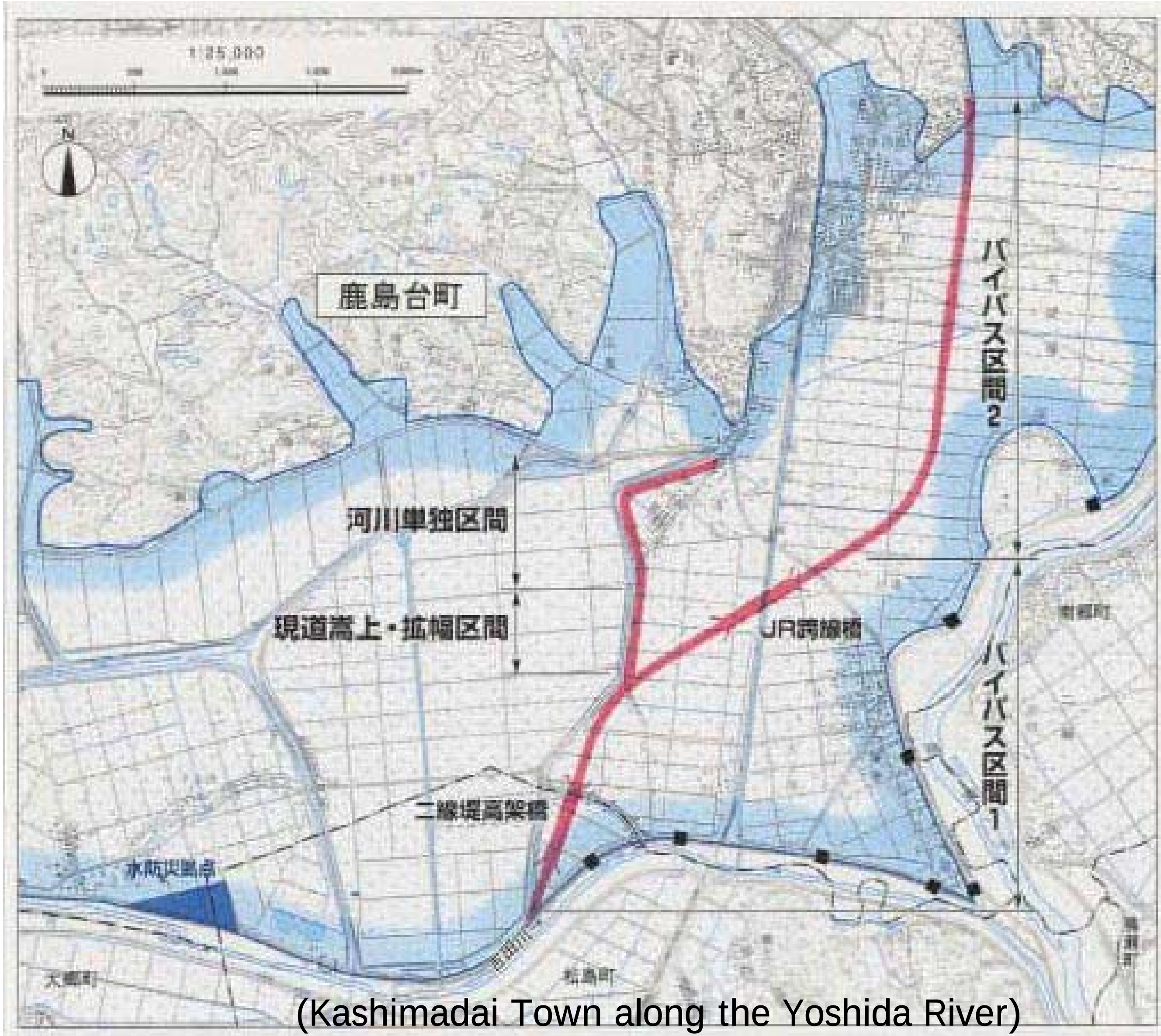
The storage function of the adjusting pond and the filtering of the well serve to both control outflow and process the drained water.

Figure 4.8 flood-Pumping Engines

Flood-control vehicles, such as drainage pump vehicles, satellite communication vehicles, and commander vehicles, are to be deployed at the flood-control stations and other flood-control centers.

Drainage pump vehicle deployed in Sukagawa City

Secondary Levee to Restrict Inundated Area

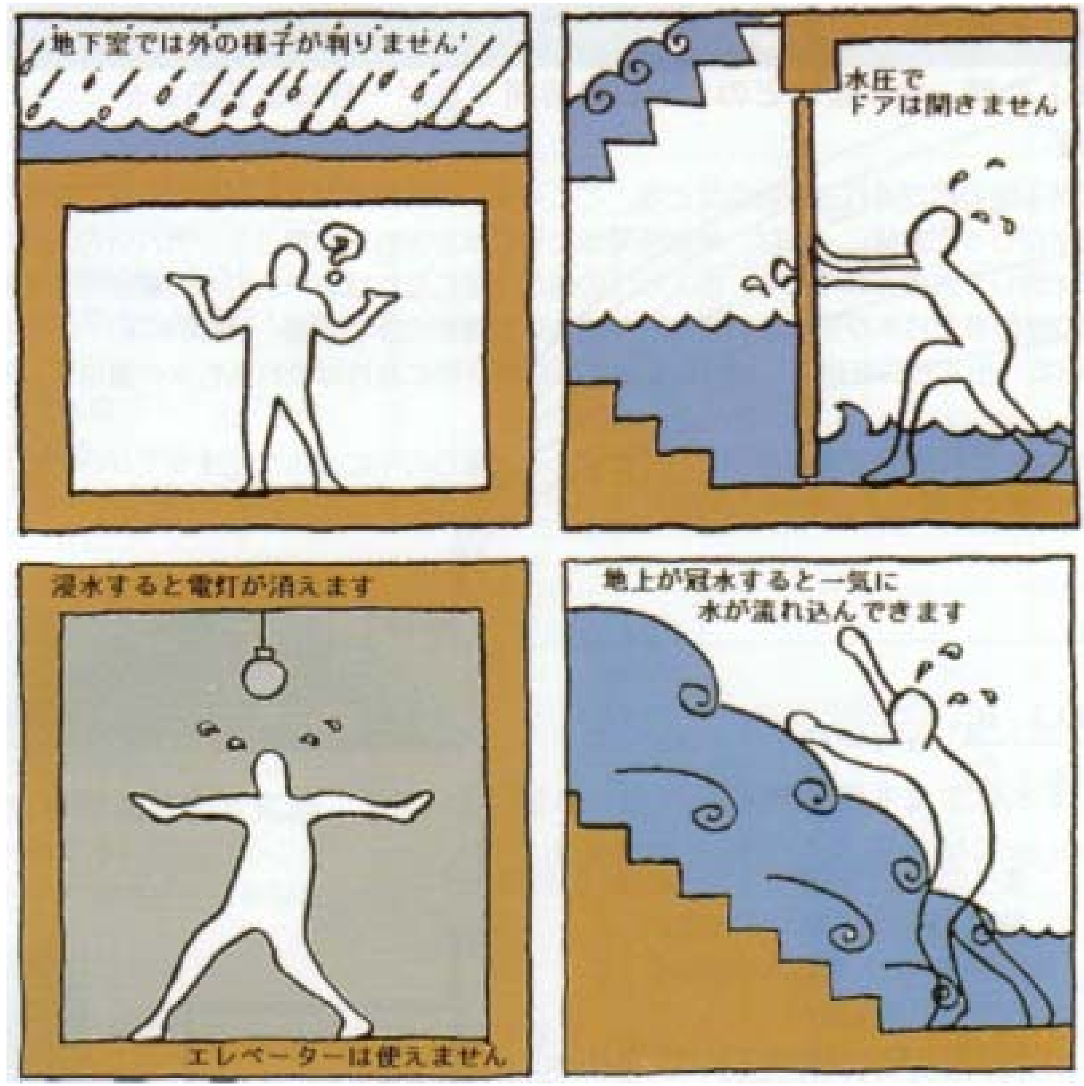


(Kashimadai Town along the Yoshida River)

Flood in Fukuoka City   June 1999

Inundation of Underground Spaces

Brochure to notify the danger of staying in basements during flood



Coastal Disaster and Its Countermeasures

Coast Division

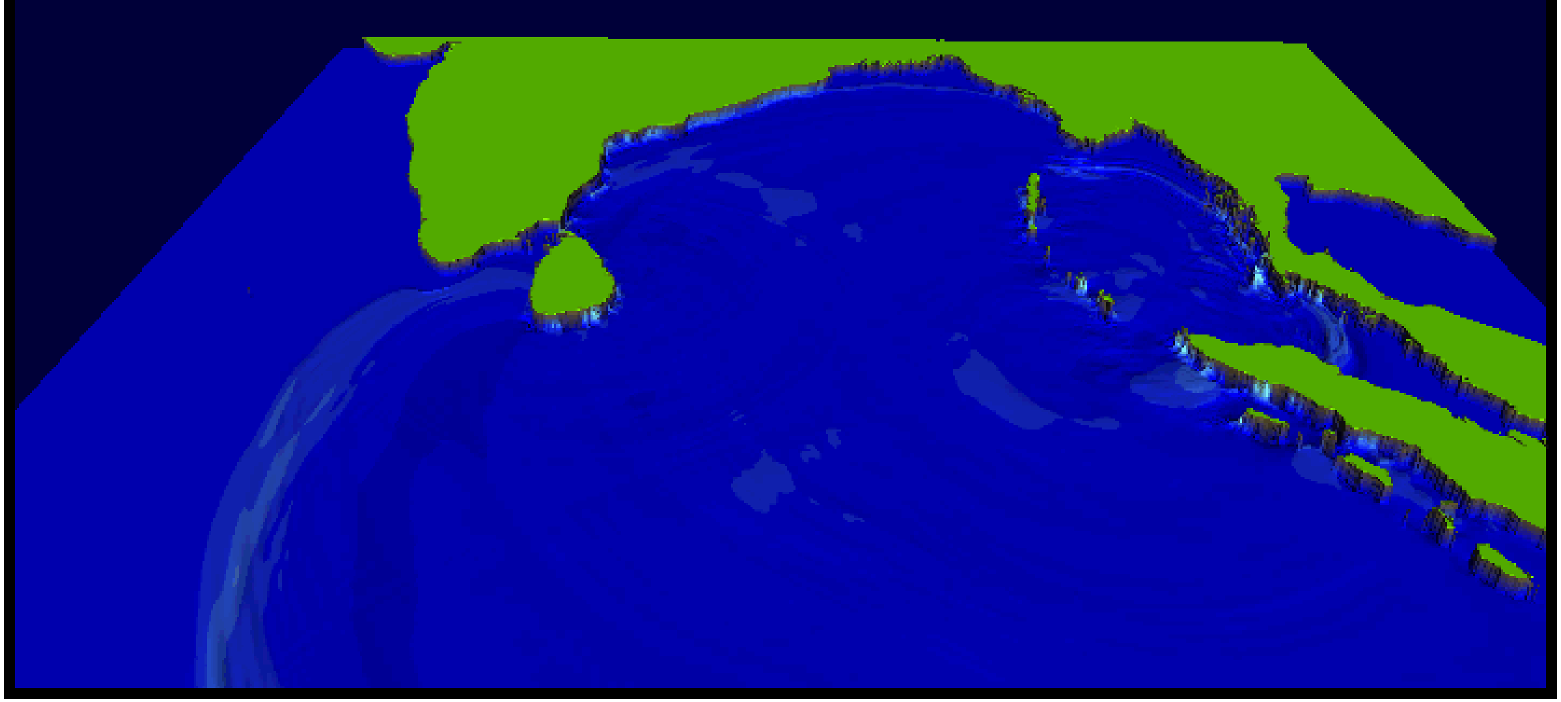
National Institute for Land and Infrastructure Management, Japan

Agenda

1. Recent Coastal Disasters
   tsunamis, storm surges, coastal erosion

2. Measures against Coastal Disasters
   basic policy against tsunamis
   shore protection facilities
   storm surge warning system
   comprehensive sediment management

Indian Ocean Tsunami in 2004

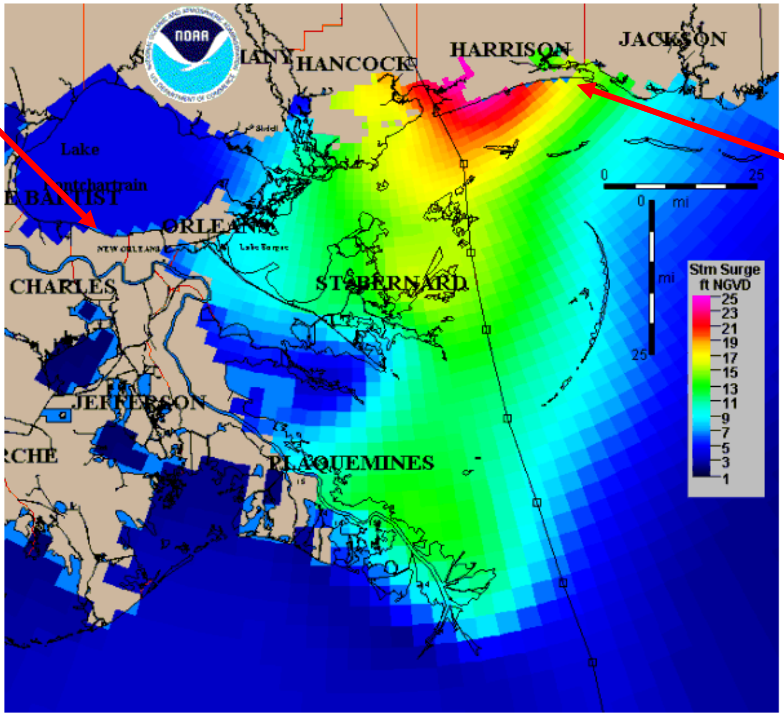


Hurricane Katrina in 2005

(Wilson Shaffer, National Weather Service/NOAA)

New Orleans

Biloxi

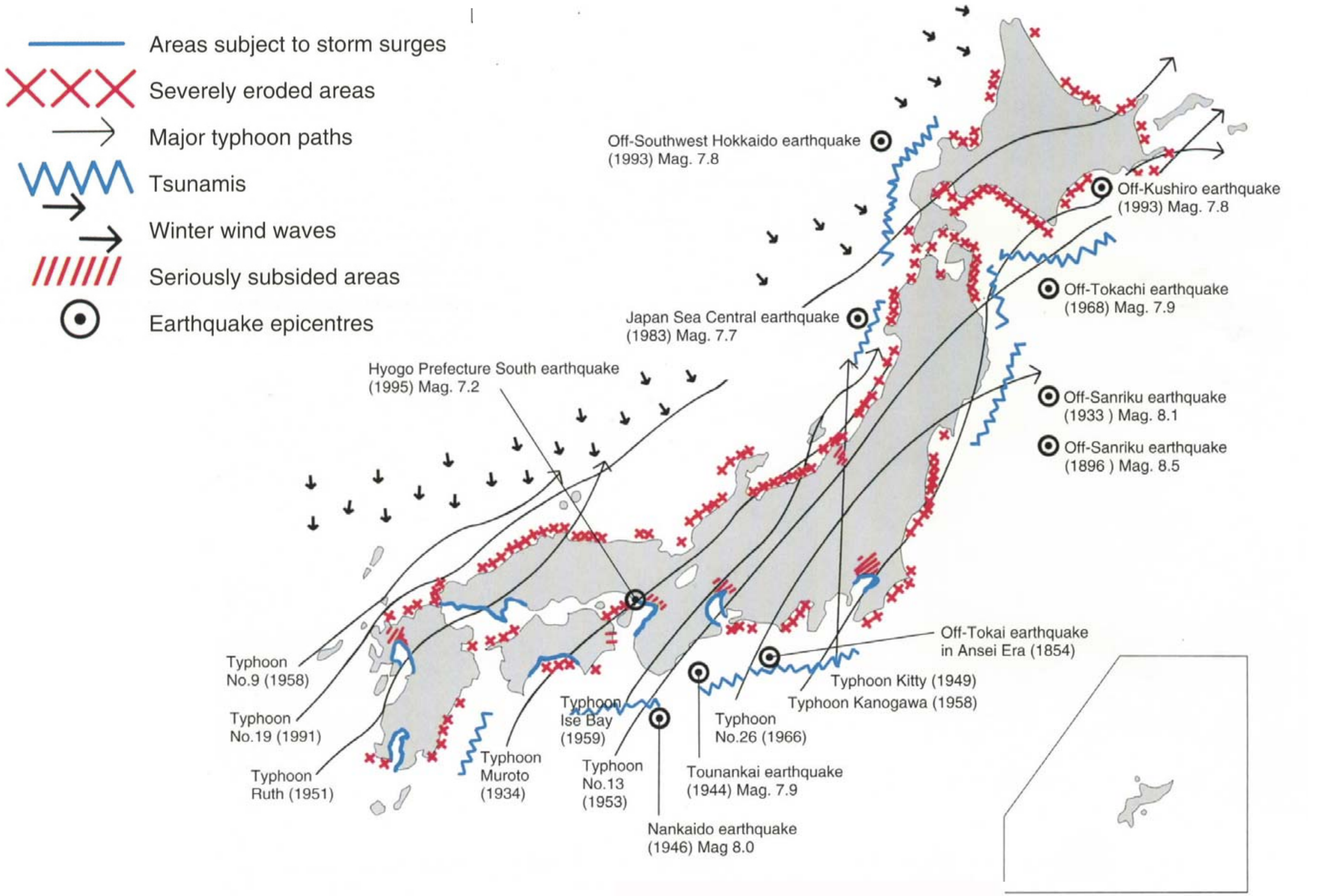


Camille's Envelope of High Water From SLOSH Model

Storm surge of up to 7.5m high

(photo: Reuter)

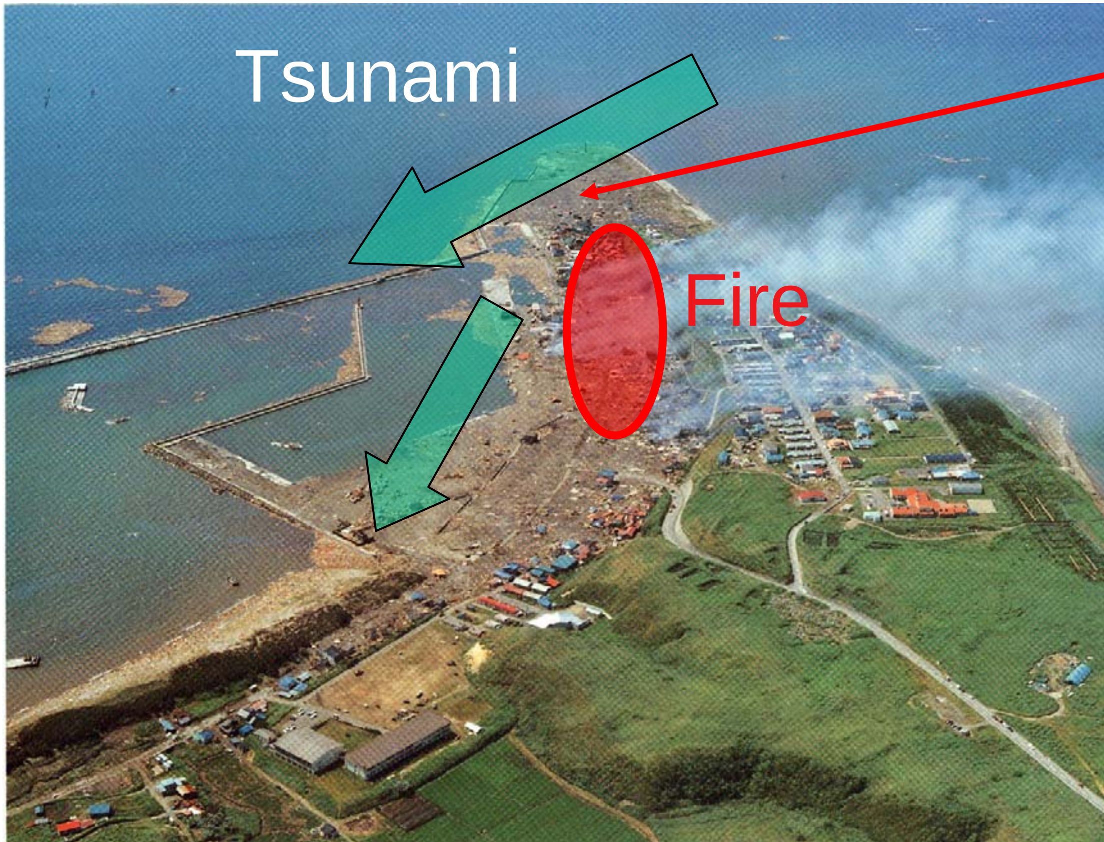
Coastal Disasters in Japan



Tsunami Disasters in Japan

Date	Major damaged area	Damage				Earthquake	Remarks
		Dead	Injured	Missing	Houses		
15 June 1896	Sanriku	21,759	4,403		14,087	Meiji-Sanriku	
3 Mar. 1933	Sanriku	1,522	1,092	1,542	9,869	Showa-Sanriku	
7 Dec. 1944	Mie, Wakayama	189	129	449	10,626	Tonankai	
21 Dec. 1946	Wakayama, Mie, Tokushima, Kochi	1,330	3,942	113	68,006	Nankai	including earthquake damage
23 May 1960	Sanriku	119	872	20	22,693	Chilean	
16 May 1968	Aomori	52	329		19,695	Off-Tokachi	including earthquake damage
26 May 1983	Akita, Aomori	104	163		6,359	Japan Sea Central	including earthquake damage
12 July 1993	Hokkaido	202	305	29	3,443	Off-Southwest Hokkaido	including earthquake damage

Tsunami hit Okushiri Island (1993)



(photo: JSCE)

about 200 residents died

Earthquake

Storm Surge Disasters in Japan

Date	Major damaged area	Human casualties			Damage to houses		
		Dead	Injured	Missing	Completely destroyed	Partially destroyed	Washed away
1 Oct. 1917	Tokyo Bay	1,127	2,022	197	34,459	21,274	2,442
13 Sep. 1927	Ariake Sea	373	181	66	1,420		791
21 Sep. 1934	Osaka Bay	2,702	14,994	334	38,771	49,275	4,277
27 Aug. 1942	Suo Sea	891	1,438	267	33,283	66,486	2,605
17 Sep. 1945	Southern Kyushu	2,076	2,329	1,046	58,432	55,006	2,546
3 Sep. 1950	Osaka Bay	393	26,062	141	17,062	101,792	2,069
14 Oct. 1951	Southern Kyushu	572	2,644	371	21,527	47,948	1,178
25 Sep. 1953	Ise Bay	393	2,559	85	5,985	17,467	2,615
7 Sep. 1959	Ise Bay	4,697	38,921	401	38,921	113,052	4,703
16 Sep. 1961	Osaka Bay	185	3,897	15	13,292	40,954	536
21 Aug. 1970	Tosa Bay	12	352	1	811	3,628	40
30 Aug. 1985	Ariake Sea	3	16	0	0	589	0
24 Sep. 1999	Yatsushiro Sea	12	10	0	52	99	0

Storm Surge Flood in 2004

Takamatsu City

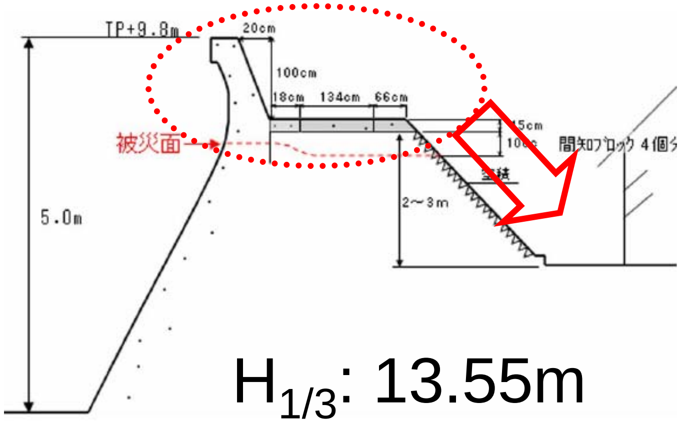
(facing the Seto Inland Sea)

3 people died, 15561 houses flooded

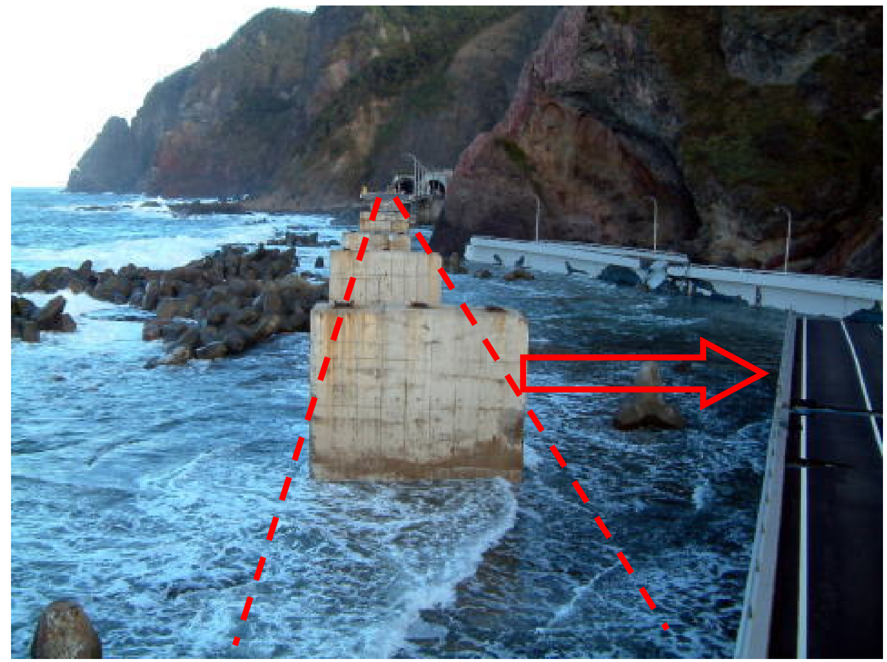
(photo: Shikoku Regional Development Bureau)

Recent Disasters caused by High Waves (2004)

Dike Failure



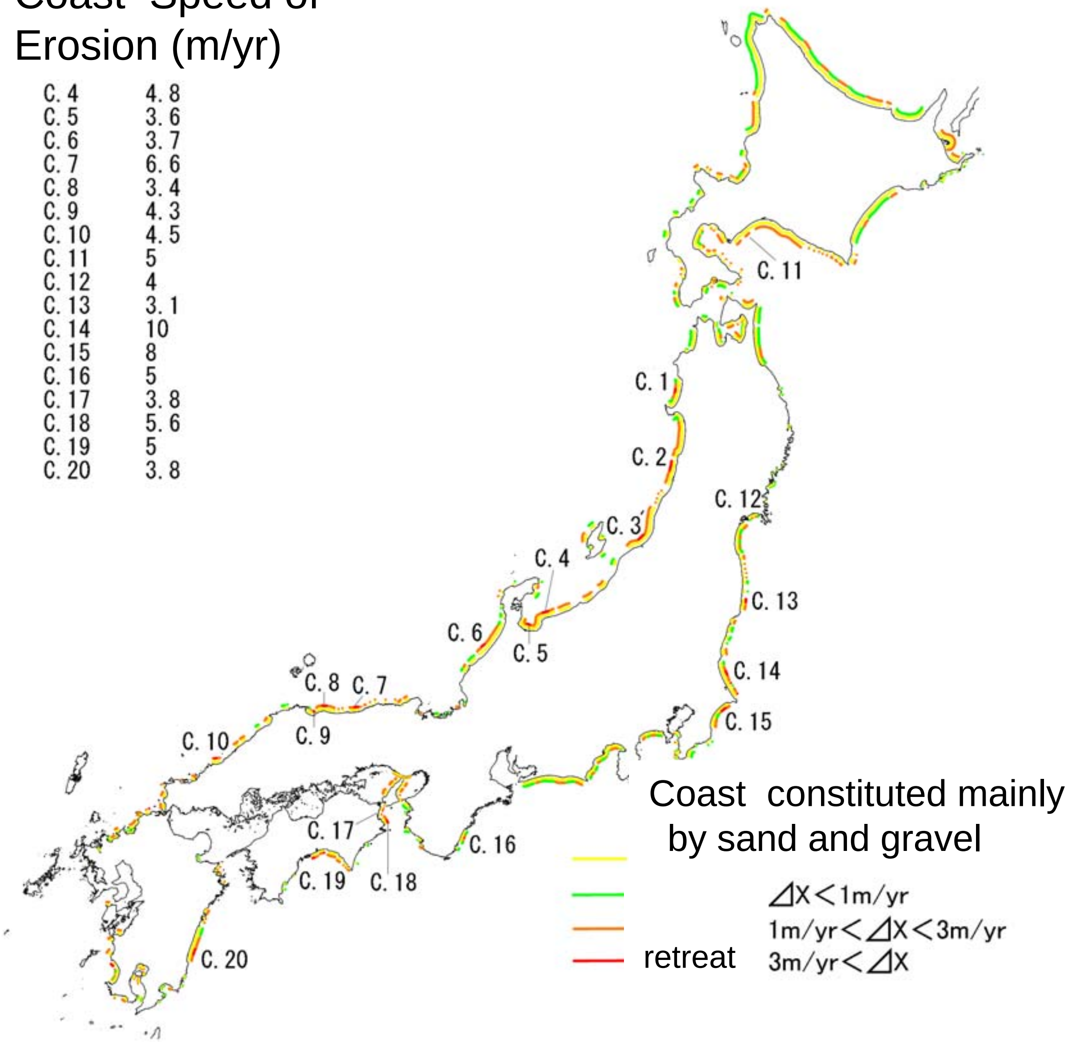
Fall of Bridge Girder



Coastal Erosion in Japan

Coast Speed of Erosion (m/yr)

Coast	Speed of Erosion (m/yr)
C. 4	4. 8
C. 5	3. 6
C. 6	3. 7
C. 7	6. 6
C. 8	3. 4
C. 9	4. 3
C. 10	4. 5
C. 11	5
C. 12	4
C. 13	3. 1
C. 14	10
C. 15	8
C. 16	5
C. 17	3. 8
C. 18	5. 6
C. 19	5
C. 20	3. 8



Erosion Area: 1.6km^2/year

Main causes:

- Steep coast
- Shortage of sediment supply from rivers and coastal cliffs
- Interruption of sediment transport by coastal facilities

Recommendation of The Tsunami Protection Committee

(March, 2005)

Basic Policy:

To strategically and strongly implement an integrated combination of structural and nonstructural measures as comprehensive disaster mitigation measures

Specific Urgent Goals and Damage Mitigation Measures

Medium to Long Term Goals and Tsunami Protection Measures

Specific Urgent Goals and Damage Mitigation Measures

(1)Warning and Information Provision

warnings, communication, observation

(2)Preventive Measures

evacuation, shore protection, tsunami-resistant communities

(3)Post-tsunami Measures

damage information, transportation network, restration

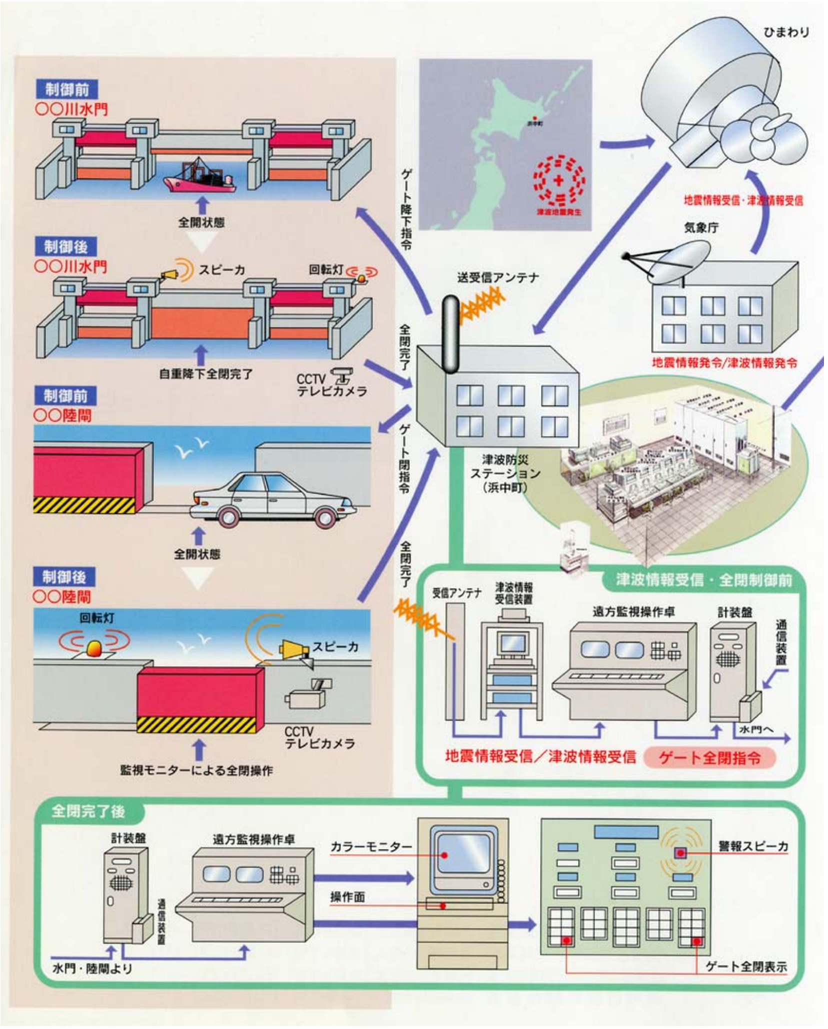
(4)Accumulation and Dissemination of Technology and Knowledge for Tsunami Disaster Prevention

research for administration

Facilities against Tsunami

Seawall

Tsunami Breakwater



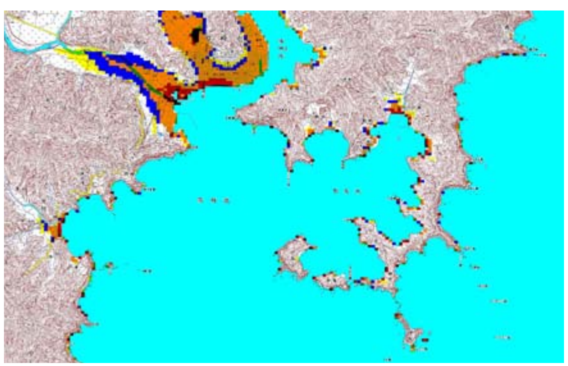
Tsunami Disaster Prevention Station

(Remote Gate Control)

Tsunami Information for Evacuation

Tsunami Warning (Japan Meteorological Agency)

Type of forecast	Message	Contents
Tsunami attention	Tsunami attention	Some minor tsunami may be anticipated. Height of tsunami is up to several tens centimeters.
Tsunami Warning	Tsunami anticipated	Tsunami is anticipated. Height of the tsunami is up to 2 meters in the maximum.
	Major tsunami anticipated	Major tsunami is anticipated. Height of the tsunami is more than 3 meters in the maximum. Greatest caution is required for tsunami.



Hazard map

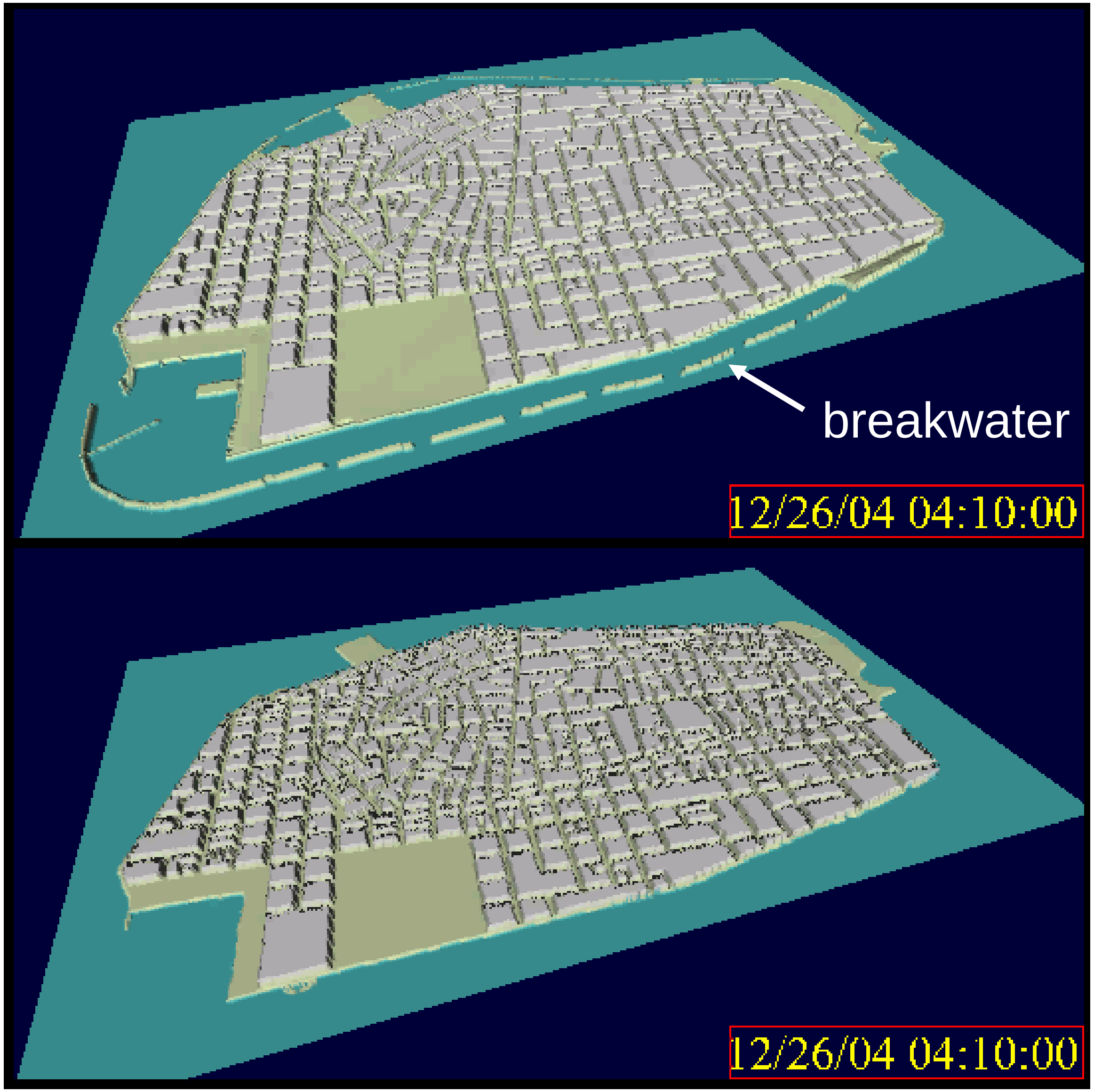
Tsunami Shelter

Effect of Shore Protection Facilities

Male (Maldives)

with parapet and breakwaters

without parapet and breakwaters



Measures against Storm Surge

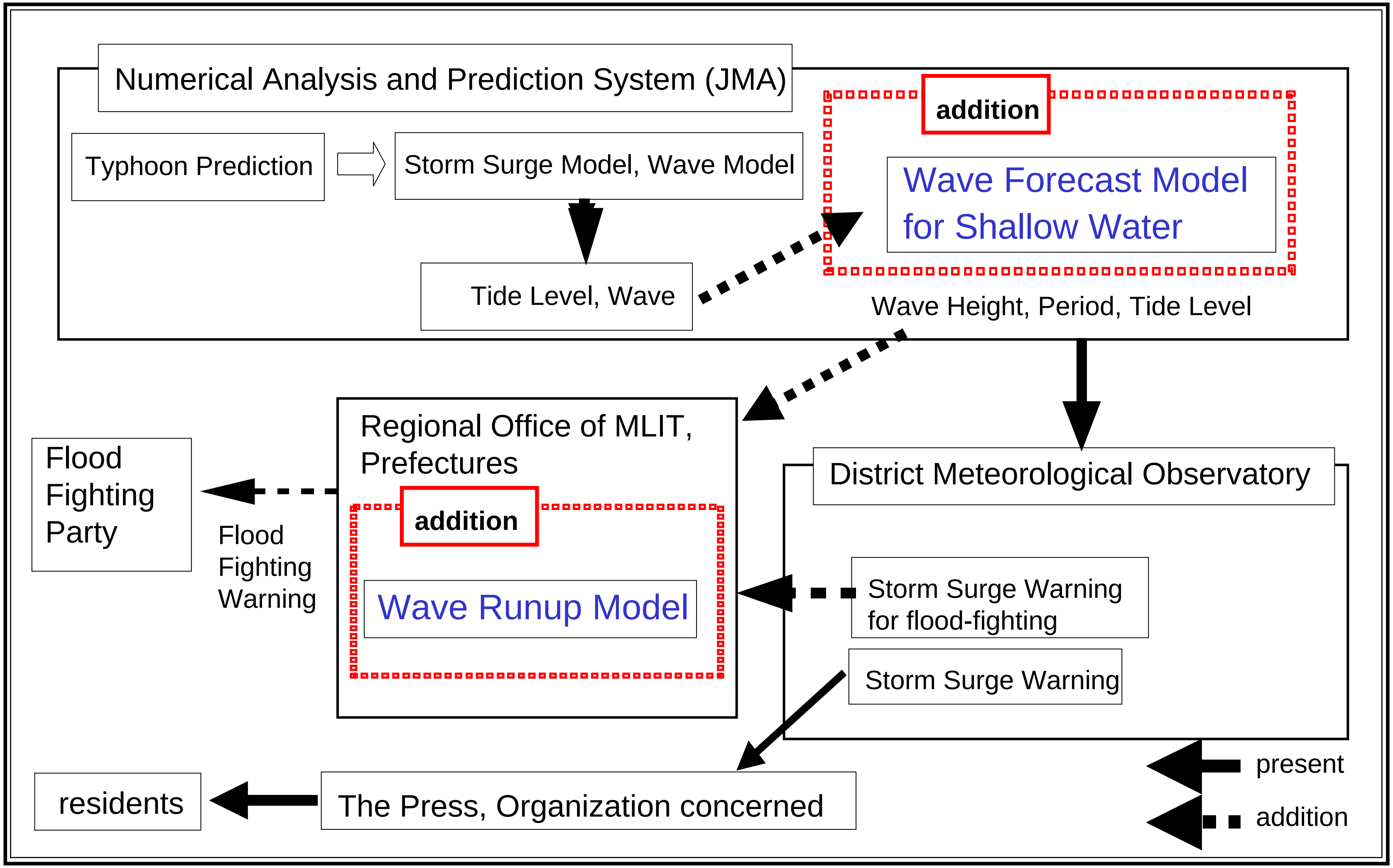
‘Hard’ Measures

Coastal Dike

‘Soft’ Measures

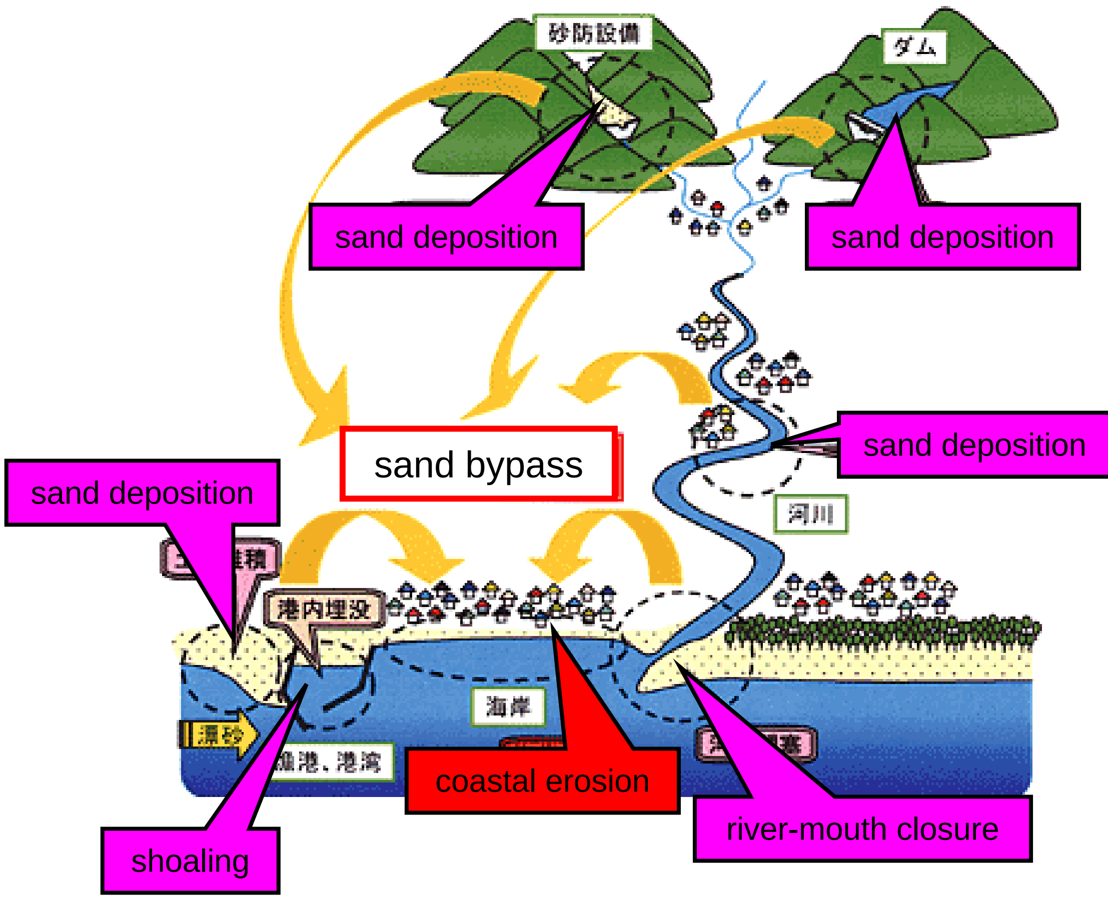
Hazard Map

Improvement of Storm Surge Warning System



Measures against Beach Erosion

Comprehensive Sediment Management



Coastal Facilities

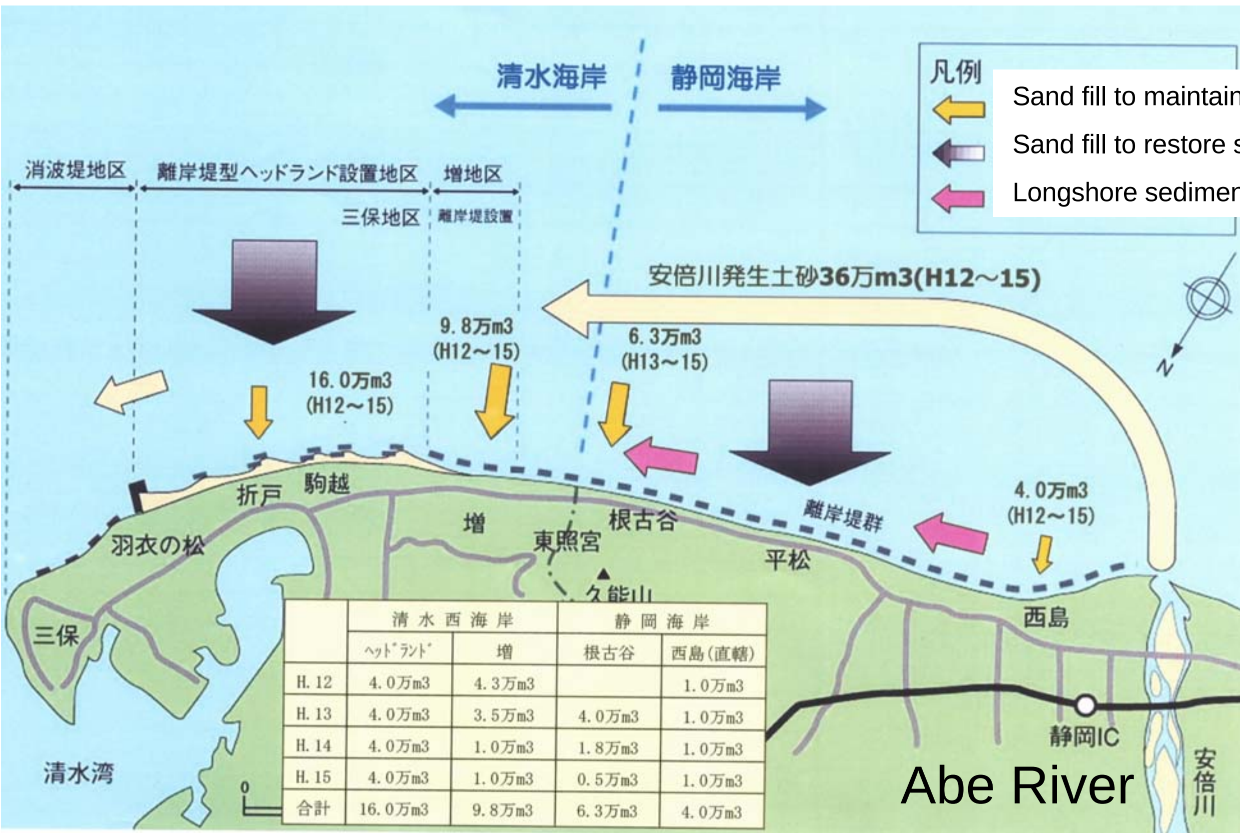
artificial headland

detached breakwaters

An Example of Comprehensive Sediment Management

1) To control floods of the Abe River, approximately 450,000 m³/year of sediment on the river bed is to be dredged from 2000 to 2003.

2) The dredged sediment will be used for constructing high-water channels and as fill materials for Shizuoka-Shimizu Coast.



	清水西海岸		静岡海岸	
	ヘッドランド	増	根古谷	西島(直轄)
H.12	4.0万m3	4.3万m3		1.0万m3
H.13	4.0万m3	3.5万m3	4.0万m3	1.0万m3
H.14	4.0万m3	1.0万m3	1.8万m3	1.0万m3
H.15	4.0万m3	1.0万m3	0.5万m3	1.0万m3
合計	16.0万m3	9.8万m3	6.3万m3	4.0万m3

RECOMMENDATIONS OF THE TSUNAMI PROTECTION COMMITTEE

MARCH, 2005

TSUNAMI PROTECTION COMMITTEE

CONTENTS

INTRODUCTION

Japan has undergone many great tsunami disasters, and the scars left by tsunamis can be found everywhere in the land and culture of the country like fingerprints and genes. The measures that Japan has been taking to mitigate tsunami-induced damage are recognized as being advanced in the international community.

There were many people, however, who were not fully aware of the horror of tsunami because a great tsunami is a once-in-several generations occurrence.

Vivid photographs and video footages of the recent Indian Ocean tsunami have taught us how dreadful and disastrous a tsunami could be. A number of important pieces of knowledge have been gained and some important lessons have also been learned.

In view of lessons learned from the tsunami disaster, therefore, we have re-examined a wide range of tsunami disaster mitigation measures that Japan has been taking.

In order to ensure safety from tsunami, it is necessary to take comprehensive measures over a large area, knowing how disastrous a tsunami can be and identifying vulnerable places and safety measures that can be taken. It is also important to regard tsunami protection efforts as a continuous process beginning with prevention efforts and ending with restoration and rehabilitation and use a strategic combination of structural measures and nonstructural measures.

The basic policy for the coming years, therefore, is to try to implement an effective combination of structural measures and nonstructural measures before and after tsunami, instead of relying solely on structural measures to prevent disasters, in order to minimize tsunami-induced damage.

In accordance with this policy, "minimizing human suffering" has been set as an urgent goal and "minimizing damage and human suffering" as a medium to long range goal, and targets and concrete measures to achieve them are described in this report.

The central government should be responsible for taking tsunami protection measures, but damage and suffering cannot be minimized by the administrative authorities alone. Awareness and actions of the public and people in all circles and at all levels are essential. It is our sincere hope that the recommendations described in this report will help to start various forms of cooperative efforts of the public and private sectors.

1. TSUNAMI PROTECTION MEASURES IN JAPAN: CURRENT STATE AND PROBLEMS

Sitting practically on top of four tectonic plates, Japan is prone to large-scale ocean-trench earthquakes. In fact, Japan has suffered major tsunami damage roughly once every 10 years.

Furthermore, only about 10 percent of the land of Japan can be used as residential land, and population and industry are inevitably concentrated in alluvial plains and coastal areas. Even in those dangerous areas, intensive and efficient use is made of available space including underground space and highly urbanized cities have been constructed.

The imminence of ocean-trench earthquakes such as the Tokai, Tonankai and Nankai earthquakes* has been pointed out for some time, and the occurrence of nearshore tsunamis caused by those earthquakes has been predicted. There is also concern about a major tsunami caused by a Cascadia earthquake†† expected in the North Pacific Coast or a Chilean earthquake. A nearshore tsunami reaches a shore soon after an earthquake occurs and inflicts secondary damage on earthquake-damaged areas.

Under these circumstances, the current state and problems of pre- and post-tsunami safety measures are as follows.

(1) Current state and problems of warning and information provision

(a) Today, it is possible to issue a tsunami warning within three to five minutes after the occurrence of an earthquake. In the event of some earthquakes such as the Tokai, Tonankai and Nankai earthquakes, however, the first wave is likely to arrive within several minutes after the occurrence of the earthquake.

(b) Tsunami height is highly dependent on such factors as coastal and submarine topography. The percentage of people who can evacuate in the event of a tsunami is low, and effort to provide information to help the public to understand the true nature of tsunami is insufficient.

(c) Facilities for communicating information to visitors such as tourists are inadequate.

(d) Existing systems for providing tsunami information to moving vehicles and running trains, watercraft, etc., in a timely manner are inadequate.

(e) Tide and wave height observation is not timely enough, and offshore observation is inadequate. Reference levels used by different organizations for tide observation are not consistent, and there is no established system for providing easy-to-understand information to local public bodies, local residents, etc.

(f) There is no established standard for conveying information for people who need help in a time of disaster.

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1) * It has been pointed out that besides the Tokai, Tonankai and Nankai earthquakes, ocean-trench earthquakes along the Nippon Trench and the Chishima Trench are also likely to occur.

2) † A Cascadia earthquake is a magnitude 8–9 earthquake that has occurred in the region along the Northwest Pacific Coast mainly along the Canada–US boarder at recurrence intervals of 300–350 years. The last Cascadia earthquake occurred in 1700. It has been said for some time that another Cascadia earthquake is imminent.

(2) Current state and problems of preventive measures

(a) Inspection and performance evaluation of facilities that have a tsunami protection function are inadequate. The target levels of the tsunami protection function are inadequate.

(b) The seismic performance and gap-closing performance of 59 percent and 55 percent, respectively, of the seawalls in important coastal zones [‡] have not been checked.

(c) Even in important coastal zones, somewhere between 10 and 20 percent of all municipalities have published their tsunami hazard maps.

(d) There should be more shelters and evacuation routes designed taking topography and evacuation time into consideration.

(e) In areas where it is difficult to provide sufficient shelters because of relatively flat topography, adequate consideration has not been given to the designation of buildings that are to be used as tsunami shelters and requirements for such shelter buildings.

(f) Roads, railways and airports located near coastlines have not been inspected adequately with respect to safety against the expected tsunami height.

(g) There are many facilities for storing hazardous and noxious substances (HNS) such as LNG located in coastal areas. Many of these facilities are not protected from tsunami.

(h) Marine vessels sunk, stranded, broken or swept away and cargoes or other objects washed away could impair port and harbor functions, cause water pollution, and aggravate damage in the hinterland areas.

(3) Current state and problems of post-tsunami measures

(a) It has been pointed out that the systems for collecting tsunami damage information from municipalities to prefectural governments and the Ministry of Land, Infrastructure and Transport are not functioning well.

(b) There is no system for timely collection of such information as whether or not port and harbor facilities are usable.

(c) Damage to emergency transportation roads or important ports and harbors could impair the function of regional transportation networks.

(d) Helicopters and other means of transportation for collecting information and performing rescue and relief operations and disaster prevention bases necessary for relief and emergency restoration operations are inadequate.

(e) The ability to pick up many people drifting in the sea is limited.

(f) Disposal of large volumes of debris containing saltwater in tsunami-affected areas is a problem that needs to be addressed.

(g) Since there are as yet no plans for creating highly disaster-resistant communities, appropriate and timely rehabilitation is difficult to achieve.

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3) ‡ Important coastal zones are coastal areas that are likely to be affected by the Tokai, Tonankai and Nankai earthquakes and ocean-trench earthquakes occurring along the Nippon Trench or the Chishima Trench (as of August, 2004, a total of 402 municipalities are located in important coastal zones).

(4) Current state and problems of accumulation and dissemination of tsunami protection technology and knowledge

(a) Even in important coastal zones, about 20 percent of the municipalities do not conduct tsunami response drills.

(b) There is no institutional system under which the causes of major disasters are determined promptly and the findings are reflected in government actions.

(c) Neither administrators, researchers nor citizens can easily obtain information regarding tsunami disaster prevention.

2. BASIC POLICY FOR TSUNAMI PROTECTION MEASURES IN THE COMING YEARS

Tsunami protection measures in the past relied mainly on structural measures such as seawalls designed to guard against a tsunami of an expected magnitude, and there was even no policy for dealing with a tsunami of a greater magnitude.

In view of the current state and problems, the basic proposition in the coming years is to enhance the level of safety as soon as possible despite the limitations in the amount of investment and the response time requirements and strategically promote activities for minimizing damage even in the event of a beyond-design-basis tsunami.

The magnitude of damage is determined by the level of tsunami risk reduction achieved by means of structural measures such as seawalls and the level of effectiveness of nonstructural functions such as the safety level of the social organization of the local community and the inherent fire resistance and disaster tolerance of land use patterns.

In order to minimize damage in an area, therefore, it is necessary to take appropriate and reliable structural measures so that the risk level can be lowered and to take nonstructural measures so that the safety level, disaster resistance and disaster tolerance of the area can be enhanced.

In short, it is necessary to strategically and strongly implement an integrated combination of structural and nonstructural measures as comprehensive disaster mitigation measures.

Since, however, those measures are interrelated, their implementation requires close coordination among the people concerned in view of the realities in the area. At the same time, effort should be made to implement conventional, more or less standardized structural measures in a manner suitable for the area.

On the basis of this concept, comprehensive measures ranging from pre-tsunami to post-tsunami measures that can be taken against tsunami through the allocation of the roles of "self-help," "mutual assistance" and "public assistance" and through cooperation must be taken.

Public awareness of the importance of tsunami preparedness is apt to fade because tsunami is characterized by long recurrence intervals. "Self-help," "mutual assistance" and "public assistance" are based on public awareness. Continued effort must be made, therefore, in the areas of safety education, public relations and tsunami response drills.

3. SPECIFIC URGENT GOALS AND DAMAGE MITIGATION MEASURES

The first step in damage mitigation is to take urgently needed measures to "minimize human suffering."

To this end, educational effort should be made make the residents of coastal areas and tourists and other visitors in coastal areas aware that it is their duty in the spirit of "self-help" and "mutual assistance" to escape to higher areas in the event of an earthquake.

As a provider of assistance to the "self-help" and "mutual assistance" efforts, the government should implement comprehensive measures to disseminate basic knowledge about tsunami, provide tsunami information in an appropriate manner and in a timely manner, and improve the evacuation environment for rescue and relief operations by making evacuation routes and shelters available and providing tsunami protection facilities for tsunami risk reduction.

In so doing, it is necessary to keep in mind that the level of understanding on the part of the public at the receiving end of information and the level of functionality of facilities with a tsunami protection function are deciding factors.

Therefore, with the aim of "minimizing human suffering" due to tsumanis induced by ocean-trench earthquakes whose probability of occurrence is thought to be high such as the Tokai, Tonankai and Nankai earthquakes, specific urgent measures that should be taken within five years from now have been identified.

(1) Warning and information provision

1) Better tsunami warnings

- To improve the earthquake observation network using nowcasting seismographs and achieve faster tsunami forecasting by use of the emergency earthquake information technology
- To construct a system for directly conveying tsunami forecasts and other information to municipal governments
- To disseminate knowledge about tsunami height, methods for expressing the destructive power of tsunami, etc.

2) Conveying and providing tsunami information in an appropriate manner

- To provide easy-to-understand tsunami information such as inundation depth, tsunami arrival time, flow velocity and destructive power in the form of tsunami-prone area maps
- To construct a system for providing information on areas that are likely to be flooded immediately in the event of tsunami for a model area
- To provide information to visitors such as tourists, road users and moving trains, ships, etc. through a variety of means of communication such as telecommunications devices such as cellular phones and other communications facilities
- To establish a method for conveying tsunami-related information to facilities used by people in need of assistance in the event of a disaster
- To exchange opinions with the media on a regular basis about what disaster information should be like and deliberate on methods for conveying information, the content of the information to be provided, etc.

3) Better tsunami observation

- To collect more real-time tsunami observation data obtained at a greater number of locations including offshore locations and to share with the organizations concerned and publish the data thus collected

(2) Preventive measures

1) Improvement of evacuation measures

- To prepare and publish tsunami-prone area maps so that all municipalities in the important coastal zones can compile their tsunami hazard maps
- To ensure the availability of shelters and evacuation routes that are friendly to people in need of assistance in the event of a disaster and assist in eliminating difficult-to-evacuate areas in important coastal zones
- To compile information on buildings to be evacuated in the event of a tsunami, such as requirements and improvement methods, and promote the dissemination of such information
- To disseminate tsunami risk information on a continual basis by use of standardized graphic symbols
- To strengthen evacuation measures so as to facilitate the evacuation of coast and port users
- To create an environment in which moving vehicles, running trains, and ships and boats can evacuate easily

2) Provision of facilities with tsunami protection function

- To substantially complete the compiling and publicizing of coastal conservation area registers, the inspection and performance evaluation such as earthquake resistance studies of facilities with a tsunami protection function, and a review of the master plans for coastal conservation for important coastal zones
- To substantially complete the automation, remote control implementation or other upgrading of water gates in key regional function concentration districts§ and promote the seismic retrofit and raising of levees in important coastal zones; and establish an improvement method suitable for each area
- To promote the raising of breakwaters at ports and harbors along important coastal zones

3) Promotion of tsunami protection measures for facilities located in coastal areas

- The managers of the facilities located near coasts will inspect their facilities with respect to safety against the expected tsunami height and take protection measures in cooperation with one another.
- The administrative authorities (e.g., port managers, regional development bureaus, maritime safety departments, district transport bureaus) and private sector stakeholders will draw up comprehensive tsunami protection plans and implement protection measures.
- To establish an organizational system for control to be activated in the case where a tanker or coastal facility storing a large volume of a hazardous and obnoxious substance (HNS) such as crude oil or LNG has been damaged by a tsunami; and implement

4) § Areas behind which there are facilities that are to perform crisis management functions such as relief and restoration (e.g., municipal government offices, police stations, fire stations, hospitals)

measures to prevent cargoes and small marine vessels from being swept away and protect other marine vessels
- To provide guidance to passenger ship operators so as to ensure safety of passenger ships in the event of a tsunami

4) Damage reduction through better land uses and better ways of living
- To recommend that developers incorporate damage mitigation measures into their integrated development plans for coastal areas in order to create communities that are highly resistant to tsunamis.
- To promote the application of the philosophy of damage mitigation to the siting, project methods and usage of public facilities
- To conduct studies on the requirements for disaster-resistant communities in order to reflect the findings in community planning and regional planning

(3) Post-tsunami measures

1) Collecting regional damage information
- To build an investigation system that can respond quickly in the event of a disaster
- To strengthen the system for exchanging damage information between the central and local governments
- To enhance information gathering ability by making more effective use of helicopters, etc.
- To construct an information collection system using artificial satellites
- To assist in establishing organizational systems for cooperation in collecting information in affected areas

2) Ensuring the availability of regional transportation networks in a time of disaster
- To promote the seismic retrofit of road bridges and the construction of high-standard arterial expressway and other road networks in order to secure the availability of emergency transportation roads that play an important role in relief activities and the transportation of relief goods
- To restore damaged roads quickly by, for example, removing obstacles from damaged roads and carrying out emergency rehabilitation
- To construct a system for managing information on the usability of port facilities in an integrated manner and providing such information to users
- To promote the construction of earthquake resistant seawalls at ports in important coastal zones; and to improve detection systems using the laser-based depth measurement technology and other related technologies and establish systems for urgent removal of obstacles on sea routes that can be activated in conjunction with the detection systems

3) Promoting measures related to isolated areas
- To upgrade the functions of facilities that can be used as disaster prevention bases, such as tsunami/storm surge disaster prevention stations, river disaster prevention stations, Michi-no-Eki stations, coastal disaster prevention bases, located in the areas in important coastal zones where such functional upgrading is necessary, and promote the construction of such facilities; and to collect information that can be used to assist in disaster prevention efforts, and share such information among the organizations concerned
- To establish systems for wide-area joint operations involving the administrative authorities concerned

- To select emergency heliports and share the information on such heliports
- To build a system for cooperating with NGOs
- To enhance the rescue and relief capability of helipcopters

4) Strengthening restoration and rehabilitation measures

- To promote the research and development of equipment for disaster response operations such as debris removal and strengthen the institutional framework for providing assistance
- To improve rehabilitation assistance measures for disaster-resistant areas
- To strengthen the ability to pick up and transport people rescued from the sea

(4) Accumulation and dissemination of technology and knowledge for tsunami disaster prevention

1) Accumulating technology and knowledge for tsunami disaster prevention

- To promote disaster prevention education at schools, provide assistance for the education of community leaders in the area of disaster prevention and conduct comprehensive tsunami response drills every year in order to maintain and enhance public awareness of the importance of disaster prevention efforts
- To prepare pictorial illustrations showing expected tsunami behavior on the land or in the sea at ports in important coastal zones
- To construct a three-dimensional database integrating the information on terrestrial and submarine topography
- To compile high-accuracy terrain data for important coastal zones
- To establish a system for sharing information related to tsunami disaster prevention

2) Tsunami disaster prevention research and use of research findings for administration

- To conduct research on tsunami disasters drawing on expert knowledge and build a system for reflecting research findings in administration on a continual basis
- To promote research on the following:
  mechanism of tsunami generation; tsunami behavior on the land and in the sea and the spread of damage; building behavior in response to tsunami and control methods; strength performance of structures against tsunami; rehabilitation policies and methods of rehabilitation planning and implementation; study on the content of information and appropriate communication methods, etc.

4. MEDIUM TO LONG RANGE GOALS AND TSUNAMI PROTECTION MEASURES

The goal of tsunami protection measures is to minimize tsunami-induced damage including property damage.

Humankind is destined to inherit tsunami risk from generation to generation. The best way to mitigate tsunami damage, therefore, is to incorporate damage mitigation measures into land uses and the way of living in each of future generations so that the philosophy of damage mitigation is reflected in daily life.

In this country, which is not blessed with geographic conditions from the viewpoint of tsunami disaster prevention, it is necessary to make consistent efforts to raise the level of protection in areas where key community functions or key economic and social functions are concentrated. At the same time, it is necessary to implement various measures making effective use of every community planning and building construction opportunity in order to prevent destructive damage even in the event of a beyond-design-basis tsunami.

Furthermore, it is also important to reduce the use of high-tsunami-risk areas as living zones and steer land use so that living zones occur more in low-tsunami-risk areas than in high-risk areas.

Japan has entered an era of population decline, and it is predicted that the population of Japan will begin to gradually decrease in about 20 to 30 years and the demographic composition will change considerably. During the same period, sea level is expected to rise because of global warming. In order to cope with these unprecedented changes in changes in demography and natural conditions, it is necessary to accumulate and utilize scientific and technological knowledge and take appropriate measures.

In any case, a new policy is essential, and various institutional systems need to be constructed with the understanding of the public.

In accordance with these requirements and taking into consideration the expected changes in demography and natural conditions, medium to long range measures that should be taken over a period of about 20 years have been identified with the aim of "minimizing tsunami-induced damage and suffering including property damage."

(1) Medium to long range tsunami protection measures including emergency measures

1) Warning and information provision

- To develop methods for estimating the magnitude of tsunami-induced earthquakes to enhance the accuracy of tsunami forecasting
- To perform recomputation of tsunami simulation reflecting the effects of topography and land use changes
- To establish a system for providing information on areas that are likely to be flooded immediately in the event of a tsunami and enhance the accuracy of prediction

2) Preventive measures

- To construct shelters and evacuation routes to help to eliminate difficult-to-evacuate areas
- To perform the seismic retrofit of coastal conservation facilities, construct seawalls and breakwaters, and perform the automation and remote control implementation of water gates at openings, on an as-needed basis, mainly in important coastal zones
- The managers of the facilities located near coasts will take necessary measures.
- To promote the formulation of land use plans (municipal plans) that give consideration to disaster prevention

3) Post-tsunami measures

- To construct systems for urgent removal of obstacles such as sunken ships in port areas throughout the country
- To construct facilities that can be used as disaster prevention bases in the areas where such facilities are necessary
- To establish the technology and support systems for equipment for disaster response operations such as debris removal

4) Accumulation and dissemination of technology and knowledge for tsunami disaster prevention

- To establish functional maintenance methods and design technology for various facilities subjected to beyond-design-level external forces
- To promote widespread use of the knowledge gained and the research results obtained in administrative authorities and society

(2) Measures that take demographics into consideration

- To improve assistance to the growing number of people in need of assistance in the event of a disaster
- To upgrade the measures designed to steer land use so that living zones occur in low-tsunami-risk areas than in high-risk areas

(3) Measures against sea level rise due to global warming

- To decide on conservation measures to be taken as part of the tsunami protection measures against sea level rise
- To decide on measures to be taken in order to create a country and economic and social systems that are highly resistant to increases in external force caused by natural disasters

CONCLUSION

The recommendations described in this document are the first of their kind to deal specifically with tsunami protection measures. It is significant that the Tsunami Protection Committee deliberated on the varied themes falling into the categories normally covered by the National Land Development Council, the Infrastructure Development Council and the Council for Transport Policy, addressed short- and long-range policies under a clearly defined strategy, and has come up with a wide-ranging set of concrete measures to be taken.

In order to implement the recommendations, it is necessary to draw up action plans, carry them out, verify their effectiveness and, if necessary, modify them. It is also important to reflect the knowledge gained by analyzing the recent Indian Ocean tsunami in the administrative measures to be taken in the coming years. The challenge of developing new types of measures that need to be debated on a nationwide scale should also be taken up.

Tsunami protection measures that require follow-up as part of earthquake disaster prevention measures, should be implemented by more than one ministry or agency and require further deliberation should be implemented jointly by the ministries and agencies involved with the help of expert knowledge.

Whether or not these recommendations will have historical value is solely dependent on the efforts of not only the government but also the public and the various circles at various levels. Needless to say, the Ministry of Land, Infrastructure and Transport (MLIT) should promptly set out to implement the recommended measures that fall into the categories for which the ministry is directly responsible. In addition, MLIT should also present the other measures to the local public bodies concerned. Furthermore, MLIT should ask the local public bodies to report on the measures they have implemented or the measures they intend to implement, and should collect the reports and present the results to the public.

Members of the Tsunami Protection Committee

Tsunami
Fumihiko Imamura, Professor, Graduate School of Engineering, Tohoku University

Local government
Mitsuhisa Ito, Mayor, Owase City, Mie Prefecture

Disaster Prevention
Yoshiaki Kawata (Chairman), Professor, Disaster Prevention Research Institute, Kyoto University

Transportation
Katsuhiko Kuroda, Professor of Engineering, Kobe University (Chairman, Port Transportation Subcommittee)

Law
Tsuyoshi Nishitani, Professor, Law School, Kokugakuin University (Chairman, River Subcommittee, Infrastructure Development Council)

Housing
Tsuneo Okada, Professor Emeritus, The University of Tokyo; President, Japan Building Disaster Prevention Association (Chairman, Building Subcommittee, Infrastructure Development Council)

Local government
Kazuo Ozawa, Mayor, Kamaishi City, Iwate Prefecture

Coasts
Shinji Sato, Professor, Graduate School of Engineering

Maritime safety
Masaru Takahashi, Professor, Maritime Safety Technology, Japan Coast Guard Academy

Information
Atsushi Tanaka, Professor, Faculty of Sociology, Toyo University

Meteorology
Koji Yamamoto, Chairman, HALEX Corporation (former Director-General of the Japan Meteorological Agency)

Media
Noboru Yamazaki, Commentator, Japan Broadcasting Corporation (NHK)

(Arranged alphabetically)

APPLICATION TO PAST DISASTERS OF A METHOD OF SETTING THE RANGE OF DEBRIS FLOW DAMAGE TO HOUSES

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Ministry of Land, Infrastructure and Transport, JAPAN

Today's topic

- Background
- Objectives
- Method
- Results of application
- Conclusion

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National Institute for Land and Infrastructure Management

N I L I M

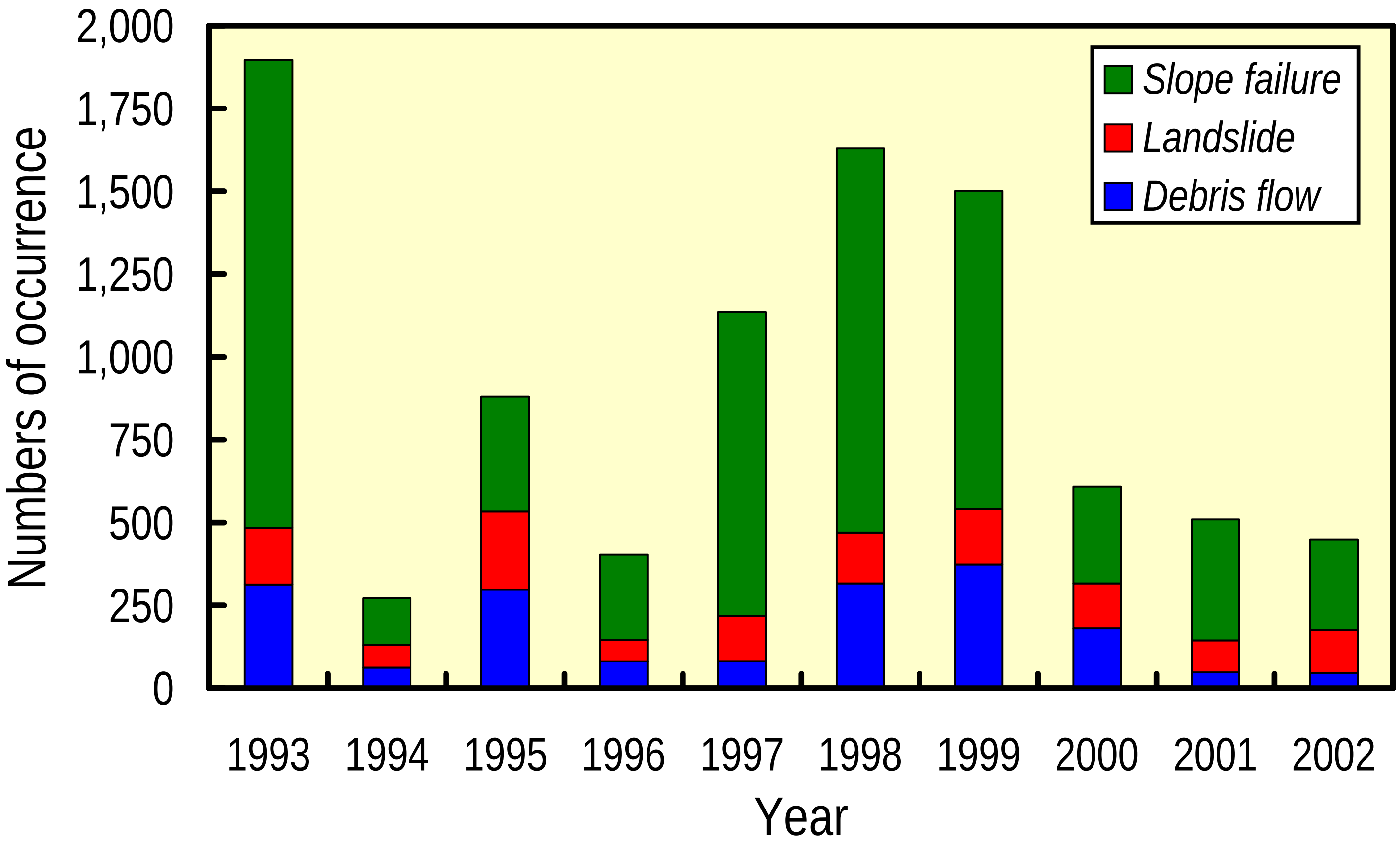
Sediment-related disasters

Debris flow

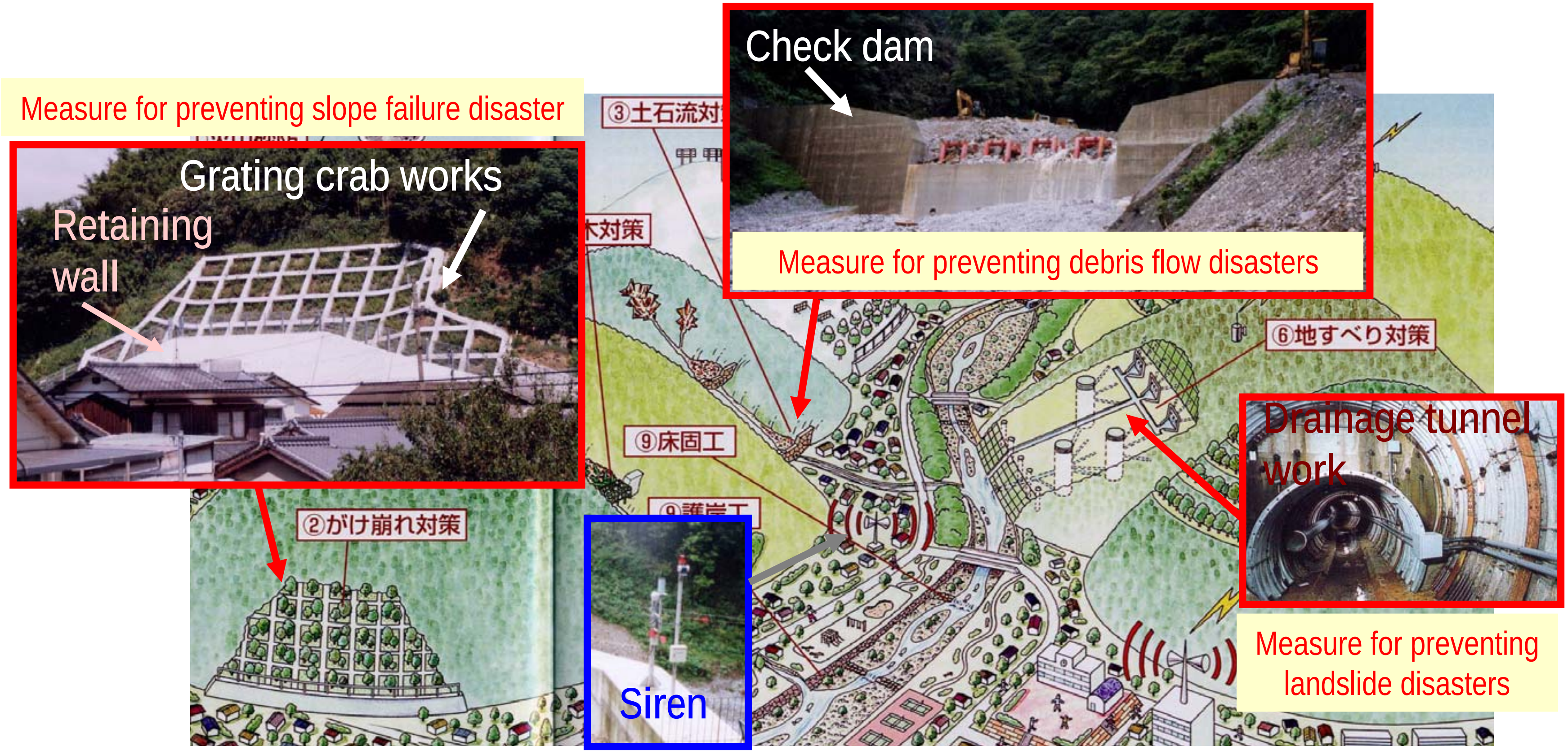
Slope failure

Landslide

Recent occurrence of sediment-related disasters



Physical and Non-physical measure

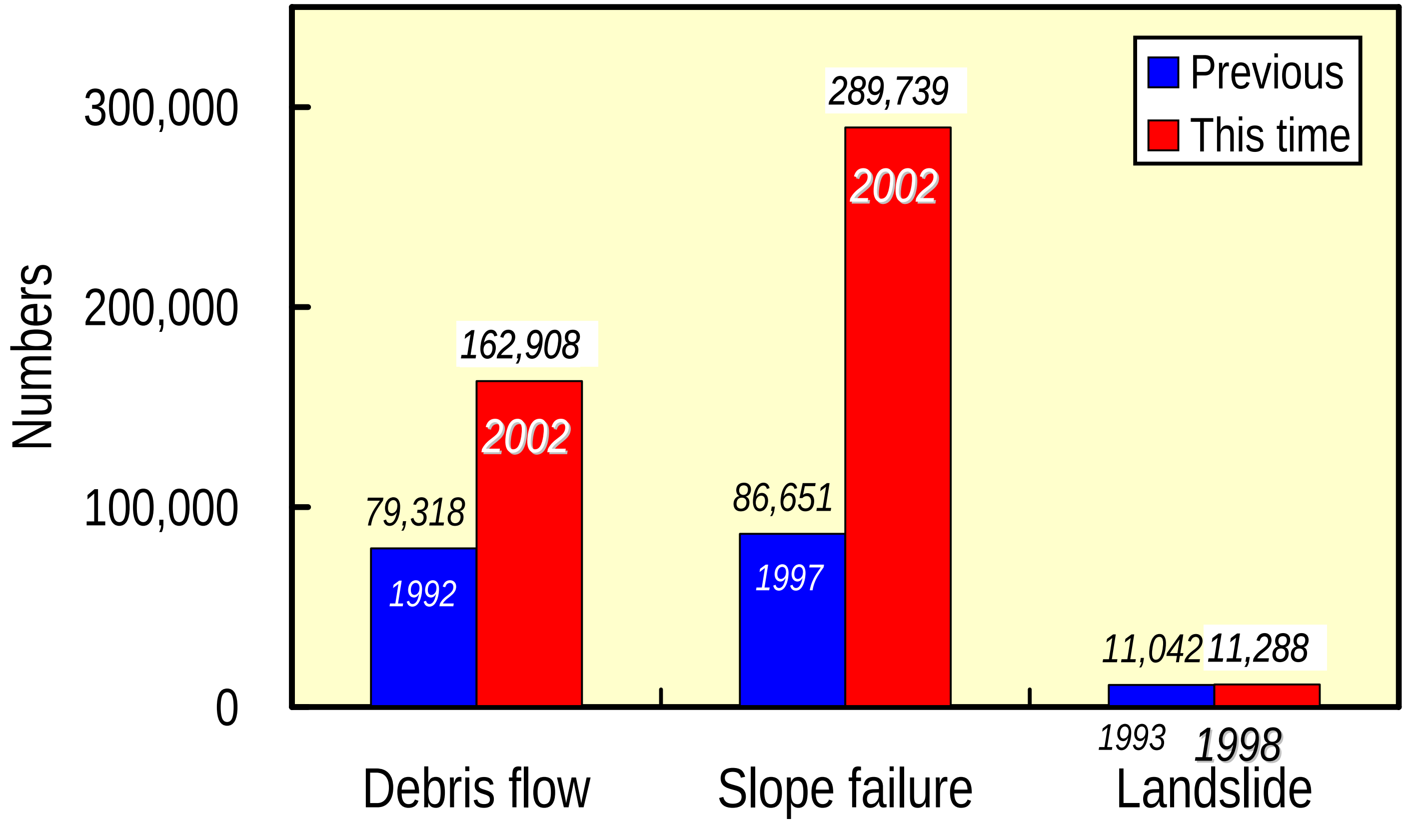


Measures with constructs are called "physical measure".

Measures without constructs are called "non-physical measures".

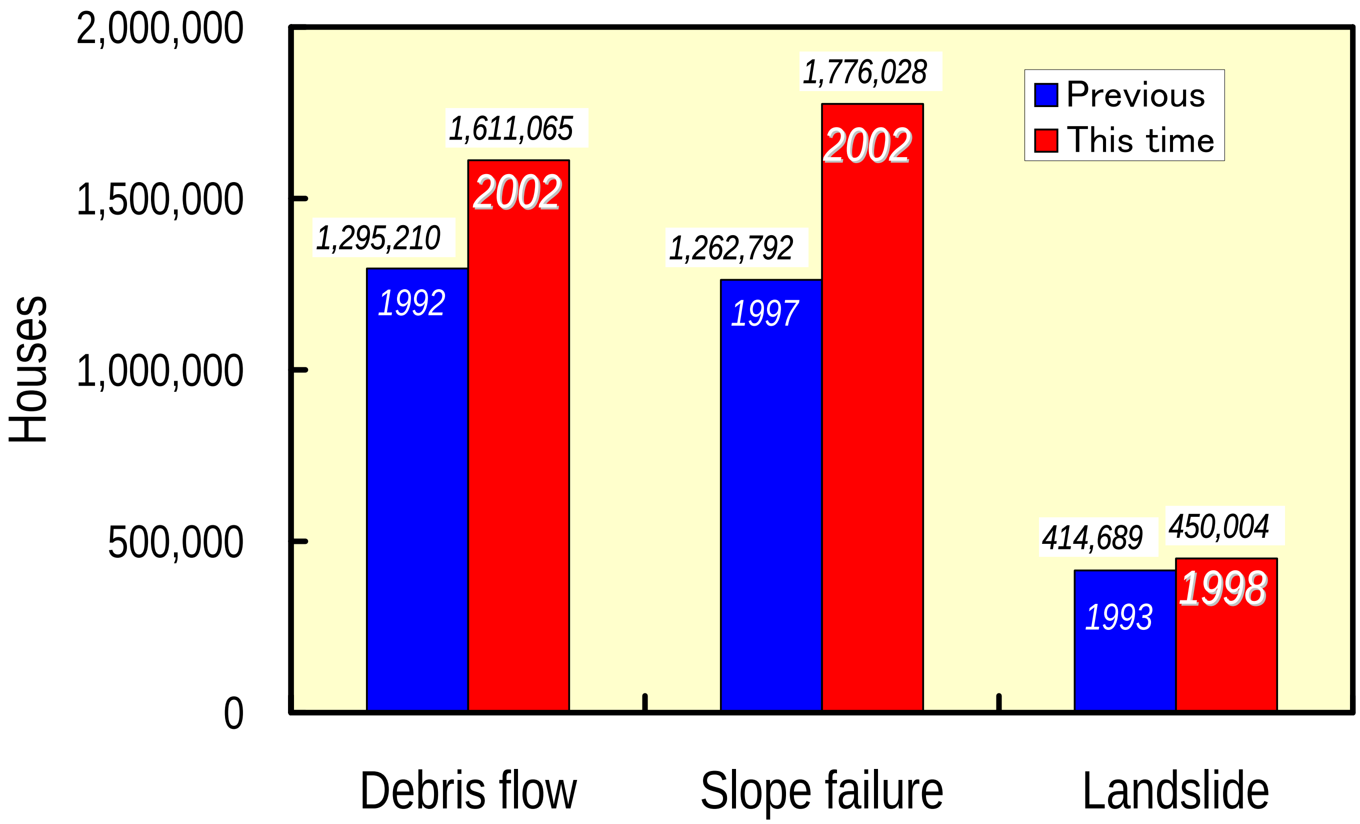
Number of hazardous area

- Numbers of hazardous area are increasing.



Number of houses in hazardous area

- Numbers of houses in the hazardous area are also increasing.



Establishment a new law

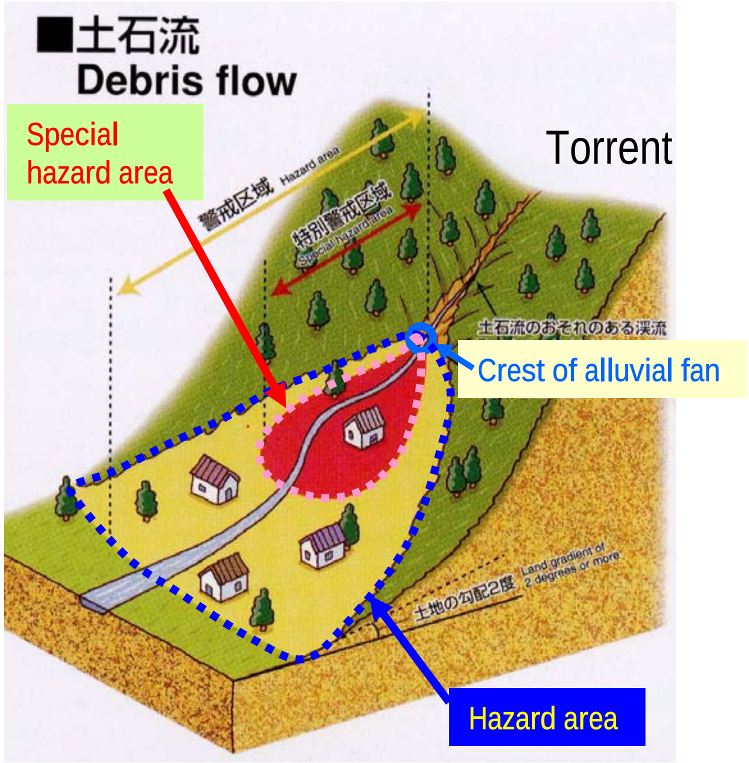
- The number of hazardous area is increasing.
- A lot of time and money will be needed to make the hazardous area safety with physical measures.

To inform the risk of the hazardous area
To install warning and evacuation systems
To restrict new land developments for housing in the hazardous area
To promote relocations of houses existing in the hazardous area

- The "Sediment-related Disaster Prevention Law" was established in 2001.

Hazardous areas in the new law

This study focuses on the sediment-related disasters due to debris flow.



Hazard zone…

Area vulnerable to sediment disasters

Land gradient of two degrees or more.

Special hazard zone…

Among hazard areas, special hazard areas are designated where is a fear of damages to buildings and serious human injuries.

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Special hazard area

- Special hazard area is the range of the land where the hydrodynamic force of a debris flow exceeds the strength of its buildings

Photo Damaged house in Kamaishi 2002

Method for setting a special hazard area

(1) Field survey

(2) Set a reference point

(3) Estimate sediment volume deposited on a torrent

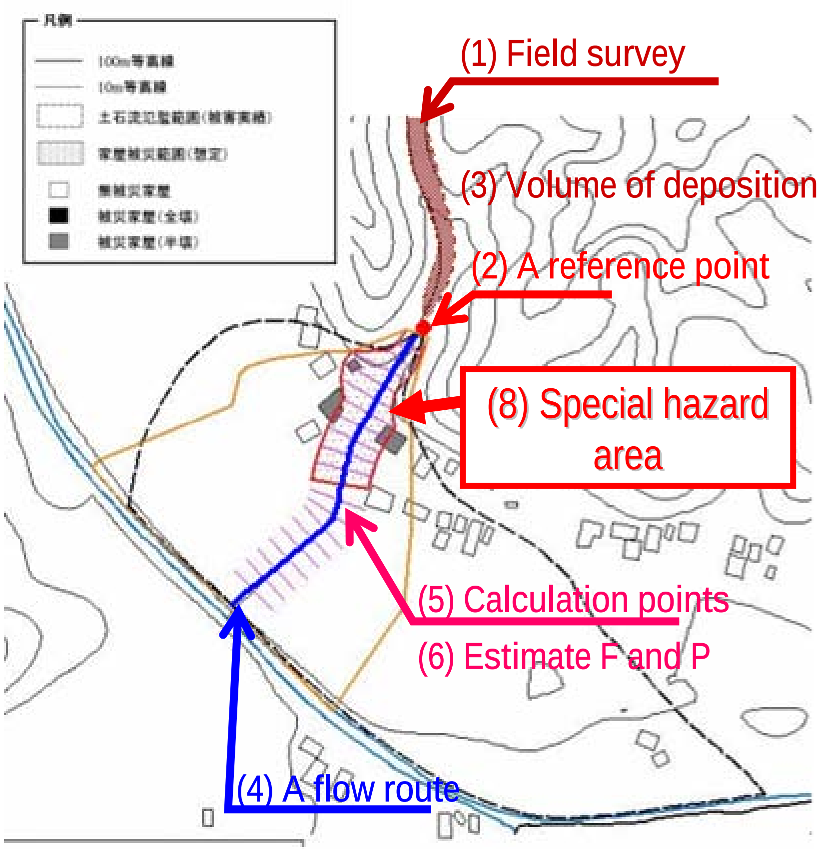
(4) Estimate the flow route

(5) Set calculation points on the flow route

(6) Estimate the hydrodynamic force and the strength of the buildings at the calculation points

(7) Compare the hydrodynamic force (Fd) and the strength of the buildings (P)

(8) Draw the range where Fd>P



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Estimation of the hydrodynamic force and the strength of houses

- Hydrodynamic force

$$F_d = \rho_d U^2$$

U :flow speed of the debris flow (m/s)

- Strength of houses

$$P = \frac{35.3}{h(5.6 - h)}$$

h :flow depth of the debris flow (m)

In order to estimate the hydrodynamic force and the strength of house, we have to estimate the velocity (***U***) and depth (***h***) of debris flow. However a method for estimation is not defined…

Objects of this study

- To develop a simplified method for estimating velocity and depth
- To apply the method to the past disasters and verify the accuracy

Method for estimating velocity and depth of debris flow

- Combining five equations

Continuity equation

$$Q_{SP} = BUh$$

Momentum equation

$$U = \frac{1}{n} \cdot h^{2/3} \cdot (\sin\theta)^{1/2}$$

Empirical formula for discharge

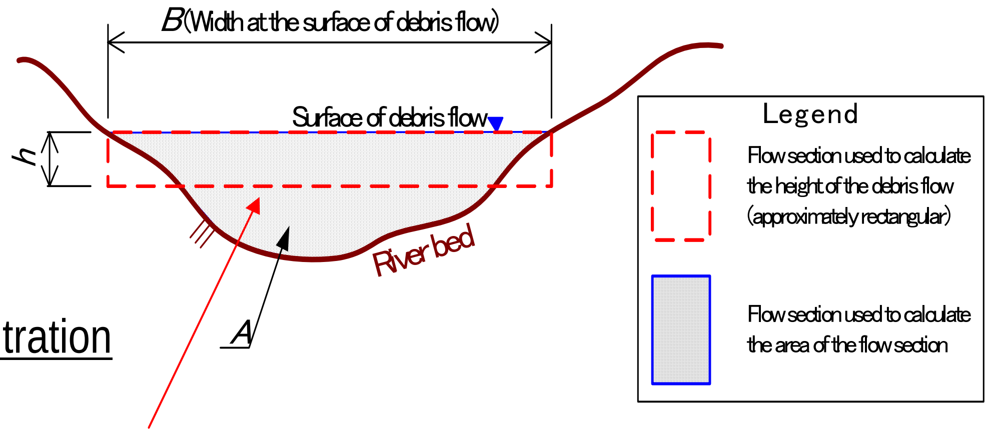
$$Q_{SP} = \frac{0.01VC_*}{C_d}$$

$$V = \frac{C_* - C_{d0}}{C_* - C_d} \cdot \frac{C_d}{C_{d0}} \cdot V_0$$

Formula for sediment volumetric concentration

$$C_d = \frac{\rho \tan\theta}{(\sigma - \rho)(\tan\phi - \tan\theta)}$$

U	:flow speed of the debris flow (m/s)
n	:roughness coefficient
H	:flow depth of the debris flow (m)
θ	: gradient of slope of the torrent bed (degrees)
Q_{sp}	:peak flow volume of the debris flow (m^3/s)
B	:flow width of the debris flow (m)
C_*:	sediment concentration of deposition on the torrent bed



The shape of the flow section resembles a rectangle such as the one enclosed by the dotted lines.

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Estimation of the flow width

- If B is calculated by the above method, there are presumed to be cases where, on an alluvial fan, the value of B is identical to the full width of the alluvial fan or cases where it cannot be set.
- So B is set as the upper limit value (B_{MAX}).

$$B_{\max} = 4\sqrt{Q_{SP}}$$

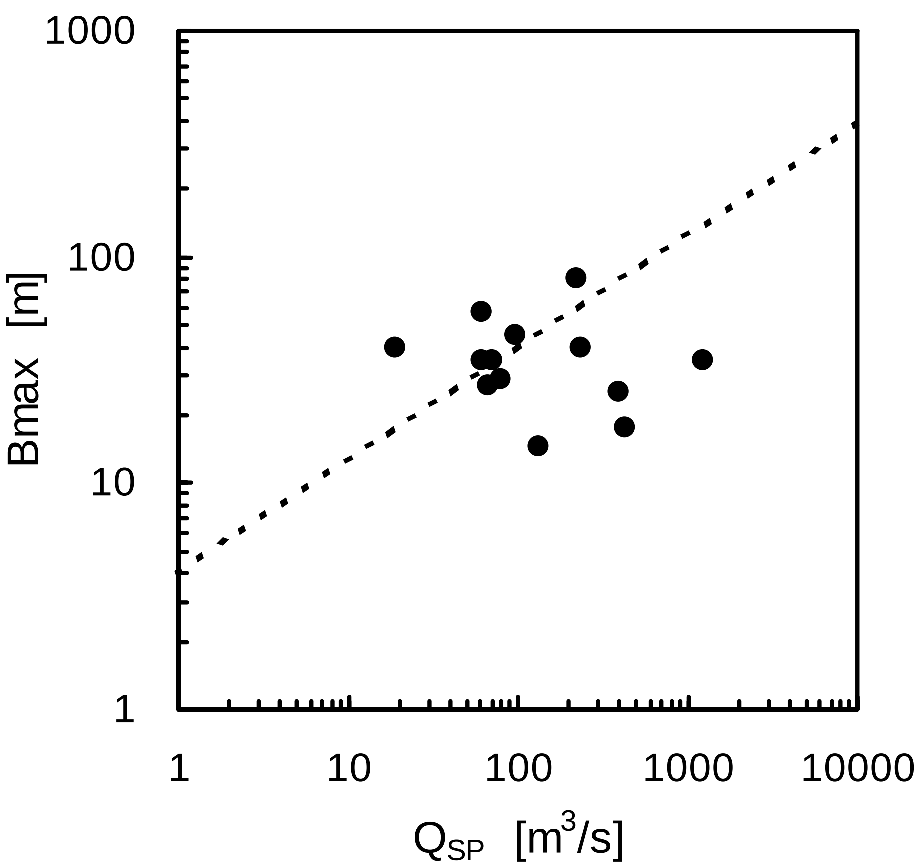
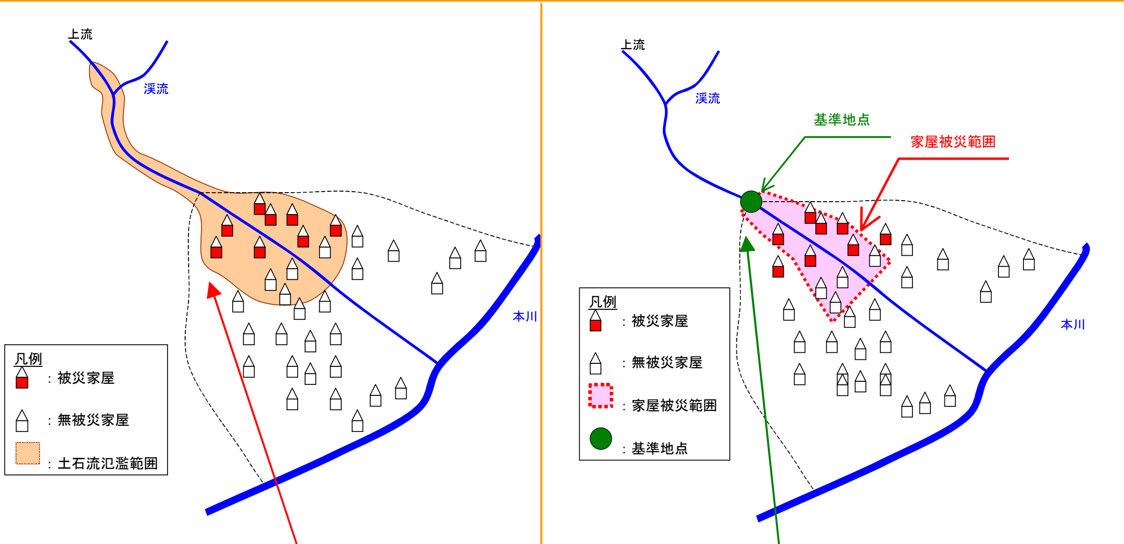


Fig. Relationship between peak discharge and maximum flow width

Application to past debris flow disasters

- Two new indices are designated for use in evaluating the results of the application - the "damaged house inclusion percentage" and the "undamaged house percentage."

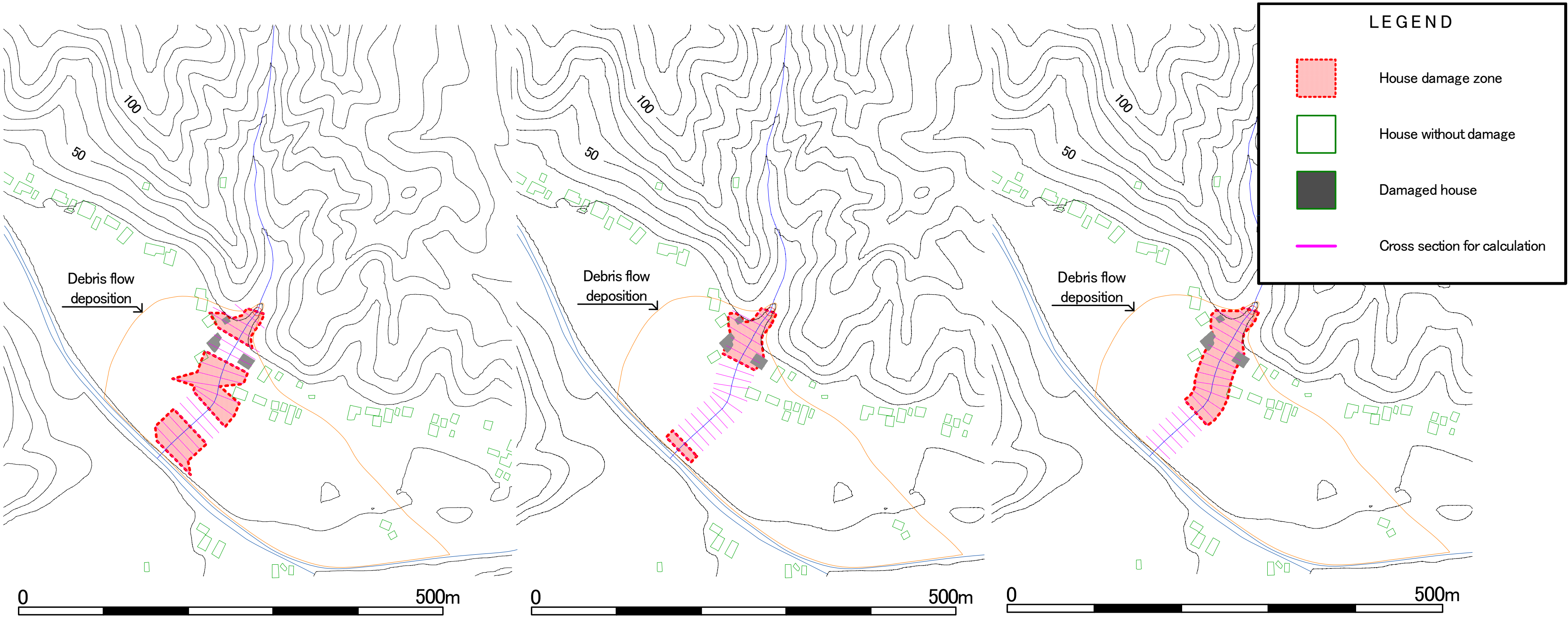


	Debris flow spreading area	Range of debris flow damage to house
Damaged house	8	6
Undamaged house	4	4

Damaged house inclusion percentage
=6/8
=0.75

Undamaged house percentage
=4/(6+4)
=0.40

Examples of the applications



(a) 10m (b) 100m (c) 200m

The damaged house inclusion percentage was 33% (10 m case) and 100% (100m case and 200 m case). Because there were two undamaged houses (10m case) and one undamaged house (100m case and 200m case), the undamaged house percentage was 66.7% (10 m case) and 25% (100m case and 200m case)

Results of the application

		Horizontal distance used to calculate gradient of the land (m)								
		10m			100m			200m		
		①／②	Breakdown: Pertinent number ①	Breakdown: All ②	③／④	Breakdown: Pertinent number ③	Breakdown: All ④	⑤／⑥	Breakdown: Pertinent number ⑤	Breakdown: All ⑥
Damaged House Inclusion Percentage	Total completely or partly destroyed	0.567	17	30	0.667	20	30	0.700	21	30
	Completely destroyed	0.400	4	10	0.500	5	10	0.600	6	10
	Partly destroyed	0.650	13	20	0.750	15	20	0.750	15	20
Undamaged house percentage		0.874	118	135	0.780	71	91	0.796	82	103

Table. Damaged House Inclusion Percentage and Undamaged House Percentage

Conclusion

- Maximum value of debris flow width is estimated by $B_{max} = 4\sqrt{Q_{SP}}$.
- About **70%** of the damaged houses in the past debris flow disasters were included in the range of debris flow damaged to houses set by the method.
- Because the undamaged house percentage is high, ranging from 70% to 80%, a method of studying a way of **lowering the undamaged home percentage** should be studied.

Development of Warning and Evacuation System against Sediment-related Disasters

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Research Center for Disaster Risk Management
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Types of sediment-related disasters

Slope failure

A phenomenon where soil is weakened by the rain, earthquakes, etc. causing a slope to crumble suddenly

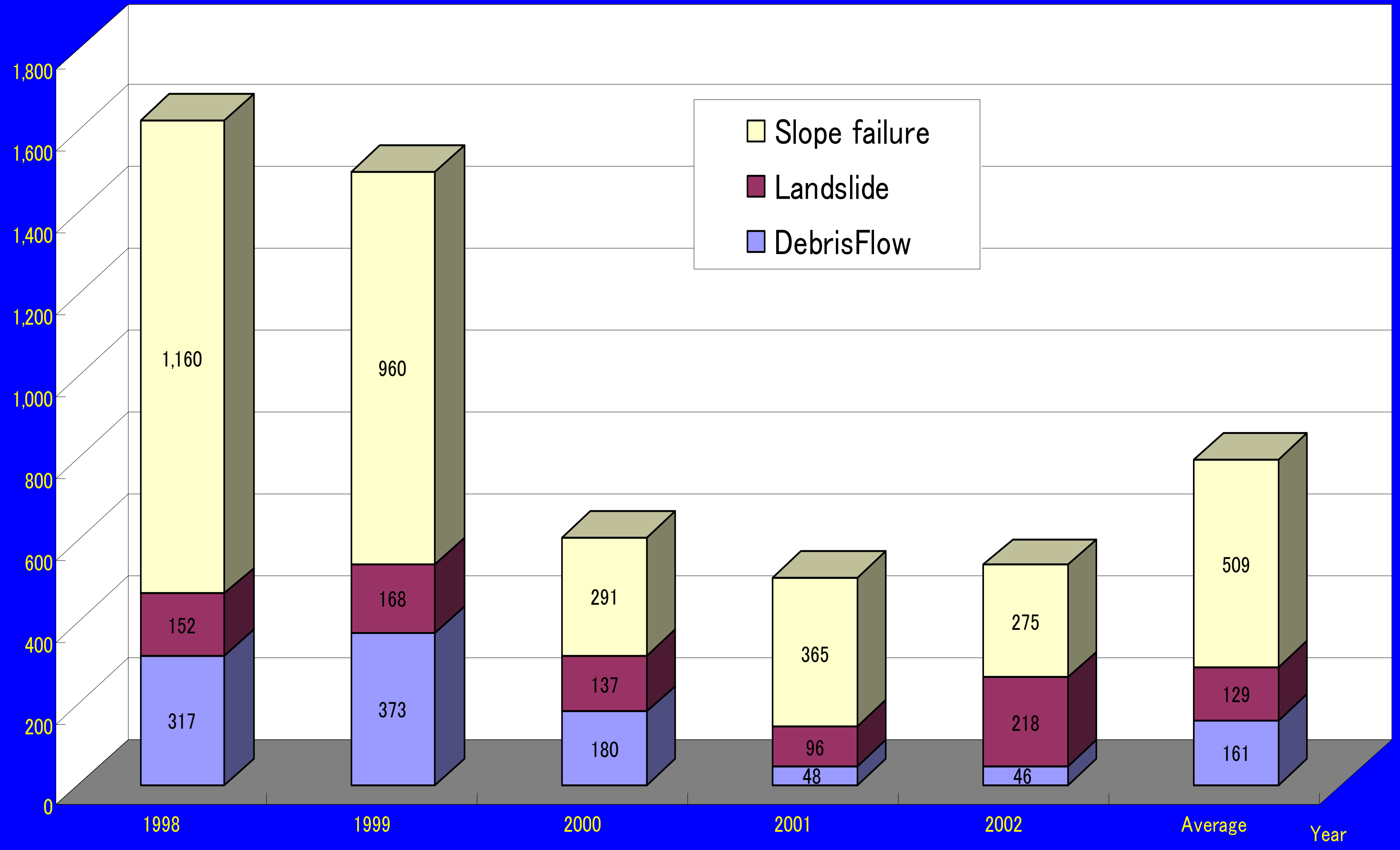
Debris flow

A phenomenon where long or localized torrential rainfall causes mountainside soil, sand, and gravel (debris) from hillsides or stream beds to fall into lower reaches, where they are suddenly washed away downstream at speeds from 20 to 40 km/h

Landslide

A phenomenon where dirt clods on a slope are slowly moved downward by groundwater, etc., along a landslide surface at speeds from 0.01 to 10 mm/day.

Sediment-related disasters which occurred these 5 years



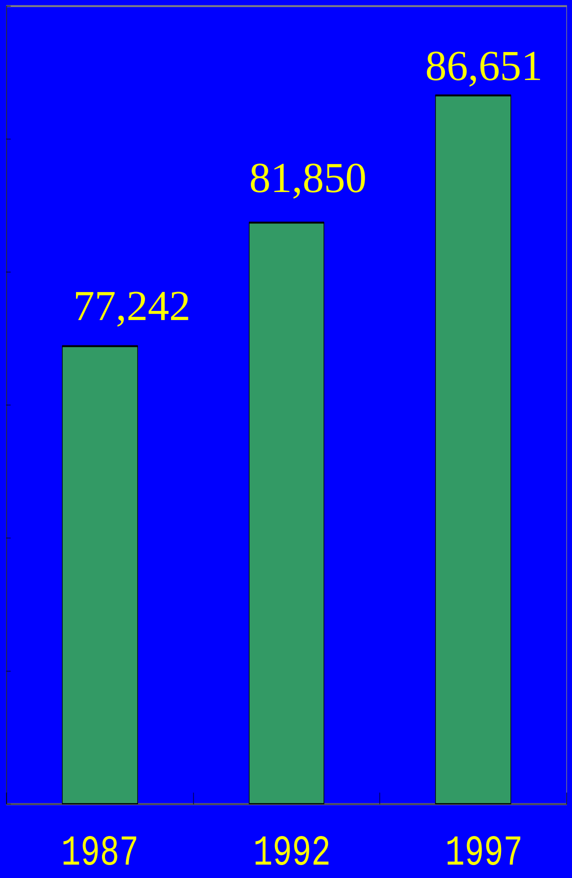
○Sediment-related disasters costing invaluable lives are commonplace in many countries in the world.

○The sediment-related disaster hazard area is numerous in number and extends over a vast area.

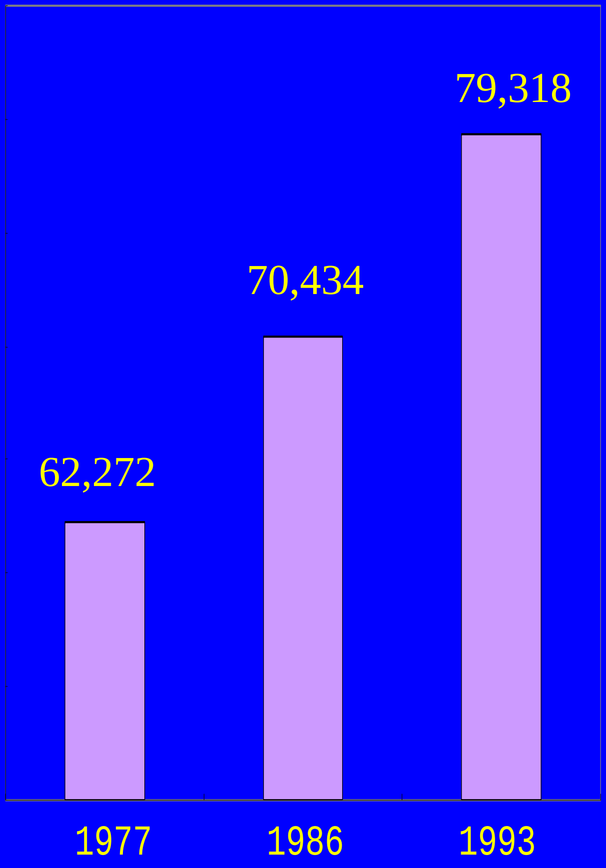
○An enormous amount of time and cost are required to make all the hazard areas safe with the installation of disaster prevention works.

Increases in the number of dangerous spots for sediment-related disasters

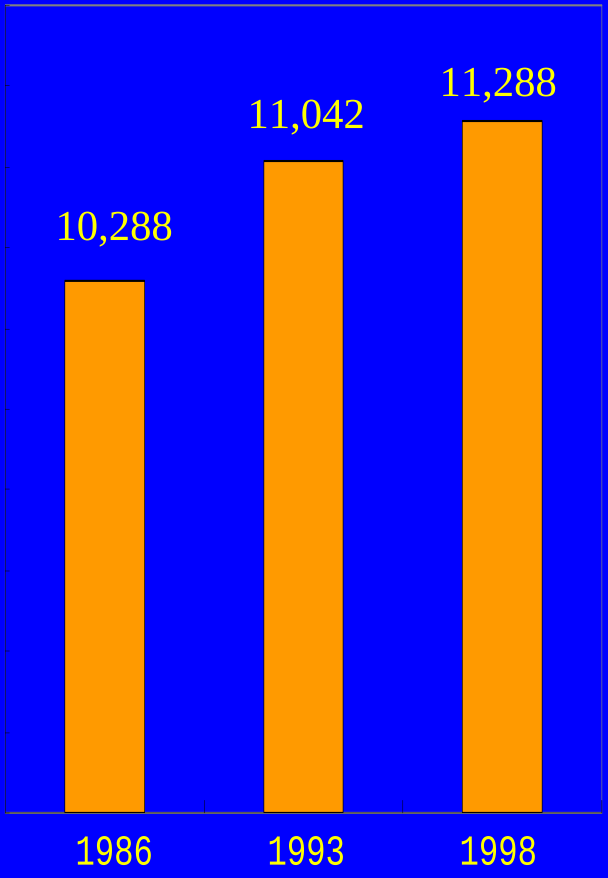
The number of dangerous slopes of slope failure



The number of streams or rivers that posed the danger of mud and debris flows

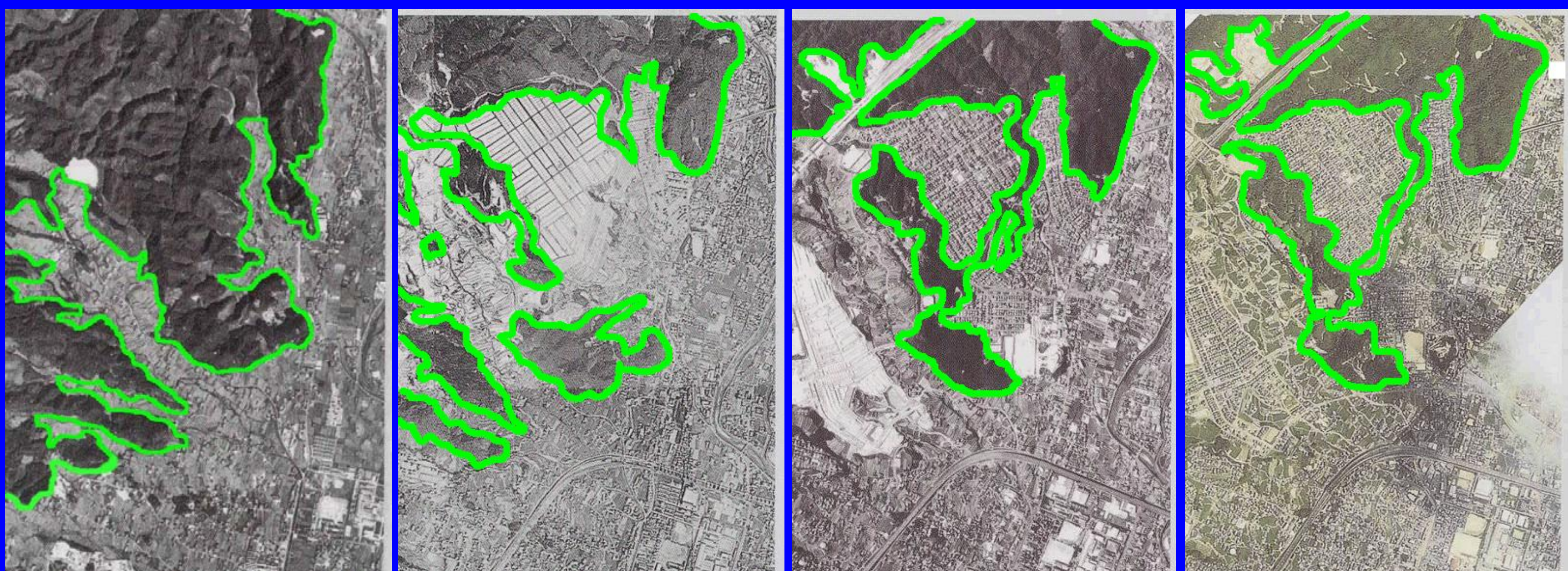


The number of potential landslide sites



What caused the increase of sites?

- The Ministry of Construction thought that one of the main reasons was the development of residential areas on hillsides as well as on foothills.



1966 1974 1986 1999 (Presented by MLIT)

Example of Hiroshima City: disaster-prone sites increased from 4 to 24 between 1966 and 1999.

What should be done to mitigate the damages?

- The Japanese government was prompted to establish a new act for designating hazard areas in order to:
  - Restrict new development for housing and other purposes,
  - Promote relocation of existing houses, and
  - Develop an early warning system.

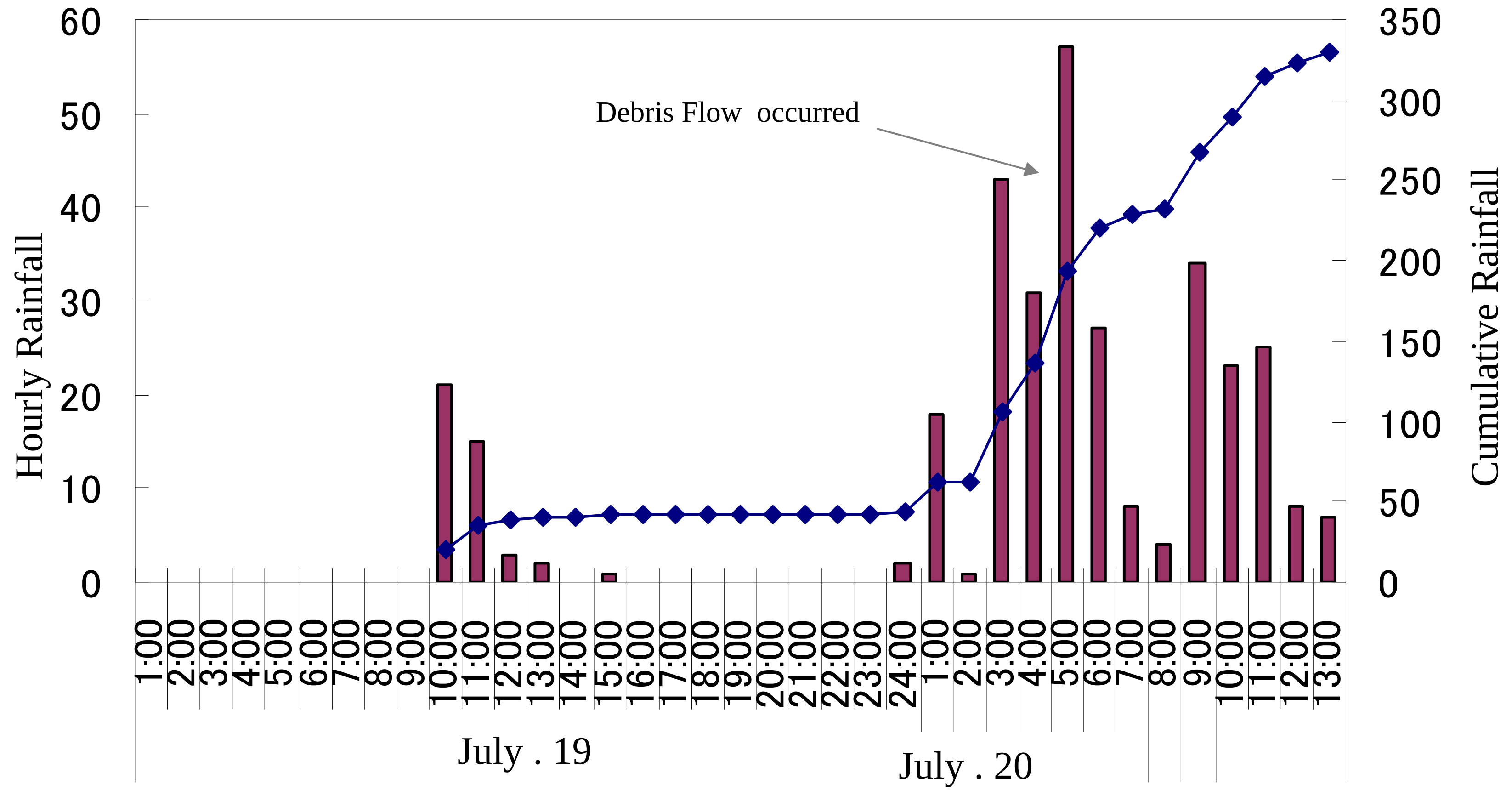
○When promoting sediment-related disaster prevention measures, versatile non-structural measures should be taken in addition to structural measures.

○Non-structural measures include the designation of a sediment-related disaster hazard area and the development of a warning and evacuation system.

Debris Flow Disaster in Kumamoto

Date of occurrence	Number of dead (persons)	Damaged houses (partially destroyed)
July. 2003	15	14 (1)

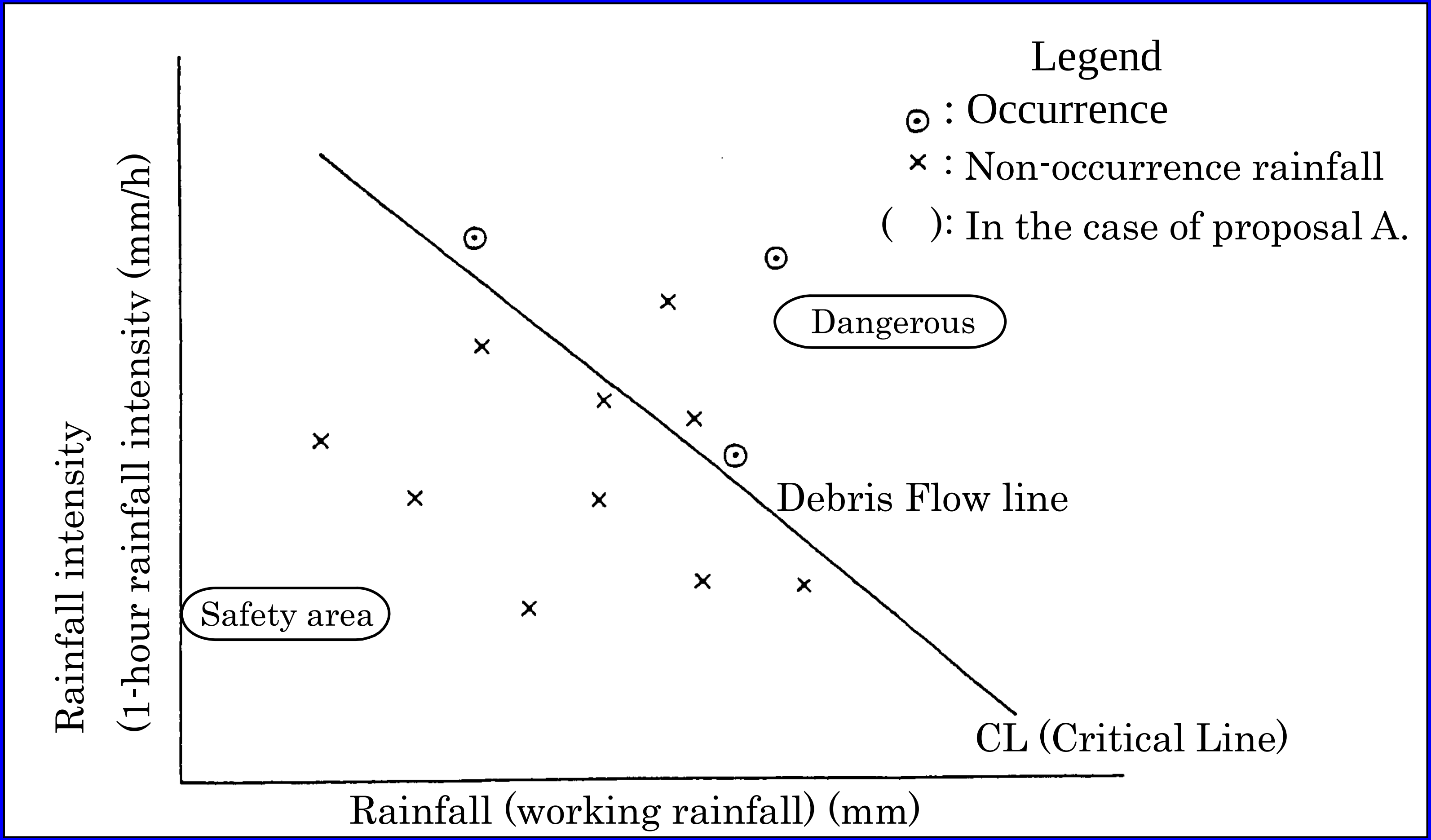
Cumulative Rainfall and Hourly Rainfall



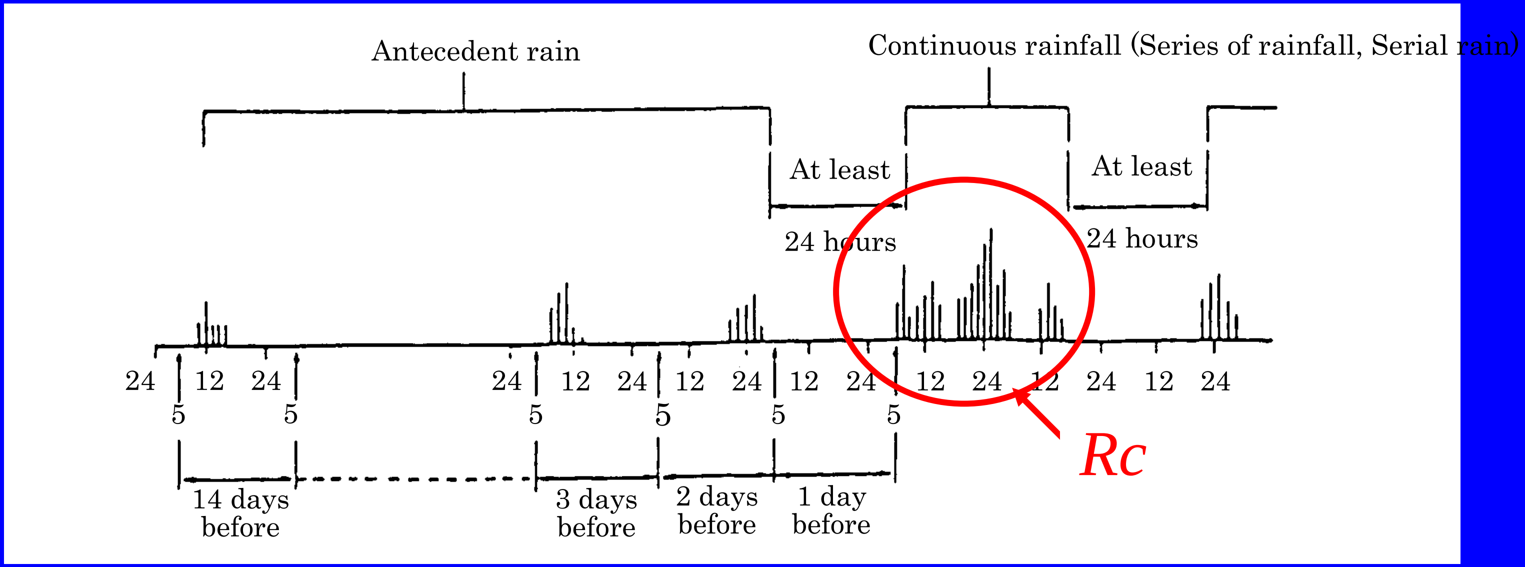
Target Phenomena

- Debris flow
  - ➢ Mostly predictable
- Volcanic mudflow
  - ➢ Mostly predictable
- Landslide
  - ➢ Difficult to predict
- Slope failure
  - ➢ Depending on a method and a disaster pattern

Concept of Critical Line



Calculation of Working Rainfall



$$R_{WA} = \sum_{t=1}^{14} \alpha t \; R_{dt}$$

R_{WA}: Antecedent working rainfall

$$\alpha t = 0.5^{t/T}$$

T: Half-life period (Days)

Definition of Working rainfall

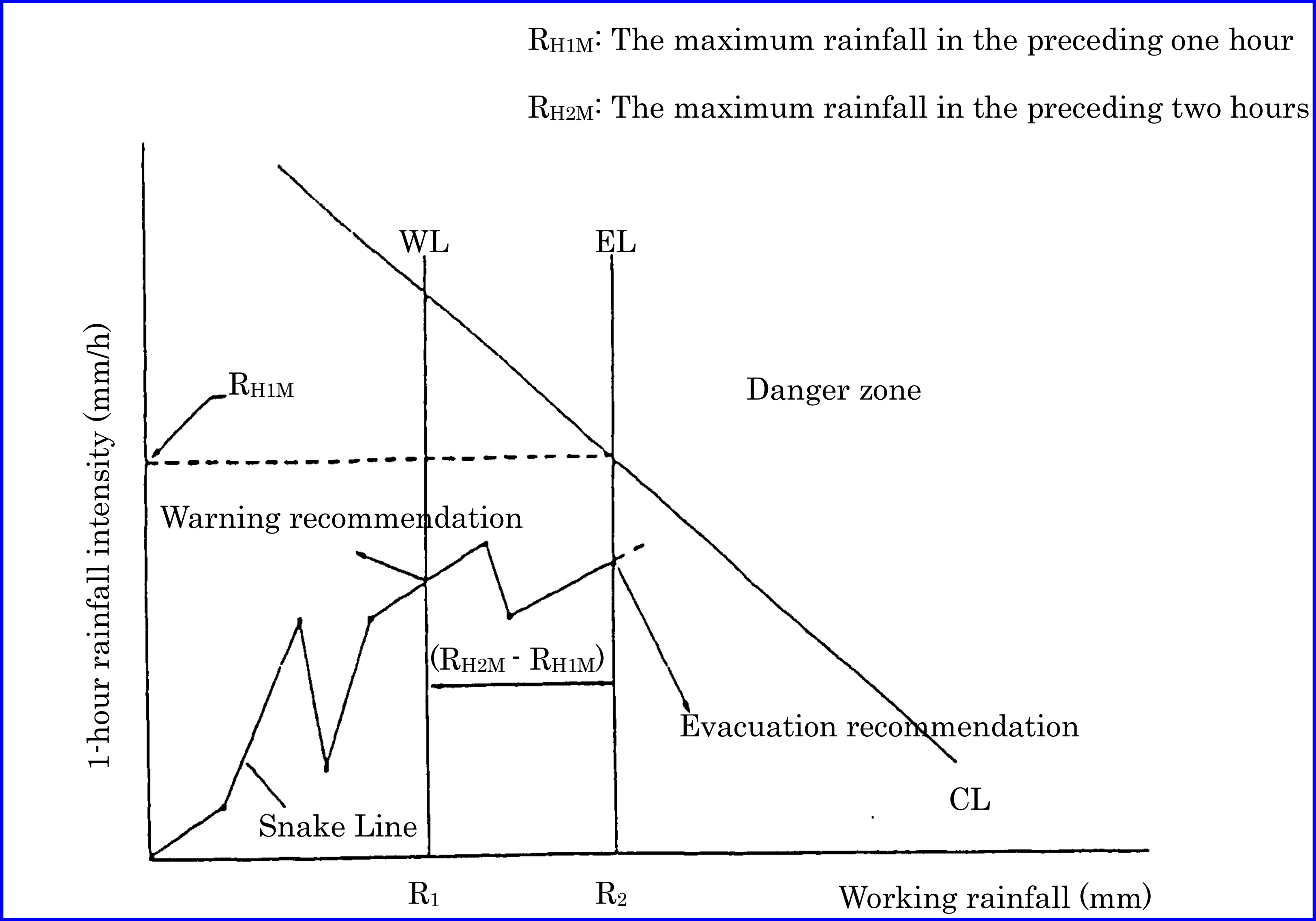
- R_W : *working rainfall*
- R_{WA} : *Antecedent working rainfall*
- R_C : *continuous rainfall*
- $R_W = R_{WA} + R_C$

(Example) Antecedent working rainfall (In case of T=1 day)

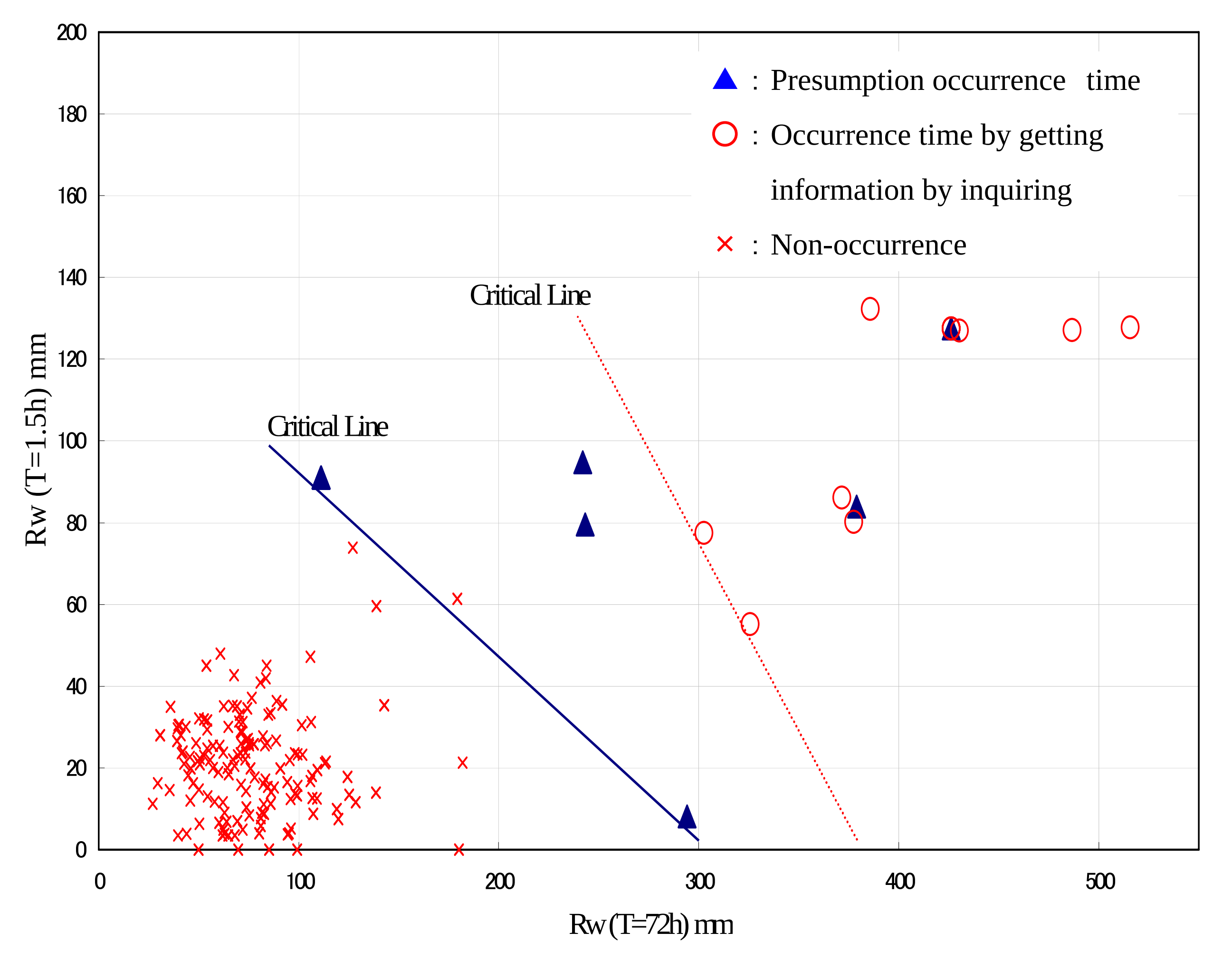
•$R_{WA} = Rd_1 \times 0.5 + Rd_2 \times (0.5)^2 ... + Rd_{14} \times (0.5)^{14}$

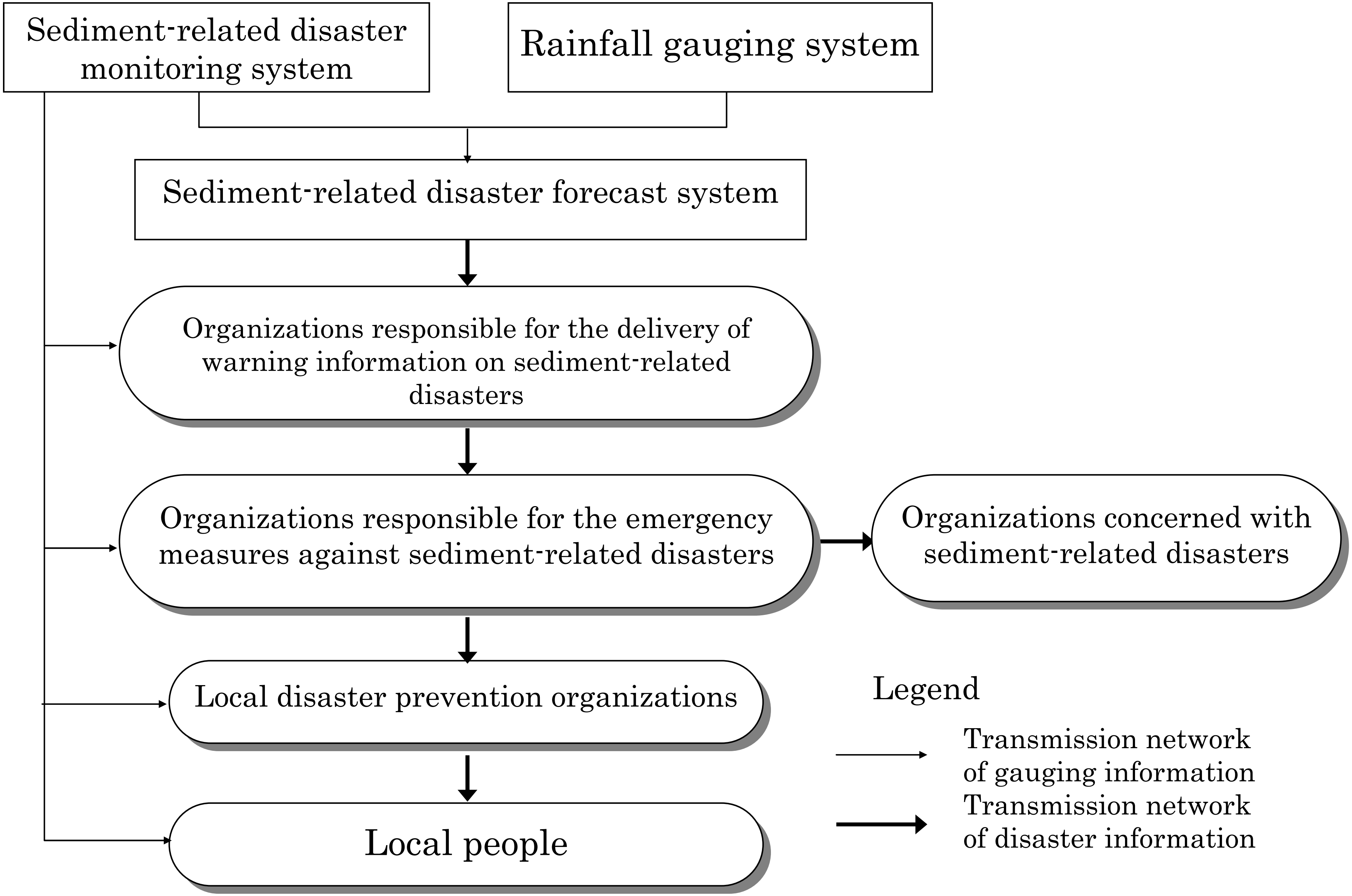
•*Rdt: daily rainfall t days before*

Warning, Evacuation and Snake Line



Example of changing the occurrence time





The structure of the sediment-related disaster warning system

Debris Flow Detection Sensors

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Volcano and Debris Flow Team
Erosion and Sediment Control Research Group
Public Works Research Institute

1. Significance of Debris Flow Detection Sensors

In Japan, sediment related disasters occur frequently, claiming many human lives. To protect people's lives from sediment disasters, it is important that in addition to constructing sabo works such as sabo dams and channel works, we establish warning and evacuation systems.

One technical challenge is to use sensors to reliably detect a debris flow.

This means using sensors to detect a debris flow that has occurred as a standard for evacuating residents.

The following are cases where debris flow detection sensors are needed.

(1) Cases of emergency installation in order to prevent secondary disasters during, for example, work to rescue missing people following a disaster.

(2) Cases of emergency installation where there is danger of a debris flow caused by the formation of a natural dam or by rainfall after a volcanic eruption.

(3) Cases where safety of the sites of sabo works is guaranteed.

(4) Cases where it is used as a trigger to start the evacuation of residents to escape a debris flow.

In Japan, worsening finances have sharply reduced sabo works project budgets, making it difficult to perform works to ensure safety. The future will bring a growing need to use detection sensors etc. to establish reliable warning and evacuation systems.

2. Sensors: Outline and Problems

(1) Contact type sensors

A type of sensor that is activated by direct contact of a debris flow with the sensor.

Wire sensor, Touch sensor

(2) Non-contact sensors

A type of sensor that is activated without direct contact with a debris flow.

Vibration sensor, Optical sensor, Ultrasonic wave sensor, Sensing movement on a screen

a) Wire sensor

A wire that has been laterally stretched at a height between 0.6m and 1m, it detects a debris flow when it is cut.

Wire sensors are inexpensive and the type most widely used in Japan.

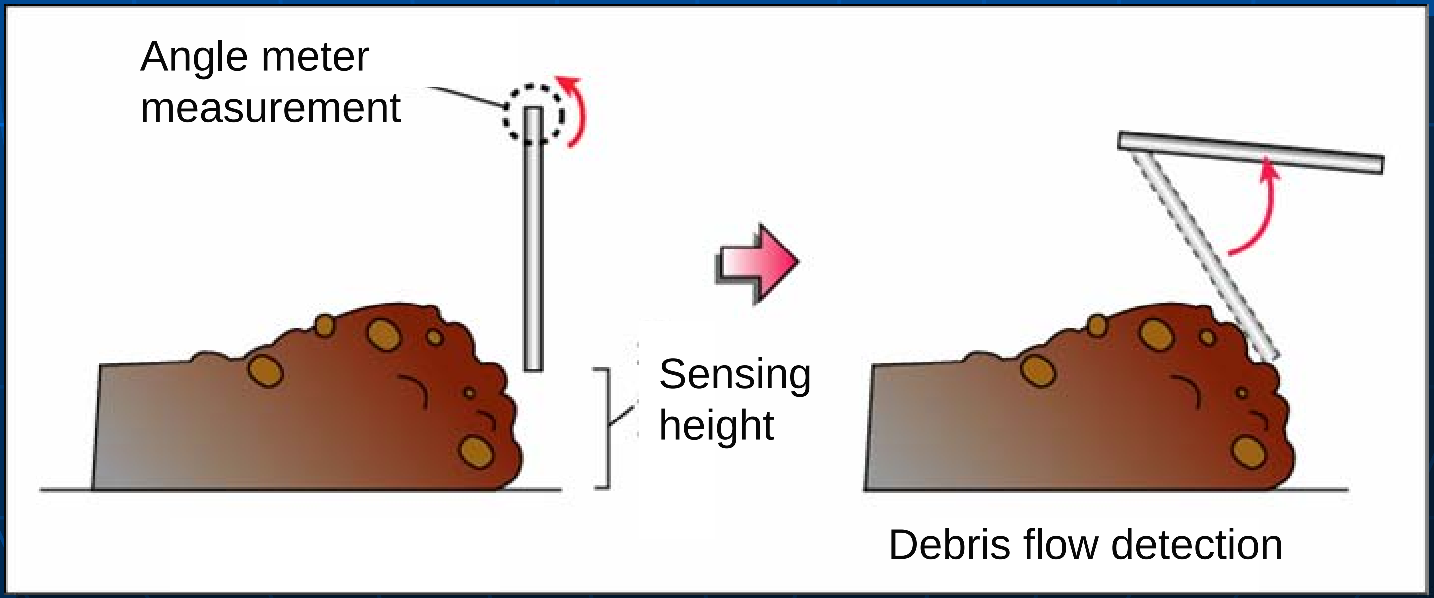
But once a wire has been cut, it cannot detect subsequent debris flows. Personnel must, therefore, return to the site to replace the wire. Wires may also be cut by animals, snow, wind, or falling rocks, causing incorrect operation.

Wire Sensor

Sensor Being Installed

b) Touch sensor (Swinging rod-type surface detecting sensor)

A rod-shaped pendulum sensor is suspended above a torrent so that it when it is pushed upwards by the front of a debris flow and reaches a specified inclination, the system indicates that a debris flow has occurred.



Touch sensor
(Swinging rod-type surface detecting sensor)

c) Optical sensor

An optical sensor transmits an infrared beam laterally across a river course to detect a debris flow when it breaks the beam. This type is not widely used in Japan.

It may operate incorrectly because of intensive rain, mist, or falling ash, etc.

d) Ultrasonic wave sensor

This type measures the flow depth by transmitting ultrasonic waves vertically. It also measures flow velocity by transmitting the waves diagonally. The precision of its data falls if the shape of the surface of the debris flow fluctuates remarkably because it contains large rocks.

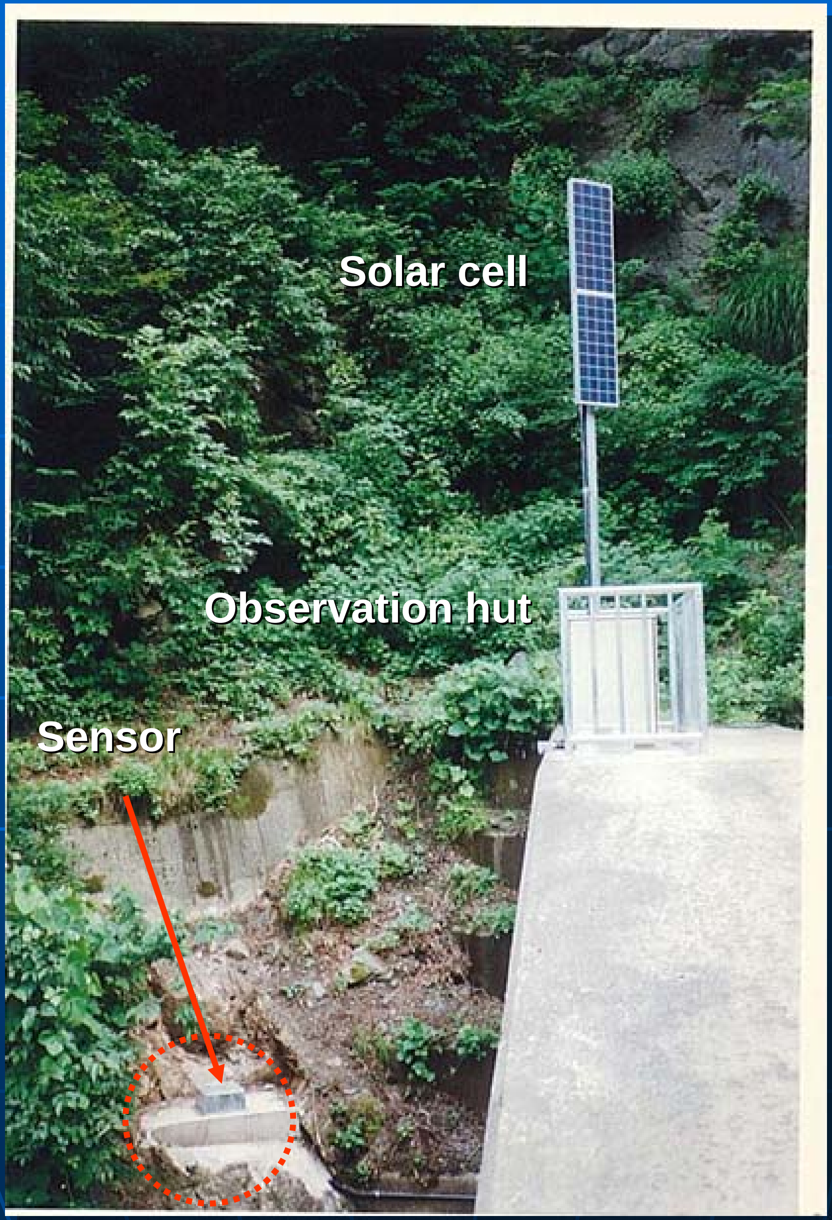
Ultrasonic wave water gauge

e) Vibration sensor

This is a sensor embedded in the ground where it senses the ground vibration caused by the flow of a debris flow. It can detect a series of debris flow and requires little maintenance.

But no objective method of setting the threshold of detection has been established.

Embedded Sensor
(Acceleration Gauge)



Vibration Sensor System

f) Sensing movement on a screen

Video images obtained by CCTV are processed by a computer to detect a debris flow from movement on the screen. In Japan, it is at the trial stage and has not been introduced as a practical system. Because the images can be monitored automatically, it is expected to come into wide use.

Analysis screen

Debris flow occurrence sensor

* Red ellipse shows the sensed debris flow

3. Vibration sensor trigger level setting method

In order for a vibration sensor to accurately sense debris flows, the trigger level of the vibration sensor must be accurately set. If the trigger level is low, it detects small debris flows or noise so its false-alarm rate is high. If the trigger level is set too high, it may fail to detect debris flows.

The Public Works Research Institute (PWRI) has prepared an objective trigger level setting method that will now be introduced.

(1) Debris flow vibration – discharge relational equation

The PWRI decided to estimate the ground vibration intensity that is the sensor standard value based on the discharge of the debris flow.

Based on the results of debris flow observations in Japan, it has been reported that the discharge and vibration of debris flows is represented by the following equation (Suwa et al., 1999).

$$P = CQ^{2/3} \quad \cdots ①$$

Where: *P*: intensity of vibration caused by a debris flow

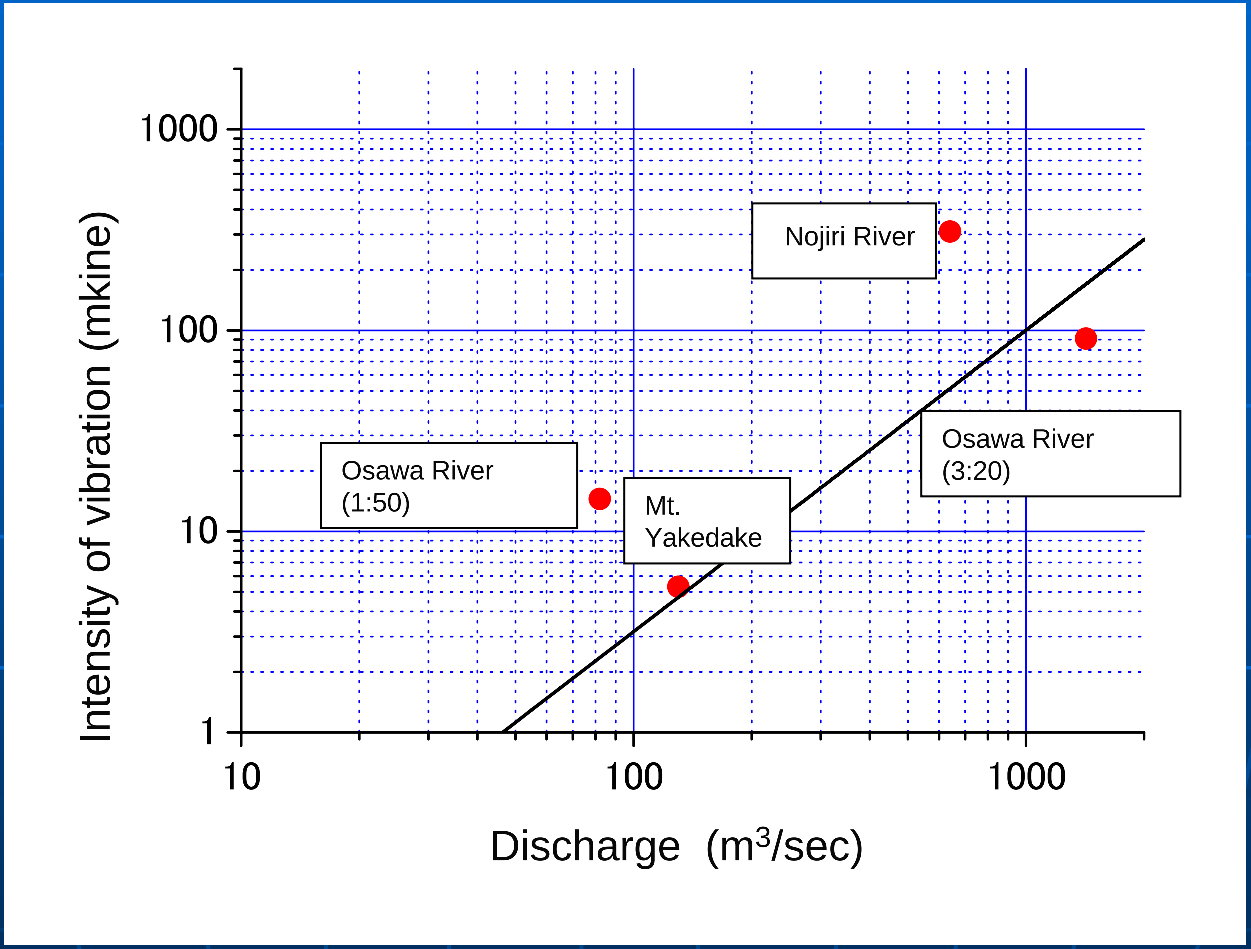
Q: discharge of the debris flow

C: coefficient

The following equation representing the relationship between Q and P is obtained based on the observed data.

$$P = 0.003Q^{2/3} \quad \cdots ②$$

But because there are only 4 cases of observed data, more data must be accumulated in the future.



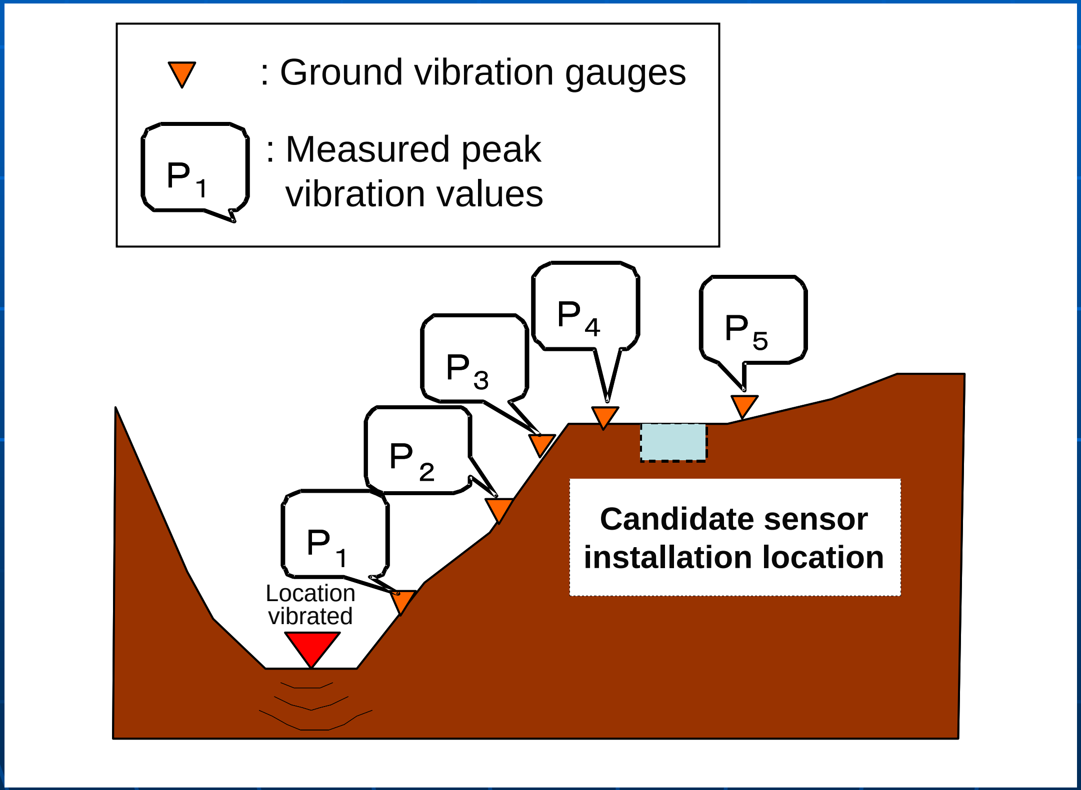
Relationship between the discharge and ground vibration intensity of a debris flow estimated based on past observations (value at a standard distance (25m))

Above, the standard distance was assumed to be 25m for the calculation, but because the actual distance between a sensor and the center of flow varies from place to place, a general equation that finds P for an optional distance was obtained. So the equation is obtained by a vibration damping equation for a semi-infinite homogenous plastic body that is in general use.

$$P = P' \cdot \left(\frac{d'}{d} \right)^{-n} \cdot e^{-\alpha (d - d')} \quad \cdots ③$$

- P : vibration intensity at the standard distance of 25m
- P' : vibration intensity at distance d'
- d' : standard distance (25m)
- d : distance from the source of the vibration
- α : coefficient
- n : 0.75 (constant)

α is a coefficient that is assumed to vary according to the ground. α is obtained by striking the ground surface at the site with a wooden mallet to vibrate the ground and performing a back calculation of data observed at varying distances (P1 – P5) from the center of the flow.



Layout of measurement instruments used to obtain α

(2) Future subjects facing vibration sensors

[1] Observations will be done to accumulate data. Because the reliability of the precision is not fully satisfactory, they will be applied in combination with other types of sensors for the time being.

[2] A large capacity memory device is necessary. It is also necessary to guarantee electric power.

[3] Motor vehicles passing near sensors may cause incorrect sensor operation. There was a case where a sensor recorded 3gal as heavy equipment passed 30m from it has been reported.

[4] It is now determined if vibration is caused by the peak discharge of the debris flow. But errors will be further reduced in the future if not only the peak discharge, but the vibration wave shape etc. is also sensed to make such a determination.

Development of the landslide displacement detection sensor using optical fiber

Extensometer using optical fiber

Landslide Research Team

Erosion and Sediment Control Research Group

Public Works Research Institute

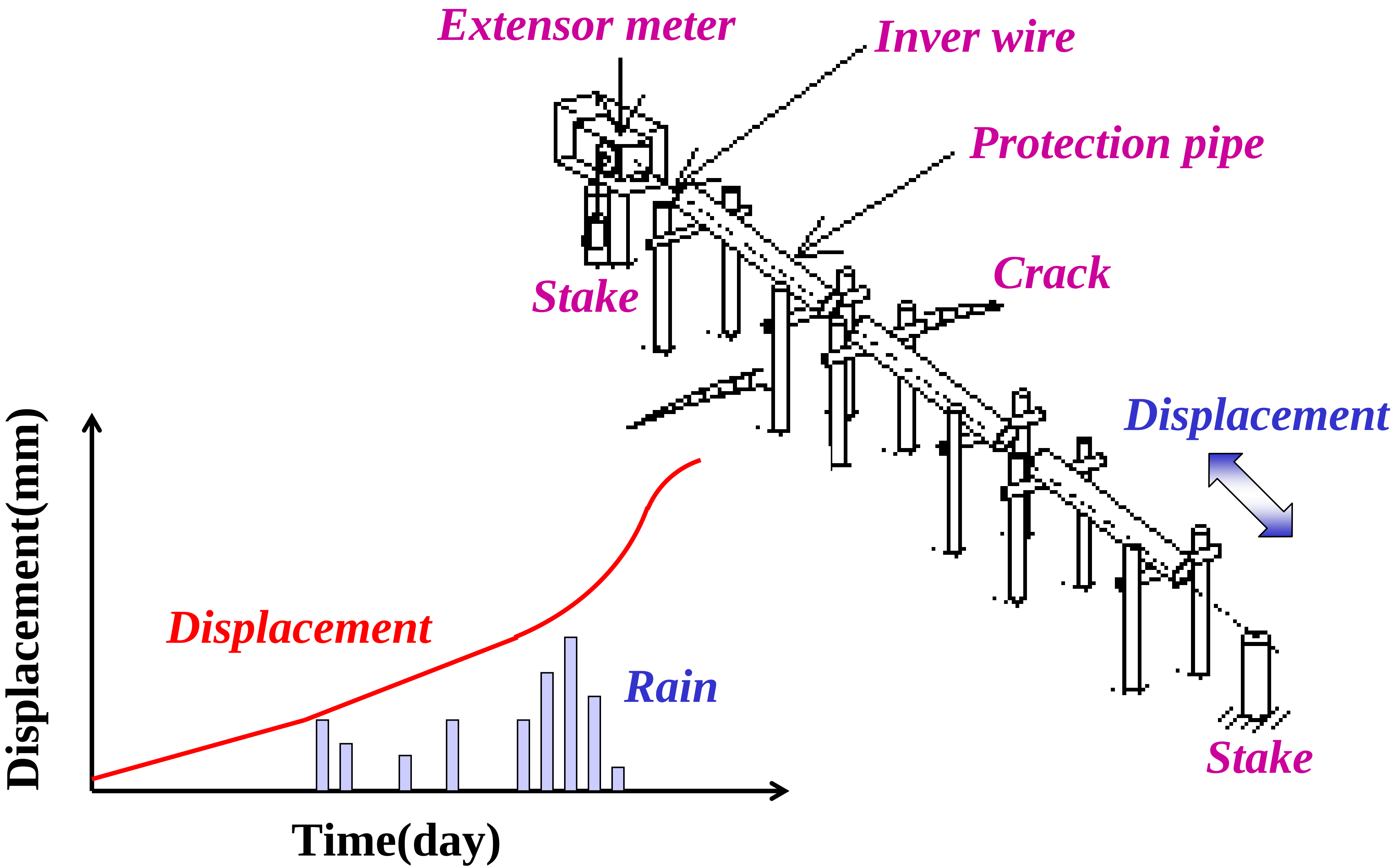
Monitoring of land slide

Aerial photograph of landslide

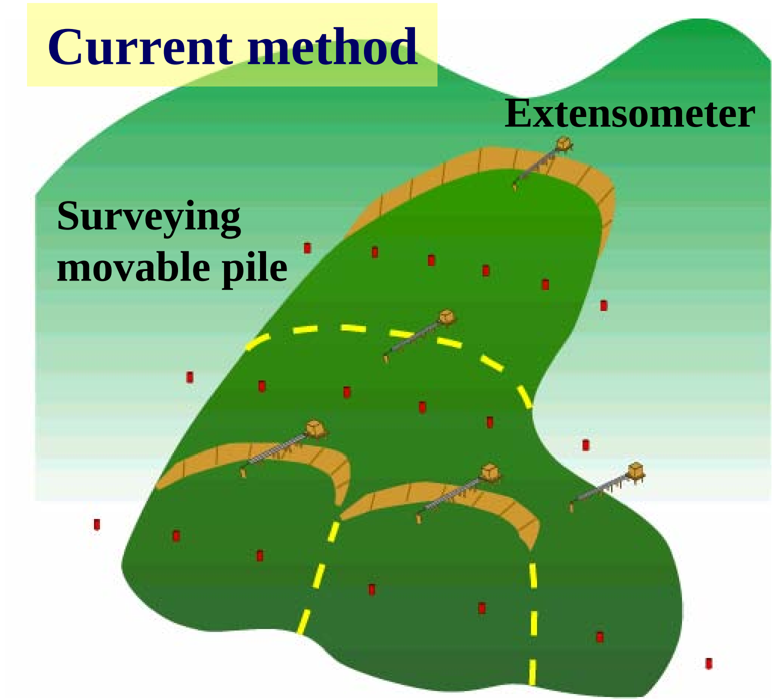
Photo showing how extensometer is installed

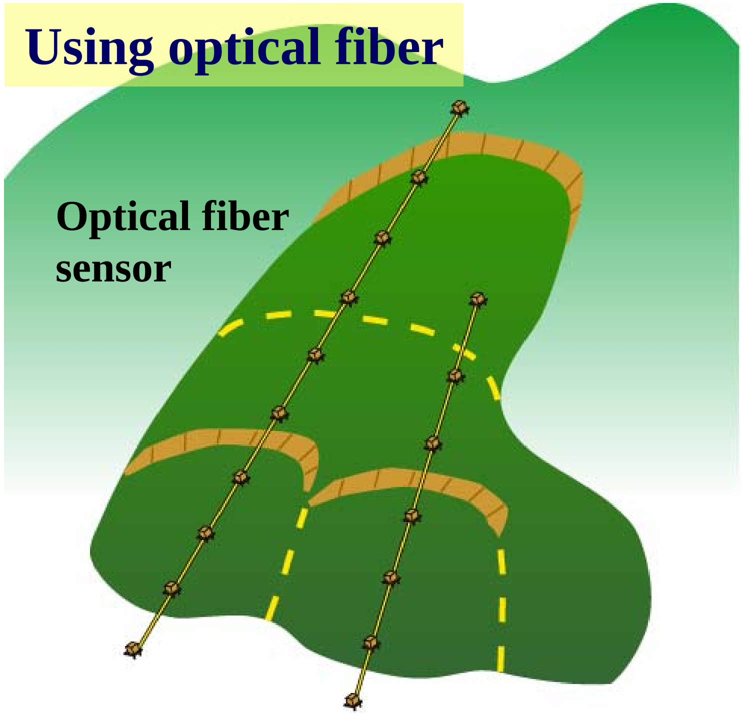
Crack

Conventional extensometer



Merit of monitoring by optical fiber sensor





Problem of current method

- Need many measurement equipments
- Take many time, cost, and effort
- Breakdown by thunderbolt

Merit of optical fiber

- Measure cover a wide area
- Measure at the end of fiber
- No breakdown by thunderbolt

⇒ reduce a time, cost, effort

Optical fiber sensing

Characteristic of optical fiber

The characteristics of light that passes through optical fiber are altered by temperature and distortion.

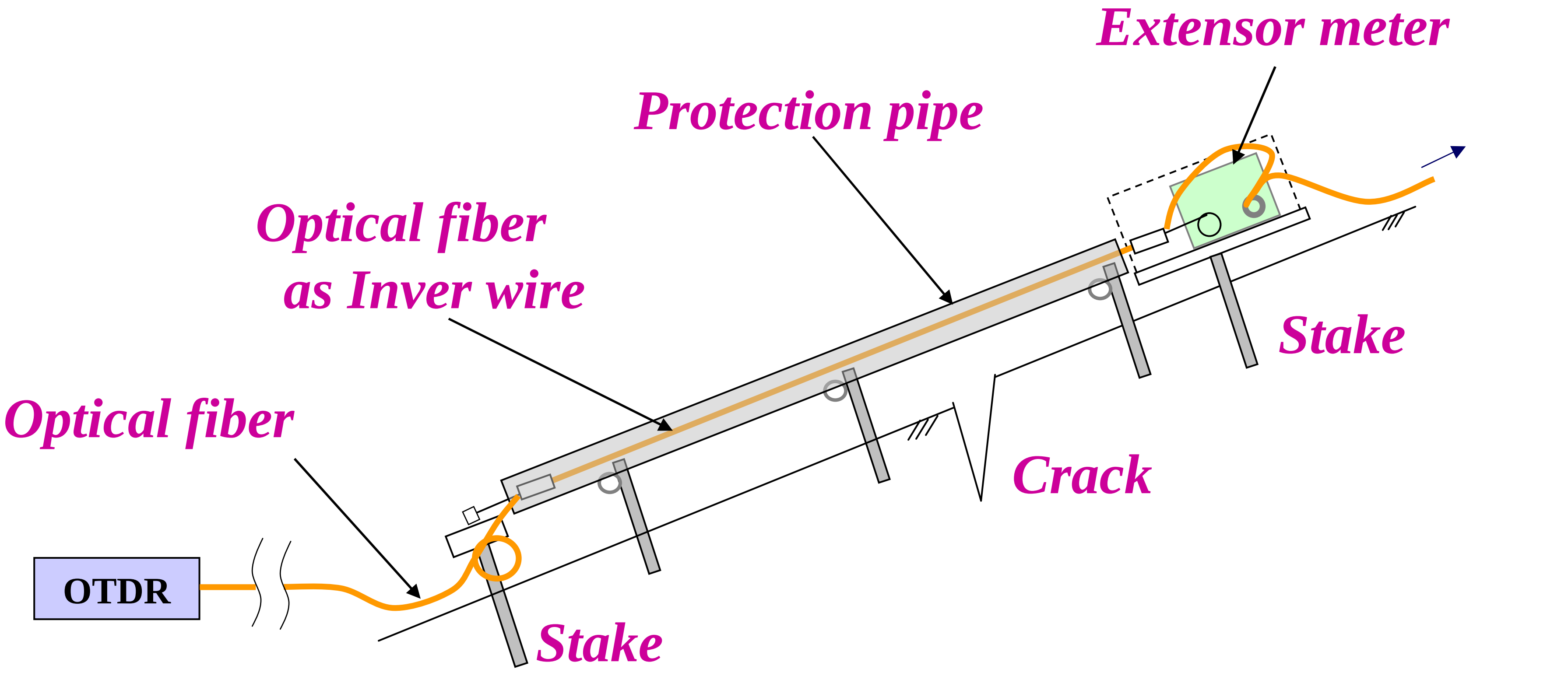
↓

Optical fiber can be used not only for communication but also as a sensor.

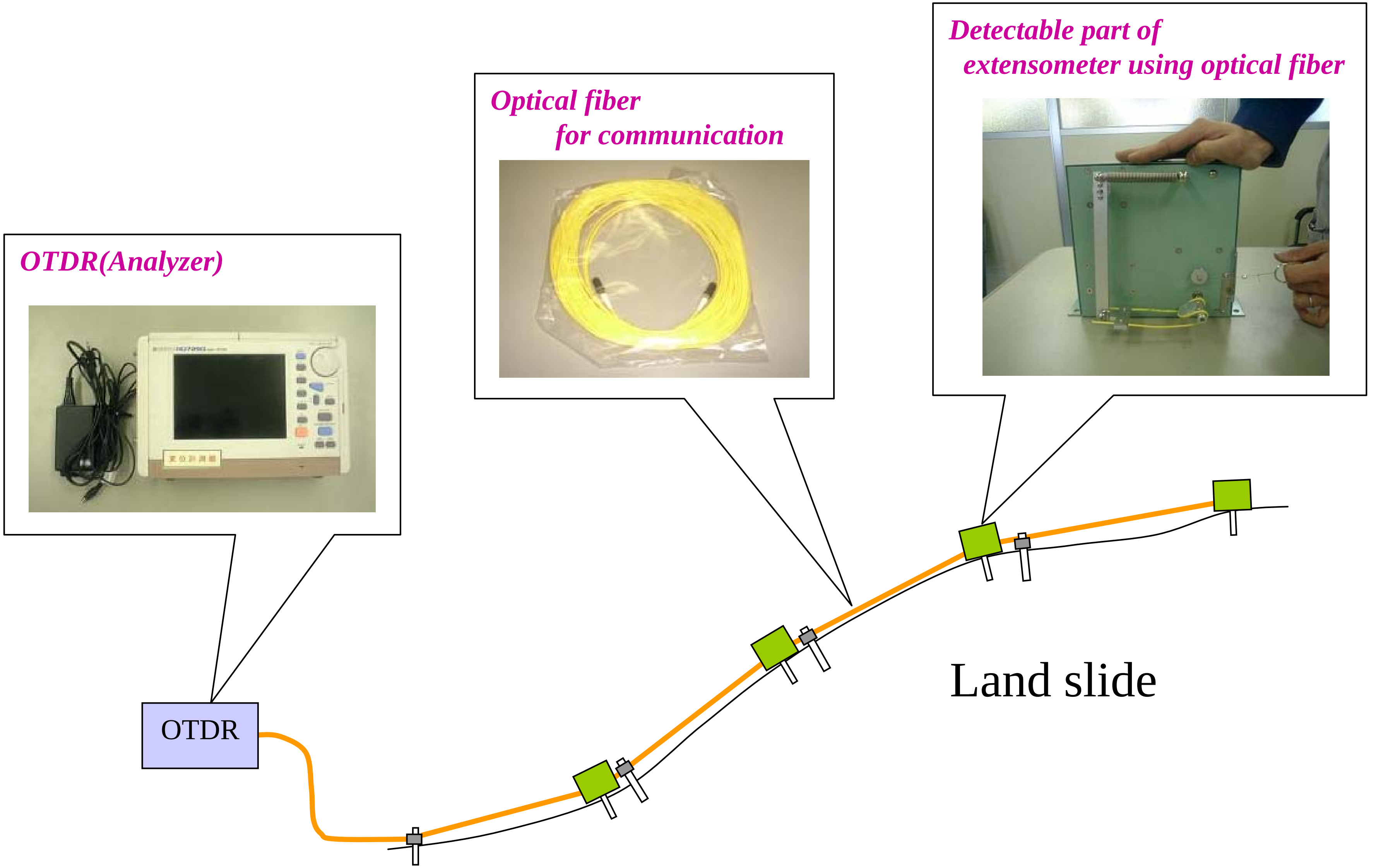
For example:

- ***Measurement of distortion (FBG)***
- ***Measurement of distortion distribution (BOTDR)***
- ***Measurement of displacement (SOFO, MDM)***
- ***Measurement of vibration (OFRI)***
- ***Measurement of temperature (Raman scattering)...***

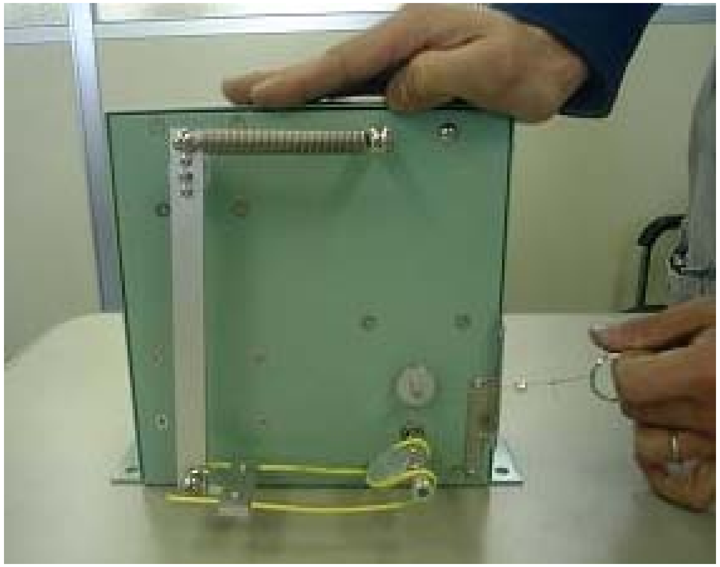
Extensometer using optical fiber

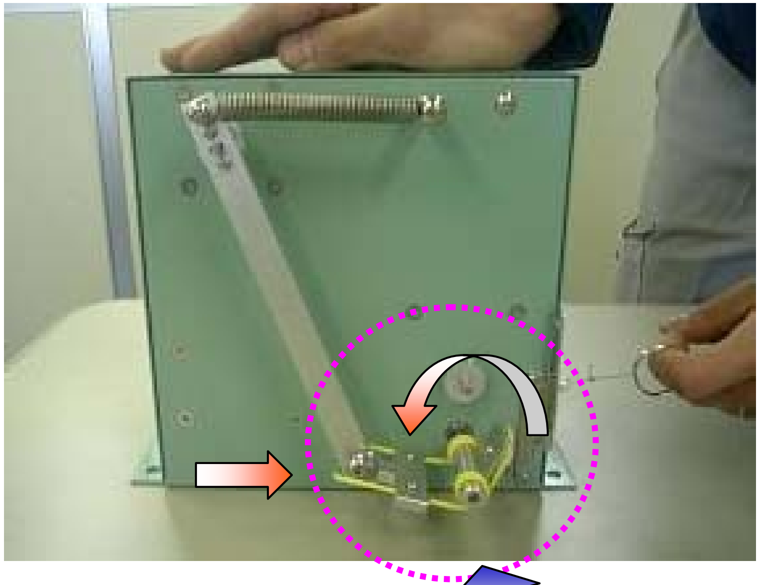


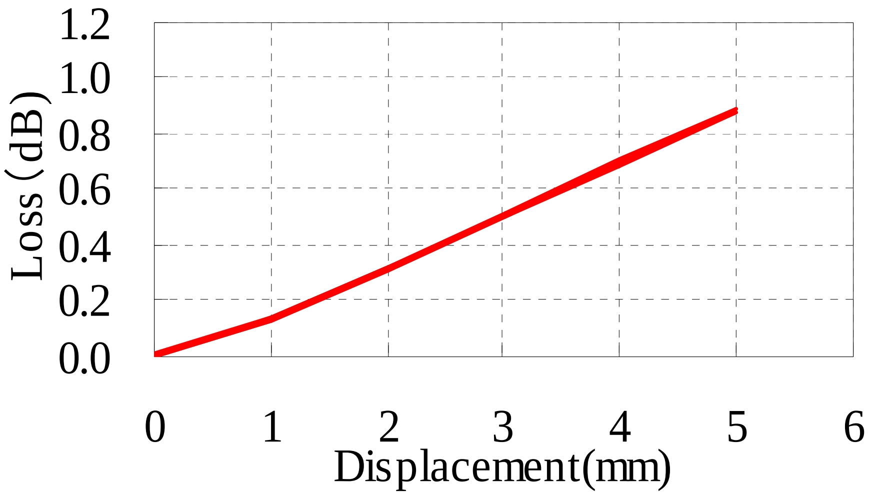
Extensometer using optical fiber

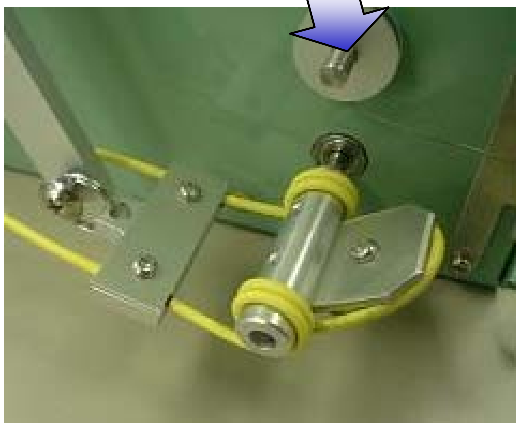


Extensometer using optical fiber

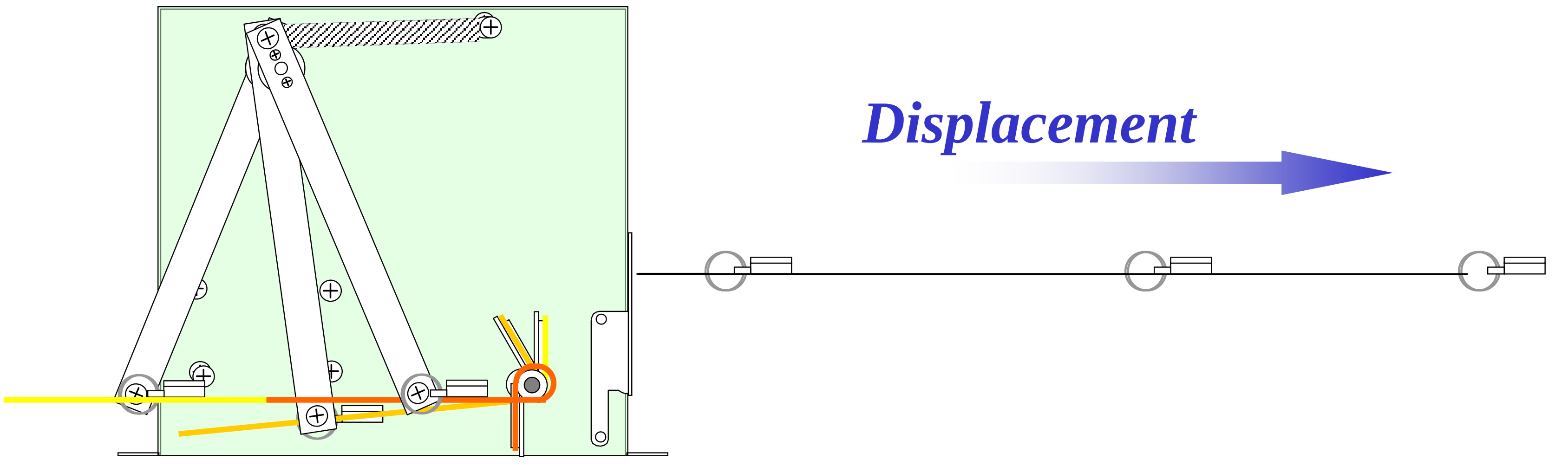


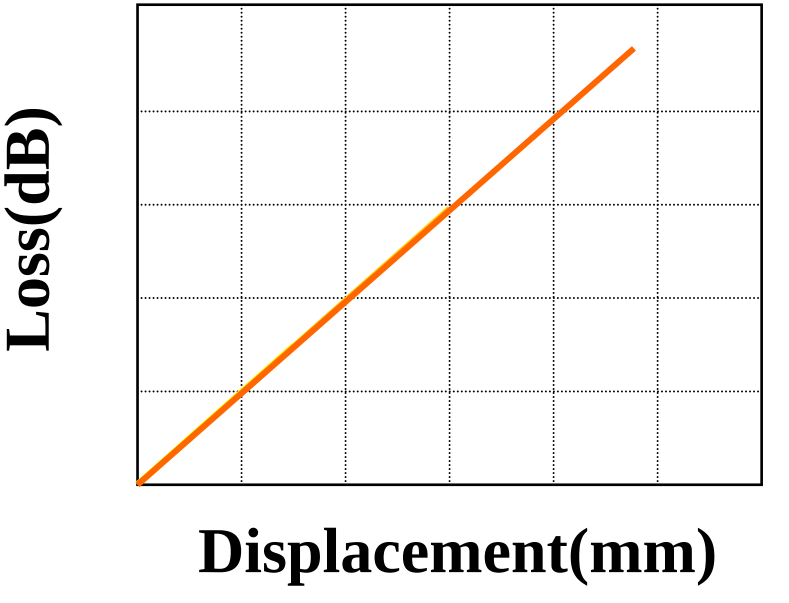






Extensometer using optical fiber

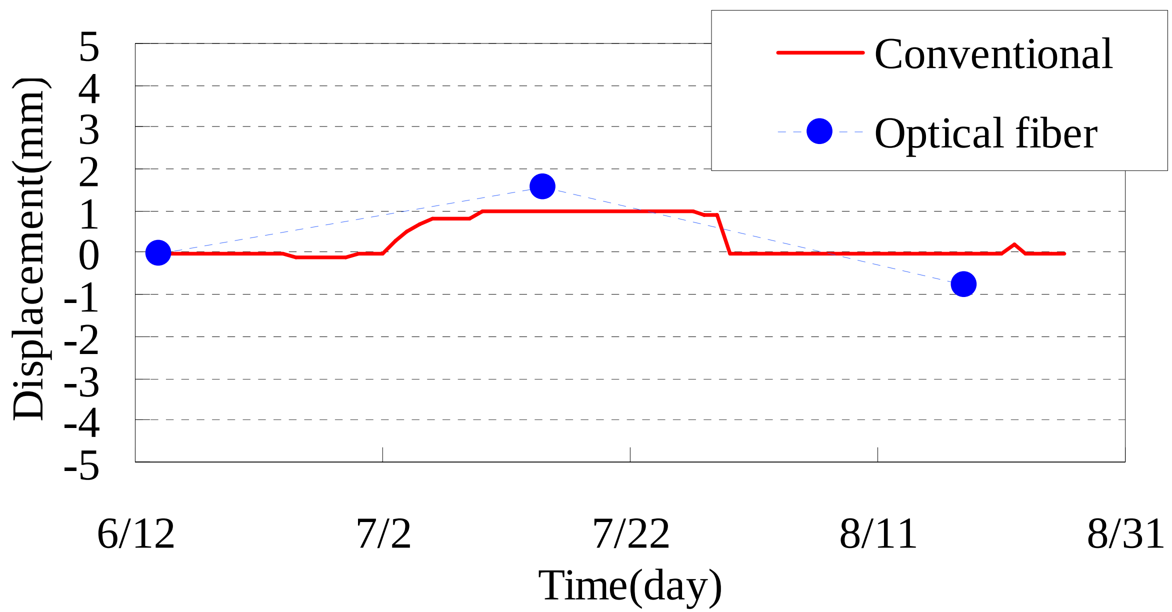




Extensometer using optical fiber

Measurement in the field based on joint installation with conventional extensometers

The behavior shown is roughly the same for both.



The 14th Conference on Public Works Research and Development in Asia

Special Session on Flood Forecasting and Warning

by

Secretariat for Preparatory Activities of UNESCO-PWRI Centre
Public Works Research Institute

October 21 (Fri.) 2005

Summary

The Special Session on Flood Forecasting and Warning (hereafter PWRI session) was held on 21 October 2005, at the opportunity of the 14th Conference on Public Works Research and Development in Asia. The conference was organized by the National Institute for Land and Infrastructure Institute (NLIM), Ministry of Land, Infrastructure and Transport (MLIT), supported by the Japan International Cooperation Agency (JICA) during the period from 17 to 28 October 2005 in Tsukuba and Sendai, Japan. The session was participated by representatives of seven countries, namely, Cambodia, India, Lao PDR, Philippines, Thailand, Vietnam and Japan.

The objective of the Special Session by the PWRI was to introduce the current flood forecasting and warning systems in each country and discuss their efficiency and deficiency to reduce death tolls during actual sever floods. The outcomes of the discussion are prospected to serve as complementary base to derive practical and serviceable action plan for advancing scientific research and technical approaches to enhance flood warning and forecasting systems with the ultimate goal to reduce death tolls. To this aim the presentations and discussion was directed to focus on the following three goals: (1) to deeply understand the real causes of death in actual flood disaster events; (2) to identify critical weakness in the whole cyclic system of “Risk Reduction” - “Damage Reduction” - “Emergency Management” - “Rehabilitation and Restoration” that are supported by role-sharing work by individual, community, and government; and (3) to analyze the significance and limitation of flood forecasting and warning systems for saving loss of lives.

The opening address was presented by Mr. Yoshitani (PWRI) to introduce the current issues in flood forecasting and warning in Japan and in developing countries. He emphasized that the future directions in flood disaster mitigation should seek for the best combination of structural and non-structural alternatives that are defined under an appropriate role and responsibilities sharing and involvement of all related people in the decision process. Mr. Suwa (PWRI) summarized the country reports solely prepared by each participant to serve the objective of the Special Session. He emphasized the need to clarify the problems that our society is facing during disasters. The Niigata flood disaster experience in Japan in 2004 raised important considerations and concerns to accurately evaluate the real causes of death and general public responses for each flood disaster.

Mr. Janak Jerambehai Siyani from India introduced the particular conditions of the flood of 26 July 2005, acknowledged the worst ever recorded flood event in the history of the Numbai City. The major issue during the flood was the incapability of the existing forecasting system to predict the highly localized phenomena. Despite the issuing of flood warning, the death toll was unprecedented high and reached 736 in Mumbai City and more than 1000 death in Maharashtra State. During the flood about 150,000 people were stranded in their offices and schools and many people died drown inside their cars. The coincidence of high tide and heavy rain worsened the situation. The state government had released Rs.5 billion for emergency relief.

Dr. Bunna Yit from Cambodia introduced the existing efforts of the government represented by the Ministry of Public Works and Transport (MPWT) with the National Committee for Disaster Management in putting concrete actions to improve the efficiency of current flood mitigation issues despite the limited number of measuring stations. Promoted actions are to (1) collect disaster information along the affected or damaged road and hydro-structure, (2) inspect and survey critical section and ready to warn the road users and people when the flood water reaches the freeboard design level. Many sections of road in the flood basin are considering as evacuate place for the animals and people from the villages nearby. MPWT shall and is ready to warn the transporters of possibility to disrupt traffic or minimize the loading traffic by heavy trucks for high risk and high safety. Boats are also valuable mean for rescue activities during flood.

Mr. Keophilavanh Aphaylath from Lao PDR introduced the existing flood forecasting system in Lao PDR, which is coordinated with the Mekong River Commission (MRC). The real-time information (water level and rainfall data) includes data from five key hydrological and meteorological stations in Thailand, and five key hydrological and meteorological stations in Lao PDR to transmit flood information by radio or facsimile to the MRC Secretariat daily at 17 00 hours or, during peak periods twice daily, at 11 00 and 17 00 hours. Normally, the forecast is issued five days in advance. The death toll in Lao PDR is very small or none existing but economic damage to agriculture in particular is still very high.

Ms. Rebecca Trazo Garsuta from the Philippines emphasize that the Disaster mitigation program in The Philippines include both proactive and reactive responses are adopted. As proactive measures, communities undertake exercise and evacuation drills along many awareness campaign and volunteer team actions. As damage mitigation measures, the local communities issue guidelines on safety measures such as suspension of school classes) as well as local ordinances to use calamity fund. Much legislation for water disaster mitigation are continuously formulated by the Government.

Mr. Akkapong Boonmash from Thailand introduced the current flood conditions in the country and the concurrent impacts afflicting the country on a yearly basis. Flooding in

Thailand occur in average 10 times/year. The inundated land is about 32% of the total. Every year more than 100 people die due to flood and more 16 thousand people are affected. The average damage is as high as 4,094 million Baht. Disaster preparedness in Thailand is conducted as part of the country's civil defence management, which is comprised of three levels: National Level (the Department of Disaster Prevention and Mitigation (DPM) is the principal government agency responsible for formulating policy on disaster management and prevention), Provincial Level (the Provincial Governor is designated as Director of Provincial Civil Defence) and Local Level (the Mayor is concurrently the Municipal Civil Defence)

Mr. Nguyen Xuan Hien from Vietnam emphasized that flood forecasting in the Mekong delta is not an easy task. Thailand has tried to carry out the long-term flood forecasting (month, season), medium-term flood forecasting (10-15 days) and short-term flood forecasting (3 to 7 days). The results show that short-term flood forecasting is enough accuracy and the others are only for reference. In Vietnam we found that most of the death people were children. As a response the government establishes the child care houses during the flood season. The statistical data clearly shows that the current efforts have resulted in net decrease in the number of death. For instance the 2000 floods killed 448 people, in 2001 floods 412 people, in 2002 floods 170 people, in 2003 floods 85 people and in 2004 floods 42 people.

The second period of the half day workshop was free-flowing discussion to evaluate the practical significance and limitation of flood forecast and warning systems for saving loss of life as a part of a holistic flood management framework highlighting the importance to implement systematic analysis of the cause of death and the added value of sharing roles, lessons and experiences. The outcome of the discussion that was simultaneously recoded and presented at the closing of the session by Dr. Tarek Merabtene was circulated among all participants for review and final feedback. The findings and outcomes of the special session are reported at the end of this summary.

General Outcomes and Recommendations from the Session

Outcomes and Reflections from the Session

The Special Session was a unique opportunity to discuss the actual state (i.e., effectiveness and limitations) of flood forecasting and warning systems in our region. The knowledge shared clearly shows that there is a need to undertake intensive research and capacity building programmes to achieve our ultimate goal behind flood forecasting and warning systems, that is to reduce the loss of life.

The global trend of the number of flood disasters has been continuously increasing. The international figure shows that floods kill about 5000 people in average (See Figure 1) and affect more than hundreds million people every year (see Figure 2). In order to derive concrete conclusions from this global disastrous picture and advance our policies in flood mitigation it is important to segregate the real causes of death during any flood events.

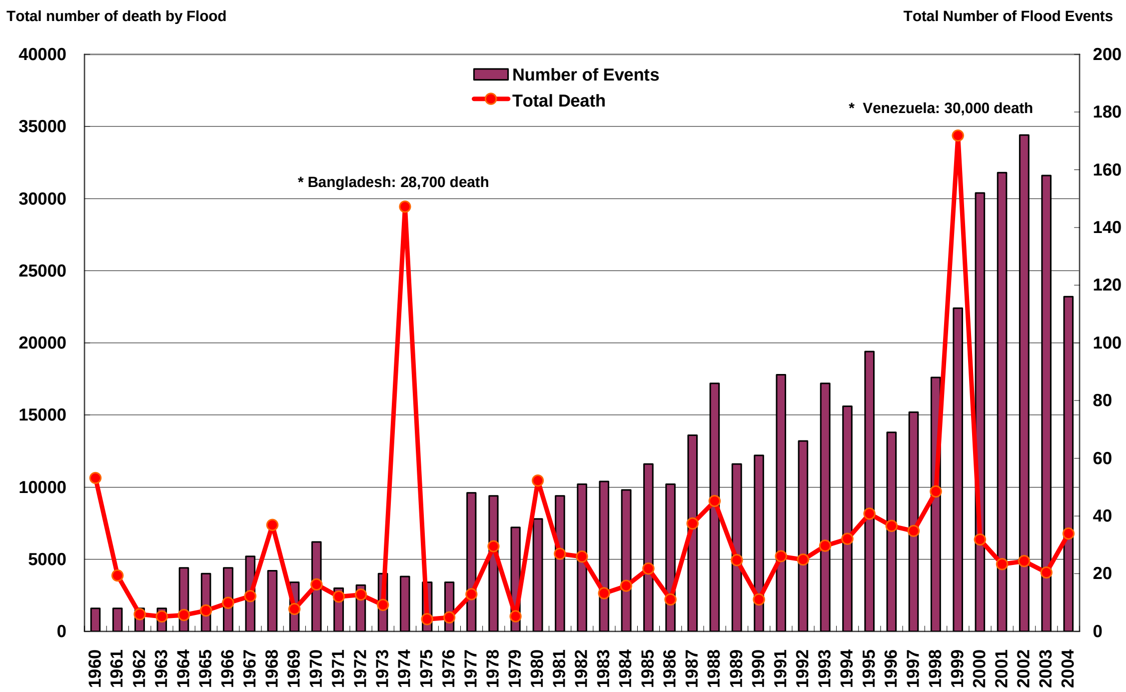


Figure 1. Trend of killed people by flood worldwide. Source CRED/EMDAT database.

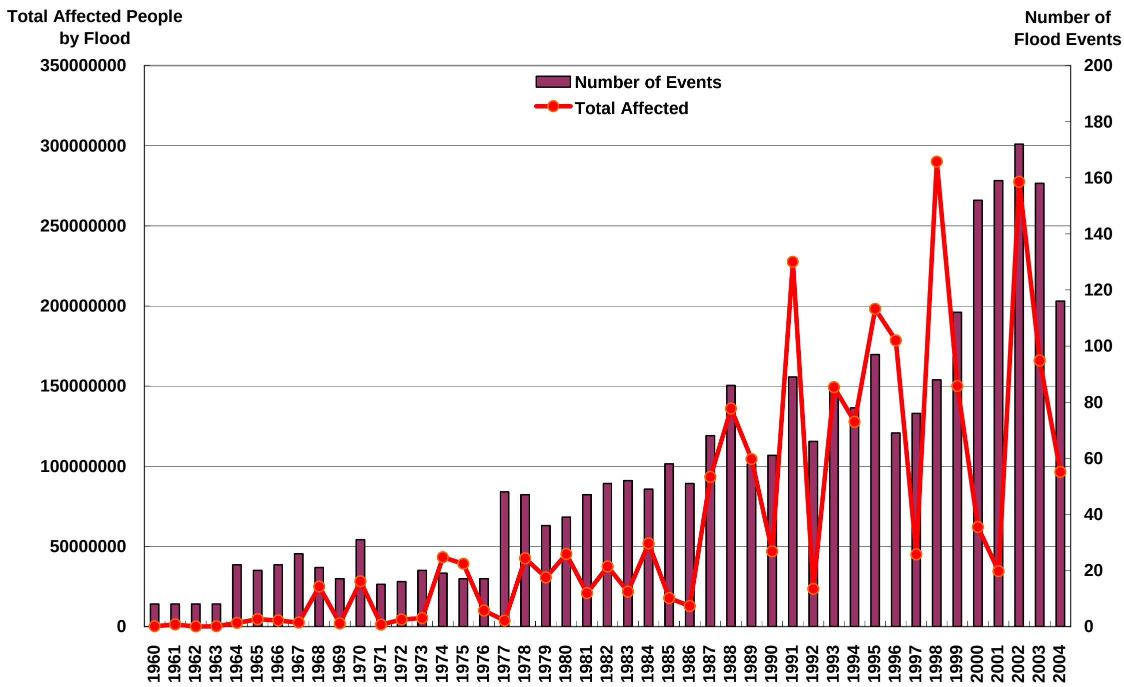


Figure 2. Trend of affected people by flood worldwide. Source CRED/EMDAT database.

The outcomes of the discussion outlined the following items:

- While governments have the responsibility to develop flood forecasting and warning systems, it is the responsibility of the community and citizens to initiate and take proactive measures to safe their lives. For instance, refusal of early evacuation by citizens has proved to increase difficulties to mobilize enough facilities such helicopters and boats for rescue operation.
- The issue of why people do not respond to warning is still questionable. In many areas poverty and lack of safety are some prevailing reasons. Nevertheless, in many cases the real reasons are still needed to be identified. In this regard undertaking case basis analysis is an important mean to improve the utilization of the existing warning systems.
- In Japan recent problems such as death of old people had put forward the issue of evacuation system and evacuation order and directive for elderly people.
- Disaster from small scale rivers, where no flood forecasting and warning system exist, should be carefully considered. The recent floods in many countries including Japan are increasingly suffering flood hazards from small rivers.
- During flood event, car’s traffic control is an important issue to be retaken under discussion.
- Sharing good practices and examples for safe evacuation: Good practices such as the case of the flood fighting in Kochi Prefecture, Japan, must be promoted and analyzed to draw lessons for the future. In this case “community flood fighting”, “smooth communication between citizens” and “mutual support between individual” have highly demarcated the event.

- Another outstanding practice is the initiative of the government of Vietnam to create “child care centers” during the flood season in aim to reduce the loss of life among children.
- Evacuation systems are proven to be as important as warning system. In many cases, precious human lives have not been saved because of the lack of proper evacuation systems hampered by the poor social and security conditions as well as the lack of warning systems.
- For instance, the flood water level in the Mekong Delta rises very slowly and thus it questionable to be considered as the direct cause of death. Further investigation based on actual flood hazard situation is required to understand the real impediment to ensure smooth and safe evacuation.
- Analysis of the real causes of death for every flood disaster is recognized to be a very important issue to accurately assess the reliability and effectiveness of FFWS.
- The mechanism of the flow of information concerning flood warning is proven to be different among countries. Efficient of each mechanism if well documented is foreseen to improve our global view for implementation of flood warnings.
- In major rural area the main limitation for effective warning is the lack of the perception of information. For instance, farmers have a very poor or even absent knowledge to understand forecasting and warning information.
- There is an emerging need to establish accurate database for global analysis of flood disasters in order to draw robust indicators to assess the effectiveness of adopted counter measures.
- Rescue of animals during flood hazard is also a major concern in many rural and agriculture areas. For instance, many people are using their private boat, mostly made of timber, as mean to rescue their property. There are witnessed cases of people drawn because they also tend to rescue their valuable animal resources. Other cause of death is sudden biting by wild animals such as by snake, absence of high spot, submergence of occupied vehicles, etc.
- Strengthening of the international collaboration for technical support, data and information exchange, sharing knowledge base and experiences on flood forecasting and warning is very important and indispensable more then ever before..
- The FFWS are limited in many of our countries due to limited rain gauges.
- The efficiency of measurement stations was brought forward by the case of Mumbai flood where two meteorological stations recorded different precipitation.
- Practical case study, such as in the case of the localized rain in Mumbai, has proven that even with higher resolution system it would be difficult to make accurate flood forecast. Therefore, forecasting of flash floods due to localized rain is another important issue to research.
- The preparation of manuals and warning information in local languages, such as practiced in The Philippines, is a leading initiative for efficient risk communication to local residents.
- People in remote area are not connected to media, therefore indigenous approaches and communication means are also valuable information that we need to survey and document properly.

Ⅸ-1　Program

The 14th Conference on Public Works Research and Development in Asia

The 14th International Symposium on National Land Development and Civil Engineering in Asia

Flood, Sediment and Tsunami Related Disasters in Asia

Thursday October 27, 2005
13:10 - 17:00

Sendai International Center

National Institute for Land and Infrastructure Management (NILIM)
Ministry of Land, Infrastructure and Transport (MLIT)
JAPAN

〔Contents〕

13:10–13:20	Opening Address	Mr. Tsuneyoshi MOCHIZUKI Director General, NILIM, MLIT
	Guest Address	Mr. Michio TANAHASHI (for Mr. Masato SEIJI, Vice Minister for Engineering Affairs, MLIT)
	Overseas Participant's Address	Mr. Nguyen Xuan Hien from Vietnam
13:20–14:20	Keynote Speech	

"Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami"

Prof. Fumihiko IMAMURA
Professor, Disaster Control Research Center,
Graduate School of Engineering, TOHOKU UNIVERSITY

**The earthquake of M9.0 took place on December 26, 2004, followed by the oceanic tsunami affecting all coast in the Indian Ocean. The number of casualties in the ocean exceeds 200,000. We carried out the field survey and numerical analysis to clarify the mechanism of the source and damage in the suffered areas. The video and satellite information are also compiled to have the lesson*

14:20–14:30	Case of Japan Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM	
14:30–14:45	Case of Tohoku District Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau, MLIT	
14:45–15:00	Case of Korea Dr. Chang Wan KIM Research Fellow, Korea Institute of Construction Technology	
15:00–15:15	Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO Mr. Akira TERAKAWA Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute	
15:15–15:35	Break	
15:35–16:55	**Panel Discussion** **"Flood, Sediment and Tsunami Related Disasters in Asia"** 〔Chair: Mr. Ryosuke TSUNAKI, Director, Research Center for Disaster Risk Management〕	

〈PANELISTS〉

1. Prof. Fumihiko IMAMURA	Professor, Disaster Control Research Center, Graduate School of Engineering, TOHOKU UNIVERSITY
2. Mr. Tsuneyoshi MOCHIZUKI	Director General, NILIM
3. Mr. Masaharu SHINOHARA	Director, River Department, Tohoku Regional Bureau
4. Dr. Bunna YIT	Director, Public Works Research Center, Ministry of Public Works and Transport, Kingdom of Cambodia
5. Mr. Janak Jerambhai SIYANI	Chief Engineer (R&B) & Add Secretary, Roads & Buildings Department, Government of Gujarat, India
6. Dr. Chang Was KIM	Research Fellow, Water Resources Research Department, Korea Institute of Construction Technology, Republic of Korea
7. Mr. Keophilavanh APHAYLATH	Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic
8. Ms. Rebecca Trazo GARSUTA	Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH) Republic of the Philippines
9. Mr. Akkapong BOONMASH	Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Kingdom of Thailand
10. Mr. NGUYEN Xuan Hien	Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development, Socialist Republic of Viet Nam

16:55–17:00	Closing Address	Mr. Shin-ichiro TANAKA (for Mr. Norio MORINAGAI, Director General, Tohoku Regional Bureau, MLIT)

17:30-19:00	Reception hosted by Vice Minister for Engineering Affairs, MLIT

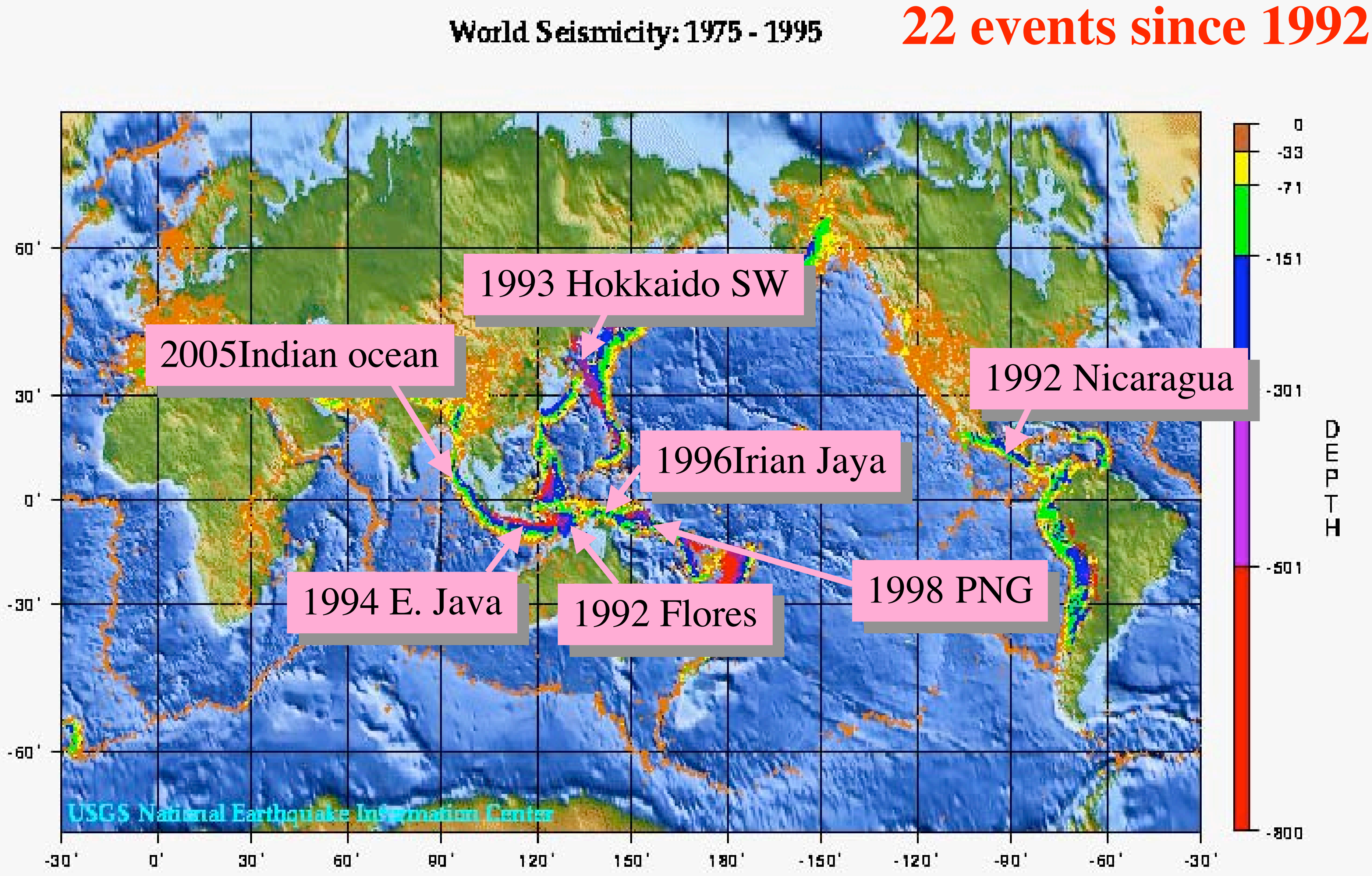
Global disaster; Lessons from the 2004 Sumatra Eq. and Indian ocean tsunami

F.Imamura
Prof. Tsunami Eng, DCRC, Tohoku Univ.

- Recent tsunamis in Asia and Pacific regions
- 1993 Okushiri in Hokkaido, Japan
- 1998 Aitape in PNG
- 2004 Sumatra Eq. And Indian Ocean Tsunami
  - Damage in SW coast in Sri Lanka
  - Damage at Banda Aceh in Indonesia
- Community based workshop to make regional hazards map

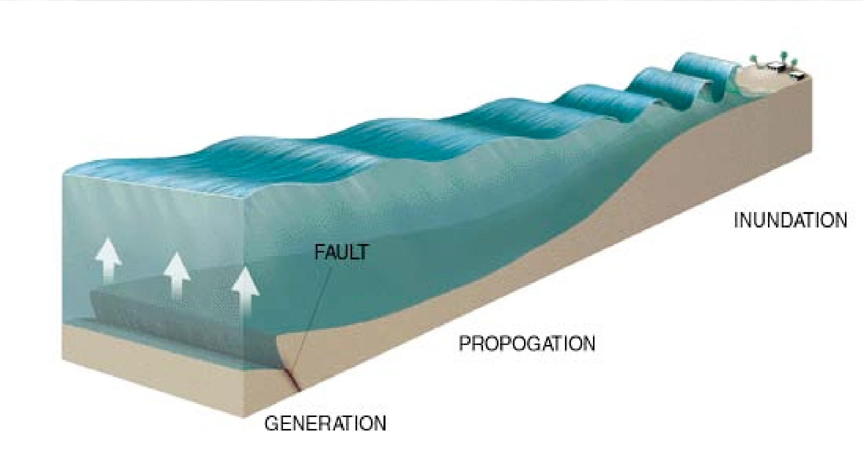
DCRC TSUNAMI ENGINEERING

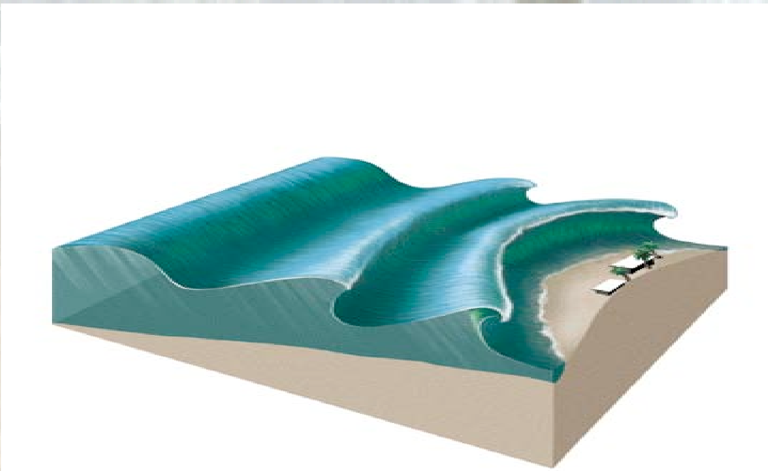
Recent Major Tsunami Disasters



Tsunami Wave System

- Generation
  - A seafloor disturbance, such as motion along a fault, pushes up and down the overlying water.
- Propagation
  - The wave propagates across the deep ocean at jetliner speeds
  - Shoaling and refraction to amplify the wave
- Inundation
  - As the wave moves into shallower water, increased energy density increases both the wave height and the currents.
  - Runup on a land and run-down





1993 Hokkaido SW, Multiple Disaster

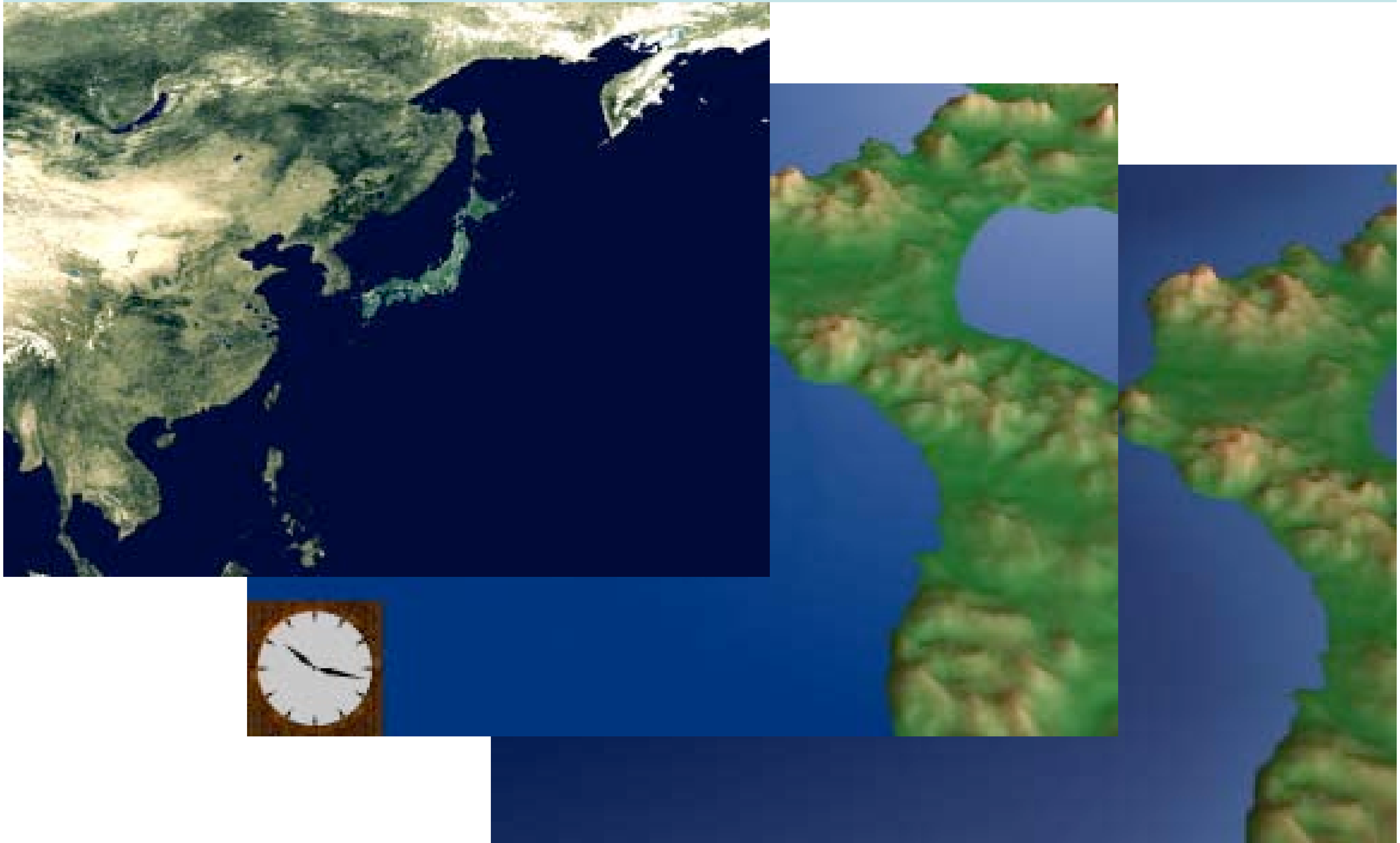
1. Earthquake

2. Tsunami

3. Fires

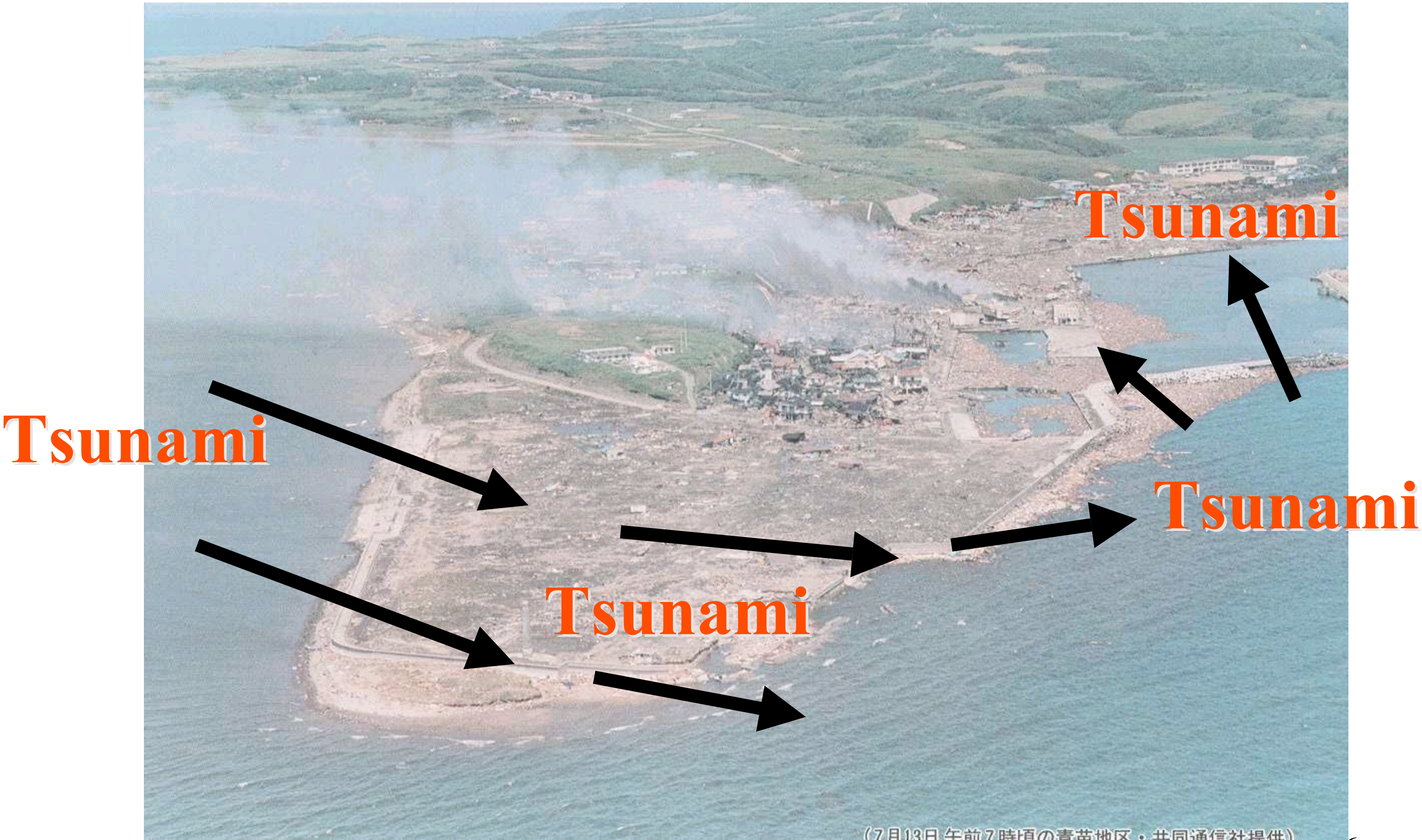
- 12 July 1993
- Magnitude of the earthquake: M 7.8
- Maximum wave height: 31m
- Fatalities: 239 (198 in Okushiri)
- Fire and landslide as secondary disaster
- Tsunami arrival: 2 - 3 minutes(Inaho)
  5 minutes (Aonae)

1993 Hokkaido SW Tsunami



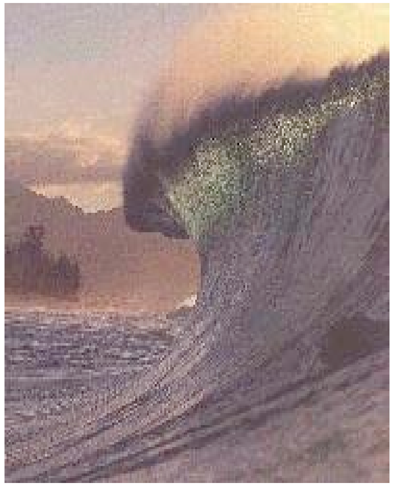
Aonae District, Okushiri Is.

Tsunami and fires devastated this fishermen's town.



At 7 am 13 July 1993, Kyodo

PNG Tsunami Awareness Pamphlet/Booklet Project



17 July 1998

Magnitude of the earthquake:

M 7.1

Maximum wave height: 15m

Fatalities: more than 2,200
cause: earthquake.

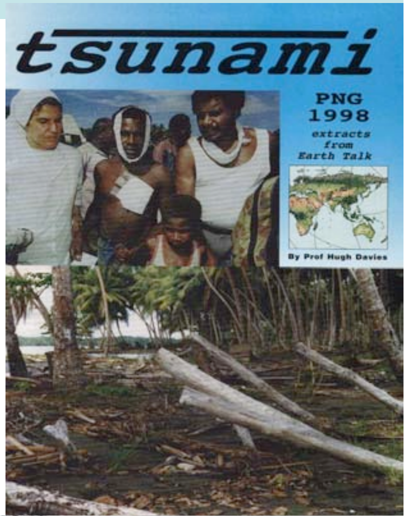
In addition, submarine landslide?

Why Such Disaster?

- **Aitape at PNG was attacked by the tsunami in 1907 and by the earthquake in 1935.**
- **The past disaster experiences had not been transferred to the present generations sufficiently.**
- **People did not know what to do when they felt strong ground motion.**
- **People lived on the low-lying areas without knowing such risk. No place for evacuation.**

Awareness with experts

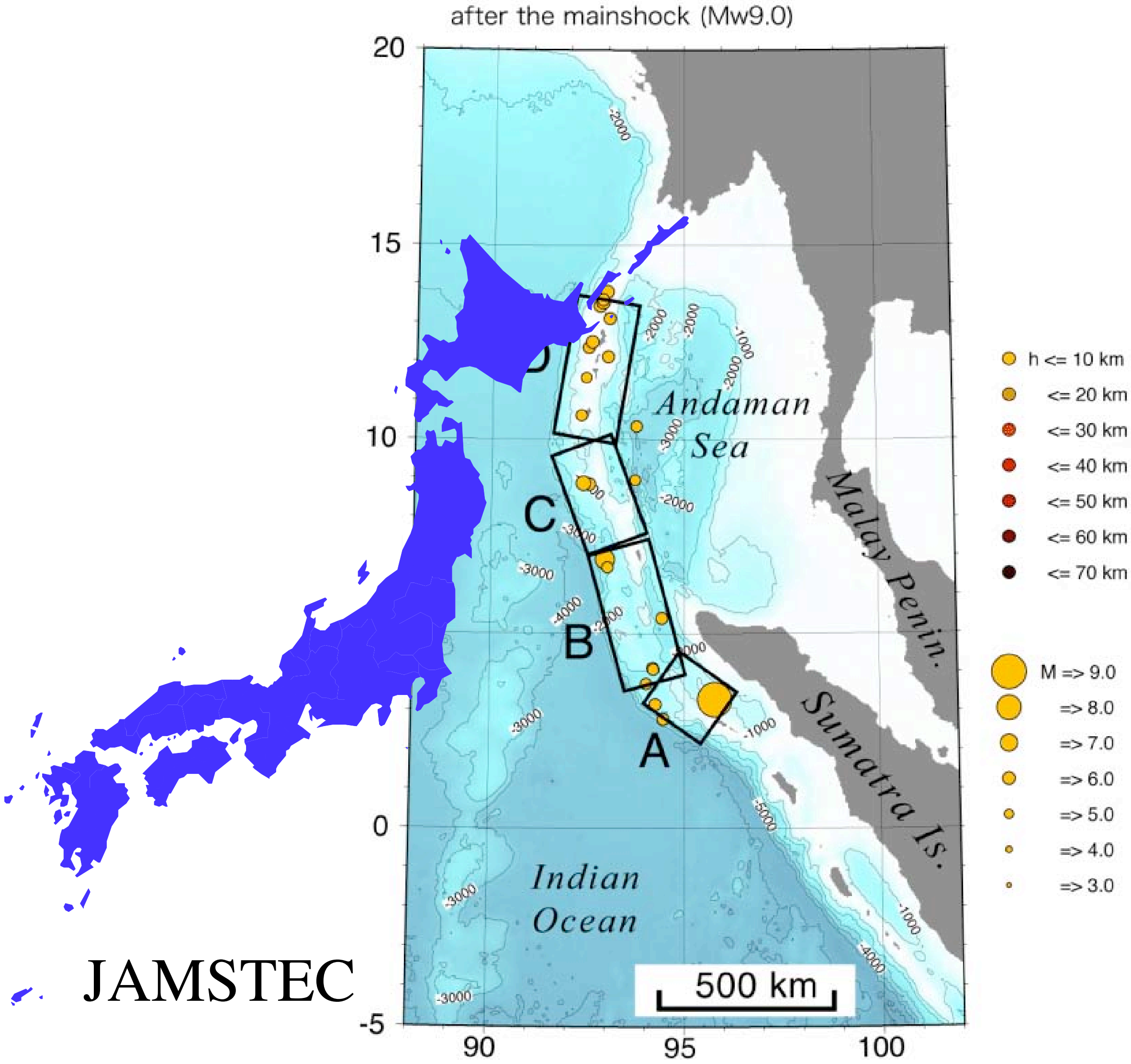
- **Booklet "Tsunami PNG 1998", ADC**
- **Tsunami awareness pamphlet/booklet/video**
- **All PNG children have learned about tsunamis at schools**



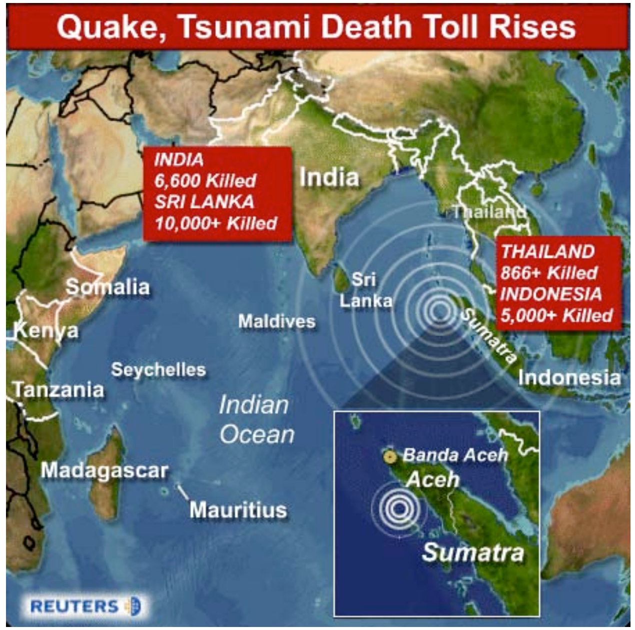
PARTIC (PNG and Region Tsunami Conference) Sep. 1999

1. **Public Awareness to visit the areas, talk with the people**
2. **Tsunami Science Information**
3. **Disaster Management**

2004 Sumatra Earthquake M=9.0 & Indian ocean tsunami



JAMSTEC

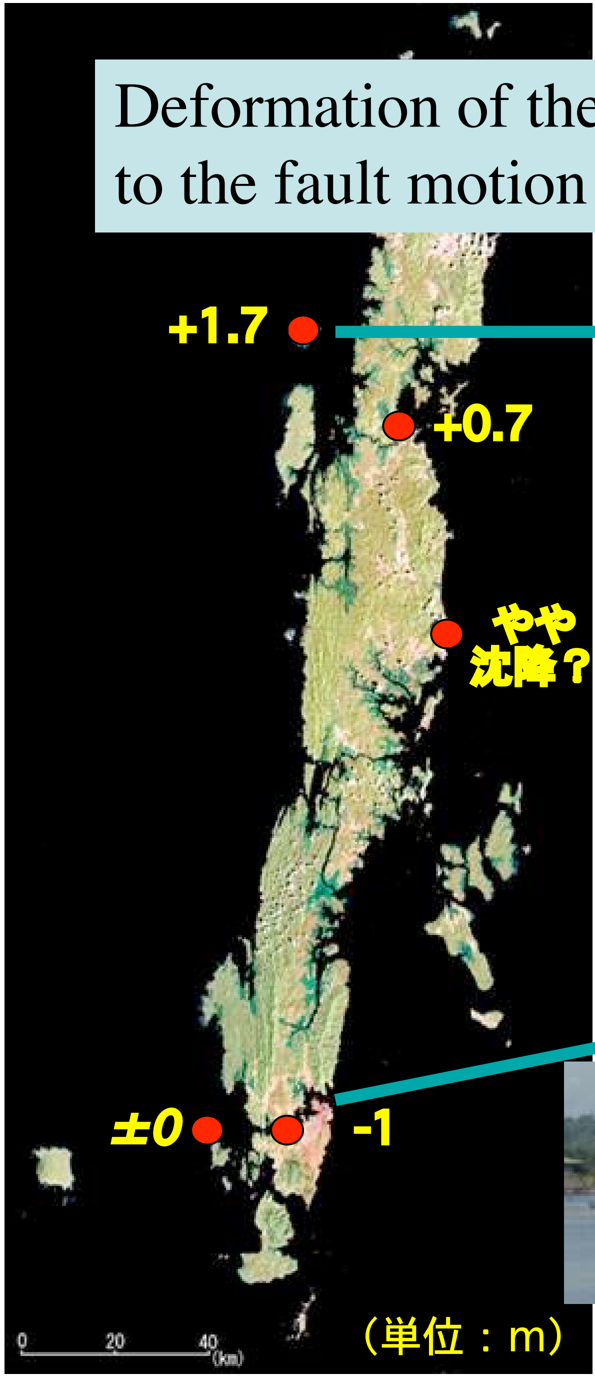


Earthquake & Tsunami generation, Propagation

アンダマン諸島における地殻変動（暫定値）

Deformation of the sea floor and land due to the fault motion

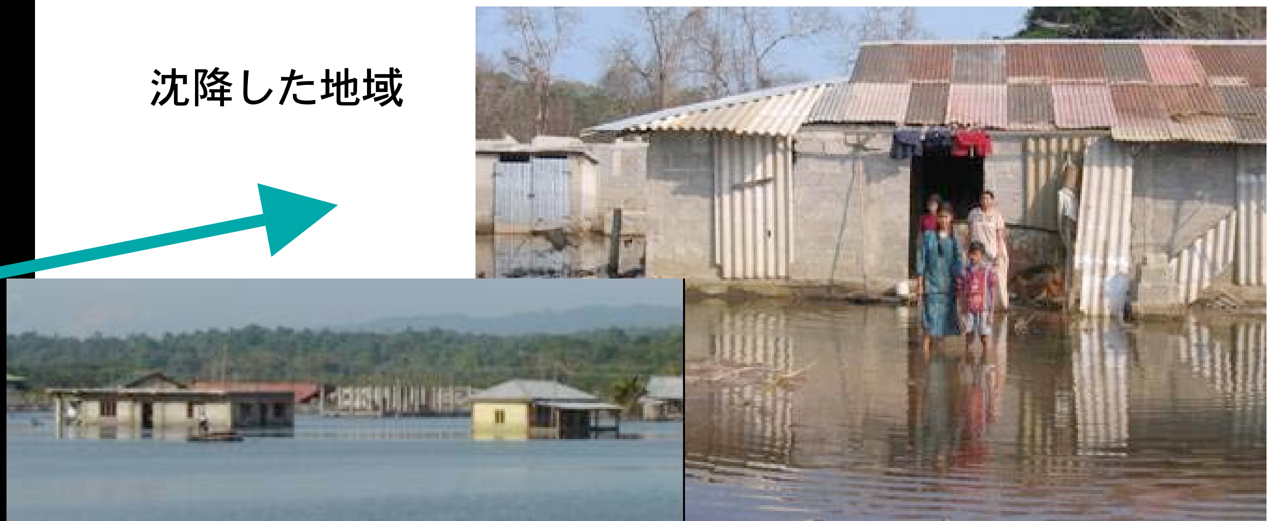
東京大学・産総研



隆起した地域

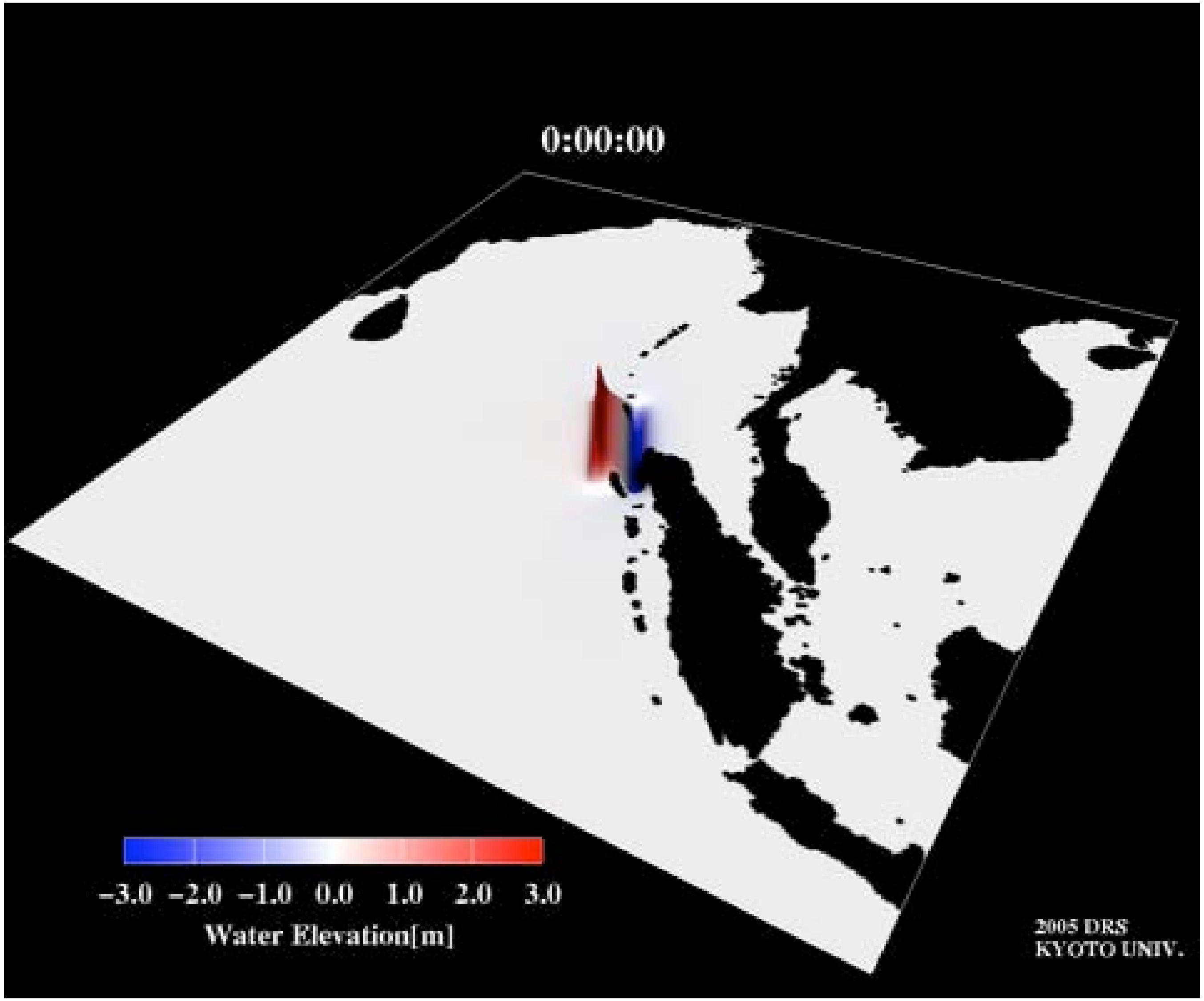
地震隆起によって離水し，一斉に死滅した各種のサンゴ群体.
北アンダマン島西方 North Reef.

沈降した地域

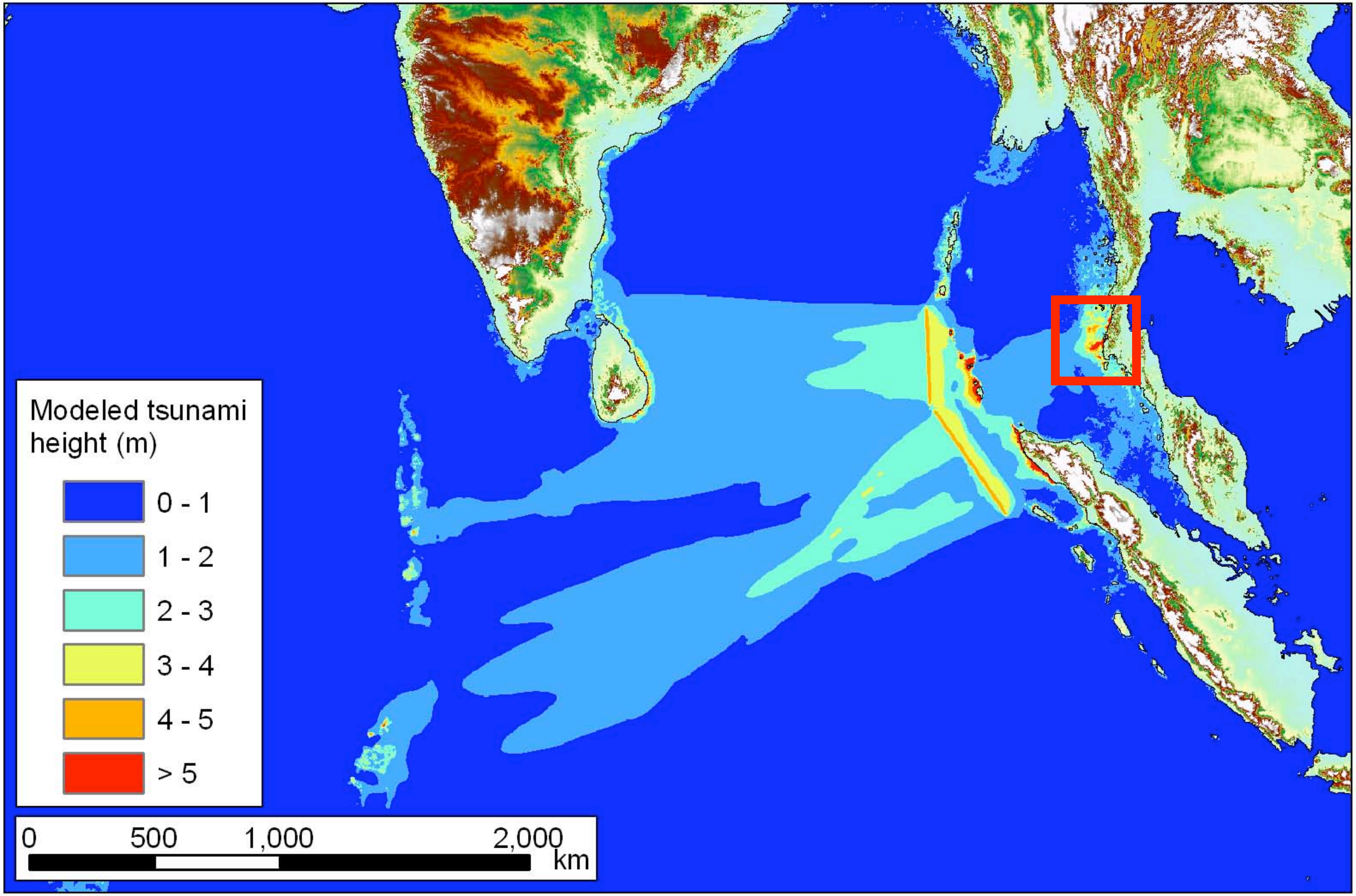


沈降のため，満潮時には家屋床上まで浸水する．南アンダマン島 Wandoor付近.

The 2004 Tsunami Generation and Propagation By DPRI, Kyoto Univ.



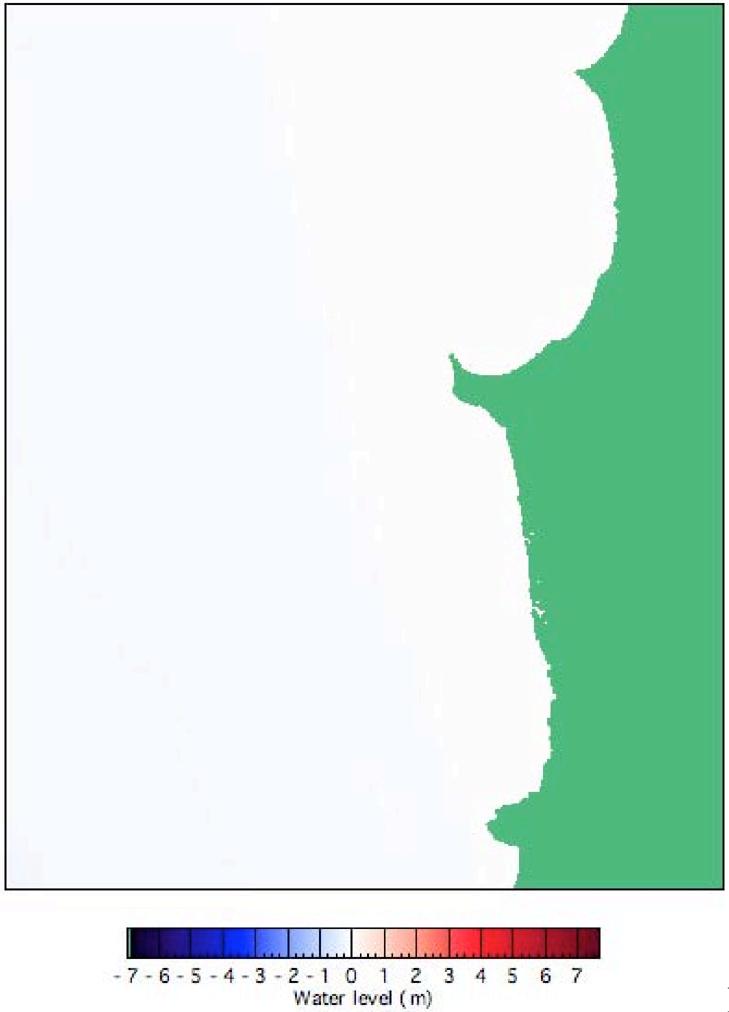
Tsunami Energy from source



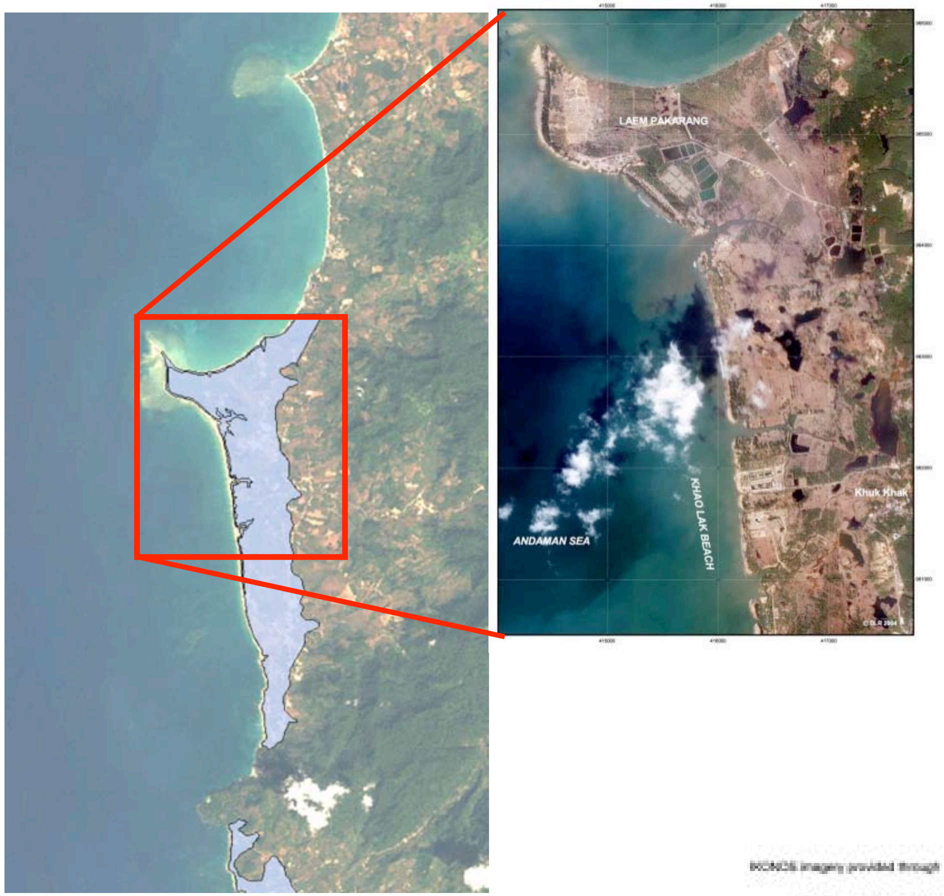
Tsunami Model : Thailand,Khao Lak north

With the cooperation of Dr.Anat, Chula Univ.

Model



Field Survey **Satellite Imagery**



Extent of inundation zone

F.Imamura, DRCR

IKONOS imagery provided through

Centre for Remote Imaging, Sensing and Processing (CRISP)

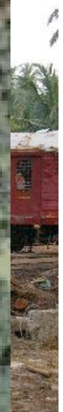
SPACE IMAGING

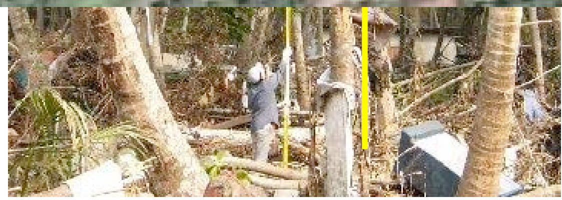
Newspaper on the damaged train by the tsunami


TRAPPED by the sea and river

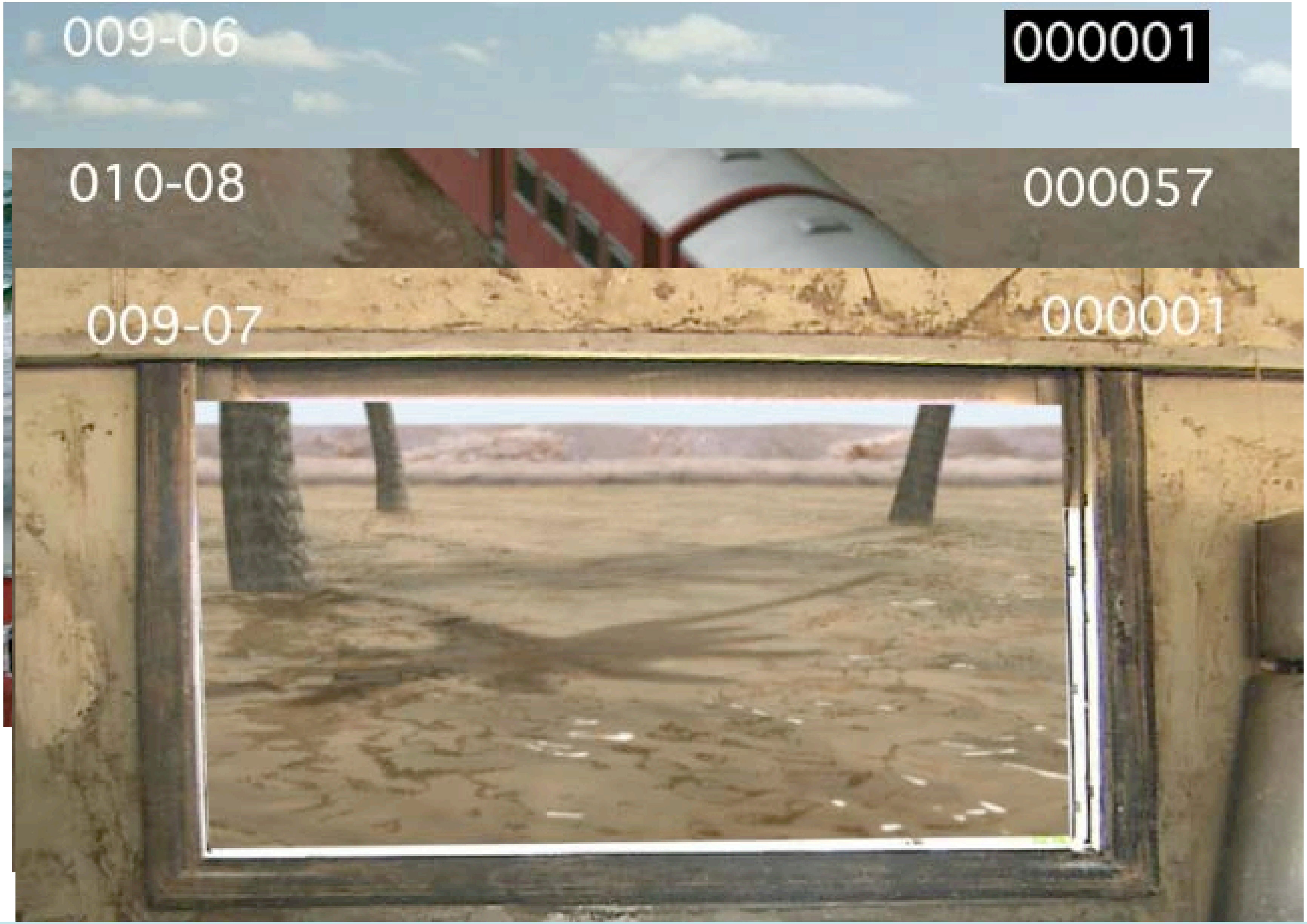
Stricken with fear, passengers of an ill-fated train had very little chance to survive Sri Lanka's worst-ever rail disaster


008-03
000000



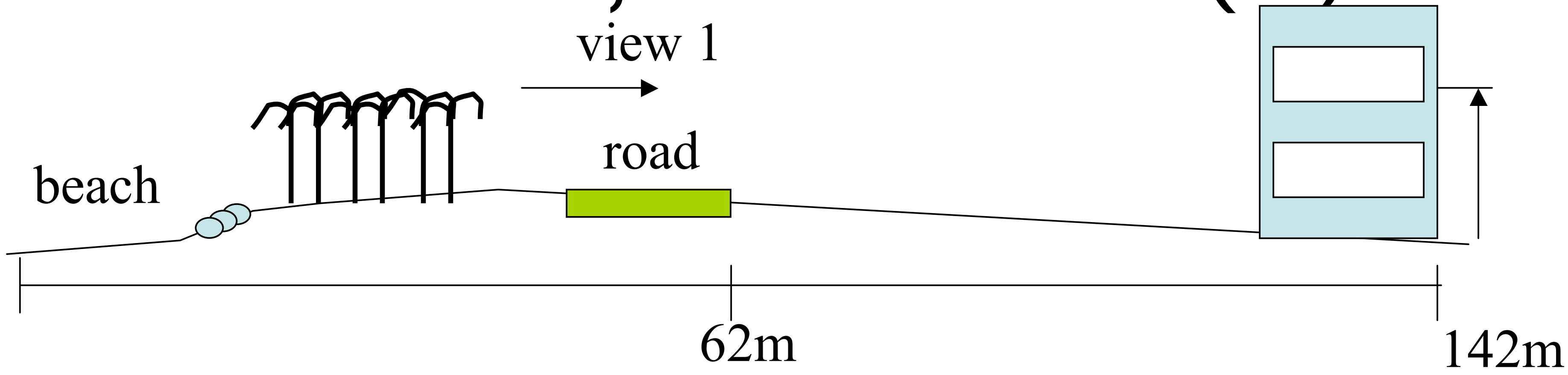


Hikkaduwa　列車事故の発生した場所

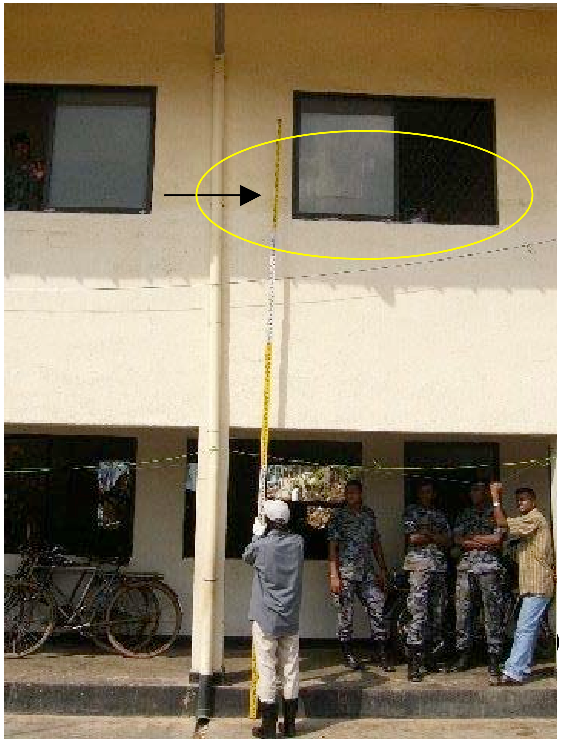


The Computer Graphic which is made for public awareness, cooperated by NHK, Japan

KAHAWA, Hikkaduwa (2)



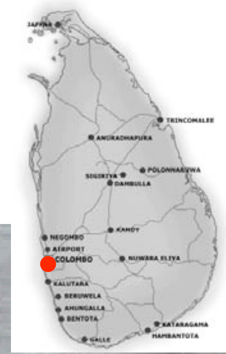
view 1



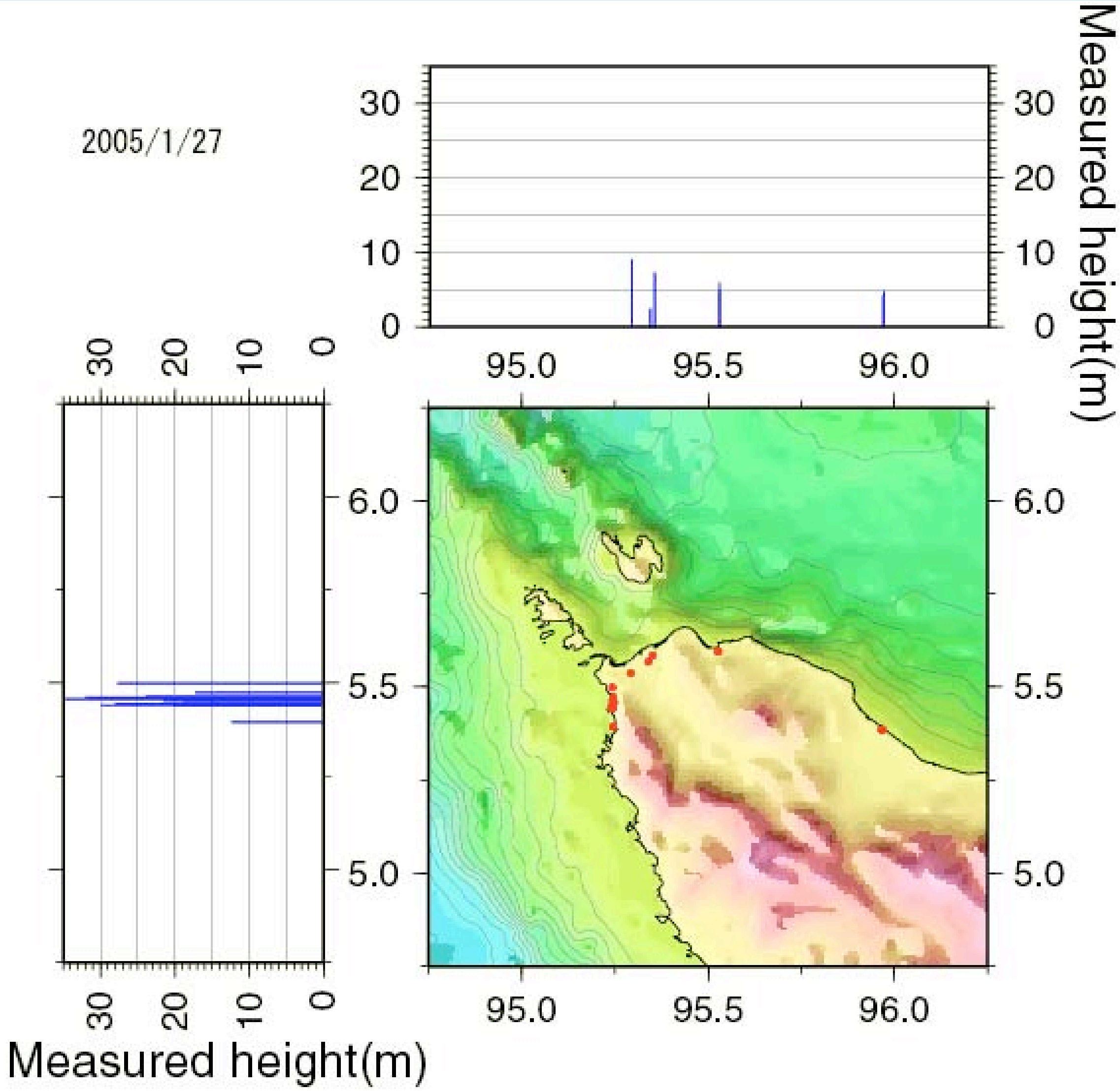
All houses at Kahawa were destroyed completely by the tsunami

Study on the effect of the green to reduce a tsunami impact
Criteria of building damage by including impact as well as its design, structure, material

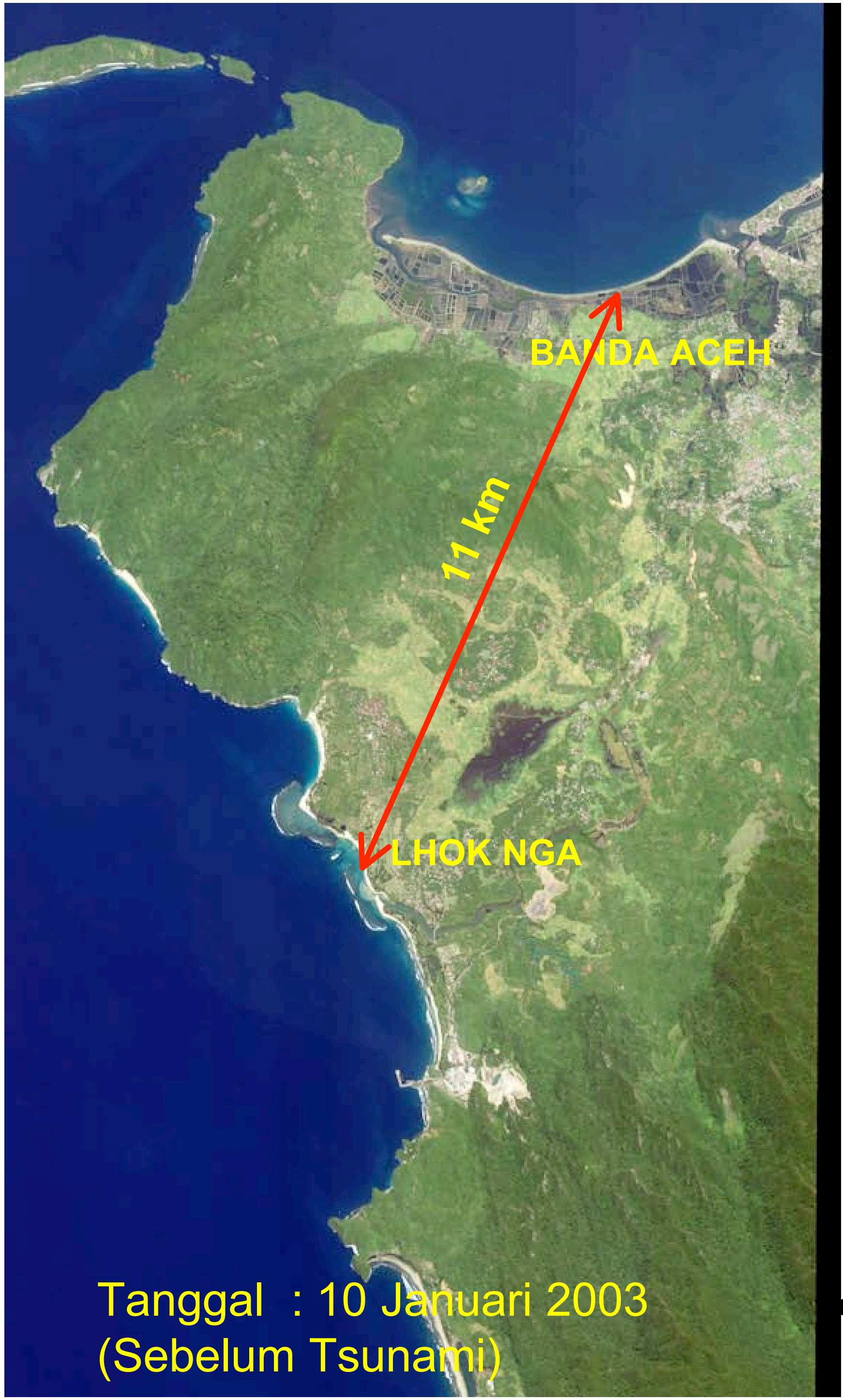
Moratuwa　モロツア,　　住宅の被害



インドネシア・バンダアチェ周辺での津波遡上高さ
Measured tsunami runups at Banda Aceh and surround



人工衛星データ(RADARSAT)


BANDA ACEH
11 km
LHOK NGA
Tanggal : 10 Januari 2003
(Sebelum Tsunami)


Arah Gempuran Tsunami
Gempuran tsunami
dari selatan dan utara
Hampir tembus
BANDA ACEH
LHOK NGA
Arah Gempuran Tsunami
Tanggal : 29 Desember 2004
(Sesudah Tsunami)


PLTD APUNG 1

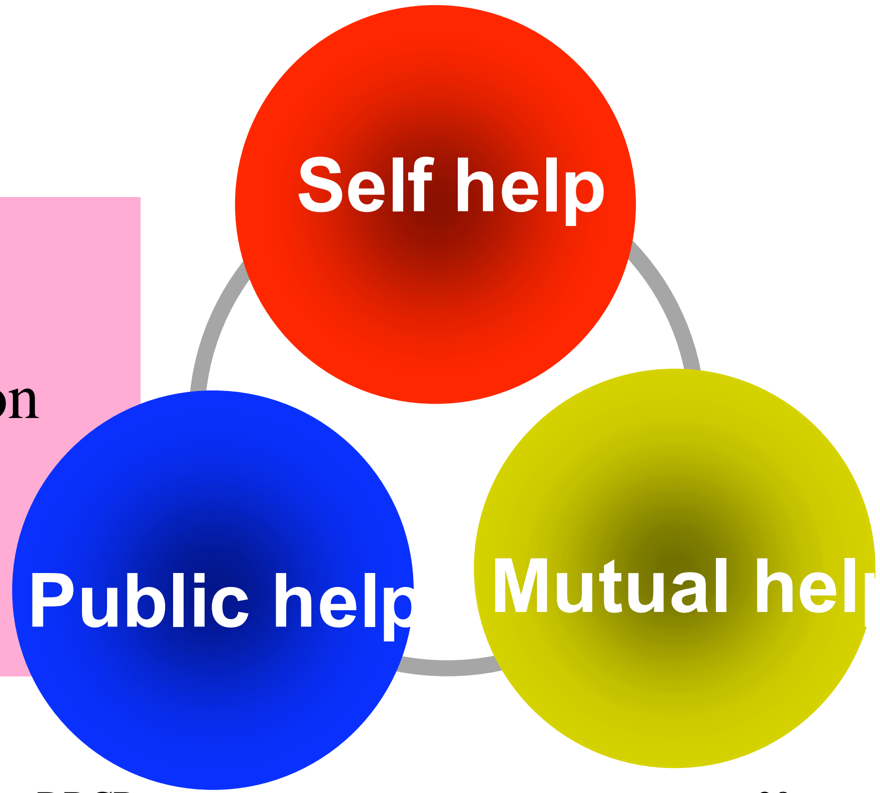
インドネシア，バンダアチェでの映像

To reduce damage and casualties

The "Three Helps" for disaster measures

One of lessons through 1995 Kobe earthquake

Tsunami warning
Facility to reduce impact
Risk evaluation and communication
Education system
Memorial Activity to remind experience



Response of the people on tsunami warning in Japan

Hazards map and WS
making HM with the residents

Powerful tool to increase the awareness;
Example of Hazards map with the image on GIS

Public awareness and education at Banda Aceh

- **Example Radio program on RRI**
- **Cooperated by the Syiah Kuala Univ. and JICA**
- **Started on 25 July 2005**
- **Every Saturday 10-11 AM**

Meeting at univ.

Program at RRI on 24 Sep

Lessons from 2004 Indian Ocean tsunami

- High activity of tsunamis at the period of 1992-Now
- Developing the monitoring and warning system with information technology and evacuation system
- Data base to compile the all data; runup, tidal records, visual record
- Criteria of house/infrastructure damage by adding design, structure, materials & green belt information
- Integrated disaster mitigation program for each region to mitigate tsunamis as well as typhoons, erosion and flood.
- International network for the community, education and Hazards map

Disaster Reduction and Risk Management Approach to Flood, Landslide, and Tsunami Problems in Japan

Tsuneyoshi Mochizuki

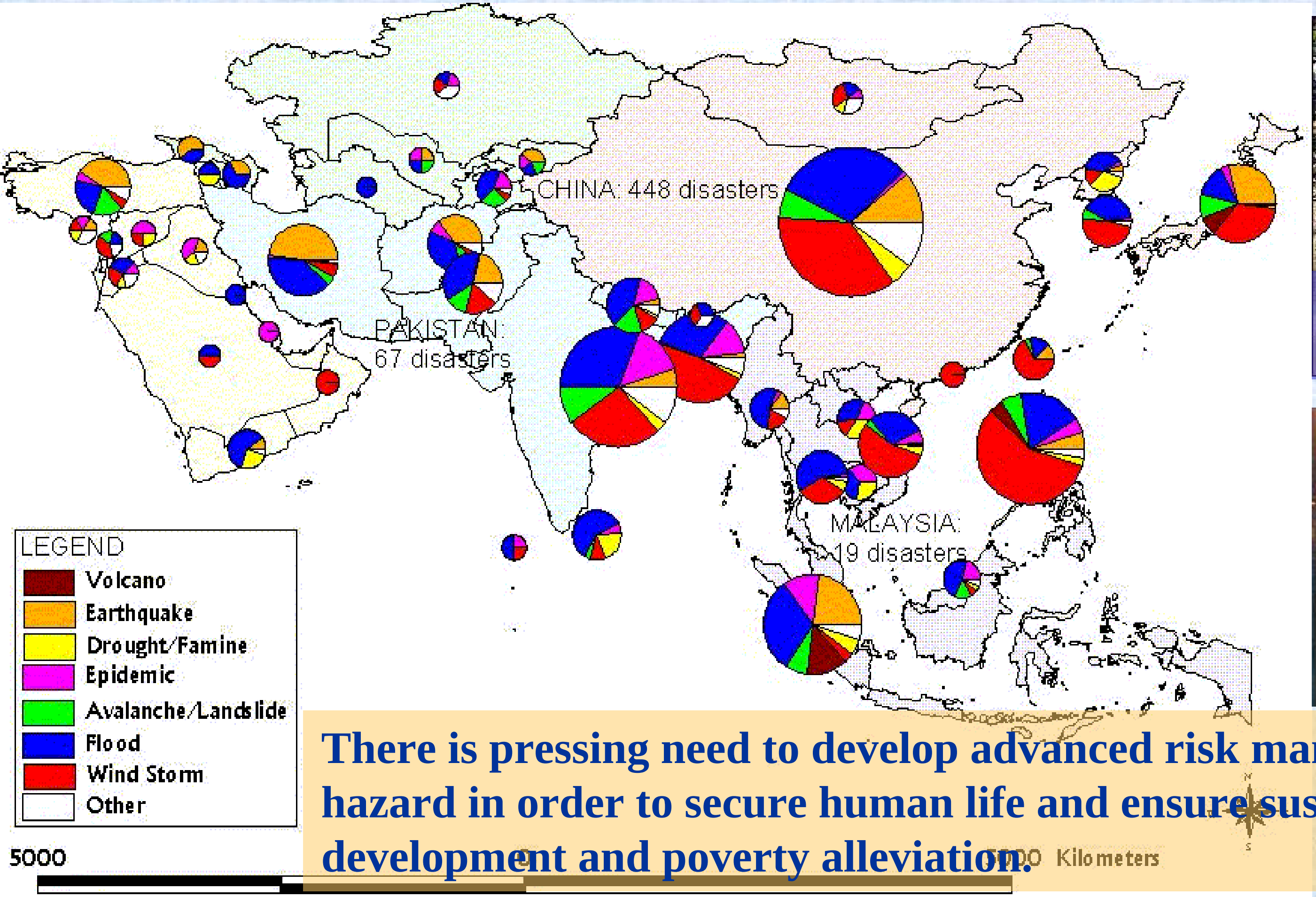
Director General

National Institute for Land and Infrastructure Management

27 Oct. 2005

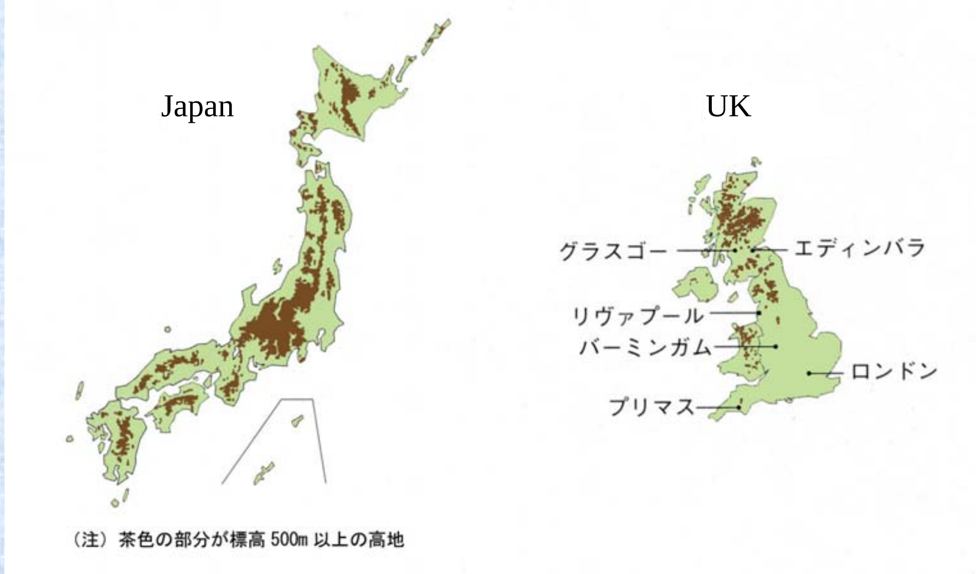
Asia Most Affected by Flood Disasters

People outlook to disasters! Can it make a difference

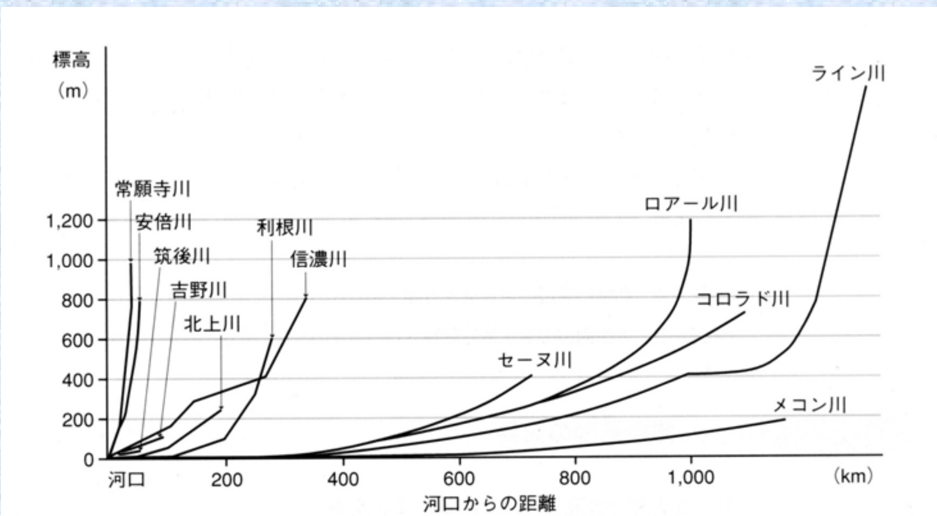


There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.

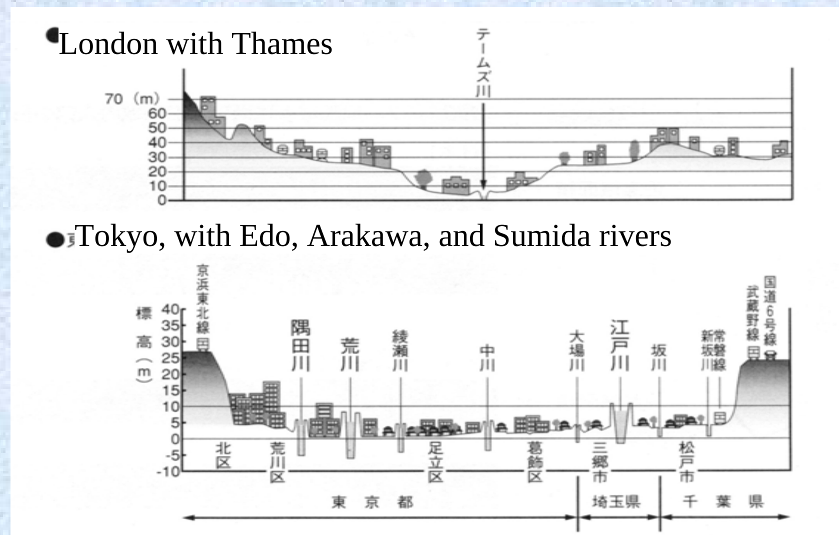
Geographical Features of Japan



Smaller area of level ground (as compared with UK)



Steeply sloping rivers (in terms of longitudinal slope)

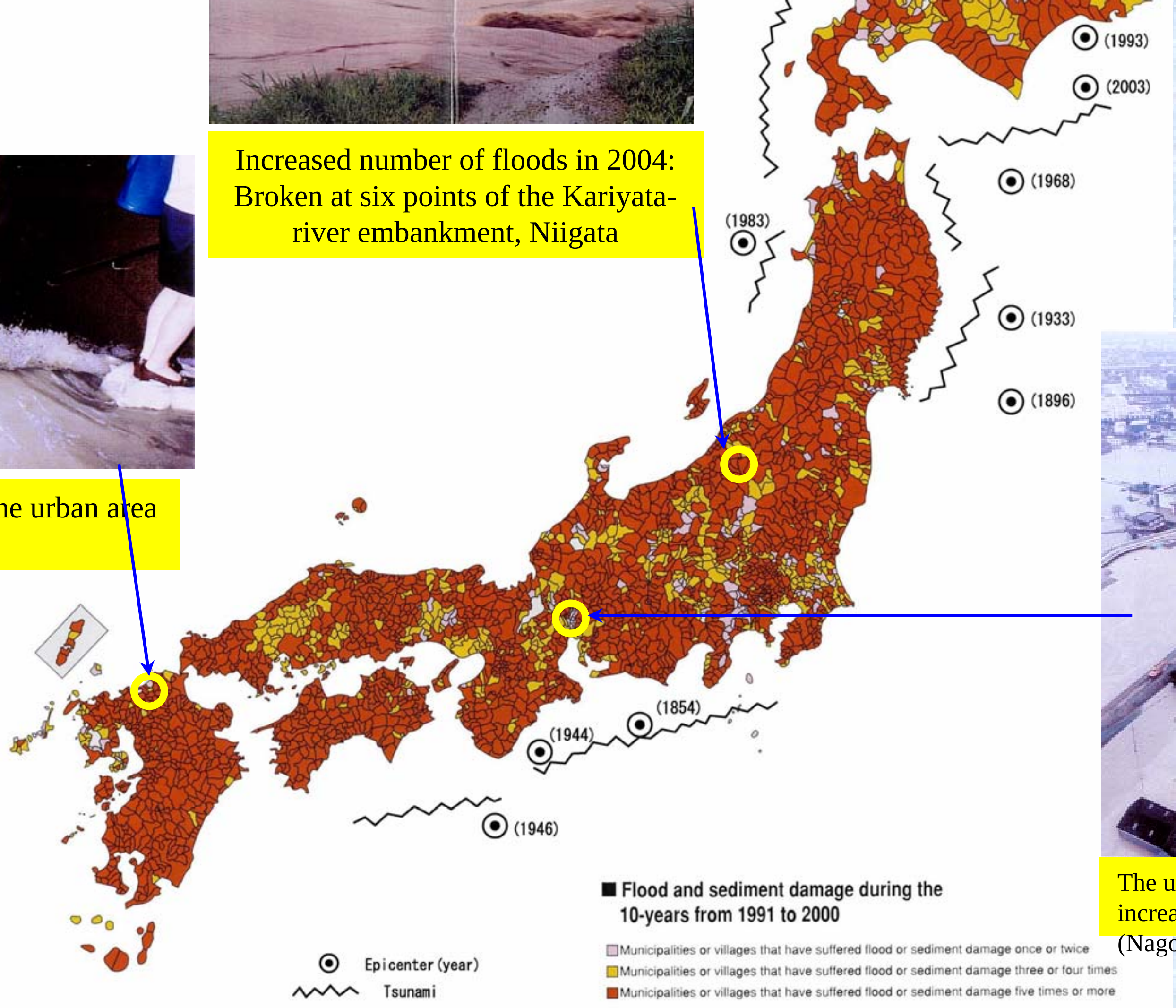


Concentration of population and properties in flood plains
(The ground levels in Tokyo and London)

Characteristics of Recent Flood Damages

Increased number of floods in 2004: Broken at six points of the Kariyata-river embankment, Niigata

Underground flood in the urban area (Fukuoka)



The urban flood disaster caused increased damage cost (Nagoya)

Overview and Characteristics of Flood Disasters

- The numbers of missing and dead and damaged houses have been reduced.

←Improvement of flood control system and weather information

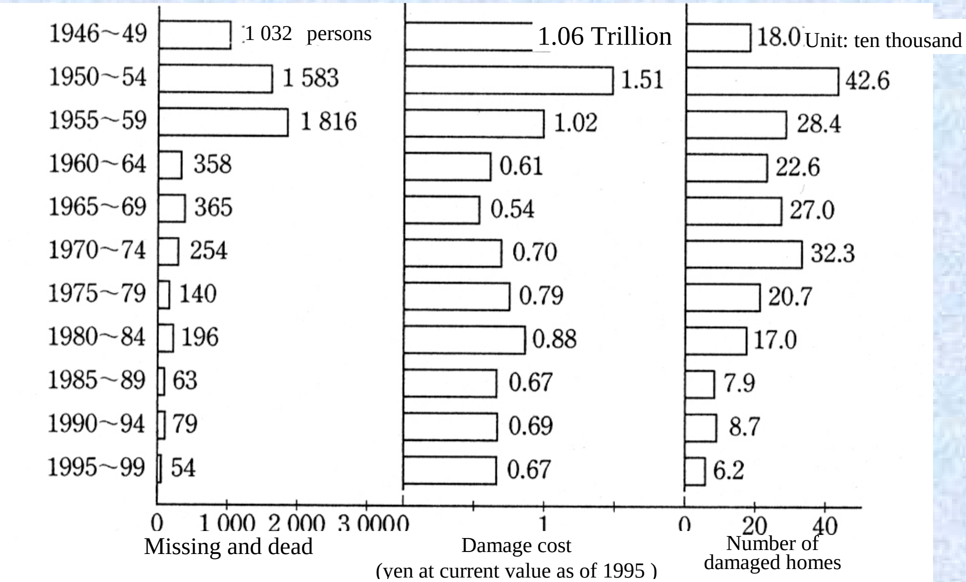
Rate of completed embankment: 38%(1976) →56%(2002)

The number of warning increased six-fold after the introduction of AMeDAS (in early 1970s).

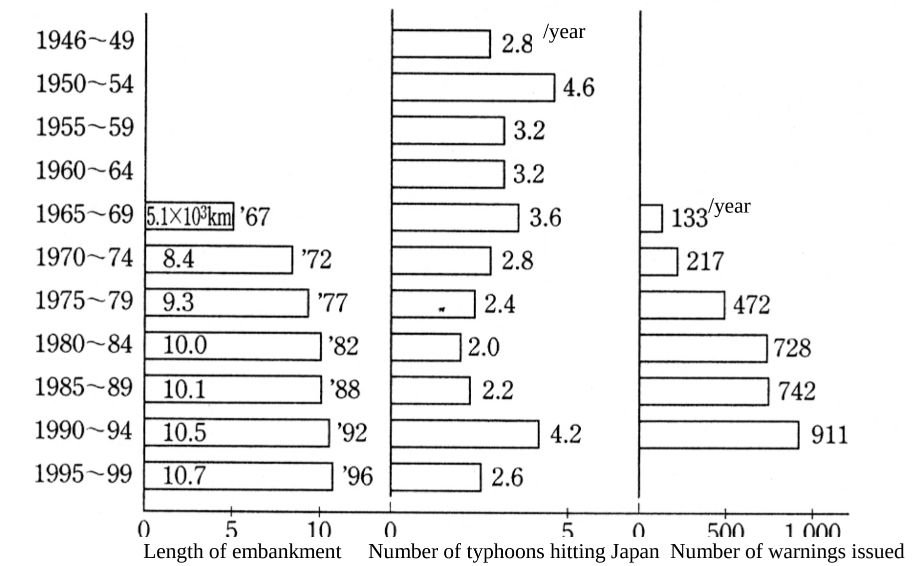
- The monetary amount of damages has remained flat.

←The area of submerged surface has decreased, but it tends to concentrate large and midsized cities.

＊The disaster victims realized that lifeline disruption has a large impact (accounting for 1% of the damages)



(1) Year-to-year changes in damages from flood disasters



(2) Factors contributing to flood disaster prevention

Lessons from and Mitigation Measures against Flood Disasters

Water running over or passing through the embankment.

→ Develop and improve embankment systems

Delay in collection and distribution of information

→ Put rain and water gauge systems in place, and improve the information transmission systems.

No guidelines on issuing evacuation advisories, or delay in issuing.

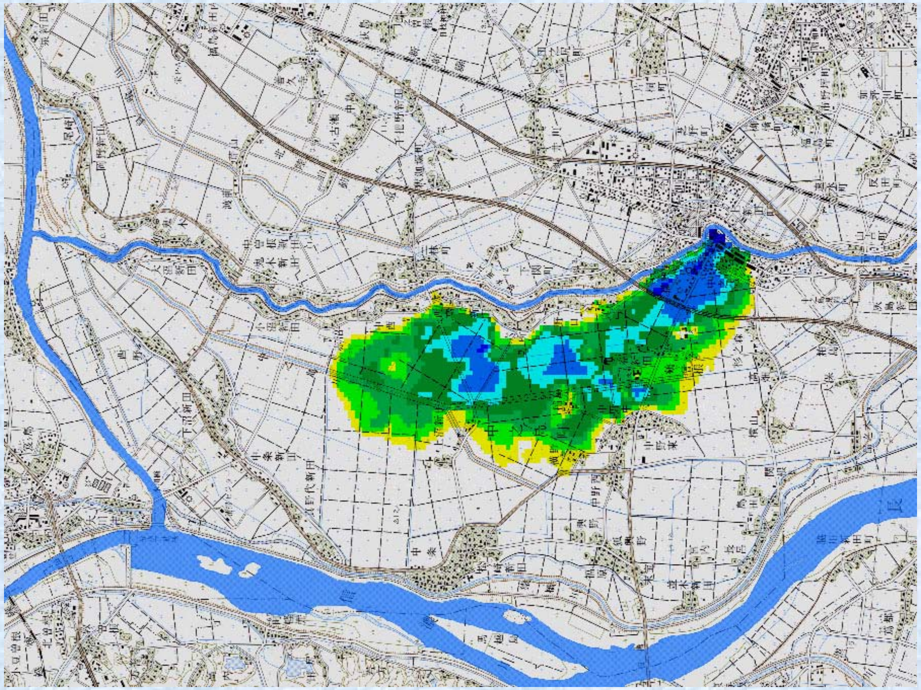
→ Establish the warning water levels allowing for the rising rate of flood water level.

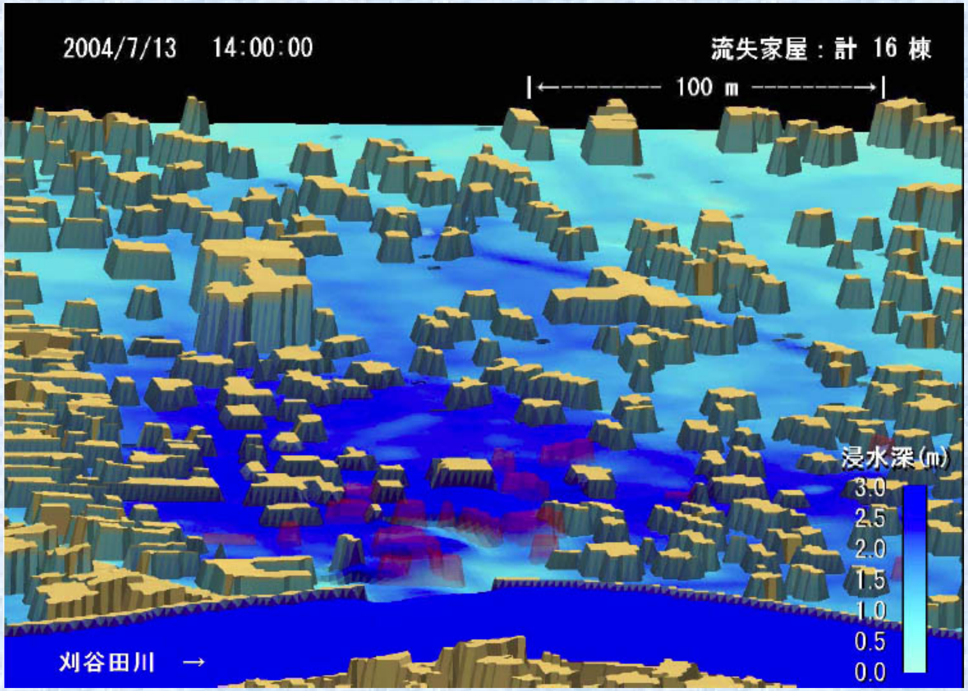
Improve the information transmission systems

Increased the number of elderly victims

Enhancement of Flood Simulation Technology

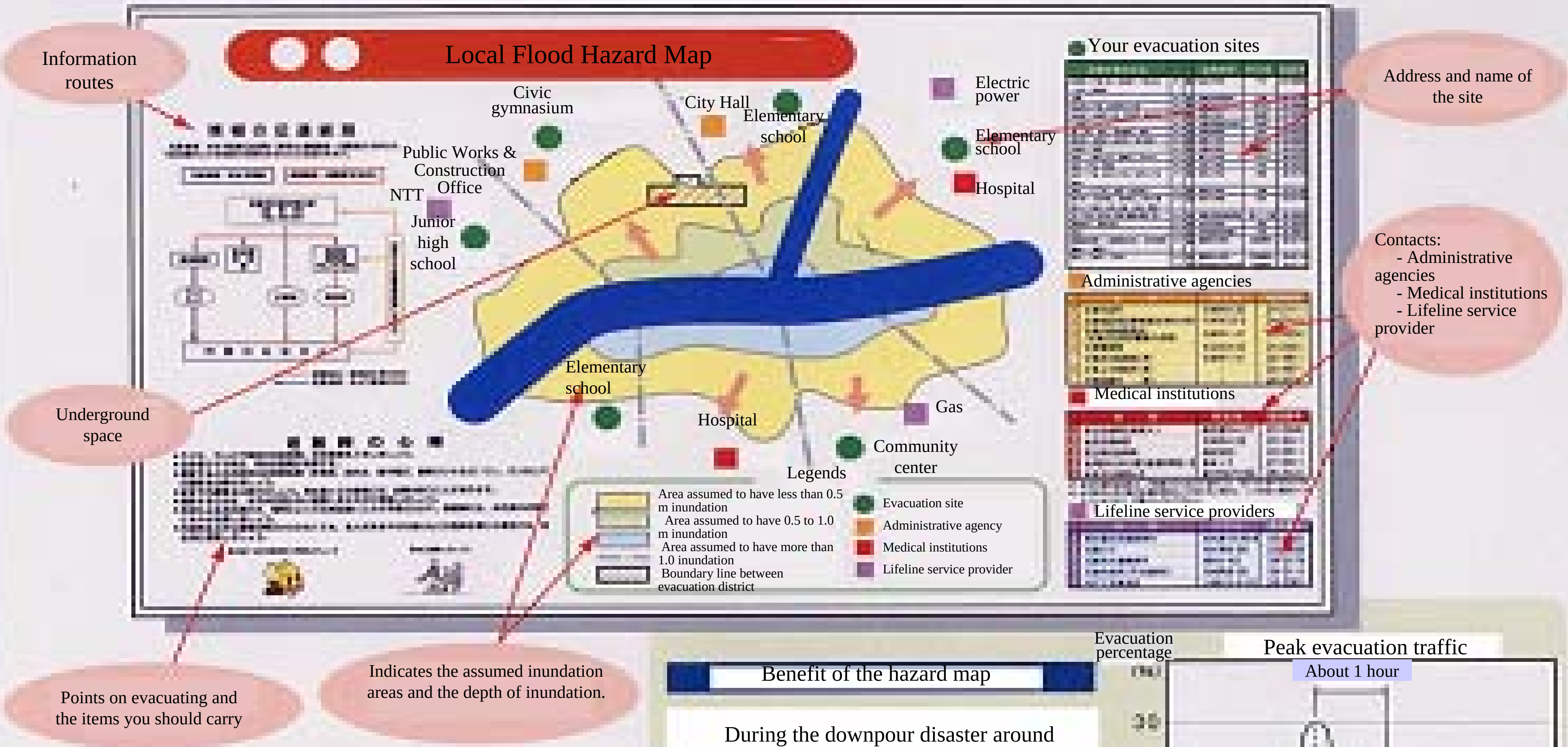
Analysis of the flood and inundation flows in combination by using the Flux Difference Splitting (FDS) Method will reveal the behaviors of inundation flow in the vicinity of the dike break spot and contribute to mitigation of damages.





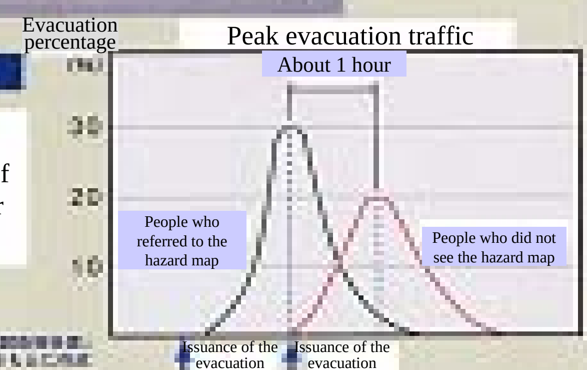
Disaster Risk Management Activities
– Flood Hazard Map -

The Flood Hazard Map indicates the assumed inundation areas and evacuation sites intelligibly, which will assist people to take speedy and reasonable evacuation activities in a disaster as well as raise their awareness about disaster preparedness.



Benefit of the hazard map

During the downpour disaster around Koriyama, Fukushima, in the late August of 1998, the hazard map proved helpful in for earlier evacuation.



Characteristics of Sediment Disasters

Debris flow:
A mixture of earth, rocks and water moves downstream at 20 to 40 km per hour, resulting in destruction of farms and homes.

Sakurajima, Kagoshima (Sept., 1986)

Landslide:
A heap of earth on a slope moves downward slowly. It occurs in an extensive slope area at a time and carries a huge volume of earth, causing vast destruction.

Nagano (Sept., 1986)

Rock fall:
A cliff may fall suddenly during sever rainfall or earthquake. Many of the victims might fail to escape and be killed.

Minamata, Kumamoto (Sept., 1997)

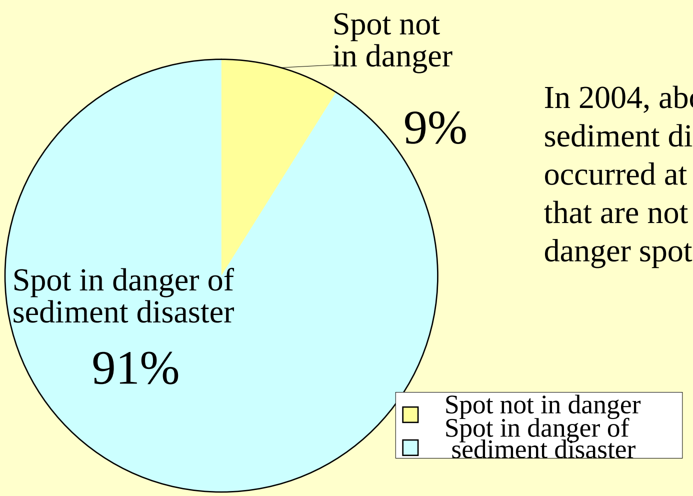
Volcanic disaster:
Volcanic disaster are caused by lava flow,volcanic mudflows and pyroclastic flows and so on.

Izu-Oshima, Tokyo (1986)

Avalanche:
A large mass of snow falls down the side of a mountain, causing an extensive coverage of damage.

Obanazawa, Yamagata (1986)

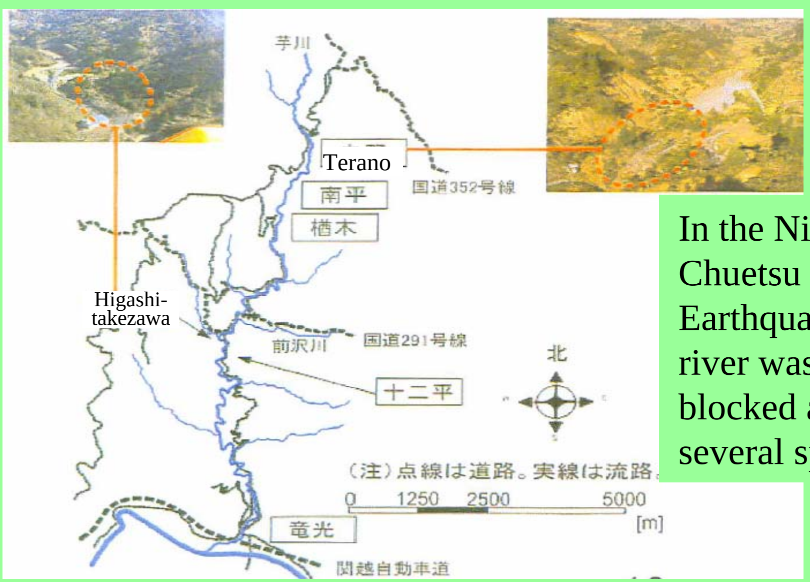
Lessons from and Mitigation Measures against Sediment Disasters



In 2004, about 10% of sediment disasters occurred at those spots that are not recognized as danger spots.

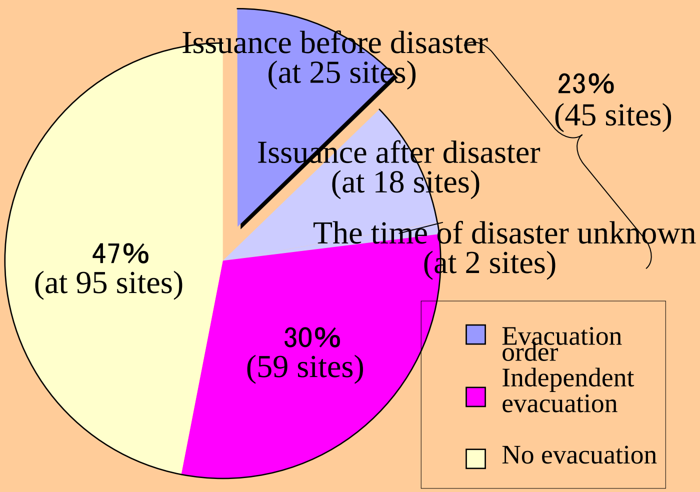
Improve the accuracy of identifying the danger spots.

Install check dams that can trap the logs more efficiently.



In the Niigata Chuetsu Earthquake, a river was blocked at several spots.

Review and revise the manual for responding to a large-scale waterway blockage.



Evacuation order was issued before occurrence of sediment disaster only at 10% of the relevant sites.

Develop the objective guidelines for issuing evacuation orders.

Disaster Risk Management Activities

－Lifesaving of Persons from a Car Trapped under Sediment (Chuetsu, Niigata)－

The experts from PWRI were monitoring without a break until a boy was rescued successfully.
(the upper left corner on the photo)
Photo credit: Asahi Shimbun.

The full view of the slope failure site. This disaster attacked across a 200 m long portion of the road.

The rescue operation in progress, which was carefully carried out under the continuous aftershocks.

Course of events

Oct., 23, 2004, a large-scale slope failure occurred in Myoken-cho, Nagaoka, when the earthquake attacked the Chuetsu region,

↓

Around 15:00, Oct., 26, a car was found trapped under sediment.

↓

In the night of Oct., 26, the Niigata Governor asked MLIT, through the Cabinet Office, to dispatch the experts to the disaster site.

↓

Around 12:00, Oct., 27, the experts from PWRI arrived at the site via helicopter.

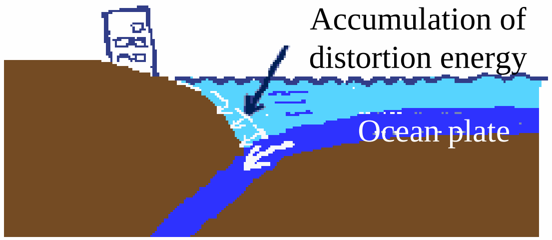
- **The expert from P.W.R.I checked if the site conditions allow the rescue party to start their operations. →Operations started.**
- **The team determined and advised which rocks could be moved or not.**
- **The team continued monitoring the operations for the safety of the rescue party .**

↓

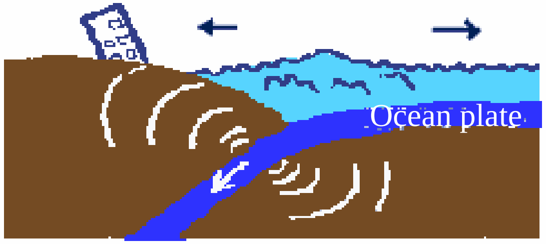
Around 14:30,Oct.,27,a boy was rescued！

Overview and Characteristics of Tsunami Disaster

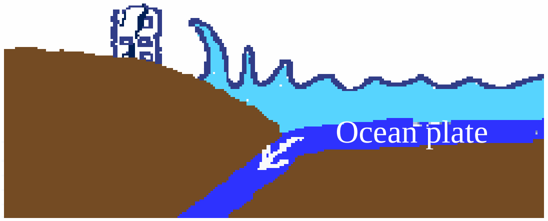
Formation of Tsunami



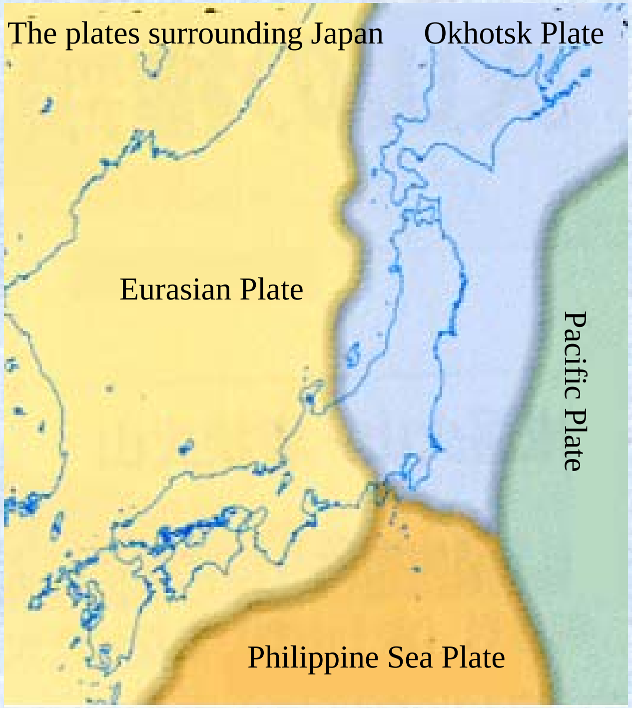
The distortion increases as the edge of the continental plate is dragged downward, which increases the distortion.



When the distortion reaches its limit, the end of the plate is broken away and the remaining part of the plate edge springs back up .



Upon entering shallow coastal waters, tsunami suddenly grows in height.



Data source: the Meteorological Agency

Disaster Risk Management Activities

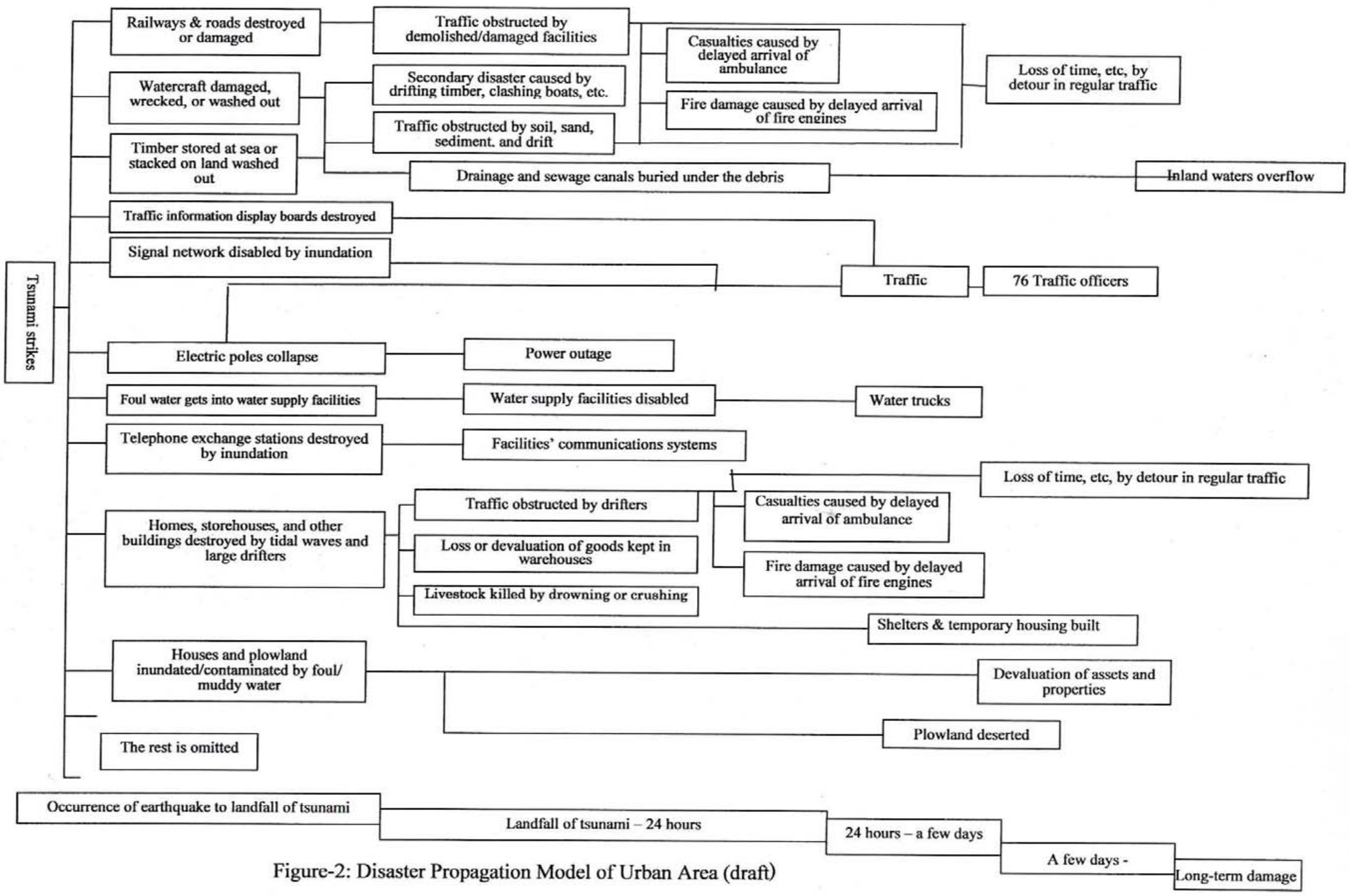


Figure-2: Disaster Propagation Model of Urban Area (draft)

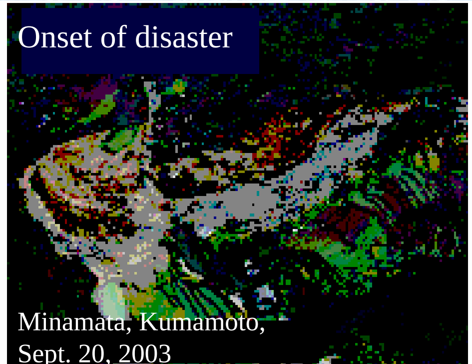
Japan's Disaster Prevention Scheme

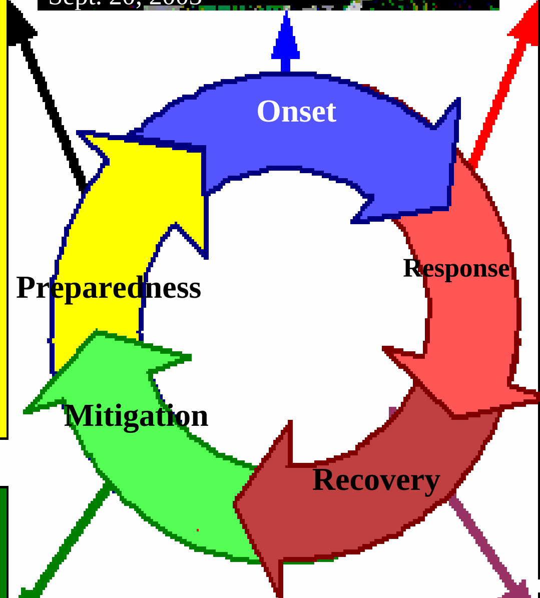
- The Japanese disaster prevention scheme consists of the four phases: Response, Recovery, Mitigation, and Preparedness.
- As part of the designated administrative system, the Ministry of Land, Infrastructure and Transport has worked on development of the anti-disaster operation plan and taken the response, recovery, and mitigation measures.

Well-planned systematic government administration of disaster prevention

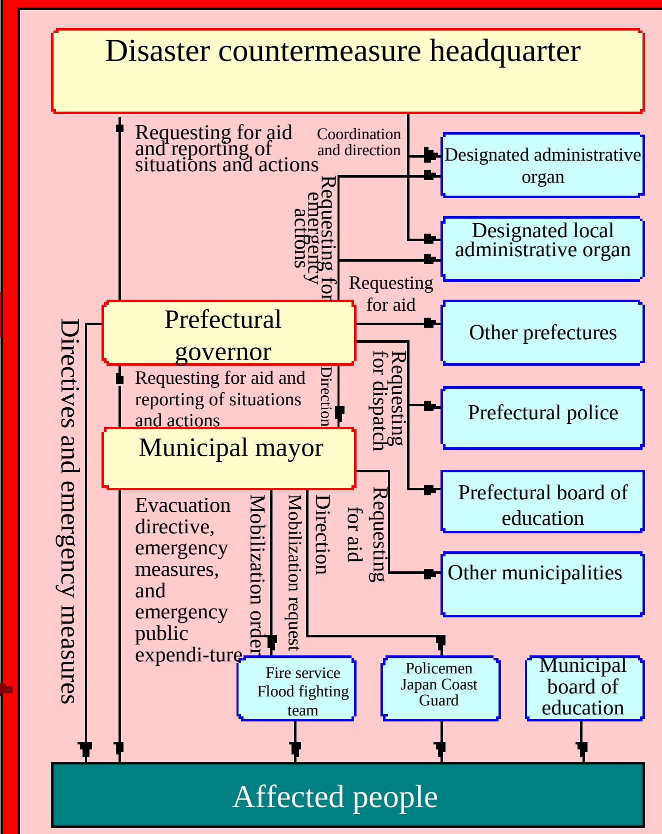
Central Disaster Management Council	Basic Disaster Prevention Planning
Designated administrative organs and public corporations	Disaster Prevention Activities Plan
Prefectural Disaster Management Councils	Basic Disaster Prevention Plan at prefecture level
Municipal Disaster Management Council	Basic Disaster Prevention Plan at municipality level

Definition of alarming areas, development of disaster prevention organization, and conduct of disaster drills,etc.





Division of roles in the emergency responses



Construction or improvement of the preventive structures

(Facilities of river management, flood prevention, coastal protection, etc.)

Financial support to the affected people and conduct of disaster restoration activities

Our Challenges for the Future

Future Directions

- To seek the best combination of structural and nonstructural alternatives for each river basin

- To seek effective scheme of involving people in decision process

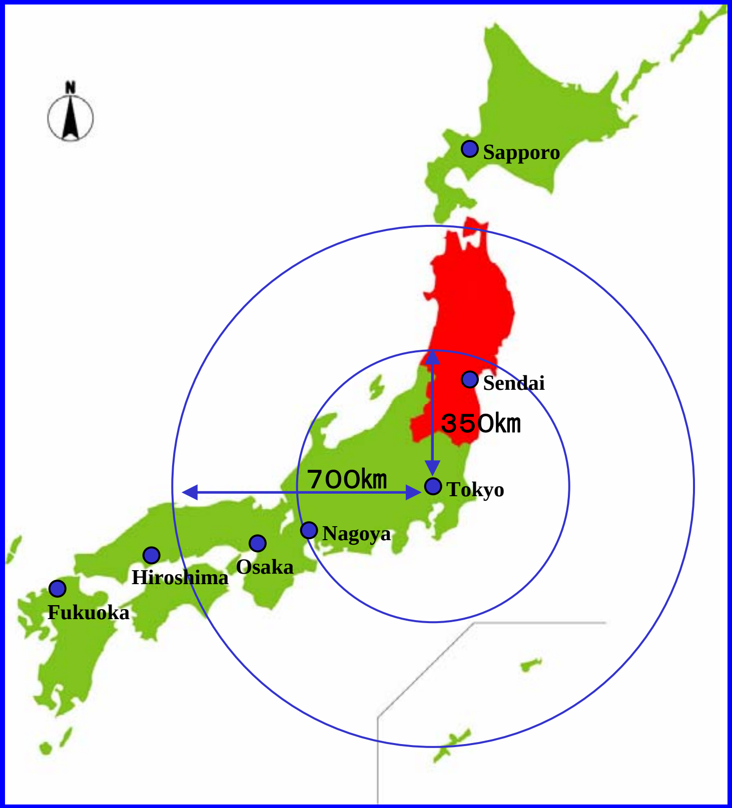
- To seek appropriate role and responsibility sharing between the national gov, local gov., municipality and individuals.

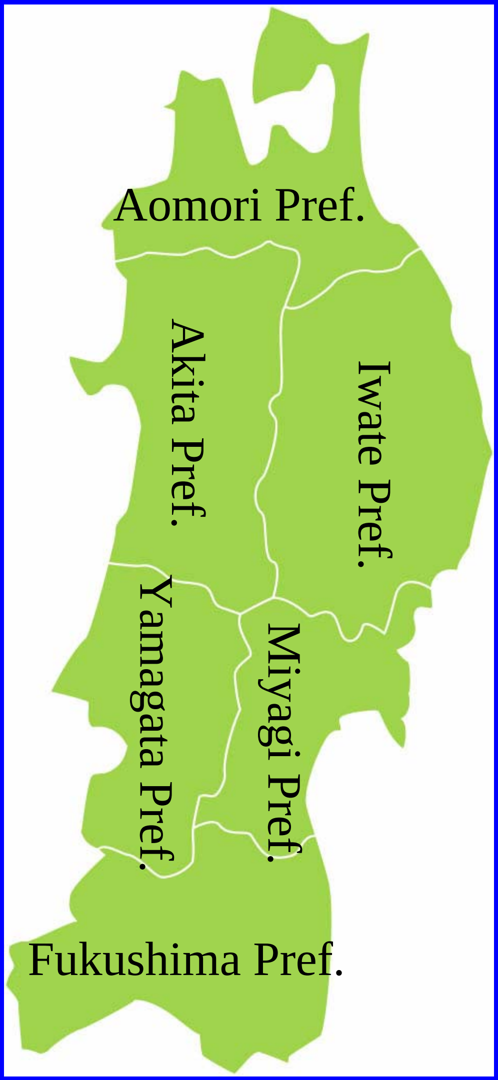
Disaster Reduction and Crisis Control

On Flood, Landslide and Tsunami Disaster in Tohoku Region

River Department, Tohoku Regional Bureau,
Ministry of Land, Infrastructure and Transport

Position of Tohoku Region in Japan





Area: Approx. 18% of the national territory
($66,889 km^2$)

*Resource: National survey of land by prefecture and municipality

Population: Approx. 8% of the national population
(9,812,849 people)

* Resource: Population Digest of 2002 Basic Resident Register

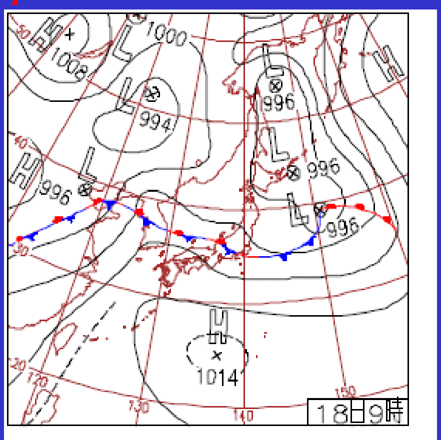
Characteristics of Floods in Tohoku - 1

[Typhoon and Front Activities]

■ Many floods occur on the coastal area of Sea of Japan due to the effect of fronts.

[Downpour in July 2004]

■ Flooding by front activities (Sake River of Mogami River System)

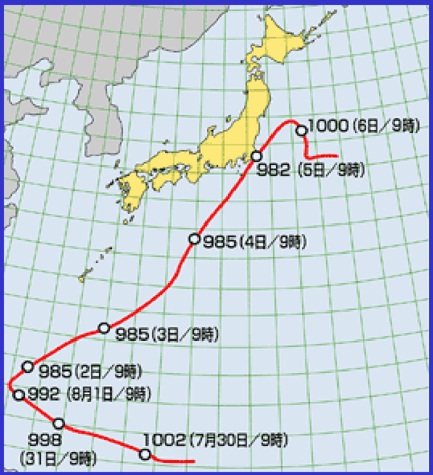


■ Meteorological Chart (July 18, 2004)

■ Many floods occur on the coastal area of the Pacific Ocean due to the effect of typhoons.

[Flood on August 5, 1986] **(Entire coastal area of the Pacific Ocean)**

■ Flooding by typhoon **(Surikami River of Abukuma River System)**



■ Typhoon route diagram (August 1986)

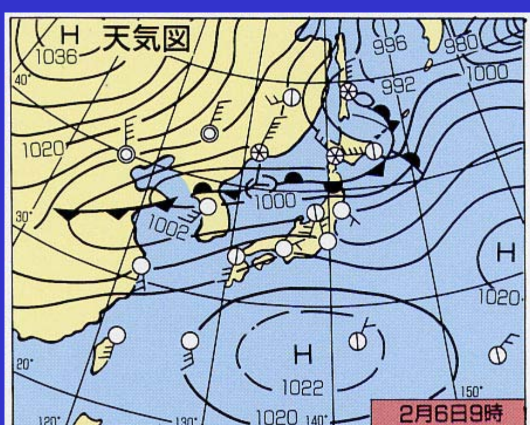
Characteristics of Floods in Tohoku - 2

[Snowmelt Floods]

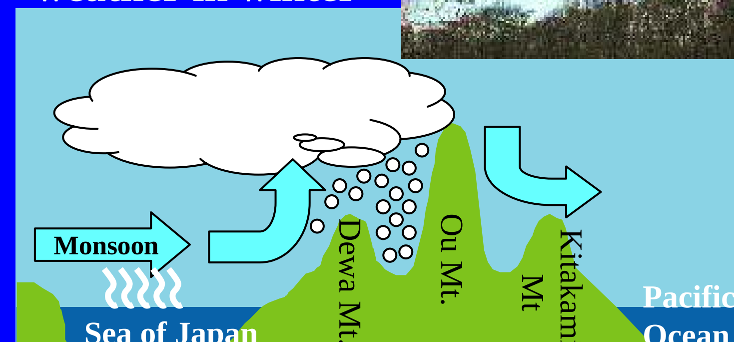
- ◆ Tohoku region is a heavy snowfall area
- ◆ Melting of remaining snow due to south wind and rise of temperature
- ◆ **"Snowmelt floods"** may occur even under small rainfall due to snow melting.

[Flood on February 7, 1993]

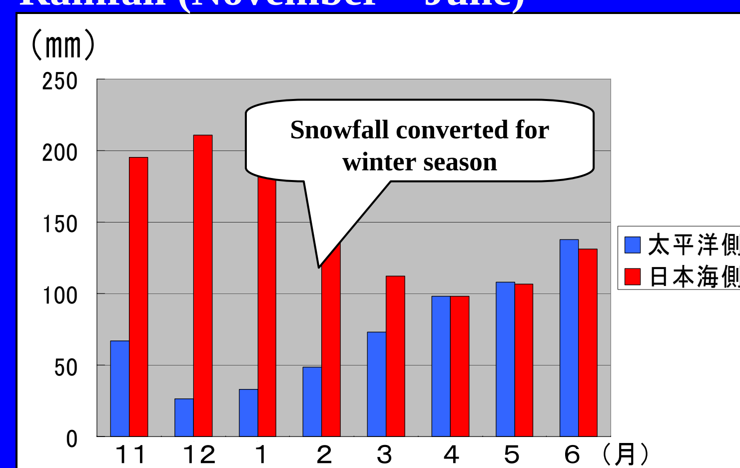
Flooding by rainfall and snowmelt (Naraoka River of Omono River System)



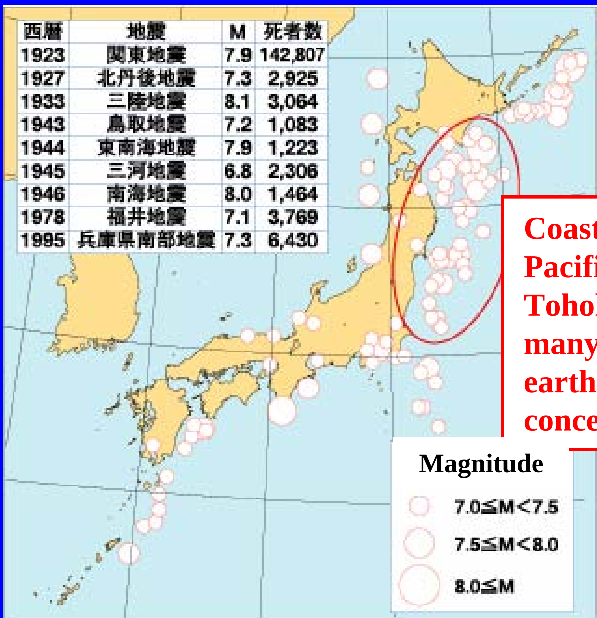
Characteristics of weather in winter



Rainfall (November – June)



Points of Earthquake Occurrence and Tsunami Damage



西暦	地震	M	死者数
1923	関東地震	7.9	142,807
1927	北丹後地震	7.3	2,925
1933	三陸地震	8.1	3,064
1943	鳥取地震	7.2	1,083
1944	東南海地震	7.9	1,223
1945	三河地震	6.8	2,306
1946	南海地震	8.0	1,464
1978	福井地震	7.1	3,769
1995	兵庫県南部地震	7.3	6,430

Coastal area of Pacific Ocean in Tohoku where many large earthquake foci concentrate

Earthquake foci of M7 or larger during the past 100 years (1900 – 1999)

Damages of Tsunami by Sanriku Earthquake (1933)

Taro Town, Iwate Prefecture

Miyako City, Iwate Prefecture

Damage Record

Date	Name of Earthquake	Description
June 15, 1896	Meiji Sanriku Earthquake Tsunami	[M8.5] Tsunami attacked coasts from Hokkaido to Oshika Peninsula. 21,959 deaths and more than 10,000 houses were lost in runoff or collapsed completely/partially.
March 3, 1933	Sanriku Earthquake Tsunami	[M8.1] Tsunami attacked the Pacific Ocean and damage was great on Sanriku Coast. 3,064 people were reported as dead or missing, houses lost to runoff 4,034, 1,817 houses were collapsed, and 4,018 houses flooded.
May 23, 1960	Chile Earthquake Tsunami	[Ms8.5] 142 people reported as dead or missing for entire Japan, over 1,500 houses were collapsed completely and over 2,000 partially. * Ms (surface wave magnitude): The method in which magnitude is calculated based on the maximum fluctuation of surface wave for a cycle of earthquake waves of about 20 seconds observed by seismograph (time from wave peak to another peak) and the distance between the seismograph and earthquake center (not origin).
May 16, 1968	Tokachi Offshore Earthquake	[M7.9] 52 deaths, 330 injuries, 673 totally collapsed houses, and 3,004 partially collapsed houses. Many damaged roads in Aomori Prefecture.
June 12, 1978	Miyagi Pref. Offshore Earthquake	[M7.4] 28 deaths, 1,325 injuries, 1,183 totally collapsed houses and 5,574 partially collapsed houses. 888 locations of road damage and 529 locations of landslide.
Dec. 28, 1994	Sanriku Haruka Offshore Earthquake	[M7.6] 3 deaths, 788 injuries, and 501 totally or partially collapsed houses. There were also damaged roads and coasts.

2003 Scientific Chronology (edited by National Astronomical Observatory, Ministry of Education, Culture, Sports, Science and Technology)

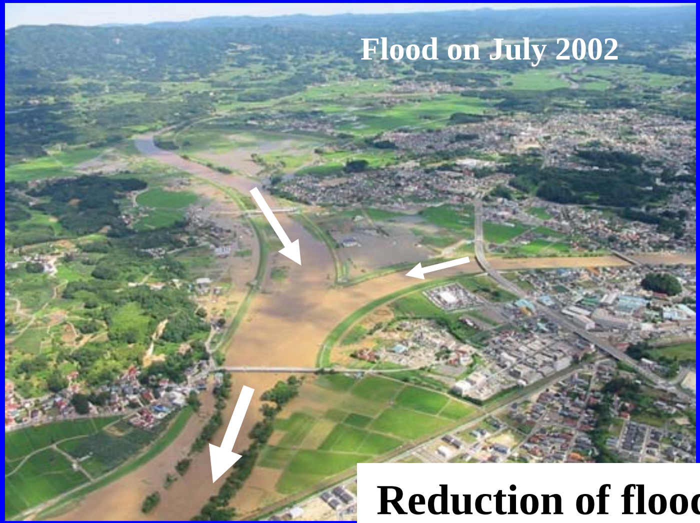
Tohoku region has

many earthquakes and tsunamis

River Improvements

Flood by downpour at the end of August 1998

Flood occurred in the same scale



Damages of downpour at the end of August 1998

Deaths	11
Severe injuries	9
Totally/partially collapsed houses	about 240
Flooded houses	about 3,800
Total damages	Approx. 40 billion yen

(Total of Miyagi and Fukushima Prefectures)

Reduction of flood damages

Implementation of comprehensive river improvement and short-term, concentrated disaster restoration project

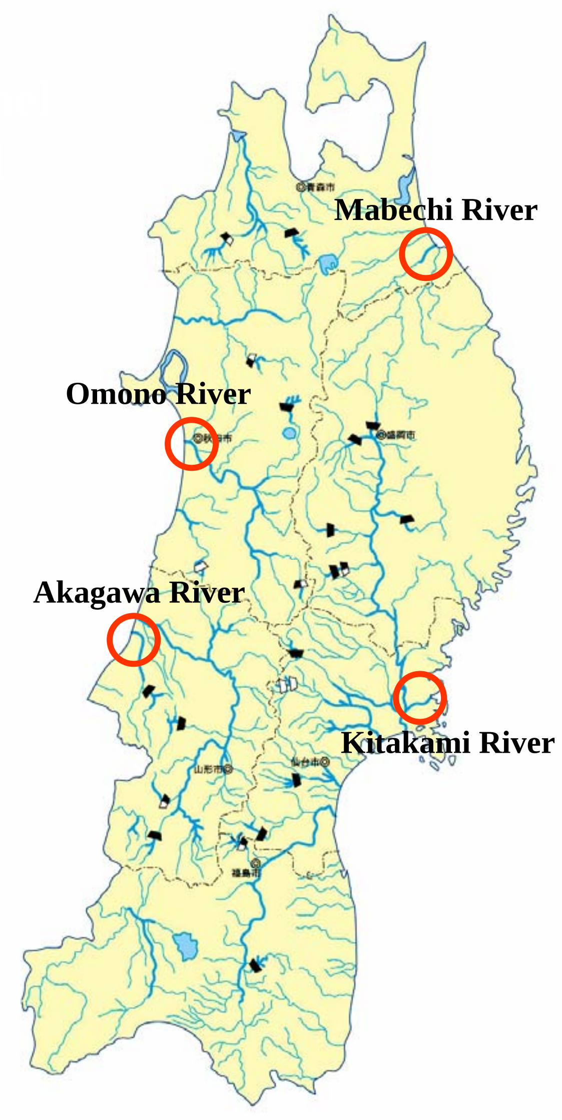
Project term: Approx. 3 years

Discharge Channel Establishment Project

Discharge channels in Tohoku region

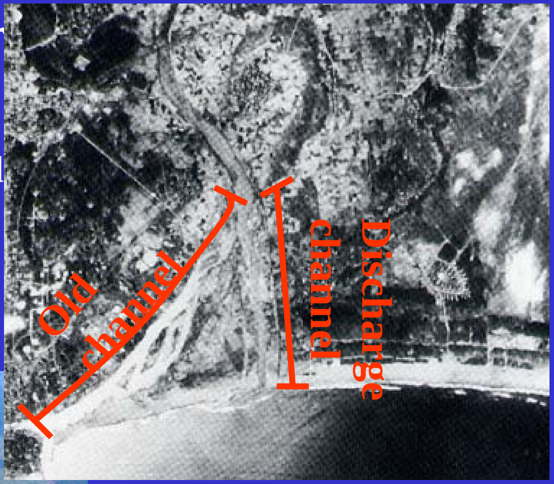
(Kitakami River, Omono River, Aka River, Mabechi River)

- **1927 Discharge in Aka River discharge channel**
- **1932 Discharge in Kitakami River discharge chann**
- **1938 Discharge in Omono River discharge channel**



Mabuchi River dischar

1950 Discharge in discharge channel
1955 Completion of discharge channel
1964 Specification of Hachinohe New Industrial City
1967 Specification as Class 1 river



Mabechi River discharge channel (before discharge)

Mabechi River discharge channel (present)

Flood Control Basin Establishment Project

Flood control basin in Tohoku region

(Ohkubo flood control basin, Hamao flood control basin, Ichinoseki flood control basin)

- ◆ **1997 Completion of Ohkubo Flood Control Basin (Mogami River)**
- ◆ **2005 Completion of Hamao Flood Control Basin (Abukuma River)**

◆Ichinoseki Flood Control Basin◆

1972 Kitakami River Flood Control Project

1980 Groundbreaking Ceremony for Ichinoseki Flood Control Basin

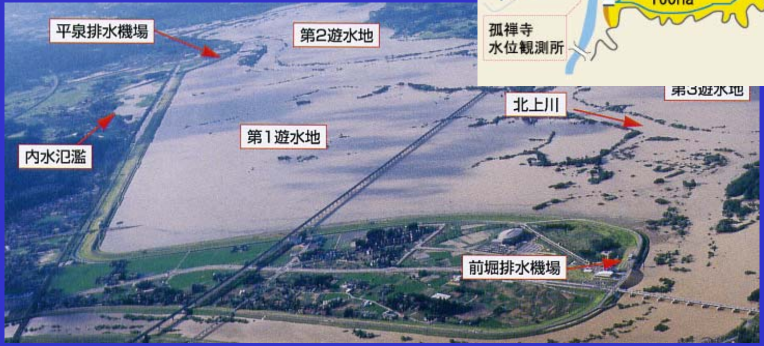
2002 Overall completion of surrounding bank

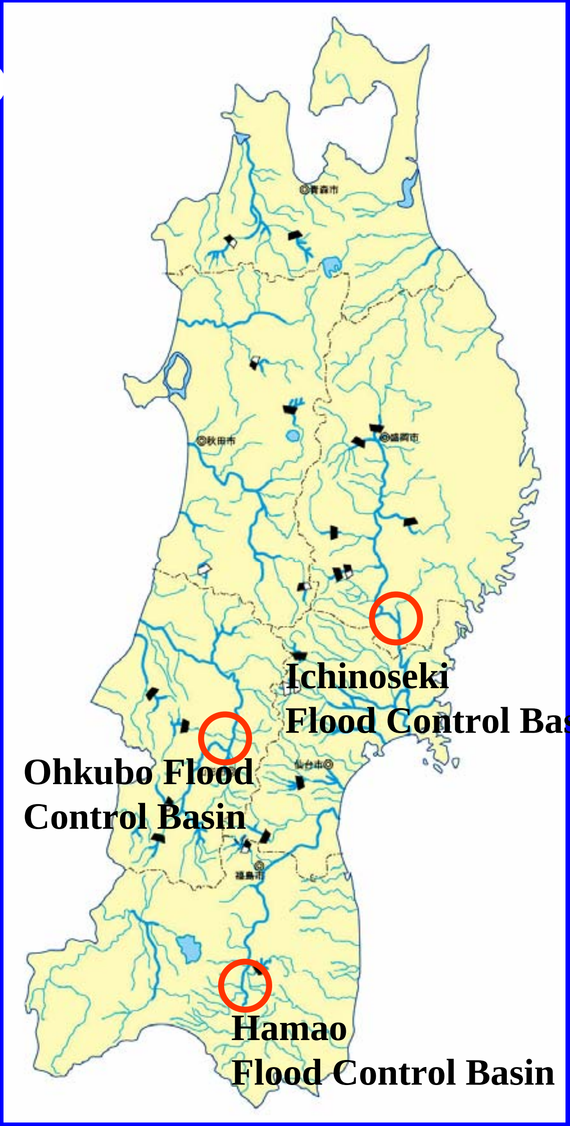
Present

Project in implementation

Ichinoseki Flood Control Basin Plan Drawing

Photograph of Flood in July 2002





TVA Project of KVA-Japan (5 Great Dams of Kitakami River)

1945 – Reconstruction after war

1947 Typhoon Kathleen

◆Damages of Typhoon Kathleen◆

Deaths/missing about 170

Injuries about 3,500

Totally/partially collapsed houses or runoff houses 3,096

Photo: Ichinoseki City, Iwate Pref.

1948 Typhoon Ione

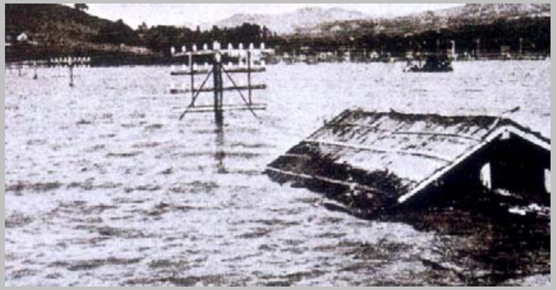
◆Damages of Typhoon Ione◆

Deaths/missing about 710

Injuries about 500

Totally/partially collapsed houses or runoff houses 3,700

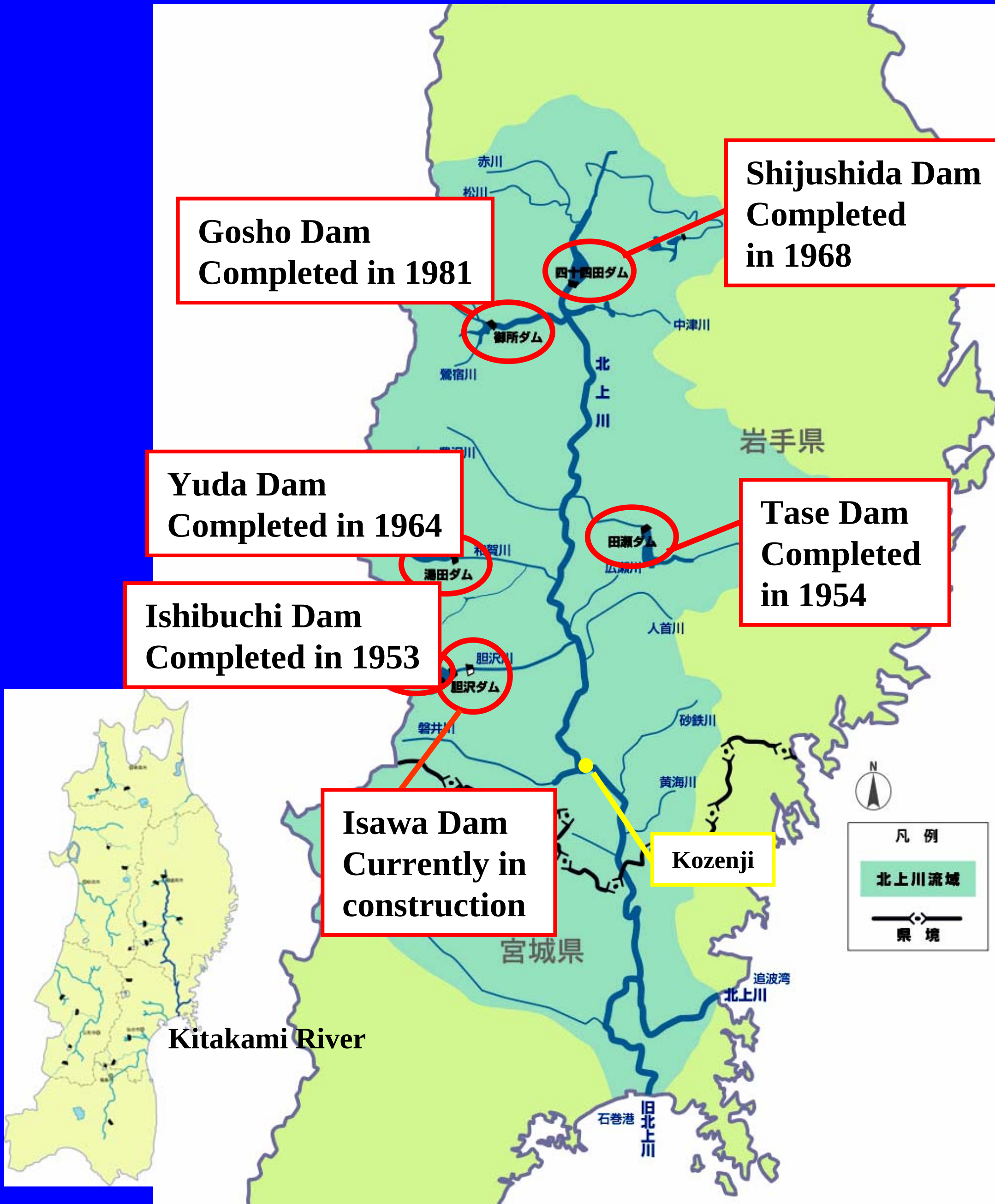
Photo: Ichinoseki City, Iwate Pref.



1951 – Specification as area applicable to
“Act for Comprehensive Development of the National Land”

1953 – Launch of Comprehensive Development Project
in Kitakami Specific Region (KVA)

Comprehensive Development Project in Kitakami Specific Region (KVA)



1. Flood adjustment

◆ Reduction of floods in downstream Kitakami River area by 5 great dams at upstream Kitakami River and Ichinoseki Flood Control Basin

◆ Effect of dams

Basic high level flow rate 13,000 m3/s

→ Approx. 11,000 m3/s

(Reference point:

Approx. 2,000 m3/s reduction at Kozenji)

2. Irrigation project

◆ Irrigation water supply to rice paddies/fields

* Supply to 86,000 ha and reclamation project of approx. 13,000 ha. Irrigation capacity of approx. 170 million m3

3. Power generation project

◆ Hydroelectric power generation

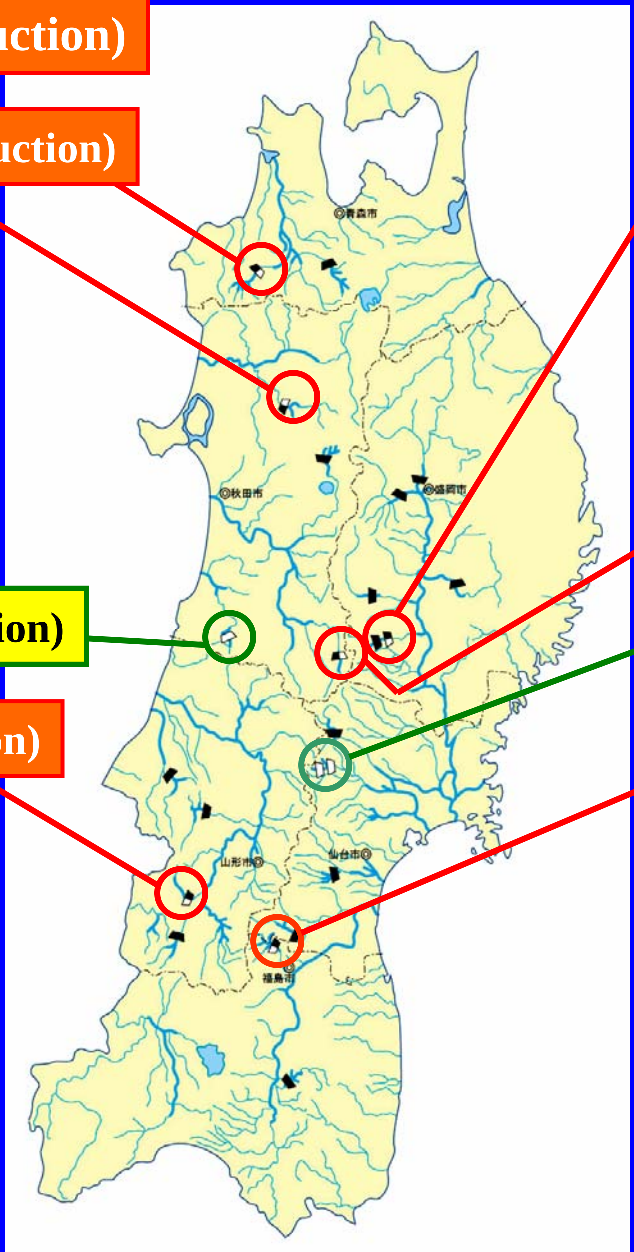
* Power of 113,500kw generated at maximum

Total power generation capacity of approx. 340 million m3

Dams in Construction/Investigation in Tohoku Region

Tsugaru Dam (in construction)

Moriyoshizan Dam (in construction)



Isawa Dam (in construction)

Naruse Dam (in construction)

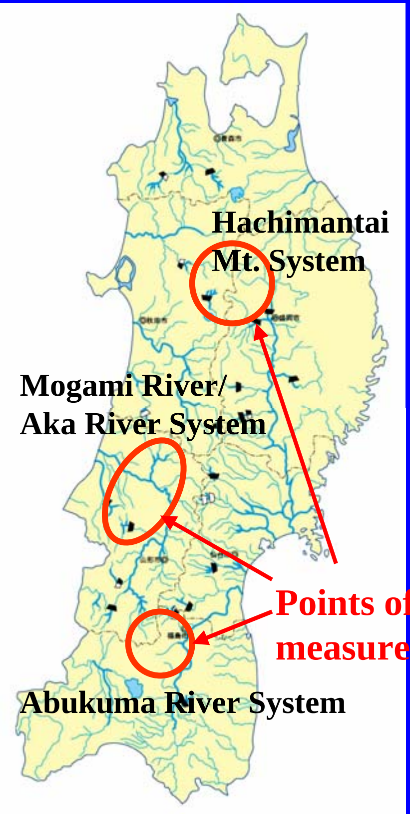
Tagawa 1st/2nd Dams (in investigation)

Chokai Dam (in investigation)

Nagai Dam (in construction)

Surikami River Dam
(in construction)
Control planned to be shifted in April 2006

Landslide Disaster Measures



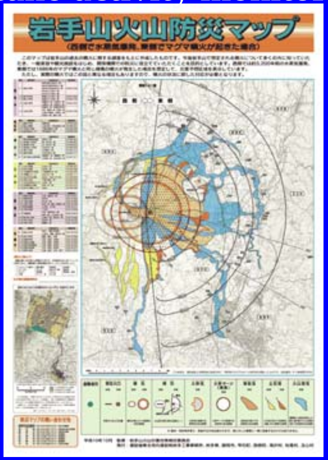
- Landslide disasters by earth, driftwood runoff are prevented by erosion control weir, etc.
- Establishment of fish pass with consideration of continuance of transmissive erosion control weir and environment for ensuring the drift sand system
- Support for preparation of volcano disaster prevention map, guideline, etc.

Image from Iwate volcano activity monitoring

Erosion control weir on Kosendatsu River (Akita Prefecture)

Masudama 2nd erosion control weir <transmissive> (Yamagata Pref.)

Fish pass establishment status



Iwate volcano disaster prevention map

Earthquake Measures

～Naruse River earthquake measures～

North Miyagi Earthquake on July 26, 2003

◆ Earthquakes occurred 3 times in intensities of 6 or larger.◆

Damges

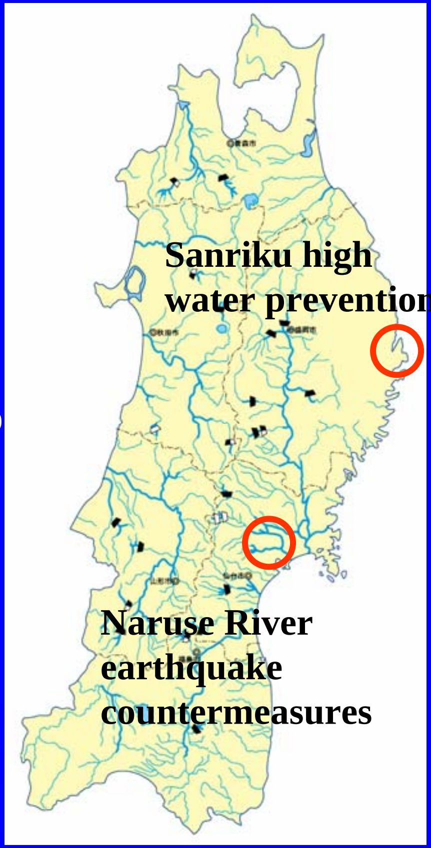
Injuries: 675

Totally/partially collapsed houses: 4,966

Vertical crack at the edge of weir top

Emergency recovery construction

Completion of full recovery construction



～Sanriku high water prevention Tsugaruishi Water Gate construction～

◆ Bank raising for tide enbankment

◆ Gate installation near Tsugaru Ishikawa estuary

◆ Preparation of disaster prevention map

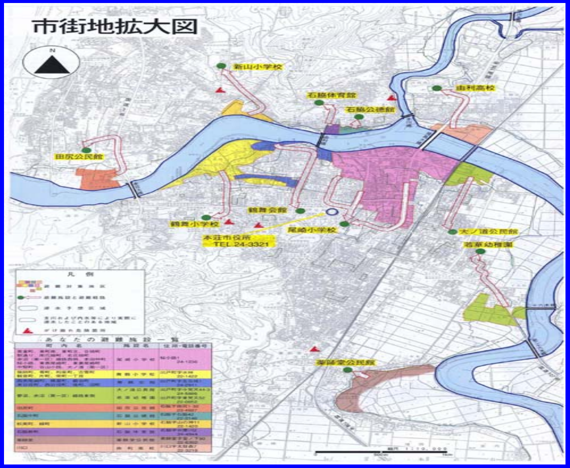
Tsugaruishi water gate

Kesennuma City disaster prevention map

Software Measures

～Integration of hardware establishment and software measures～

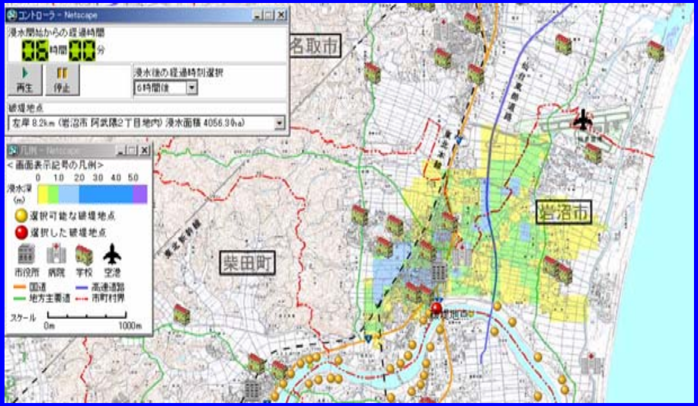
- ◆ Provision of river disaster prevention information on the Internet or mobile phone sites (water level, rainfall, flood forecast, flood warning, etc.)
- ◆ Information provided in real time for 24 hours
- ◆ Flood images in rivers provided to public broadcast
- ◆ Support for hazard map preparation



Flood hazard map (Yurihonjo City, Akita Pref.)

Information provided by utilization of the Internet

Information provided by live broadcast



Flood simulation

Typhoon Rusa and Super Typhoon Maemi: Impacts and Aftermath

The 14th International Symposium on National Land Development and Civil Engineering in Asia

Prepared by Chang Wan KIM

Water Resource Research Department

Research Fellow, Korea Institute of Construction Technology

Korea

1. Introduction

Two recent major typhoons, Typhoon Rusa in 2002 and Super Typhoon Maemi in 2003, imposed a heavy toll on Korean society. Typhoon Rusa was labeled as one of the worst tropical storms of the last 45 years. Super Typhoon Maemi was the strongest typhoon since records began almost 100 years ago. Characteristics of Typhoon Rusa and Maemi are analyzed using the typhoon tracks, hydrologic data, and flood damages.

Figure 1. Satellite image of Typhoon Rusa

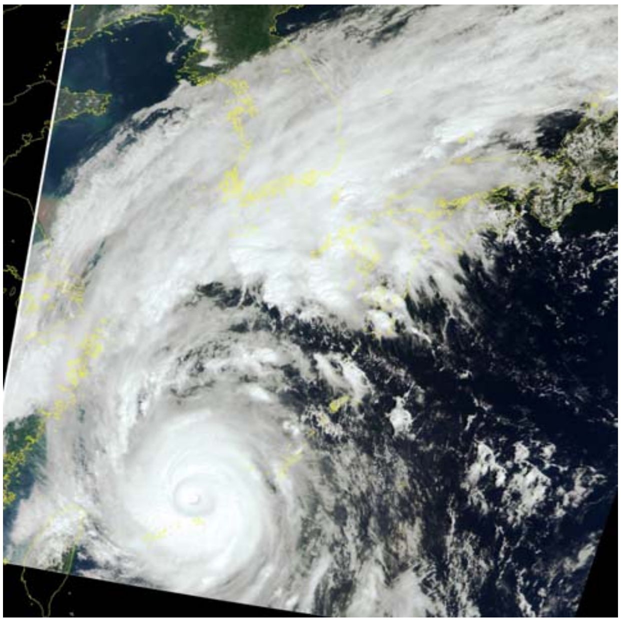
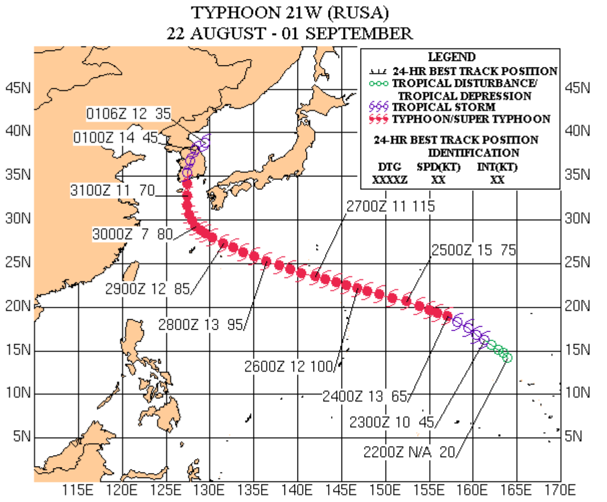


Figure 2. Satellite image of Typhoon Maemi

2. Typhoon Tracks

'Rusa' is the Malaysian word for deer. Typhoon Rusa developed southwest of Wake Island at the eastern periphery of the monsoon trough. The cyclone tracked northwest toward Okinawa for approximately 8 days before turning toward the Korean Peninsula and subsequently made landfall at approximately at 06:30 UTC on 31 August 2002 near Goheung-gun, Korea, with maximum sustained winds of 120 km/hr (65 knots), gusting to 150 km/hr (80 knots). Typhoon Rusa reached a peak intensity of 215 km/hr (115 knots) on 26 August near the Bonin Islands and maintained this intensity for 24 hours before beginning a slow weakening trend until landfall in Korea.



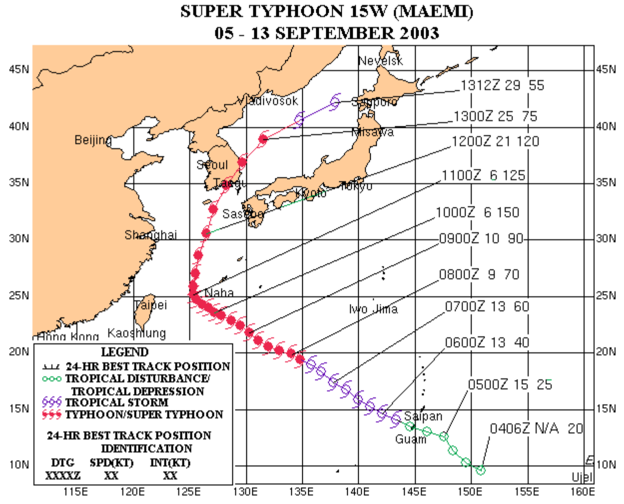


Figure 3. Track map of Typhoon Rusa **Figure 4. Track map of Typhoon Maemi**

'Maemi' is the Korean word for cicada. Super Typhoon Maemi formed in the monsoon trough approximately 110 km east-southeast of Guam. As the typhoon approached Okinawa, it developed into a super typhoon (category-5) by 12:00 UTC on 9 September and attained maximum intensity of 280 km (150 knots) 12 hours later. Typhoon Maemi made landfall at 13:00 UTC on 12 September near Goseong-gun, Korea, with maximum sustained winds of 140 km/hr (75 knots), gusting to 175 km/hr (95 knots) and, subsequently, tracked along the southeastern coast of Korea.

3. Renewal of Rainfall and Wind Speed Record

Typhoon Rusa caused a historical precipitation in northeastern part of Korea. Table 1 shows rainfall depths measured at two gauging stations. As shown in Table 1, all the recorded data exceed the probable precipitation of 200-year return period at every duration time both in the two stations. A PMP (Probable Maximum Precipitation) analysis shows that for the duration time of 24 hours the recorded amount of rainfall exceeds the existing PMP in the basin area of up to 2,000 km^2. It shows also that for the duration times of 12 and 48 hours, the recorded ones exceed the existing PMP in the basin area of up to 200 km^2.

Table 1. Rainfall depths recorded at two stations in northeastern part of Korea

Stations	Item	Duration(hr)				
		1	6	12	24	48
Gangneung	Return period (yr)	Over 200	Over 200	Over 200	Over 200	Over 200
	Rainfall depth (mm)	98.0	399.5	576.0	880.0	897.5
Yangyang	Return period (yr)	Over 200	Over 200	Over 200	Over 200	Over 200
	Rainfall depth (mm)	83.0	403.0	560.0	664.0	679.0

Super Typhoon Maemi caused a historical wind gust in Jeju Island and southeastern part of Korea. The typhoon struck the south coast of Korea during the night of September 12 as a category-3 typhoon, with wind gusts reaching 216 km/hr and rainfall of up to 450 mm before it made landfall. The maximum wind speed of 60 m/s (216 km/hr) at Jeju gauging station is the national record of Korea. This fact indicates that the characteristics of Super Typhoon Maemi is the very strong wind around the center of typhoon.

Figure 5 shows the gauging stations which made new records among eighty-seven stations. While Typhoon Rusa made the new records of one-day maximum rainfall at eight stations, Super Typhoon Maemi made the new records of maximum instantaneous wind speed at twenty stations. From this fact, it can be noticeable that Typhoon Rusa was a wet typhoon but Super Typhoon was a dry typhoon.

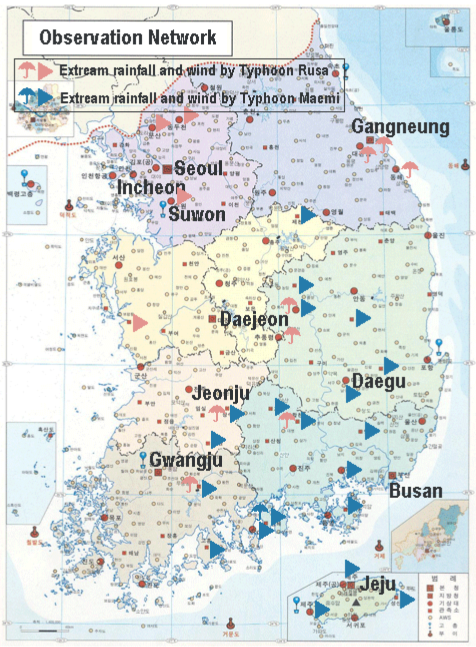


Figure 5. Meteorological observation stations

4. Rainfall and Floods

As shown in Figure 6 and 7, the amount of precipitation caused by Typhoon Rusa in the northeastern part of Korea was almost twice of that caused by Super Typhoon Maemi . Figure 8 shows the stage hydrograph and the spatially averaged-rainfall hyetograph at Gangneung stage-gauging station located at the downstream in the basin. The design water level of 100-year return period at this station is 3.54m and the flood level exceeded it by 1.8m. In this figure, too, the peak flood coincides the peak rainfall, which implies the flood is a type of flash flood.

Figure 8 shows the stage hydrograph and the spatially averaged-rainfall hyetograph at Gupo stage-gauging station located at the downstream of the Nakdong River while Super Typhoon Maemi made landfall at 21:00 KST (13:00 UTC) on September 12 near Goseong-gun. The typhoon kept its strength over category-1 typhoon for 12 hours after the landfall. The stage-gauging stations near the sea experienced the storm surge of about 1.4 m during this period.

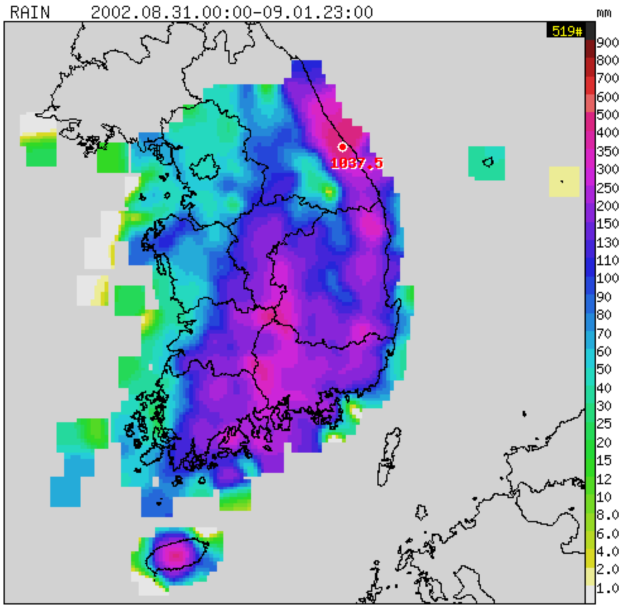


Figure 6. Rainfall by Typhoon Rusa

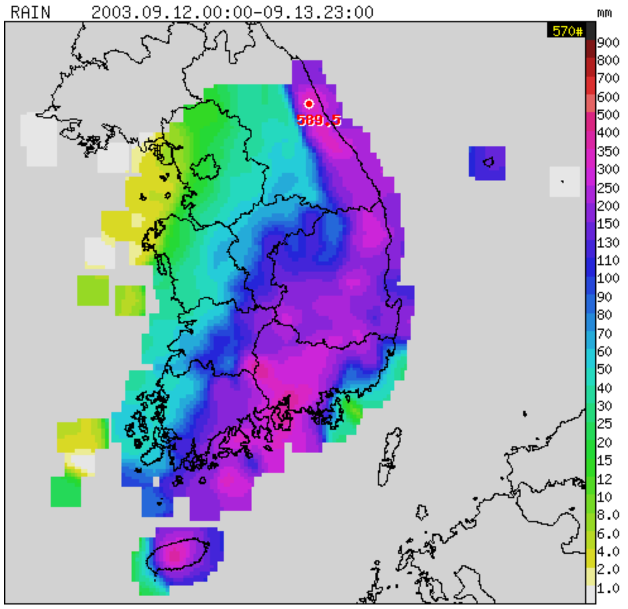


Figure 7. Rainfall by Typhoon Maemi

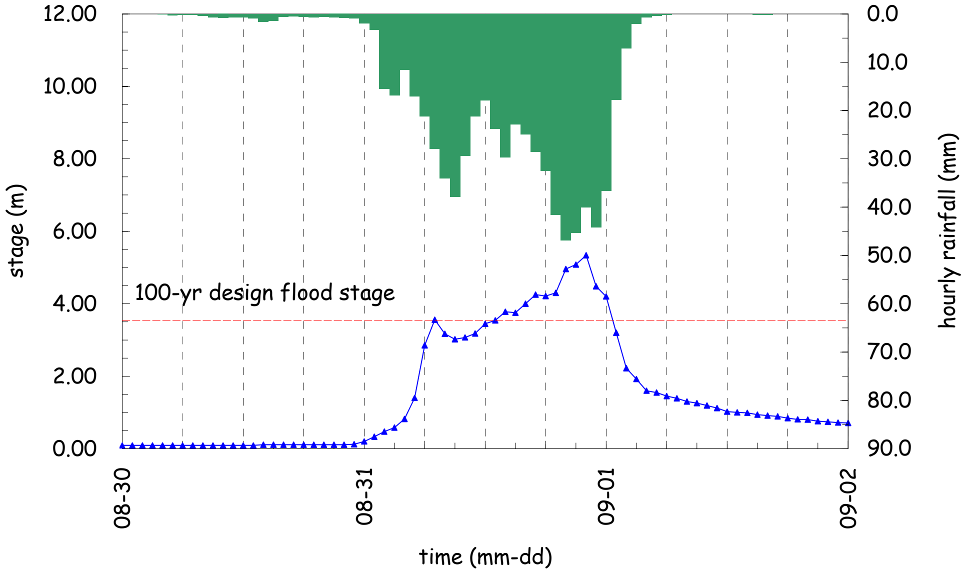


Figure 8. Hydrograph at Gangneung stage-gauging station

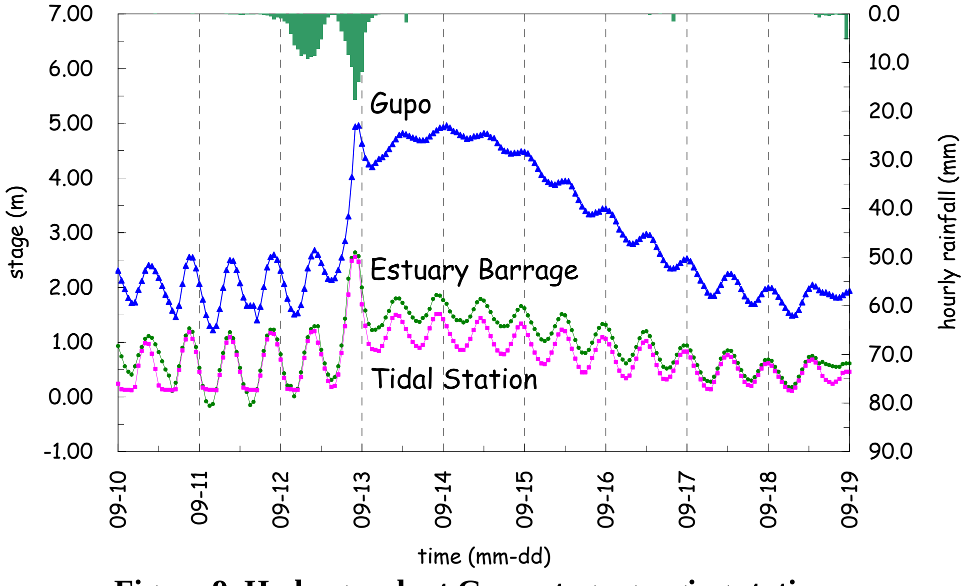


Figure 9. Hydrograph at Gupo stage-gauging station

5. Flood Damages

The resulting floods of Typhoon Rusa left 213 dead and another 33 missing in the whole country. Heavy storms accompanied with the typhoon destroyed more than 45,000 houses, washed away 850 km^2 of farmland, swept 202 bridges, destroyed several sections of roadway and railway, and cut off fresh water to 400,000 people. Besides, they destroyed completely and nearly hundreds of stream channels in the regions. Altogether, the damage caused by the typhoon was as much as $ 5.4 billion.

During the floods, morphologies of many streams flowing especially to the East Coast from the mountainous regions were dramatically changed by the high-speed and highly concentrated flows. Channel response to such extreme flood clearly shows the inertia-dominant behavior of channel straitening, widening, and steepening. Re-channelization is to restore the stream channel with new channel forms and new floodplain management practices after a stream channel and surrounding floodplain are completely or near-completely altered by the extreme flood. It would usually follow, in case that the channel and socio-economic conditions allow, the channel forms newly shaped by the extreme flood.

Super Typhoon Maemi damaged 774 roads, 27 bridges, and submerged 174 km^2 of farmland. More than 25,000 were left homeless and at least 117 fatalities were reported. The storm destroyed more than 5,000 houses and damaged a further 13,000 homes and businesses. Almost 40,000 cars were damaged in the storm. A total of 465 vessels were destroyed or marooned. The most severe damage caused by this typhoon was that Korea's main port of Busan and the industrial areas in Yecheon, Ulsan and Daegu were heavily affected. Altogether, the damage caused by the typhoon was as much as $ 4.8 billion.

Up to 453 mm of rainfall fell across the Nakdong River basin. The Nakdong River Flood Control Center issued flood warnings along the Nakdong River, which runs through the center and south of Korea, as overflowing dams had to open floodgates. About 25,000 people had to be evacuated and several thousand were camped out in public buildings on Sunday 14th September, two days after the event.

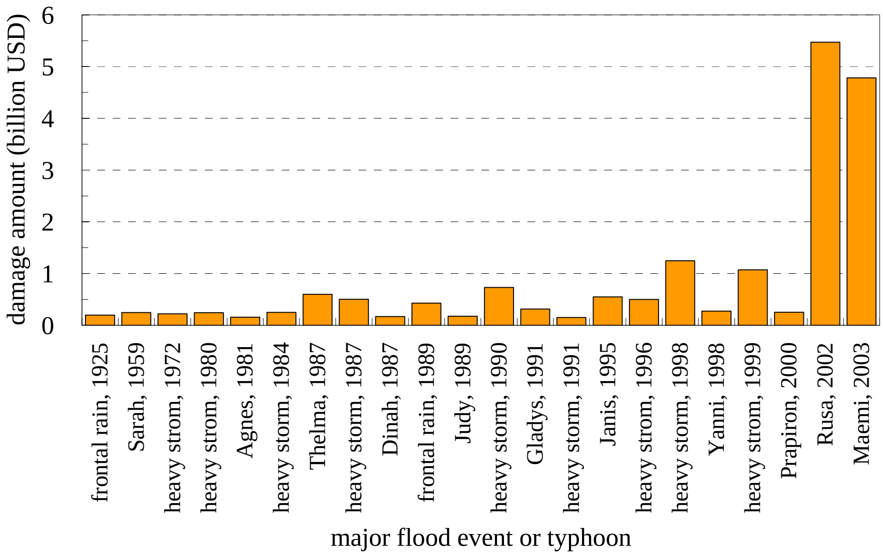


Figure 10. Flood damage amount by major flood event or typhoon

Figure 10 shows the damage of past twenty-two flood events or typhoons. From this figure, damage amount by Typhoon Rusa is about ten times as large as the average. It is also about 5 times as large as the previous maximum damage amount. Damage amount by Super Typhoon Maemi is as large as that by Typhoon. So, damage amount by both typhoons exceeds the rest damage amount.

Flood damages caused by the typhoon Rusa show a very different characteristic as compared with the previous ones in terms of the scale and type of damage. In a word, almost all of the river channels were changed and the most levees along those channels were washed away. Moreover, two small dams were overtopped in the Gangneungnamdae River running through Gangneung city causing losses of lives and property. The flood damages in the region can be categorized into several types as follows:

Type 1 is the levee failure and channel re-coursing. During the floods, morphologies of the many channels in the region were dramatically changed by the high-speed flows as well as highly concentrated debris flows. These streams affected by the floods had been channelized during the 1970's - 90's by the river regulation works, including levee construction along the both sides of the channel and bridges crossing the streams. Figure 11 shows a typical one of such type.

Type 2 is the debris flow caused by the torrential water along the narrow river valley and landslides from the slopes of mountain. Debris flow is not common in Korea because the basins are geologically mature and have relatively thin soil layers over the mother rocks. This time, the catastrophic rainstorms and floods by the typhoon caused numerous landslides and debris flows especially in the steep and narrow river valleys. Figure 12 shows a remnant of debris flow burying houses and lands.

Type 3 is the dam overtopping and resulting downstream floods. This was caused probably by the near-PMP condition. Figure 13 shows the Dongmak dam site, one of the two dam-overtopping cases during the flood.

Figure 11. Levee failure, channel widening and recoursing (flow from center-left to lower-left)

Figure 12. Houses buried by debris flow

Figure 13. Dam collapse (Dongmak Reservoir; view from upstream to downstream)

Figure 14. Container cranes destroyed in Busan Port

The damage due to Typhoon Maemi was mostly dominated by wind and occurred in private property. Busan, as Korea's largest port, normally handles 80 percent of the country's container shipping. Typhoon Maemi blew into Busan with such intensity that not only tossed shipping containers and fishing boats into the air but also toppled eleven giant container-lifting cranes, each weighing around 900 tons. Figure 14 shows container cranes destroyed in Busan Port.

6. Lessons Learned

There are lessons which can be learned from Typhoon Rusa in 2002 and again Super Typhoon Maemi in 2003.

Although Typhoon Rusa and Super Typhoon Maemi were both closely monitored and categorized in meteorological term, the significant differences in their physical characteristics led to different damages to the society. The forecasts and severe weather warnings were also too later for disaster management teams to react.

The climate is changing but policy for dealing with it has not changed. Korea is carrying out the first Korean geosynchronous multi-functional satellite (COMeS) development program to improve the capability of obtaining real-time meteorological observation data that provides higher time, spatial and spectral resolution data than currently available. For more rapid and precise forecast of rainfall and streamflow, Korea is installing hydrological radars and the automated flow measurements.

As many people complained about the slow relief measures after Typhoon Rusa, the new administration had not carried out effective evacuation actions when Super Typhoon Maemi hit again one year later. The Korean government is now pursuing several improvements to its disaster management system. These improvements would cover the entire country simultaneously through the use of advanced information and communication technologies.

Rapid urbanization and industrialization but lacking sufficient infrastructure for disaster management contributed more in property damage and life loss. Moreover, construction standards are still based on flood frequencies from decades past. The Korean government has established a new concept in measures for flood damage such as the Comprehensive River Basin Flood Control Plan. The focus of this plan is that the whole basin can be protected from flooding through effective combination of embankments, dams, retention and flood control pond. Besides, the Korean government checked the safety of dams to implement proper adjustments for better flood control by dams.

References

Kim, C.W., Woo, H., Kim, W., Lee, D.H. and Yoon, K.S. (2004) "Re-channelization of Stream Channels Affected by an Extreme Flood due to the 2002 Typhoon Rusa in Korea," *Proceedings of the 2004 World Water and Environmental Resources Congress,* ASCE EWRI, Salt Lake City, UT, June 27-July 1, 2004.

Ministry of Construction and Transportation (2005) *Water Resources in Korea 2005*.

Ye, Q. (2004) *Typhoon Rusa and Super Typhoon Maemi in Korea*. NCAR/ESIG.

Outline of ICHARM

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Public Works Research Institute (PWRI)

Tsukuba, Japan

the International Centre for Water Hazard and Risk Management

(ICHARM)

under the auspices of UNESCO

I am going to talk about

- 世界の水災害の動向

  (Trend of water related disasters in the world)

- 土木研究所の概要

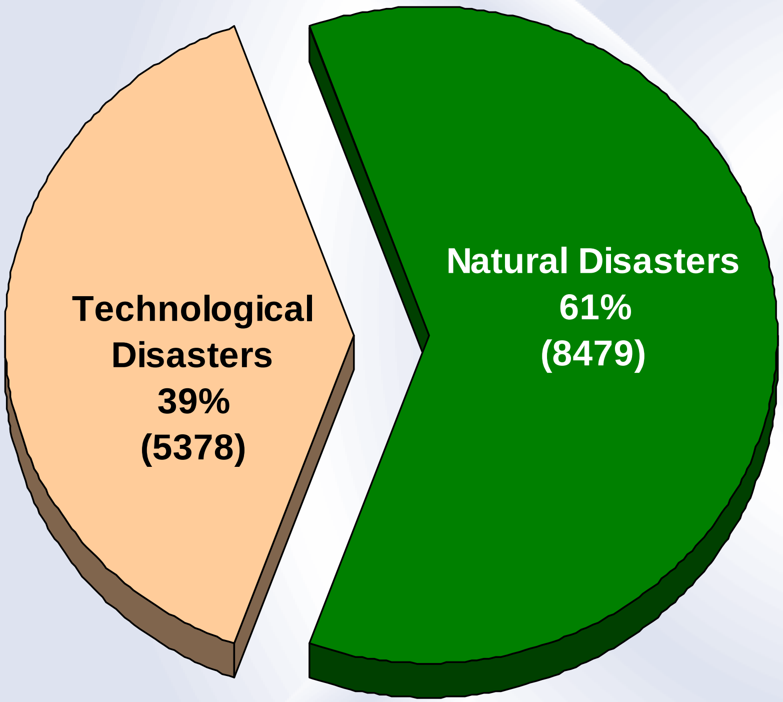
  (Outline of PWRI)

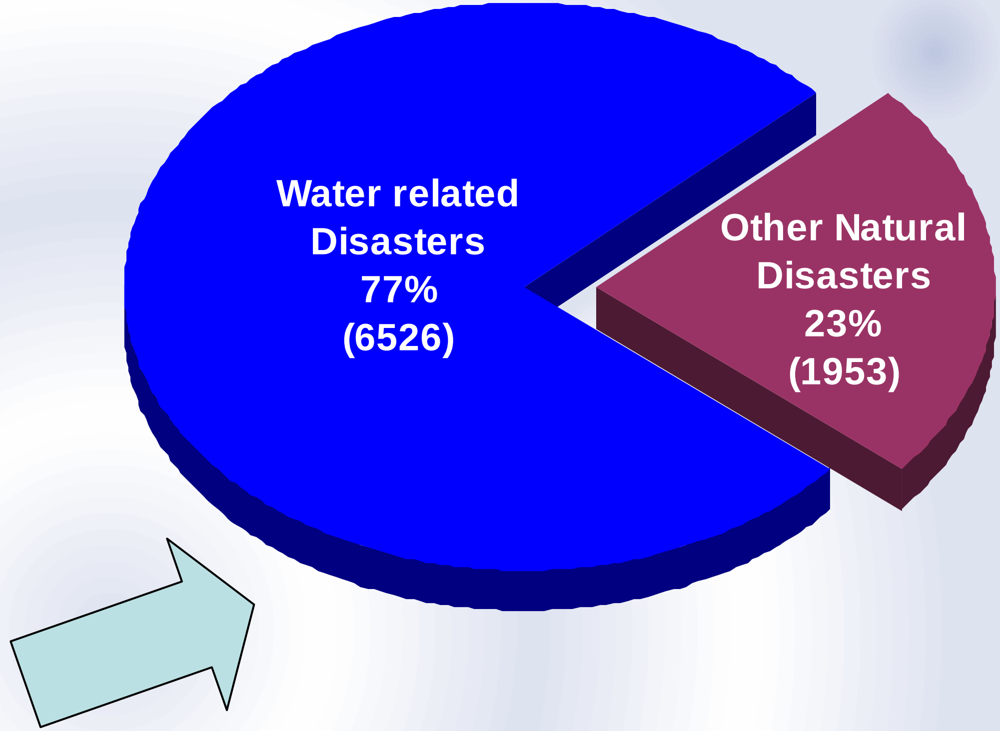
- ICHARMの活動予定

  (Planned activities of ICHARM)

- ICHARMの設立準備状況

  (Preparatory activities of ICHARM)

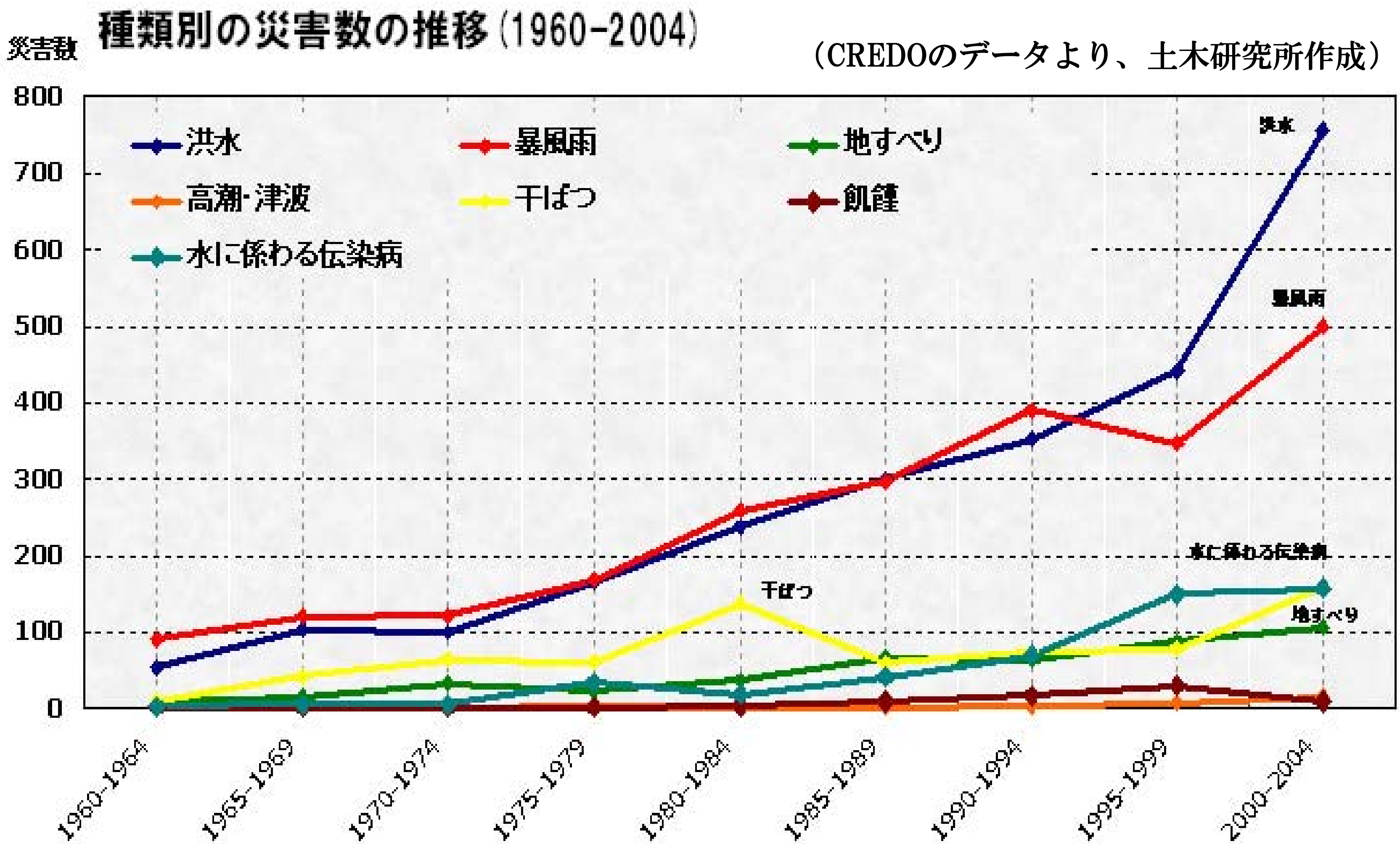




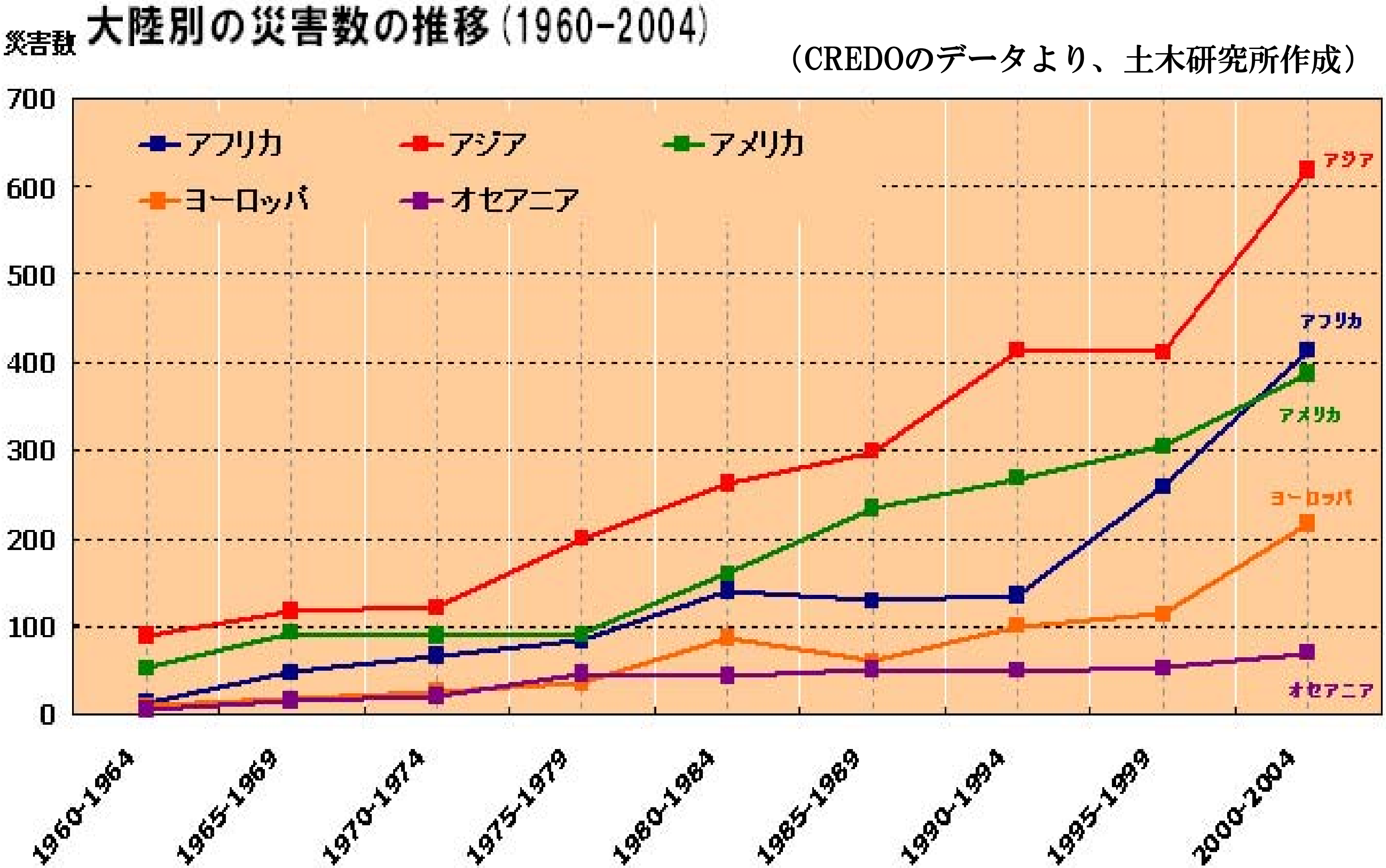
世界の自然災害発生件数のうち、約８割は水関連災害である。

Disasters in the World（1960－2004）

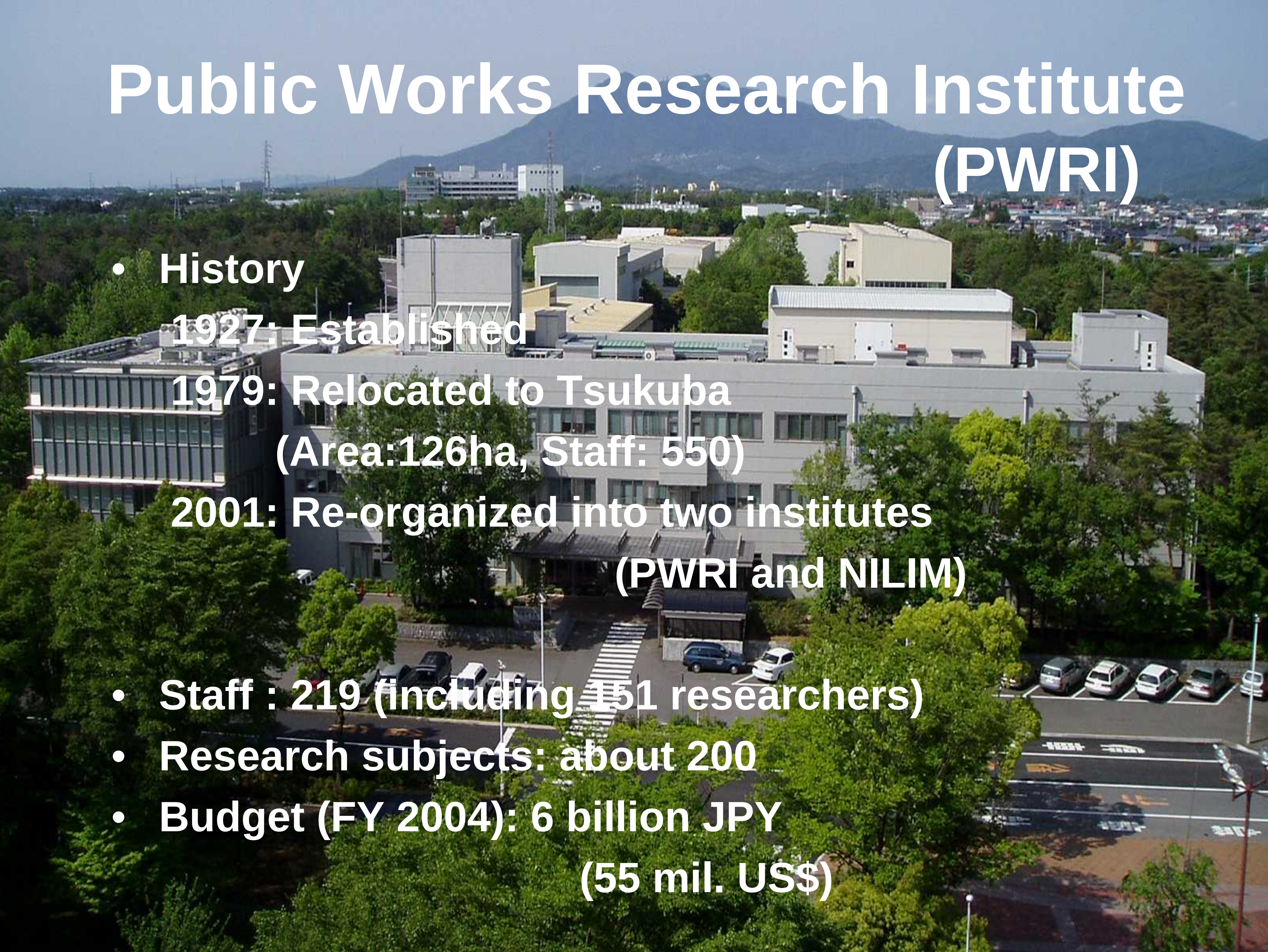
※ CREDOのデータより、土木研究所作成



死者１０名以上もしくは被災者１００名以上等の要件を満たす災害のうち、
洪水や暴風雨によるものが圧倒的な比率を占めており、近年増加傾向にある。



アジア地域の水災害発生件数は、世界の1/３以上を占めており、これも近年増加傾向にある。



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)

- Staff : 219 (including 151 researchers)
- Research subjects: about 200
- Budget (FY 2004): 6 billion JPY (55 mil. US$)

200 Research topics focusing on 14 priority research projects

- to ensure **safety**
- to conserve and restore the **environment**
- for **efficient management** of infrastructure

9 Research Groups with 20 teams

- **Construction Technology Research Dept.**
- **Material and Geotechnical Engineering**
- **Earthquake Disaster Prevention**
- **Water Environment (水循環G)**
- **Hydraulic Engineering (水工G)**
- **Erosion and Sediment Control (土砂管理G)**
- **Road Technology**
- **Structure**
- **Niigata Experimental Laboratory**

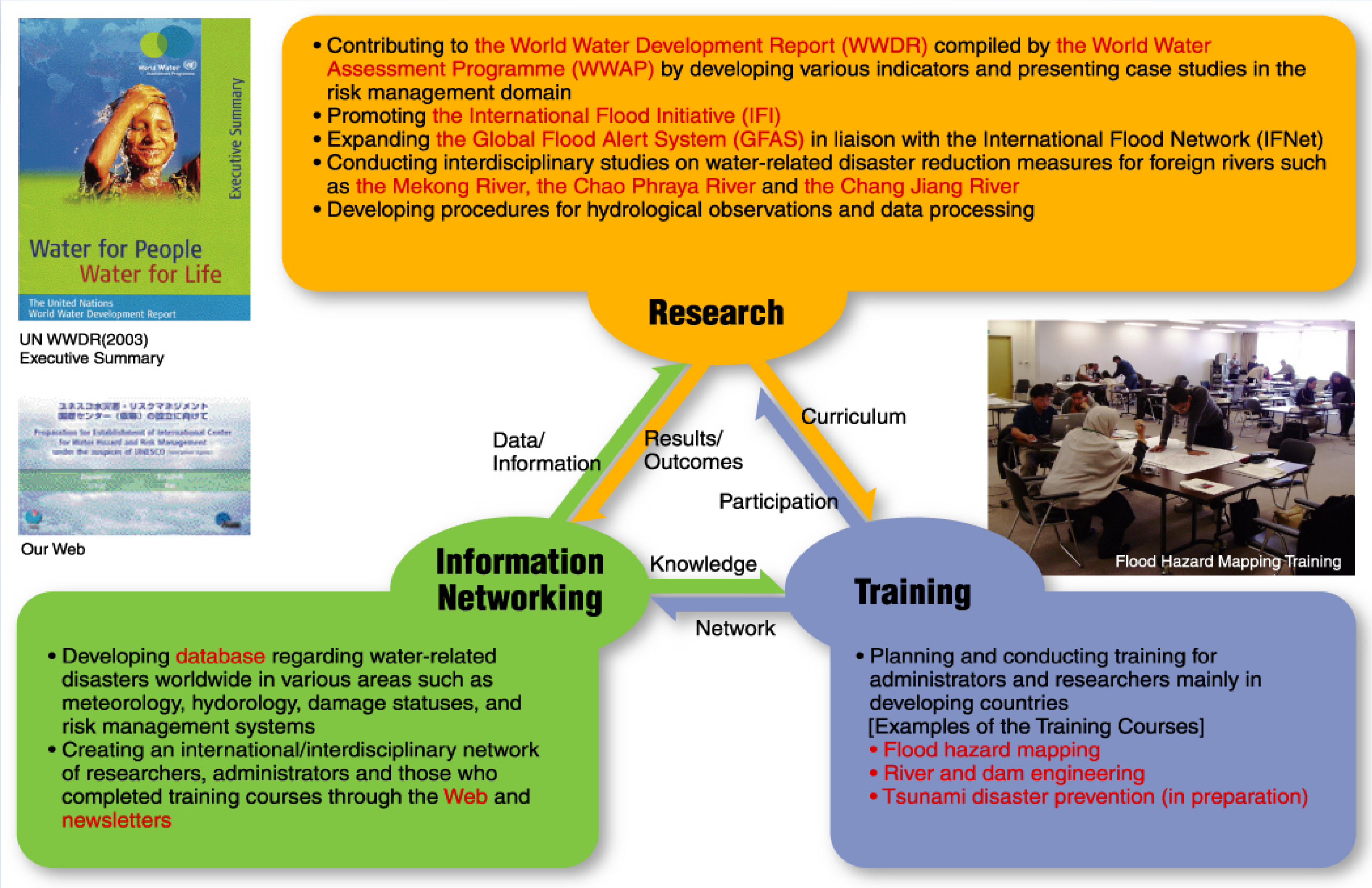
International Research Cooperation

Implementation arrangements with overseas organization

Objective of ICHARM

- **Accumulated knowledge and experience** trying to overcome water-related disasters
- **Global network of UNESCO-IHP** for internationally sharing valuable information

→ Contribution to prevent or mitigate water-related disasters in the world



Research, Training and Information networking activities would be promoted in a combined manner

Activities

- Research -

- Contribution to international projects such as WWAP and IFI/P (UNESCO/WMO)
- Hydraulic / hydrological prediction, observation, modeling and analysis
- Risk assessment and risk management technologies for water-related hazards under various socio-economic, geographic and climatic conditions

Activities

- Training and Capacity building -

Conducts JICA training courses, including

- River and dam engineering
- Flood Hazard Mapping

A new course on comprehensive tsunami disaster prevention is in preparation

Strengthen the follow up activities to link the training course to concrete action for preventing or mitigating water related disasters

TC on Flood Hazard Mapping

Objective

- Acquire professional knowledge necessary to produce flood hazard maps
- Enhance understanding of its effectiveness
- Seek application in his/her own country

Framework

- 4 weeks for 5 years (2004-2008)
- 16 trainees from 8 countries of Asia
- Place: Tsukuba, Japan (PWRI & JICA)

Activities

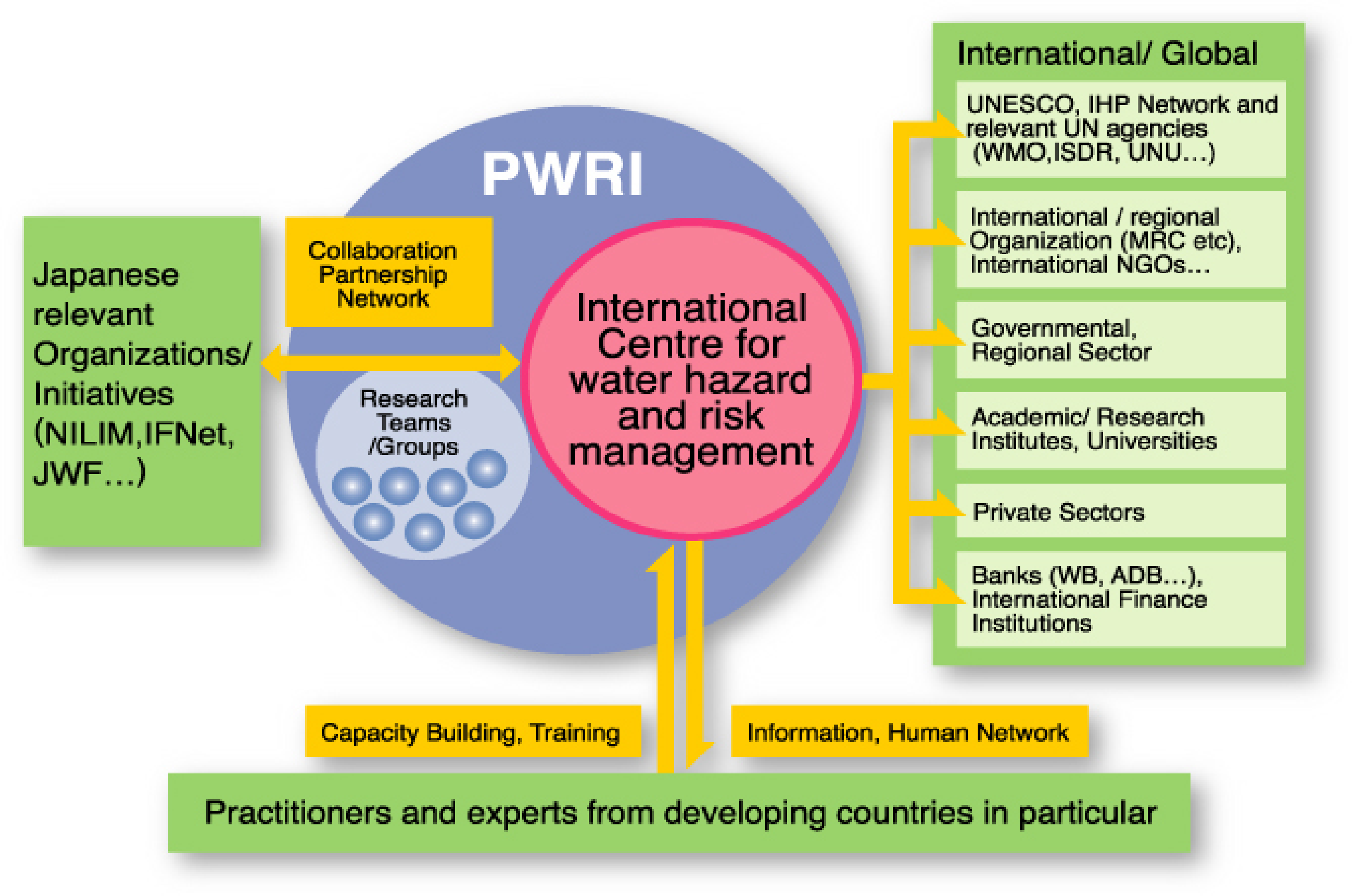
- Information Networking -

Information networking will be synergized with research and training activities

in order to enhance integration and coordination:

Through the information network…

- Research output will be widely disseminated
- Feedback from countries / regions will be reflected in the research projects
- Trainees will develop domestic links to their own countries/ regions
- Local needs for training items would be clarified



ICHARM would collaborate with the UNESCO-IHP networks, relevant UN agencies and other key institutes & organizations of the world

Preparatory activities

October 2003

32nd UNESCO General Conference

→ Announcement of intention to set up the Centre by the representative of Japanese Government

October 2003

RSC meeting in Southeast Asia & Pacific and in Latin America & Caribbean

→ Resolutions strongly supporting the establishment of the Centre

Preparatory activities (cont'd)

January 2004

International technical workshop at PWRI

→ Experts from Asia, Africa, East & West Europe, and North & South America

→ Summary Report on directions of the Centre

International Symposium in Tokyo

April 2004

Proposal of the new Center was welcomed at UNESCO IHP Bureau Meeting

July 2004

A preparatory meeting of IFI/P hosted by PWRI

Preparatory activities (cont'd)

September 2004

UNESCO IHP Intergovernmental Council

→ Resolution to support the proposal

January 2005

World Conference on Disaster Reduction

(Hyogo Japan, organized by ISDR)

→ Recognition of the role of ICHARM

→ Official launch of IFI


International Strategy
ISDR
for Disaster Reduction
Welcome to Hyogo
World Conference
18-22 January 2005, Kobe, Hyogo,

Dr. Sakamoto, CEO of PWRI, at the opening of the thematic session entitled ‘Research on Floods and Landslides and a new Initiative for Risk Reduction’

International Flood Initiative (1/2)

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 ･･･

Secretariat : ICHARM

International Flood Initiative (2/2)

Guiding principles

- Living with flood
- Equity
- Empowered participation
- Inter-disciplinary and trans-sectorality
- International and regional cooperation

Strategic Activities

- Research
- Training and education
- Information networking
- Capacity building
- Technical assistance

Preparatory activities (cont'd)

April 2005

- **UNESCO Executive Board (FA & PX)**

  →Draft decision was adopted to approve ICHARM at the General Conference in October 2005.

Preparatory activities (cont'd)

October 2005

33rd UNESCO General Conference

→ Proposal of the Japanese Government was accredited by 191 member countries

Office Space of ICHARM

Research Staff 20
(in the initial stage)

Office space
2,000m^2

END

Thank you for your attention

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

The 1st Conference on Public Works Research and Development in Asia

Duration	February 15, 1993 - February 26, 1993
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Infrastructure Policies for Economic and Social Development of Asian Countries by Prof. Fumio Nishino, University of Tokyo 2) Progress of Civil Engineering and Its Contribution to Economic and Social Development in Modern Japan － PWRI's 70 Years and Perspective － by Mr. Yukihiko Sumiyoshi, Director-General, Public Works Research Institute 3) The Role of Research and Technology Development in International Technical Cooperation by Mr. Hiroaki Tamamitsu, Vice President, Japan Construction Training Center
	Country Report 1) Outline of Country 2) Public Works System 3) Description of the Department/Institute in charge of R&D of Public Works 4) Major R&D projects in the Department/Institute 5) International Research Exchange Programmes in the Department/Institute 6) Activities concerning "Disaster and Disaster Prevention" 7) Activities concerning "Harmony between the Environment and Improvement of Infra."
	Subject of Common Interests on "Future Perspective for R&D of Disaster Prevention Techniques against Disaster caused by Rainfall" 1) River-Related Disaster 2) Sediment-Related Disaster
	Specific Subjects 1) Sedimentation of Dam Reservoir （China, Japan） 2) Water Pollution Control （Indonesia, Japan） 3) River Environment （Korea, Japan） 4) Soil Improvement （Thailand, Japan） 5) Tunnel （Singapore, Thailand, Japan） 6) Volcanic Disaster, Debris Flow and Road Disaster Prevention （Malaysia, Philippines, Japan） 7) River （China, Japan） 8) Water Quality （Korea, Japan） 9) Soil Mechanics and Foundation Engineering,Traffic Engineering （Malaysia, Thailand, Japan） 10) Pavement （Philippines, Singapore, Thailand, Japan） 11) Highway Bridges （Philippines, Japan）
	Study Tour Hokkaido （Shin-Chitose Airport, CERI, Muroran Hakucho-Bridge, Seikan-Tunnel etc.） Kanto (Trans-Tokyo Bay Highway、Miyagase-Dam）
Participants	Overseas: 8, Japan:37, Guests:35 (Overseas:5, Japan:30)

The 2nd Conference on Public Works Research and Development in Asia

Duration	November 15, 1993 - November 26, 1993
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Role of Civil Engineers for Sustainable Development by Mr. Atsushi Hamamori, President, Japan Overseas Consultants Co. Ltd. 2) Socio-Economic Development and Construction Technology Transfer by Mr. Yukihiko Sumiyoshi, Director-General, Public Works Research Institute 3) Research in Japan -Focusing Civil Engineering- by Prof. Hiroyoshi Shi-igai, University of Tsukuba
	Country Report 1) Outline of Country 2) Public Works System 3) Description of the Department/Institute in charge of R&D of Public Works 4) Major R&D projects in the Department/Institute 5) International Research Exchange Programmes in the Department/Institute
	・Subject of Common Interests on "Disaster and Disaster Prevention" 1) Comprehensive Countermeasure against Floods 2) Countermeasure against Highway Slope Failure ・Subject of Common Interests on "Harmony between the Environment and Improvement of Infrastructure" 1) Measures for Water Quality Control of Reservoirs and Rivers 2) Countermeasures against Air Pollution and Noise caused by Road Traffics in Urban Areas
	Specific Subjects 1) Debris Flow （China, Philippines, Japan） 2) Materials of the Highway Bridges -Concrete- （Indonesia, Japan） 3) Flood Control （Korea, Japan） 4) Care for the Rivers （Malaysia, Japan） 5) Utilization of the Underground Space （Singapore, Japan） 6) Air Pollution （Thailand, Japan） 7) Materials of the Pavement （Indonesia, Japan） 8) Environment Improvement -Water Quality Control- Korea, Thailand, Japan） 9) Creation of the River Environment （Malaysia, Japan） 10) Traffic Management （Singapore, Japan）
	Study Tour Chugoku-Shikoku（Seto-Ohashi） Kyushu（Yoshinogari Historical Park, Rokkaku River, Mt.Unzen etc.） Kanto （Trans-Tokyo Bay Highway）
Participants	Overseas: 7, Japan:41, Guests:60 (Overseas:7, Japan:53)

The 3rd Conference on Public Works Research and Development in Asia

<table>
<tr><td>Duration</td><td>October 17, 1994 - October 28, 1994</td></tr>
<tr><td>Place</td><td>Public Works Research Institute, MOC</td></tr>
<tr><td rowspan="5">Program</td><td>Keynote Lecture
1) Viewpoints on Panama Canal Alternative Study
by Dr. Akira Ishido, Managing Director, Yachiyo Engineering Co. Ltd.
2) Vision of Construction Technical Research and Development to the 21st Century
by Dr. Takashi Iijima, Director-General, Public Works Research Institute
3) Economic Growth, Infrastructure Development and International Cooperation in Asian Counties
by Prof. Yuzo Akatsuka, Saitama University</td></tr>
<tr><td>Trend of Public Works Research and Development
1) Role and Outline of Research Organization in Public Works
2) Activities and Topics of Research and Development in Research Organization
3) Research Management
(Implementation of Research, Mid-term or Annual Research Plan, Research Budget, Improvement of Researcher)</td></tr>
<tr><td>・ Subject of Common Interests on "Environmental Policy of Rivers, Lakes and Marshes" (Improvement of Water Quality, Infrastructure Development with Considerations for the Environment)
・ Subject of Common Interests on "Infrastructure Development in the field of Roads" (Establishment of Road Network, Maintenance and Management of Roads such as Pavement and Bridge)</td></tr>
<tr><td>Specific Subjects
1) Flood Control (Bangladesh, India Indonesia, Thiland, Japan)
2) Highway Planning, Traffic System (China, Korea, Japan)
3) Soil Improvement (Malaysia, Japan)
4) Water Pollution Control (Philippines, Thailand, Japan)
5) Volcanic Disaster, Debris Flow (Indonesia, Japan)
6) Geological Survey (Malaysia, Japan)
7) Water Quality for Drinking (Philippines, Japan)</td></tr>
<tr><td>Study Tour
Kinki （Akashi Kaikyo Ohashi, Osaka Bay Highway, Kansai International Airport, Asuka Historical Park, Otaki Dam）</td></tr>
<tr><td>Participants</td><td>Overseas: 9, Japan:36, Guests:65 (Overseas:7,Japan:58)</td></tr>
</table>

The 4th Conference on Public Works Research and Development in Asia

Duration	September 25, 1995 - October 4, 1995
Place	Public Works Research Institute, MOC
Program	Trend of Public Works Research and Development 1) Role and Outline of Research Organization in Public Works 2) Activities and Topics of Research and Development in Research Organization 3) Research Management (Implementation of Research, Mid-term or Annual Research Plan, Research Budget, Improvement of Researcher)
	Subject of Common Interests on " Research and Development for Natural Disaster Reduction"
	Specific Subjects 1) Flood Control (Bangladesh, India, Indonesia, Thailand, Japan) 2) Highway Planning, Traffic System (China, Korea, Japan) 3) Soil Improvement (Malaysia, Japan) 4) Water Pollution Control (Philippines, Thailand, Japan) 5) Volcanic Disaster, Debris Flow (Indonesia, Japan) 6) Geological Survey (Malaysia, Japan) 7) Water Quality for Drinking (Philippines, Japan)
	Study Tour Kinki （Akashi Kaikyo Ohashi, Osaka Bay Highway, Kansai International Airport, Asuka Historical Park, Otaki Dam）
Participants	Overseas: 9, Japan: 36, Guests: 65 (Overseas: 7,Japan: 58)

The 5th Conference on Public Works Research and Development in Asia

Duration	October 25, 1996 - October 22, 1996
Place	Public Works Research Institute, MOC
Program	Keynote Lecture 1) Case Study from my Overseas Work by Dr. Yorio MURAKAMI, Vice President, Kawasaki Geological Engineering Ltd. 2) Report on the Disaster Caused by 1995 Hyogoken Nanbu Earthquake by Mr. Tadahiko SAKAMOTO, Director-General, Public Works Research Institute 3) Development Cooperation and Public Works in Asia by Dr. Akira TAKAHASHI, Professor Emeritus, University of Tokyo
	Subject of Common Interests 1) Harmony between Public Works and Environment 2) Securement and Training of Civil Engineers
	Specific Subjects 1) Earthquake Disaster (India, Philippines, Japan) 2) River Management (Malaysia, Thailand, Japan) 3) Road Technology (China, Japan) 4) Soft Ground (Bangladesh, Korea, Japan) 5) Air Pollution (Indonesia, Nepal, Japan)
	Study Tour Tohoku（Ichinoseki Retarding Basin, Onikobe Road, Sen-en Road)
Participants	Overseas: 9, Japan: 36, Guests: 65 (Overseas: 7,Japan: 58)

The 6th Conference on Public Works Research and Development in Asia

Duration	October 14, 1997 - October 21, 1997
Place	Harbor View Hotel, Okinawa
Program	Keynote Lecture
	1) Regional Development and the Environment Dr. Hosei Uehara, Professor, University of the Ryukyus
	2) Intelligent Transport Systems (ITS) Mr. Seizo Tsuji, Director General, PWRI
	3) Okinawa's Social Capital and Development Technologies Mr. Tamio Shimogami, Engineering General, Okinawa Prefectural Government
	Subject of Common Interests
	"Research and Development of Public Infrastructure Suitable to Environmental and Climatic Condition"
	Specific Subjects
	1) Soil Mechanics and Foundation .... Bangladesh, India, Japan 2) Flood Control .... Thailand, Japan 3) Traffic Management .... China, Nepal, Japan 4) Water Quality Control .... Indonesia, Malaysia, Japan 5) Volcanic Disaster, Debris Flow .... Philippines, Japan
	Study Tour
	Kinjo Dam Gushigawa Sewage Disposal Facility Haneji Dam Okinawa National Memorial Park
Participants	200

The 7th Conference on Public Works Research and Development in Asia

Duration	October 12, 1998 - October 23, 1998
Place	Okinawa Convention Center, Okinawa
Program	Keynote Lectures
	1)Surveyal,Planning,Design and Implementation of Bridge Construction in Japan's Grant Aid Projects Mr. Satoshi Watabe, Pacific Consultants International
	2)Disaster Preventive Project under the Consideration of Nearby Environmental Condition － The Project for Flood Mitigation in Ormoc City, Phillippines Mr. Hitoshi Kin, CTI Engineering Co., Ltd.
	3)Infrastructure Development and Management Prof.Masahiko Kunishima, University of Tokyo
	4)Okinawa's Coastal Waves and Outflow of Red Soil to the Seashore Dr. Seikoh Tsukayama, Professor, University of Ryukyus
	5)New Direction for Sustainable Development in Asia Mr. Yasutake Inoue, Director General, PWRI
	6)Promotion and Development of Okinawa and Its Public Works Technology Mr. Masamichi Shirahase, Vice Director General, Okinawa General Bureau
	Subject of Common Interests
	"Research and Development on the Comprehensive Disaster Prevention Measures Considering Ecological Environment and Social Condition"
	Specific Subjects
	1) Water Pollution .... Bangladesh, India, Japan 2) Flood Control .... Bangladesh, Philippines, Korea, Japan 3) Soil Improvement and Slope Protection...................India, Laos, Malaysia, Japan 4) Pavement .... Indonesia, India, Malaysia, Japan 5) Sedimentation of Dam Reservoir .... Malaysia, Korea, Japan 6) Earthquake Disasters .... Nepal, Japan 7) Coastal Erosion .... Thailand, Japan
	Study Tour
	Haneji Dam Okinawa National Memorial Park
Participants	Oveaseas: 11, Japan: 30, Guests: 60

The 8th Conference on Public Works Research and Development in Asia

Duration	October 12, 1999 - October 21, 1999
Place	Kariyushi Urban Resort Naha, Okinawa
Program	Keynote Lectures
	1)Present Situation and Tasks of Japan's ODA－Mainly on Infrastructures Mr. Kenji Kiyomizu, Development Specialist on Civil Engineering of JICA
	2)Infrastructure Development and Management in Asia Prof.Masahiko Kunishima, University of Tokyo
	3)Asian Concrete Model Code Asso. Prof. Tamon Ueda, University of Hokkaido
	Subject of Common Interests
	"Research and Development on the Construction Technology Which is Applicable to the Local Natural Environment and Social Condition"
	Specific Subjects
	1) National Disaster Prevention... India, Japan 2) Soil Improvement..Bangladesh, Malaysia, Japan 3) Sedimentation of Dam Reservo..................................... Nepal,Philippines, Japan 4) Design Load of Bridges ....Thailand, Japan 5) Under Ground Use ....Indonesia, Korea, Japan 6) Pavement .... Laos, Japan 7) River Management...China, Japan
	Study Tour
	Okinawa National Memorial Park Haneji Dam Seawater Desalination Plant
Participants	200

The 9th Conference on Public Works Research and Development in Asia

Duration	October 10, 2000 - October 19, 2000
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Keynote Lectures
	Public Works Management Mr. Akira Fujimoto Research Coordinator for Public Works Management, Research Center for Public Works Management, PWRI Prof. Masahiko Kunishima, University of Tokyo Mr. Takenori Yamashita Head, Management Research Division Research Center for Public Works Management, PWRI Mr. Kenichi Matsui Head, System Development Division Research Center for Public Works Management, PWRI
	Subject of Common Interests
	"Research and Development on Promoting Technology Transfer in the Field of Construction Technology"
	Specific Subjects
	1) River Management..Laos, Japan 2) Water Quality Control... China, Japan 3) Sedimentation of Dam Reservoir ....Malaysia, Japan 4) Traffic Management ....Nepal, Philippines, Japan 5) Soil Improvement..Thailand, Japan 6) Earthquake Disaster Prevention..India,Indonesia, Japan
	Study Tour
	ITS Information Center Haneji Dam Okinawa National Memorial Park Kanna Dam Historical Road
Participants	130

The 10th Conference on Public Works Research and Development in Asia

Duration	October 16, 2001 - October 25, 2001
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Lectures
	Public Works Management Mr. Kenichi Matsui Head, Construction Management Division Research Center for Land and Construction Management, NILIM
	Subject of Common Interests
	"Research and Development on Public Works Concerned with Reducing Environmental Impact for Sustainable Development"
	Specific Subjects
	1) Water Quality Management..India, Japan 2) River Management...Lao, Nepal, Japan 3) Coast Management...Malaysia, Japan 4) Traffic Management ....Thailand, Japan 5 Earthquake Disaster Prevention...... ....Bangladesh, India, Japan
	Study Tour
	1)Arakawa River Channel 2)Kobe Akashi Kaikyo Bridge 3)Okinawa ITS Information Center Electric Power Plant Kanna Dam Plastic Bridge
Participants	100

The 11th Conference on Public Works Research and Development in Asia

Duration	October 15, 2002 - October 24, 2002
Place	National Institute for Land and Infrastructure Management, MLIT Bankoku Shinryokan, Okinawa
Program	Keynote Lectures
	1) Hydrology and Water Resources in Monsoon Asia Dr. Katumi Musiake President, Japan Society of Hydrology and Water Resources Department of Human and Society, Institute of Industrial Science University of Tokyo
	2) Flood and Sediment-related Disasters in Japan Mr. Yasuo Nakano, Director Research Center for Disaster Risk Management, NILIM
	3) Comprehensive Water-Resource Issues of Island Communities Dr. Housei Uehara, Honorary Professor, University of the Ryukyus
	Subject of Common Interest
	"Water Resources and River Management for Sustainable Development"
	Specific Subjects
	1) Specific Subjets [1] a) Flood Control and Water Resources Management .... India, Indonesia, Laos, Philippines, Thailand, Japan b) Water quality.. Malaysia, Sri Lanka, Japan c) Groundwater... Pakistan, Japan 2) Specific Subjects [2] a) Roads, Pavement, Traffic Management & Safety .... India, Indonesia, Laos, Pakistan, Sri Lanka, Japan b) Volcanic Disaster, Erosion Control & Debris Flow .... Philippines, Malaysia, Thailand, Japan 3) Specific Subjects [3] -Red Soil Erosion Countermeasures & Environmental Preservation in Okinawa- a) Integrated Operation of dams b) Road Construction... Indonesia, Korea, Laos, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Japan
	Study Tour
	1) Kyoto: Ohtsu Auxiliary Conduit, Seta River Weir(Outlet Flow Control) Amagase Dam, Drainage of Lake Biwa and the Incline, 2) Osaka: Legacy of Sayama Pond 3) Okinawa: The Urban Monorail System, Le Village, Haneo Dam, Taiho Dam
Participants	130

The 12th Conference on Public Works Research and Development in Asia

Duration	October 20, 2003 to October 31, 2003
Place	National Institute for Land and Infrastructure Management, MLIT Tokyo International Center, JICA Okinawa Convention Center
Program	**Keynote Lectures** 1) Public Transport in Urban Areas Dr. Fumihiko NAKAMURA Associate Professor, Department of Civil Engineering Yokohama National University 2) Development Trend and Urban Traffic Problem in Okinawa Central and Southern City Area Dr. Takayuki IKEDA Professor, Department of Civil Engineering & Architecture, University of Ryukyus
	Lectures 1) Technical Standard for Pavement and Asset Management in Japan Mr. Masahide ITO Team Leader, Pavement Research Team, Road Technology Research Group, Public Works Research Institute 2) Maintenance of Bridge Mr. Shoichi NAKATANI Head, Bridge Division, Road Dept. NILIM 3) ITS and Transportation - What will be changed? Dr. Harutoshi YAMADA Director, Research Center for Advanced Information Technology, NILIM 4) Environmental Problems in Urban Transport Mr. Michio TANAHASHI Director, Environment Dept., NILIM 5) Promotion of International Mobility of Engineers - APEC Engineer Project Mr. Shigeatsu TAKI Representative, Taki Associates
	Subject of Common Interest Session Traffic and Road - Measures for Urban Traffic Problem in Asian Big Cities
	Discussions of Specific Subjects 1) Technical Standard for Pavement and Asset Management in Japan 2) Maintenance of Bridge 3) Environmental Problems in Urban Transport 4) Restoration of Environment
	Study Tour 1) Tsukuba: Tsukuba Express Railway Construction Site, Tsukuba Space Center 2) Tokyo: Japan Highway Public Corporation(Electronic Toll Collection System, Tokyo Bay Cross Highway: Tokyo Bay Aqua Line) 3) Okinawa: Okinawa Urban Monorail: YUI RAIL, Shurijo Castle, Okinawa Churaumi Aquarium
Participants	130

The 13th Conference on Public Works Research and Development in Asia

Duration	October 18, 2004 - October 29, 2004
Place	National Institute for Land and Infrastructure Management, MLIT Tokyo International Center, JICA Okinawa Convention Center
Program	**Keynote Lectures** 1) Appropriate Sewage Treatment Technology for Developing Region Dr. Hideki HARADA Professor, Environmental Biotechnology Laboratory, Nagaoka University of Technology 2) Water Issues in Ryukyu Islands Dr. Chokei YOSHIDA Board Member, Okinawa P. Public Health Association
	Lectures 1) Treated Wastewater Reuse in Japan Mr. Atsushi TAJIMA Senior Researcher, Wastewater and Sludge Management Division, Water Quality Control Dept. NILIM 2) Occurrence of Endocrine Disrupting Compounds in Wastewater and Their Fate in Wastewater Treatment Plant and Environment Mr. Yutaka SUZUKI Team Leader, Water Quality Team, Water Environment Research Group, PWRI Mr. Hiromasa YAMASHITA Senior Researcher, Recycling Team, Material and Geotechnical Engineering Research Group, PWRI 3) Water Quality Management in Japan Dr. Hiroyuki ITO Senior Researcher, River Environment Division, Environment Dept., NILIM 4) Comprehensive Flood Control Measures Mr. Koichi FUJITA, Head, River Environment Division, Environment Dept., NILIM 5) Urban Flood Management Mr. Tetsuya NAKAMURA Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM 6) Urban Drainage and Inundation Prevention Measures in Japan Mr. Kazuya FUJIU (for Mr. Motoi NASU) Head, Wastewater System Division, Water Quality Control Dept., NILIM 7) The World Water Forum Mr. Hideaki ODA, Secretary General, Japan Water Forum
	Subject of Common Interest Session Management of Urban Water Environment
	Discussions of Specific Subjects 1) Water Quality 2) Flood Control in Urban Areas
	Study Tour 1) Tsuchiura: Kasumigaura Kohoku Regional Sewerage System / Kasumigaura Sewage Treatment Plant, Tsuchiura Bio-Park 2) Tokyo: Morigasaki Water Reclamation Center, Digestive Gas Power Facilities, Ariake Wastewater Treatment Plant, Purification Plant, Odaiba Marine Park, Shiodome Reclaimed Water & Sprincle Test Facilities 3) Okinawa: Naha Sewage Treatment Plant, A Building Using Reclaimed Water in Naha New Urban Center, Makabi Retarding Basin, Kinjo Dam, Shuri Castle
Participants	130

The 14th Conference on Public Works Research and Development in Asia

Duration	October 17, 2005 - October 28, 2005
Place	National Institute for Land and Infrastructure Management, MLIT Japan International Cooperation Agency, Sendai International Center
Program	**Keynote Lectures** (1) Disaster Mitigation Perspective – From Engineering to Citizen's Participation Dr. Yujiro OGAWA, Professor, College of Environment and Disaster Research, Fuji Tokoha University (2) Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami Dr. Fumihiko IMAMURA, Professor, Disaster Control Research Center, Graduate School of Engineering, Tohoku University
	Lectures (1) Mitigation Measures and Risk Management against Flood and Coastal Disaster 1)Dr. Tadashi SUETSUGI, Head, River Division, River Dept. NILIM 2)Mr. Tetsuya NAKAMURA, Head, Flood Disaster Prevention Division, Research Center for Disaster Risk Management, NILIM 3)Mr. Fumihiko KATO, Senior Researcher, Coast Division, River Dept. NILIM (2) Procedure for Setting Area for Restriction on Land Use in order to Reduce Risk due to Sediment-related Disasters Dr. Hideaki MIZUNO, Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (3) Development of Warning and Evacuation System against Sediment-related Disasters Dr. Nobutomo OSANAI, Head, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM (4) Debris Flows Detection Sensors Mr. Jun'ichi KURIHARA, Team Leader, Volcano and Debris Flow Research Team, Erosion and Sediment Control Research Group, PWRI (5) Development of the Landslide Displacement Detection Sensor Using Optical Fiber Mr. Kazunori FUJISAWA, Team Leader, Landslide Research Team, Erosion and Sediment Control Research Group, PWRI (6) The World Water Forum Mr. Hideaki ODA, Secretary General, Japan Water Forum
	Subject of Common Interest Session Risk Management and Mitigation for Flood and Sediment Related Disasters
	Discussions of Specific Subjects 1) Mitigation Measures and Risk Management against Flood and Coastal Disaster 2) Risk Management and Mitigation for Sediment-related Disasters 3) Flood Forecasting and Warning
	Study Tour 1) Tsukuba Area: 1986 Kokai River Embankment Destruction Part, Kokai River Hakojima Retarding Basin 2) NILIM and PWRI: UNESCO-PWRI Centre, Current Meter Calibration Channel, River Model Test Yard, Coastal Hydraulics Laboratory, Smart Communication & Advanced Cruise-assist Highway Systems 3) Tokyo Area: Kanda River/Loop 7 Underground Regulation Pond Works, Tsurumi River Multipurpose Retarding Basin, Slope Failure Prevention Works in Yokohama, PARI's Large Hydro-Geo Flume and Intelligent Wave Basin for Maritime Environments, NILIM Yokosuka's Airplane Loading Test Systems 3) Tohoku Area: Ishibuchi Dam, Isawa Dam, Chusonji-Temple, Ichinoseki Retarding Basin, Satetsu-River Disaster Restoration Site
Participants	100

The 1st Symposium on Public Infrastructure and Civil Engineering in Asia

Date	February 22, 1993
Place	Sapporo Grand Hotel
Host	Public Works Research Institute of MOC, Civil Engineer Research Institute of Hokkaido Development Bureau
Program	Keynote Lecture on "Development and Infrastructure of Hokkaido" by Prof. Hideo IGARASHI, Hokkaido University
	Panel Discussion on "Public Infrastructure Projects in Each Country and Their Technical Problems" Coordinator: Toshitaka OHTA, Director General, CERI, Hokkaido Development Bureau, JAPAN Panelists : Yukihiko SUMIYOSHI, Director-General, PWRI, MOC, JAPAN CHEN Bing Xin, Director, IWHR, CHINA BADRUDDIN Machbub, Director, RIWRD, ARD, MPW, INDONESIA LEE Sang Eun, Vice President, KICT, KOREA Abdul RAHMAN B. Abdullah, Deputy Director General, PWD, MALAYSIA Manuel M. BONOAN, Assistant Secretary for Planning, DPWH, PHILIPPINES TAN Siong Leng, Director, Building Control Div., PWD, SINGAPORE TEERACHARTI Ruenkrairergsa, Director, Road R&D Center, DOH, THAILAND
Participants	200

The 2nd Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	November 22, 1993
Place	Soralia Nishi-Tetsu Hotel
Host	Public Works Research Institute and Kyushu Regional Construction Bureau, MOC
Program	Keynote Lecture on "Regional Development and Civil Engineering Technology in Kyushu" by Prof. Takeshi CHISHAKI, Kyushu University
	Panel Discussion on "Striving for a Better Environment -Regional Development Projects, Disaster Prevention, Environmental Issue-" Coordinator: Yukihiko Sumiyoshi, Director-General, PWRI, MOC, JAPAN Panelists: Eiki ARAMAKI, Director General, Kyushu Regional Construction Bureau, MOC, JAPAN WU Ji Shan, Director, IMHE, CHINA SOEDARMANTO Darmonegoro, Secretary, ARD, MPW, INDONESIA KIM Keung Hwan, Director, Planning & Coordination Div., KICT, KOREA TEH Siew Keat, Director of River Engineering, DID, MALAYSIA Jose H. ESPIRITU, Director, BRS, DPWH, PHILIPPINES KHOR Poh Hwa, Chief Civil Engineer, PWD, SINGAPORE ANUSORNANT Mahavinichaimontri, Director, Materials and Research Div., PWD, THAILAND
Participants	200

The 3rd Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 24, 1994
Place	Mainichi Oval Hall
Host	Public Works Research Institute and Kinki Regional Construction Bureau, MOC
Program	Keynote Lecture on "Struggling to Develop the New Construction Technology" by Mr. Koutaro HASHIMOTO, Director General, Kinki Regional Construction Bureau, MOC Keynote Lecture on "Cultural Exchange in Global Age" by Prof. Nobuyuki HATA, National Museum of Ethnology
	Panel Discussion on "Public Infrastructure and Development of Construction Technology in Asia" Coordinator: Hiroji NAKAGAWA, Professor, Kyoto University, JAPAN Panelists : Takashi IIJIMA, Director-General, PWRI, MOC, JAPAN Abdul Wahed CHOWDURI, Joint Secretary, MHPW, BANGLADESH XIONG Qiu Shui, Senior Engineer, SPTD, Min. of Com., CHINA Kewal Krishan MADAN, Director General, CPWD, MUD, INDIA Mohamad Yusuf GAYO, Director of MIER, DGWRD, MPW, INDONESIA KIM Il-Joong, Director, Technology Promotion Div., MOC, KOREA Abdul KADIR bin Awang Hamat, Director, IKRAM, PWD, MOW, MALAYSIA Luis A. MAMITAG, Jr., Chief of R&D Div., BRS, DPWH, PHILIPPINES WIJARN Thunthithum, Senior Engineer, DWD Sub-Div., SED, PWD, THAILAND
Participants	300

The 4th Symposium on Public Infrastructure and Civil Engineering in Asia
（Session of Ministers' Forum on Infrastructure Development in the Asia-Pacific Region）

Duration	September 27, 1995
Place	Hotel New Otani Osaka
Host	Public Works Research Institute and Kinki Regional Construction Bureau, MOC
Program	Panel Discussion on "Research and Development and International Research Cooperation for Great N atural Disaster Reduction" Coordinator: Takashi IIJIMA, Director-General, PWRI, MOC, JAPAN Panelists : Yasuyuki KOGA, Director, Earthquake Disaster Prevention Dept. ,PWRI, MOC, JAPAN Abdul MAJID Khan, Director General, RRI, BANGLADESH Guowei YANG, Senior Engineer, CWRC, CHINA Digvijai SINGH, Director General, CRRI, MST, INDIA PATANA Rantetoding, Director General, IRE, MPW, INDONESIA Antonio A. STA. ELENA, Regional Director, DPWH, Region Ⅸ, PHILIPPINES SURAPOL Pongthaipatana, Deputy Director General, TTI, PWD, MOI, THAILAND
Participants	200

The 5th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 21, 1996
Place	Sendai International Center
Host	Public Works Research Institute and Tohoku Regional Construction Bureau, MOC
Program	Panel Discussion on "Harmony between Regional Development Projects and Environment" Coordinator: Tadahiko SAKAMOTO, Director-General, PWRI, MOC, JAPAN Panelists : Toshiki AOYAMA, Director-General, Tohoku Regional Construction Bureau, MOC, JAPAN MD. Siddique Ullah, Chief Engineer, Public Works Department, Ministry of Housing and Public Works, BANGLADESH Zhang Yuan-fang, Deputy Director, Research Institute of Highway, Ministry of Communications, CHINA Surinder Kumar Chawla, Chief Engineer, Central Public Works Department, Ministry of Urban Affairs and Employment, INDIA Joelianto Hendro Moeljono, Director General, Agency for Research and Development, Ministry of Public Works, INDONESIA Hong Sung-Wan, Vice President, Korea Institute of Construction Technology, KOREA Keizrul Bin Abdullah, Deputy Director General I, Department of Irrigation and Drainage, Ministry of Agriculture, MALAYSIA Nestor V. Agustin, Assistant Regional Director, Region IV, Department of Public Highways ,Region IX, PHILIPPINES Siripong Hungspreug, Director, Project Planning Division, Royal Irrigation Department, THAILAND Mohan Bahadur Karki, Director General, Department of Roads, Ministry of Works and Transport, NEPAL
Participants	200

The 6th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 17, 1997	
Place	The Busena Terrace Beach Resort	
Host	Public Works Research Institute Okinawa General Bureau and Okinawa Prefectural Government	
Program	Keynote Address	Prof. Kiyoshi UEMA "Okinawa's Heritage and Social Infrastructure"
	Panel Discussion	"Research and Development of Social Infrastructure Suitable to the Environment and Climatic Condition"
Panelists	Tamio Shimogami	Engineer General, Okinawa Prefectural Government, JAPAN
	Azizul Haque	Additional Chief Engineer, Public Works Department Under Ministry of Works, Govt. of BANGLADESH
	Qi Ji	Vice Director, China Building Technology Department Center, CHINA
	Krishan Kumar	Chief Engineer & Project Manager, Parliament Library Project, Central Public Works Department, INDIA
	Zulkarnaen Aksa	Executive Secretary Agency for Public Works' Research and Development, Ministry of Public Works, INDONESIA
	Ahmad Fuad Bin Embi	Director, Drainage Division, Department of Irrigation and Drainage, MALAYSIA
	Devendra Prasad Rimal	Joint Secretary, Ministry of Works and Transport, NEPAL
	Salvador L. Manto	Division Chief, Portworks & Shore Protection Division Bureau of Construction, Department of Public Works and Highway's, PHILIPPINES
	Vidhaya Samaharn	Director, Research and Laboratory Division, Royal Irrigation Department, THAILAND
	Coordinator Seizo Tsuji	Director - General, PWRI
Participants	200	

The 7th Symposium on Public Infrastructure and Civil Engineering in Asia

Duration	October 18, 1999	
Place	Okinawa Convention Center	
Host	Okinawa General Bureau	
Program	Theme	"R&D of Paving Technologies Suited to Environmental and Climatic Conditions"
	Keynote Address	"Recent Development in Paving Technology" Tamotsu Kobayashi, Research Coordinator for Traffic Safety, PWRI
		"R&D of Paving Technologies in Okinawa" Kaoru Seto, Sr. Officer, Planning & Coordination, Development Construction Department, Okinawa General Bureau
	Site Visits	Test Site: Semi-Flexible Pavement（Nakanishi Area, Urasoe City）
Paticipants	A. K. M. Mukitur Rahman	Additional Chief Engineer, Public Works Department, BANGLADESH
	Indu Prakash	Chief Engineer, Ministry of Surface Transport（Road Wing）, INDIA
	Mohammad Sjahdanulirwan	Acting Director, Institute of Road Engineering, Agency for Research and Development of Public Works, Ministry of Public Works, INDONESIA
	Chai Sung Gee	Research Fellow, Korea Institute of Construction Technology, KOREA
	Laokham Sompheth	Project Manager, Ministry of Communication Transport, Post, and Construction, LAOS
	Haji Ghazali Bin Omar	Director, Drainage Division, Department of Irrigation & Drainage, MALAYSIA
	Abdul Razak Bin Dahalan	Deputy Director, Department of Irrigation & Drainage, Perak, MALAYSIA
	Lekh Raj Upadhyay	Director General, Department of Building, Ministry of Housing and Physical Planning, NEPAL
	Manuel Agyao Y. Swegen	Regional Director, Cordillera Administrative Region, Department of Public Works and Highways, PHILIPPINES
	Thiraphan Thongpravati	Chief Engineer, Public Works Department, Ministry of Interior, THAILAND
	Masamichi Shirahase	Vice Director-General, Okinawa General Bureau
Others	70	

The 8th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 18, 1999	
Place	Kariyushi Urban Resort Naha	
Host	Okinawa General Bureau and Okinawa Prefectural Government	
Program	Keynote Lecture	Prof. Takeshi OSHIRO "Corrosive Environment and Salt Induced Damage of RC Structures"
	Panel Discussion	"Research and Development on the construction technology which is applicable to the local natural environment and social condition"
Panelists	Ayumu Yasukawa	Engineer General, Okinawa Prefectural Government, JAPAN
	Morshed Uddin	Additional Chief Engineer, Public Works Department Under Ministry of Works, Govt. of BANGLADESH
	Qian, Min	Vice Director General, Huaihe River Commission, Ministry of Water Resources, CHINA
	Prabodh Gopal Dhar Chakrabartir	Director, Ministry of Urban Development, INDIA
	Supardiyono Sobirin	Director, Research Institute for Human Settlements, INDONESIA
	Hong, Sung Wan	Senior Research Fellow, Korea Institute of Construction Technology, KOREA
	Math Sounmala	Director General, Cabinet Office, Ministry of Communication Transport Post and Construction, LAOS
	Wahid bin Omar	Deputy Director General Ⅱ, Public Works Department, MALAYSIA
	Kedar Prakash Rizal	Project Director, Water Induced Disaster Prevention Technical Centre, Ministry of Water Resources, NEPAL
	Eleno Uttoh Colinares,Jr	Regional Director, Department of Public Works and Highways, Region Ⅴ, PHILIPPINES
	Samart Yolpak	Chief Engineer, Public Works Department, Ministry of Interior, THAILAND
	Coordinator Tomomitsu Fujii	Director - General, PWRI
Participants	200	

The 9th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 17, 2000
Place	Bankoku Shinryokan, Okinawa
Host	Public Works Research Institute Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Tetsuya YABUKI, Professor, University of the Ryukyus "Case of Japan Ⅰ″ －New Developments in Bridges－ Mr. Takeshi HASHIMOTO, Deputy Director General, Okinawa General Bureau, Okinawa Development Agency "Case of Japan Ⅱ″ －Infrastructure Development in Okinawa- Mr. Subhash Chander VASUDEVA, Additional Director General, Central Public Works Department, Ministry of Urban Development, INDIA "Case of INDIA" Ir. SAROSO Bambang Suksmono, Operation Management Director, The Research Institute for Road Infrastructure Technology, Ministry of Settlement & Regional Development, Republic of INDONESIA "Case of Republic of INDONESIA" Dr. Hyoseop WOO, Senior Research Fellow, Korea Institute of Construction Technology, Republic of KOREA "Case of KOREA" Mr. Jesus Pedro CAMMAYO, Assistant Secretary, Department of Public Works and Highways, Republic of the PHILIPPINES "Case of PHILIPPINES"
Participants	130

The 10th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 23, 2001
Place	Bankoku Shinryokan, Okinawa
Host	National Institute for Land and Infrastructure Management Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Toshiya SHINJO, Professor, University of the Ryukyus "Case of Japan Ⅰ″ －Foundation Work on the Limestone Ground Layer of the Southwest Islands－ Mr. Tadayuki TAZAKI, Director-General, National Institute for Land and Infrastructure Management "Case of Japan Ⅱ″ －Public Works Environmental Technology in Japan－ Dr. Gyn-Jin Bae, Director, Civil Engineering Research Division, Korea Institute of Construction Technology, Republic of KOREA "Case of KOREA" Mr. Hin Seang SAW, Director, Coastal Engineering Division, Department of Irrigation and Drainage, MALAYSIA "Case of Republic of MALAYSIA" Mr. Amoda Nand MISHRA, Director-General, Department of Water Induced Disaster Prevention, Kingdom of NEPAL "Case of Kingdom of NEPAL" Mr. Oravit HEMACHUDHA, Chief, Public Works Planning Subdiv., Department of Public Works, Bangkok Metropolitan Administration, Kingdom of THAILAND "Case of Kingdom of THAILAND" Mr. Hirokazu MIYAO, Engineer General, Okinawa Prefecture Government "Case of OKINAWA" －Okinawa Prefecture's Infrastructure Development for the 21st Century－
Participants	100

The 11th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 22, 2002
Place	Bankoku Shinryokan, Okinawa
Host	National Institute for Land and Infrastructure Management Okinawa General Bureau and Okinawa Prefectural Government
Program	Lectures Dr. Housei UEHARA, Honorary Professor, University of the Ryukyus "Case of Japan Ⅰ″ －Comprehensive Water -Resource Issues of Island Communities－ Mr. Haruhiko OKUNO, Director-General, National Institute for Land and Infrastructure Management "Case of JapanⅡ″ －Tokyo Metropolitan Region and Tonegawa－ Dr. Lee Jang-Hwa, Senior Research Fellow Structural Materials Research Group Korea Institute of Construction Technology, Republic of Korea "Case of Korea" Mr. Kaushal N. AGRAWAL, Additional Director General, Central Public Works Department Ministry of Urban Development, India "Case of India" Ms. Sofia Torio SANTIAGO, Project Manager, and OIC Assistant Director Bureau of Design Department of Public Works & Highways, Philippines "Case of Philippines" Mr. Zubair Emran KHAWAJA, Director Road Research and Material Testing Institute/ Praivate Sector Project Investment Cell Communication & Works Department Government of Punjab, Lahore, Pakistan "Case of Pakistan" Mr. Tamio SHIMOGAMI, Deputy Director General, Okinawa General Bureau, Okinawa Development Agency "Case of Okinawa" －Integrated Dam Management and the Development of Okinawa's Water Resources－
Participants	130

The 12th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 30, 2003
Place	Okinawa Convention Center, Okinawa
Host	National Institute for Land and Infrastructure Management
Support	Okinawa General Bureau and Okinawa Prefectural Government
Program	**Keynote Speech "Development Trend and Urban Traffic Problem in Okinawa Central and Southern City Area"** Dr. Takayuki IKEDA Professor, Department of Civil Engineering & Architecture, University of the Ryukyus
	Lectures 1）Case of Japan Mr. Haruhiko OKUNO, Director General, National Institute for Land and Infrastructure Management 2）Case of Cambodia Mr. VONG Pisith, Deputy Director General, Ministry of Public Works and Transport 3）Case of China Mr. LU, Kangcheng, Professor of Tunnel and Underground Works, Chang'an University 4）Case of Korea Dr. KIM, Yeon Bok, Senior Research Fellow, Highway Research Dept., and Group Leader, Advanced Highway System Group, Highway Research Dept., Korea Institute of Construction Technology 5）Case of Laos Mr. Houngla SENGMUANG, Director of Luangnamtha Province, Department of Communication, Transport, Post and Construction 6）Case of Malaysia Mr. LAU Hieng Ung, Deputy Director Kuching North City Commission 7）Case of Nepal Mr. Sharad Kumar SHRESTHA, Senior Divisional Engineer, Maintenance Branch, Department of Roads, Ministry of Physical Planning and Works 8）Case of Pakistan Mr. Aziz Ul Haq MIRZA, Member（Operations）， National Highway Authority, Ministry of Communications 9）Case of Sri Lanka Mr. Ranasinghe Hewawasamge KARUMARATNE, Provincial Director, Road Development Authority 10）Case of Okinawa Mr. Hirokazu MIYAO, Engineer-General Okinawa Prefectural Government
Participants	130

The 13th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 28, 2004
Place	Okinawa Convention Center, Okinawa
Host	National Institute for Land and Infrastructure Management
Program	**Keynote Speech "Water Issues in Ryukyu Islands"** Dr. Chokei YOSHIDA Board Member, Okinawa P. Public Health Association
	Lectures 1) Case of Japan Mr. Tatsuo HAMAGUCHI, Director General, National Institute for Land and Infrastructure Management 2) Case of Bangladesh Mr. A. K. M. Jafar ULLAH, Superintending Engineer & Project Director, Water Supply System Expansion & Rehabilitation Project (WSSERP), Dhaka Water Supply & Sewerage Authority 3) Case of Bhutan Mr. Passang DORJI, District Engineer, Dzongkhag Engineering Sector(District) 4) Case of Cambodia Dr. Visoth CHEA, Assistant General Director, Phnom Penh Water Supply Authority 5) Case of China Dr. LIU Dongfang, Vice Chief Engineer/Director of R/D Center, Tianjin Capital Environmental Protection Company Limited 6) Case of India Mr. Sukamal BHATTACHARYA, Executive Engineer, Public Works Department, Government of Tripura 7) Case of Indonesia Dr. Ramalis Subandi PRIHANDANA, Senior Researcher, Research Institute for Human Settlement, Ministry of Settlement and Regional Infrastructure Development 8) Case of Korea Dr. Youngsug KIM, Research Fellow, Construction Environment Research Division, Korea Institute of Construction Technology 9) Case of Laos Mr. Phouthasenh ARKHAVONG, General Deputy Director, Urban Research Institute, Ministry of Communication Transport Post and Construction 10) Case of Malaysia Mr. Mohd Ridhuan Bin ISMAIL, Deputy Director General, Sewerage Services Department, Ministry of Energy, Water and Communications 11) Case of Nepal Mr. Bishnu Prasad TIMILSINA, Divisional Chief (Engineer) Water Supply and Sanitation Division Office, Department of Water Supply and Sewerage, Ministry of Physical Planning and Work 12) Case of Pakistan Mr. Tahir AZIM, Project Director, NWFP Urban Development Project, Local Govt. Elections & Rural Development Department, Government of North West Frontier Province 13) Case of Okinawa Mr. Masaki MATSUI Engineer- General, Okinawa Prefectural Government
Participants	130

The 14th International Symposium on National Land Development and Civil Engineering in Asia

Duration	October 27, 2005
Place	Sendai International Center, Miyagi
Host	National Institute for Land and Infrastructure Management
Theme	Flood, Sediment and Tsunami Related Disasters in Asia
Program	**Keynote Speech "Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami"** Dr. Fumihiko IMAMURA Professor, Disaster Control Research Center, Graduate School of Engineering, Tohoku University
	Lectures 1) Case of Japan Mr. Tsuneyoshi MOCHIZUKI, Director General, National Institute for Land and Infrastructure Management 2) Case of Tohoku District Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau, Ministry of Land, Infrastructure and Transport 3) Case of Korea Dr. Chang Wan KIM, Research Fellow, Korea Institute of Construction Technology 4) Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO Mr. Akira TERAKAWA, Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute
	Panel Discussion "Flood, Sediment and Tsunami Related Disasters in Asia" - M.C.: Mr. Ryosuke TSUNAKI, Director, Research Center for Disaster Risk Management, NILIM - Panelists: 1) Dr. Fumihiko IMAMURA, Professor, Tohoku University 2) Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 3) Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau 4) Dr. Bunna YIT, Director, Public Works Research Center, Ministry of Public Work and Transport, Kingdom of Cambodia 5) Mr. Janak Jerambhai SIYANI, Chief Engineer (R&B) & Add Secretary, Roads & Buildings Department, Government of Gujarat, India 6) Dr. Chang Wan KIM, Research Fellow, Water Resources Research Department, Korea Institute of Construction Technology, Republic of Korea 7) Mr. Keophilavanh APHAYLATH, Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic 8) Ms. Rebecca Trazo GARSUTA, Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH), Republic of the Philippines 9) Mr. Akkapong BOONMASH, Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Kingdom of Thailand 10) Mr. NGUYEN Xuan Hien, Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development, Socialist Republic of Viet Nam
Participants	80

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