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THE 16TH CONFERENCE ON PUBLIC WORKS RESEARCH AND DEVELOPMENT IN ASIA

Proceedings

December 2007

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

Technical Note of NILIM
Vol.437 , December 2007

The 16th Conference on Public Works Research and Development in Asia

Proceedings

December 2007

Synopsis:
This proceedings summarizes the reports of the session on subject of common interest, symposium papers, lecture notes, etc. on the 16th Conference on Public Works Research and Development in Asia held mainly at the National Institute for Land and Infrastructure Management (NILIM) in Tsukuba and Hotel Shiragiku in Beppu from November 26, 2007 to December 7, 2007.

Keywords:
Integrated Water Resource Management Adapting to the Global Climate Change in Asia
Conference on Public Works Research and Development in Asia
National Institute for Land and Infrastructure Management

FOREWORD

The 16th 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 Hotel Shiragiku in Beppu City, Oita Prefecture from Monday, November 26 to Friday, December 7, 2007.

The conference has been held every year since 1993 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 7(seven) countries : India, Korea, Malaysia, the Philippines, Sri Lanka, Vietnam and Japan attended the 16th conference. In line with the subjects of "Integrated Water Resource Management Adapting to the Global Climate Change", they presented their papers and discussed the related problems.

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 MLIT for the support of and cooperation with the conference

NILIM Conference Secretariat

The 16th Conference on Public Works Research and development in Asia

Opening Ceremony
Nov. 26, 2007

Observation Tour of NILIM & PWRI
Nov. 26, 2007

Observation Tour of Meteorological research Institute
Nov.27, 2007

Keynote lecture
Nov. 27, 2007

Session on Subject of Commom Interest
Nov. 28, 2007

Session on Specitic Subject
Nov. 29, 2007

Visit to the Senior Vice Minister of Land, Infrastructure and Transport
Nov. 30, 2007

Opening of the International Sympoium
Dec. 3, 2007

Panel Discussion of the International Sympoium
Dec. 3, 2007

Study Tour in Fukuoka
Dec. 5, 2007

Study Tour in Fukuoka
Dec. 5, 2007

General Discussion
Dec. 7, 2007

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   Environmental Department, NILIM
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   Mr. Takayuki ISHIGAMI
   Senior Researcher, River Division,
   River Department, NILIM
6. Storm Surge Forecast System for Floodfighting Warning
   Mr. Masaya FUKUHAMA
   Head, Coast Division, River Department, NILIM
7. Support for Evaluation Ahead of Sediment Disasters
   - Using Rainfall Indices to Predict the Danger of Sediment Disasters -
   Mr. Kazuya AKIYAMA
   Senior Researcher, Erosion and Sediment Control Division,
   Research Center for Disaster Risk Management, NILIM
8. Planning Adaptation Programs for Future Climate Change
   Mr. Junichi YOSHITANI
   Team Leader, Disaster Prevention Team, ICHARM, PWRI
9. Outline of Sewerage Works and The Strategies for The Future in Japan
   Mr. Osamu FUJIKI
   Director, Water Quality Control Department, NILIM
10. Urban Stormwater Management
   Mr. Takashi SAKAKIBARA
   Head, Wastewater System Division,
   Water Quality Control Department, NILIM
11. Utilization of Reclaimed Wastewater
   Mr. Mizuhiko MINAMIYAMA
   Head, Wastewater and Sludge Management Division,
   Water Quality Control Department, NILIM

12. Beneficial Use of Biomass at Wastewater Treatment Plants
    Mr. Masaaki OZAKI
    Team Leader, Recycling Research Team,
    Material and Geotechnical Management, PWRI

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      Professor, Faculty of Engineering, Kyushu University
3. Presentation of Case Study
   1) Japan
      Mr. Shin TSUBOKA
      Director General, NILIM
   2) Kyusyu District
      Mr. Yoshinori ASHIDA
      Director, Planning Dept., Kyusyu Regional Bureau, MLIT
   3) India
      Mr. Dhinadhayalan MURUGESAN
      Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development
   4) Republic of Korea
      Dr. Seok-Young YOON
      Director, Policy research Division , Korea Institute of Construction Technology
   5) Malaysia
      Mr. Wan Abd Rahim Bin WAN ABDULLAH
      Director, Sewerage Services Dept.,
      Ministry of Energy, Water & Communication
   6) Republic of the Philippines
      Dr. Judy Famoso SESE
      Director Ⅲ, Bureau of Research & Standards,
      Dept. of Public Works and Highways
   7) Democratic Socialist Republic of Sri Lanka
      Ms. Paniyanduwage Nalanie Sriyalatha YAPA
      Deputy General Manager,
      National Water Supply & Drainage Board
   8) Socialist Republic of Vietnam
      Ms. DANG Anh Thu

Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction

X REFERENCE

1. History
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I OBJECTIVE

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 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

Ⅱ SCHEDULE

No.	DATE		FUNCTIONS	ACCOMMODATIONS
1	2007/ Nov.25	Sun	Arrival in Japan (Overseas Participants)	Tsukuba
2	Nov.26	Mon	JICA Orientation Opening Ceremony NILIM Orientation Introduction of NILIM Tour of Research Loboratories in NILIM & PWRI Welcome Party	Tsukuba
3	Nov.27	Tue	Keynote Lecture "Water-related Disaster Management for Adaptation to Climate Change" Tour of the Meteorological Research Institute Individual Studies	Tsukuba
4	Nov.28	Wed	Session on Subject of Common Interest "Integrated Water Resource Management Adapting to the Global Climate Change"	Tsukuba
5	Nov.29	Thu	Lecture Session on Water Resource Management Session on Water Disaster Management	Tsukuba
6	Nov.30	Fri	Lecture Session on Water Environment and Wastewater Management Move(From Tsukuba to Tokyo) Courtesy Call to Senior Vice-Minister of Land, Infrastructure and Transport (at MLIT)	Tokyo
7	Dec.1	Sat	Move (From Tokyo to Oita)	Oita
8	Dec.2	Sun	An Open Event of the 1st Asia-Pacific Water Summit Symposium on Current Condition of Water Resource and Riverine Environment An Open Event of the 1st Asia-Pacific Water Summit Theme B：Water-related Disaster Management, 2. Climate Change	Beppu
9	Dec.3	Mon	The 16th International Symposium on National Land Development and Civil Engineering in Asia "Integrated Water Resource Management Adapting to the Global Climate Change in Asia" Symposium Reception	Beppu

No.	DATE		FUNCTIONS	ACCOMMODATIONS
10	Dec.4	Tue	Lecture The 1st Asia-Pacific Water Summit Session on the Special Theme "Special Assembly -Towards the International Year of Sanitation 2008-" Move (From Oita to Fukuoka)	Beppu
11	Dec.5	Wed	Study Tour: The Seawater Desalination Center Chikugo Ohzeki (The Chikugo River Weir) Suigou Yanagawa (River of Yanagawa)	Fukuoka
12	Dec.6	Thu	Move (From Fukuoka to Tsukuba)	Tsukuba
13	Dec.7	Fri	General Discussion Closing Ceremony	Tsukuba
14	Dec.8	Sat	Departure from Japan (Overseas Participants)	

Ⅲ　PROGRAM

Ⅲ PROGRAM

November 25 (Sun) **Arrival in Japan**

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 26 (Mon) **Venue: NILIM**

Morning Orientation by JICA（at JICA Tsukuba International Center）

13:30-14:00 Opening Ceremony of "The 16th Conference on Public Works Research and Development in Asia"
（8th floor, International Conference Room）

14:00-14:15 Orientation by NILIM

14:15-14:30 Introduction on NILIM

14:30-17:00 Tour of Research Laboratories in NILIM and the Public Works Research Institute (PWRI)

- 14:35-15:05 Oceanic and Coastal Experimental Facilities
  Mr. Masaya Fukuhama, Head of Coast Division
  River Department, NILIM
- 15:10-15:40 River Hydraulic Experimental Facilities
  Dr. Atsuhiro YOROZUYA, Researcher,
  River Division, River Department, NILIM
- 15:45-16:15 Dam Hydraulic Experimental Facilities
  Mr. Toshiyuki Sakurai, Senior Researcher,
  River and Dam Hydraulic Engineering Team,
  Hydraulic Engineering Research Group, PWRI
- 16:20-16:45 Water Quality Experimental Facilities
  Mr. Jun ENDOU, Researcher,
  Mr. Yasuo FUKUDA, Researcher,
  Wastewater System Division,
  Water Quality Control Department, NILIM

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

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 27 (Tue) **Venue: The Meteorological Research Institute**
8thF International Conference Room, NILIM

09:30-12:00 Tour of the Meteorological Research Institute

12:00-13:00 Lunch

13:30-15:30 Keynote Lecture
" Water-related Disaster Management for Adaptation to Climate Change"

Dr. Kuniyoshi TAKEUCHI
Director of the International Centre for Water Hazard and Risk Management (ICHARM), PWRI

Water management is the basis of adaptation to climate change and water-related disaster management is the most important part of it. Climate change is an accelerator to ever increasing problems of population growth, economic development, urbanization, environmental degradation etc. What strategy should be taken in national land management against water-related disasters? The presentation will review the on-going climate change adaptation activities in developed countries including Japan and talk about the necessary approach towards a new way of and a smooth shift to living with nature supported by advanced sciences.

15:30-17:00 Individual Studies
(Preparation for the presentation on Nov.28)

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 28 (Wed) **Venue: 8thF International Conference Room, NILIM**

(Chair: Mr. Jyunji TAKAYANAGI, Director, Environment Department, NILIM)

09:30-09:45 Conference Report
Mr. Jun INOMATA,
Director, Planning and Research Administration Department, NILIM

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

09:45-15:00 Session on Subject of Common Interest
"Integrated Water Resource Management Adapting to the Global Climate Change"

09:45-10:15 Japan
Mr. Shin TSUBOKA
Director General, NILIM

10:15-10:45 India
Mr. Dhinadhayalan MURUGESAN
Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development

10:45-11:00 Break

11:00-11:30 Malaysia
Mr. Wan Abd Rahim Bin WAN ABDULLAH
Director, Sewerage Services Department,
Ministry of Energy, Water & Communication

11:30-12:00 Republic of the Philippines
Dr. Judy Famoso SESE
Director III, Bureau of Research & Standards,
Department of Public Works and Highways

12:00-13:30 Lunch

13:30-14:00 Democratic Socialist Republic of Sri Lanka
Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Deputy General Manager,
National Water Supply & Drainage Board

14:00-14:30 Socialist Republic of Vietnam
Ms. DANG Anh Thu
Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction

14:30-15:00 Discussion

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 29 (Thu) **Venue: 8thF International Conference Room, NILIM**

09:00-12:00 Session on “Water Resource Management”

09:00-10:00 Lecture “Predicted Effect of Global Climate Change on Precipitation Characteristics in Japan and Related Research Activities in NILIM”
Mr. Josuke KASHIWAI
Research Coordinator for Watershed Management,
River Department, NILIM

10:00-11:00 Lecture “The Investigation on the Drought Risk Assessment in Japan Due to Global Warming”
Mr. Nario YASUDA
Head, Water Management and Dam Division,
River Department, NILIM

11:00-12:00 Lecture “Policy Making and Implementation Processes for Securing Water Resources in the Tokyo Metropolitan Area to Cope with the Rapid Population Growth”
Mr. Koichi FUJITA
Head, River Environment Division,
Environmental Department, NILIM

12:00-13:00 Lunch

13:00-16:00 Session on “Water Disaster Management”

13:00-13:40 Lecture “The Evaluation of Flood Risk and Prevention of Flood Disaster”
Mr. Takayuki ISHIGAMI
Senior Researcher, River Division, River Department, NILIM

13:40-14:20 Lecture “Storm Surge Forecast System for Floodfighting Warning”
Mr. Masaya Fukuhama
Head of Coast Division, River Department, NILIM

14:20-14:50 Lecture “Support for Evaluation Ahead of Sediment Disasters - Using Rainfall Indices to Predict the Danger of Sediment Disasters -”
Mr. Kazuya AKIYAMA
Senior Researcher, Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM

14:50-15:00 Break

15:00-16:00 Lecture “Planning Adaptation Programs for Future Climate Change”
Mr. Junichi YOSHITANI
Team Leader, Disaster Prevention Team, ICHARM, PWRI

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

November 30 (Fri) Venue: 8thF International Conference Room, NILIM and MLIT

09:00-11:30 Session on "Water Environment and Wastewater Management"

09:00-:09:40 Lecture "Outline of Sewerage Works and the Strategies for the Future in Japan"
Mr. Osamu Fujiki
Director, Water Quality Control Department, NILIM

09:40-10:10 Lecture "Urban Stormwater Management"
Mr. Takashi SAKAKIBARA
Head, Wastewater System Division
Water Quality Control Department, NILIM

10:10-10:20 Break

10:20-10:50 Lecture " Utilization of Reclaimed Wastewater"
Mr. Mizuhiko MINAMIYAMA
Head, Wastewater and Sludge Management Division,
Water Quality Control Department, NILIM

10:50-11:20 Lecture "Beneficial Use of Biomass at Wastewater Treatment Plants"
Mr. Masaaki OZAKI
Leader, Recycle Team, Material and Geotechnical Management, PWRI

11:20-11:30 Question and Answer Session "Water Quality Management"
Mr. Osamu Fujiki
Director, Water Quality Control Department, NILIM

11:30-12:00 Lunch

12:00-14:15 Move (From Tsukuba to Tokyo)

14:30-14:50 Courtesy Call to Senior Vice-Minister of Land, Infrastructure and Transport (at MLIT)

Accommodations: Institute for International Cooperation
10-5, Ichigaya Honmura-cho, Shinzyuku-ku, Tokyo 162-8433, Japan
TEL. +81-3-3269-2911, FAX: 81-3-3269-2054

December 1 (Sat)	Day Off

Move (From Tokyo to Oita)

From the Haneda Airport to the Oita Airport
ANA995 14:05-15:45

Accommodations: The Comfort Hotel Oita
1-4-35, Maizuru-cho, Oita, Oita 870-0044, Japan
TEL. +81-97-536-1181, FAX: 81-97-536-1888

December 2 (Sun)	Beppu, Oita

09:00-12:00 An Open Event of the 1st Asia-Pacific Water Summit
"Symposium on Current Condition of Water Resource and Riverine Environment"
Organizer: Symposium Executive Committee
Venue: Beppu Syakai-fukusi Kaikan

13:00-18:00 An Open Event of the 1st Asia-Pacific Water Summit
"Theme B : Water-related Disaster Management, 2. Climate Change"
Organizer:
Venue: Beppu Syakai-fukusi Kaikan

Accommodations: Hotel Shiragiku
16-36, Kamitanoyu-machi, Beppu, Oita 874-0908, Japan
TEL. +81-97-721-2111, FAX: 81-97-721-5633

December 3 (Mon)   Venue: B1stF "Garden Hall" Higashi-kan, Hotel Shiragiku

The 16th International Symposium on National Land Development and Civil Engineering in Asia

"Integrated Water Resource Management Adapting to the Global Climate Change in Asia"

(Chair :Dr. Ryutaro OOISHI,
Research Coordinator for Evaluation,
Planning and Research Administration Dept., National Institute of Land and Infrastructure Management (NILIM))

13:00-13:15	Opening Address	Mr. Shin TSUBOKA Director General, NILIM
	Address	Mr. Hiroaki TANIGUCHI Vice Minister for Engineering Affairs, Ministry of Land, Infrastructure and Transport (MLIT)
	Address	Representative of Overseas Participants

13:15- 14:15   Lecture

"Integrated Water Management under the Global Warming Scenario
–Case Study of Northern Kyusyu with Scarce Water Resources–"

Dr. Kenji JINNO
Professor, Faculty of Engineering, Kyushu University

Global warming is believed to be the one of the major causes of the abnormal climate at present. Beside the regulation of the emission of warming gas, the countermeasures against the threat of flood and drought need to be taken simultaneously. The role of central and local governments which are responsible for the infrastructure management is increasing than before. It is expected for them to take practical and appropriate counteractions.

On the other hand, the water environment in megacities where a half of the world people live is also another concern. Frequent flooding, inappropriate waste water management, and insufficient water resources are mostly related to the negative impact of rapid urbanization. In order to conquer the above subjects caused by both abnormal climate and urbanization, the concrete measures need to be initiated in a river basin or regional scale integrating various water users and residents living there.

In the present speech, the state of art for the relationship between the potential threat of global warming and the impact of rapid urbanization will be discussed.

14:15-17:00   Presentation and Discussion
（Chair : Mr. Kazunori ODAIRA, Director, River Dept., NILIM）

14:15-15:45   Presentation of Case Study

(14:15-14:25)   Mr. Shin TSUBOKA
Director General, NILIM

(14:25-14:35) Mr. Yoshinori ASHIDA
Director, Planning Dept., Kyusyu Regional Bureau, MLIT

(14:35-14:45) Mr. Dhinadhayalan MURUGESAN
Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development
India

(14:45-14:55) Dr. Seok-Young YOON
Director, Policy research Division , Korea Institute of Construction Technology, Republic of Korea

(14:55-15:05) Mr. Wan Abd Rahim Bin WAN ABDULLAH
Director, Sewerage Services Dept.,
Ministry of Energy, Water & Communication, Malaysia

(15:05-15:15) Dr. Judy Famoso SESE
Director III, Bureau of Research & Standards,
Dept. of Public Works and Highways,
Republic of the Philippines

(15:15-15:25) Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Deputy General Manager,
National Water Supply & Drainage Board
Democratic Socialist Republic of Sri Lanka

(15:25-15:35) Ms. DANG Anh Thu
Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction, Socialist Republic of Vietnam

15:35-15:50 Break

15:50-17:00 Question and Answer Session / Panel Discussion

(PANELISTS)

1. Dr. Kenji JINNO, Professor, Faculty of Engineering, Kyushu University
2. Mr. Shin TSUBOKA, Director General, NILIM
3. Mr. Yoshinori ASHIDA, Director, Planning Dept.,
   Kyusyu Regional Bureau, MLIT
4. Mr. Dhinadhayalan MURUGESAN, India
5. Dr. Seok-Young YOON, Republic of Korea
6. Mr. Wan Abd Rahim Bin WAN ABDULLAH, Malaysia
7. Dr. Judy Famoso SESE , Republic of the Philippines
8. Ms. Paniyanduwage Nalanie Sriyalatha YAPA,
   Democratic Socialist Republic of Sri Lanka

9. Ms. DANG Anh Thu, Socialist Republic of Vietnam

17:00-17:10 Closing Address
Mr. Katsumune SUZUKI
Director General, Kyusyu Regional Bureau, MLIT

17:30-19:00 Reception
(Venue : Banquet room, Hotel Shiragiku)

Host Vice Minister for Engineering Affairs, MLIT
Guests Director General, Kyusyu Regional Bureau, MLIT

Accommodations: Hotel Shiragiku
16-36, Kamitanoyu-machi, Beppu, Oita 874-0908, Japan
TEL. +81-97-721-2111, FAX: 81-97-721-5633

December 4 (Tue)	**Venue: Beppu Convention Center (B-CON Plaza)**
08:20-08:30	Move (From hotel to the B-CON Plaza)
08:30-09:00	Entry Procedure to the B-CON Plaza
09:00-12:20	The 1st Asia-Pacific Water Summit Session on the Special Theme “Special Assembly -Towards the International Year of Sanitation 2008-”
12:20-13:00	Lunch
13:00-14:00	Open Event of the 1st Asia-Pacific Water Summit Looking around exhibitions in the B-CON Plaza
14:00-17:00	Move (From Oita to Fukuoka)

Accommodations: Hotel Okura Fukuoka
3-2 Shimokawabata-machi, Hakata-ku, Fukuoka 812-0027, Japan
TEL. +81-92-262-1111, FAX: 81-92-262-7701

December 5 (Wed)	**Tour in Fukuoka**
09:00-09:40	Move (From Hotel)
09:40-10:40	The Seawater Desalination Center
10:40-12:00	Move
12:00-12:40	Lunch
12:40-13:00	Move
13:00-13:50	Chikugo Ohzeki (The Chikugo River Weir)
13:50-14:40	Move
14:40-16:00	Suigou Yanagawa (River of Yanagawa)
16:00-17:30	Move (To Hotel)

Accommodations: Hotel Okura Fukuoka
3-2 Shimokawabata-machi, Hakata-ku, Fukuoka 812-0027, Japan
TEL. +81-92-262-1111, FAX: 81-92-262-7701

December 6 (Thu)

Move (From Fukuoka to Tsukuba)

From the Fukuoka Airport to the Haneda Airport
SKY008 10:30-12:00

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki, 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

December 7 (Fri) **Venue: 8thF International Conference Room, NILIM**

09:30-10:30 General Discussion
(Chair: Mr. Shin TSUBOKA, Director General, NILIM)

10:30-11:00 Closing Ceremony of "The 16th Conference on Public Works Research and Development in Asia"

Accommodation: JICA Tsukuba International Center
3-6, Koyadai, Tsukuba, Ibaraki, 305-0074, Japan
TEL. +81-29-838-1111, FAX +81-29-838-1119

December 8 (Sat) **Return to Home Country**

Ⅳ 16th CONFERENCE PARTICIPANTS

The 15 Conference on Public Works Reserch and Development in Asia

No.	Country	Title	Name	Office/posion	Address	Contact
1	India	Mr.	Dhinadhayalan MURUGESAN	Assiatant Adviser of Public Health and Environmental Engineering Central Public Health and Environmental Engineering Organization(CPHEEO) , Ministry of Urban Development	Room No.654 A Wing, Nirman Bhawan, New Delhi 110 011 INDIA	Tel:+91-11-2306-2482 Fax:+91-11-2306-2559 email:mdheen@sify.com
2	Republic of Korea	Dr.	Seok-Young YOON	Director of Policy Research Division Korea Institute of Construction Technology, Republic of Korea	2311 Daehwa-dong, Ilsan-gu, Goyangyang-si, Gyeonggi-do 411-712 KOREA	Tel:+82-31-910-0025 Fax:+82-31-910-0091 email:syyoon@kict.re.kr
3	Malaysia	Mr.	Wan Abd Rahim Bin WAN ABDULLAH	Director of Sewerage Services Dept. Ministry of Energy, Water & Communication	7th Floor, Block B(north), Damansara Town Center, 50490 Kuala Lumpur, MALAYSIA	Tel:+60-3-20809400 Fax:+60-3-20962609 email: wanabudlrahim@ktak.gov.my
4	Republic of the Philippines	Dr.	Judy Famoso SESE	Director III of Bureau of Research & Standards Dept. of Public Works and Highways (DPWH)	EDSA, Diliman, Quezon City Philppines 1101 PHILIPPINES	Tel:+632-926-3735 Fax:+632-926-3735 email:sesejudy@yahoo.com.ph
5	Democratic Socialist Republic of Sri Lanka	Ms.	Paniyanduwage Nalanie Sriyalatha YAPA	Deputy General Manager National Water Supply & Drainage Board (NWS&DB)	Regional Support Centre, 3rd Floor, Welikada Plaza Building, Rajagiriya, Sri Lanka	Tel. +94-11-2887151 Fax. +94-11-2887152 E-mail. dgmgcrsc@hotmail.com
6	Socialist Republic of Viet Nam	Ms.	Anh Thu DANG	Expert (environmental management and urban planning) Department of Urban Technical Infrastructure, Ministry of Construction (MOC)	37 Le Dai Hanh str. Hai Ba Trung dist. Hanoi, VIETNAM	Tel:+84-4-9760271 Fax: +84-4-9742132 email: danganhthu@moc.gov.com
7	Japan	Mr.	Mr. Shin TSUBOKA	Director-General National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport	Asahi 1, Tsukuba-Shi, Ibaraki-Ken 305-0804 JAPAN	Tel. +81-29-864 -2211 Fax. +81-29-864 -4322 email:kokusai@nilim.go.jp

V MINUTES

The 16th Conference on Public Works Research and Development in Asia

Session on Subject of Common Interest

"Integrated Water Resource Management Adapting to the Global Climate Change"

MINUTES

1. Date and Venue: 9:30-15:00 Wednesday 28 November 2007
International Conference Room, NILIM

2. Participants:

India	Mr. Dhinadhayalan MURUGESAN
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Viet Nam	Ms. Anh Thu DANG
Japan	Mr. Shin TSUBOKA, Director-General
	Mr. Jun INOMATA, Director, Planning and Research Administration Department
	Mr. Junji TAKAYANAGI, Director, Environment Department
	Mr. Kazunori OODAIRA, Director, River Department
	Dr. Ryutaro OOISHI, Research Coordinator for Evaluation
	Mr.Jyosuke KASHIWAI, Research Coordinator for Watershed Management
	Mr. Junzo INOUE, Head, International Research Division, Planning and Research Administration Department, NILIM
Observers	Mr. Resito DAVID, Project Director, Department of Public Works and Highways (Philippines)

3. Opening of Session on Issues of Common Interest, Mr. TAKAYANAGI, Director, Environment Department

Mr. Takayanagi, Director of the Environment Department opened the session and introduced Mr. Jun Inomata who is going to speak on the purpose of this session on the subject of common interest.

4. Conference Report, Mr. INOMATA, Planning and Research Administration Department, NILIM

It was approximately 16 years ago that we decided to gather experts in the field for a frank exchange of opinions on various challenges and to share ideas for improving disaster prevention. We are a diverse group with unique cultural differences among the 536 participants from 16 nations which have attended this conference, yet we have made significant advancements in the development of infrastructure in the various countries throughout Asia.

We have covered various issues over the course of the years under 16 themes such as flood disaster, landslides, urban traffic congestion, volcanic disasters and today's theme, "Integrated

Water Resource Management Adapting to the Global Climate Change" which are still major issues for all countries today.

Since 1993 we have dispatched 772 researchers and engineers from NILIM and have received 1,523 professionals from throughout Asia. The Sabo Technical Center in the Philippines and the project on cap building for regional road management in Indonesia are just a few examples of successful technological cooperation with JICA. We hope that your countries will continue to pursue further development and I hope today's discussion will be fruitful and rich.

5. Summaries of the Country Reports

Country Report for Japan by Mr. Shin TSUBOKA

Japan's alluvial plains are situated in low land areas and are extremely flood prone. Recently, flood damage areas are decreasing but in the past 10 years damage assets on average has increased. The water level in the Sea of Japan is rising. If sea levels continue to rise, and reach to IPCC's maximum level of 0.59m, 2.7 million people will be forced to live in the zero meter area of Tokyo Bay.

So what needs to be done? Adaptation measures such as an understanding of soil mechanics in embankment bodies, the investigation of caves in storm surge barriers and land use revision are absolutely essential. Flood hazard maps are useful tools for disseminating information to the public. While improvement of adaptation measures and development of structures are important they have limitations; therefore it is essential to improve damage reduction capabilities in local communities.

Questions were raised on the Japan's possibility of droughts, the frequency and source of information dissemination, and limitations of flood prevention methods.

Country Report for India by Mr. Dhinadhayalan MURUGESAN:

India is a vast country with a dense population of more than one billion people and is experiencing a population growth rate of about 3.1% per year. India has sufficient utilizable water resources to meet the growing demand, but much of the water supply is not effectively available, therefore development and management are needed to balance the inequality in natural availability and growing demand.

At present, about 93% of the urban population has access to safe and clean water supplies however hours of water supply service have declined over time. For example, in Chennai water service is available only 1.5 hours per day. The most significant impacts of climate change are expected to be in water availability.

India is the most disaster prone country in the South Asian region. Every year, approximately 19 million hectares of land are inundated by floods and on average about 15,000 people are killed each year by earthquake. The Indian Government remains committed to achieving the targets set forth in the Millennium Development Goal (MDG) and has framed broad policies accordingly in line with the Tenth Fifth Year Plan.

Recently there has been a shift in focus from post-disaster management to preparedness and mitigation. The National Policy on Disaster Management was formulated in 2003 in line with this new focus but India still has very far to go. India's per capita GNP is only $500; one of the poorest in the world.

Questions were raised on the future plans to address growing water demands as India faces an explosion in population growth and development, and the priority that the Indian government places on flood prevention countermeasures regarding the massive devastation following the flooding of the Ganges River Basin.

Country Report for Malaysia by Mr. Wan Abd Rahim Bin WAN ABDULLAH:

Prior to the Sewerage Services Act in June 1993, sewerage management in Malaysia was overseen 87 out of 144 local authorities. However the Act empowered the Government to regulate the sewerage industry and a bold step forward was taken toward privatizing sewerage management. A concession agreement was established with Indah Water Konsortium Sdn Bhd (IWK) to undertake the implementation of a suitable and modern sewerage system in the interest of consumers in the hopes of ensuring high quality services at an affordable cost and to assist in the growth of the national economy through the development of a modern and eco-friendly sewerage sector. However the sewerage tariff is the lowest in the region and the company was not able to fully recover the OPEX and CAPEX tariffs, placing burden on the organization.

Sewerage technology in Malaysia has evolved from pour flush systems (1950'), septic tanks (1960') and biological filters (1990'), to a fully mechanized plant in 2007. The Sewerage Development Quality System (SDQS) was established to monitoring indicators and key indexes, policy, guidelines, best practice and enforcement.

Integrated River Basin Management includes river corridor management, flood mitigation and water resources management and sewerage management is now linked with IRWM for maximum benefit.

Questions were raised on the sewerage coverage per population in Malaysia, responsible organizations for sewerage facilities and the calculation and collection of waste water tariffs.

Country Report for the Republic of the Philippines by Dr. Judy Famoso SESE:

In the Philippines, the Department of Public Works and Highways (DPWH) is responsible for the planning, design, construction and maintenance of the country's infrastructure and is likewise responsible for the monitoring of the National Water Data Collection Program. This mechanism is an accepted adaptation method for the effects of global climate unpredictability.

In January 2006, the Philippines started the implementation of the UNEP-IWRM assisted South East Asia Project and the formation of the Project Steering Committee. We have also participated in the consultation workshops with various National Government Organizations and other government agencies to formulate framework and guidelines supporting the IWRM of the Philippines.

The Philippines has about 7,107 islands. The country is rich in water resources, consisting of 421 principal river basins of which 20 are major river basins. The Philippines boasts one of the longest coastlines covering about 36,789Kms in the world, with an average rainfall of 2,400 mm per year of which much are collected as runoff in natural river basins. However, despite abundant water resources, the Philippines is facing potential water shortages and deteriorating water quality due to increasing population, and faces challenges with respect to the sectoral water governance and regulation which over 30 government agencies are tasked to oversee.

In 2006, the Government of Japan dispatched a study team to the Philippines with the objective of selecting priority areas based on flood risk assessment and to development flood mitigation plans and technology transfer. The study covers 954 flood prone areas and will continue until mid-March 2008. The "Project for Enhancement Capabilities in Flood Control and Sabo Engineering of the DPWH" is a JICA assisted technical cooperation project enhancing the capability of the DPWH engineers and investigates damaged structures.

Questions were raised about the impacts of climate change in the Philippines, the use of flood hazard maps in disaster prevention and penalties for illegal water use.

Country Report for the Democratic Socialist Republic of Sri Lanka by Ms. Paniyanduwage Nalanie Sriyalatha YAPA:

The National Water Supply & Drainage Board (NWSDB) has considerably expanded the scope of its activities and is presently operating 291 water supply schemes with 30% of the population with pipe-borne water supply. In accordance with the United Nations Millennium Development Goals, Sri Lanka has set ambitious goals and it is anticipated to achieve 40% pipe borne coverage by the year 2011.

As a commercial organization, the NWSDB began consumer metering and billing in 1982. The water tariff at present is just sufficient to meet operational costs and debt service.

The last 15 years have seen a severe cycle of drought, flood, cyclones, landslides and oppressive heat waves resulting in the loss of property and life, and the displacement of thousands of people. Urban squatters are exposed to water-borne parasites and dengue epidemics. A sea level rise of just 0.3 meters could results in a land loss of six square kilometers with severe impacts on tourism, industrial output and fisheries. In Sri Lanka poor communities are heavily dependent on natural systems and therefore will be most greatly affected.

In response to climate change, Sri Lanka has prepared a National Strategy for Clean Development Mechanisms to implement the Kyoto Protocol. Fuel-efficient stoves, clean-fuel technology, facilitation of rain water harvesting in dry regions and identification of cost-effective utility scale wind power development are just a few of the environmentally friendly practices currently underway and the NWSDB hopes to exceed the United Nations Millennium Development Goals of 85% safe drinking water coverage by 2015.

Questions were raised on countermeasures in the aftermath of the devastating 2004 tsunami that wiped out many coastal villages in Sri Lanka, the progress of a proposed salinity barrier and countermeasures against siltation of dams.

Country Report for the Socialist Republic of Viet Nam by Ms. Anh Thu DANG:

Rapid growth followed the economic reforms of the 1980s. The road network in Viet Nam doubled in length since 1990 and access to water grew from 26% to 50% between 1993 and 2003 but as the population increases competition and conflict for fresh water resources is growing. In addition, deteriorating water source and water quality due to excessive water exploitation, unreasonable use, pollution influences upstream, calamity etc. threaten public health and the functioning of ecosystems. Currently, there is an abundant supply of water resources in Viet Nam but the demand for water is still not satisfied.

Water pollution is inherently connected with human impact and climate change. The country's canals have become dumping sites and in addition, increasing population, deforestation and droughts have negatively affected the water supply availability. The surface water capacity outside of the country occupies two thirds of total achieved water volume while exhaustion of natural water sources is anticipated to increase. As sea levels continue to rise, it is predicted that with each meter rise in sea level, approximately 10.8% of the population will be displaced.

Although most countries give top priority to water supply demand, water shortages and degradation and flood impacts require greater attention. Increasingly countries are challenged by safe water for food production, ecosystem protection and the variability of water resources in time and space. The effects of global warming may add further stress to an already delicate situation.

At now and coming time, IWRM findings and best practices have been received from key ministries of Viet Nam and will serve as guidelines and direction for future IWRM practices.

Questions arose on the reasons of water degradation in Viet Nam, cooperation with upstream countries to achieve IWRM and experiences of negative impacts from water use upstream.

6. Open Discussion

Q: Have you actually felt any changes due to global warming particularly in the last 10 years in your country?

A: (India) The last 10 years India has seen a lot of climate changes. There were a lot of droughts in some areas while Bombay experienced heavy rainfall and subsequent flooding.

A: (Malaysia) Malaysia is also facing a lot of changes. After the tsunami hit in December, we had to spend a lot of money resettling a few housing schemes near the beach areas. This year very heavy rains caused flooding which continued for one month. We lost a lot of infrastructure and property during this time at a cost of US$3-5 million.

A: (Philippines) In the Philippines, we were hit by one of the strongest typhoons this year. There was a great loss of life and property. Destructive landslides, flash flooding, rising sea levels and unpredictable volcanic eruptions are visible effects of global warming in my country.

A: (Philippines Observer) I think we are experiencing a very vicious cycle of flood and drought. But sometimes this is not all the fault of climate change; we also need to consider the effects of human impact and volcanic eruptions.

A: (Sri Lanka) This year there is significantly heavy rain and there are more landslides in the wet zones.

A: (Viet Nam) Viet Nam is one of the most disaster-prone areas in the world. Each year typhoons, flood and droughts cause loss of life, property and infrastructure.

Q: A number of our colleagues noted significant climate changes. Maybe we need to implement new ideas or initiatives. If you have any new opinions, please share these ideas with us.

A: (India) The Government of India has proposed a scheme for Bombay. They are going to design a system for very high return period to tackle the storm water management issue and continue promotion of rain water harvesting.

A: (Malaysia) Our Government has spent one billion Ringgit to build a small tunnel which will divert water from the capital city to the sea.

A: (Philippines) The Philippines has some countermeasures in place based on flood hazard maps. We have already identified flood prone areas that allow us to plan and construct an appropriate structure for that specific area but a lack of funds is the main reason for the lack of countermeasures in many developing countries.

A: (Philippines Observer) The Philippines does not have a river engineering course and we are just beginning to gain the public trust and interest through this JICA assisted project. We still have to revisit and strengthen our flood management functions. Our flood control infrastructure is only 16% after 30 years of effort; obviously there are many things lacking in our country.

A: (Sri Lanka) We are not doing much on flood control prevention.

A: (Viet Nam) We are facing difficulties in countermeasures. We have a lot of assistance from foreign organizations so we have the support of flood control but the technology is still weak.

Q: In urban areas, people do not have close contact with their neighbors, so especially in Japan it is important that people have more awareness about floods. Do you think the people in your country have a high awareness about the flood threat?

A: (India) Under the Ministry of Foreign Affairs there is a Disaster Management Division. They forecast disasters and flooding and alert the affected districts so people will be aware and can avoid disaster.

A: (Philippines) We have coordination with local government units to inform the public of coming disasters and organizations that help the government promote awareness and disseminate information.

Through the wealth of information from each country participants were able to gain deeper understanding of the importance of integrated water resource management in order to adapt to climate change.

7. Secretariat Affairs

It was announced that Mr. Tsuboka would chair the final session on December 7, 2007.

The 16th Conference on Public Works Research and Development in Asia
Session on Water resource management

MINUTES

1. Date and Venue: 9:00-12:00 Thursday November 29, 2007
International Conference Room

2. Participants:

India	Mr.Dhinadhayalan MURUGESAN
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage NALANIE
Vietnam	Ms. Anh Thu DANG
Japan	Mr. Josuke KASHIWAI Research Coordinator for Watershed Management, River Department, NILIM Dr. Nario YASUDA Head, Water management and Dam Division, River Department, NILIM Dr. Koichi FUJITA Head, River Environment Department, Environmental Department, NILIM

3. Discussion summary

(1) Change in rainfall characteristics in Japan due to global warming and related NILIM research activities

A study on changes in the amount of rainfall in Japan due to global warming based on the results of a 20km mesh simulation was presented. This study mainly focuses on the problem of flooding caused by extreme rain. The study uses a global computational model, which is able to possibly provide the same level of accuracy even for areas outside of Japan. In conjunction, NILIM research on flood related adaptation was presented.

Questions

Q1 Regarding the return period of river planning, what are you deciding and what do you take into consideration?

A1 This is different for each river; it is decided based on the degree of importance, which is established corresponding to the situation of the assets and so on of the population in the river vicinity. In order that floods which occur during the established return period are able to drain away, points such as the drainage capability of rivers are decided upon.

Q2 What do you think of the handling of sections where data is not with in a confidence interval of 95%? Are the future and present distribution of these sections judged to be different?

A2 Investigation of this is currently being attempted, but regarding the results of GCM20, we think that the assumption that the future and present distribution will be the same possibly has substance. As for the fact that there are many sections in Hokkaido and Kanto where the confidence level is out of 95%, there can be considered a problem in regional division and that is something we are investigating further. So we would rather judge the handling of a few sections from an engineering and administrative point of view. There is also an issue with the reliability of the model, and when actually considering a plan we feel it is necessary to give due thought to things such as setting some margin for error.

Q3 Are you saying that when investigating extreme rainfall levels, a 20km mesh is extremely large?

A3 Well it is not extremely large but by the same token it is not sufficiently small. At present in the Meteorological Office and the Meteorological Research Institute calculations for a smaller mesh are being considered, but at this point in time 20km is the smallest, so we have no choice but to use the results of that.

Q4 As the effects of warming will gradually appear, in what way will they be fed into the plan?

A4 The question of how to respond is something that engineers and those in charge of administration must consider. Regarding that point, no sufficient policies are in place, so it is a future challenge for us. In MLIT, the River Bureau has established the “River subcommittee of the council on Infrastructure Development Board for investigating flood fighting measures to cope with climate changes” and is investigating basic countermeasures for climate change. The interim report is planned for release at the Asia-Pacific Water Summit that will be held in December in Beppu.

Q5 Have these results been subject to examination?

A5 They are under consideration at present, and in the future they will be subject to examination. What I wanted to say in the presentation is that the results of the model used, although required verification, could be used outside of Japan as well. In the event that the results are used in river planning there will be a necessity for some kind of analysis, and we have shown one method for that.

(2) Approaches to drought risk assessment associated with global warming in Japan

Due to a shift in the balance of supply and demand for water arising from future climate and societal changes, a change in future drought risk is predicted. Consequently, with regard to drought risk assessments associated with global warming in Japan that the NILIM has hitherto undertaken, considerations for sound water catchment system indicators, research results on the effects of climate change on water resources in the Tone River basin and future initiatives was presented.

Questions

Q1 There are many dams in Japan, over 2000. As water resources, what are the most common areas they are used for?

A1 They have water for use in irrigation, industry and cities etc., but the irrigation target is the larger.

Q2 To what extend do you consider the effects downriver when constructing a dam?

A2 The effects downriver are a very important element in dam construction, so they are sufficiently considered.

Q3 I expect that depending on the situation, dispute can arise in the needs of water for agricultural and domestic use. How are you dealing with this?

A3 In Japan there are acquired rights for agricultural water. Therefore, when there is a water shortage, we request effective use to the water rights holder so that no water is uselessly pumped into the sea.

Q4 Is there a problem with sedimentation?

A5 There is. In Japan we have carried out investigation into integrated sediment management in dams. I do hope you find it informative.

Q5 What is the coverage of water piping in Japan?

A5 It is 97%.

Q6 Are there any problems in the quality of groundwater?

A6 The groundwater pollution in California's Silicon Valley is serious, but that kind of problem does not exist in Japan.

(3) Analysis of water policies aimed at securing water resources to cope with rapid population growth in the Tokyo Metropolitan area

From the late 1950's in Japan, centering on a high economic growth period, a concentration of people in large cities such as the Tokyo Metropolitan area took place, in addition to a rapid expansion of urban areas. In order to overcome flooding, irrigation and environmental problems, various water policies were formulated and implemented and were successful to a certain degree. Results of investigations and analyses of these processes was presented, providing subject matter for debate on the state of water policies for catchment basins that are under intense external pressures such as rapid population growth and urbanization.

Questions

Q1 In the water policy analysis that used the final graph you showed (Fig. 17), there are a lot of points that should be considered. Which would you say in particular were the three most important?

A1 Ultimately, the fact that they should be considered in a unified manner is one answer I could give without forcing myself to narrow them down. However, if I dare to venture an answer they would probably be, evaluation of impact on the environment, how to draw out the mutualism between related water policies that have differing objectives, and then how to create a situation whereby many citizens actively participate in policy promotion, In particular, regarding the final point, as can be understood from consideration of global warming countermeasures, I think that it will become more and more important in future water policy promotion.

Q2 I would like to know more about the process of circulation and reuse of industrial water. Could you also say if there are a number of levels of water quality when it comes to reused water?

A2 I do not know the technological details regarding the circulation and reuse of industrial water. However, I am aware that improvements to the rate of recovering industrial water have basically been carried out internally at individual factories. I do not believe the reuse of industrial water in intermediate water supplies for general use is being widely approached.

Q3 How much are the water rates?

A3 This varies depending on the region; I do not know the entire picture.

Q4 Please tell us about standards relating to water quality.

A4 I have some handouts which I will distribute later which gather information regarding Japan’s water environment preservation systems and water quality standards.

Q5 I would like to hear your thoughts regarding the degree of power the government can have, in the impetus of policy execution column on Fig. 17. Many influential sectors have emerged including the media, so does this mean it has become harder?

A5 This is a difficult issue. It is important for the government to carry out sound dialog with the various related sectors. In some cases the media can mislead people through inaccurate information, and even if the government puts out more appropriate information to redress this, people have a tendency to trust the media and the critics. How the government ensures its reliability and credibility is an important point in making policy-related dialog sounder.

Q5’ That challenge applies to the “universality” in policymaking that has been expressed throughout the presentation, does it not?

A5’ Exactly. It is also probably important to share the experience and coping techniques of each country relating to this.

The 16th Conference on Public Works Research and Development in Asia
Session on Water disaster Management

MINUTES

1. Date and Venue: 13:00-16:00 Thursday November 29, 2007
International Conference Room

2. Participants:

India	Mr.Dhinadhayalan MURUGESAN
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage NALANIE
Vietnam	Ms. Anh Thu DANG
Japan	Mr. Takayuki ISHIGAMI Senior Researcher, River Division, River Department, NILIM
	Mr. Masaya FUKUHAMA Head of Coast Division, River Department, NILIM
	Mr. Kazuya AKIYAMA Senior Researcher, Erosion and Sediment Control Division, Research Center for Disaster Risk Management, NILIM
	Mr. Junichi YOSHITANI Team Leader, Disaster Prevention Team, ICHARM, PWRI

3. Discussion summary

(1) Flood risk evaluation and countermeasures

Presentation of the use of laser profilers for studying and evaluating how small and medium sized rivers can be maintained as an adaptive measure against climate change and concepts for flood countermeasures to deal with increased external pressures.

Q (India): What kind of flood management is being carried out in this region (Anpachi-cho)? (Regarding the information at the top of P12-10)
A: The area shown in the material is sandwiched between two major rivers (Ibi River and Nagara River), and it has suffered flood damage since long ago. River managers have built levees against the large rivers, but in this area the villagers themselves have built ring levees to protect their own villages. During the

floods of September 1976, these ring levees prevented the increase of damage to other areas. Therefore, it seems that in the future river managers should also implement countermeasures like these ring levees.

(2) Construction of a storm surge forecast system

This session will present current developments in the construction of a real-time wave surge forecast system to ensure appropriate flood prevention warnings in coastal areas. This system consists of a typhoon model, storm surge model, wave models, and a wave surge model. A wave model for shallow water was improved by implementing numerical tests on precision and wave hindcasting. Results of tests show that an improved WAM that takes into consideration wave breaking and tides, is able to forecast waves in inner bays in real time with a high degree of accuracy.

Q (Philippines): By what kind of procedure are warnings sent by flood prevention managers delivered to flood fighting group.
A: It is not the same for every individual group, but methods such as telephone, FAX, internet and so on are used in urban areas.

Q (Philippines): Even if you forecast a typhoon 72 hours in advance, surely the significance of doing so is small. Why?
A: Well, if we look at the necessary forecasts, it actually takes one or two hours of preparation for example, in order for flood fighting corps to get to work two or three hours before a typhoon hits. This means it is vital to forecast it six hours in advance. If on the other hand, we look at it from the perspective of when to plan to start preparing for a typhoon, it is necessary to grasp the information even earlier, three days in advance.

Q : What is WAM an abbreviation of?
A: It is an abbreviation for Wave Analysis Model.

(3) Managing landslide disaster warning data

Presentation of landslide disaster warning data that utilizes rainfall indices currently being implemented nation wide, in addition to differences with previous methods, configuration methods for warning data, transmission methods and the verification of data for recent disasters.

Q (Philippines): How are the areas that are in danger of sediment disaster decided upon?
A: This is decided on by referring to past disaster data. For example, a place in danger of slope failure is considered as somewhere with a slope gradient of 30º, a sloping cliff height of five meters and over (the ten meters given at the time of the answer was a mistake), and with buildings etc., established beneath.

Q (Sri Lanka):There are many sediment disasters in Sri Lanka as well. Are you doing surveys, such as soil investigation carried out on each of the danger areas in Japan?
A: Surveys are not carried out on each and every area. In our sediment disaster warning information, we predict the moisture content in the soil layers related to the occurrence of sediment disasters.

Q (Philippines): Could you tell us whether or not factors other than rainfall (such as topography and geology) are used as indices when judging degree of risk? Also, is monitoring carried out in areas in

danger of sediment?
A: In Japan there are an extremely large number of areas in danger of sediment, so monitoring is not carried out in all of them. In our sediment disaster warning information, we focus our attention only on the element that has the greatest effect on sediment disasters, rainfall. It is the rainfall itself as well as the moisture in the soil layers that we use as indices in forecast of sediment disaster occurrence.

Q (India): Discussion is going on that sediments deposited in the dam contributing GHG emission. Any study is going on in this regard?
A: I do not think this problem has occurred in Japan.

(4) Implementation planning for global warming measures

Flood control will be focused on during this session. Firstly, some examples of observed trends will be presented, such as rises in sea levels and increases in the occurrence of floods. Secondly, some examples of plans to cope with increased flooding will be explained. Thirdly, current discussions from the climate change adaptation committee of the MLIT will be presented. Lastly, the direction of countermeasures in Asia will be discussed and comparisons made with other regions.

Q (Philippines): In what way is ICHARM aiding developing countries?
A: It is not the kind of ODA technological aid of JICA; it is instead working to carry out support in policymaking.

Q (Malaysia): Is the Thames Barrier defending the Thames River area from flooding?
A: The proposed plan of the Department for Environment, Food and Rural Affairs in England that includes the option of abandoning defenses which I introduced, is something aimed at a region being partially developed in the Thames River basin. It is not a plan for the area alongside the Thames River itself.

The 16th Conference on Public Works Research and Development in Asia
Session on Water Environment and Wastewater Management

MINUTES

1. Date and Venue: 9:00-11:30 Friday November 30, 2007
International Conference Room

2. Participants:

India	Mr.Dhinadhayalan MURUGESAN
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage NALANIE
Vietnam	Ms. Anh Thu DANG
Japan	Mr. Osamu FUJIKI Director, Water Quality Control Department, NILIM Mr. Takashi SAKAKIBARA Head, Wastewater System Division, Water Quality Control Department, NILIM Mr. Mizuhiko MINAMIYAMA Head, Wastewater and Sludge Management Division, Water Quality Control Department, NILIM Mr. Masaaki OZAKI Leader, Recycling Research Team, Material and Geotechnical Engineering Research Group, PWRI
Observer	Mr. Kensuke SAKURAI Researcher, Wastewater and Sludge Management Division, Water Quality Control Department, NILIM

3. Discussion summary

(1) Outline of Sewerage Works and the Strategies for the Future in Japan

The first part of the presentation summarized a brief history of the rapid development of sewerage and its dramatic effects on the water environment in Japan, followed by an overview of the institutional systems which have been facilitating the sewerage works of local authorities. The latter part of the presentation dealt with the newly-launched initiative "The Way to Recycling", and particularly focused on the mitigation and adaptation strategies of sewerage works in addressing climate change issues.

(2) Urban Stormwater Management

In recent years, much flooding has occurred in association with localized torrential rainfall in Japan's urban regions, requiring countermeasures to be urgently drawn up. Based on this, in discussing stormwater management in urban regions, examples of flood damage brought about by urbanization in Japan and stormwater drainage plans were presented, in addition to discussions on improving combined sewer systems.

The following questions were asked regarding the presentations (1) and (2).

Q (Vietnam): Would it not be difficult to build new sewerage systems in large cities and densely populated areas? How was the sewage disposed of in times when such systems were inadequate?

A: It is certainly true that newly covering densely populated areas with sewer networks is no easy task. Even in Tokyo, 20 years ago there were still many areas where vault toilets and septic tanks were being used. A lot of funding was focused into sewerage improvement, and as a result sanitary conditions and the living environment got significantly better.

Q (Philippines): What is the best way to decide between centralized and individual disposal?

A: There are guidelines relating to this. Basically, they are criteria which emphasize economic evaluation. According to these guidelines for instance, if the average distance between residential buildings is greater than 60 – 70m then the introduction of an individual disposal system is judged to be appropriate. The points requiring consideration differ from place to place. It is not based solely on economic reasons though; autonomous bodies judge in accordance with their individual circumstances.

Q (India): What is the difference between "ordinary sewerage" and "innovative sewerage"?

A: In "Innovative sewerage" the objective is the recycling of sewage, as expressed in the catchphrase "The Way to Recycling". Aims for example include reuse of the wastewater and effective use of the sludge. The concept is decidedly different from the past one of "Collect, treat, discharge into public waters, and dump the sludge".

Q (Malaysia): What kinds of measures were carried out in the cleanup of Sumida River?

A: Strict standards were established for industrial effluent, and sewerage systems were built. Both the country and the Tokyo Metropolitan Government invested a large amount of money into construction of the sewerage systems.

Q (India): If it is a densely populated area but one where there is no spatial room to lay sewer network, what method should be considered as most appropriate?

A: The measures currently under consideration are so-called "simplified sewerage" solutions, such as community toilets and condominium sewerage. However this is certainly a difficult challenge.

Q (Malaysia): When it comes to sludge incineration, is there no opposition from local inhabitants?

A: Even in Japan sludge incineration is a sensitive subject. Technological development relating to atmospheric pollution countermeasures was an important element. At this point in time most people in Japan do approve. I think it is dependant on the circumstances of the individual country though.

Q (Vietnam): How are you deciding on sewerage charges?

A: Basically, it is determined on the "polluter pays principle". In large cities the cost can be covered by the sewerage rates, but in most small autonomous bodies a great amount is paid out from general accounts. The repayment of municipal bonds is a big problem. In France, England and Wales, and in some areas of Germany there are watershed-based financial systems, so the fees are averaged out and disparity between autonomous bodies is small. I think this example can serve as a useful reference.

(3) Utilization of Reclaimed Wastewater

From the perspective of one of precious water resources in urban regions, the importance of water reuse will increase in the future. During discussions, the recent state of utilization of reclaimed water in Japan was presented and a summary was given regarding the *Guidelines for the Utilization of Reclaimed Water,* released in April 2005 by the MLIT.

(4) Beneficial Use of Biomass at Wastewater Treatment Plants

The objectives of sludge treatment include reduction and stabilization; however, in contrast to the use of mechanical dehydration, the past few years have seen more and more treatment plants not to adopting the use of anaerobic digestion. Approximately 2.2 million tons of sludge is produced every year, while the efficient use of this amount is around 70 percent. Currently, in terms of material uses, the utilization of sludge as a form of energy, such as digestive gas, is a topic of much discussion and there is much expectation for cars running on natural gas to be able to directly employ a biogas automobile system using purified gas.

The following questions were asked regarding the presentations (3) and (4).

Q (India): What is mixed into blended compost? Would urban refuse be suitable?

A: Sewage sludge and cattle dung are used. I am not aware of any instances of autonomous bodies making compost using urban refuse and sewage sludge.

Q (Philippines): To what extent are the guidelines to be revised?

A: The 2005 guidelines of MLIT were the first officially published guidelines. The proposal guidelines were published about ten years prior. I believe they will be revised as the state of society changes through the accumulation of technological innovation and scientific knowledge, or through some other means.

(5) Question and Answer for Session on Water Environment and Wastewater Management

Q (India): Which do you think are better, centralized or on-site sanitary systems?

A: There is no cure-all solution to the question. The most appropriate method is thought to differ depending on the area. Generally speaking, on-site treatment is superior in terms of cost in sparsely inhabited areas, but the management of them often does not run adequately. The advantages and disadvantages of each should be carefully considered before deciding the most appropriate system for the area..

Q (India): Could you tell us about return period for rainwater plans?

A: Five year plans are common; in Tokyo it is five years, and it is ten in Osaka. Japan stretches a long way from North to South, and as a result the patterns of rainfall also vary from place to place.

In this section, the presentations from the Japanese side helped participants gain a deeper understanding of the history, current status and future direction of Japan’s sewerage works and water environment preservation. In particular, the discussion on diverse potential roles that sewerage is expected to play for the mitigation of GHG emissions as well as for the adaptation to anticipated climate change were recognized as very suggestive for the future. In addition, a fruitful discussion was held for the purpose of bringing the presented information to bear on each participant’s actual situation in policymaking of the management of urban wastewater and water environment preservation We shared recognition regarding the importance of sharing information in this field throughout the Asian region.

The 16th Conference on Public Works Research and Development in Asia

The 16th International Symposium on National Land Development and Civil Engineering in Asia

"Integrated Water Resource Management Adapting to the Global Climate Change in Asia"

MINUTES

1. Date and Venue: 13:00-17:10 Monday 3 December 2007
B1F "Garden Floor," Hotel Shiragiku, Beppu City, Japan

2. Participants:

India	Mr. Dhinadhayalan MURUGESAN
Rep. of Korea	Dr. Seok-Young YOON
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Viet Nam	Ms. Anh Thu DANG
Japan	Dr. Kenji JINNO, Professor, Faculty of Engineering, Kyushu University
	Mr. Hiroaki TANIGUCHI, Vice Minister for Engineering Affairs, MLIT
	Mr. Shin TSUBOKA, Director General, NILIM
	Mr. Yoshinori ASHIDA, Director, Planning Department, Kyushu Regional Development Bureau, MLIT
	Mr. Kazunori OODAIRA, Director, River Department, NILIM
	Dr. Ryutaro OOISHI, Research Coordinator for Evaluation, NILIM

3. Welcome Address, Dr. Ryutaro OOISHI, Research Coordinator for Evaluation

Welcome to the 16th International Symposium on National Land Development and Civil Engineering in Asia, “Integrated Water Resource Management Adapting to the Global Climate Change in Asia.” My name is Dr. Ooishi, and I am the Research Coordinator for Evaluation, NILIM. Unfortunately the representative from Georgia is not able to be with us but without further adieu, I would like to call on Mr. Shin Tsuboka to deliver the opening address.

4. Opening Address, Mr. Shin TSUBOKA, Director General, NILIM

I would like to express my sincere gratitude to all the participants as well as our guests from MLIT, JICA and the Kyushu Regional Development Bureau. Today’s theme is Integrated Water Resource Management Adapting to the Global Climate Change. In Asian countries, increasing economic demands and population are straining the capacities of water supplies. This symposium is held as an opening event for the 1st Asia-Pacific Water Summit. I hope through this symposium there will be greater cooperation and deeper understanding amongst all the countries present.

5. Overseas Participant Address, Ms. YAPA, Sri Lanka

I would like to thank the organizers of this symposium for the opportunity to represent my country and I look forward to a vibrant and meaningful discussion today. Thank you very much.

6. Lecture on “Integrated Water Management under the Global Warming Scenario” by Dr. JINNO, Professor, Kyushu University:

Facing growing population and increasing urbanization the need to secure a stable water resource through environmental conservation and restoration has never been more critical. What does global warming really mean? There are no textbooks that can answer this; therefore we are rather overwhelmed because we have never faced this situation before. Until 1975 we saw a sort of “business as usual” approach to mitigation but we are now at a symbolic crossroad as to what type of direction we should take. We must identify where we are right now in order to adopt an effective approach to climate change.

Dr. Pachauri presented the IPCC Fourth Assessment Report in May 2007, which predicted that drought-affected areas and heavy precipitation events are likely to increase. Even so, some are still not convinced that the phenomenon of global warming is real yet we are at a dangerous turning point where we must take action if we are to have any impact on mitigating future climate change. The large effects of global warming will come and likewise sufficient investment for adaptation and small mitigation will see less of an impact on global warming. It is not yet possible to say whether or not adaptation buys time for mitigation, for example by deferring CO2 emissions. The method of analysis depends on the capacity however it is important to conduct this kind of analysis, particularly at regional, sectoral and specific socio-economic levels. More careful observation of water related indices seems to be necessary in order to implement concrete measures on a wide-spread scale.

A 102 year record of precipitation and temperature was measured at the Fukuoka meteorological station. The classification of climate indices by SOM identified a distinct change in climate patterns which have been observed since 1960. The fluctuation of the annual precipitation in Fukuoka seems to be correlated with the employed four indices.

Does urbanization bring the same effect as global warming? Before urbanization there is a gentle rise of discharge and sufficient base flow, but after urbanization the levels go up and down very sharply. We see more droughts and more flood occurrences, so in that perspective, similar consequences are induced by urbanization as by global warming. So the mechanisms may be different but the impacts of urbanization and global warming may be closely related. Urbanization without proper measures for water management will result in a worsened environment. Rapid urbanization in Fukuoka City has decreased the river base flow and increased flood peak. In order to improve these matters, the city is committed to take the necessary actions based on the aesthetic water cycle which is not yet sufficiently realized.

Regarding integrated water management at the basin level, 30% of the water used in urban cities comes from the Chikugo River Basin. The river basins are actually connected so through the effective use of water we can see an interrelationship between the different basins. The impact of drought and water scarcity affects all aspects of life. One Chinese noodle shop was forced to close periodically when water ran out, placing a negative impact on the livelihood of the shop owner. The basins are not independent, so we must manage water resources in an integrated manner and I think that is beginning to happen. When you develop water resources you have to think in a span of 50 years. Managing water resources takes decades if not longer, so we must act now or we will not have the mechanisms in place when it truly matters.

Cooperation is essential. You need federal and central government to develop technology and provide funding and the municipalities must also work on this. We have open dialogue on the various options with stakeholders and a competitive spirit could be the driving force which leads to more public concern.

Finally, urbanization is a negative index and we are going to have global warming on top of urbanization; in other words things are going to get worse, not better. But if we do what is necessary today we can turn the direction in a positive way. Mitigation does not just mean reducing CO2 emissions. We can reduce the impacts of global warming and urbanization by integrating surface water and subsurface water at the basin scale. Ultimately, only when we take responsibility for global warming as our own problem and decide what to do in cooperation with the stakeholders of that region will we be successful.

7. Case Study

7-1. Case of Japan by Mr. Shin TSUBOKA, Director General, NILIM:

There is a high concentration of population and property in the alluvial plains of Japan. About 10% of the land area is inundation-prone and there we have the concentration of about 50% of population and 75% of property. During the last 10 years we have witnessed an increase in the frequency of precipitation downpours. Currently 1.78 million people live in the average sea surface levels where even a 0.59 meter rise in sea level would force an estimated 2.7 million people to relocate. We have developed a model to predict wave run up which is provided to regional governments in the event of typhoon and other natural disasters.

Hazard maps require extensive rainfall and topography data but can serve as a support system in the development of flood hazard maps. Because of climate change, the difference of heavy rainfall and light rainfall areas varies greatly. The NILIM has preparedness measures in place to confront the threat of climate change but admittedly adaptation measures have limitations, therefore it is necessary to improve damage reduction capabilities of local communities against flooding.

Q: (Mr. ISHIDA, Fukuoka Prefecture) Regarding the boring investigation of embankments, what were the rivers where you conducted boring investigations? Also, do you have monitoring investigation data for rivers managed by prefectural governments?

A: We are conducting the boring investigation from 2000-2009 but we cannot do the boring at a high density. It is impossible to conduct at all sites, so we are doing boring and infiltration calculations which may not be sufficient. I hope that the investigation will be further enhanced. Monitoring is a big challenge because if there is inundation you have to set up monitoring stations and the durability of the equipment is tested. And for water damage we accumulate water damages by calculations and we feel this is not sufficient so this is something we have to overcome.

7-2. Case of Kyushu District by Mr. Yoshinori ASHIDA, MLIT:

Kyushu can be called the window to Asia as it is relatively close to the Korean Peninsula, Shanghai, etc. In recent years, Kyushu has frequently experienced abnormal weather. Eight large-scale disasters have occurred in the last 10 years with most of the landslide disasters in Japan occurring in Kyushu. Last year, the southern part of Kyushu received 1,000 mm of rain in just four days. Due to frequent concentrated downpours and an expanding urban district, the risk of flood disaster is increasing. Therefore, the provision of information and evacuation plans needs to be improved.

There is a large disparity in the precipitation rates between the North and South with Northern Kyushu facing frequent droughts. The water resources in Fukuoka City are scarce, about 60% is obtained within the region, 10% from ground water and the remaining 30% is brought in from the Chikugo River, outside the region. Water in the Chikugo River is used for irrigation in the largest agricultural production area in Kyushu. Still we suffer from water shortages, with droughts once every two years. Water resources become especially low in summertime. The flow condition needs to be improved. To address this problem we have implemented water provision facilities along the Chikugo River but this requires the support and coordination of the people for the promotion and success of these projects.

7-3. Case of India by Mr. Dhinadhayalan MURUGESAN, Ministry of Urban Development:

India is surrounded by water on three sides. India's rivers carry 90% of the water volume during the period of June-November, therefore only 10% of the river flow is available during the other six months. The total water requirement of the country estimated at 694 BCM in 2010 is predicted to rise to 973 by 2050 while the available utilizable water resources are about 1,086 BCM. In the urban areas, 93% of the population enjoys access to a safe water supply and 72% in the rural areas have access, however the water supply by and large is intermittent, ranging from 3 to 10 hours per day.

The National Water Policy 2002 accords top priority to drinking water supply followed by irrigation, hydropower, navigation, industrial and other uses. Water stress exists in different regions due to peculiar rainfall patterns in the country. The situation could worsen substantially due to changes in precipitation patterns. Every year, an average of 19 million hectares of land become flooded and the yearly loss of life is estimated at 2,590. In response, 173 flood forecasting and warning stations have been established throughout the country but rapid advances in all spheres must take place in concert for the management of water to be a prominent one. India has undertaken response measures that are contributing to the objective of the UNFCCC.

7-4. Case of Republic of Korea by Dr. Seok-Young YOON, Korea Institute of Construction:

Climate change is no longer a controversial issue in South Korea; it is real and evident South Korea was recognized as a developing country in 1992 when the UN Framework Convention on Climate Change was established therefore it is not required to reduce greenhouse gases (GHGs), however the effects of climate change can no longer be ignored. Climate change not only causes floods but also affects droughts. Unfortunately until now there have been no water resource plans or polices that reflect climate change.

The amount of precipitation in South Korea has increased by 7% while transpiration has decreased. Due to small land and overpopulation, intensity of land and water resource use in South Korea is much higher than other countries. Even a small change in climate can impose a serious problem to water resources. Both structural and non-structural design of water resource systems must consider potential impacts of climate changes.

The Water Resources Committee of Korea is implementing research projects to cope with climate change to which the Ministry of Construction and Transportation provides $7 million. Additionally, we need a nationwide flood control plan based on national capacity, in conjunction with IWRM designed for each individual basin to effectively address the changing situation of water resource management. We also need improvement in the current flood forecasting system and we need to incorporate meteorological techniques in basin control.

Q: (Mr. YAMAMOTO, Fukuoka Prefecture) Regarding water disasters and rain water reservoirs in urban areas, I am interested in the building codes for new construction which require a storage system for drainage. Can you please elaborate on this?

A: The Government of Korea wants to change some of the building codes. We currently design building codes under a 1-in-100 or 200 year scenario but we are proposing a 1-in-500 and 1,000 year frequency building code design.

7-5. Case of Malaysia by Mr. Wan Abd Rahim Bin WAN ABDULLAH, Ministry of Energy, Water & Communication:

Sewerage treatment is a necessary service which has evolved from pour flush systems, septic tanks and biological filters, to a fully mechanized plant in 2007. The Sewerage Development Quality System establishes monitoring indicators and key indexes.

Integrated River Basin Management includes river corridor management, flood mitigation and water resources management and sewerage management is now linked with IWRM for maximum benefit. Effluent from treatment plants, overflow discharges, sludge disposal, and health and safety concerns are just a few of the potential environmental impacts of sewerage activities.

In the local context of global warming, Malaysia contributes 2% of the total world CO2 equivalent. Indirect and direct sources of GHGs are emitted from sewerage and sludge treatment processing, such as the pumping and aeration of sewage (indirect) and N2O from the nitrification and denitrification process (direct). Sewerage, which is a vital service for

developed and developing countries alike has progressed well over the decades and sewerage planning is now regarded together in the context of IWRM for maximum benefit, but future adaptation and mitigation efforts are required to minimize the impact of global warming in Malaysia.

7-6. Case of Republic of the Philippines by Dr. Judy Famoso SESE, Department of Public Works and Highways:

In the Philippines, the Department of Public Works and Highways (DPWH) is the country's engineering and construction arm, responsible for the planning, design and construction and maintenance of infrastructure, such as roads, bridges, flood control systems, water resource development projects and other public works in accordance with the national objectives. The DPWH is likewise responsible in the monitoring of the National Water Data Collection Program and recognizes the importance of Integrated Water Resource Management (IWRM) to ensure and secure sustainable water resources for all.

The Philippines archipelago has a population of about 80 million and consists of 7,107 islands and islets with a land area of about 300,000 sq. km. The country is rich in water resources, which has about 421 principal river basins of which 20 are considered major river basins. The total coastline is about 36,289 km and the average annual rainfall is about 2,400 mm of which 1,000 mm to 2,000 mm is collected as run-off. Despite having relatively rich water resources the Philippines is facing an eminent water shortage due to over population, urbanization and industrialization.

Other views and concerns dominating the water resources are the deteriorating water quality, declining access to safe drinking water, inadequate sanitation and sewerage facilities and degradation of major ecosystems. These concerns are aggravated by the increasing frequency and intensity of extreme climate events and variability.

In view of these water-related concerns and issues, in January 2006, the Philippines started the implementation of the United Nations Environmental Programme (UNEP)-assisted IWRM project to develop a plan framework. This plan framework has a broader focus that looks at water in relation to other dimensions, dynamic and adaptive, which is integrated and coordinated in all levels in a holistic manner. Four sustainable outcomes were identified and nine strategic themes were also identified to support the four sustainable outcomes.

7-7. Case of Democratic Socialist Republic of Sri Lanka by Ms. Paniyanduwage Nalanie Sriyalatha YAPA, National Water Supply and Drainage Board:

In Sri Lanka the agricultural sector accounts for 96% of water usage and 30% of national pipe borne coverage. Water access is 70% in urban areas and 15% in the rural areas. Climate change directly and indirectly affects economic activities, national environment of settlements and the health of resident and commuting populations while the collapse of health infrastructure and the displacement of affected populations would bring illness, injury and death.

The vulnerability of coastal areas due to sea level rises is a real and probable threat, leading to a loss of land area with negative impacts on industrial output, fish production, tourism and transportation infrastructure. The National Rainwater Harvesting Policy is to be adopted making rainwater harvesting mandatory, and the construction of salinity barriers and dams to prevent salinity intrusion are just a few examples of mitigation and adaptation measures currently in place.

Q: (Mr. MURATA, Fukuoka Prefecture) Do you have any data on the recent trend of sea level increase and mean temperature increase?

A: I do not have the data on the sea level temperature but as you know in 2004 we were hit by a devastating tsunami which resulted in an increase in sea level and caused contamination in the rivers and we are still experiencing hygiene problems.

7-8. Case of Socialist Republic of Viet Nam by Ms. Anh Thu DANG:

Viet Nam is divided into seven zones, each with unique characteristics in regards to geology, climate, natural resources, ecology and natural disaster patterns. It is predicted that global climate change will lead to a reduction in water resources while sea levels will increase considerably. With each one meter rise in sea level, about 10.8% of the population will need to be relocated. The Huong River is the biggest river in Hue Province with a 300 sq km catchment area. Currently the total demand of water utilization across all sectors is 444.4 million m3/year, with agriculture accounting for 390 million m3/year or 87% of the total. It was discovered that irrigation was not sufficient during the eight month dry season and reservoirs and water resources in the whole region were limited. It is predicted that by 2070, the annual flow will be reduced by 23-40% in the central region and increase by 49% in the south central region. To ensure water demand in the long term it is necessary to develop human resource capabilities for the management and exploitation of water resources in conjunction with policy improvement and community education.

8. Panel Discussion

Q: (Mr. Oodaira) What kind of adaptive policies do you have in place in your countries? We have discussed firstly about flooding from downpour and typhoons and inundation of areas including hygienic issues, secondly due to limited precipitation there can be a shortage of drinking water and a degradation of quality and thirdly with the sea level rise there could be an inundation of coastal areas and people would need to be relocated, so out of these threats, what is the most serious issue as you perceive it?

(India) First I would like to mention one of the methods proposed by the Government of India. In order to address the issue of flood damage, we are implementing the construction of reservoirs, canal improvements, embankment construction, etc. We still need to speed up the process and additional forecasting stations need to be established. Different parts of the country are facing droughts. We are promoting rainwater harvesting measures. Watershed management projects are being undertaken in rural areas and model building codes have been formulated for promoting rooftop rainwater harvesting. Regarding the rise of sea water level, mitigation measures need to be adapted. Measures including compressed natural gas to reduce pollution and energy efficiency vehicles have been undertaken.

Q: (Mr. Oodaira) Out of three threats what is your major concern? I stated three issues above.

A: The biggest threat is flood. We need to take immediate measures. Mumbai is experiencing severe flooding so now we are proposing a new storm water management system.

(Republic of Korea) We cannot ignore or delay water resource policies any longer. Since the late 1990s, major drought has occurred frequently in Korea. It is difficult to say that climate change is solely responsible for the decrease in precipitation however it is important to recognize the concentration of population due to urbanization which may contribute to the occurrence of drought. Government countermeasures are currently being discussed.

(Mr. Ashida) We are having a lot of damage as a result of flood however compared to other Asian regions we have a smaller degree of casualties. One flood per 150 years is the planned frequency but we are unable to meet this target. Currently we are conducting 1 per 50 years with a 75% success rate. The highways are elevated which can aid in evacuation.

(Malaysia) The rising sea level is not a major problem in Malaysia actually but we are facing flash floods and a drinking water shortage crisis. The government predicts that by 2010 the capital city will face a very heavy dry season and a shortage of drinking water. We faced a similar problem in the early 1990s and the government launched a substantial project in cooperation with JBIC which transferred water from the largest river in Peninsular Malaysia to the dams in the urban areas (Gombak Dam).

(Philippines) In the Philippines, the most threatening and most serious phenomenon that I can see in the country among the three is flood damage. As experienced, there were about five La Nina episodes from 1970-2000 compared to only three La Nina episodes from 1950-1970. The most common extreme climate events with significant economic and social impacts in the Philippines are tropical cyclone occurrences of which typhoons and cyclones are the most destructive. Several typhoon extremes were observed from 1990-2006 which registered the highest 24-hour record of rainfall during this period. Hundreds of people died, agricultural production was greatly affected and several infrastructures were damaged. These historical data served as a basis among others for increasing flood control mitigation measures. The national and local governments and the National Disasters Coordinating Council (NDCC) worked hand-in-hand by giving priority to providing structural and non-structural measures to affected areas by constructing Sabo dams, dredging silted rivers, relocation of affected families, etc. On the other hand, the DPWH is currently undertaking two flood control mitigation research projects through a JICA-assisted Technical Cooperation Project, namely: the Study on the Nationwide Flood Risk Assessment and Flood Mitigation Plan; and the Project for Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH.

(Sri Lanka) Sri Lanka is experiencing extreme climate events including major floods in the city and related landslides which cause damage and death forcing evacuation and relocation of a large number of people. We are also affected by droughts and sea level increases and various diseases related to flood and squatters in unauthorized make-shift dwelling living close to marshes.

Q: (Mr. Oodaira) In Sri Lanka, which do you think is going to be the biggest threat?
A: I think we will be impacted greatest by the threat of flood.

(Viet Nam) The major disaster is flood. From 1996-1999 the annual losses were US$459 million. We are facing several challenges including the application of new scientific and technological achievements to forecast disaster and address the degradation of water, and the promotion of policy awareness in the community. The Government has received strategy on disaster preparedness and mitigation but community level countermeasures and further international cooperation are needed.

Q: (Mr. Oodaira) Flood seems to be the major threat in many of the countries. Dr. Jinno, including Japan, seven countries pinpointed what should be done for prevention. In your opinion, what sort of research is necessary?

A: (Dr. Jinno) Is it the impact of global warming or the lack of infrastructure? If urbanization is posing a bigger threat we must have a reservoir; that is the viewpoint of Japan. In Fukuoka we have turned a park into a reservoir pond. So the point is how you pool the rain that comes and dams are another thing.

Q: (Mr. Oodaira) Dr. Sese, you mentioned that you are building dikes. Has that been successful? Also can you talk about the project to create the flood hazard map?

A: (Philippines) The flood hazard map is just one output of the research. In the hazard maps, we are able to identify the flood prone areas to ensure that the structure we want to construct would be an effective one. Likewise, hazard maps will be disseminated to local government units to inform them of the flood prone areas. So in the meantime we need to have immediate structures like dams to slow down the gravity of water, and then we can identify long term solutions using flood hazard maps and other considerations.

Q: (Mr. Oodaira) Can you give us more detail on how you use the flood hazard maps?

A: Flood hazard maps help us identify flood prone areas and then planners can identify the best structure for that specific area.

Q: (Mr. Oodaira) I would like to ask India about the melting glacier in the Himalayas. Is there currently any international cooperation to address this issue?

A: (India) As for the recent study, the Gangotri Glacier is melting causing heavy flooding. It is observed that the receding of glaciers is due to climate change and we need to address the issue with the cooperation of the international community. The government of India has an early warning system and evacuation plans in place but we need further international cooperation. However, widespread poverty in our country presents a financial barrier to addressing these issues.

Q: (Mr. Oodaira) I believe it was this year that the Ganges River Basin flooded. Judy talked about flood hazard maps, taking an aerial picture to create a map and using it to notify the local people in order to mitigate devastation. Does that sort of thing work in India too?

A: Yes, organizations under the Ministry of Water Resources have developed in-house capabilities to interpret satellite images in some of the facets of water resource planning that is sedimentation and river behavior. The capacity needs to be improved to cover other areas in water resource planning like land use, irrigated area assessment, salinity crop conditions, river morphology studies, etc.

Q: (Mr. Oodaira) As for Viet Nam, you are a specialist in city planning and I think you said that what you need is to mobilize the local citizens. You need to make plans and invite people to participate. I suppose the Mekong River has to flood for the farmers' benefit, so are you doing something to mobilize the people? Do you use the hazard maps?

A: (Viet Nam) The Government has strategy on disaster and the main point is to implement flood solutions including non-structural solutions. It is very important to mobilize the support of local community for non-structural solutions like changing the timing of regional crops. The community plays an important role in living with floods.

Q: (Mr. Oodaira) Viet Nam has given us rich thought to live with floods. Regarding the use of hazard maps and developing international cooperation, those are very productive propositions. Mr. Tsuboka, what is your reaction on behalf of NILIM? What sort of cooperation is possible?

A: (Mr. Tsuboka) Every country has unique situations and priorities effecting disaster prevention. In the last 10 years, natural disasters are more wide-spread and frequent so old priority setting may have to change, and may need to be done quicker depending on the country. Opportunities like this are important to promote international cooperation and to exchange opinions.

Q: (Mr. Oodaira) Mr. Yoon, can you elaborate on countermeasures and research you are conducting in regards to drought?

A: (Republic of Korea) In Korea water resource problems are associated with climate change. For water resource management we are pursuing technological development in order to adapt to climate change so we can improve the quality of life.

Q: (Mr. Oodaira) In Malaysia the repeated use of rivers is being conducted and the water is put back into the river. What is the state of the plan for reuse of water in your country?

A: (Malaysia) Right now it is not economical to treat and reuse the effluent water from the sewerage treatment plant because of the small scale of the STP, but with the support of the JBIC loan, 13 regional treatment plants are under construction. We hope that after the project is complete we will be able to treat and reuse the effluent water.

Q: (Mr. Oodaira) We tend to think we have an abundance of water resources, but we need to come up with different measures to cope with climate change. I hear that dams are buried into the land at the same time I hear that you have a problem with water resources. What are the efforts made to secure water resources in your countries?

(Sri Lanka) We have some programs to secure the water boundaries and we are using ground water also as a water resource. Sometimes, mainly during the drought season, the sea water is coming into the rivers because of the sand mining. In rural areas there are more streams but they are polluted by human behavior.

Q: (Mr. Oodaira) Dr. Jinno, we have many countries represented here, so there are various problems. What is the most important stance a nation should have?

A: (Dr. Jinno) Mitigation means the reduction of CO2 emissions. If that is the case than the emissions have been produced by developed nations and the developing nations are experiencing the consequences. Then to a certain degree the infrastructure development should be transferred to developing nations. Also, international cooperation is indispensable. We should make full use of organizations like the United Nations and the IPCC for those developing countries.

(Mr. Oodaira) All the countries have unique issues and challenges but we could understand that through venues like this information exchange and research cooperation among Asian countries, we can create effective countermeasures to adapt to climate change.

8. Closing Address, Mr. TANIGUCHI, Vice Minister for Engineering Affairs, MLIT

It is a great pleasure to deliver this closing address. Through this symposium we have come to recognize that there are common issues around the world and we must agree to establish efforts in order to allow people to live safely. Civil engineering has an important role to play taking into consideration, natural, social and economic situations of each country. The Kyushu region enjoys international exchange with many Asian countries. It is also a region that has close relations to water issues and I think it is significant that this symposium is being held in conjunction with the Asia-Pacific Water Summit. I hope this symposium will be instrumental in developing further exchange and with that I would like to close today’s symposium.

The 16th Conference on Public Works Research and Development in Asia

Concluding Discussion Session

"Integrated Water Resource Management Adapting to the Global Climate Change"

MINUTES

1. Date and Venue: 9:30-10:30 Friday 7 December 2007
International Conference Room, NILIM

2. Participants:

India	Mr. Dhinadhayalan MURUGESAN
Rep. of Korea	Dr. Seok-Young YOON
Malaysia	Mr. Wan Abd Rahim Bin WAN ABDULLAH
Philippines	Dr. Judy Famoso SESE
Sri Lanka	Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Viet Nam	Ms. Anh Thu DANG
Japan	Mr. Shin TSUBOKA, Director-General
	Mr. Kazuhiro NISHIKAWA, Executive Director for Research Affairs
	Mr. Jun INOMATA, Director, Planning and Research Administration Department
	Mr. Junji TAKAYANAGI, Director, Environment Department
	Mr. Osamu FUJIKI, Director, Water Quality Control Department
	Mr. Kazunori OODAIRA, Director, River Department
	Mr. Shozo KOGA, Director, Research Center for Disaster Risk Management
	Dr. Ryutaro OOISHI, Research Coordinator for Evaluation
	Mr. Takenori YAMASHITA, Head, River Division
	Mr. Junzo INOUE, Head, International Research Division, Planning and Research Administration Department, NILIM

3. Opening Remarks

(Dr. Ooishi) Good morning ladies and gentlemen. Today's closing session will be chaired by Mr. Tsuboka, Director-General of NILIM.

(Mr. Tsuboka) First we will review and wrap up the conclusions of the conference. Then I would like to ask the representatives to give their presentations on the contents and conclusions of each session after which we will invite all of you to comment and then adopt them.

4. Review of Session on Subject of Common Interest, "Integrated Water Resource Management Adapting to the Global Climate Change"

(Mr. Takayanagi) I would like to highlight the main areas of the minutes. The purpose and background of the conference was provided by the representative from NILIM. Country reports were presented under the theme of "Integrated Water Resource Management Adapting to the Global Climate Change" by Japan, India, Malaysia, the Philippines, Sri Lanka and Viet Nam.

Exchange of information took place on the impacts of global warming in the various countries, new ideas and concepts to cope with them and the measures for the improvement of awareness to cope with flood or water-related disasters. With this I close my report on the Session on Subject of Common Interest and ask for all participants' confirmation on the draft minutes of this session.

(Mr. Tsuboka) If there are no remarks? (No remarks.) We confirmed the minutes were an accurate reflection of the session. I would like to invite the next presenter to give his conclusion on the sessions on specific subjects.

5. Review of Sessions on Specific Subjects

5-1. Session on "Water Resource Management"

(Mr. Yamashita) The first session held on the morning of Thursday, November 29 discussed three themes pertaining to water resource management. Two of the three themes were related to global warming (i.e. the change of rainfall patterns, climate change models, etc.). The third theme addressed the measures being taken in the Tokyo metropolitan area concerning forest management and water utilization. There were additional questions and comments that exceeded the allotted time but a very significant exchange of information occurred.

5-2. Session on "Water Disaster Management"

(Mr. Koga) The second session held on the afternoon of Thursday, November 29 discussed 'flood risk evaluation and countermeasures', 'construction of storm surge forecast systems', 'managing sediment disasters warning data ' and 'implementation planning for global warning measures '. The main questions were about the flood control in regions between the Ibi River and Nagara River, the media and timing of the information dissemination on storm surges, ways to identify hazardous areas for sediment disasters and the content of assistance to developing countries by ICHARM. Through the presentations and Q&A, the participants could get the common recognition about the main issues concerning water disaster management.

5-3. Session on "Water Environment and Wastewater Management"

(Mr. Fujiki) The third session held on the morning of Friday, November 30 discussed the current situation of sewerage works and future strategies for Japan, emphasizing the rapid development of sewerage and its dramatic effects on the water environment of Japan. Four presentations were given on the outline of sewerage works and strategies for the future in Japan; urban storm water management; utilization of reclaimed wastewater; and beneficial use of biomass at wastewater treatment plants. We also discussed the potential role of sewerage in mitigation of GHG emissions. After the presentations fruitful discussions were held for the purpose of the application of relevant information to each participant's actual situation.

(Mr. Tsuboka) If there are no comments? (No comments.) We confirmed the minutes were an accurate reflection of the session. I would like to invite the reporter on the international symposium.

6. Review of the "The 16th International Symposium on National Land Development and Civil Engineering in Asia"

(Mr. Oodaira) Mr. Tsuboka delivered the opening address and Mr. Ashida presented the case of Kyushu District. Professor Jinno stressed the need for discussion with central and federal governments as well as stakeholders, and called for a sense of ownership to address global warming issues. There were presentations of specific cases by the participating countries which was followed by a panel discussion. Questions were raised regarding the biggest concern in the participating countries following the onset of global warming. Responses were made which indicated the concern of flood and water-related disasters. The session was concluded with an understanding of the respective problems of each country and the importance of establishing a cooperative network for tackling climate change problems was stressed and Mr. Taniguchi delivered the closing remarks. The participants noted that they found the panel discussion very meaningful to gain understanding of the various efforts being undertaken in the different countries.

(Mr. Tsuboka) If there are no comments? (No comments.) We confirmed the minutes were an accurate reflection of the session. I would like to proceed to the conclusions of the conference.

7. Conclusions of the Conference

(Mr. Tsuboka) I would like to ask the Secretariat to deliver the Conclusion.

(Mr. Inomata) The 16th Conference on Public Works Research and Development in Asia was held mainly in Beppu and Tsukuba from November 26 to December 7 with participants from India, the Republic of Korea, Malaysia, the Philippines, Sri Lanka, Viet Nam and Japan. The 16th conference addressed Integrated Water Resource Management Adapting to the Global Climate Change as the subject of common interest as well as Water Resource Management, Water Disaster Management and Water Environment and Sewage Management as specific subjects. The participants gained mutual understanding through presentations, site visits and active discussion. The 16th International Symposium on National Land and Development and Civil Engineering in Asia was held in connection with the 1st Asia-Pacific Water Summit.

The Conference on Public Works Research and Development in Asia is summarized as follows; the participants gained and shared knowledge of the current situation and challenges facing "Integrated Water Resource Management Adapting to the Global Climate Change" and recognized the importance of continuing research on the matter. The participants affirmed the need to establish an international cooperative framework for research and implementation of adaptation measures and recognized the need for further cooperation to continue this conference in the future.

(Mr. Tsuboka) If there are no comments, I would like to confirm the adoption of the conclusions of the conference. Thanks to your cooperation we have been able to successfully conclude this conference and I would like to welcome your opinions in regard to the conference overall.

7-1. Comments by Participants

(India) Through this conference, I have realized the need to initiate adaptation measures and continued research. I hope my country will further efforts in this regard and establish an international cooperation framework for research. I would like to express my sincere gratitude to NILIM and JICA for the opportunity to attend this conference.

(Republic of Korea) I was deeply impressed by the organization of this conference and I look forward to reporting the success and results of this conference to my President.

(Sri Lanka) This was a very useful conference. We gained valuable knowledge through the site visits and I would like to thank all of you for organizing this conference.

(Malaysia) I gained a lot of experience about the working environment and Japanese culture to enhance international exchange. All the presentations were very useful, but for me coming from the sewerage department, I would like to discuss further about how we can use effluent water in the future, sludge disposal, residential storage tanks, and so forth. I would also like to recommend a longer Q&A session for the next conference.

(Philippines) I would like to express my profound appreciation to NILIM and the organizers of this conference and emphasize the gratitude of the government of the Philippines for the support of JICA in our important research projects. Due to your efforts, it is possible that research will focus on water-related issues in the future.

(Viet Nam) I think through the lectures and discussion I have gained new information, ideas and concepts which will help me introduce new policies and transfer knowledge to the local authorities in Viet Nam. I hope to gain more information on cooperative river basins management efforts but I am very much grateful for this opportunity.

(Mr. Tsuboka) I would like to express our appreciation for your active participation and discussion throughout the session. Lastly, there are two more points that we must cover.

8. Others

8-1. Proposal of the Networking of Researchers and Engineers

(Mr. Nishikawa) I have two proposals. The first is a proposal to initiate mutual information exchange between NILIM and your organization. We propose an exchange of newsletters or manuals (i.e. publications by NILIM and your organization) to expand information exchange on a regular basis. Also we would like to utilize the Internet to build a more active information network among the countries. Secondly, we would like to ask you to communicate the significance and meaningful outcomes of this conference to your country's institutions and organizations, and JICA offices and Japanese embassies to ensure the continuation of this conference.

8-2. List of Contacts for Further Discussion after the 16th Conference

(Mr. Oodaira) Now that you have heard the two proposals, for the sake of the future exchange of information and the continuation of this conference, I would like you to make use of the contact information on the list of contacts. If you have any questions, please feel free to contact any of these individuals and likewise these people may come to you for information sharing. Any other requests may be directed to the international research division of your organizations.

9. Closing Remarks

(Mr. Tsuboka)We will continue to work very hard and make every effort to ensure the further development of this conference. With this we would like to close the general discussions and I would like to express my sincere gratitude to everyone for their cooperation and contribution.

VI　CONCLUSION

CONCLUSIONS **19.12.7**

THE 16TH 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 researcher's network.

The 16th Conference on Public Works Research and Development in Asia was held mainly in Tsukuba and in Beppu from November 26 to December 7 in 2007. 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; India, Korea, Malaysia, Philippines, Sri Lanka, Vietnam and Japan**.**

With the increasing concern of the global environmental problem and the frequent occurrence of the flood and drought in recent years, the adaptation to the climate change is becoming an urgent subject in the civil engineering field. The 16th conference took up "Integrated Water Resource Management Adapting to the Global Climate Change" as the subject of common interest among nations and also took up 'Water Resource Management', 'Water Disaster Management' and 'Water Environment and Wastewater Management' as the specific subjects.

In the conference, the participants had the presentations and discussions to enhance mutual understanding and to acquire knowledge to solve these problems, and had site visits related to advanced technologies and practices. In addition, the participants joined "The 16th International Symposium on National Land and Development and Civil Engineering in Asia" which was held in connection with the 1st Asia-Pacific Water Summit and had a panel discussion on the "Integrated Water Resource Management Adapting to the Global Climate Change in Asia" followed by the presentation of the situation and problems in each country.

The conference, through the presentations, the discussions, site visits and the symposium, is summarized as follows:

1) The participants could get the better understanding of the present situation, problems and works concerning the "Integrated Water Resource Management Adapting to the Global Climate Change" in each country and shared the knowledge and experience to solve the problem of each country.
2) The participants recognize the importance of working on the "Integrated Water Resource Management Adapting to the Global Climate Change" as well as the importance of conducting researches for them.
3) The participants affirmed a common recognition of the need to establish an international cooperative framework for research and implementation of adaptation measures about "Integrated Water Resource Management Adapting to the Global Climate Change".
4) The participants recognize the needs to cooperate with each other and continue the conference in the future.

Ⅶ SESSION REPORTS

Ⅶ-1　Japan

Mr. Shin TSUBOKA
Director General,
National Institute for Land and
Infrastructure Management

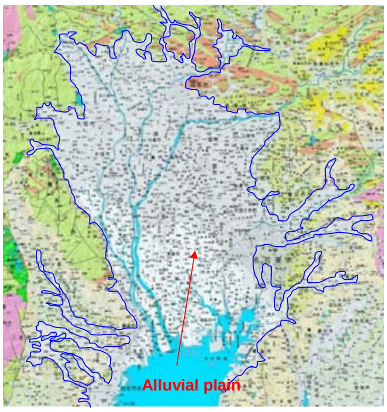
Adaptation to Flood Change Due to Warming in Japan

National Institute for Land and Infrastructure Management
Director General : Shin Tsuboka

Geographic Features and City Formation

Most of the plains in Japan are alluvial plains and many cities are formed over these alluvial plains.

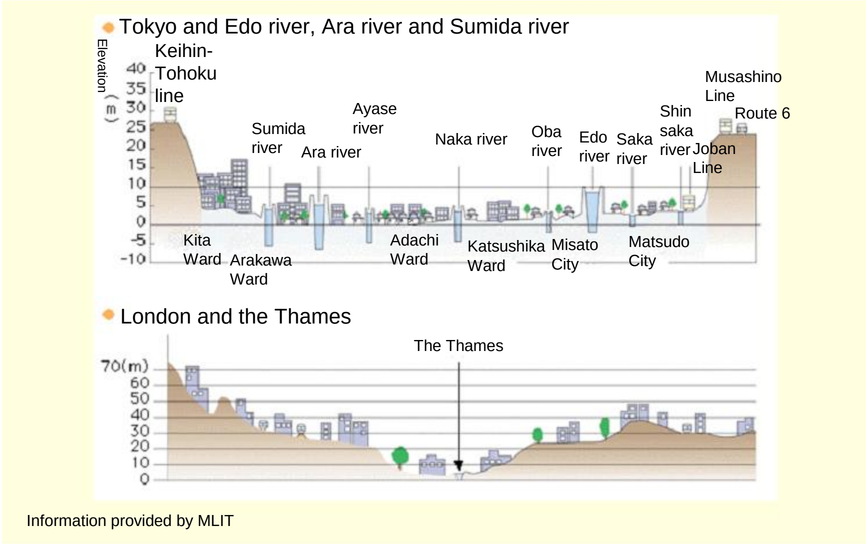
Tokyo area
(The Kanto Plain)



Chukyo area
(The Noubi plain)

1

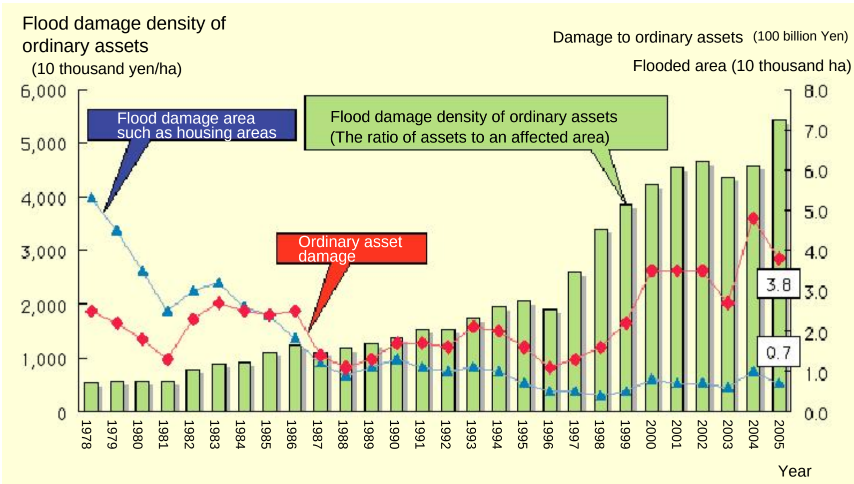
Flood Vulnerability



The relation of grounds and rivers level in Tokyo and London

2

Flood damages



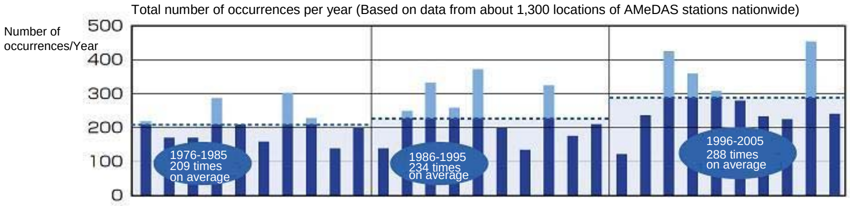
Transition of Ordinary asset damages and flooded area

3

Precipitation change (1)

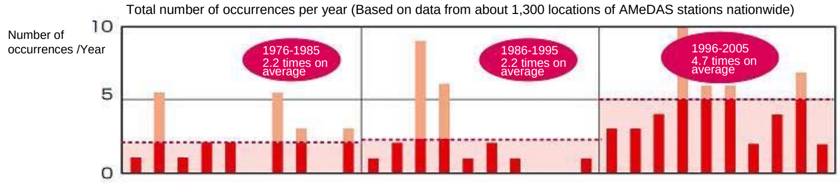
Number of downpour occurrences with 50mm rainfall per hour or larger

Total number of occurrences per year (Based on data from about 1,300 locations of AMeDAS stations nationwide)



Number of downpour occurrences with 100 mm rainfall per hour or larger

Total number of occurrences per year (Based on data from about 1,300 locations of AMeDAS stations nationwide)



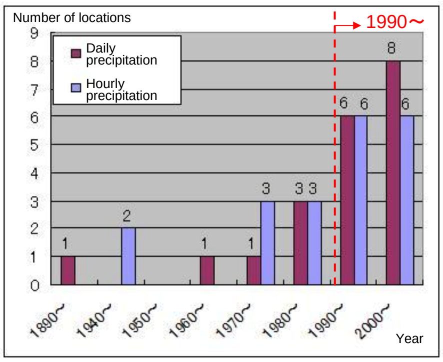
Prepared by MLIT based on data by Japan Meteorological Agency

Recent changes in heavy rain frequency based on AMeDAS data by Japan Meteorological Agency

4

Precipitation change (2)

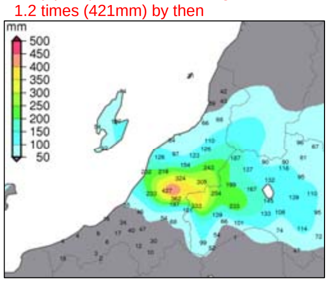
Recorded decade distribution of top 20 largest precipitation
(Observatories of Japan Meteorological Agency)



Most of the largest precipitation events in various areas in Japan were recorded after 1990.

2004 Niigata and Fukushima Heavy Rainfall

Daily precipitation was the largest amount of 1.2 times (421mm) by then

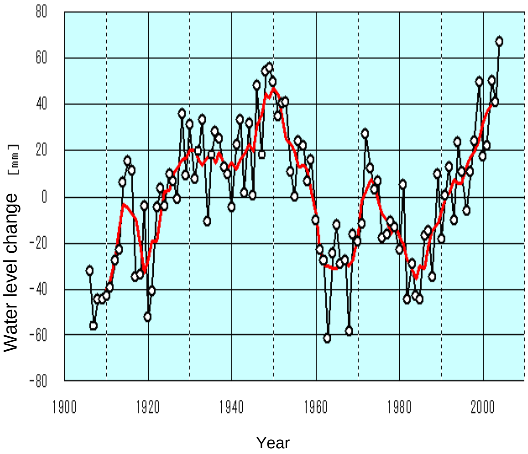


Precipitation distribution map

Levee breach (Kariyata River)

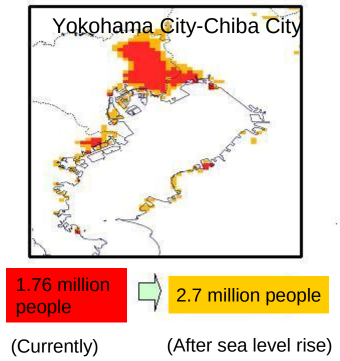
5

Changes in Sea Surface Level and their influences



Changes in sea surface in Japan's coastal areas

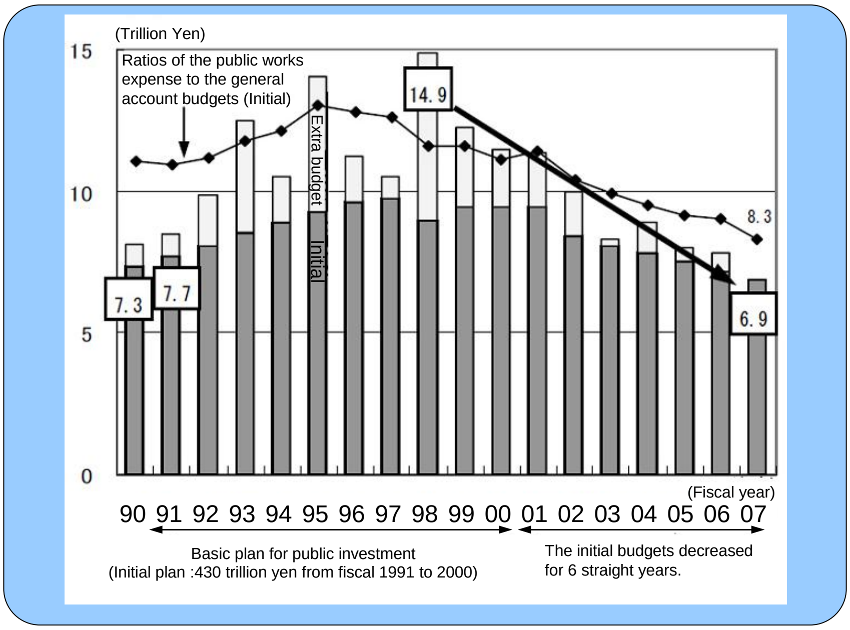
Tokyo Bay



Change in the under sea surface area in Tokyo Bay in the case of rise of 0.59m

6

Transition national budget concerning public works

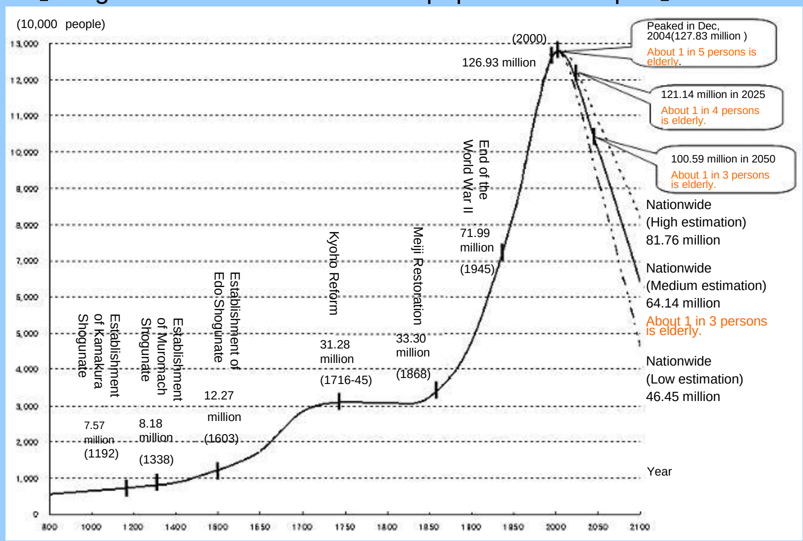


Data:Road-related budget for fiscal 2007【MLIT Press Release (January, 2007) 】

7

Coming of Depopulating Society

【Long-term transition of the total population of Japan】



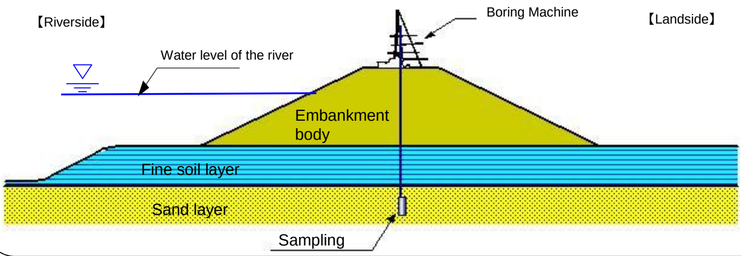
(Source) Prepared by National and Regional Planning Bureau of MLIT based on data from National Institute of Population and Social Security Research

Worry ・Uncertainty about the future is growing in minds of Japanese peoples

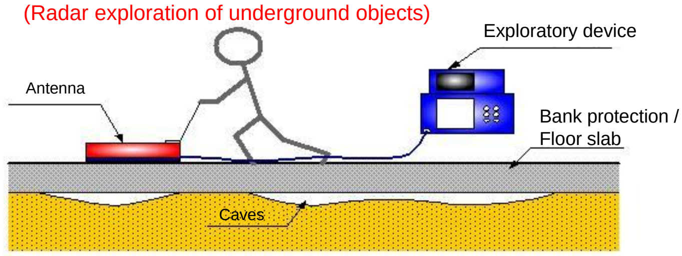
8

Adaptation Measures in Terms of Structure (1)

Understanding of soil mechanics of embankment body by boring



Investigation of caves in storm surge barriers
(Radar exploration of underground objects)

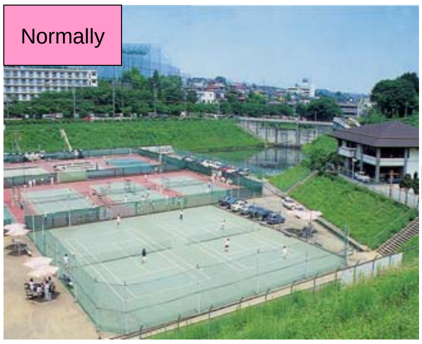


Implementation of dike inspections

9

Adaptation Measures in Terms of Structure(2)

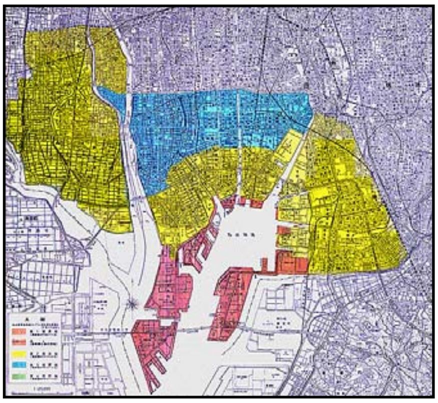
Kirigaoka retarding basin (Tsurumi River)

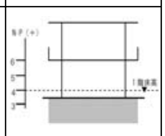
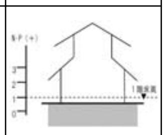
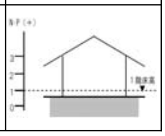


Utilization of multipurpose storage facilities

10

Adaptation Measures in Terms of Land Use Revision



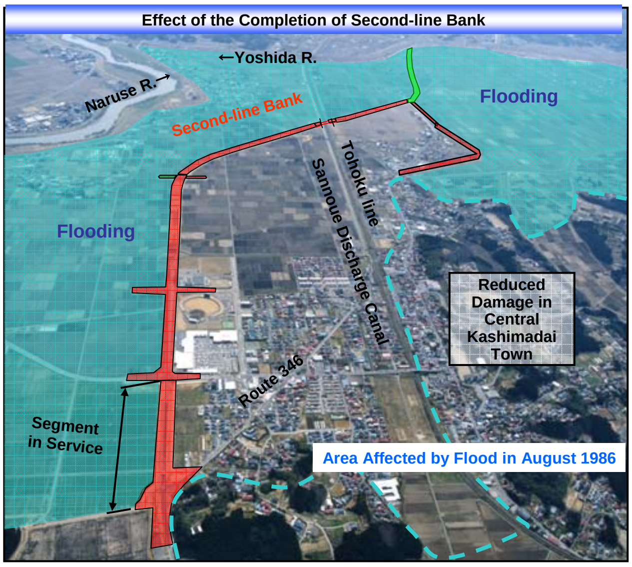
	Floor height of 1st story	Structural limitation	Diagram
(magenta)	N･P (+) 4 m or more	Wooden buildings are prohibited	
(yellow)	N･P (+)1m or more	Rooms for human occupation must be on the 2nd or higher stories.	
(cyan)	N･P (+)1m or more	–	

Example of Restrictions under Ordinance (Nagoya City)

－Hazardous areas designation based on Building Standard Law －

11

Adaptation Measures in Terms of Damage Reduction Measures (1)



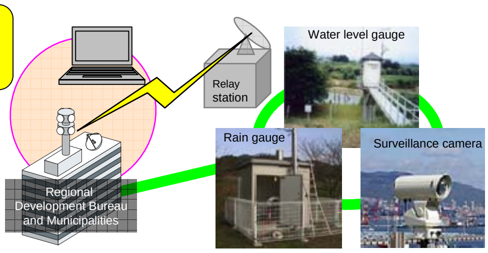
The construction of second-line bank in this district is promoted combined with a road project (bypass construction).

Flood Flow Control Using Second-line Banks

Adaptation Measures in Terms of Damage Reduction Measures (2)

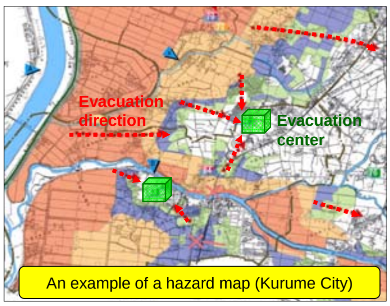
Improvement and Maintenance of Information offer System

Improvement and maintenance of observation equipment such as rain gauges, surveillance cameras, etc.



Preparation of Flood Hazard Map

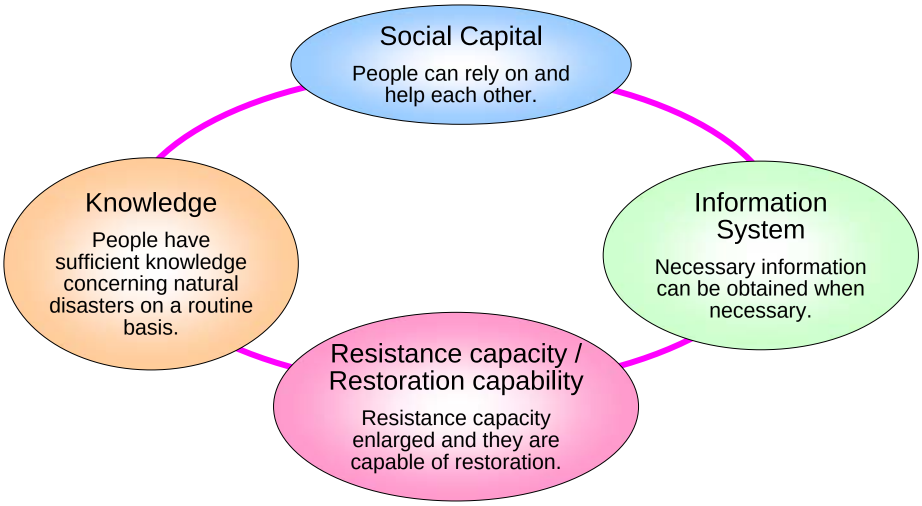
Preparation and publication of flood hazard maps based on the area where flood is expected.



An example of a hazard map (Kurume City)

Implementation of required information offer for safe evacuation such as preparation and publication of hazard maps

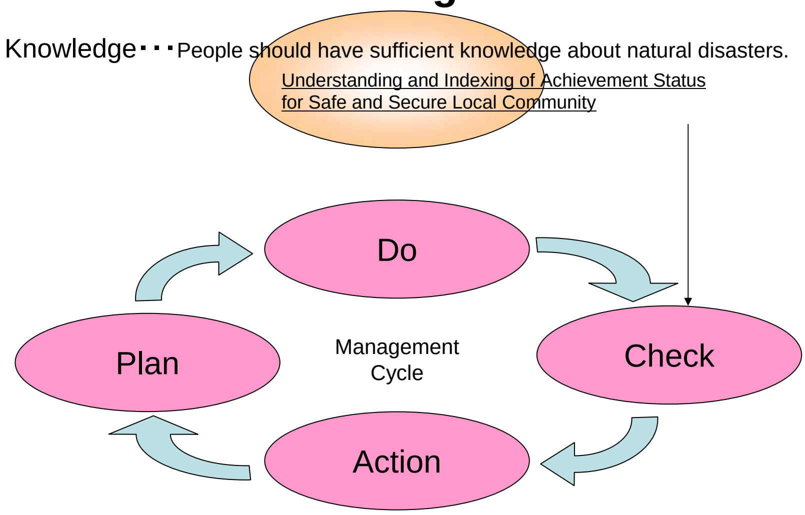
For Safe and Secure Local Communities against Natural Disasters



Four basic elements for safe and secure local communities

14

Management Cycle of Activities of Disaster Prevention Organizations



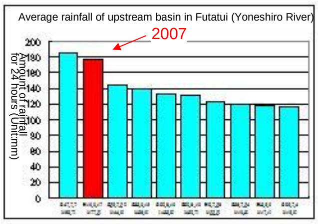
PDCA Management Cycle related to Activities of Disaster Prevention Organizations

15

Local Disaster Prevention Capability and Disaster Damage Occurrences

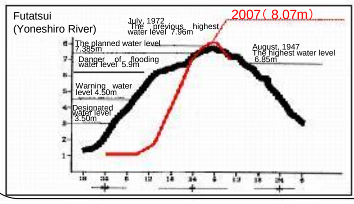
September 17, 2007 Frontal heavy rain (Yoneshiro River)

The previous second largest rainfall



Those houses were located outside the flooded area and suffered no damage.

The previous highest water level



Most of the flooded Area is arable land.

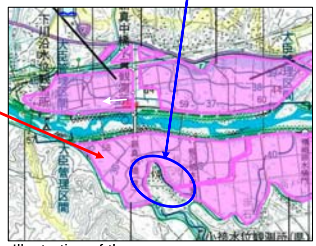


Illustration of the flooded areas (: Flooded area)

16

Examples of Support Activities by NILIM for Improvement of Disaster Prevention Capabilities of Local Communities (1)

Support for planning Small and Medium-Sized Companies BCP（Business Continuity Plan）

- Opinion exchange about common items / Consensus building
  - ･Damage anticipation
  - ･Mutual assistance activities, etc
- BCP planning by each company
- Opinion collection, Training and Checking
- Improvement of business and planning

:Exchange of opinions and their review at skull sessions

【 **Members of the skull session** 】
Chamber of Commerce, Representative Company, Offices of municipalities and prefectures, Regional work offices of MLIT, NILIM, etc

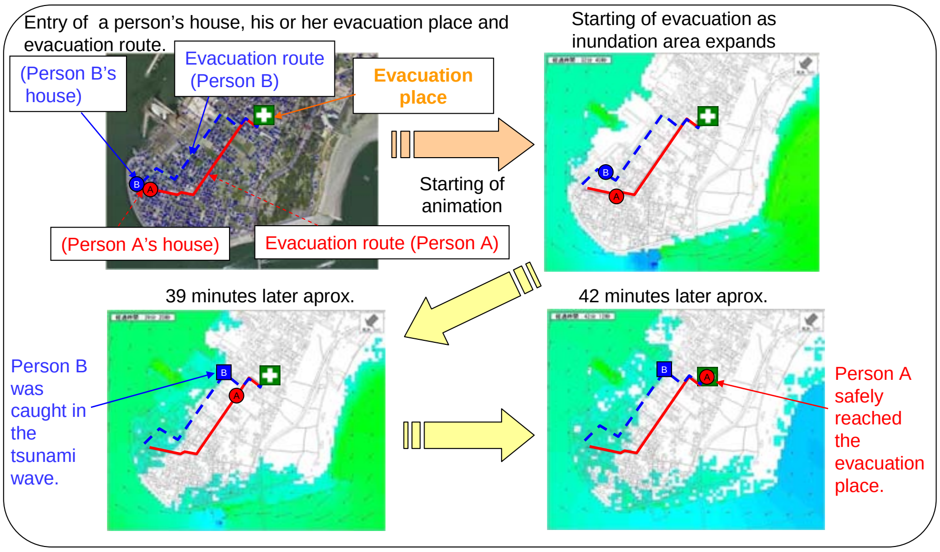
Procedure of BCP preparation support

A scene from a planning meeting

17

Examples of Support Activities by NILIM for Improvement of Disaster Prevention Capabilities of Local Communities (2)

Development of the animated hazard map and cooperation with local communities



18

Conclusion

1) Japan has many cities over alluvial plains and vulnerable structure to flooding.

2) Because of global warming, extreme precipitation in Japan is expected to increase.

3) As adaptation measures, improvement and development of structures are important but have limitations. So it is necessary to improve damage reduction capability of local communities against flooding.

4) National Institute for Land and Infrastructure Management has implemented researches for various technical tasks. We take it important for local communities to make efforts especially to improve their damage reduction capabilities from now on.

19

Ⅶ-2　India

Mr. Dhinadhayalan MURUGESAN
Assiatant Adviser of Public Health
and Environmental Engineering,
Central Public Health and Environmental
Engineering Organization,
Ministry of Urban Development

ANNEX-I

COUNTRY REPORT OF INDIA

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

JICA ECXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
JFY 2007

Prepared by

M. Dhinadhayalan
Assistant Adviser(PHE)
Central Public Health & Environmental Engineering Organization (CPHEEO),
Ministry of Urban Development
Government of India
New Delhi

COUNTRY REPORT OF INDIA

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

Executive Summary

Urbanization in India is taking place in a rapid manner. Out of the total population of 1027 million as per 2001 census, the urban population was about 285 million, or 27.8% of the total population living in 5161 towns.

The most difficult challenges will be faced by the developing countries, particularly in the field of water. Development and management is needed in view of mismatch between natural availability and demand. This is especially important for countries of the south in view of the climatic-hydrologic considerations. Water resources development has, therefore, been given importance in India from times immemorial. However, very serious challenges emerge in the context of massive development needed in the context of increasing population and high economic growth required for development.

Far reaching and rapid socio-economic and environmental changes will take place as India commits to come in the mainstream of human endeavor, as postulated in the Tenth Five Year Plan. Focusing on water, a revolution will be required in the concepts, policies, technology, planning, management and institutions to meet the futures challenges.

A National Program of Flood Management was launched and reasonable degree of flood protection has been provided to an area of 14.374 mha by March 1993 out of the total area of 32 mha, which is estimated to be protectable. A variety of programs for watershed management have been undertaken. Integrated land-water development has been undertaken through Canal Command Area Development. Procedures for environmental conservation have been established and several Acts have been passed in this context. An integrated development of water has been attempted and a National Water Policy (NWP) has been formulated.

There is however another side of the picture also. India has not been able to provide even drinking water facilities to the world's largest group of people, be it in terms of numbers or percentage of population. The irrigation performance is one of the poorest in the world in terms of agricultural yields or agricultural productivity. Large scale water withdrawals from rivers and polluted inflows have turned several rivers over large stretches into open gutters. There is increasing problem of ground water over exploitation and pollution in many areas. Floods and drought over large parts of the country are perennial phenomenon.

India has very for to go. With a per capita GNP of about $500, it is one of the poorest countries and home to world's largest population of the poorest of the poor. Rapid advances in all spheres have to take place, management of water being a prominent one. Drinking water and sanitary facilities have to be provided to the vast mass of rural and urban population. Reliable, timely and adequate water supply has to be provided for modernizing the agricultural activities. There is going to be a very serious pressure on resources and problem of environmental degradation as the consequent large-scale transformation of the hydrological cycle is undertaken. Serious problem of pollution from point and non-point sources will follow as economic development takes place. Conflicts are bound to arise between states and sectors as perceptions and demands very.

Yet, there is little perception of the stupendous challenge and even less capability or commitment to undertake the revolutionary changes. The socio political milieu is daunting in its impedance to the accomplishment of the task. Some of the activities of the Government to meet the futures challenge may by examined in this context.

1.Organisation data

(1) Name of Organization :- Central Public Health & Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Govt. of India

(2) Summary of Organization :-

CPHEEO is a technical wing of the Ministry of Urban Development. CPHHEO assists Ministry in formulation of policies and programmes in urban Water Supply & Sanitation Sector and advises the Ministry on technical matters. The Govt. of India has launched a reform linked programme of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for creating urban infrastructure facilities including water supply and sanitation in all 5161 towns/cities in the country with a budgetary provision of 1,00,000 crore to be implemented over period of 7 years ie., from 2005-2012.

(3) Organization Chart

Organizational chart indicating my position is enclosed at Annexure-II.

(4) Organization's Position in Government

CPHEEO is a advisory body in the Ministry of Urban Development, Govt. of India. I assist the Ministry on technical matters in the field of Water supply & Sanitation.

2.Personal Data

(1) Recent Work

I have assisted Ministry in framing the guidelines for JNNURM. I have appraised about 200 nos. of water supply, sewerage, solid waste management, and storm water management projects posed by the various State Govts. under the Centrally sponsored programme viz., Accelerated Urban Water Supply Programme, JNNURM and under the External Funding during the lat 3 years. I have monitored the schemes implemented under the Central progarmme. I have served as a member in the Expert Committee constituted for the preparation of Manual on Municipal Solid Waste Management. I advise State Govts/ULBs on technical matters time to time and frame reply to the Parliament questions, VIP references etc and attend various meetings in different Ministries.

(2) Contact Address

Office address:- CPHEEO, Ministry of Urban Development,
654- A wing, Nirman Bhawan,
New Delhi -110011

Phone number:- 91- 11-23062418 /Mobile No. 09818477087
Fax number :- 91-11-23062559
email address : mdheen@sify.com

COUNTRY REPORT OF INDIA

3. INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

(i) Current Situation and Problem

A. Population and Urbanisation

Urbanization in India is taking place in a rapid manner. Out of the total population of 1027 million as per 2001 census, the urban population was about 285 million, or 27.8% of the total population living in 5161 towns. Of the 5161 urban agglomerations and other towns, the 35 metropolitan cities contained about 37% of the total urban population. The rate of urban population growth in the country is still very high as compared to developed countries, and the large cities in the country are becoming larger due to accretion of population to these cities. On the assumption that the urban population would continue to grow at a rate of about 3.1% per year in the next few decades, the urban population is expected to increase to an estimated 550 million by 2021 and the level of urbanization at that time will be about 41%.

B. Water Availability and Demand in India

India roughly accounts for about 2.5% of the World's land mass, 4.5% of the World's fresh water resources and 16% of the World's Population. Due to increase in population, the total annual renewable fresh water available has reduced from 5177 cubic metres per person per year in 1951 to 1820 cubic metres per person per year in 2001. It has been assessed that the per capita average annual fresh water availability may be reduced to 1341 cubic metres per person per year by 2025 and 1140 cubic metres per person per year by 2050. Any situation of water availability of less than 1000 cubic meters per person per year is considered as scarcity condition. Though India may not be water scarce country, based on the national average, but due to vagaries of rainfall and drought conditions in some parts of the country, there may be water scarcity conditions prevailing in such areas.

According to the assessment made by Ministry of Water Resources, the total water requirement of the country for various uses, such as irrigation, drinking, industry, power, navigation, ecology including evaporation losses would be :-

694 Km^3 in the year 2010,
784 Km^3 in 2025 and
973 Km^3 in the year 2050.

Against this, the total utilizable water (surface and ground water availability) will be 996 Km^3 upto the year 2050. As such, overall, in India there may not be any water shortage upto the year 2050. However, due to regional imbalances prevailing in different parts of the country, it is likely that water shortage may be felt in some regions of the country. As such, efforts should be made for effective and efficient water management so as to satisfy the various sector needs in the years to come.

Moreover, the quantum of water required for domestic needs of urban and rural areas is estimated to go up from about 42 Km^3 (5% of the total water demand for all uses) at present to 90 Km^3 in the year 2050 (9% of the total water demand for all uses). When compared to demand of water for irrigation, which is about 80% of the total demand for all uses, the requirement of water for domestic use is very small and hence as per National Water Policy adequate priority should be given for allocation of water drinking needs.

C. Current state Development of Water Resource Management in India

With the attainment of Independence in 1947, highest emphasis was laid on water resources development and impressive achievements like Bhakra Dam, just to name one, followed. Highest level of technological capability was achieved by indigenous self-sustained efforts.

The developments have slackened of late of several reasons, but even then impressive developments have taken place. Extensive surface and groundwater development has been undertaken and the irrigated area potential of 22.6 mha in 1951 ha been increased to 99.76 mha by 2001 end, making India the leader in irrigated area in the world. Many impressive large-scale dams have been constructed for multipurpose development with the storage potential of about 174 bcm, which is about 10 percent of the total water potential available in the country.

An important change from early 1960s was the development of tubewells in the north region, mainly private, as power became available with the construction of multipurpose dams in the area. Rapid development of tubewells took place and by 1997, minor irrigation, in which tubewells are predominant, covered an area of 56.60 mha against 32.96 mha irrigated by the traditional canal irrigation.

A National Program of Flood Management was launched and reasonable degree of flood protection has been provided to an area of 14.374 mha by March 1993 out of the total area of 32 mha, which is estimated to be protectable. A variety of programs for watershed management have been undertaken. Integrated land-water development has been undertaken through Canal Command Area Development. Procedures for environmental conservation have been established and several Acts have been passed in this context. An integrated development of water has been attempted and a National Water Policy (NWP) has been formulated.

There is however another side of the picture also. India has not been able to provide even drinking water facilities to the world's largest group of people, be it in terms of numbers or percentage of population. The irrigation performance is one of the poorest in the world in terms of agricultural yields or agricultural productivity. Large scale water withdrawals from rivers and polluted inflows have turned several rivers over large stretches into open gutters. There is increasing problem of ground water over exploitation and pollution in many areas. Floods and drought over large parts of the country are perennial phenomenon.

Another area of very serious concern is that of contaminated groundwater and its implications on human health and economy. Groundwater is the major source of rural water supply. However, it is well known that groundwater is seriously polluted at several locations and is a health hazard. According to the report to press by the rural development Ministry "water supplies to two lake habitations contain dangerous levels of iron, arsenic, fluoride and nitrates. Country-wide block surveys between 2000 and 2004 reveal that 31,000 habitations are fluoride-affected, 5,209 are arsenic affected, 23,495 salinity affected, 13,958 nitrate-affected 1,11,201 iron-affected".

Arsenic pollution in Bangladesh and West Bengal is well known. However, it is now feared that large areas of even the central region of the Ganga basin may be seriously contaminated with arsenic. Besides the serious and disturbing adverse health impacts, it may have serious implications for the economy..

D. Provision of Water Supply & Sanitation Facilities

At present about 90% of the urban population has got access to safe water supply and 63% has got access to sewerage and sanitation facilities respectively. The coverage figures indicate only the accessibility, whereas adequacy and equitable distribution and per-capita provision of these basic services may not be as per the prescribed norms in some cases. For instance, the poor, particularly those living in slums and squatter settlements, are generally deprived of these basic facilities.

The 2001 Census further indicates that, out of total 53.69 million urban households, 36.86 million households are having tap water source, the remaining households have water supply from other sources such as handpumps, tubewells, etc. Out of 36.86 million households, 26.67 million urban households are having tap water source within the premises, 8.08 million near the premises and 2.09 million away from the premises (i.e., the source is located at a distance of more than 100 metres from the premises).

E. Rain Water Harvesting:

Realizing the depleting ground water potential and deteriorating quality due to contamination and pollution, the Central Ground Water Board (CGWB), Ministry of Water Resources has brought out Model Ground Water Legislation and circulated to all States for preparation of similar State Ground Water Legislations and implementation. But so far, only a few States have brought out such legislation; but its implementation is not much encouraging so far. The CGWB brought out information brochures in regard to Roof Top Rainwater Harvesting and Artificial Recharge of ground water in order to increase the ground water potential in various parts of the country.

F. UNACCOUNTED FOR WATER (NON REVENUE WATER)

Several pilot studies conducted in the country have shown water losses in the distribution line to be the order of 20% to 50% of the total flow in the system and maximum leakage caused in the house service connections. In India, where water supply is by and large intermittent (supply hours ranging from 3 hours to 10 hours), during non-supply hours when the system is not under pressure, external pollution may get sucked into the system at the points of leak causing health hazards.

There is need for systematic approach for reduction of wastage of water through leaks and hence preventive maintenance should form an integral part of O&M on a regular basis. If such measures are taken by the water supply agencies, then there may not be any immediate need to take up augmentation scheme and it will also help increase revenue to make the system self-sufficient.

G. REUSE OF MUNICIPAL WASTEWATER

A major catalyst for the evolution of wastewater reclamation, recycling and reuse has been the need to provide alternative water sources to satisfy water requirements for irrigation, industry and non-potable applications due to unprecedented urban growth. Water shortages, particularly during the periods of droughts, have necessitated stricter control measures on per-capita water consumption and development of alternative water sources. Such an attempt would result in waste reduction and reduction in pollution load, which eventually helps maintain a healthy and eco-friendly environment for better quality of life in the cities and towns.

It should be made mandatory in a phased manner so that large industries and commercial establishments may meet at least 50 percent of their non-potable water requirements from the reclaimed water. Similarly, for irrigating crops, horticulture, watering public lawns/gardens, flushing of sewers, fire-fighting etc. reclaimed water should only be used and to this effect, there is a need for legislation or amendment in the municipal bye-laws.

H. Natural disaster scene in the world

Between 1970 and 2000, natural disasters in the world killed at least three million people and affected millions more. The average annual economic losses due to disasters were eight times more than in previous decades. The losses in the 1990s were more than US$ 400 billion.

Ninety percent of natural disasters and 95 percent of all deaths in such disasters occur in developing countries. The average annual population affected is highest in China (90 million), followed by India (56.6 million) and Bangladesh (18.5 million). In November 1970, a cyclone claimed 500,000 lives in Bangladesh.

I. Why is India classified as a disaster prone country?

India's size, geographical position, and the behaviour of the monsoon make it one of the most disaster-prone countries in the world. The subcontinent is highly vulnerable to droughts, floods, cyclones, and earthquakes, In addition, the Himalayan region experiences landslides, avalanches, and bush fires. However, volcanoes are uncommon in India, with just two active ones in the Andamans.

The number of people affected in earthquakes, cyclones, and floods is the highest, followed by those affected by droughts. The areas prone to different types of natural disasters are as follows:

- Cyclones: The eastern coastline and the islands of Lakshadweep, Andaman and Nicobar.
- Floods: The major river valleys such as those of the Ganga and the Brahmaputra.
- Earthquakes: Fifty six percent of the land area.
- Droughts: Sixteen percent of land area spread over 16 states.
- Landslides: The Himalayan region and Western Ghats.
- Fires: Bihar, West Bengal, Orissa, and the North East.

Cyclones occur mainly in the Indian Ocean. They are violent tropical storms in which strong winds move in a circular fashion. Hurricanes and typhoons are violent storms with very strong winds experienced mainly in the western Atlantic Ocean.

J. How do floods occur in India?

Floods are the result of the peculiar rainfall pattern in most of the country. Of the total annual rainfall, 75 percent occurs over three to four months. This leads to a very heavey discharge from the rivers, which floods large areas.

Off all the natural disasters that occur in India, the most frequent and devastating are river floods. The Ganga-Brahmaputra-Meghna basin, which carries 60 percent of the total river flow in India, is most susceptible to floods. The rivers Brahamputra, Ganga, and their tributaries carry tons of debris and water throughout the year, and during the monsoon the water flow exceeds the capacity of the rivers, breaks the man-made ridges, and floods whole areas. Hectares of land in the country are flood-prone. Every year, an average of 19 million hectares of land becomes flooded.

K. What is the impact of earthquakes in India?

The primary effect of an earthquake is the shaking and possible displacement of the ground. This results in damage to buildings, roads, dams, pipelines, etc., and causes loss of life and property. The secondary effects include flooding caused by subsidence of land, fires, epidemics, etc. Coastal areas could be hit by earthquake-generated waves called tsunamis (see the section on tsunamis).

On an average, about 15,000 people are killed every year in earthquakes. They destroy property and cause fires and floods. Earthquakes in the ocean create giant waves and cause coastal or underwater landslides.

A severe earthquake with a magnitude of 6.9 on the Richter scale had hit Gujarat with its epicenter 20km northeast of the town of Bhuj in Kutch. The shock was felt in most parts of the country. The districts of Kutch, Bhavnagar, Surendranagar, Rajkot, and the Ahmedabad districts were devastated.

It was the most severe earthquake in the last 50 years in India, with 20,000-30,000 dead, 150,000 inured, and 15.9 million affected. The total economic loss was estimated at Rs. 225 billion.

Bhuj was the worst affected town with about 10,000 people killed. Almost half of its structures has been leveled. Amazingly, its historic tower was still standing. This was the case in other places too, with many old buildings remaining intact, while new buildings had collapsed.

L. Tsunamis in India

Tsunami is a Japanese word meaning ‘harbour wave’. A tsunami is not a tidal wave and is not caused by winds or the gravitational pull of the Moon or the Sun. Most tsunamis are caused by undersea earthquakes that set off waves in water. A tsunami moves silently but rapidly across the ocean and when it hits the coast, it unexpectedly rises as destructive high waves. These waves many last just minutes, but can cause widespread devastation along the coast.

Most tsunamis occur in the Pacific Ocean. During the 1990s, 82 tsunamis occurred worldwide, many more than the historical average of 57 a decide. They are relatively rare in the Indian Ocean but not unprecedented.

The tsunami that hit south East and South Asia on December 26, 2004, was the biggest ever in history. It was triggered by a massive undersea earthquake measuring nearly 9.0 on the Richter scale that occurred in Sumatra. It moved with a speed of about 900 kmph and hit the Andaman and Nicobar Islands barely an hour after the quake occurred.

Nearly 300,000 people died in this disaster and entire coastal villages were wiped out in Thailand, Sri Lanka, and India. Car Nicobar, Cuddalore, and Nagapattinam were the worst affected places in India. Thousands of people, particularly fisherfolk, lost their homes and livelihoods. It is noteworthy that the damage was less in those parts of the coast that had natural barriers like mangroves and casuarinas trees.

2. Research and Study

A. Interlinking of Rivers in India

Of late, considerable emphasis has been laid on the subject. The Ministry of Water Resources formulated a National Perspective Plan for water resources development with the objective of transferring water from surplus basins to water deficient basins/regions by Interlinking of Rivers, as early as 1980. The National Perspective Plan has two main components, i.e. the Himalayan Rivers Development and Peninsular Rivers Development. Subsequently, a National Water development Agency (NWDA) was set up as a society in 1982 to carry out surveys and investigations and to prepare feasibility reports of the links under the National Perspective Plan.

The studies revealed that the work is seriously deficient in engineering-economic terms, more in the neglect of the environmental and political aspects. It is unfortunate that even some basic engineering principles have been violated while making the proposals and estimates. For example, the proposed transfer from Brahmputra will raise serious problems of water logging and flooding in view of interference with drainage in that area of heavy floods. Second, interbasin transfer in Himalyan region is going to be very expensive, which was the basis of classical Cotton-Cautley controversy about location of the Upper Ganges Canal. It was found to be vastly true as the Ramganga-Ganga link was designed by the author, which was accordingly proposed to be shifted as far downstream as possible, though it could not be implemented fro certain reasons.

Third, large canals in Himalayan foothills suffer from the serious danger of natural disasters on account of land slides and possibility of complete silting, as was the experience of the Upper Ganges canal recently. Fourth, all interbasin canals will have to be developed in full cutting and not in balanced filling and cutting, as is the usual practice and as proposed currently. Thereby the costs will be further increased substantially. It can be argued that technology can deal with all these problems but it has to be noted that, then the proposals will become economically infeasible.

The group recommended that the proposed interlinking was not warranted. It can be said that the river linking project is “a big dream of little logic”. The Parliamentary Agriculture Committee invited the views of the author on the subject and it had to be stated that the subject has not been scientifically studied and some of the proposals are preposterous. As per latest media reports, the matter is being pursued (even through there may be second thoughts by some influential members of the Government).

3. Policy & Practices

A. National Water Policy, 2002

The National Water Policy, 2002 has assigned overriding priority for drinking water allocation in the planning and operation of systems. The National Water Policy, inter alia, suggests the following:-

- There should be a periodical reassessment of the ground water potential on a scientific basis, taking into consideration the quality of the water available and economic viability of its extraction.

- Exploitation of ground water resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The detrimental environmental consequences of over-exploitation of ground water need to be effectively prevented by the Central and State Governments. Ground water recharge projects should be developed and implemented for improving both the quality and availability of ground water resource.

- Integrated and coordinated development of surface water and ground water resources and their conjunctive use should be envisaged right from the project planning stage and should form an integral part of the project implementation.

- Over exploitation of ground water should be avoided especially near the coast to prevent ingress of seawater into sweet water aquifers.

B. General policy on disaster management in India

In recent years, there has been a shift of focus from post-disaster management to preparedness and mitigation. Forecasting and monitoring systems are now in place for earthquakes, droughts, floods, and cyclones.

The draft National Policy on Disaster Management released in 2003, proposes the following:

- A holistic, and proactive approach towards prevention, mitigation, and preparedness.

- Each ministry and department of the central and state governments should set apart adequate funds for vulnerability reduction and preparedness.
- Mitigation measures should be built into ongoing schemes and programmes.
- Each project in a hazard-prone area should include mitigation measures and vulnerability reduction.
- A national disaster management law should be enacted covering all the existing mechanisms.

C. National Lake Conservation Plan (NLCP)

The National Lake Conservation Plan was initiated in 1994 for cleaning important lakes with high levels of silting and pollution.

The 10th National Fiver-year plan has appreciated the importance of the National Lake Conservation Plan (NLCP) undertaken by Ministry of Environment and Forest, GoI.

The objective of NLCP is to develop national level policies and actions with focus on urban lakes. It envisages a comprehensive and holistic approach for Lake Conservation. The socio-economic development of the people dependent on the lake ecology shall also be fully integrated.

The programme includes the following:

- Prevention of pollution from point and non-point sources
- Catchment area treatment
- Desilting and weed control
- Research & Development studies on flora and fauna
- Other lake specific activities such as integrated development approach, including interface with human populations

Under NLCP, the Central and State Governments share the capital costs in the ratio of 70:30.The scope of NLCP has been enlarged during the 10th Plan by including the rural lakes in the programme, with corresponding increase in plan outlay.

Initially ten lakes were identified for conservation under the NLCP – Ooty (Karnataka), Kodikanal (Tamil Nadu), Powai (Mumbai), Dal (Jammu and Kashmir), Sukhna (Chandigarh), Man Sagar (Rajasthan), Nainital (Uttaranchal), Udaipur (Rajasthan, Rabindra Sagar (Thane, Maharashtra) and Hussain Sagar (Hyderabad, Andhra Pradesh). Out of these 10 lakes work has been completed on Powai Lake in Mumbai and Rabindra Sagar in Thane and work has started on two lakes, namely, Ooty and Kodikanal. The progress regarding other lakes is extremely slow because of delays in the finalization of detailed projects reports (DPRs), tender procedure and award of contract. The progress of the work on Dal Lake has been hampered by the delay in approval of the DPR by the State Government.

D. TENTH FIVE YEAR PLAN TARGETS IN WATER SUPPLY & SANIATAION :

For achieving 100%population coverage with drinking water supply facilities and 75% with sewerage & sanitation facilities in the urban areas and solid waste management facilities in 300 Class-I cities, the 10th Plan document has indicated the following requirements of funds:

Water supply	- Rs.28, 240 crore
Sanitation	- Rs.23, 157 crore
Solid Waste management	- Rs.2, 322 crore
Total	-Rs.53, 719 crore

In this background, there is an estimated deficit of Rs.33, 960 crore for the urban water supply and sanitation sector during the 10th Plan period.

E. *Govt. of India Initiatives on Water Supply & sanitation*

The Govt. of India stands committed to achieve the target of Millennium Development and Johannesburg Summit Goals which requires India to half by 2015 the proportion of the people who had no access to safe drinking water and basic sanitation services.

Government of India frames broad policies in line with the international decisions and its obligations viz. Millennium Development Goal (MDG) and formulates various programmes to provide Central funding for augmenting water supply sanitation services.

Govt. of India attaches top priority to sector reforms viz, institutional and financial reforms including capacity building at water utility level to ensure efficient management of water supply system in urban areas as per 2001 Census

Recognizing the need for financial handholding and radical reform in urban infrastructural sector, particularly water supply & sanitation sector, Government of India has launched two new programmes viz. Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and the Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT) to implement reform oriented schemes to augment drinking water supply and sanitation facilities in all the 5161 towns in the country.

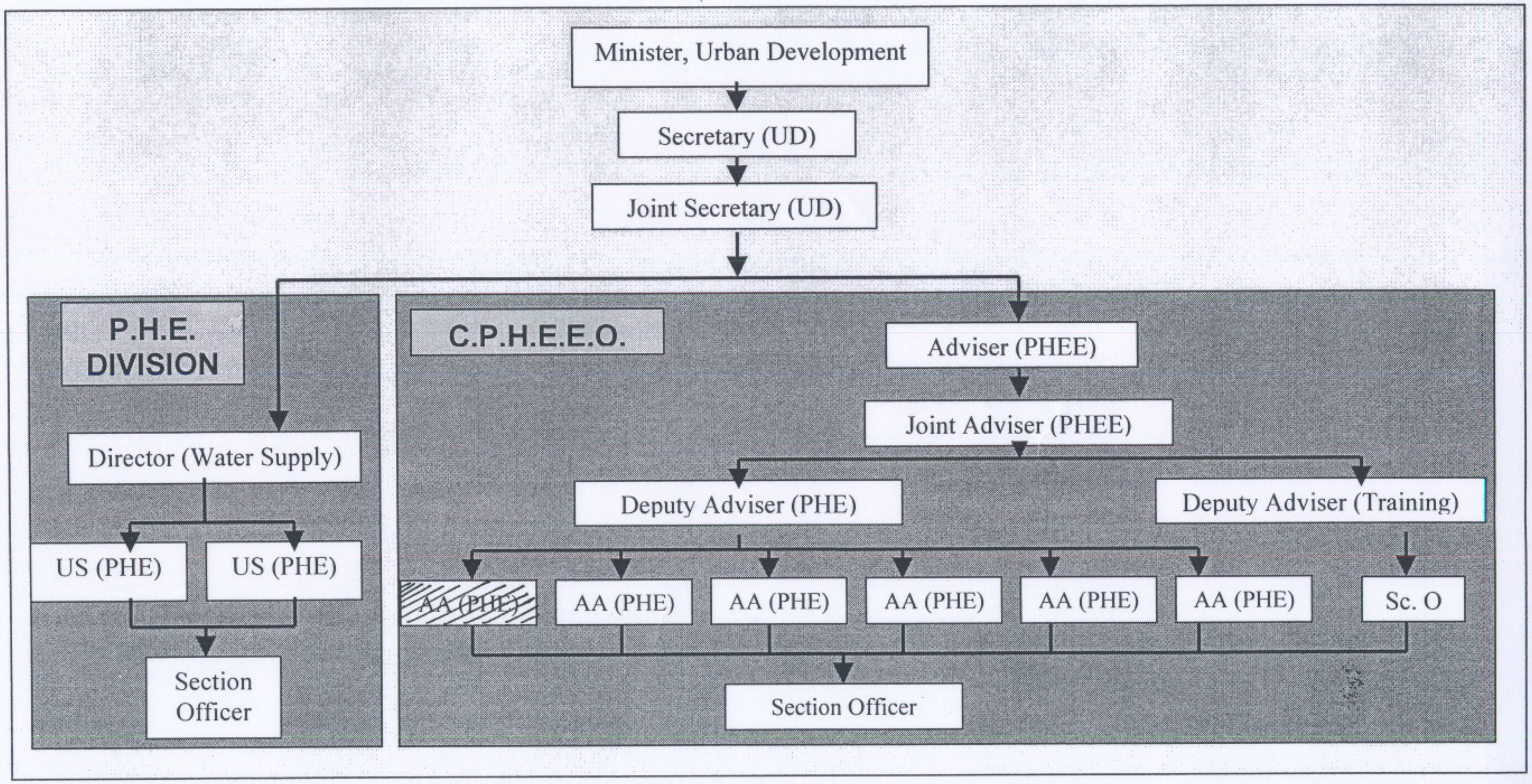
F. Future Challenge

There are two concurrent dimensions of development, which have particular relevance for the developing countries. While in the first instance, immediate issues of water supply and sanitation, irrigation, hydroelectric development and flood mitigation, and environmental conservation have to be attended to and can be met, there is the very serious long term challenge, which must also be conjunctively kept in view. This will require constant study as sustainable development is a journey rather than an end.

India has very for to go. With a per capita GNP of about $500, it is one of the poorest countries and home to world's largest population of the poorest of the poor. Rapid advances in all spheres have to take place, management of water being a prominent one. Drinking water and sanitary facilities have to be provided to the vast mass of rural and urban population. Reliable, timely and adequate water supply has to be provided for modernizing the agricultural activities. There is going to be a very serious pressure on resources and problem of environmental degradation as the consequent large-scale transformation of the hydrological cycle is undertaken. Serious problem of pollution from point and non-point sources will follow as economic development takes place. Conflicts are bound to arise between states and sectors as perceptions and demands very.

Yet, there is little perception of the stupendous challenge and even less capability or commitment to undertake the revolutionary changes. The socio political milieu is daunting in its impedance to the accomplishment of the task. Some of the activities of the Government to meet the futures challenge may by examined in this context.

ANNEX-II



Minister, Urban Development
Secretary (UD)
Joint Secretary (UD)
P.H.E. DIVISION
Director (Water Supply)
US (PHE)
US (PHE)
Section Officer
C.P.H.E.E.O.
Adviser (PHEE)
Joint Adviser (PHEE)
Deputy Adviser (PHE)
Deputy Adviser (Training)
AA (PHE)
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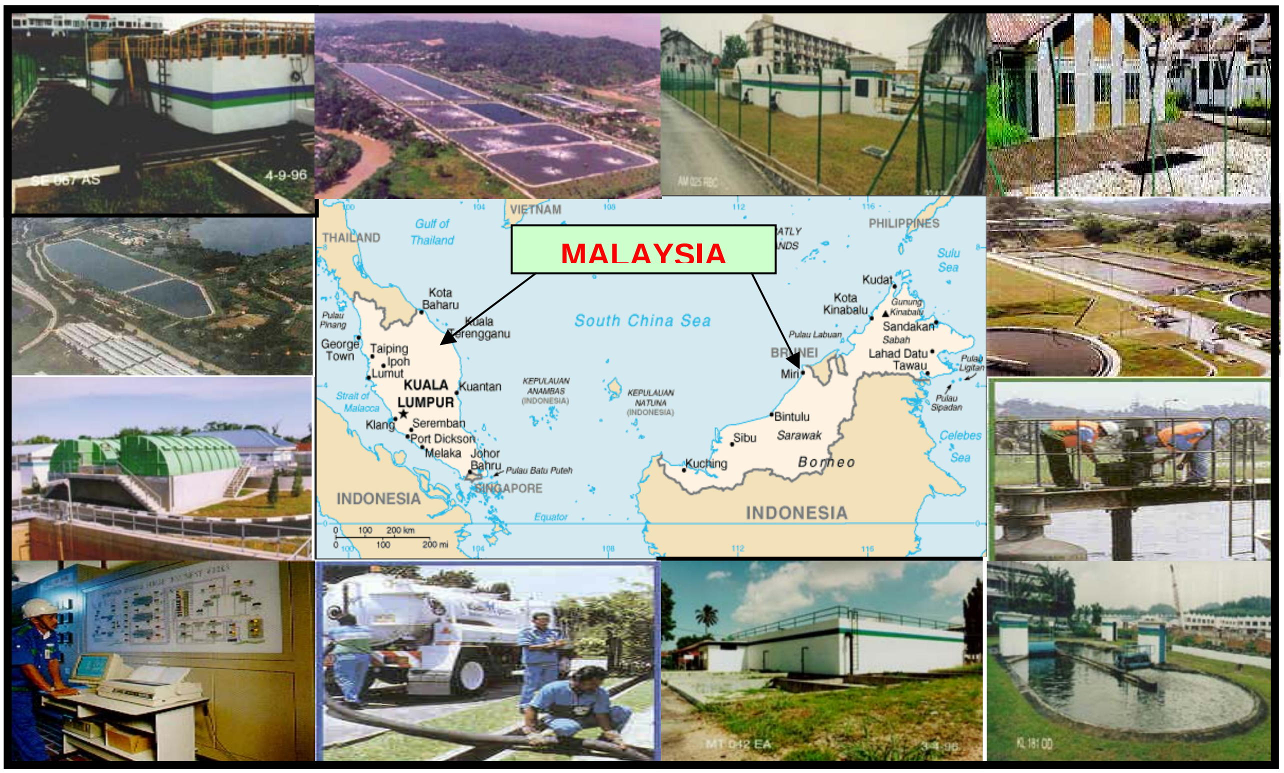
AA (PHE)
AA (PHE)
Sc. O
Section Officer

Ⅶ-3 Malaysia

Mr. Wan Abd Rahim Bin WAN ABDULLAH
Director, Sewerage Services Dept.,
Ministry of Energy, Water & Communication

EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT (J-07-00762)

Country Report



Country : **MALAYSIA**

Organization : **SEWERAGE SERVICES DEPARTMENT MINISTRY OF ENERGY, WATER AND COMMUNICATIONS, MALAYSIA.**

OCTOBER 2007

EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
(J-07-00762)

Executive summary a presentation about Country Report (MALAYSIA)
"Integrated Water Resource Management Adapting to the Global Climate Change"

1. Name, Roles and Responsibilities of Organization

   Sewerage Services Department, Ministry of Energy, Water and Communication Malaysia.
   Roles :
   i. To plan, regulate and enforce all rules and regulations
   ii. To facilitate the implementation of a suitable and modern sewerage system
   iii. To nurture the development of local sewerage in terms of competitiveness, technology innovation and application
   iv. To protect the consumers interest by ensuring excellent services at and affordable cost
   v. To ensure that the privatization project is implemented successfully and satisfactorily
   vi. To assist in the growth of the national economy through the development of a modern sewerage sector that protects the water resources and the environment.

   Responsibilities :
   i. Physical development programme
   ii. Approval of plans and certified of fitness
   iii. Licensing and enforcement
   iv. Monitoring the privatised sewerage services
   v. Development of sewerage standard and guidelines
   vi. Registration of sewerage system and product

2. Background and Overview of Sewerage Issues Over Last 10 years
   - sewerage services Act 1993
   - sewerage services Department as a Regulatory Body took place 1994
   - federalization of sewerage services and concession agreement with IWK
   - Tariff OPEX and CAPEX

3. Federal Development Fund for Sewerage Sector and Capex Investment
   - Long Term Sewerage Development Plan

4. Conflicts Resolution - Social, Economic and Enviroment.
   - create awareness and campaign to the public
   - tariff, affordability and willingness to pay
   - enforcement of the current /exisiting Enviroment Regulation

5. Profile of Sewerage Coverage in Peninsular Malaysia, Status of Public Sewage Treatment Plant and Status of Rivers in the Country.

6. Evolution of Sewerage Technology, Market Analysis and Local R & D.
    - evolution of sewerage treatment technology over the years in Malaysia
    - control of equipment and products ~ process equipments & non-process product
    - equipment asset statistics
    - R & D ~ long term planning, competitiveness market driven ..

7. Sewerage Development Quality System
    - establishing monitoring indicators
    - key performance indicators (KPI)
    - set policies
    - guidelines and standardization
    - enforcement

8. The Way Forward in Managing the Water Demand and Sewage Generation
    - a holistic approach to manage water demand and sewage generation.

9. Integrated River Basin Management
    - river corridor management plan
    - flood mitigation plan
    - environment management plan
    - water resources management plan

10. The Way Forward in Managing the Urban Water Cycle
    ~ Water Supply and Sewerage Integration
    - legislative reforms
    - regulalatory reforms
    - sectorial regulatory reforms

11. The Way Forward – Possible Solution
    - Government and Private Sector jointly delivering infrastructure or services

WAN ABD RAHIM WAN ABDULLAH
DIRECTOR
REGULATORY DIVISION
SEWERAGE SERVICES DEPARTMENT
MINISTRY OF ENERGY, WATER AND CUMMUNICATIONS
MALAYSIA.

1. NAME OF APPLICANT/COUNTRY

I.	Name of Applicant Country Designation Organization	: : : :	**WAN ABD. RAHIM WAN ABDULLAH** **MALAYSIA** **DIRECTOR** **SEWERAGE SERVICES DEPARTMENT, MALAYSIA**

2. NAME, ROLES AND RESPONSIBILITIES OF ORGANIZATION

Sewerage Services Department, Ministry of Energy, Water and Communication , Malaysia

2.1 Roles of Organization

1) To plan, regulate and enforce all rules and regulations related to sewerage in accordance with the provisions given in the Sewerage Services Act 1993.

2) To facilitate the implementation of a suitable and modern sewerage system for the whole country in compliance to established standards.

3) To nurture the development of local sewerage industry in terms of competitiveness, technology innovation and application as well as human resources.

4) To protect the consumer's interest by ensuring excellent services at an affordable cost.

5) To ensure that the privatisation project is implemented successfully and satisfactorily.

6) To assist in the growth of the national economy through the development of a modern sewerage sector that protects the water resources and the environment.

2.2 Responsibilities of Organization

1) Physical Development Programme
The Government has taken over the responsibility of funding and implementing public sewerage projects after it has taken control of the full equity in IWK in the year 2000. Through SSD, Government has implemented a number of new sewerage projects and works relating to refurbishment and upgrading of sewerage facility by utilizing the development funding.

2) Approval of Plans and Certificate of Fitness

The SSD also responsible for the approval of new sewerage system development and provides technical input to the Local Authorities in the process of issuing the Certificate of Fitness for Occupation for buildings by the Local Authorities.

3) Licensing and Enforcement

SSD is responsible for the supervision of all tasks related to the provision of sewerage services, issuing of sewerage services licenses and reviewing sewerage tariff.

4) Monitoring the Privatised Sewerage Services

The SSD has been entrusted by the Malaysian Government to regulate the provision of sewerage services by IWK under the privatization Concession awarded in the year 1993.

5) Development of Sewerage Standards and Guidelines

SSD is a SIRIM's Standard Writing Organisation (SWO) on sewerage matters. With the regards, SSD has initiated the review of the Malaysian Code of Practice for the Planning, Design, Installation, Operation and Maintenance of Sewerage System (MS 1228: 1991) and development of a number of standards and guidelines for sewerage works as follows:

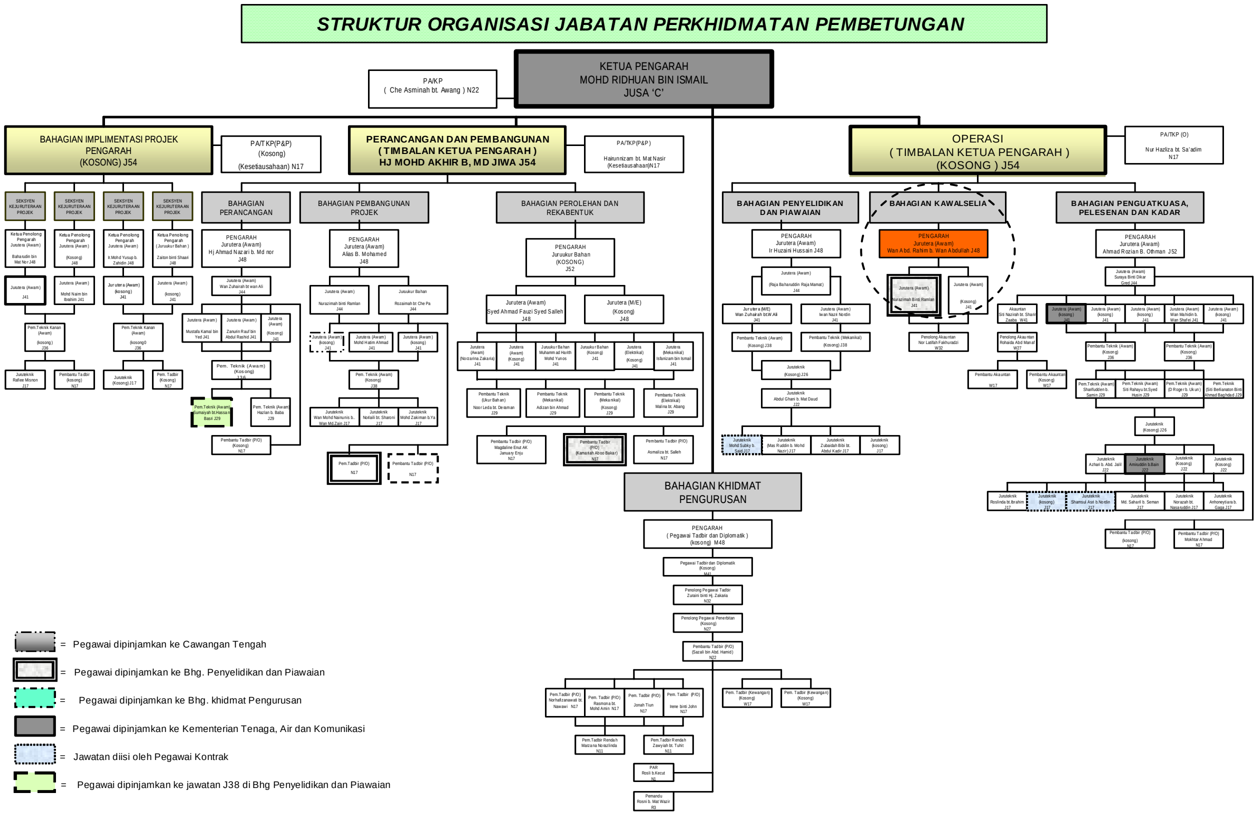
a. Restructuring of MS 1228 : 1991 into four sections – Part 1: Planning for Sewerage Infrastructure, Part 2: Design, Part 3: Material, Construction and Installation & Part 4: Operation and Maintenance.

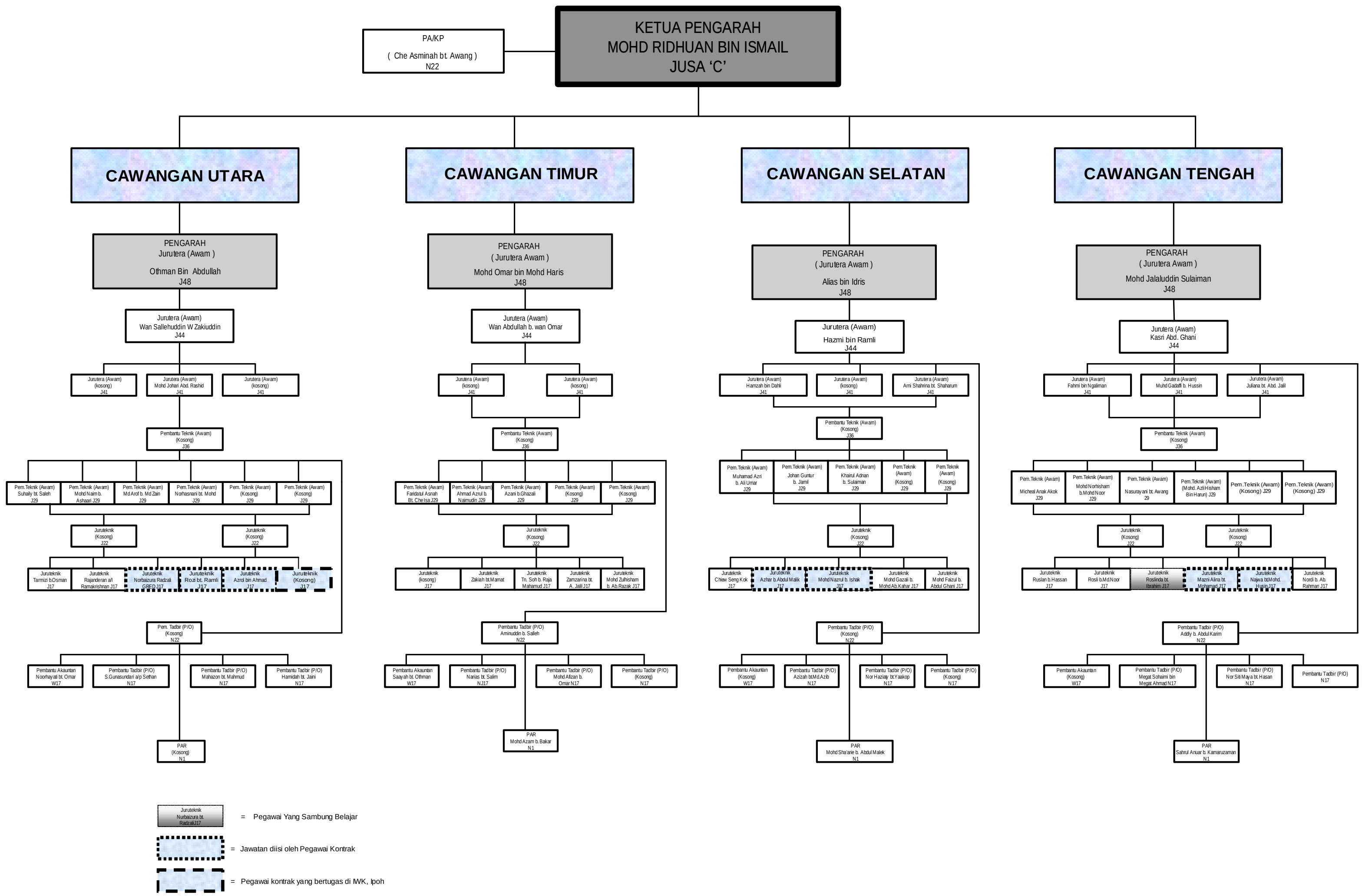
b. New Standards – Malaysian Standard (Manhole Tops)
c. Guidelines for Developers – Volume I: Sewerage Policy for New Development, Volume II: Sewerage Works Procedure, Volume III: Sewer Networks and Pump Stations, Volume IV: Sewage Treatment Plant and Volume V: Septic Tanks.

6) Registration of Sewerage Systems and Products

Under Part III Section 9 (c) of Sewerage Services Act 1993, all sewerage systems and products to be used in the country must be registered with Sewerage Services Department (SSD). All applications for the registration are processed by SSD and evaluated by Products Evaluation Committee to make decision on the application. Members of the committee comprises of SSD and IWK (the concessionaire contractor for sewerage system in Malaysia). The registration is valid for a period of 3 years and must be applied for renewal six months before the expiry date.

3. ORGANISATION STRUCTURE




PA/KP
(Che Asminah bt. Awang)
N22
KETUA PENGARAH
MOHD RIDHUAN BIN ISMAIL
JUSA 'C'
CAWANGAN UTARA
CAWANGAN TIMUR
CAWANGAN SELATAN
CAWANGAN TENGAH
PENGARAH Jurutera (Awam) Othman Bin Abdullah J48
Jurutera (Awam) Wan Sallehuddin W Zakiuddin J44
Jurutera (Awam) (kosong) J41
Jurutera (Awam) Mohd Johari Abd. Rashid J41
Jurutera (Awam) (kosong) J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Suhaily bt. Saleh J29
Pem.Teknik (Awam) Mohd Naim b. Ashaari J29
Pem.Teknik (Awam) Md Arof b. Md Zain J29
Pem.Teknik (Awam) Norhasnani bt. Mohd J29
Pem. Teknik (Awam) (Kosong) J29
Pem.Teknik (Awam) (Kosong) J29
Juruteknik (Kosong) J22
Juruteknik (Kosong) J22
Juruteknik Tarmizi b.Osman J17
Juruteknik Rajanderan a/l Ramakrishnan J17
Juruteknik Norbaizura Radzali GRED J17
Juruteknik Rozi bt. Ramli J17
Juruteknik Azrol bin Ahmad J17
Juruteknik (Kosong) J17
Pem. Tadbir (P/O) (Kosong) N22
Pembantu Akauntan Noorhayati bt. Omar W17
Pembantu Tadbir (P/O) S.Gunasundari a/p Sethan N17
Pembantu Tadbir (P/O) Mahazon bt. Mahmud N17
Pembantu Tadbir (P/O) Hamidah bt. Jaini N17
PAR (Kosong) N1
PENGARAH (Jurutera Awam) Mohd Omar bin Mohd Haris J48
Jurutera (Awam) Wan Abdullah b. wan Omar J44
Jurutera (Awam) (kosong) J41
Jurutera (Awam) (kosong) J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Faridatul Asnah Bt. Che Isa J29
Pem.Teknik (Awam) Ahmad Azrul b. Naimudin J29
Pem.Teknik (Awam) Azani b.Ghazali J29
Pem.Teknik (Awam) (Kosong) J29
Pem.Teknik (Awam) (Kosong) J29
Juruteknik (Kosong) J22
Juruteknik (kosong) J17
Juruteknik Zakiah bt.Mamat J17
Juruteknik Tn. Soh b. Raja Mahamud J17
Juruteknik Zamzarina bt. A. Jalil J17
Juruteknik Mohd Zulhisham b. Ab.Razak J17
Pembantu Tadbir (P/O) Aminuddin b. Salleh N22
Pembantu Akauntan Saayah bt. Othman W17
Pembantu Tadbir (P/O) Narias bt. Salim NJ17
Pembantu Tadbir (P/O) Mohd Afizan b. Omar N17
Pembantu Tadbir (P/O) (Kosong) N17
PAR Mohd Azam b. Bakar N1
PENGARAH (Jurutera Awam) Alias bin Idris J48
Jurutera (Awam) Hazmi bin Ramli J44
Jurutera (Awam) Hamzah bin Dahli J41
Jurutera (Awam) (kosong) J41
Jurutera (Awam) Arni Shahrina bt. Shaharum J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Muhamad Azri b. Ali Umar J29
Pem.Teknik (Awam) Johan Guntur b. Jamil J29
Pem.Teknik (Awam) Khairul Adnan b. Sulaiman J29
Pem.Teknik (Awam) (Kosong) J29
Pem.Teknik (Awam) (Kosong) J29
Juruteknik (Kosong) J22
Juruteknik Chiew Seng Kok J17
Juruteknik Azhar b.Abdul Malik J17
Juruteknik Mohd Nazrul b. Ishak J17
Juruteknik Mohd Gazali b. Mohd Ab.Kahar J17
Juruteknik Mohd Faizul b. Abdul Ghani J17
Pembantu Tadbir (P/O) (Kosong) N22
Pembantu Akauntan (Kosong) W17
Pembantu Tadbir (P/O) Azizah bt.Md.Azib N17
Pembantu Tadbir (P/O) Nor Haziaty bt.Yaakop N17
Pembantu Tadbir (P/O) (Kosong) N17
PAR Mohd Sha'arie b. Abdul Malek N1
PENGARAH (Jurutera Awam) Mohd Jalaluddin Sulaiman J48
Jurutera (Awam) Kasri Abd. Ghani J44
Jurutera (Awam) Fahmi bin Ngaliman J41
Jurutera (Awam) Muhd Gadaffi b. Hussin J41
Jurutera (Awam) Juliana bt. Abd. Jalil J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Micheal Anak Akok J29
Pem.Teknik (Awam) Mohd Norhisham b.Mohd Noor J29
Pem.Teknik (Awam) Nasurayani bt. Awang 29
Pem.Teknik (Awam) (Mohd. Azli Hisham Bin Harun) J29
Pem.Teknik (Awam) (Kosong) J29
Pem.Teknik (Awam) (Kosong) J29
Juruteknik (Kosong) J22
Juruteknik (Kosong) J22
Juruteknik Ruslan b.Hassan J17
Juruteknik Rosli b.Md.Noor J17
Juruteknik Roslinda bt. Ibrahim J17
Juruteknik Mazni Alina bt. Mohamad J17
Juruteknik Najwa bt.Mohd. Husin J17
Juruteknik Nordi b. Ab. Rahman J17
Pembantu Tadbir (P/O) Addly b. Abdul Karim N22
Pembantu Akauntan (Kosong) W17
Pembantu Tadbir (P/O) Megat Sohaimi bin Megat Ahmad N17
Pembantu Tadbir (P/O) Nor Siti Maya bt. Hasan N17
Pembantu Tadbir (P/O) N17
PAR Sahrul Anuar b. Kamaruzaman N1
Juruteknik Nurbaizura bt. RadzaliJ17
= Pegawai Yang Sambung Belajar
= Jawatan diisi oleh Pegawai Kontrak
= Pegawai kontrak yang bertugas di IWK, Ipoh

4. APPLICANTS ADDRESS :

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5. SEWERAGE STATUS OF THE COUNTRY

5.1 a) Total Population Equivalent in the Country :26,000,000 PE

5.1 b) Estimated Population with sewers :12,000,000 PE

5.1 c) Total population and estimated population with sewers of the six(6) large cities is shown below:

6 Major Cities in Malaysia	Population Equivalent	Connected Public Services		IST		Pour Flush		Private Plant		Outside operating Area	
		PE	%	PE	%	PE	%	PE	%	PE	%
Langkawi	103,502	18,721	18	18,000	17	6,280	6	10,740	10	49,761	48
Melaka Town	599,458	342,301	50	171,115	25	38,310	6	131,509	19	0	0
Kuantan Town	358,449	126,798	24	198,530	37	173,680	32	40,381	7	0	0
Penang	898,800	888,261	91	31,425	3	30,000	3	22,486	2	0	0
Shah Alam	1,095,776	790,106	99	4,860	1	500	0	1,115	0	0	0
Kuala Lumpur	2,296,875	1,503,383	65	286,640	12	25,000	1	10,355	0	471,497	21
TOTAL	**23,931,395**	**4,584,439**	66	**1,041,525**	15	**359,770**	5	**235,833**	3	**718,694**	10

Note: IST – Individual septic tank
PE – Population Equivalent

5.2 SOURCES OF POLLUTION IN RIVERS

In general, the sources and main pollutants of concern in rivers in Malaysia identified as sediment, nutrients, pathogens, organic materials, heavy metal and other toxic chemicals. The relative importance of each pollutant depends on particular circumstances in each river system.

Most sources of pollution have been caused by human activity, although natural sources of pollution such as organic matters from forest and rural areas and also natural minerals from existing soils. The solid waste issues also the contributor to the floatable materials that result in unsightly scene in the river especially in urban areas.

The sources of pollution can be categorised in two category :-

a) Point Pollution

Where the point source of pollution or pollution generated can easily identified which are as follows:-

i) Manufacturing Industries

1. Industrial Wastewater from big, medium and small industries

ii) Sewage Treatment Plant

Domestic wastes have been identified as one of dominant source of pollution which contribute significant amount of pollution loading in the river system and in many places either in rural or urban areas. As the source of treated or partially treated domestic waste water contains organic pollutants, pathogens and suspended solid especially where waste is discharged directly to the river. Listed below list of source of possible pollution from sewage treatment plants :-

1. Effluent from public Sewage Treatment Plants
2. Effluent from private Sewage treatment Plants
3. Effluent from Individual Septic Tanks
4. Sullage (from households)
5. Discharge of raw sewage(squatters & rural areas)
6. Sewage from primitive systems

iii) Livestock and Aquaculture Farms

1. All type including poultry, cow, goat, pigs, fish and prawns

iv) Miscellaneous Pollution Sources

1. Wet markets/Eateries
2. Institutional including office buildings, hospital, educational institution.
3. Trade/commercial e.g. vehicle service workshop, petrol stations, laundry, water treatment plant etc.
4. Sand mining area, quarry

b) Non -Point Pollution

Where the point source of pollution or pollution originating from diffused sources and generated as wash-off by stormwater runoff which are as follows:-

1. Fertilizers from Farmland and Golf Courses
2. Agricultural areas e.g. plantation estates, orchards etc;
3. Earthworks from construction sites
4. Developed urban areas.
5. Forest clearing and Forest reserve
6. other type of vacant or barren lands.

5.3 <u>FIVE (5) LARGEST EXISTING TREATMENT PLANT IN THE CAPITAL CITY</u>

a) Name and Location of the plants

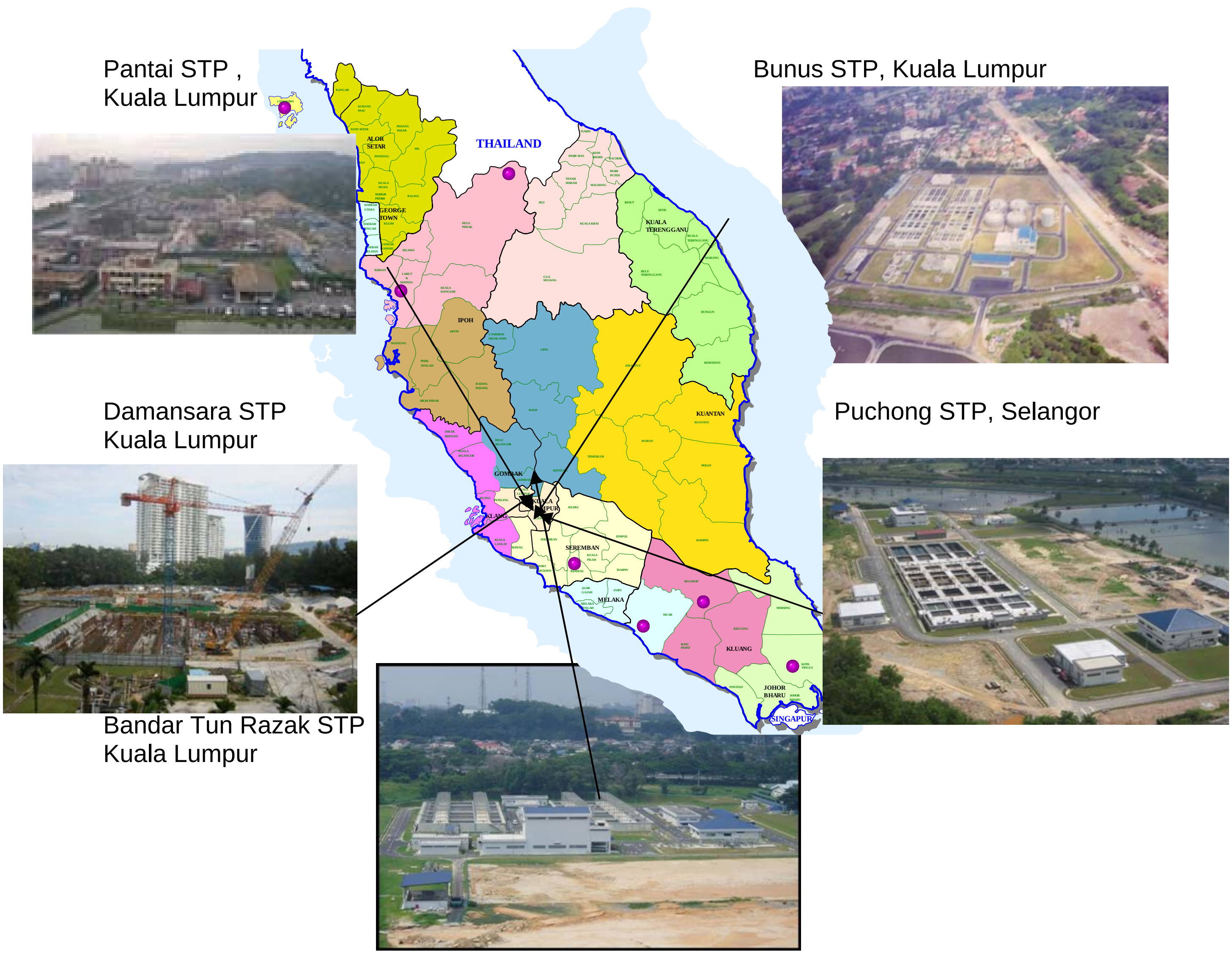


Figure 1 above shows the location of the five largest STPs in the capital city (Kuala Lumpur).

b) Size and Capacity of the Plants

Table 1 below shows the capacity of 5 large plants in the country

Plant	Plant Type	Existing Population Equivalent	Average Domestic Wastewater Flow (m3/day)	Industrial Wastewater Flow (m3/day)	To be upgraded. #
Damansara STP	Extended Aeration	50,000 PE	11,250m3/day	-	150,000
Pantai STP	Aerated Lagoon	636,000 PE	143,100m3/day	-	1,000,000
Bunus STP	Axtended Aeration	437,000 PE	98,325m3/day	-	
Puchong STP	Axtended Aeration	300,000 PE	67,500m3/day	-	
Bandar Tun Razak STP	SBR	100,000 PE	22,500m3/day	-	

Note : # Part of the existing Module will be maintain and part of it will be converted to mechanised Sewage Treatment Plant under Japan Bank for International Cooperation (JBIC) loan.

c) Efficient Quality criteria implemented, parameter control limits

For the rivers in Malaysia, the water quality standards are monitored based on the Interim National River Water Quality. To control the level of pollution in the waterways, 2 effluent discharge standards are enforced:

- Standard A – for upstream of water catchments areas.
- Standard B – for downstream of water catchments areas.

The effluent standards set as Absolute Standards. In design, Average Standards much lower than the limits should be used to have 95% level of confidence of maintaining the effluent below the set Absolute Standards. Table 2 illustrates the Absolute Standards and the respective Average Standards to be adopted in design.

Table 2: Malaysian's Effluent Standards

Parameter		Standards A		Standards B	
		Absolute	Design	Absolute	Design
BOD_5	mg/L	20	10	50	20
SS	mg/L	50	20	100	40

d) The effluent of all 5 regional plants mentioned above is discharged into Klang River, main river that cut cross the city of Kuala Lumpur and eventually leads to the Straits of Malacca

e) Types of Sludge Stabilisation and dewatering

For Aerated Lagoons, sludge is allowed to settle and it is desilted once in 10 to 15 years.
For Mechanised Sewage Treatment Plant, sludge facilities comes along with Sludge Treatment Facilities.

f) Is treated effluent reclaimed and reused?

No. Treated Effluent is not reclaimed and is discharged into the river.

6. <u>SEWERAGE FACILITIES</u>

6.0 Brief description of the Geography

- Location: South-eastern Asia, peninsula and northern one-third of the island of Borneo, bordering Indonesia and the South China Sea, south of Vietnam
- Geographic coordinates: 2 30 N, 112 30 E
- Map references: Southeast Asia
- Area: total: 329,750 sq km land: 328,550 sq km water: 1,200 sq km
- Area - comparative: slightly larger than New Mexico
- Land boundaries: total: 2,669 km border countries: Brunei 381 km, Indonesia 1,782 km, Thailand 506 km
- Coastline: 4,675 km (Peninsular Malaysia 2,068 km, East Malaysia 2,607 km)

- Maritime claims: continental shelf: 200-m depth or to the depth of exploitation; specified boundary in the South China Sea exclusive economic zone: 200 nm territorial sea: 12 nm
- Climate: tropical; annual southwest (April to October) and northeast (October to February) monsoons
- Terrain: coastal plains rising to hills and mountains
- Elevation extremes: lowest point: Indian Ocean 0 m highest point: Gunung Kinabalu 4,100 m
- Natural resources: tin, petroleum, timber, copper, iron ore, natural gas, bauxite
- Land use: arable land: 3% permanent crops: 12% permanent pastures: 0% forests and woodland: 68% other: 17% (1993 est.)
- Irrigated land: 2,941 sq km (1998 est.)
- Natural hazards: flooding, landslides
- Environment - current issues: air pollution from industrial and vehicular emissions; water pollution from raw sewage; deforestation; smoke/haze from Indonesian forest fires
- Environment - international agreements: party to: Biodiversity, Climate Change, Desertification, Endangered Species, Hazardous Wastes, Law of the Sea, Marine Life Conservation, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Tropical Timber 83, Tropical Timber 94, Wetlands signed, but not ratified: Climate Change-Kyoto Protocol
- Geography - note: strategic location along Strait of Malacca and southern South China Sea

6.1 Sewerage Status Of The Country

Malaysia has seen the evolution of its sewerage industry over the last half a century. Prior to the country's independence in 1957, there were no proper sewerage systems in Malaya. At that time, there wasn't a need for proper sewage treatment due to the low population densities and very limited urbanised developments. Sewage treatment was mainly by way of primitive methods such as pit and bucket latrines, over-hanging latrines and direct discharge to rivers and seas. When Malaya begun to develop itself and move from an agricultural base to an industry base country, the needs for proper sanitation arose.

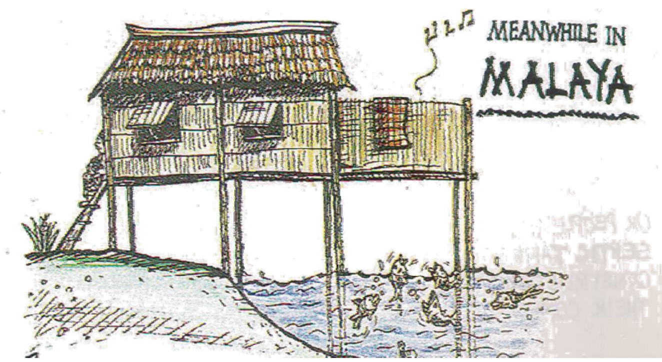
In the 1960s, sewage treatment systems in the form of individual septic tanks and pour flush systems were introduced. Small communal systems engaging mainly primary treatment, such as the Communal Septic Tanks and Imhoff Tanks also started developing. In the 1970's, the technology engaged expanded to biological treatment processes in the form of oxidation pond systems utilising natural means of treatment. Then in the 1980s, mechanised systems started to be introduced in Malaysia and oxidation ponds were being converted to aerated lagoon systems. The late 1980's and the 1990s, saw the accelerated development of fully mechanised systems in the form of Biological Filters and Activated Sludge Systems.

Later part of the 1990's saw efforts concentrated on the control of mechanised systems, which allows for process optimisation of new systems. This evolution of treatment processes from primitive to primary and then to secondary systems was

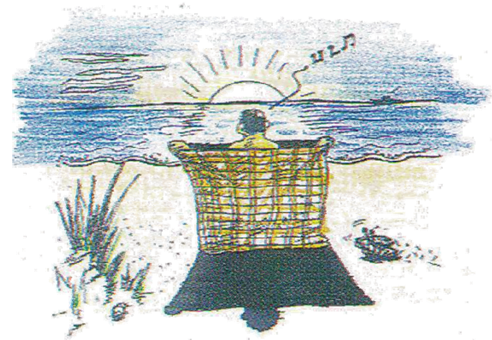
mainly due to development of technologies in the sewerage industry. The evolution has also seen the movement from non-mechanical systems to a more mechanical and automated system. New and improved equipment were also continuously being introduced due to technological advancements. This with time has also increased the expectation on environmental standards and the skill level in the design, construction and operations of new sewerage works.
The advancement in technological development in the local sewerage industry has mainly been dependent upon foreign development, especially from the developed nations i.e. the import of technologies from abroad. Most treatment systems and equipment were being developed in the western countries. Even the design parameters were derived from studies conducted in the developed nations.

6.1.1 Pre-Independence Sanitation in Malaya

Meanwhile, during the pre-independence period in Malaya, the development of sanitation facilities was very limited as the need for sanitation was not critical. Figure 4 illustrates sanitation practices in the rural areas, and Figure 5 illustrates sanitation practices in the town areas.



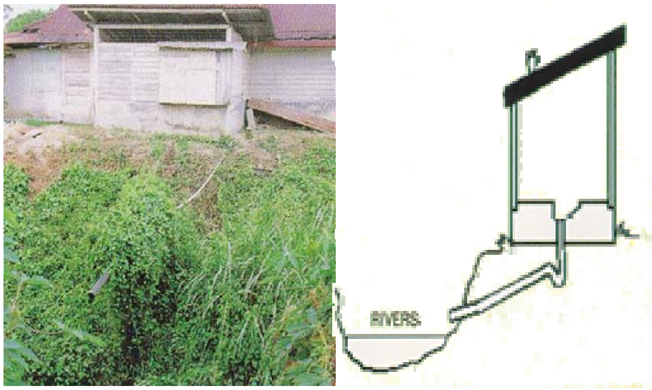
THE RIVER'



'THE BEACH'

Figure 4: Rural Sanitation – Direct Discharges

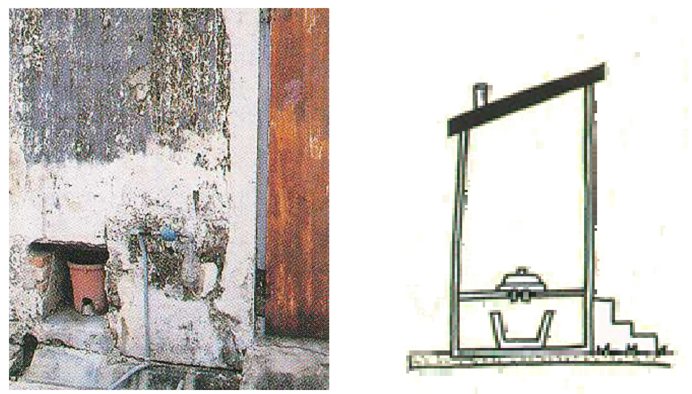
Figure 5: Town Sanitation – Night Soil Systems



Pour Flush

Hanging Latrines

Pit Latrines



Bucket Latrines

Figure 6 – Technologies in the early days in Malaya

6.1.2 Technology of the 1950s

In the 1950s, towns started to develop and population densities began to grow. There was an increased need for improvement in the sanitation sector. Technological advancement at the time was the use of primary systems, which utilised sedimentation processes. Individual septic tanks utilised this treatment concept. Figures 7 and 8 illustrate the Individual Septic Tank (IST) Systems. This primary system is only capable of providing basic primary treatment via sedimentation and digestion. The expected performance of such systems is as shown in Figure 9.

In the towns, individual septic tanks started to be used to replace primitive systems. This formed the early evolution of technological advancement, where primary systems replaced the primitive systems. This evolution reduced the direct pollution levels to the environment. For example, BOD is reduced from 200-400 mg/l to 150-200 mg/l (as shown in Figure 9).

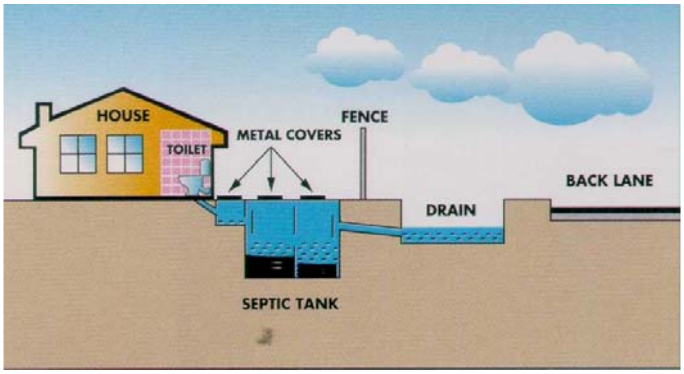
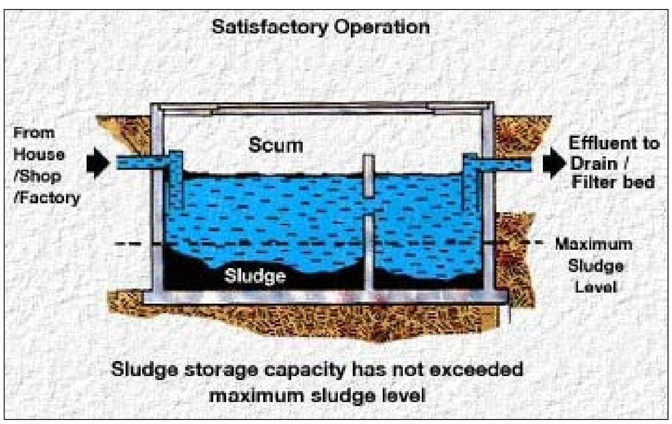
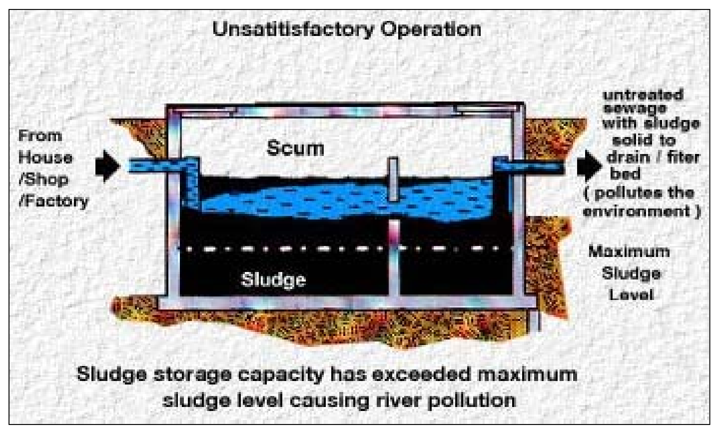


Figure 7: Individual Septic Tank





6.1.3 Technology in the 1960s

After the independence in 1957, Malaya at the time started to develop. More towns were established and more people occupied these towns. The need for improved sanitation expanded to community based sanitation. Communal Septic Tanks were introduced and utilised to improve the community sewerage systems. Figure 10 illustrates examples of Communal Septic Tanks (CST) systems. In terms of performance, Communal Septic Tanks are similar to Individual Septic Tanks but the CST, serve a bigger population via a series of pipes connecting a row of tanks.

Imhoff Tanks (IT) systems, which is another improved version of primary treatment system, were later introduced for the community sewerage systems. Figure 11 illustrates examples of Imhoff Tanks. Imhoff Tanks further helped in improved treatment performances. For example, BOD is reduced from 200-400 mg/l to 50-175 mg/l (as shown in Figure 12).

Figure 10: Communal Septic Tanks

improved sewerage systems was further enforced via the enactment of the Act. Partial secondary treatment systems such as Oxidation Ponds were introduced in Malaysia in the 1970s. Figure 13 illustrates examples of Oxidation Ponds.

Oxidation ponds were capable of providing partial secondary treatment, mainly in the form of biological treatment. The treatment performance improved as BOD could be reduced from 200-400 mg/l to 20-100 mg/l (as shown in Figure 14).

Figure 13: Oxidation Ponds

In late 1970s, Aerated Lagoons were introduced where there was a need to serve a larger population within a limited land area reserved for oxidation ponds. This was done (by introducing aerators to the systems). This technological advancement allowed for enhancement of oxidation ponds capacities up to more than 5 times the original capacities. Figure 15 illustrates typical performance of Aerated Lagoons systems.

6.1.5 Technology in the 1980s and 1990s

The needs for improvement in the sewerage systems became more prevalent in 1980s. When the (The Environmental Quality Regulations were enacted in 1979). The technological advancement in the 1980s includes the introduction of full secondary treatment via mechanised sewage treatment plants. There are various types of mechanised sewage treatment plants. Examples include Conventional Activated Sludge, Extended Aeration, Rotating Biological Contactors and Trickling Filters. Figure 16 shows example of an Extended Aeration Activated Sludge System.

Mechanised sewage treatment plants are capable of providing full secondary treatment and the treatment performance is more superior than the other systems discussed earlier. Figure 17 illustrates typical unit processess of mechanised sewage treatment plants.

Figure 16: Mechanised Sewage Treatment Plant

6.2.6 Overview of the Sewerage Industry Evolution

In Malaysia, the sewerage technology has evolved from pre-independence era of no treatment to the primary treatment by individual septic tanks in the 1950s. This has improved the level of sanitation by providing partial treatment of sewage. In the 1960s, introduction of Communal Septic Tanks and Imhoff Tanks, further improved the effluent quality. In the 1970s, introduction of partial secondary systems like

Oxidation Ponds which is capable of producing better effluent quality. Fully mechanised systems were introduced in the 1980s, which provide full secondary treatment, which is capable of meeting DOE effluent standards consistently.

PROGRESSES IN SEWERAGE SECTOR

Privatisation of National Sewerage Services

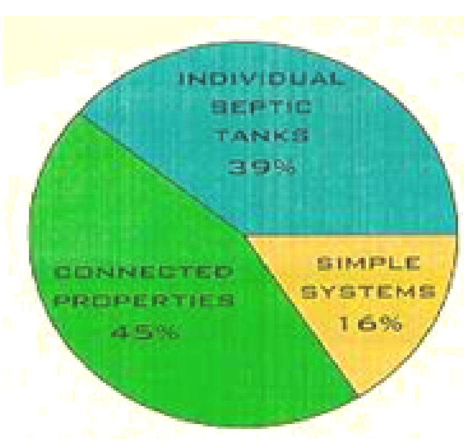
Prior to 1993, sewerage management in Malaysia fell under the jurisdiction of local authorities. The local authorities already has too many responsibilities such roads, drainage, buildings, planning, etc. Furthermore, there were 144 local authorities and the level of expertise and financial capabilities between these local authorities widely varied. Thus, the standard of sewerage services was not consistent throughout the country.

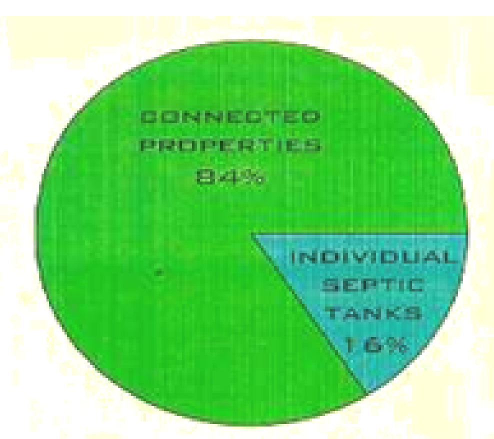
In realising the needs to upgrade the sanitation level in the country, in 1993, the Malaysian government took a bold step in privatising the management of the sewerage systems to the National Concession Company. The Sewerage Services Act was enacted in 1993 to empower the Federal Government to regulate the sewerage industry. The Department of Sewerage Services was formed under the Ministry of Housing and Local Government, as the regulator of the sewerage industry. A National Concession Company by the name **of Indah Water Konsortium Sdn Bhd (IWK)** was formed in April 1994 to undertake the management of the sewerage services of the country.

To date, IWK has taken over the management of sewerage services in the local authorities operational areas of Peninsular Malaysia (except Majlis Bandaraya Johor Bahru, Johor and Kelantan), and Federal Territory of Labuan. IWK is responsible to operate and maintain public sewerage systems in these areas, as well as planning and manage the implementation of national sewerage projects by assist the government in controlling sewerage systems built by developers.

Concession Targets

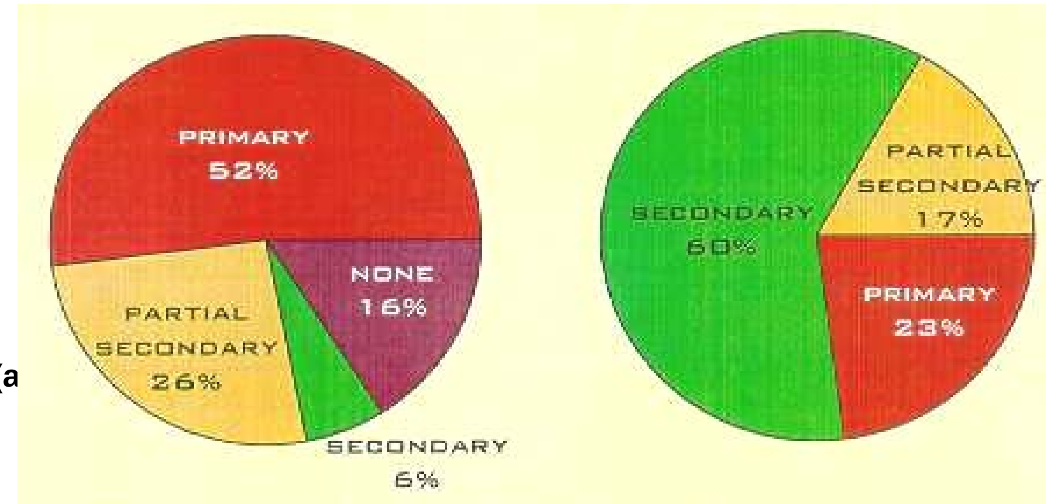
The targets of the concession are to achieve total coverage of sewerage services by the end of the concession period. Figure 22 shows the targets for major local authorities and Figure 23 shows the target for smaller local authorities.





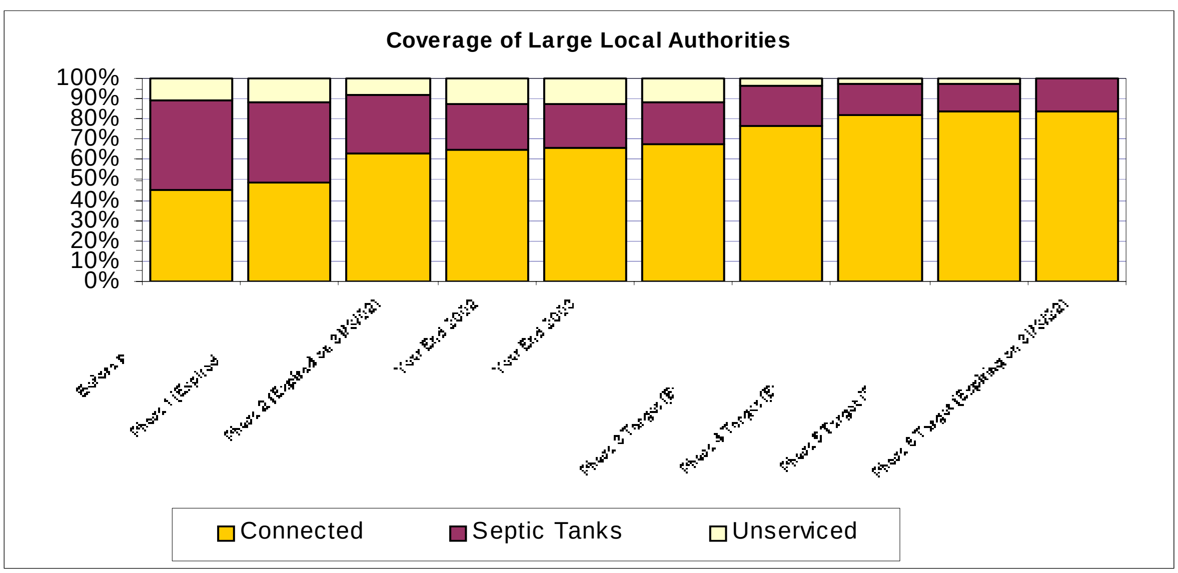
(a) At start of Concession **(b) At end of Concession**

Figure 22: Concession Targets for 48 Major Towns



(a

The original privatization of the national sewerage service aims to achieve full coverage throughout Malaysia, as shown in the following graphs:

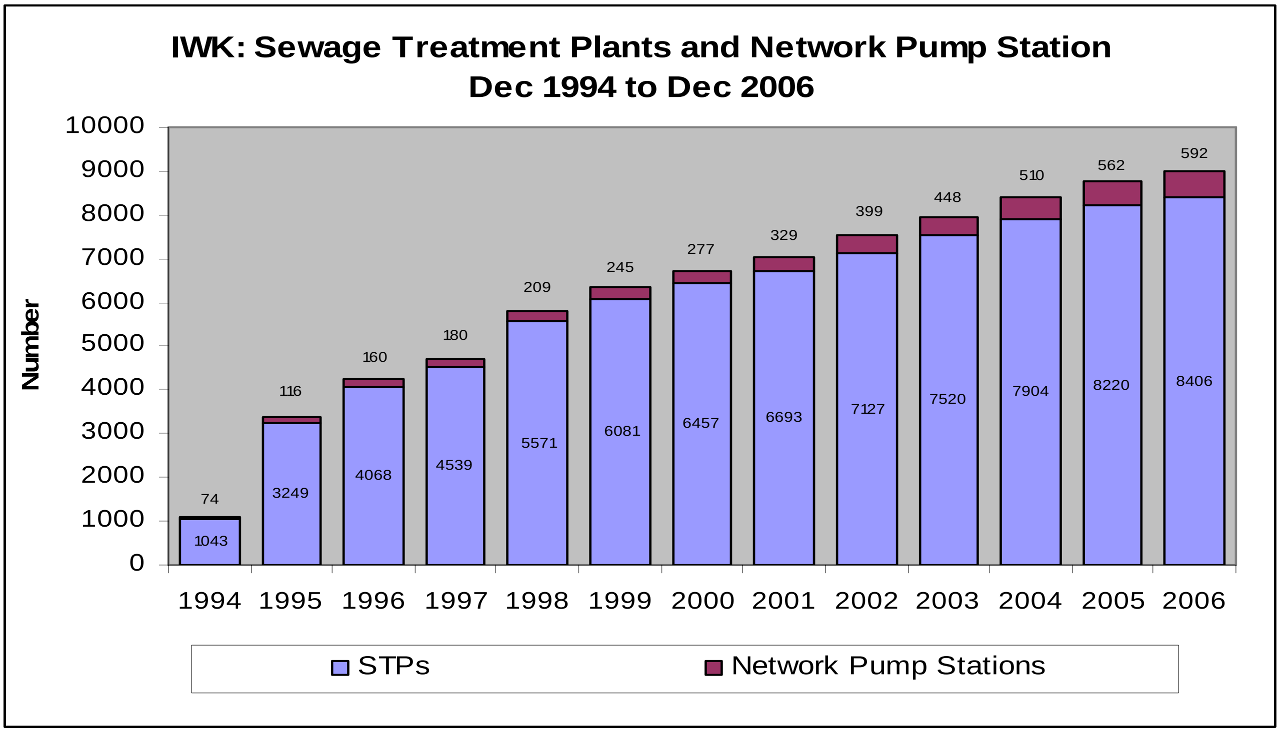


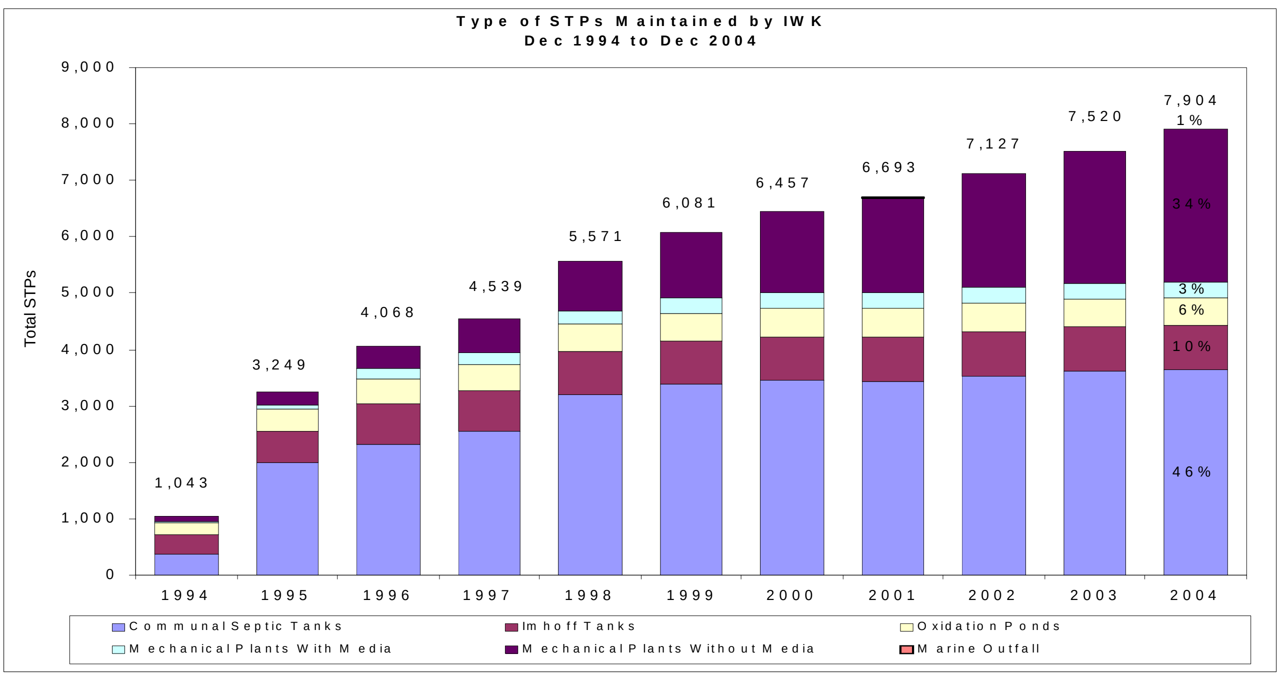
Sewerage Systems in Malaysia

Currently, there are approximately 7,600 public sewage treatment plants and more than 14,000 km of sewers managed by IWK in Malaysia. Most of the sewage treatment plants are constructed using 1960s technology, such as Communal Septic Tanks and Imhoff Tanks, which utilised primary treatment systems. There is also substantial portion of Oxidation Ponds and Aerated Lagoons, which utilised partial secondary treatment systems.

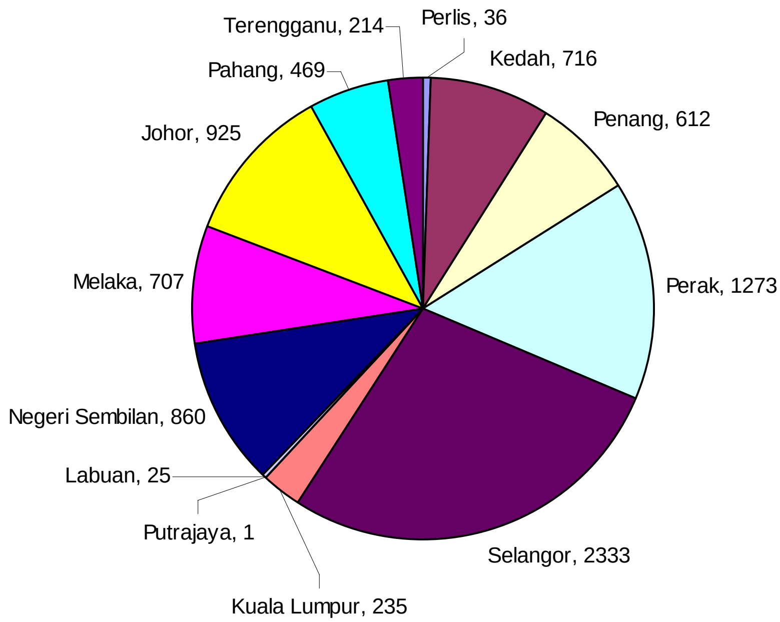
Asset Profile of Treatment Plants in Malaysia are as Follows

- Aerated Lagoon - 2% of total STPs (15% of Population Served)
- Mechanical Plant - 31% of total STPs (55% of Population Served)
- Oxidation Pond - 7% of total STPs (18% of Population Served)
- Communal Septic Tank & Imhoff Tank - 60% of total STPs (9% of Population Served)

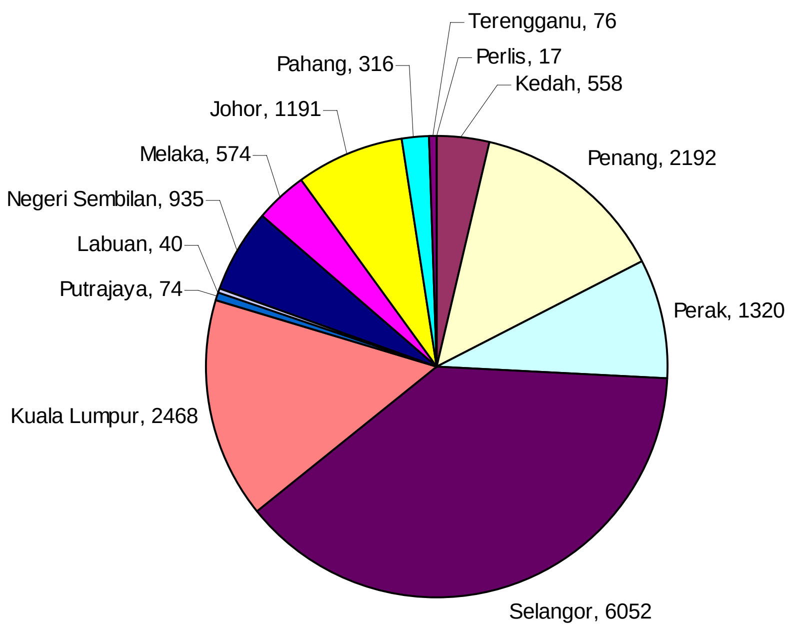

IWK: Sewage Treatment Plants and Network Pump Station
Dec 1994 to Dec 2006
Number
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
STPs
Network Pump Stations
1043 3249 4068 4539 5571 6081 6457 6693 7127 7520 7904 8220 8406
74 116 160 180 209 245 277 329 399 448 510 562 592

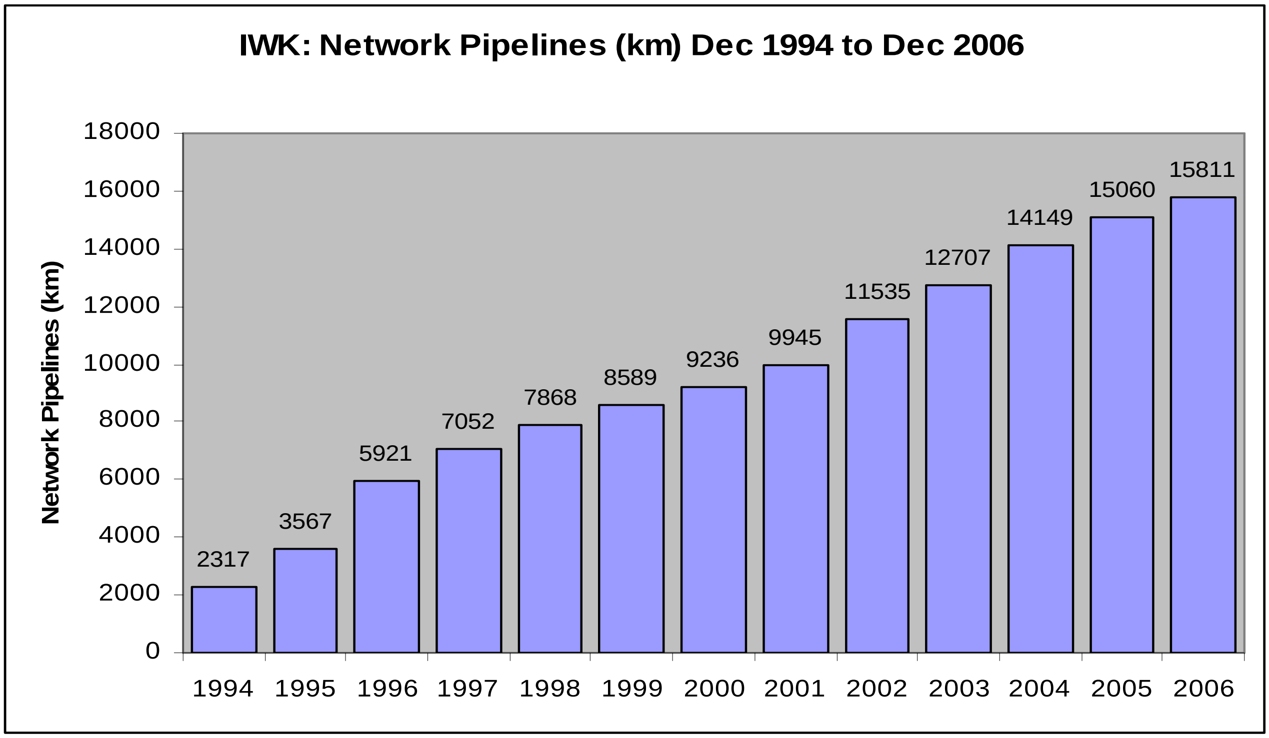

Type of STPs Maintained by IWK
Dec 1994 to Dec 2004
Total STPs
1,043 3,249 4,068 4,539 5,571 6,081 6,457 6,693 7,127 7,520 7,904
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
1%
34%
3%
6%
10%
46%
Communal Septic Tanks
Imhoff Tanks
Oxidation Ponds
Mechanical Plants With Media
Mechanical Plants Without Media
Marine Outfall

Number Of STPs and NPSs as at Dec 2006



Length of Network Pipelines (km) as at Dec 2006




IWK: Network Pipelines (km) Dec 1994 to Dec 2006
Network Pipelines (km)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
2317
3567
5921
7052
7868
8589
9236
9945
11535
12707
14149
15060
15811
1994
1995
1996
1997
1998
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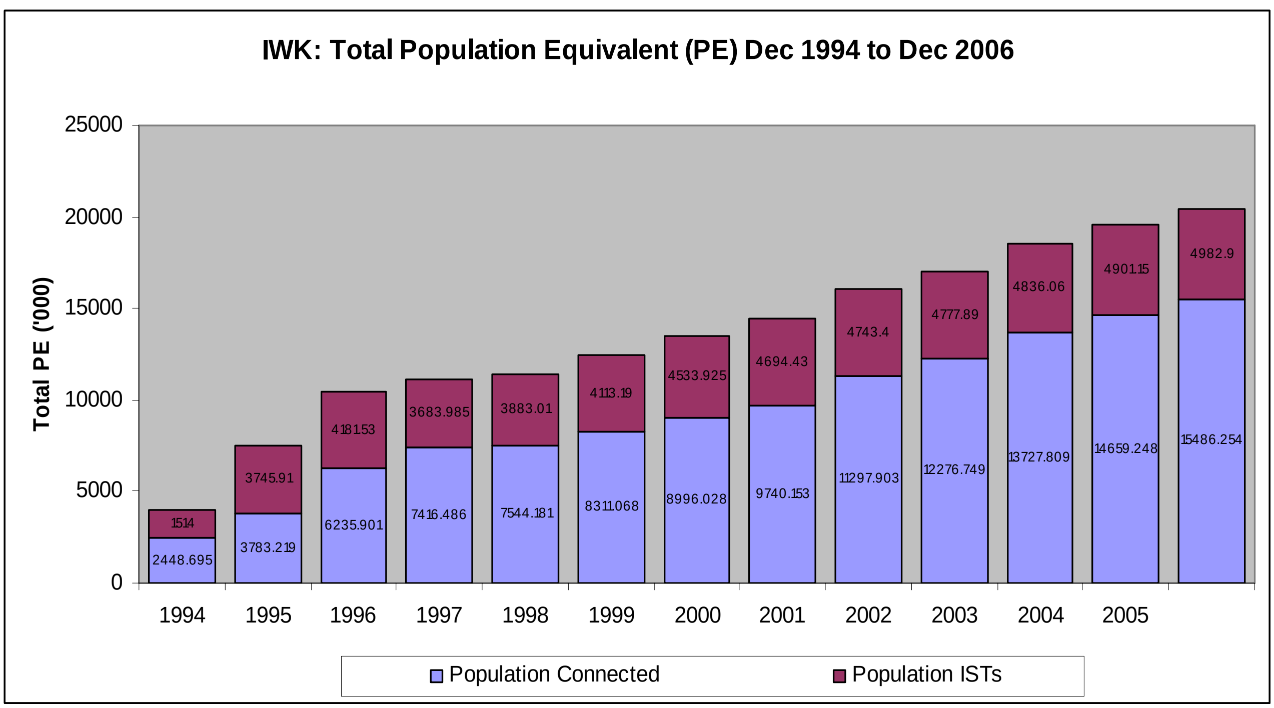
2001
2002
2003
2004
2005
2006


IWK: Total Population Equivalent (PE) Dec 1994 to Dec 2006
Total PE ('000)
0
5000
10000
15000
20000
25000
2448.695
3783.219
6235.901
7416.486
7544.181
8311.068
8996.028
9740.153
11297.903
12276.749
13727.809
14659.248
15486.254
1514
3745.91
4181.53
3683.985
3883.01
4113.19
4533.925
4694.43
4743.4
4777.89
4836.06
4901.15
4982.9
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Population Connected
Population ISTs

Standards

For the rivers in Malaysia, the water quality standards is monitored based on the Interim National River Water Quality. To control the level of pollution in the waterways, 2 effluent discharge standards are enforced:

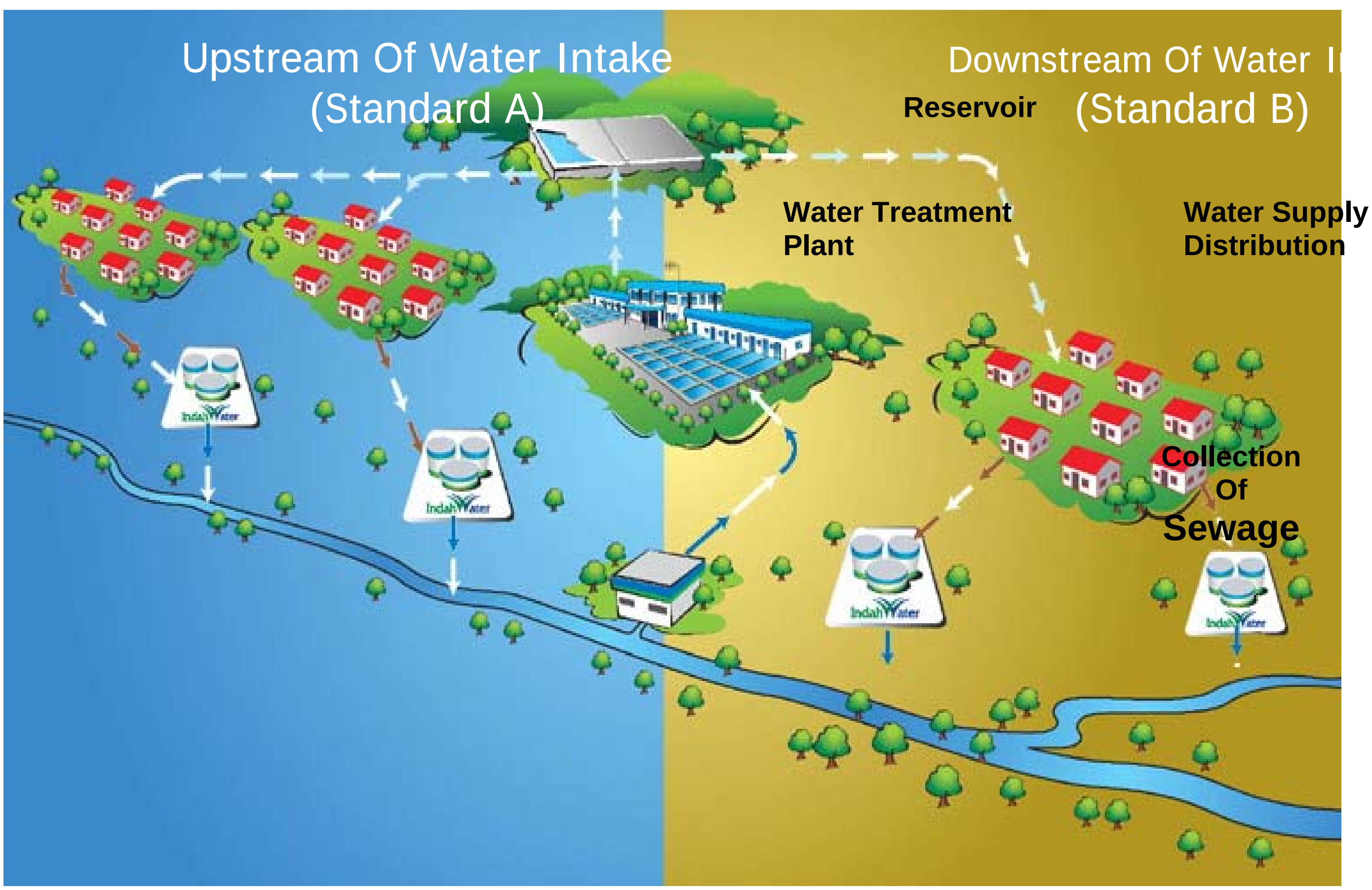
- Standard A – for upstream of water catchments areas.
- Standard B – for downstream of water catchments areas.

The effluent standards set as Absolute Standards. In design, Average Standards much lower than the limits should be used to have 95% level of confidence of maintaining the effluent below the set Absolute Standards. Table 3.2 illustrates the Absolute Standards and the respective Average Standards to be adopted in design.

Table 3.2: Effluent Standards

Parameter		Standards A		Standards B	
		Absolute	Design	Absolute	Design
BOD_5	mg/L	20	10	50	20
SS	mg/L	50	20	100	40

In the past, the Absolute Standards have been misinterpreted as the value to be adopted in design. Thus, most plants designed prior to 1994 have been designed to give average effluent of 50 mg/l BOD and 100 mg/l SS for Standard B areas. Most biological systems' performance will fluctuate depending upon the incoming flow ..quality, thus most plants designed prior to 1994 will fail at least 50% of the time due to misinterpretation of the effluent standards.



6.1.6.5 Controls

In order to ensure all new sewerage developments are designed according to correct interpretation of the effluent standards, and also to ensure consistent quality in the sewerage development, Sewerage Services Department prepared Guidelines for developers to follow the requirements. In 1994, the first edition of the Guidelines was published in 2 volumes. In 1998, revisions were initiated and the second edition was published in stages of volume by volume. There are 5 volumes of the Guidelines:

Volume 1 – Sewerage Policy for New Developments
Volume 2 – Sewerage Works Procedures
Volume 3 – Sewer Networks and Pump Stations
Volume 4 – Sewage Treatment Plants
Volume 5 – Septic Tanks

In line with the drive towards improved sewerage standards in Malaysia, Sewerage Services Department became a Standards Writing Organisation (SWO). In 1998, revision of the Malaysian Standards for Sewerage (MS 1228:1991) was initiated. Other Malaysian Standards such as Standards for Manhole Tops, Standards for FRP Tanks, and Standards for Septic Tanks were also initiated. Design Manuals were also developed to assist designers in design of sewerage systems. Design Manuals include STP Design Manual, Hydraulics Manual, Pumping Station Design Manual, M&E Design Manual, Drafting Manual, Guides to Sewer Selection & Installation, Engineering Specifications, Products Specifications and Typical Drawings. All these standards and manuals will assist in assuring the consistency and enhancement of standards of sewerage systems in Malaysia.

6.1.6.6 The Management of Sludge in the country

The annual sludge volume produced currently is estimated to be 3 million cubic metres. This equates to filling the twin-tower at KLCC to the 78th floor in the first year and requires some 600,000 tanker trips to transport the sludge to designated treatment and disposal sites. By the year 2020, the volume is estimated to increase to 7 million cubic metres which will require about double the KLCC twin-tower to fill, or almost 1.4 million tanker trips to manage. Figure 4 shows the annual sludge production rate in Malaysia.

The increase in volume is mainly due to the population growth, intensive developments and improvements on wastewater treatment efficiencies. To manage these volume of sludge in order to minimise the impact onto the surrounding environment, IWK has been directed to desludge all septic tanks within local authority operational areas on a periodic basis once every two years. All existing plants also will be desludged regularly while all new plants will require proper on-site sludge handling facilities. IWK is also required to have the correct size of manpower, tanker and appropriate equipment to cope with the volume of sludge to be handled. They are also required to construct proper sludge handling facilities at strategic locations. Land needs to be leased, purchased, acquired or alienated in order to construct these facilities. Co-operations from state governments are urgently required. Remember that this is a government project and IWK is merely a contractor who has been appointed to serve the Federal Government for 28 years. All land will remain as the property of the Federal Government.

6.1.6.7 Annual Sewage Sludge Production

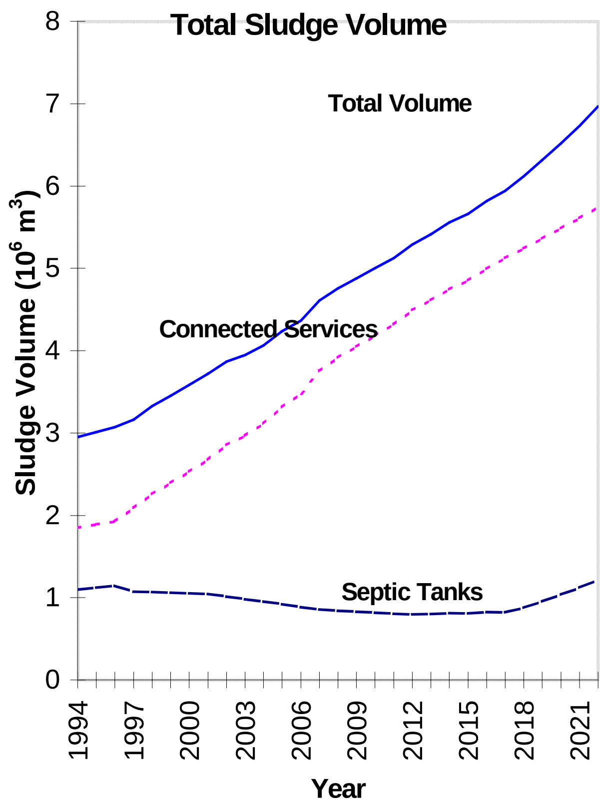


Figure 19 above shows the Sludge Volume Projection

6.1.6.8 Planned Strategy

In order to properly manage and treat the existing and future sludge volume, a three (3) stage strategy has been planned by the government and IWK as follows :-

Stage I

The *Immediate Strategy* which deals with the existing sludge problems effective from the date of takeover of a particular local authority. At this stage, responsive and scheduled desludging will be the main sludge concerns. The privately operated plants will not be included in this case. Existing sewage treatment facilities such as the oxidation ponds and aerated lagoons are being used for receiving sludge from individual and communal septic tanks. This will facilitate IWK's desludging requirements under the Concession Agreement and allows sufficient time for the establishment of the short terms solutions.

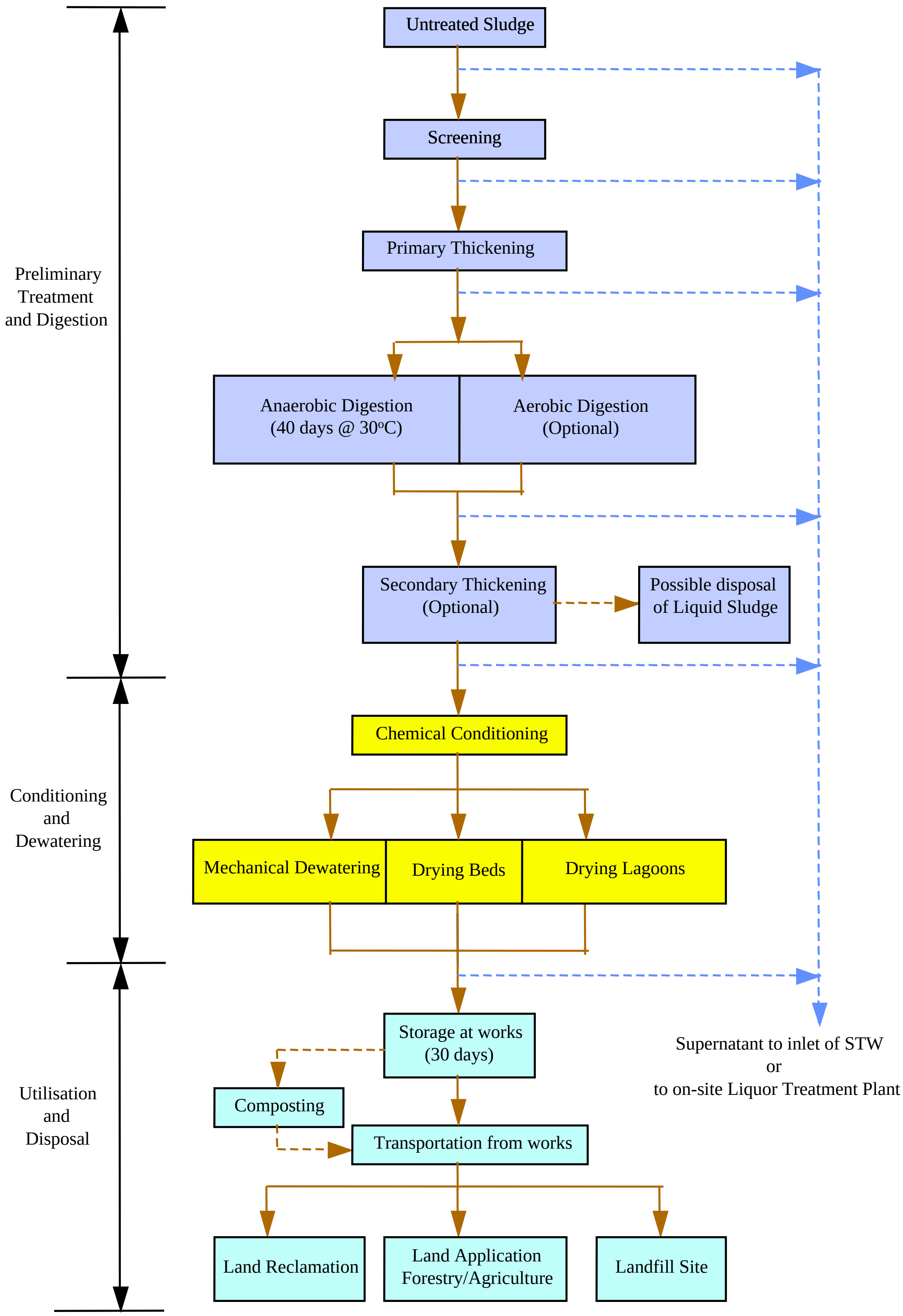
Stage II

The *Short Term Strategy* will involve acquiring land and constructing sludge lagoons and sludge transfer stations for a period of approximately 5 years until the selected centralised sludge treatment facility is commissioned. It is proposed that each local authority will have at least one treatment/disposal outlet for sludge generated in that particular area. Sludge lagoons and drying beds are selected for the short term because they provide standard methods of design, simple to construct and can be commissioned within a short period of time. An estimated budget of RM250 millions will be spent over the next 5 years to establish the short term solutions.

Stage III

The *Long Term Strategy* will involve the acquiring of lands and constructing modern centralised sludge treatment plants at selected locations with digestion and mechanical dewatering facilities to achieve at least 25% dry solids content of sludge cake. About 40 large scale mechanised plants will be constructed under this strategy which will involve an estimated budget of RM750 millions over a 15 years expenditure period.

Figure 20 : Sludge Treatment Flow Chart



For the *Short Term* solution - trenching, lagooning, drying beds and sludge transfer stations are the selected treatment technologies because they offer simple solutions within a reasonable short period of time.

a) Trenching is the simplest and fastest method of sludge disposal on land where stabilised or unstabilised sludge maybe disposed of to the ground in liquid form and covered with soil. Sludge trenching is usually carried out in forest areas or plantations where narrow trenches are placed in between trees. It can also be used in abused land sites or near landfill areas.

b) Sludge lagoons provide a safe and economical way of treating sludge. They can be easily built and provide both short and long term solutions to sludge management. Sludge lagoons are sized to receive sludge for up to 12 months. The filling of a lagoon will start at the first lagoon and will move to the second lagoon as soon as the first lagoon is filled. While filling the second lagoon, the sludge inside the first lagoon will undergo anaerobic digestion and dewatering under natural conditions by evaporation and draining of supernatant. An anaerobic liquor treatment plant is provided to handle supernatant. Picture 2 shows a typical view of sludge lagoons.

c) Sludge drying beds are shallow tanks with a system of under drainage overlaid with filtering media. Liquid sludge is discharged onto the surface of the media and dewatering occurs as a result of water entering the under drainage system. Water is also removed from the surface by decantation and evaporation. The drained liquor is normally returned to the supernatant treatment plant for further treatment.

d) Sludge transfer stations are collection points where smaller tanker transfers sludge into a central tank from where a bigger size tanker is used to transfer sludge to the centralised sludge treatment facility, sludge lagoons or drying beds for further treatment and disposal. The main reason for using sludge transfer stations is to reduce sludge tankers travelling distance and hence reducing the tankerage costs. It will also reduce the number of small capacity tankers. Whether sludge transfer stations are provided or not is purely a matter of economics.

As for the *Long Term* solutions, sludge lagoons will continue to be used in remote, less urbanised areas while proper mechanised plants will be constructed at urbanised centres. These facilities offer the benefits of occupying a relatively smaller area of land, offers control over the treatment processes and minimises the impute of sludge treatment on neighbouring communities. The treatment process for a fully mechanised sludge treatment facility comprises the following basic processes: -

a) Raw sludge reception well with transfer pump
b) Mechanical drum screen (including screening, washing and dewatering systems)

c) Screened sludge holding tanks for 3 days storage
d) Rotary drum thickeners/centrifuge or equivalent up to 6% DS
e) Single stage anaerobic digester with 40 days holding capacity (unheated)
f) Digested sludge holding tank with 5 days capacity
g) Mechanical dewatering using Filter Press to achieve 30% DS
h) Dried sludge storage facility for 1 month storage
i) Liquor treatment plant
j) Ancillary works

6.1.6.9 Ultimate Disposal

There are various methods of ultimate sludge disposal which can be carried out in the form of liquid or dried sludge. The methods that will be employed here in Malaysia are:

- Agriculture /Forestry Land Improvement
- Land Reclamation
- Land fill
- Composting

a) Sludge utilisation on agricultural and forestry land has proven to be most resourceful. Sludge contains most of the organic loads from the sewage, which can help farmers reduce their fertiliser requirements and improve soil fertility. Sewage sludge contains significant proportion of nitrogen and phosphorus and can supply a large part of the requirements of most crops. The organic content of sludge can also improve the water retaining capability and the structure of certain soils. It is also a very useful product for reforestation.

b) Sludge cake can be very effective in improving disturbed soils or providing a growing media where no soil exists. For example, soil is normally stripped and stockpiled prior to mineral extraction for reinstatement on completion of the operation. When reinstatement takes place, the stockpiled soil is generally structurally damaged and the addition of sludge cake provides extra organic matter, improving both the physical and hydraulic properties of soil. In areas where no topsoil exists, sludge cake can be used as a soil forming material providing a cheap alternative as topsoil. In Malaysia, land reclamation techniques will be most suited to ex-mining lands.

c) Land filling of sewage sludge with domestic refuse is the most common method of sludge disposal. The basic procedure is to construct a series of clay sided cells or lagoons, which are capable of being filled to an average depth of 3 metres with sewage sludge. Thickened sludge is pumped into the lagoons and allowed to stand for a period of time after which any surface water can be decanted of and additional sludge pumped in. Once the maximum volume of sludge has been passed into the lagoon it is again allowed to stand for a period of time to remove water. At this point dry solid wastes are tipped into the lagoon and this absorbs most of the remaining moisture of the sludge. Additional solid waste are then deposited on top of this, up to the final and agreed contour levels. Ground compaction is done and final restoration of the site takes place.

d) Composting of sewage sludge is new to Malaysia and maybe considered in the future if the economies are favorable. Liquid or dewatered sewage sludge can be stabilised by mixing it with a bulking agent such as wood chip, straw or municipal waste, provided that non-degradable materials such as metal, plastic and glass is removed.

An overview of sludge management in Malaysia has been presented. Municipal sludge has not been given due respect prior to 1994. As a result, over 70 percent of our river systems throughout the country has been reported to be polluted by human wastes. A strategy has been put forward to tackle this massive issue in stages over a 15 years timeframe. The total cost of the project is estimated at RM 1 billion (inclusive of land costs). Cooperations from state governments are required to release reasonable land sites for construction of dedicated sludge treatment facilities at their respective states. Consumers are being enlightened to understand the seriousness of the municipal sludge problems in Malaysia and do their bit in helping manage this massive tasks. Efforts by all of us today will ensure good health, safety and prosperity of our future generation in Malaysia.

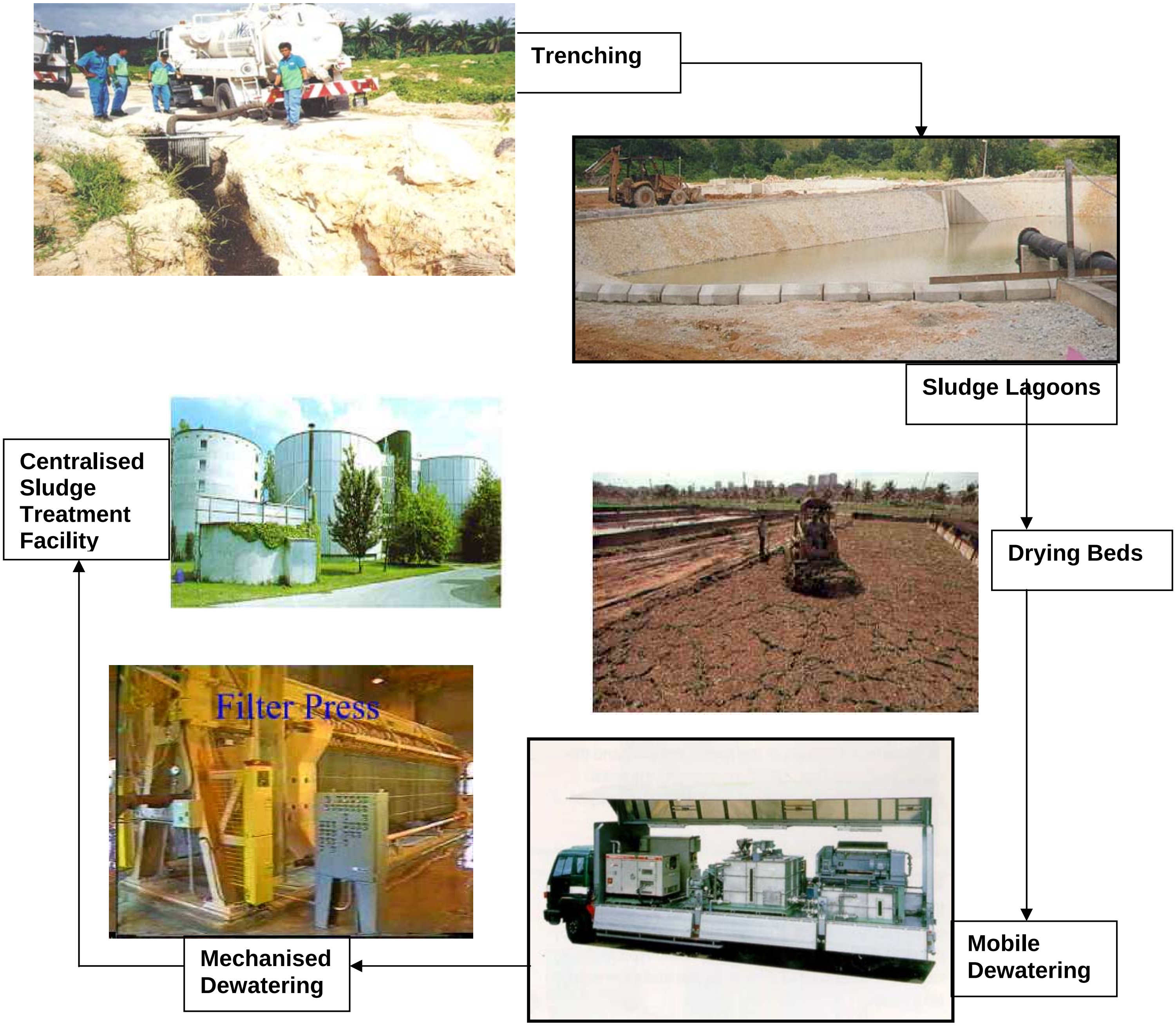


Figure 21: Progress Improvements of Sludge Management

The above figure demonstrates the technology developments of sewage treatment over the years. One very interesting fact can be observed from the figure is that with advancement in treatment technology , the user of mechanical and electrical equipment shows a steep increasing trend.

6.2 Master Plan For Sewerage Work.

A comprehensive Malaysian National Sewerage Development Plan where sewerage facilities for the nation, outlining the strategic investments in the development of sewerage infrastructure, in order to sustain continued public health protection, preserve our national water resources and enhance environmental quality has been drawn up to address the above issues. The plan will have components to address the various issues highlighted earlier. It is estimated that a total of RM 33 billion will be required for the National Sewerage Development Plan over the next 30 years.

The main objectives of the comprehensive National Sewerage Development Plan to provide better management of sewerage systems for: -

1. Safeguarding public health
2. Protection of water resources from sewage related pollution
3. Preservation of the environment from detrimental effect of sewage.

These are the target of National Sewerage Development Plan:-

- Priory Need (2005-2020) : To improve asset condition and meet regulatory Standard
- Long Term Needs (2021-2035) : Enhance Environmental Efficiencies through Regionalisation

These are the issues and components need to be address in National Sewerage Development Plan:-

- Refurbishment works
  - Upgrading and consolidation of 4,632 STPs to meet DOE Effluent Standards within set timeframes
  - located within 12 states.
  - STPs having operational problems and public issues.
  - STPs located in water catchment areas or within catchments of critically polluted rivers and areas of tourism importance will be given priority
  - includes network rehabilitation for approximately 1,300 km of critical sewer networks.
  - rehabilitate sewer networks experiencing poor structural , hydraulic or operational conditions.
- Sludge
  - Provision of a total of sludge facilities for all priority Local Authority areas.
  - to handle sludge from desludging of ISTs and multipoint plants.
  - to serve an eventual PE of 22.5 million after discounting PE served by Regionalised systems
  - will enable desludging program of IST and multipoint STPs to be carried out in a systematic manner.
- Regionalisation
  - expansion of sewer networks. construction of new STPs and networks to enable regionalisation of all key urban areas.
  - to provide efficient sewerage management.
  - Estimated of about 42% of the total PE of 44 million will be regionalised by the end of the plan period.
  - Sub-components include acquisition of land for siting of facilities.

- Property connection
    - maximise benefits of new projects.
    - minimise impact of IST effluents
    - a total of 550,000 properties in water catchments and other sensitive areas.
- Pour flush system conversion
    - estimated 850,000 pour flush systems.
    - major source of sewage pollution.
    - convert all of pour flush to a basic septic tank system.
- Sullage connection
    - major source of sewage pollution in many critical areas.
    - program of replumbing of such properties to intercept sullage wastes into sewerage systems.
    - involve an estimated 250,000 premises in high priority areas

PROJECT DESCRIPTION	***QTY***	***TARGET COMPLETION DATE***
❖ *Refurbish / Upgrade of Sewage Treatment Plants (STP) and Sewers to Meet Proposed Effluent Standards* *A)Standard A (in water catchment areas)* *B)Standard B (non-water catchment areas)* *C)Sewer Rehabilitation*	*884 STPs* *3,748 STPs* *1,300 km*	*2015* *2020* *2010*
❖ *Sludge Treatment Facility Development*	*22.5 Mil PE*	*2015*
❖ *Regional Sewerage System Development*	*17.4 Mil PE*	*2035*
❖ *Financing Property Connection Up To Private Property Boundary*	*550,000 Properties*	*2035*
❖ *Financing Property Connection Within Private Property Boundary*	*550,000 Properties*	*2035*
❖ *Pour Flush System Conversion*	*850,000 Properties*	*2035*
❖ *Re-plumbing for Sullage Collection*	*250,000 Properties*	*2035*

Sewerage Development Plan (2006 - 2035)

This comprehensive National Sewerage Development Plan is considered to be the required Capital Investment Plan for the sewerage sector. The plan must have supported by adequate non-structural components including legal and institutional frameworks, policy support and enforcements. A matching operational plan is also required to complement the Sewerage Development Plan for effective and sustainable development.

6.3 Industrial Wastes that produce water pollution.

Industrial waste control is not covered under Sewerage Services Department . It is under jurisdictions of Department of Environment, Malaysia.

6.4 Current Technical Problems

In implementing the sewerage projects, some issues and challenges has been identified and need to be overcome in an orderly manner so that the strategies can be smoothly implemented:

(a) Co-ordination of planning concept with different developers
(b) High capital cost for installation of sewerage infrastructures
(c) Lack of reliable database on trunk sewers and treatment works resulting in the delay of the response to developers regarding their new developments.
(d) Unavailability of strategic lands especially downstream of major rivers where lands are fully developed. Sufficient lands at these areas are not available or have not been allocated for sewerage infrastructures. Apart from land being expensive, residents mostly do not agree with the location of sewerage infrastructures within their neighbourhood. This has opted for the construction of sewage treatment plants to move upstream or to some other locations further from the actual development and thus resulting in high capital, operations and maintenance costs.
(e) Providing for sufficient land bank for multi-point projects.

(f) Identifying suitable treatment locations and plans so that upgrading made possible as required at proposed development.
(g) Developers need to understand that long term planning for sewerage is a must and up-front capital funding for utility must be considered for ultimate development.
(h) High Capital Cost creates pinch for the Government to implement several projects large projects at one time.
(i) Plant operability - Although most newer design require approvals from Sewerage Services department, operability still remain an issue since it is often difficult to conceptualized operability issues based on drawings alone. For IWK internal project, IWK has established its own HAZOP (hazards and operability) committee review requirements. However, there is no HAZOP requirement for privately developed STP. When IWK take over significant numbers of Sewage treatment plant, a large no of STP are difficult to operate.

(j) Staff retention presents IWK's one of the greatest challenges in human resources management. With the negative publicity that the company is facing, it has been difficult to maintain staffs for a long period of time. In addition, as the overall Malaysian Industry places high importance on environmental compliance and requirements, demand for highly trained professionals has increased. This has indirect affect IWK's ability to operate and maintain it's STP as many of it's trained professional opted for lucrative offers in the market. IWK expenditure on training and staff development will increase as more and more replacements are needed to fill up the void created due to the high staff turnover.
(k) Some of STPs constructed before year 1994 are under-designed (designed to absolute standard without any margin).
(l) Many STPs do not have Oil & Grease trap.
(m) Inadequate Operation and maintenances - many Individual Septic Tank, Oxidation Ponds, imfoff tank, Communal Septic tank have not desludged (especially private operated) while most IST never desludged, damaged component remains un-repaired inadequate scheduled maintenance, lack of operating manual and as-built drawings.
(n) Vandalism – parts are stolen or damaged by irresponsible people.
(o) Inadequate enforcement and monitoring especially private plants.

There are many factors that presents challenges in operation and performance of treatment plants. The key decision factors affected by the challenges are as stated below.

- Human resource
- Location and Logistics
- STP Maintenance, scheduling, inventory and performance
- Quality and Service

Another factor that can influence key decision factors mentioned above id financial strength. It is the utmost quintessential factor that can dictate how IWK should operate it's business and at the same time meet STP performance target that is expected by it's regulators and the general public.

7.0 PLEASE DESCRIBE WHAT YOU WANT TO LEARN INTENSIVELY THROUGH THIS SEMINAR.

From this seminar do expect that we want to learn the implementation of sewerage work as following:

1. Based on the lessons learned from the past experience in your country what are the strategies to put in place for better plan and implementation of sewerage system that could be applied in Malaysia.

2. What are the policies that to be formulated to achieve the above goals and objectives in managing sewerage services industry in Malaysia.

3. In an ideal case, the cost of implementing good planned and high quality effluent, the cost will be very high. What is the best way forward for Malaysia in planning and implementing well planned and designed sewerage systems in our country.

4. Is high technically design sewerage treatment system required in Malaysia? If yes, what is eventual cost to the layman in street?

5. The implementation, monitoring and enforcement of the regulation in sewerage industry In Japan?

6. Best technology and latest invention used in sewage treatment system and managing sewerage services in Japan which are can be introduced or implemented in Malaysia?

7. The application of advanced IT system and other ICT technology developed in sewage treatment system and managing sewerage services in Japan ?

7. Implementation of sewerage development project in Japan including planning, tendering & procurement processes, engineering & design, construction & refurbishment, operation and maintenance.

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DEPARTMENT, MALAYSIA

OKTOBER 2007

Ⅶ-4 Republic of the Philippines

Dr. Judy Famoso SESE
Director Ⅲ,
Bureau of Research & Standards,
Dept. of Public Works and Highways

COUNTRY REPORT OF THE PHILIPPINES

On

Integrated Water Resource Management Adapting to the Global Climate Change

JICA EXECUTIVES' SEMINAR
ON
PUBLIC WORKS AND MANAGEMENT
JFY 2007

Prepared by:

DR. JUDY F. SESE
Director III
Bureau of Research and Standards
Department of Public Works and Highways
PHILIPPINES

SUMMARY

The Department of Public Works and Highways (DPWH) being the country's engineering and construction arm, is responsible for the planning, design, construction and maintenance of infrastructure such as roads and bridges, flood control systems, water resource development projects and other public works in accordance with national objectives.

The DPWH is likewise responsible in the monitoring of National Water Data Collection Program and recognizes the importance of the Integrated Water Resources Management (IWRM) to ensure and secure sustainable water for all. This mechanism is also accepted as a way of adapting to the effects of global climate unpredictability.

In January 2006, the Philippines started the implementation of the United Nation Environmental Program (UNEP) - Assisted IWRM project to come out with a plan in implementing the IWRM. Preparation of the plan was undertaken by Multi-Sectoral Task Force of water related key government agencies and Non-Governmental Organizations (NGOs). A series of activities were conducted in preparation of the IWRM Plan Framework. These include workshops, conferences and consultations with all sectors of the society. The Philippine planners also attended meeting with Southeast Asian neighbors where the Philippine Plan Framework was presented.

The Philippines archipelago is abundant in water resources. It has 421 principal river basins, 20 of which is considered major river basins. The country receives an annual rainfall of about 2,400 mm of which 1000 mm to 2000 mm goes to run-off. Despite having a relatively rich water resources; the Philippines is facing an imminent water shortage due to over population, urbanization and industrialization, which created problems of water resources management. Control in water utilization poses a great problem due to unregistered/illegal water users.

Other concerns and issues dominating the water sectors are the deteriorating water quality, declining access to safe drinking water, inadequate sanitation and sewerage facilities and degradation of major ecosystem. These concerns were aggravated by the increasing frequency and intensity of extreme climate event and variability. Likewise, there is also a problem with respect to sectoral water governance and regulation with 30 government agencies and offices dealing with water.

In view of the above issues and concerns, the DPWH, who is responsible with flood control and water development systems and being aware of the role of the IWRM, has embarked on water-related researches and studies. Currently, it conduct studies on "Nationwide Flood Risk Assessment and Flood Mitigation Plan" in selected areas of the country and the "Project for Enhancement Capabilities in Flood Control and Sabo Engineering of the DPWH" which is a JICA-Assisted Project.

I. Organization Data

(1) Name of Organization: **Bureau of Research & Standards (BRS)**
Department of Public Works and Highways (DPWH)

(2) Summary of Organization

2.1 The BRS was created under Executive Order No. 124, dated January 30, 1987 and mandated to develop and set effective standards and reasonable guidelines to ensure the safety of all infrastructure facilities in the country and to assume efficiency and proper quality in the construction of government public works.

The following are the specific functions of the Bureau:

(a) Study, on a continuing basis, and formulate and recommend guidelines, standards, criteria and system for the survey and design, construction, rehabilitation, maintenance, and improvement of all public works and highways;
(b) Conduct or sponsor research on construction materials and formulate and recommend policies, standards, and guidelines on materials and quality control;
(c) Undertake or cause to undertaken specialized technical studies to advance the in-house technology of the Department and secure the most complete information for project development and implementation;
(d) Formulate technical training programs for Department technical personnel, including the identification of appropriate local and foreign training program, and recommend the selection of Department personnel for such programs;
(e) Review and study, for the purpose of recognizing new technologies especially those utilizing indigenous resources, current national building and construction standards and procedures, and make appropriate recommendations thereon;
(f) Promote, publish, and disseminate technical publications;
(g) Provide technical assistance to the Department Proper, other Bureaus, Regional Offices and other agencies on matters within its competence, including technical assistance in the upgrading or updating of the building code, and other services;
(h) Cooperate or coordinate with other established research, development, and engineering centers in area of common or national interest;

2.2 The BRS has six (6) technical divisions and has an administrative unit. It has a total of 175 personnel and staff. See Figure 1 for the Organization Chart of BRS.

2.3 The BRS has no fixed budget. For the Fiscal Year 2007, a total of P97,882,000.00 was allotted, as summarized below:

2007 Fiscal Year Budget of BRS

ACTIVITY	PERSONAL SERVICES (PS)	MOOE	TOTAL
Infrastructure Research, Quality Control and Management, Production and Processing of Construction Materials and Ancillary Facilities	P 40,174,000	P 8,767,000	P 48,941,000
Formulation and development of guidelines, standards, systems and procedures for areas of infrastructure, including quality control and management of materials and ancillary facilities for the production and processing of construction materials	P 2,752,000	P 321,000	P 3,073,000
Conduct of research on construction materials for infrastructure projects and evaluation of feasibility studies of potential material supply sites	P 30,802,000	P 5,852,000	P 36,654,000
Conduct of hydrologic surveys and establishment, operation and maintenance of a national water resources data collection network	P 6,620,000	P 2,594,000	P 9,214,000
TOTAL	**P 80,348,000.00**	**P 17,534,000.00**	**P 97,882,000.00**

(2) Organization Chart

Refer to Figure 1 – Annex A

(3) Organization's Position in Government

The BRS is one of the Staff Bureau of DPWH. The DPWH is the country's engineering and construction arm, and responsible for the planning, design, construction and maintenance of infrastructure such as roads and bridges, flood control systems, water resource development projects and other public works in accordance with national objectives. See Figure 2- Annex A (Organizational Chart of DPWH).

In pursuit of the above tasks, the BRS shall engage in research and development on all major areas pertinent to infrastructure development. The BRS is looking forward to be the center of excellence in research, standards formulation and materials testing, and a leading advocate of quality assurance practices. It shall also promote innovation by providing DPWH and its stakeholders with improved access to engineering developments and advances through publications and the use of state-of-the-art technology. Finally, BRS shall be a respected DPWH institution providing technical advice and services to the Philippine Construction Industry in the age of Technology.

2. Personal Data

(1)Recent Works

As Director III of BRS, I am responsible to assist the Director IV in the macro-planning of research, standards formulation, materials testing, quality assurance, technical services and technical training and publication including administrative and financial management functions.

I am also responsible in monitoring and control of the planned activities and targets of each Division to ensure quality outputs. Provide assistance in the management of the physical and financial resources of the Bureau; introduce innovation for more effective implementation of the BRS goals and plans and to recommend policies and actions to top management of DPWH to further improve the research and development and quality assurance programs of the Department.

The Hydrology Section under the Research and Development Division of BRS, undertakes the evaluation and processing of streamflow data whose outputs are used in the design of water-related infrastructure projects. In these activities, I monitor the hydrologic activities of the said section including 16 DPWH Regional Offices in terms of targets and accomplishments of water level, river discharge measurement, collection of surface water sample, conduct of river-cross section survey, establishment, rehabilitation and maintenance of gaging stations and review of processed streamflow data, water quality results and sediment load analysis of water samples.

For water-related activities, I provided technical assistance to some water-related agencies specifically in the implementation of National Hydrologic Data Collection Program and the National Water Information Network (NWIN) under the Water Resources Development Project funded by the World Bank. Also, I actively participated in the annual meeting of the Philippine Water Partnership which was attended by institutional foreign and local members and offi/cers.

I actively participated and provide technical advice to the on-going study on Nationwide Flood Risk Assessment and Flood Mitigation Plan and the Project for Enhancement of Capabilities in Flood Control and Sabo Engineering of DPWH. I was been the resource speaker in seminar/training conducted by JICA and DPWH relative to implementation of the above-mentioned studies.

At present, I was designated Project Manager of the JICA-Assisted Technical Cooperation Project (TCP) on the "Improvement of Quality Management Systems for Highway and Bridge Construction and Maintenance."

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1. Integrated Water Resource Management Adapting to the Global Climate Change

(1) Current Situation and Problems

1.1 The Philippine IWRM Plan Formulation Process

In January 2006, the United Nation Environmental Program-assisted IWRM 2005 South East Asia Project commenced implementation in the Philippines. The project intended to accelerate IWRM implementation in the country through the development of a National IWRM and Water Efficiency Improvement Plan.

A series of key activities were conducted relative to the preparation of the IWRM Plan Framework. These included the following:

a. *Multi-Sectoral Task Force (MSTF) workshops and conferences.* The MSTF conducted a series of activities for the formulation of the plan including an organizational meeting, a leveling workshop, an IWRM Orientation, IWRM Strategic Framework meeting, institutional mapping workshops and thematic group consultative meetings among the MSTF.

b. *Consultation-Workshop with Non-Government Organizations and Civil Society Organizations.* The workshop, entitled "Building Partnerships and Enhancing Synergies for IWRM", oriented the representatives from various NGOs and CSOs on the commitment and initiatives of the Philippine government on IWRM. It also generated feedback on the IWRM Plan Framework. Key water-related issues of the NGO/CSO sector were articulated and suggestions and recommendations on the process and content (both form and substance) were discussed.

c. *Multi-sectoral Consultation-Workshops on the proposed National IWRM and Water Efficiency Improvement Plans in Visayas and Mindanao.* With the theme "Working Together to Secure Sustainable Water for All," the consultations generated feedback on the IWRM plan framework from a wider stakeholder base. The scope covers both sectoral and regional concerns since the participants were from different sectors and based in different regions in Visayas and Mindanao.

d. *IWRM-SEA Project Meeting (Rayong, Thailand).* The meeting brought together different Southeast asian countries to assess the status of IWRM implementation. The draft Philippine Plan framework was presented and generated positive feedback in terms of its scope, planning process and its multi-stakeholding approach.

e. IWRM Plan Framework Launching and Partners' Forum. The IWRM Plan Framework was presented to key stakeholders and said stakeholders adopted a platform for action to implement IWRM.

1.2 Purpose of Philippine IWRM Plan Framework

The IWRM Plan Framework is a directional plan. It is intended to guide the different stakeholders involved in water resources management, at different levels, to either prepare their respective IWRM plans, update/enhance their existing IWRM related plans or make IWRM an integral part of their development plans/programs.

It provides a clear roadmap and a collaborative platform for all stakeholders and water-related agencies to effectively work together to achieve water for all in a sustainable, equitable and ecologically balanced manner.

1.3 Philippine Water Resources Situation

(a). Land and Water Systems

The Philippines is an archipelago consisting of 7,100 islands and islets with a land area of about 300,000 km^2. The country is rich in water resources. It has 421 principal river basins with drainage area varying from 41 to 27,280 km^2. Out of these 421 principal river basins, 20 are considered as major river basins, with each one having at least 990 km^2 basin area. These major river basins cover a total area of 111,269 km^2 equivalent to 37.1% of the total land area of the Philippines.

In addition, the Philippines has 15 major lakes, covering 400 hectares and above. Its coastal bays and coastal waters covers an area of 266,000 sq. km.; while its oceanic waters cover 1,934,000 sq. km. It is considered the center of marine biodiversity in the world, characterized by extensive coral reefs, sea grass beds, dense mangrove forests, and pristine and beautiful beaches. The country's total coastline is one of the longest in the world and stretches over 36,289 kilometers. Average annual rainfall is about 2,400 mm of which 1,000 mm to 2,000 mm are collected as run-off by a natural topography of river basins, natural lakes and numerous small streams.

(b). Availability of Water Resources - Increasing Water Stress and Potential Water Scarcity

The country is now facing the prospects of an emerging water crisis. Rapid population growth, indiscriminate urban sprawl, industrialization and economic growth are creating serious problems for water resources management, water security and sustainability.

Over the years, per capita water availability has been declining. The Philippines has reported 1,907 cubic meters availability per capita as the second lowest among the South east Asian Countries. The increasing demand for water has resulted in a number of regions and at least 9 key urban centers experiencing water stress. Some areas are subject to devastating floods during the wet season while many areas experience water shortages during the dry season.

Total area provided by DPWH with river control and drainage facilities reached about 305,725 hectares, representing only 15.69 percent of the total potential coverage of 1,947,950 hectares.

(c.) Water Production and Use

As of December 2006, there are 19,247 water rights grantees for domestic (municipal), agriculture, power, and commercial users of water. These represent only the legal water users and do not include unregistered and illegal water appropriators.

Agriculture water use covers irrigation, livestock and fisheries. More than half of the water rights grants are for irrigation purposes, followed by domestic use. Currently, the total area with irrigation facilities is 1,515,347, representing only 48.47% of the total irrigable area. Considering that over the next 25 years, food will be required for another 25-26 million Filipinos, this is cause by concern.

The country's total water resources production is 5,792,857 liters per second (lps). Surface water contributes 98.4 percent of production and the remaining 1.6 percent is produced from groundwater.

The increasing demand for potable water especially in urbanized areas has resulted in over-extraction and the unabated exploration of groundwater resources. These in turn have resulted to saline water intrusion in some coastal areas and ground subsidence. Groundwater pollution is yet another growing problem.

(d.) Deteriorating Water Quality

Water quality standards for environmental water bodies are regulated by the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR) while standards for drinking water are set by the Department of Health (DOH).

Ideally, the bulk of our potable water should be sourced from surface water, as it is much more abundant than groundwater. However, the results of the Water Quality Scorecard (as reported in the 2003 Philippines Environmental Monitor) indicate that only a little over one third (36%) of our river systems/surface water areas are potential sources for drinking water. Of this, only one percent falls under Class AA, or those that require only disinfection to meet the Philippine National Standards for drinking Water. The rest of the sampling points (35%) fall under Class A which require complete treatment to pass drinking water standards. The remaining 2/3 (64%) are not fit for drinking.

Likewise, preliminary data from the National Water Resources Board (NWRB) - NWIN project and Local Water Utilities Administration (LWUA) indicate that up to 58 percent of groundwater intended for drinking water supplies are contaminated with total coliform and would need treatment.

The poor quality of water affects the health status of the population. Data from the National Epidemiology Center of DOH indicates that almost 1/3 (31%) of. the reported illnesses from 1996 to 2000 are water-related diseases. Contaminated drinking water is one of the most prevalent causes of health decline among the population. On the average, DOH estimates a total of P 3.3 billion direct income losses and medical hospitalization costs, annually.

Aquatic ecosystems depend on water flows, seasonality and water-table fluctuations and are similarly threatened by poor water quality.

(e.) Water Supply - Equity and Sustainability Issues

Domestic water systems delivery is classified into three main types of facilities:
Level I or point source system without distribution facilities,
Level II or communal faucet system,
Level III or individual household connection system.

Individual piped supplies (Level III) are provided by water districts, private operators, LGUs and Community-Based Organizations (CBOs). Shared water supplies are provided by LGUs and CBOs through Barangay Waterworks and Sanitation Associations (BWSAs) for point sources (Level I), and Rural Waterworks and Sanitation Associations (RWSAs) for communal faucet systems (Level II).

The Annual Poverty Indicators Survey (APIS) shows that access of the population to safe drinking water deteriorated from 81.4 percent in 1999 to 80 percent in 2002. This decline in coverage is largely due to the increasing demand of potable water brought about by a growing population.

(f.) Inadequate Sanitation and Sewerage Services

The proportion of the population with access to adequate sanitation in 2000 was estimated to be at 74.2 percent. This is a slight decrease from the 1991 coverage rate of 74.9 percent. The quality of sanitation services leaves much to be desired. Non-poor urban households rely mostly on septic tanks, which have been found to be poorly constructed and maintained, without provisions for desludging; thus, affecting their efficacy for primary treatment of wastewater.

Sewerage coverage is very low. Less than 8% of households in Metro Manila have access to sewerage, while the over-all urban sewerage coverage is a measly 4 percent (six cities.) The few sewerage systems that exist at present cater mostly to commercial establishments and affluent residential communities. In other parts of the country, coverage is much lower (estimated to be 1 percent).In the last 30 years, investment in urban sanitation totaled only 15% of amount spent on urban water supply.

(g.) Degradation of Major Ecosystems

The present status of coastal ecosystems in the country is a cause for alarm. Almost all Philippine coral reefs are at risk due to the impact of human activities; only 4 to 5 percent remain in excellent condition. More than 70 percent of the nation's mangrove forests have been covered to aquaculture, logged, or reclaimed for other uses. Half of the seagrass beds have either been lost or severely degraded, and the rate of degradation is increasing.

Beaches and foreshore areas are under increasing pressures from rapid population growth and uncontrolled development, which in turn leads to erosion, sedimentation and water quality problems.

Watersheds supply water according to the requirements of various domestic and industrial water and irrigation systems, as well as hydroelectric dams. About 140 priority watersheds with a total area of 4.5 million hectares nationwide need to be protected and/or rehabilitated.

One of the most formidable environmental challenges the Philippines faces today is diminishing forest cover. Of the country's total forestland areas of 15.88M hectares, only 5.4M hectares re covered with forests and fewer than a million hectares of these are left with old growth forests. Over exploitation of the forest resources and inappropriate land use practices have disrupted the hydrological condition of watersheds, resulting in accelerated soil erosion, siltation rivers and valuable reservoirs, increased incidence and severity of flooding and decreasing supply of water.

(h.) Increasing Frequency and Intensity of Extreme Climate Events and Variability

The Third Assessment Report of Intergovernmental Panel on Climate Change (as cited by Greenpeace, 2005) indicated that extreme climate events/availability, such as, floods, droughts, forest fires, and tropical cyclones have increased in temperate and tropical Asia. The warm episodes of the El Niño-Southern Oscillation (ENSO) phenomena have been more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years. This IPCC finding has manifested itself in the Philippines through the more frequent occurrence of severe El Niño and La Niña events, as well as, deadly and damaging typhoons and other severe storms; floods, landslides, drought, forest fires, etc.

There were 5 La Niña episodes and 7 El Niño episodes from 1970 to 2000 compared to only 3 La Niña episodes and 2 El Niño episodes from 1950 to 1970, The strong warm (El Niño) events were in 1972-73, 1982-83, 1997-98, while the strong cold (El Niña) events were in 1974-74, 1988-89 and 1998-99. The most common extreme climate events with significant economic and social impacts in the Philippines are tropical cyclone occurrences of which typhoons are the strongest and most destructive. Several typhoon extremes were observed from 1990 to 2004. The highest and lowest frequency of tropical cyclone occurrence, the strongest typhoon, the 2 most destructive typhoons, deadliest storm and the typhoon that registered the highest 24-hour record rainfall occurred during this period. There were seven (&) extreme tropical cyclone/southwest monsoon induced extreme events from 1991 to late 2004, namely, the Ormoc Catastrophe, 1991; Cherry Hill Tragedy, 1999; Payatas Garbage-slide, 2000; Baguio-La Trinidad landslides, 2001; Camiguin flashfloods, 2001; Southern Leyte-Surigao disaster, 2003; and the Aurora floods, 2004.

The sector most affected by climate change, so far, is agriculture and food security. The sharpest fall in agricultural productions are experienced during strong El Niño events and after the occurrence of severe tropical cyclones. However, increases in rice and corn productions are attributed to favorable rainfall conditions during La Niña years. The highest typhoon damage was 1.17% of GDP and and 4.21% of agriculture. In the health sector, many of the biological organisms linked to the spread of infectious diseases are especially influenced by the fluctuations in climate variables. Among other factors, dengue fever and malaria are sensitive to such climate parameters as temperature, relative humidity and rainfall. Other-related diseases like cholera have been associated with extremes of precipitation, droughts and floods.

The climate change impacts on coastal zones and marine ecosystems observed in 1998 were massive coral bleaching in various reefs throughout the Philippines caused by the elevated sea temperature during the severe 1997-98 ENSO episode. Fish kills and high mortality of cultured after the strong El NiñO periods. The worst incidence of red tide in Manila Bay occurred in 1992, another El Niño period.

(i.) Water Governance and Regulation: Sectoral Approach

Water resource governance is the responsibility of multiple national agencies in varying capacities. LGUs and local water districts also exercise certain powers but subject to national government decisions. NGO intervention has also been emerging. The current institutional and regulatory framework in the water resources sector is the product of incremental developments over many years, each in response to particular challenges of the time. This has led to the absence of an integrated water resources management system that adopts a holistic approach to sector demands.

There are some 30 government agencies and offices concerned with water resources development and management responsible with their own sectoral concerns. These agencies deal with water supply, irrigation, hydropower, flood control, water management, and other water-related concerns. For administrative supervision, these agencies are distributed among executive departments of the national government.

The DOH is responsible for overseeing the implementation and enforcement Sanitation Code of the Philippines. As part of its mandate to protect public health, DOH monitors the quality of drinking water and regulates premises with sanitation installation.

Based on the Local Government Code (LGC), the LGUs can also perform watershed management functions but are subject to DENR supervision and control. Provinces and municipalities implement community base forest management, social forestry, and watershed projects, but the barangay's role depends on the discretion of LGU executives. LGUs are likewise empowered to implement Level I to Level III water supply subsystems, communal irrigation systems and local flood control projects.

Unfortunately, there are no cross-sectional water resources plans and policies that will enable and ensure integration of various water and land use activities, water quantity and quality management, conjunctive use of surface and groundwater, upstream and downstream uses, with due consideration for the full hydrologic cycle.

(2.) Current Researches and Studies of the DPWH

(a.) The Study on The Nationwide Flood Risk Assessment and Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines

In response to the request, GOJ dispatched the preparatory study team, headed by Mr. Hiroyasu Tonokawa (herein after referred to as "the Team") to the Republic of the Philippines from 26 February to 17 March 2006, through the Japan International Cooperation Agency (hereinafter refer to as "JICA") to discuss the Implementing Arrangement (I/A) on the Study. I/A was finally agreed upon between the GOP and the Team, as spelled out in the Minutes of Meeting prepared as attached in Annex-1.

The objectives of the study are to select prioritized areas based on the flood risk assessment and to prepare flood mitigation plans for these selected areas, and to conduct technical transfer to DPWH counterpart personnel during the course of the study.

The study area shall cover the 954 flood-prone cities/municipalities identified by the National Disaster Coordinating Council (NDCC). **The study schedule** was started in the beginning of September 2006 in a manner of Home Work. In the middle of September, the Field Survey Work will start and continue until the middle of March 2008.

(b). The Project for Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

Enhancing the capability of the DPWH in the planning and design of flood control and sabo structure properly addressed to the water induced disaster in the country is the main focus of the Project ENCA. However, lower priority is given to flood control, hence, most of engineers had been shifted to road engineering. Consequently, the engineers don't have enough occasions to plan and design flood control structures, and it makes the vicious circle of few flood control projects. The Implementation of the Project-Type Technical Cooperation of Japan International Cooperation Agency (JICA) for the Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH Stage I (Project ENCA) started on January 2000. The DPWH established the PMO-FCSEC (Flood Control and Sabo Engineering Center) as the implementing body of Project JICA.

As the implementing body of Project ENCA, the Flood Control and Sabo Engineering Center (FCSEC) undertook a number of activities in order to achieve the project goal. These include the following:

1. Investigate damaged structures/insufficiently functioning structures and/or flood prone/bank erosion areas, and undertake problem analysis for each structures.
2. Formulate Damaged Structure Information System
3. Analyze the problem of planning and design of flood control projects.
4. Identify solutions of the problem and conducts training.
5. Formulate/Update the DPWH Technical Standards and Guidelines
6. Establish the Research System of FCSEC

(3.) Policy and Practices

a. Integrated Water Resources Management Plan Framework

The National IWRM Plan Framework is not just another water plan. There are key differences between the IWRM Plan Framework and a traditional water plan. The IWRM Plan Framework has the following distinctive features.

A Broader focus: It looks at water in relation to other dimensions needed to achieve larger development goals and meet strategic water related challenges

Dynamic and adaptive: It provides framework for a continuing and adaptive process of strategic, integrated and coordinated action in all levels.

Integrated and holistic: All the different uses of water are considered together. Water allocation and management decisions consider the interrelationships and effects of these various uses. They are not viewed purely from a sectoral or project focus.

Multi stakeholder engagement and environment in all stages and key processes: Includes government agencies, non government organizations, private/business sector, academe and civil society organizations working in the areas of health, environment, energy, finance, agriculture, education, tourism and disaster management.

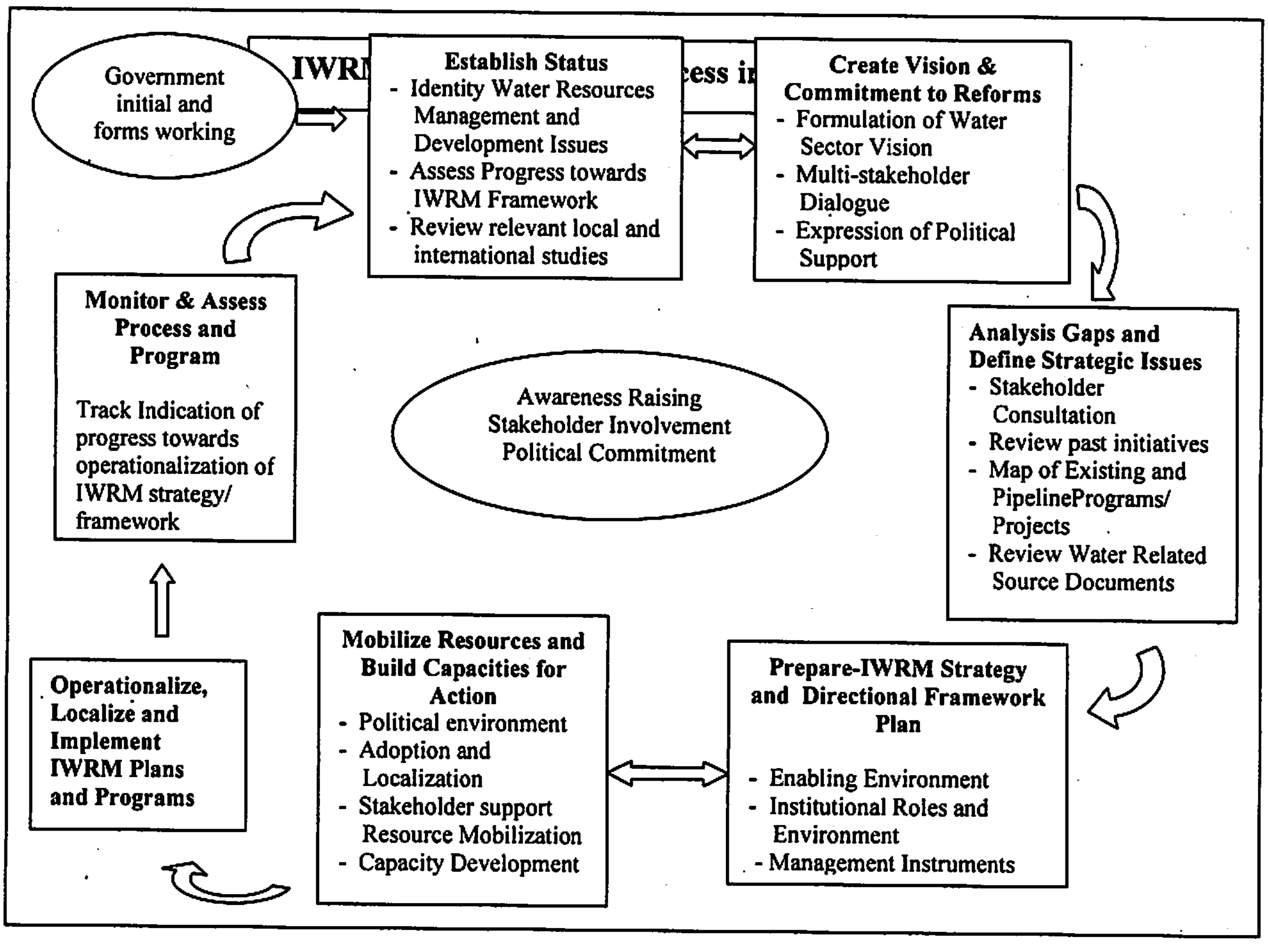


Figure 3 : The Structure of the Integrated Water Resources Management Plan Framework

The plan framework was developed based on the hierarchy of initiatives consistent with the challenges and issues confronting water resources management in the Philippines.

SUSTAINABLE OUTCOMES

Four (4) Sustainable Outcomes were identified. These are the medium to long-term goals that we aspire for our resources management system. These outcomes reflect our development aspirations for IWRM, and would ensure sustainability for our water resources. These include the following:

1. Effective Protection and regulation for Water Security and Ecosystem Health
2. Sustainable Water Resources and Responsive Services for Present and Future Needs
3. Improved Effectiveness, Accountability, and Synergy among Water Related Institutions and Stakeholders
4. Adaptive and Proactive Response to Emerging/Future Challenges

STRATEGIC THEMES

Each of these sustainable outcomes is supported by Strategic Themes. A strategic theme is either a sectoral or cross cutting imperative that are necessary to achieve the desired outcomes. The strategic themes under a particular outcome are mutually reinforcing and are inter-dependent. Nine (9) strategic themes were identified to support the four (4) sustainable outcomes. These are:

a. *For Effective Protection and Regulation for Water Security and Ecosystem Health*
   1. Ensuring Rational, Efficient and Ecologically Sustainable Allocation of Water
   2. Enhancing Effectiveness in Groundwater Management and Aquifer Protection
   3. Achieving Clean and Healthy Water
   4. Managing and Mitigating Risks from Climate Change Events and Water Related Disasters
b. *For Sustainable Water Resources and Responsive Services for Present and Future Needs*
   1. Promoting Water Conservation/Stewardship and Improving Water Use Efficiency
   2. Expanding Access and Ensuring Availability of Affordable and Responsive Water Supply and Sanitation Services
c. *For Improved Effectiveness, Accountability, and Synergy among Water Related Institutions and Stakeholders*
   1. Promoting Participatory Water Governance and Supportive Enabling Environment
   2. Strengthening Knowledge Management and Building Capacity for IWRM
d. *For Adaptive and Proactive Response to future Challenges*
   1. Exploring New Pathways to Water Resources Management: Water Sensitive Design and Water Rights Trading

Each strategic theme is supported by several Strategic Objectives and each strategic objective is supported by several Key Actions. These key actions are major steps or initiatives required to accomplish the said strategic objectives. Note that the specific activities and their respective timeframes are not indicated. This will be defined through the different operational plans to be prepared by different government agencies and stakeholder groups, at different levels.

1. Integrated Water Quality Management Framework

A. Requirements of the Clean Water Act

Republic Act 9275, otherwise known as the Philippine Clean Water Act of 2004 (CWA), declares that the State shall pursue a policy of economic growth in a manner consistent with the protection, preservation, and revival of the quality of our fresh, brackish, and marine waters. As such and following the principle of sustainable development, the State shall "formulate an integrated water quality management framework through proper delegation and effective coordination of functions and activities."

Article 2, Section 4 of RA 9275 defines Integrated Water Quality Management Framework (IWQMF) as "the policy guideline integrating all the existing frameworks prepared by all government agencies on water quality involving pollution from all sources". Specifically, the framework shall contain the following:

1. Water quality goals and targets
2. Period of compliance
3. Water pollution control strategies and techniques
4. Water quality information and education program
5. Human resources development program

Furthermore, Chapter 3, Section 19 of RA 9275 and Rule 19 of its Implementing Rules and regulations (IRR), states that it is the responsibility of the Department of Environment and Natural Resources (DENR) as the lead agency to prepare an integrated water quality management framework, and to evaluate the same at the end of every five (5) years or as the need arises. The framework may contain, but not limited to: (a) assessment of policies and institutional arrangements and capacities relevant to water quality management including strategy for devolution to local government units (LGUs); (b) management strategies; (c) sustainable financing strategies; and (d) performance monitoring.

B. Coverage of the Framework

This Framework applies to all natural and man-made bodies of fresh, brackish, and saline waters, and includes, but is not limited to, aquifers, groundwater, springs, creeks, streams, rivers, ponds, lagoons, water reservoirs, lakes, bays, estuarine, coastal, and marine waters.

It supports the Integrated Water Resources Management Framework (IWRMF) which calls for a systematic, adaptive process conducted in collaboration with stakeholders for the sustainable development and management of water and related resources in the context of equity, social, economic and environmental objectives.

IWQMF integrates all existing frameworks in so far as these frameworks cover water quality involving pollution from various sources. Major frameworks that were integrated or referred to in this document are:

1. Philippine Strategy for Sustainable Development (PSSD) – which aims to achieve economic growth with adequate protection of the country's biological resources and its diversity, vital ecosystem functions, and overall environmental quality.
2. Framework for Sustainable Philippine Archipelagic Development (ArcDev) – which (a) calls for functional cooperation between government and relevant stakeholders to strengthen the existing terrestrial focused, national planning and policy framework; (b) recognizes that the people's welfare relied on management bodies incorporating institutional mechanisms which account for both the vast potential and sustainable use of the country's predominant maritime resources, environment and heritage; and (c) promotes integrated archipelago that recognizes the interaction of land, sea, air and people within the archipelagic setting.
3. Integrated Coastal Management (ICM) – an Executive Order No. 533 which aims to ensure the sustainable development of the country's coastal and marine environment and resources.

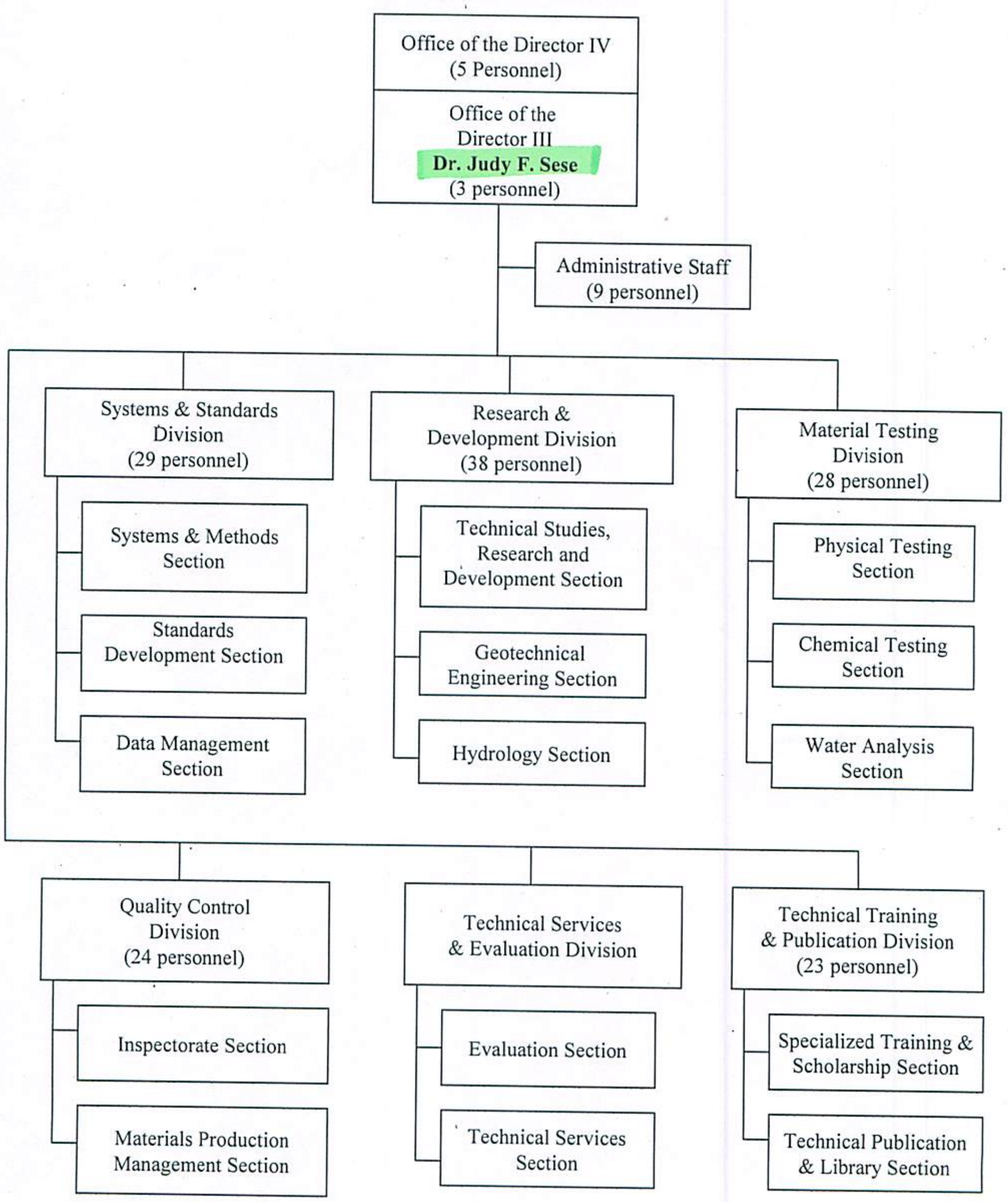
The Medium-Term Philippine Development Plan (MTPDP) for 2004-2010 was likewise considered in this framework, and on an international scale, the United Nations Millennium Development Goals, which aims to ensure environmental sustainability, was also taken into account.

ANNEX A

FIGURE 1

Organizational Chart of the Bureau of Research and Standards (BRS)

Organizational Chart



Total Number of Personnel/Staff = 175

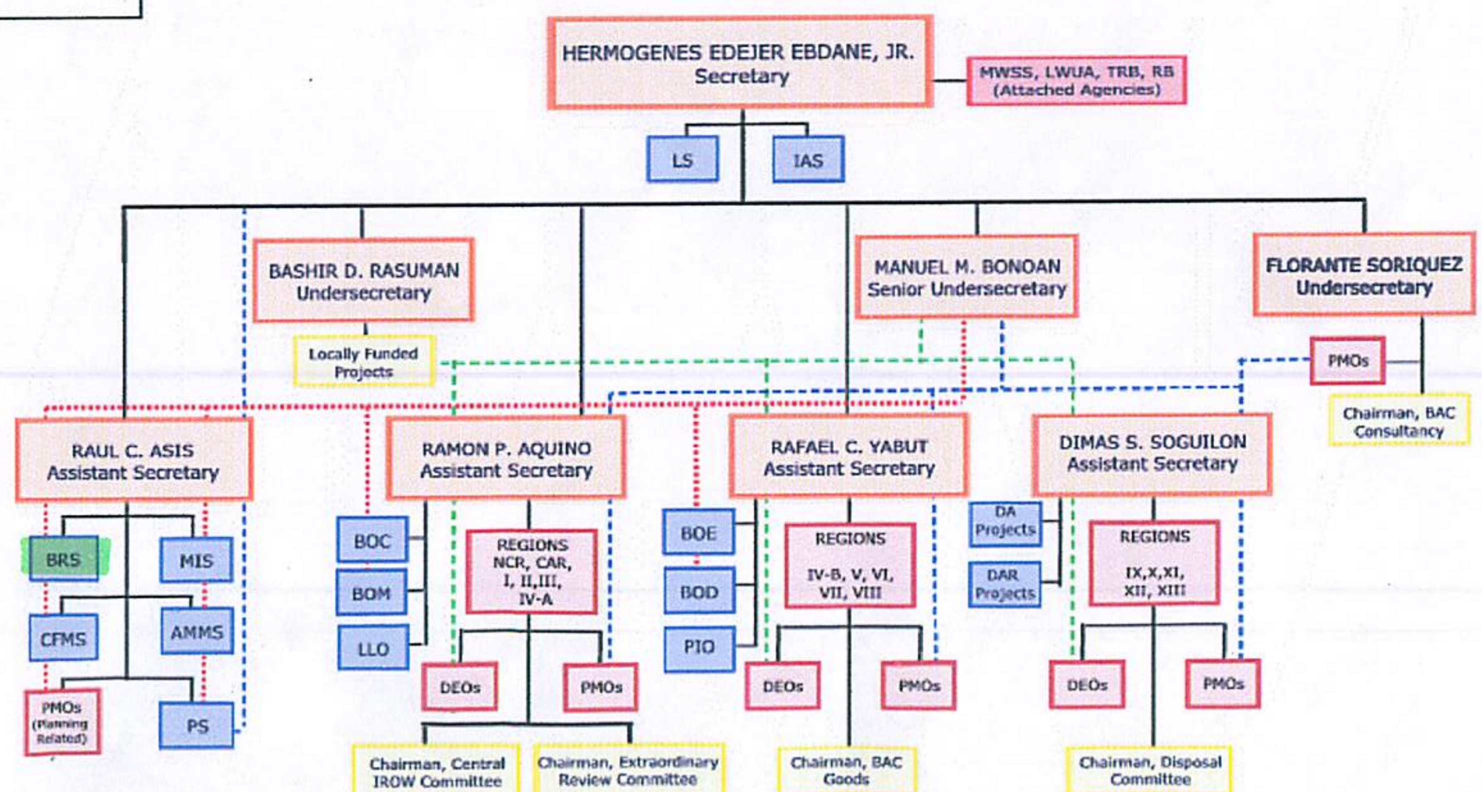
Department of Public Works and Highways

About Us

Organizational Chart

Figure 2

The Department of Public Works and Highways is pursuant to Executive Order No. 124 dated 30 January 1987.



AMMS - Administrative & Manpower Management Service
BAC - Bidding and Awards Committee
BOC - Bureau of Construction
BOD - Bureau of Design
BOE - Bureau of Equipment
BOM - Bureau of Maintenance
BRS - Bureau of Research and Standards
CFMS - Comptrollership & Financial Management Service
IAS - Internal Audit Service
LS - Legal Service
MIS - Monitoring and Information Service
PS - Planning Service

CAR - Cordillera Administrative Region
DEOs - District Engineering Office
IROW - Infrastructure Right-of-Way
LLO - Legislative Liaison Office
LWUA - Local Water Utility Administration
MWSS - Metropolitan Waterworks and Sewage System
NCR - National Capital Region
PIO - Public Information Office
PMO's - Project Management Office
PPP - Pump Priming Projects
RB - Road Board
TRB - Toll Regulatory Board

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Ⅶ-5 Democratic Socialist Republic of Sri Lanka

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COUNTRY REPORT OF SRI LANKA

Integrated Water Resource Management

Adapting to the Global Climate Change

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

JFY 2007

Prepared by

ENG. (MRS.) P.N.S YAPA

DEPUTY GENERAL MANAGER, NATIONAL WATER SUPPLY & DRAINAGE BOARD

SRI LANKA

TABLE OF CONTENT

Summary

The world's climatologists agree that climate change is underway. The "Global Climate Change" has a strong probability of an increase in frequency and severity of rainfall extremes, which may cause unexpected floods and droughts and rise in sea level, which will affect the low-lying islands and deltas.
The change in climate, which is induced by the influence of the increasing atmospheric concentrations of greenhouse gases and aerosols and the projected human induced changes in climate, regionally or globally, has resulted in;

- The frequency and magnitude of climate fluctuations
- The duration, location, frequency and intensity of extreme events such as heat waves, droughts, floods, heavy precipitation, avalanches, storms, tornados, and tropical cyclones.
- The risk in abrupt or non-linear changes in ecological systems.

The projected changes during the 21st century in extreme climate phenomena, due to the above, and their likelihood are;

- Higher maximum temperatures, more hot days and heat waves over nearly all island areas
- Higher (increasing) minimum temperatures, fewer cold days, frost days and cold waves over nearly all land areas (*very likely*)
- More intense precipitation events (*very likely* over many areas)
- Increased summer drying over most mid latitude continental interiors and associated risk of droughts (*likely*)
- Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities
- Intensified droughts and floods
- Increased Asian summer monsoon precipitation variability
- Increased variability of mid-latitude storms

As such, the impact of this increasing variability will seriously affect livelihoods, societies, economies and ecosystems across the world. Especially the poor in the developing countries will be the mostly affected and will find it most difficult to recuperate.

Hence, in addition to the mitigation, it is important to adapt integrated water systems to the impacts of climate change, within their development agendas for water and other sectors. Adaptation has the potential to reduce adverse effects of climate change and can often produce immediate ancillary benefits, but will not prevent all damages.

Sri Lanka, being an island and a developing country, is most vulnerable to such impacts. Empirical evidence indicates that climate variability in the recent past had adversely affected environment, food, health, and all other dimensions of human security in Sri Lanka. The most vulnerable are the communities in coastal, drought-prone, flood-prone, and landslide high-risk areas, whose livelihoods depend directly on rainfall, bio-diversity

and other natural resources. Although Sri Lanka was able to achieve its Millennium Development Goals, anticipated changes in climate, such as the decline in rainfall in the dry zone, the increase in temperature and the intensity and frequency of extreme weather events like prolonged droughts, heavy rainfalls, floods and landslides and sea level rise, will undoubtedly undermine the efforts for poverty alleviation, reduction of food and health insecurities and inter and intra-regional inequities. There is a likelihood that conflicts among the farmers for the use of scarce irrigation water, between the villagers and State on the utilization of forests, river sand and other resources, and between the state-environmentalists and general public regarding the development projects that could impact adversely on the environment may occur more frequently.

This report focuses on the degree, to which natural and human systems in the country are sensitive and vulnerable to existing climate variability. Special emphasis is placed on its impact, need for mitigation and adaptation to cope with longer-term climate change and its associated insecurities.

1.0 ORGANIZATION DATA

1.1 Name and Summary of Organization

NATIONAL WATER SUPPLY & DRAINAGE BOARD

The National Water Supply & Drainage Board (NWSDB) presently functions under the Ministry of Water Supply and Drainage. It is the principal authority providing safe drinking water and facilitating the provision of sanitation in Sri Lanka. The NWSDB was established in 1975 by an act of parliament.

During the past 30 years, the organization has considerably expanded its scope of activities. The NWSDB is presently operating 291 Water Supply Schemes, which covers 30% of the total population with pipe borne water supply. In addition, Rural Water Supply and Sanitation Programmes, including deep well programmes, are also being implemented by the NWSDB. Further, 8 % of the population is served with hand pump tube well.

In its Corporate Plan for the period 2007-2011, NWSDB has planned to provide additional pipe borne drinking water coverage to facilitate achievement of government goals, set in accordance with the United Nations' Millennium Development Goals. With this view, NWSDB expects to implement many more capital projects, in addition to the capital projects that are being undertaken at present. It is expected to achieve 40% pipe borne coverage by the year 2011, if required level of capital investment is made available.

Meanwhile projects were implemented to reduce non-revenue water and to improve sewerage system. Several research and development activities relevant to the NWSDB activities were undertaken in the newly established Research & Development Unit. The staff per 1,000 water connection ratio improved steadily from 27.6 in 1995 to 8.7 in 2005. Emphasis on reducing wastage, cutting down inventory costs and controlling establishment expenses continued. Training programmes and institutional development efforts were undertaken to improve productivity.

As a commercially oriented organization, NWSDB commenced consumer metering and billing in 1982. However, the National Water Supply & Drainage has to operate as a service organization in certain respects. Water had to be supplied through public stand posts to tenement gardens, public toilets and public bathing areas. This activity, in most cases did not generate revenue. The NWSDB is also compelled to maintain hand pumps installed in dry zone areas. Rain water Harvesting is becoming popular and the NWSDB is actively pursing the construction of these tanks island-wide. The NWSDB is also in charge of the sewerage system in Colombo and suburbs.

Water supply facilities to people, affected by the Tsunami disaster, were another activity undertaken by the NWSDB with the assistance of several donors.

The water tariff levied at present is just sufficient to meet the operational cost and debt service. Ideally the traffic should generate revenue for the NWSDB to be able to meet all O&M expenditure, debt service and make available additional revenue to undertake the smaller scale development works.

In addition, the Regional Support Centers of the NWSDB provide technical assistant to rural communities to develop their water supply and sanitation needs, on a regular basis. To meet this requirement, a large number of non-governmental organization, both national and international, are working with the NWSDB to provide technical support and, when need arises, to support the construction of ground water wells.

NWSDB hopes to increase the pipe borne water coverage to 45% by the year 2015 to facilitate the achievement of the United Nations' Millennium Development Goal of 85% safe drinking water coverage by that year.

1.2 Budget of Organization

NATIONAL WATER SUPPLY & DRAINAGE BOARD

Project Balance Sheet

as at 31.12.2007

(Rs. 000's)

	2006	2007
ASSETS		
Non-Current Assets		
Property, Plant & Equipment, Net - At cost	36,766,248	35,712,400
Capital Work in Progress	40,449,015	69,402,915
Intangible Assets	83,098	83,098
Investments	143,718	143,718
	77,442,079	**105,342,131**
Current Assets		
Research & Development	-	71,000
Inventories	2,144,401	2,144,401
Trade & Other Receivables	4,993,595	4,919,178
Deposits & Advances	3,170,504	3,170,504
Investments	672,617	672,617
Cash & Cash Equivalents	693,564	704,992
	11,674,681	**11,682,692**
TOTAL ASSETS	**89,116,760**	**117,024,823**
EQUITY AND LIABILITIES		
Capital and Reserves		
Assets taken over from Government Dept.	185,480	185,480
Capital Grants	73,032,153	100,518,791
Capital Recovery Fund	1,059,641	1,059,641
Staff Welfare Fund	11,571	11,571
Revaluation Reserve	309,763	309,763
Accumulated Losses	(2,613,386)	(2,329,536)
	71,985,222	**99,755,710**
Non-Current Liabilities		
Interest bearing Loans	13,551,949	13,251,949
Other Deferred Liabilities	1,482,653	1,482,653
	15,034,602	**14,734,602**
Current Liabilities		
Creditors	1,202,787	1,640,362
Interest bearing Loans	486,077	486,077
Other Payables	408,072	408,072
	2,096,936	**2,534,511**
TOTAL EQUITY AND LIABILITIES	**89,116,760**	**117,024,823**

NATIONAL WATER SUPPLY & DRAINAGE BOARD
OPERATION AND MAINTENANCE BUDGET 2007

Project Income and Expenditure Statement for the Year ending 31st December 2007

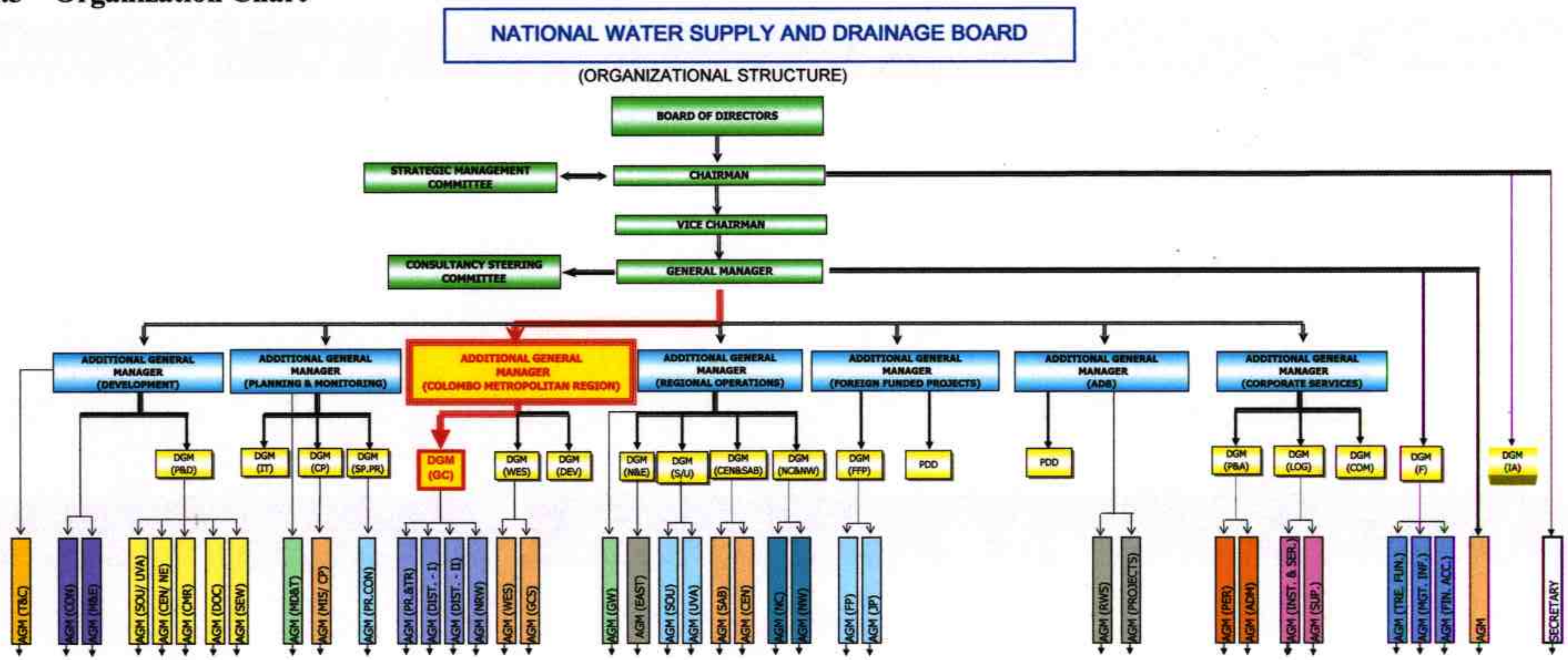
	Rs. "000"			
	2005	**2006**	**2006**	**2007**
	Actual	**1st six month Actual**	**Budget**	**Estimated**
Income				
Sale of Water	5,446,264	2,811,160	6,544,232	7,441,768
Sewerage Income	-	-	-	288,000
Capital recovery	178,885	91,243	197,092	271,284
New connection Net	218,850	113,387	233,826	376,138
Other income	416,722	211,191	250,240	344,026
Income from Investments	32,634	31,099	100,000	120,000
Total Income	***6,293,355***	***3,258,080***	***7,325,390***	***8,841,216***
Less operating Expenses				
Personal Cost	2,291,198	1,185,310	2,769,834	3,159,077
Electricity	1,217,702	589,622	1,454,786	1,618,557
Chemicals	301,387	156,365	318,569	329,823
Repairs & Maintenance / Defective Meter Cost	285,379	157,166	449,186	627,434
Establishment Expenses	281,437	148,514	320,518	383,218
Rents Rates & Finance charges	226,195	119,913	297,053	348,510
Retiring Gratuity Provision	75,353	37,676	150,000	75,000
Bad Debts and Irrecoverable	102,058	72,573	66,108	148,835
Total Operating Expenses	***4,780,709***	***2,467,139***	***5,826,054***	***6,690,454***
Surplus before Depreciation and Interest	***1,512,646***	***790,941***	***1,499,336***	***2,150,762***
Less Depreciation	1,043,414	616,923	1,007,527	1,053,848
Interest in Loans	491,504	253,570	461,173	819,000
Net Profit/ Loss Before Tax	(22,272)	(79,552)	30,636	277,914
Less Tax to be Paid	69,629	12,500	9,000	78,263
Net Profit/ Loss After Tax	***(91,901)***	***(92,052)***	***21,636***	***199,651***

NATIONAL WATER SUPPLY & DRAINAGE BOARD
OPERATION AND MAINTENANCE & CAPITAL BUDGET 2007

Project Cash flow Statement for the Year ending 31st December 2007 Rs.'000

	2006 BUDGET	2007 ESTIMATED
Inflow of Funds		
Total Operation Inflow	**9,322,846**	**11,177,512**
Capital Budget Treasure Grant		27,580,000
Total Inflow		**38,757,512**
Less Outflow of Funds		
Total Personnel Emoluments	3,450,533	3,852,877
Total Power & Electricity	1,265,031	1,668,557
Total Chemicals	277,539	329,823
Total of New Connection Extension Expenditure	378,534	490,622
Total Materials	98,115	152,840
Total Repairs	351,071	499,594
Total Establishment	320,818	483,218
Total Rent, Security	277,075	342,565
Total Finance Charges	494,995	639,288
Total Expenditure Budget	**6,913,711**	**8,459,384**
Debt Service and Capital Expenses		
Capital Budget Construction Works		27,580,000
Board Fixed Assets and Rehabilitation Expenses	320,000	470,000
Debt Service to Treasury (Principal)	301,700	300,000
Debt Service to Treasury (Interest)	1,236,828	1,323,000
Rechargeable outflows	44,000	145,000
Research & Development Expenditure	63,527	71,000
Urgent Important Development fund	300,000	400,000
Total Debt Service and Capital Expenses	**2,266,055**	**2,709,000**
Total Outflow	**9,179,766**	**38,748,384**
Net Surplus	**143,080**	**9,128**

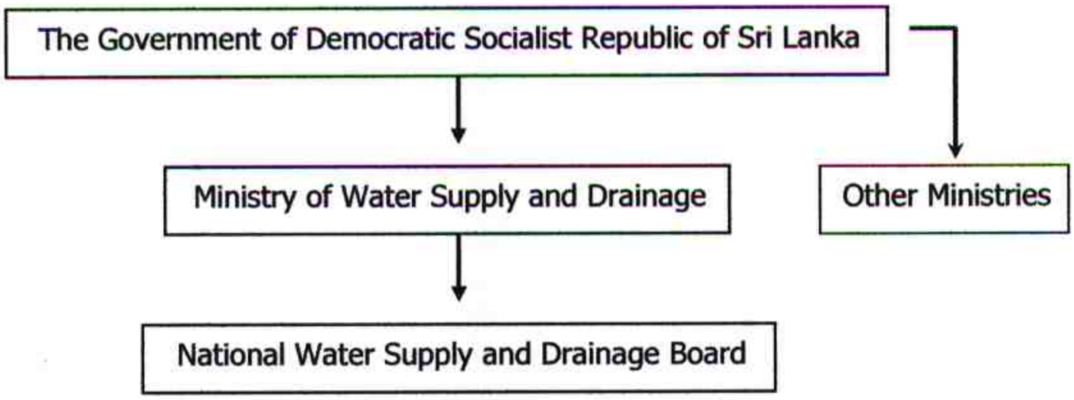
1.3 Organization Chart



Number of Employees as at August 2007:

Greater Colombo	:	2,100
Southern / Uwa	:	2,050
Central / Sabaragamuwa	:	1,200
North Central	:	710
Western	:	837
North / East	:	510
Head Office and Other	:	1,081
Total	:	**8,488**

1.4 Organization's Position in Government



The National Water Supply & Drainage Board (NWSDB) presently functions under the Ministry of Water Supply & Drainage. Being the principal and key authority of providing safe drinking water and facilitator for the provision of sanitation in Sri Lanka, National Water Supply & Drainage Board holds itself responsible for the research and development of drinking water resources and its timely management. A Research and Development Section has been set up, within the NWSDB's organization structure to the above effect. The Research and Development Section, which is under an Assistant General Manager, welcomes the ideas, researches and proposals by the Board's employees for its action plan, which in turn facilitate the implementation of them. This may be through its' own funds or donor agents' funds.

2.0 Personal Data

Work which I have done for the past three years

May 2005 Up-to-date

Deputy General Manager
Regional Support Centre – Greater Colombo

Since I assumed duties as the Deputy General Manager of the Greater Colombo Regional Support Centre in May 2005, my main function has been to monitor the Operation and Maintenance of the process to provide safe drinking water to about 460,000 consumers in the region. This monitoring covers the process of extracting water from the *Kelani* River, its purification and distribution, which caters about 140 million gallons per day to meet the water demand. Greater Colombo Regional Support Centre employs the service of 2100 personnel at different levels, which includes 06 Managers and 04 Assistant General Managers.
The regional revenue of the water sale accounts for 70% of the total revenue of the NWSDB, which requires high level of supervisory mechanism on commercial activities, such as meter reading, billing, revenue collection and control of expenses.
Region experience a major set back in its water distribution system as the Non-revenue water (NRW) percentage exceeds 53% in the Colombo city. I have been responsible for drafting and implementing a 05 year action plan to reduce the NRW from its 53% to 30% by the year 2012, which has paid special attention to reduce leakages, water theft, free water supply and administrative losses.
I was also involved in the development study of the transmission model for transmission mains in the region and in the proposed construction of the salinity barrier, across *Kelani* River to prevent the salinity intrusion, during drought season, to the main treatment plant at *Ambatale*.
Also the following projects are being implemented under my supervision and assistance;

- Towns North of Colombo (TNC) Water Supply Project
- *Kluganga* River Water Supply Project (Phase I of Stage I)
- Sri Lanka Tsunami Affected Areas Recovering and Take Off Project (STARRT)
- Enterprise Wide IT Solution Project
- *Labugama-Kalatuwawa* Rehabilitation Project
- *"Pavithra Ganga"* (Clean Rivers) Programme

July 2004 to May 2005

Deputy General Manager
Regional Support Centre – Southern/Uva

My responsibility as the Deputy General Manager (Southern/Uva Regions), from January 2002 to May 2005, involved the comprehensive supervision of water supply and sewerage in the regions, which included planning and monitoring of the operation and maintenance activities. There were about 1960 employees for the above work, which included different processes at intakes, treatment plants, transmission system, reservoirs and the distribution systems. I had the assistance from Two Assistant General Managers and 04 Managers in implementing the above duties and they helped me in planning and construction work of the following major projects to meet the forecasted future demands, and to deliver the results on time.

- Greater *Galle* Water Supply Project
- *Matara* Water Augmentation Project
- ADB 3^RD Project
- ADB 4^TH Project
- Salinity Barrier Studies for *Nilwala* River
- *Akmeemana* Rain Water Harvesting Project
- Tsunami Rehabilitation Project

During this period of my service, two major disasters hit the region. One was a severe flood due to a rainfall of 820 mm in Matara, in May 2003, which destroyed 9294 houses and partially destroyed another 30,360. Livelihoods of 138,973 were affected and caused death of 236 persons. Another was the Tsunami Disaster in December 2004, which killed about 60,000 in the country. On these two occasions, I was able to lead my staff to restore the water supply system within a very short period, which was a great achievement in my career.
Also, my personal intervention into the conflict among the farming community, NWSDB, Irrigation Department and Electricity Board, over the water sharing pattern, led to an amicable end.

Eng. (Mrs.) P.N.S. Yapa
Deputy General Manager,
Regional Support Centre (Greater Colombo),
National Water Supply & Drainage Board,
3rd Floor, Welikada Plaza,
Rajagiriya,
Sri Lanka.

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E-mail: dgmgcrsc@hotmail.com

3.0 Introduction

3.1 Geographic Introduction

Sri Lanka is an island with a central hill country, surrounded by coastal lowlands and is located in the Indian Ocean within the latitudes of 5 55' – 9 51' N and longitudes of 79 41' – 81 53' E, with a land extent of 69,450 sq.km, which includes 1,570 sq.km of internal water surface (*see figure 01*). The island is 435 km long in the North-South direction and is 240 km wide in the East-West direction. The population is about 20 million, of which 30% is urban and 70 % is rural.

Figure 01

3.2 History of Integrated Water Management

Sri Lanka heritages a history of a culture of hydraulic civilization, which dates back to 05 th Century B.C. Much of this hydraulic civilization evolved around the Lanka's famous and major river basins named; *Mahaweli, Malwattu, Kelani, Kalu, Walawe, Menik , Deduru Oya, Kirindi Oya and Kumbukkan Oya.* Many of these rivers originate in the wet zone of the central highlands and flows down to all corners of the country, facilitating

mass-scale culture of irrigated agriculture. This geographical pattern urged the ancestors to conserve the watersheds in the highlands and to store water in a network of man-made reservoirs, along the water streams, to develop lowlands in agriculture.
This system of water management is well expressed in the popular 'Dictum' by the King Parakramabahu (1153 AD), which stated as;
"Not a single drop of water shall be allowed to flow into the sea, without being utilized for human benefit"

3.3 Introduction to Climate

Being close to the equator, the climate is "Tropical-Monsoonal", governed by two main seasonal rhythms of rainfall. Thus the climate is mainly determined by the rainfall and temperature, which is a high variable to the seasonal wind pattern and pressure developments in the sub-continent.

3.3.1 Rainfall

The rainfall has a considerable spatial variation (*See figure No 02*) and its' distribution pattern is influenced by the following factors.

- The two monsoon wind regimes
- Equatorial trough of low-pressure or Inter-Tropical Convergence Zone (ITCZ)
- Convection
- Orographic characters
- Cyclonic wind circulation

Annual rainfall spreads over four distinctive periods with wet zones receiving an annual average rainfall of 2400 mm while it is 1400mm for the dry zone.

First Inter-Monsoon period;
(March-April) Convection over the land area in the afternoon affected by convergence in ITCZ

Southwest Monsoon period;
(May-Sep.) Depressions and cyclonic wind circulations in low and mid troposphere controlled by orography. Convectional rain in Northern-Eastern part.

Second Inter-Monsoon period;
(Oct.-Nov.) Widespread convection with cyclonic wind circulation and convergence.

Northeast Monsoon period;
(Dec.-Feb.) Wind waves in the Easterly air stream, cyclonic wind circulation and convection influence the rainfall

3.3.2 Temperature

The mean temperature ranges from a low figure of 15.8 ° C in the Central highlands to a high of 29 ° C in Northeast coast where temperature may reach the highest of 37 ° C. The average yearly temperature for the country as a whole ranges from 26 ° C to 28 ° C. Day and night temperatures may vary by 4 ° C to 7 ° C. (*see figure 02*)

3.3.3 Wind:

The summer monsoon or Southwest monsoon is reckoned from May to September. The onset of the monsoon is associated with a cyclonic wind circulation in the low troposphere (1500m) or with a depression. Occasionally strong westerly winds occur, just prior to the onset of persistent rain. When the monsoon is fully established, the westerly winds extend up to the mid troposphere (6000m) and is overlain by easterly winds in the upper troposphere (9000-12000m)

In winter monsoon or Northeast monsoon, the winds up to the mid troposphere (3000-6000m) are formed in Easterly direction. The winds in upper troposphere are lighter and in southeasterly direction.

3.3.4 Pressure

The pressure distribution is fairly uniform during the months of March-April and October-November. The pressure gradient, across the country during May-September, increases Southwesterly from Northeast to Southwest. During December-February the same is in the reverse direction.

The seasonal movement of the Equator Trough of Low Pressure determines the changes in the gradient of pressure. Air from two subtropical high-pressure systems converges into this trough of low pressure. Thus the Equatorial Trough of Low Pressure is also called the Inter Tropical Convergence Zone (ITCZ). During the Northern winter (January), it is located at 10° C South and in the Northern summer (July) it is at 25 ° C North. The ITCZ moves across the country in May, in its northwards migration, which ushers in the Southwest monsoon winds.

3.3.5 Humidity

The relative humidity varies generally from 70 % during daytime to 90% at night.

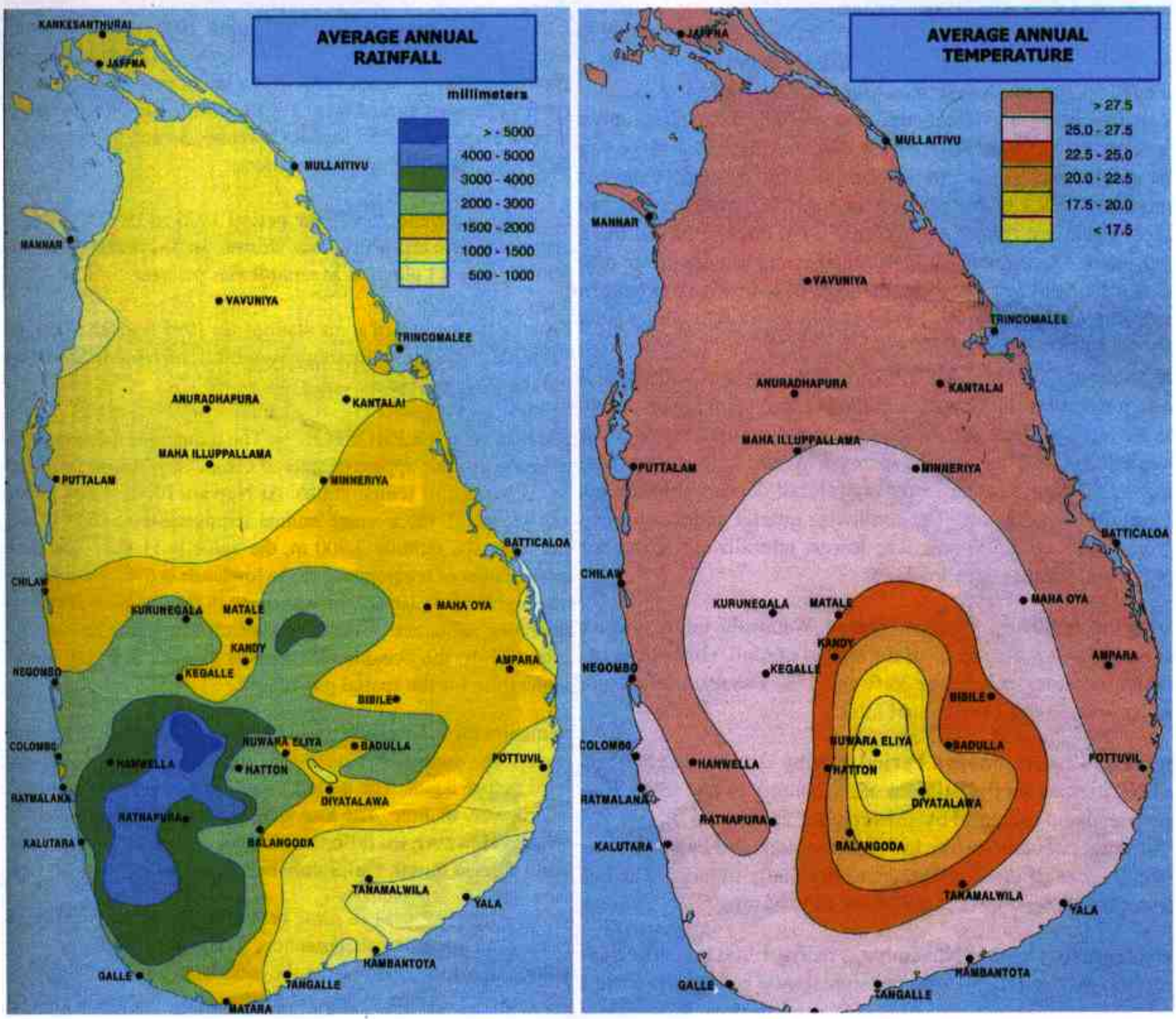


Figure 02

4.0 National Water Balance, Seepage Characteristics and Main Usage Pattern

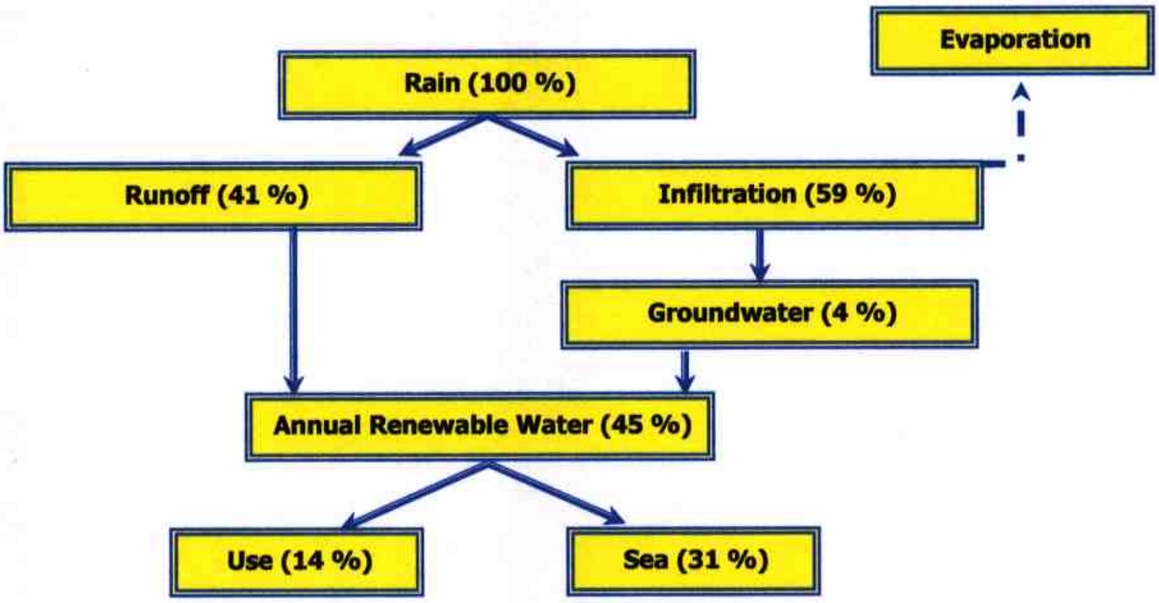
The country is endowed with about 7000 km of rivers and irrigation canals and 3500 deep tanks and reservoirs. With around 127-130 billion Cu.m of water from rainfall, Sri Lanka potentially has adequate water for all, so long as it can be properly managed.

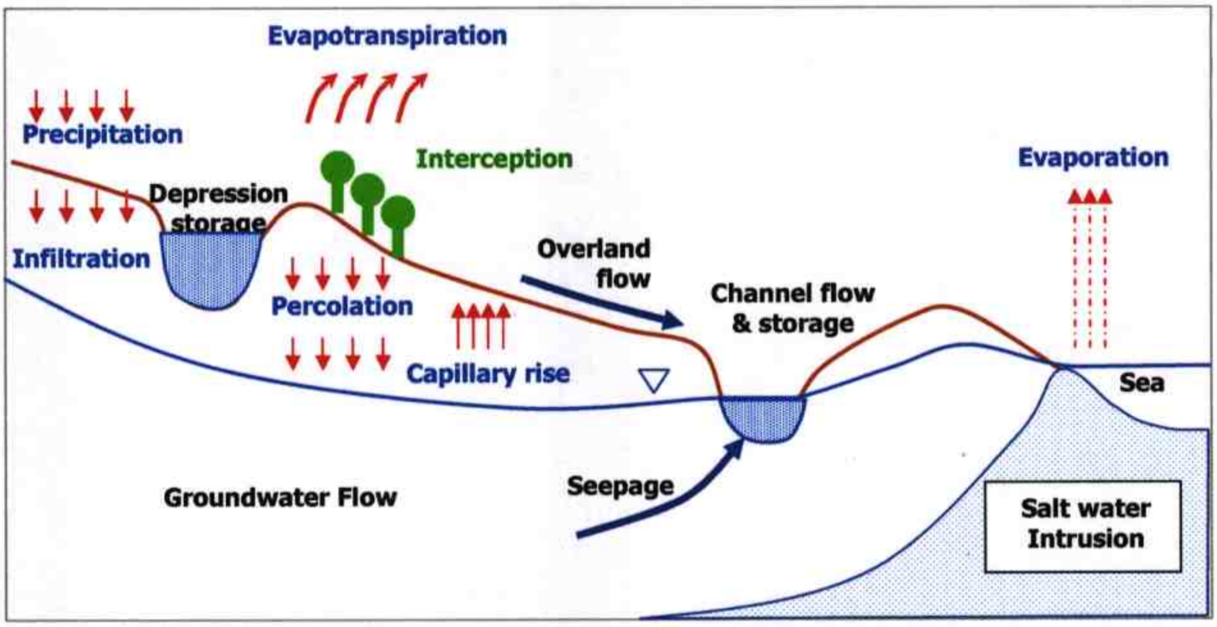
Degradation of water catchments, however, and siltation of major water bodies have been two of the main factors, threatening adequate and timely supply of water. Annual renewable freshwater resources of Sri Lanka amounted to 2134 Cu.m per capita in 2000. But with an annual population growth of 1.2-1.3 %, by 2025 it is expected that this will decline to about 1800 Cu.m per capita, only just exceeding the water scarcity threshold of 1700 Cu.m per capita.

Some 75% of the total runoff in Sri Lanka escapes to the sea; however, most of this runoff is generated in the wet season(s). In the dry season evaporation exceeds rainfall.

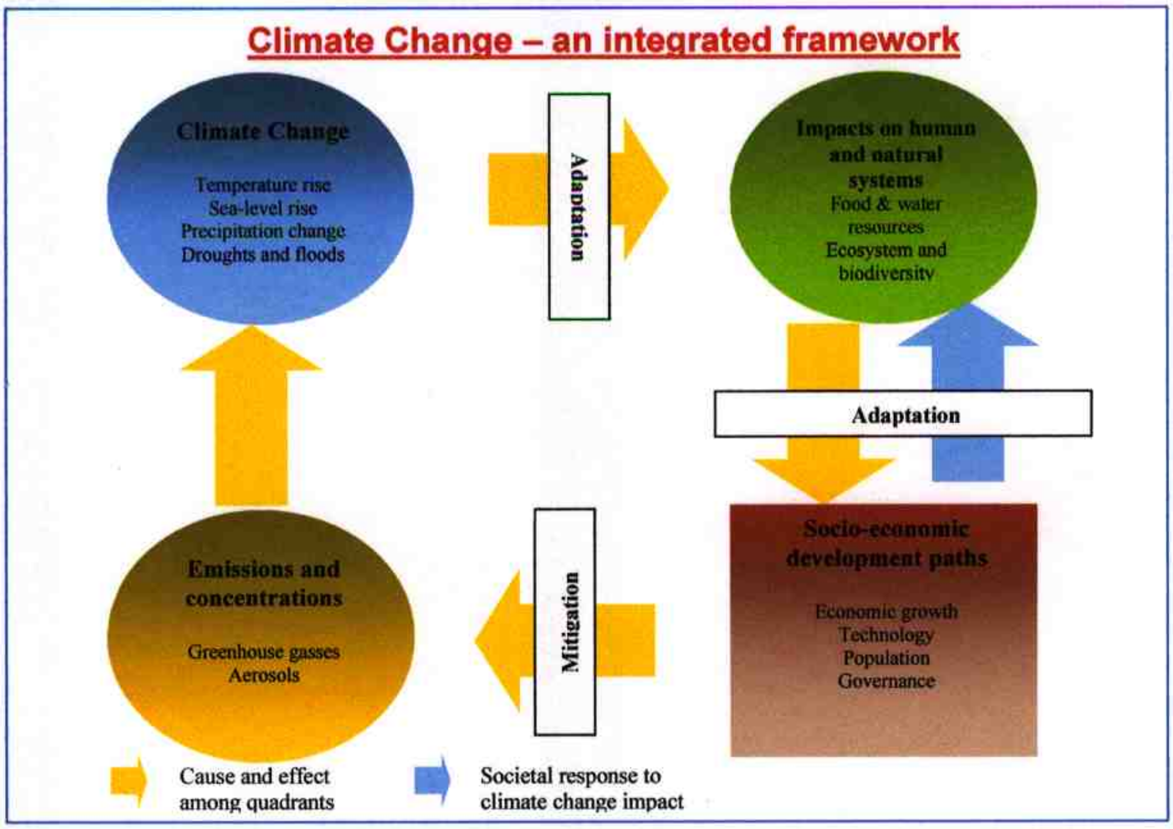
Agriculture dominates water use in Sri Lanka, accounting for 96 % of the current demand, which is in series with the production of hydro electricity. The remaining 4 % is split between the industrial and domestic sectors while about 70 % of the urban population is served with pipe borne water. Only 15 % of the rural households are served with piped water supply, the rest depend on dug wells (27 %), tube wells, streams and lakes for their domestic water requirements. This leaves a large population in the rural areas without adequate safe domestic water and it has been these people that have been most responsive to using collected rainwater as a supplementary source (Rainwater Harvesting).

National Water Balance





5.0 Integrated Framework of Climate Change



6.0 Vulnerability of Natural and Human Systems to Climate Change in Sri Lanka

An analysis of the impacts of past climate variability on water resources, bio diversity, agriculture, human settlements, health and coastal zones can provide an insight into the magnitude of the human security and issues that are climate related.

6.1 Vulnerability on Human Settlements and Health due to Change in Flood, Drought and Cyclonic Pattern

Climate change can affect human settlements in Sri Lanka directly and indirectly through impacts on the natural environment of settlements, economic activities, building and infrastructure and health of the resident and commuting population. Existing problems such as air pollution, poor waste management and inadequacy of water and sanitation facilities can be exacerbated and new problems will be created. Communities living in flood-prone areas, coastal settlements and others in resource-dependent areas are more vulnerable than others.

According to the studies by Deheragoda and Karunanayake (2004), Sri Lanka has witnessed a number of extreme rainfall events, noticeably during the last two decades of the 20th century. In the most recent past, extreme climate events such as heavy rainfall and major floods have impacted adversely on inhabitant in settlements located in landslide prone areas in the central hill country. As many as 219,870 people from 43,000 houses had been affected by floods in 1993 while in the following year the number had increased to 353,000 from 52,900. In May 2003, heavy rain of 820 mm in three days had triggered flood and landslides which had completely destroyed 9294 houses and partially destroyed another 30,360. As a result, livelihoods of 138,973 families had been severely affected and caused death to 236 persons. The damage was estimated at US$ 27 million. In 1986, a rainfall of 299 mm intensity, in few hours time, had caused unexpected land slides in the Hill country. In 1993, during Southwest monsoon, the city of *Colombo* experienced a severe rainfall of 420mm in just 7 hours, which caused the city to be completely submerged with floods in suburbs. Towards the end of the year 2006, the persistent rainfall triggered an unforeseen landslides pattern, across the Hill country, which urged the government to shift an entire city called *Peradeniya* to a safer place.

The country also faced some severe droughts in 1992, 1997 and 2001. The drought in 1992 had reduced the country's tea production by 26 %, from the amount produced in the previous year and increased the cost of production by 19 %, thus affecting the foreign exchange earnings. The drought in 1997 affected the villages in the *Hambantota* district (southern) in the Dry zone where food insecurity and loss of income due to drought had risen to a level of 90-99%.

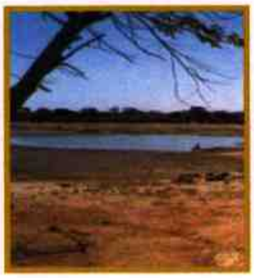
An unexpectedly prolonged, severe drought in 2001/2002 made water levels in major reservoirs to fall down drastically, virtually to reach their dead storage, despite intensified isolated rainfall in certain parts of the island. The government was forced to shut down the hydro-power generation which crippled the industrial sector. This led to the immediate investment-call for fossil-fuel power generation, which still remains a financial burden on national grid of power generation.

Other hazards include unexpected and abrupt heat affects. Very recently, in 2006, a 'Tornado' hit the centre of *Colombo* city, twice over a week, displacing about 1500 families. in 2002 a cyclone destroyed 77,000 houses, affecting 146,190 families. This abrupt change is very much highlighted by the heat wave which emanated from *Galle* road which reached above 40° C, making it similar to a middle-east country.

Extreme rainfall events have also affected urban squatters who live close to marshes that are liable to flooding. Squatters in unauthorized make-shift dwellings in Colombo have been exposed to *helminthic* and *protozoal* parasites (*Wanasinghe* 1995). Further, the Dengue vectors- *Aedes aegeyphi* and *Aeds albopictus* that breed in fresh water have been identified around these squatter settlements and the dengue epidemic in 2004 was attributed to heavy rains that occurred in the first six months.

A study by *De Alwis et al* (2004) on vector borne diseases in the dry Northwestern province illustrates the close relationship that exists between the incidence of diseases such as malaria, dengue and Japanese Encephalitis and climate factors. In the recent past extreme weather conditions such as heavy rainfall and prolonged drought have contributed to an increase of *anopheline* mosquitoes in the dry North-Central province which is hyper-epidemic for malaria. Suitable habitats for the vectors are created in the drying tank beds and rivers, during the long dry season and, pools on uneven land surfaces during wet weather conditions.

Dhanapala (1998) predicted that the malaria transmission within the dry zone would extend to areas that were hitherto free from malaria and that the seasonal pattern of malaria in the endemic zone would also change. The current minor mid-year peak would be enhanced while the traditional high transmission season (November-February) during the Northeast monsoon, would be reduced. Areas bordering the non-epidemic wet zone are likely to be highly vulnerable. At present, floods caused by the heavy rain and landslides and drought in the dry zone have been responsible to the spread of water washed and water borne diseases. Studies indicate that the increasing frequency and intensity of extreme weather events in future could bring about illness and deaths as well as injuries, collapse of health infrastructure and displacement of affected persons, as well as physical and psychological trauma.



6.2 Vulnerability of the Coastal Zone due to Sea Level Rise

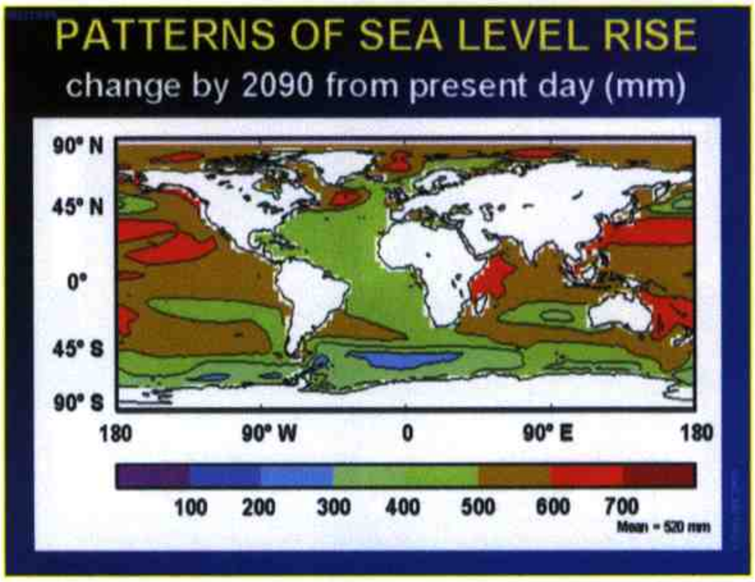
The level of the sea at the shoreline is determined by many factors in the global environment that operate on a great range of time scales, from hours (tidal) to millions of years (ocean basin changes due to tectonics and sedimentation). But more intense is the melting of glaziers in the Northern pole due to global warming. As a result, an increase of 10-20 cm in sea level was observed during 1860-2000 and the same is predicted to rise, between 9 - 88 cm during the next 100 years.

The Sri Lankan coastal zone comprises coastal habitats that include of lagoons and estuaries, beaches, barriers and spits, salt mashes and mangroves. The zone performs valuable regulation, user and productive functions. It possesses a considerable proportion of renewable and nonrenewable resources, space for residential, commercial, industrial, agricultural, administration and socio-cultural activities, infrastructure and nature conservation. This zone is the most urbanized, densely populated and economically productive (Provided 40% of the Gross Domestic Product) region in the country. As much as 62% of the total industrial units and 70% of the tourists hotels are located in this zone. The region also possesses 89 scenic and recreational sites and 253 archaeological and cultural sites of which 34 are designated as high priority sites.

The coastal ecosystems are affected by anthropogenic stresses such as the conversion of mangroves (a loss of 39% between 1986 and 2003), river sand mining (5.5 MCM in 2001), beach sand mining, coral reefs mining, inland coral mining, collection of coral from beaches and shore face, building construction and infrastructure installations close to the shoreline. The Coast Conservation Department has estimated the rate of coast erosion at 0.5 m/year with an accretion rate of 0.2m / year. Another study estimated that a sea level rise of 0.3m in the Southwest coast would lead to a land loss of 6.0 sq.km while a 1.0 m rise would cause a loss of 11.5 sq.km (*Weerakkody* 1996).
Another problem which would be accelerated by a rise in sea level is the intrusion of salt water along rivers due to river sand mining. During low flow periods, salt water extends up to 14 km along the river *Kelani* which provides portable water to Colombo Metropolitan Region. With a sea level rise in 0.3m, it is estimated that salt water intrusion in the river would extend upstream to a distance of 31km.

Thus the sea level rise will affect the country in the given extent below;

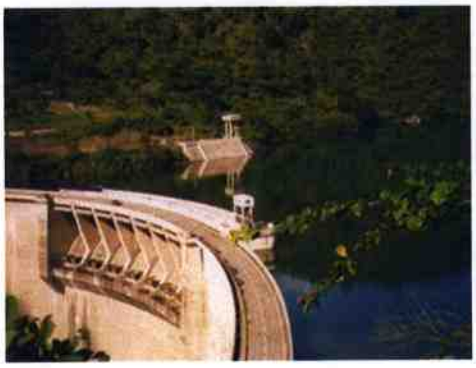
- 24 % of total land area and 32 % population
- 65 % of urbanized area
- 80 % tourism related infrastructure
- 65 % industrial outputs
- 100% commercial ports and fishery harbours and anchorages
- 80% of fish production
- Major highways and railway infrastructure
- Richest areas with biodiversity; coral reefs, lagoons, mangroves, etc. covering 160,000 hectares
- Increased coastal erosion which is 0.3-0.35 m/year at present
-



6.3 Impact on Sedimentation and Flood Vulnerability

Intensified rainfall leads to soil erosion, loss of fertility and a reduction in water holding capacity. 60 % of land slopes in Sri Lanka are vulnerable to landslide and excessive soil erosion if the intensity of a rainfall exceeds 25 mm/hour. Also the irregular urbanization, agriculture and development projects in the central hill country have contributed largely to he highland soil erosion. These eroded soils get transported by water streams and accumulates in river beds and basins, part of which, in turn gets transported down to reservoirs. This sedimentation reduces the flood carrying and retaining capacities of the rivers and reservoirs. The intensity of sedimentation is much depicted by the siltation rates and reduced storage capacities of the following reservoirs.

Polgolla reservoir	: 44 % storage with 2.8 % siltation rate/year
Rantambe reservoir	: 54 % storage with 4.3 % siltation rate/year
Victoria reservoir	: 0.08% iltation/year
Minor tanks	: 2.4 % siltation/year



7.0 Adaptation of integrated water resource management to the Global Climate Change in Sri Lanka

Mitigation is defined as an "anthropogenic intervention to reduce the sources or enhance the sinks of Greenhouse gases". As much as 95 % of the total Greenhouse gas emissions in Sri Lanka comprise carbon dioxide (CO_2.

The conversion of forest land for plantations and colonization schemes, burning of forests and scrubland for shifting cultivation and the reduction of organic matter and release of Carbon in soils are the largest sources (82%) of CO_2 emissions in future. The second important source of GHG is methane, produced mainly from waste matter in landfills followed by livestock related emissions from cattle, goats and pigs (produced by 'enteric fermentation' of food and by the decomposition of animal manure). It is likely that with intensification and extensification of paddy cultivation in the country, the amount of methane emissions would increase in future. The predominant source of nitrous oxide in Sri Lanka is agriculture due to shifting cultivation and the nitrogen found in mineral and organic fertilizers.

Adaptation to climate change means any," adjustments in ecological, social, and economic systems in response to actual or expected climate stimuli and their effects or impacts". The adaptive capacity "is the potential or ability of a system, region or a community to adapt to the effects or impacts of climate change". Enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development.

7.1 Policy and Practices:

Adjustment is necessary in both natural and human systems since the poor communities in Sri Lanka are heavily dependent (directly or indirectly) on natural resources. Action, taken so far by Sri Lanka to reduce Greenhouse gas emissions include mainstreaming of environment concerns into development decision making. The following strategies, outlined in the National Report of Sri Lanka, to the 'World Summit on Sustainable Development', the 'Initial National Communication, under the 'United Nations Framework Convention on Climate Change' (Draft 2000) and the paper on 'Multilateral Environmental Agreements (MEAs), will contribute to solving this issue to great extent with;

- Ratification of 36 Multilateral Environmental Agreements (MEAs)
- Measures undertaken to implement MEAs, which include the development of National Environment Policy, National Forestry Policy, National Policy on Wildlife Conservation and National Air Quality Management Policy,
- Development and adoption of National Environmental Action Plans (ie: Biodiversity Action Plan, National Climate Action Plan, Coastal 2000 Action Plan, Clean Air 2000 Action Plan and National Forestry Sector Master Plan.)
- Preparation of National Strategy for Clean Development Mechanism to implement the Kyoto Protocol
- Establishment of Climate Change Secretariat, Bio Diversity Secretariat and Ozone Secretariat to strengthen the capacity of implementing agencies

The environmentally friendly practices that have already benefited the country are;

- Introduction and popularization of fuel efficient stoves that reduce fuel woods
- Introduction of cleaner production technologies among polluting industries
- Installation of mini-hydro power plants as stand-alone and grid connecting system
- Facilitation of rain water harvesting in the dry zones. National Rainwater Harvesting Policy is to be adopted, making rainwater harvesting mandatory
- Identification of cost-effective utility scale wind power development (Young and Vihaure 2003)

7.2 Research & Survey

The recent 58 Nos of research studies, conducted under the auspices of Climate Change Enabling Activity Project (Phase II) of the Ministry of Environment and Natural Resources have been successful in filling some knowledge gaps on the magnitude of vulnerability of natural and human system in Sri Lanka to climate change, Greenhouse gas mitigation potential and suitable adaptation measures. A number of these research studies have focused on biological mitigation option such as;

a. Conservation of carbon pools such as forests and
b. Carbon sequestration by increasing the carbon pool size by reforestation and afforestation of degraded forests and croplands in marginal and wastelands. Forest tree species that are most suitable for carbon sequestration were screened to select species that have a higher absolute growth rate with higher level of total biomass than others and are highly responsive to elevated CO_2.

In 2004, *Nugawela, Rodrigo and Munasinghe* were able to quantify the Carbon fixing capacity of Rubber. Their research results indicate that genotype RRIC 121 was 160% superior to RRIC 100 in fixing Carbon.

Sirisena et al's (2004) study on methane emission from paddy fields showed that the lowest daily and seasonal emissions were observable in plots that did not receive any organic manure or chemical fertilizer. The most crucial period for emission of methane was 6-12 weeks after the crop was established. A further positive relationship between the number of productive tillers and the rate of methane emission was observed. Therefore, *Sirisena* et al recommended that rice varieties that produce minimum productive tillers with high yields should be introduced to reduce methane emission from paddy fields and that intermittent drying, which is commonly practiced by farmers, 7-11 weeks after transplanting 3 ½ month rice varieties shall be encouraged.

Abeywardana (2004) focused attention on selecting paddy varieties that are highly responsive to elevated CO_2 for future breeding programmes. Changes in agronomic practices, introduction of pest resistant varieties and the establishment of a surveillance and forecasting system are some of the recommendations made by their study of climatic conditions that favour the outbreaks of Brown Plant Hopper in the low country Dry Zone in order to take necessary to control pests.

The study by *Emmanual* (2004) on the Urban Heat Island (UHI) effect in Colombo discovered that the UHI has increased in recent years due to the increasing amount of energy consumed by residences, offices, institutions and other buildings and that conventional design options do not result in acceptable indoor comfort. *Emmanual* has proposed a number of strategies to ameliorate the effects of UHI, such as, the use of energy efficient designs in building construction which can reduce electricity consumption by 50%, the introduction of Guidelines for building construction and landscape control ordinances, changing of the exterior colour from dark to light, facilitation of the deeper penetration of sea breeze by discouraging construction of high rise buildings along the coast.

Senanayake (2004) has examined the possibility of reducing Greenhouse gas emissions from the Desiccated Coconut industry by improving the combustion efficient and by fuel switching. Wood gasification technologies are considered as zero GHG emission technologies, which will save foreign exchange for fuel oil, while the use of hot water boilers instead of steam boilers would ensure that there is a 40% reduction in annual GHG emissions. He recommends the introduction of industry related incentives to attract industry owners to adapt GHG mitigation actions and the dissemination of findings of researches to policy makers, equipment suppliers and academics.

Micro or mini hydropower is one of the most sustainable alternatives to the use of large scale hydroelectricity systems in Sri Lanka. The success of micro hydro projects depends on selecting suitable sites in the hill country. The study by *Pannilage* (2004) showed that water yield is affected not only by the amount of rainfall but also the land use practices in the catchments areas. Hence the anticipated change in rainfall in the hill country would have a differential impact on water yield depending on type of natural vegetation cover and type of crops. Reforestation and forest management have been recommended by the researchers.

Rain water harvesting is an effective low cost adaptation strategy to overcome the anticipated decline of rainfall in the dry zone. Different types of tanks are being used at present, but the quality (chemical, physical and biological) of rainwater differs from tank to tank. Ariyananda (2004) compared the quality of water in the different types of tanks and has recommended on the suitable types.

7.3 Mitigatory and adaptative physical measures in Sri Lanka

a) Recent, following flood control, water resource development and management projects:

- *Mauara* reservoir, 75 MCM capacity to divert water to adjacent *Malalara* basin to feed water to *Meegaha Jandura* and *Badagiriya* tanks.
- *Gal-Amuna* reservoir, feeds 05 small irrigation tanks
- Proposed *Veheragala* reservoir, 75 MCM capacity to divert water to *Lunugmvehera* reservoir for drinking and irrigation water
- Proposed *DeduruOya* reservoir to control downstream flood, 75 MCM capacity storage for irrigation and hydropower. Feeds water to *Inginimitiya* reservoir and 05 minor irrigation tanks
- Proposed Urawa reservoir, 16 MCM capacity for flood control. Diverts water to *Muruthalawa* reservoir
- Proposed *Ratnapura* reservoir, 70 MCM capacity for flood control, irrigation and hydropower

b) Construction of Salinity Barrier and Dams to prevent salinity intrusion

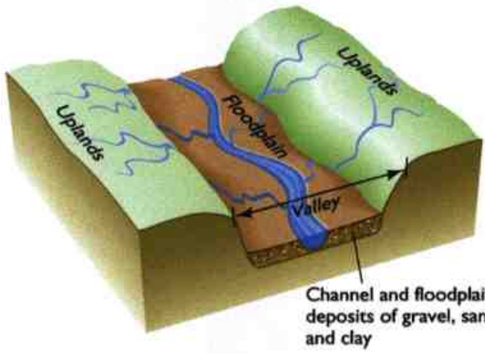
*Kelan*i River and its tributaries are the main source of potable and industrial water to Greater Colombo area. The bed of the river is below zero MSL, to a length of 14 km along the river, up to *Hanwella*. The water treatment plant of NWSDB is located at *Ambatale* which is about 10 km from river-mouth at sea. When the flow level in the river is low, sea water propagates along the river, limiting the water extraction capacity and degrading the water quality. This leads to interruption to water supply for 6-8 hours a day. The proposed construction of a salinity barrier, downstream of *Ambatale* intake, will prevent the salinity intrusion and will double the present extraction capacity, which is 0.5 MCM per day now.

Also the proposed dams, upstream of the intake will serve the irrigation and other needs, but its main objective will be to discharge high volume of water during salinity intrusion periods, flushing out the saline water back to the sea. Presently the same is achieved with high discharge from hydro power reservoirs on requests from NWSDB, but since the salinity intrusion occurs during drought periods, unnecessary such high discharge from reservoirs affect the power generation and future irrigation capacities.

Similar attempt to construct a salinity barrier at *Nilwala* River in the southern part of the country limited only to studies, due to the objections from farming community from upstream of the intake.

c) Step-land agriculture in Hill country

The farmers in the hill country are given financial grants to develop step-land for agriculture. The construction of step-barriers in the hill country will increase the rainfall infiltration and reduce surface flow, which results in reduced soil erosion, leading to less sediment transportation. This will avoid high siltation rates in major reservoirs and deposits in rivers thus enabling to maintain flood retaining and carrying capacities.



d) Advanced capacity building programme on integrated water resource management under '*Pavithra Ganga*' (Clean Rivers) pogramme

Ministry of Environment and Natural Resources has implemented the " Pavithra Ganga" programme as an attempt to keep the water bodies clean and safe in Sri Lanka, in collaboration mainly with the National Water Supply & Drainage Board, Department of Local Government (Western Province), Central Environmental Authority and 13 Local Administrative Authorities along the *Kelani* River
Kelani River being a major source of drinking water and ecologically sensitive area, 13 monitoring committees have been established in the 13 Local Administrative Authorities to identify sources of pollution and take remedial action. It has enhanced the institutional and technical capacity of the major stakeholders to promote monitoring of water quality and trace the sources of pollution in the *Kelani* River, effectively.

e) Promotion of Rain Water Harvesting in Dry Zone

A cost effective system to be adapted to the anticipated declined rainfall in the dry zone. This also reduces the exploring of ground water in aquifers through tube wells, thus saving them for the future. To adapt to the climate change impact on availability of reliable water sources, the new concept of "Accessibility, reliability and timely availability of adequate safe water to satisfy basic human needs" has been defined. Most rural house holds in the dry zone and rural areas face water insecurity. Households manage, however by lowering their consumption during seasonal shortages and by increasing their water collecting efforts and adjusting their water requirements to a minimum level. Rain water harvesting reduces water insecurity due to abrupt climatic changes by providing such households with additional source.

8.0 Mitigatory Actions in Legislation / Water Reforms

Activities of Sri Lankan Water Reforms

The following is a summary of the water 'reform' process in Sri Lanka during the last quarter century

(Nanayakkara 2003. Ariyabandu and Aheeyar 2004. L H R D : 2002, 2003, 2004, 2005)

Date	Instrument	Authority	Provisions
1980	water resources Bill	Ministry of Irrigation, Power and Mahaweli Development	Bulk water allocation to various sectoral agencies (and further allocation by those agencies) and for the establishment of a National Water Resources Council (this legislation, however, was never submitted to Parliament due to lack of cabinet support).
1983	Irrigation Ordinance (amendment)		Enable farmers to be prosecuted for non-payment of water taxes.
1984			Commencement of charging water taxes from farmers
1988	Policy of "Participatory Management of Irrigation Systems"		Substantial devolution of authority and responsibility to farmer organizations
1988	Irrigation Management Policy Support Activity (IMPSA)	International Irrigation Management Institute (IIMI)	
1992	Summary Report IMPSA	International Irrigation Management Institute (IIMI)	Recommendations on land, watershed and water resource management, and that the government should establish a high-level advisory National Water Resource Council and Secretariat.

1992			Proposal to carry out a water resources master plan was presented to external support agencies.
1993	Institutional Assessment for Comprehensive Water Resources Management (IACWRM) Project.		Assess the institutional capacity for water resources management. The action plan of the project focused mainly on the need to develop a National Water Resources Policy, to establish a permanent institutional arrangement for water sector coordination and to prepare and enact" National Water Act'
1994	Irrigation Ordinance was amended by Act No. 13 of 1994		Enable farmer organization to levy charges from the members of the organization for the operation and distribution of water through canal systems.
1995		Cabinet	The implementation of the Strategic Framework and Action Plan for the "Institutional Strengthening for Comprehensive Water Resources Management (ISCWRM) Project.
1996	IACWRM project	Government	Establishment of a Water Resources Council (WRC) and a Water Resources Secretariat (WRS).
1996 to early 2000	ISCWRM project		Production of the "National water Resources Policy and Institutional Arrangements" and the " National Water Resources Authority (NWRA) Bill"
28th March 2000		Cabinet of Ministers	Approval of the National Water resources Policy.
September 2000		Legal draftsmen's department	Release of the Draft National Water Resources Authority Bill. (Government, however, failed to push the Act through the parliament and to establish NWRA).
2001			National Policy on Rural Water Supply and Sanitation was approved.
2001	The '100 day' programme	Ministry of Irrigation and Water Management	Setting up task forces for the implementation of its water management policy at 4 levels; Village Irrigation Committee. Divisional Secretariat Irrigation Committee, District Irrigation Committee and National Irrigation Committee.

2002	PRSP	GOSL	Published the Poverty Reduction Strategy Paper (PRSP) including proposed reforms on water sector.
2002	Regaining Sri Lanka	GOSL	PRSP was incorporated into the policy document " future: Regaining Sri Lanka". Water reform policy was not taken for public discussions.
22 nd October 2003	Water Services Reform Bill	GOSL	Presented the " Water Service Reform: A Bill: to privatize pipe borne water supplies in the country in both rural and urban areas and public sewerage services. The Bill refers to drinking water and other sources of water'.
2003 to 2004	Civil action	Supreme Court	Civil Society Organizations and citizens challenged the bill before Supreme Court and a decision against the introduction of the bill was given
August 2004	Basic Policies of Usage, Conservation and Development of Local Water resources (Draft)	Agriculture Livestock, Land and Irrigation Ministry	
September 2004	water Resources Policy (Draft)	Water Resources Secretariat under the Mahaweli and River Basin Development and Rajarata Development Ministry	
22nd November 2004		The cabinet	Decided to amalgamate these two documents and come up with a common one.
24 th November 2004	National Water Resources Policy (Draft)	The special Presidential Task Force	The "common" policy document
21st December 2004		The cabinet	The document was discussed, with the versions in Sinhala and English being significantly different from each other.
January 2005		The cabinet	A four-member Cabinet sub committee was formed to come up with new proposals for a water policy.

January 2005	National Rainwater Policy And Strategies	Ministry of Urban Development and Water Supply.	In the light of increasing operational and maintenance costs to, rationalize investments, both by Government and non Government sectors, in the field of pipe borne water supply, drainage, flood control, soil conversation etc.and promote the practice on a Regional Community and family basis, in order to ensure that the 'City of tomorrow' applies Rain water harvesting broadly, by the control of water near its source, in its pursuance of becoming a 'Green city' in the future.
8th September 2005	Draft National Water Resources Management Policy	Presidential Secretariat	Attempt to reconcile the "Basic Policies of Usage, Conservation and Development of Local Water Resources (Draft)" and National Water Resources Policy (Draft)"
17th November 2005			Presidential election. At the opening of the new Parliamentary sessions, the President declares the need for National Water Policy.
2-12 December 2005	Aid-memoir on the proposed National Water Management Improvement (NAWAM) Project.	Agreement between the Cabinet and the World bank.	US$ 70 M loan from the IDA

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Ⅶ-6 Socialist Republic of Vietnam

Ms. DANG Anh Thu
Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction

COUNTRY REPORT OF VIETNAM
Integrated Water Resource Management Adapting to the Global Climate Change

JICA EXCUTES'S SEMINAR ON PUBLIC
WORKS AND MANAGEMENT
JFY 2007

Prepared by DANG ANH THU
Expert, the Department of Urban Infrastructure
The Ministry of Construction (MOC)

SUMMARY of

"Integrated Water Resource Management Adapting to the Global Climate Change"

The world's freshwater resources are under increasing pressure. Growth in pollution, increased economy activity and improved standards of living lead to increased competition for and conflicts over the limited fresh water resource. A combination of social inequity, economic marginalization and lack of poverty alleviation programmes which often result in negative impacts on water resources. Lack of pollution control measures further degrades water resources.

Populations under water stress: the world population has increased rapidly during the 20th century. It is estimated that currently one third of the world's population that experience medium to high water stress.

The impact of environment: pollution of water is inherently connected with human activities and climate change, flood, disaster... Variations in water flows and groundwater recharge, from climatic change or due to land mismanagement, can add to drought and flood event. Deteriorating water quality caused by pollution influences water downstream, threatens human health and the functioning of aquatic ecosystems so reducing effective availability and increasing competition for water of adequate quality.

The global climate is changing. The average temperature and sea levels are rising and with increasing confidence scientist worldwide predict an increase in extreme weather affecting people worldwide: their live hood assets, infrastructure and ecosystems. With poor people living in disaster prone areas being even more vulnerable to natural disasters if proper disaster coping mechanisms are inadequate or lacking. Vietnam is the one of the most disaster-prone countries in the world. Disaster occurring in Vietnam are mainly related to severe weather conditions. Each year typhoons, floods and droughts cause death, injury, loss of property and infrastructure damage.

Water governance crisis: weak of institutional capacity, shortcomings in the management of water, water resources management is sectoral approaches, this lead to the fragmented and uncoordinated development and management of the resource.

Although in the most countries give first priority for water supply needs, but water shortages, quality deterioration and flood impacts are among the problems that require greater attention and action. The main challenges that faced more and more countries are increasingly related to water: safe drinking water for people; security water for food production; ecosystem protection; variability of resources water in

time and space, the effect of global climate change may add further to this challenge; risks management, popular awareness and understanding; IWRM across sectors and boundaries...

By the end of February 2006, discussion papers that present the findings of literature reviews on international best practices in environmental stainability spects of IWRM and describe the current status in Vietnam were received from key ministries of Vietnam namely; Ministry of Fishery, Ministry of Agriculture and Rural Development, Government's Office, Electricity of Vietnam, and the Ministry of Natural Resources and Environment.

Integrated water resources management is a process which can assist to deal with water issues in a cost-effective and sustainable way.

1. Organization Data

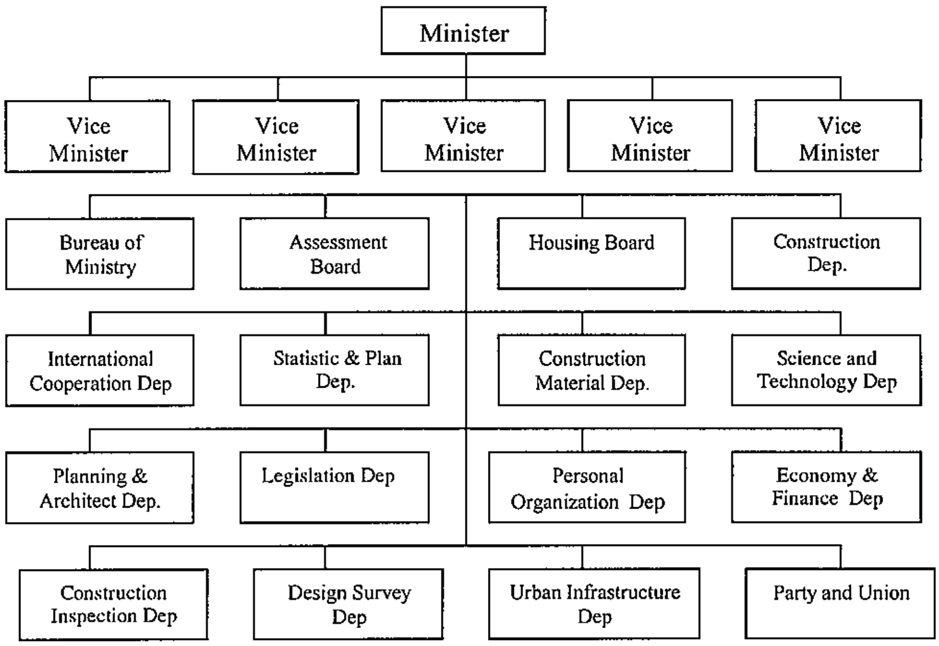
(1) Name of Organization: The Department of Urban Technical Infrastructure, Ministry of Construction (MOC),

(2) Summary of Organization

Ministry of Construction has responsible for state management related to:

- Construction;
- Urban development;
- Housing;
- Architecture;
- Urban technical Infrastructure;
- And related public services

(3) Organization Chart



(4) Organization's position in Government

The Urban technical infrastructure department (UID) is government agency help the Minister implement State management in the urban infrastructure field including: pavements, urban roads, water supply, waste water, parks and trees, urban solid waste, burial-ground, car-parking and other urban infrastructure services in accordance with law.

The UID has the following tasks and power:

- Study mechanisms and policies for submission to the Prime Minister to issue or for authorized issuance;
- Develop programs/plans in national level for submission to the Prime Minister for issuance;

and implement these programs/plans.

- Issue technical-economic regulations/standards/norms.
- Provide guidance, instruction and monitoring of activities related sectors in the urban technical infrastructure field.

2. Personal data

(1) Recent Work

I have responsible for tasks as following:

Researching, proposing, editing: policies, orientations, strategies, planning, schemes, project program, legal and instruction documents on urban infrastructure.

Appraisal mission for plan projects, construction investment projects on the urban infrastructure.

Guideline, supervising, controlling of ODA infrastructural projects: Center Urban environment improvement Project (ADB); Urban Upgrading Programe (WB), VietNam Urban Water Supply Project (WB)... are on going, Mekong deltal water supply investment program is also preparing. Examine and review construction planning projects, construction invesment projects in the field of urban infrastructure

Taking part in to execution and research on themes about infrastructure field, draft of the regulation base such as Water Supply Management Decree, Urban and Industry Sewerage System Management Decree.

Cooperate with relevant agencies and organisations and locolities to perform the state management function with regard to urban infrastructure.

(2) Contact Address

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E-mail: danganhthu@moc.gov.com

3. Integrated Water Resource

(1) Current Situation and problems

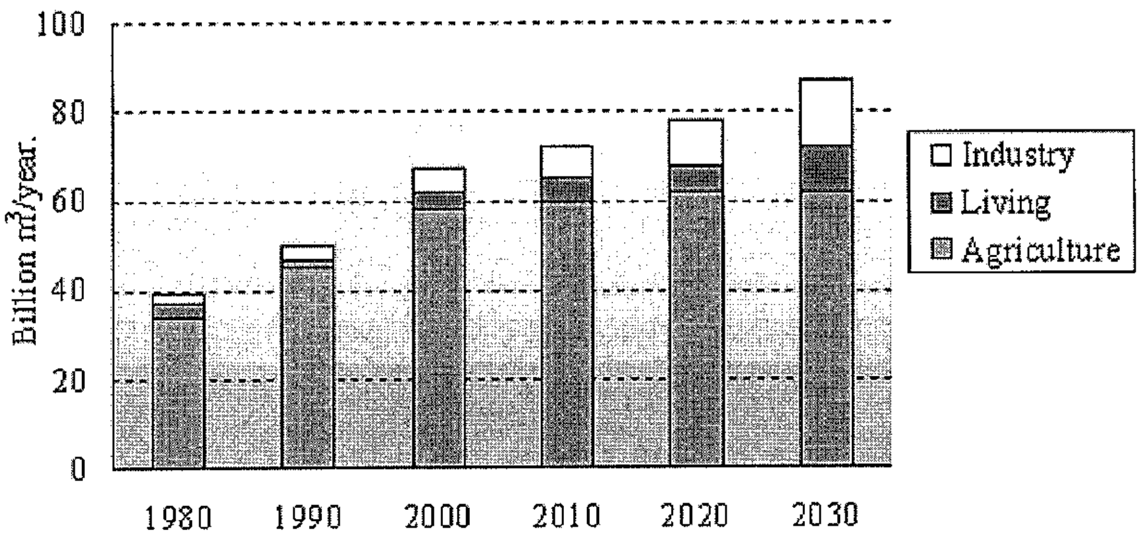
Total area of Vietnam is 331,690 km^2 including eight special zones as Red river delta, North East, North West, North Central Coast, South Central Coast, Central Highlands, North East South, Mekong River Delta. The administrative land is divided into 64 provinces and cities. Land use for cultivation, forestry, residential area and industrial account of 57.9% total reservation land.

The total of urban is 718 in which 2 special capitals (over 1.5 mill. Peoples), 4 cities range in first class (over 0.5 mill. peoples), 13 cities range in second class (over 0.25 mill. peoples), 23 urban is third class (over 0.1 mill. peoples), 54 urban range in fourth class (over 0.05 mill. peoples), 622 towns are fifth class (over 4,000 peoples). Total population is more than 83 million people (census data on 1st Apr 2005), in which 26.8% (73.2% living in rural area) is urban habitant and accounting of 22 mill peoples. Forest of Vietnam accounted of 27% total country land area with about 9.6 mill. ha. Most is secondary forest; primitive forest exists until now is not much. The average wood capacity of Vietnam forest is about $53m^2$/ha. Total reservation land for cultivation in Vietnam is about 10 – 11 mill. ha.

Vietnam is located in both a tropical and a temperate zone. It is characterized by strong monsoon influences, but has a considerable amount of sun, a high rate of rainfall, and high humidity. Regions located near the tropics and in the mountainous regions are endowed with a temperate climate. The climate in Vietnam always changes in one year, between the years, or between the areas from North to South and from low to high). The climate in Vietnam is also under disadvantage of weather, such as typhoons (advantage there are 6-10 storms and tropical low atmosphere in year), floods and droughts are threaten the life and the agriculture of Vietnam.)

Every year there are 100 rainy days and the average rainfall is 1,500 to 2,000mm. The humidity ranges around 80%. The sunny hours are 1,500 to 2,000 and the average solar radiation of 100 kcal/cm^2 in a year. The monsoon climate also influences to the changes of the tropical humidity.

Design capacity for water supply in Vietnam is 4.6 million m^3/day; actual exploitation capacity is 2.9 million m^3/day.



- **Present water coverage**

The type of available water resources and those situations: 60% of total water supply capacity in Vietnam is taken form surface water source, remaining is taken form the underground water source.

- In 2002, only about half the urban residents had regular access to piped water that meets national standards.
- In 2004, 61% of urban residents had access to treated piped water that meets national standards.

The country's many canals and waterways have become dumping sites for domestic and industrial waste. In addition to an increasing population and severe water contamination, deforestation, and natural calamities like forest fires, floods and droughts affect the water supply availability

- **Severe Contamination:**
  - Natural disasters
  - Ignorance
  - Expensive to treat water waste before discharging
  - Weak policies enforcements
- **Poor Infrastructure:**
  - Access to water and sanitation limited

Water resources in Vietnam:

Surface water

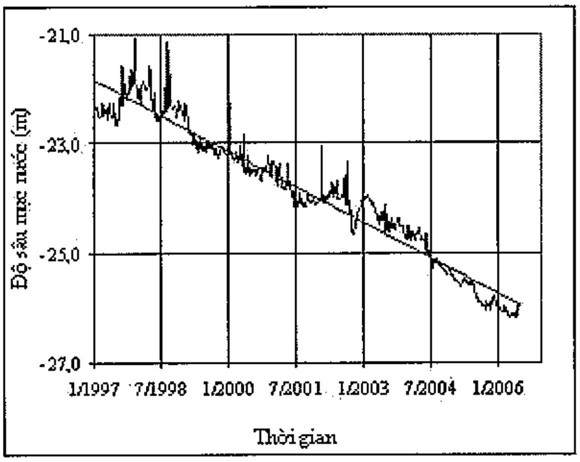
Surface water volume estimated for water supply is about 8 km^3 for 80 million peoples. In General, national surface water of Vietnam is good and save for many demand of economical fields and living supply. However, Water River is salinity at the estuary caused by tide. Salinity of river water goes down and up belonging to the tide regulation, changing by season. At the North delta, maximum salinity occurs in July - August. In Mekong delta on dry season, salinity water enters more 100km towards upstream in 2004. Latest news (3/2005) salinity water was penetrated to Sai Gon and Dong Nai river, far from Thu Duc water treatment plant about 10 Km. Salinity concentration of Dong Nai river is 10% and Sai Gon river is 7.7% comparing to the same value in 2003 respectively is 4.6% to 6.1%.

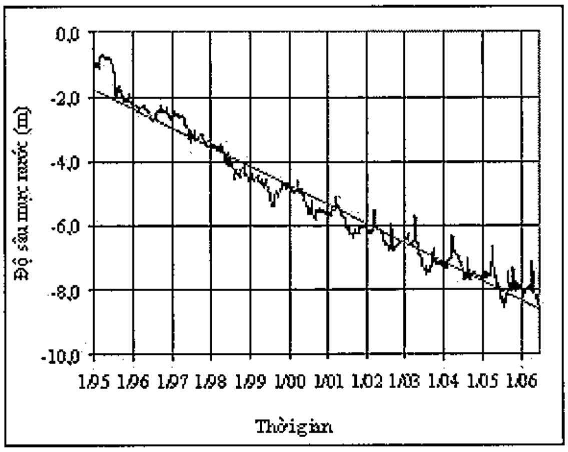
Beside of that, the reasons of irregular development for industry, agriculture, urban centralization, population growth, high water consumption demand and high wastewater those are day by day directly impact to the water environment. For instance in Ha Noi: water from To Lich river, Kim Nguu river and so on is very duty, dark water color, bad smell, dissolved oxygen (DO) is low, sometime it equals to), BOD5 is higher than 50mg/l, NH_4^+ is over 10mg/l, NO_2^- also high, H2S is approximately 30mg/l. In Ho Chi Minh city has the same condition such as COD: 596 mg/l, BOD5: 184.5mg/l. DO equals to 0.

Underground water:

Base on the estimation of the Institute for Water Resource Research and Planning, WB, UNDP show that the existing capacity of the underground water is 48 billion m3/year (equal to 131.5 million m^3/day). However, the average usage at this time per year is 1 bill. m3 for whole the country.

The average water level is decreased year by year (see diagram below)





For instance: In Tra Vinh province, statistical date in 2001, land surface level in this area is down from 2 to 2.5m; the reason is existing of more than 42.000 wells supplying water for farm and aquatic product. In Ca Mau province, base on the UNDP's investigation, water level was down from 3m in 1995 to 11m in 2003. Same condition in Ha Noi where the water supply source is mainly underground water, water level in somewhere is more 30 m deep, and appearing sign of organic pollution, specially is arsenic (Giang Vo area, arsenic concentration is higher 50 times of permitted standard).

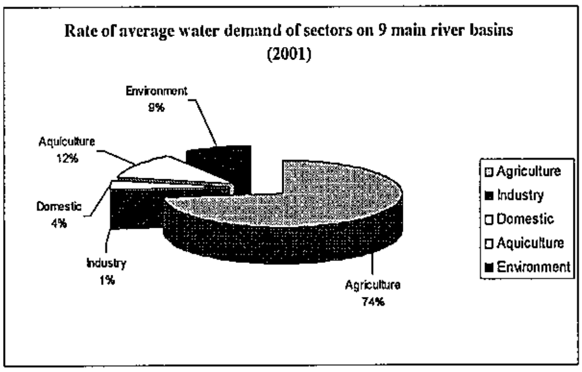
Water quality assessment for the underground water source for mountainous and midland is good, serving enough for domestic use. However, some unit are containing high ferrite concentration, hardness, carbonic erosion so that it does not convenient for some industrial sectors, necessity to treat before using. In Northern and Southern delta, water quality changes difficultly due to come between fresh water and salinity water on larger area and depth. Some cultivation land where using fertilize, pesticide and some high density of industry, water is polluted with the different level results in quality degradation.

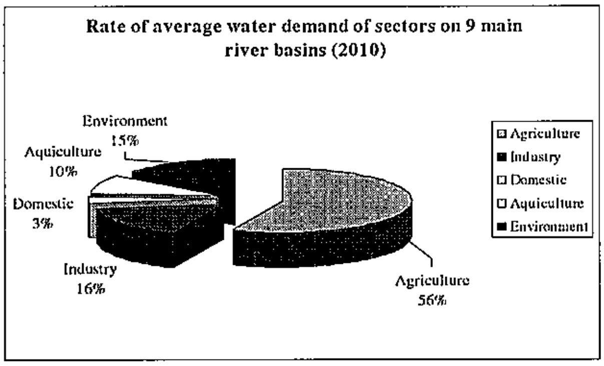
River Basins

There are bout 2,378 rivers (with length longer than 10 km) in which the main river are Mekong, Red, Dong Nai, Ma, Cau, Ky Cung, Thai Binh and Thu Bon, those rivers have basin per each is over 10,000 km^2, biggest basin is Mekong river with about 71,000 km^2.

The Mekong River's total runoff accounts for 59% of the total national runoff, followed by the Red River with 14.9%. Total water volume that the rivers can bring is about 790km^3. Quality of river water in Vietnam is soft water type (200 mg/l mineral content).

The density of Water Utilization of 9 major river basins in Viet Nam





- **Some of major issues**

Weak policies

- No consultation and coordination between agencies
- Lack of strategies on managing and protecting water environment
- Lack of manpower (overloaded with work)
- Standards of water quality not clear, not comparable to international standards
- Wastewater treatment technologies are weak and backward
- Public awareness are insufficient, given inadequate attention

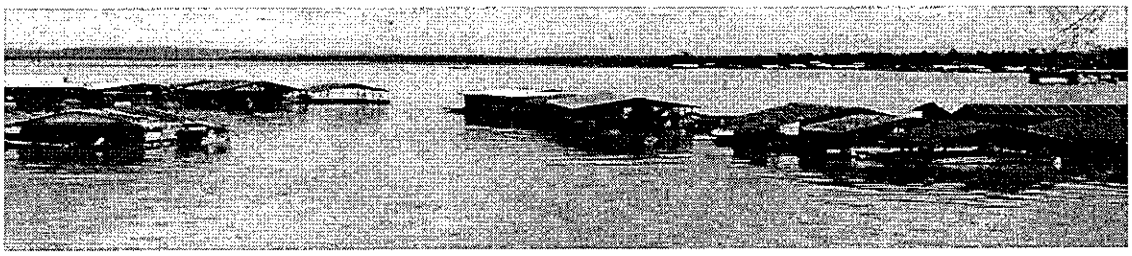
Challenges and issues

- There are still many shortcomings in terms of planning, management, utilization and protection of water resources in comparison with country development needs

- A number of water-related challenges have increased in recent times, water quality is deteriorating in many areas due to urban and industrial activities and saline water intrusion is increasing as dry season river flows are reduced, local and seasonal shortages are increasing, causing impacts on water users and environment.

- Population increasing and Industrialization

- The capacity to develop strong policy and legislation is limited.
- Some overlap of responsibilities among Government' Agencies.
- Lack of integrated river basin planning and management
- Low Institutional and capacity
- Ineffective in Inspection and enforcement and conflict resolution activities.
- Water resources data and information is still scatted, Monitoring networks are insufficient, data quality is not high
- Level of awareness, skills and technology for integrated water resources management fairly low at both the national and provincial level.
- Budget for water resources development and management is limited and has not met the demand of the sector.
- Lack of long term financial strategy including state budget, international assistance, private investment and using fees.



This isn't flooding, the houses are built over this lake.

(2) Research and survey

Case study of Tien Giang

Half of the land area of Tien Giang Province in Vietnam is exposed to annual floods and the other half to saline intrusion. Traditional sources of domestic water - rivers, canals and ponds - are naturally polluted by alluvium acidity and salinity, and also by human/animal excreta and other wastes. Water related diseases have been very serious in the Province.

Tien Giang rural residents were inspired to develop their own water sources when they saw how UNICEF supported the drilling of wells to supply fresh and clean water to communities. They followed this example and dug individual wells, but without any resources planning. The first real impact was disastrous. The water quality from the shallow wells was so bad that the water was undrinkable. The wells were abandoned and their assets lost. A more serious impact was encountered when these abandoned wells were not closed properly, resulting in aquifer deterioration that affected a widespread area. The limited national and provincial budgets prevented rehabilitation and support to these areas.

The formulation of the National RWSS Strategy (in 1998) provided a good opportunity for the Province to effect changes. Within the wider context of all economic activities, the affected communities were made aware of methods and approaches in harvesting water and well drilling that are cost effective and sustainable in their development. After three years, Tien Giang Province manages both surface and groundwater resources, ensuring water supply for 50% of rural population (nationwide proportion access to potable water is about 35%). The Province and the communities worked through self-help, without any external support. Key components of the strategy included:

- A participatory approach, throughout project planning and implementation
- Technical support from the provincial government
- Appropriate financial policies for poor and difficult areas
- Establishment of water user groups, with the legal entity to hold, manage and operate facilities.
- Training and educating for water user groups so that they have enough ability to make plans, choose technology, manage the water resources and the environment.

Lessons learned

- RWSS is considered as a useful point of departure for poverty elimination and rural development, and achievements from RWSS help to motivate other social efforts.
- Information, education and communication (IEC) activities are very important to all levels including communities, local authorities, technical and credit agencies.
- Water resources for RWSS are of small quantity and dispersed in nature, and mainly related to groundwater, the monitoring of which is still very weak. Therefore this development must be integrated within integrated regional and basin planning, thus avoiding negative impacts to water resources and the environment.

Importance of case for IWRM

- The case shows how good planning leads to efficient use of water resources, and the integrated approach has led to a harmonious and equitable share of economic and social benefits among communities: all people have clean water for use and improved their life quality by their own contribution.
- The management of sanitation, domestic waste and rural waste production has contributed to good water quality and preservation of eco-systems.

(3) Policy and Practices

- ***Targeted Coverage***
  - Water coverage: 85% for rural population (60 liter/day) and 95% for urban population (150 liter/day) by the year 2010
  - Sanitation coverage: 70% by 2010
  - Irrigation systems upgrades: 1 billion US$ (2006-2010)
  - Introduction of water resources management into river basins integrated water

resources management in river basin

- ***Enabling condition***

Law: Vietnam's Law on Water Resources and Related Legislation for Implementation of IWRM

In January 1999, Viet Nam enacted its first national Law on Water Resources. This is a major development of existing legislation and establishes an enabling environment for managing Viet Nam's water resources. The Law is up-to-date in the issues it addresses, dynamic in its approach, and practical. In December 1999, an Implementation Decree was issued by the government which specified that River Basin Planning Management Organizations be established in the Red River and Mekong River Basins (the Dong Nai River Basin has been added to this list). The Decree also specified the functions of a national apex council to help manage water resources. The National Water Resources Council advises Government on certain issues of water governance including national and international water policies. Additionally, the National Water Resources Council is responsible for settling water disputes among national-level government agencies and among provinces and cities.

Specific issues that the Law addresses are:

- Water rights.

- Responsibilities of users to protect the water resource and to prevent and overcome any harmful effects of water.

- The right to benefit from the use of water resources.

- The development of water resources in areas with difficult socio-economic conditions.

- The development of a fee-based permit system for wastewater discharge.

The Law recognises that water is an essential element of life. The Law and Implementation Decree offer a comprehensive base for water management which reflect the numerous issues identified as crucial by both the government and international agencies. Such issues include environmental protection, management from a river basin perspective, and co-operation in international river management. These ideas are embodied in the concept of integrated water resources management (IWRM).

Strategy

- The orientation for urban water supply development until 2020 (18 March 1998): 100% of the urban population using drinking water with the consumption level from 120 to 150 lpcd; branch renovation; technological modernization; fund mobilization from every economical components.

- Comprehensive poverty reduction and growth strategy: 80% of the urban population using fresh water with 50 lpcd until 2005.

- Vietnam millennium development goals: 80% of the urban population using fresh and save water until 2005.

- Environment strategy: until 2010: 95% of the urban have drinking water.

Current policies

- Priority to use the ODA fund for water supply development
- Priority to borrow national credit fund for water supply investment projects
- Grant for training and technology development
- Capital interest assistance after investment
- Assistance for building structures located outside of the fence

Specific policy:

- Highest legal document until now is decree No 117/ND-CP dated on 17 July 2007 from State about "Urban Water Supply Management"
- Decree for guiding the implementation of the law of water resources structure exploitation and management
- Decree on administrative penalty in water resources sector
- Regulations on procedure for licensing exploitation and utilization of water resources (surface and ground water) and wastewater release water release to water resources
- Direction from Prime Minister No.04/2004/CT-TTg dated on 20 Jan 2004 mentioning about "Enhancement for water supply and consumption management".
- "Renovation program for organization model and management institutional for enterprise who participating in water supply sector" composed by MOC and Prime Minister has been approved this program.

In term of policies, according to the legal documentary programmer in every year, Ministry of Construction in general and the Urban Technical Infrastructure Department - Ministry of Construction in particular is assigned to study, draft and compose a water supply, wastewater, solid waste management and underground construction works decrees. Those decrees are policy documents that provide a solid framework to guide sub-sector management for improving urban development.

• *Vision and concrete action*

- Developing National Strategy for Protection and Sustainable Development of Water Resources of which the National Goals for Water Resources is one of the leading component of the National Strategy.
- Inventory appraisal for Water resource
- Review and update the Law on Water Resources other By-law to create legal corridor for water resources management.
- Priority policy in the water sector
- Developing and upgrading water Resources monitoring network
- Integrated river basins planning and Management,

- Long term financial investment strategy

- Information exchange network among the water resources coordination and management agencies for international rivers.

- Water resources information system and provide timely and accurate information for the water resources users.

- Effective operation of water resources inspection.

- The type of water resources for the future

Orientation of water resource usage for the future is surface water; underground water will be kept as a national storage water source.

- ***Planned investment over next 5 years (2006-2010):***

Planning and management mechanism, technology development, human resources development, upgrading and modernizing water resources structures, multifunction reservoirs, water supply and sanitation, water resources protection, small case water resources development in mountainous area, water supply for Mekong Delta, natural disaster mitigation.

VIII LECTURE NOTES

Ⅷ-1 Water-related disaster management for adaptation to climate change

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Water-related Disaster Management for Adaptation to Climate Change

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Abstract

Climate change is not a matter of future but of now. Human being is experiencing more frequent and more intensified hydro-meteorological extremes all over the world. The consequences are especially tragic in developing countries where infrastructure construction and management capacity development are behind. Disasters ruin development efforts.

There is no magic solution. But a mere continuation of the current exercise is not allowed and a major paradigm shift is necessary. Human has to reconstruct our way of living with nature. The combination between structural and non-structural means under the concept of integrated water resources management (IWRM) is necessary. Although there are various strong trials, it is not an easy matter at all. It is absolutely necessary to mainstream the water-related disaster management in decision making at all levels from the national government to localities.

Climate change is definitely the major agenda of the 21st century. There are some examples already emerging for adaptation to climate change especially against sea level rise. The paper reviews the recent reports by OECD, IPCC and River Bureau of Japan and shows some efforts that support the new way of living with floods that have been exercised by ICHARM such as global flood alert system, flood hazard mapping, capacity building etc. ICHARM calls for an alliance for localism to work together to solve real problems of the people.

1. Introduction

This year again, many flood disasters have taken place in the world. The heavy rain and floods that hit southeastern China, most notably the basin of Huai River, from June to August caused tremendous damage in various regions, including the loss of nearly 1,300 lives as reported. The continuous rain in the UK from June to July was unusually heavy for this country, recording a daily rainfall exceeding 100 mm at many locations and affecting more than one million people. The damage covered by insurance was reported 2 billion pounds (approximately 500 billion yen). The floods that struck Nepal, India, and Bangladesh from July to August reportedly caused 2,200 deaths and more than 30 million refugees in total. North Korea announced that the rain from August 7 to 15 left more than 600 persons dead or missing. Serious flood disasters also took place in Pakistan, Texas, and elsewhere, and several category 5 cyclones developed in various regions. On the other hand, many areas in Europe experienced high temperatures exceeding 45℃ this year, following the extraordinary heat wave in 2003. No less than 500 persons reportedly died from heatstroke in Hungary alone. Australia is experiencing an unprecedented spell of drought that has been continuing for 5 years since 2003. In particular, the year 2006 was declared as the year of drought that would occur once in a millennium. In Japan, a temperature of 40.9℃ was recorded in Tajimi and Kumagaya on August 16, breaking the past record of 40.8℃ in Yamagata 74 years ago. The situation is obviously abnormal. The effect of climate change has become a real and tangible problem.

From June 5 to 7, 2007, the Global Platform for Disaster Risk Reduction was held at Geneva International Conference Center organized by UN/ISDR. Nearly 1,000 participants, including representatives from various countries, international organizations, and NGOs, filled the conference venue on the opening day. During the opening session, John Holmes, UN Under-Secretary-General for Humanitarian Affairs, spoke as the Chairman of the Platform and explained the central theme of this conference, emphasizing that global warming is no longer a problem of the future but of the present. As he remarked, the climate change has already caused a dramatic increase in the occurrence of meteorological disasters, and the damage from such disasters is escalating all over the world. We have no time to waste. The need for the adaptation to climate change has become extremely urgent.

This conference was the first of the biennial events held as the follow-up to the Hyogo Framework for Action (HFA) in 2005. In response to the 4th IPCC report, published in February, many speakers argued that any efforts to reduce greenhouse gas emission would not be effective in arresting the expansion of climate change in the foreseeable future, and extreme meteorological events would continue to expand. Water-related disasters, which already represent 80% of all natural disasters at the present, would become even more serious. To cope with this situation, the conference repeatedly stressed that the adaptation to climate change must be positioned in the mainstream of national policies of all countries. While the conference called for a paradigm shift toward disaster risk reduction (DDR) under the slogan of "Mainstreaming DDR," the interest of many speakers were focused on the issues of meteorological disasters, in particular the adaptation to climate change.

In June, the leaders at the G8 summit in Heiligendamm agreed to seriously consider the proposal of EU, Canada, and Japan, including the halving of global emissions by 2050. This was an epoch-making decision, expected to have immeasurable impacts on society. Because global warming becomes a real problem when disasters resulting from it get out of control, it is sure that the political interest in the issue of CO_2 reduction will soon translate into the issue of the adaptation to climate change.

What each country needs to do? This will be the main issue in the Lake Toya G8 summit in 2009.

This article reviews the adaptation options implemented in various countries, discusses the necessary future directions of water-related disaster prevention, and considers what should be the basic stance of each coountry.

2. Water Disasters on the Increase

2.1 Water Disasters in Statistical Figures

CRED EM-DAT, operated by the Catholic University of Louvain, Belgium, is virtually the only international database on natural disasters available for statistical analyses. This database is the collection of information on natural disasters occurring in and after 1900 and fulfilling at least one of the following criteria: 10 or more people

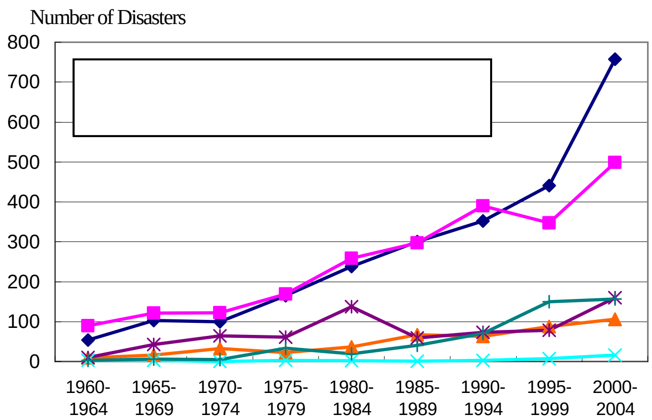

Fig. 1.1 Trend in the Occurrence of Water-related Disasters in the World (1960-2004)
Floods and storm disasters are increasing rapidly.

reported killed, 100 people reported affected, declaration of a state of emergency, or call for international assistance (http://www.em-dat.net/index.htm). However, the accuracy of this database is questionable, and some believe that NatCat, compiled by Munich Re, a reinsurance company underwriting disaster insurance, is more accurate. NatCat is, however, closed to the public and made available only in the form of reports. It is the data in EM-DAT that provides basic input for the making of most strategic plans all over the world.

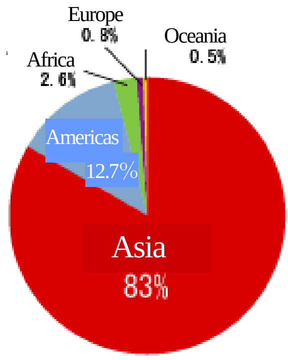

Fig. 1.2 Distribution of Deaths from Water-related Disasters by Continent (1980-2006)
The number in Asia is overwhelmingly large.

Fig. 1.1 shows the number of natural disasters in the period frc M-DAT (Merabtene and Yoshitani, 2005). The rapid increase in the number of floods and storms is remarkable. While the recent expansion of mass media coverage may be contributing to the increased number of reported disasters, these figures certainly reflect the actual occurrence of hazardous events.

Landslide and storm surge disasters are few in terms of the number of incidences. Earthquakes and droughts are also few, though the amount of damage is large. Meteorological disasters (flood, storm, landslide, debris flow, drought, storm surge, and tsunami) represent 75% of the total amount of damage.

Fig. 1.2 shows the pie chart of the number of disaster deaths in the period from 1980 to 2006 by continent. Deaths in Asia represent 83% of the total. While the share of Asia in the number of disasters is about 40%, the concentration of fatalities in Asia is overwhelming. It is partly true that there are many deaths in Asia because 60% of the world's population lives there, but the high figure in Asia is out of proportion.

2.2 Climate Change is not the Principal Cause of Increase in Water Disasters

Disaster risk is often expressed by the following formula (Davis, 1978):

Disaster Risk (R) = Hazard (H) x Vulnerability (V)

This says that the risk of disasters occurs in the intersection of the external hazardous forces and the vulnerability to disasters, and the magnitude of risk is the product of hazard and vulnerability. In the case of natural disasters, hazard is the violent forces of nature and vulnerability is the characteristic of human society. In some analyses, the vulnerability of community is further broken down to the basic coping capacity of society, including economy, organizational structure, education as well as the efforts in developing disaster prevention infrastructure and emergency preparedness. Such approaches are expressed in the following forms:

Natural Disaster Risk (R) = Natural Hazard (H) x Societal Vulnerability (V) / Coping Capacity (C)

Natural Disaster Risk (R) = Natural Hazard (H) x Societal Vulnerability (V) x Exposure (E)

The former is the one advocated and practiced by the International Federation of Red Cross and Red Crescent Societies. Here, coping capacity means disaster prevention infrastructure and preparedness. The latter is proposed by Associated Program on Flood Management (APFM) of WMO. In contrary to the above, exposure refers to the people and assets that are left exposed in places lacking sufficient disaster prevention infrastructure and preparedness to cope with disasters. These are the people and assets that are not protected by strong buildings, embankments, or reservoirs. These modified expressions reflect the endeavor to clarify quantitative evaluation of the effectiveness of disaster prevention infrastructure. However, there are difficulties in the handling of dilemmas, such as that the presence of disaster prevention infrastructure may cause overconfidence and result in larger damage in the case of unexpectedly severe hazards.

As clearly shown in this analysis, the magnitude of natural disasters is determined by the product of the hazardous forces of nature and the vulnerability of society. Earthquakes and volcanic eruptions do not seem to be increasing in the long view, but the damage from such disasters is increasing. This trend reflects the increase in the vulnerability of society resulting from such factors as population growth, expansion of poverty, urbanization, and economic development. On the other hand, meteorological disasters are aggravating because of the intensification of meteorological phenomena in addition to the disaster vulnerability of society. Water-related disasters are getting severer as a result of the increase in the forces of nature and the increase in the vulnerability of society.

However, how large is the contribution of climate change in the increase in disasters shown in Fig. 1.1? It actually is fairly small. An overwhelmingly large part of this increase is caused by the increase in the disaster vulnerability of society. With urbanization, industrialization, and other changes, communities are experiencing a rise in population density, concentration of economic assets, a shift to more and more artificial lifestyle, development of economic activities, and land development in sloped areas and low-lying wetland. As a result, the probability of damage and the density of damage (damage potential) once extreme events hit the area, i.e., disaster vulnerability, are increasing year by year. The aging of inhabitants, the disruption of the inheritance of disaster experience resulting from mobilization of inhabitants, the weakening of community solidarity, etc. are also contributing to the increase. The intensification of meteorological phenomena resulting from climate change is a factor amplifying the severity of actual water-related disasters, but it is not the principal factor at the present.

In this respect, an interesting research was presented at IPCC WGII (2007). According to the case study in the US conducted by Choi and Fisher (2003), 82% of damage from disasters is explained by population density and the density of economic activities. The magnitude of hazard is responsible for only 7% of damage. This clearly indicates that the effect of disasters is determined primarily by the exposure of people and assets to natural phenomena. The best way to avoid disaster is to displace population and activities from disaster-prone areas.

2.3 Developing Countries and Developed Countries

Disasters hit weaker people harder. In addition to senior citizens, infants, sick persons, and physically handicapped persons, women are counted among vulnerable groups in many areas. In particular, women in some developing countries where gender discrimination remains often hesitate to evacuate because of the forced responsibility to keep their homes and the fear for the harsh living conditions in refuges, including the risk of being raped. Not a few women actually become victim to crimes in refuges. A further vulnerable group is the poor, and the people in many developing countries where the nations themselves are poor. People in poverty live in dangerous areas without disaster prevention measures. They have only limited access to disaster information such as forecasts, and lack sufficient resilience to disasters. Developing countries with many poor people cannot afford to develop the capacity to overcome vulnerability, such as the construction of disaster prevention infrastructure, development of preparedness, and disaster education.

The true causes of disasters in developing countries are poverty and poor governance. Because they are poor, they cannot invest in infrastructure, preparedness, or disaster education. Because the poor majority cannot afford to choose where they live in what types of residence, they live in disaster-prone areas unprotected and suffer great damage whenever hit by a disaster. They have fallen into a vicious cycle, where they cannot prevent disasters and a large part of their hard-earned economic growth is lost to disasters. Although development and growth can help people get rid of poverty, there is a factor impeding this. It is governance. People lack the self-governing ability, which is the ability to autonomously govern a state, city, or community and join forces toward the achievement of goals. While poverty is inseparable from this situation, social order has not been established sufficiently, due to local culture and customs, as well as the lack of education opportunities. As a result, reliability is not ensured when a precise and reliable system of responsibility is needed in various aspects from the accurate measurement and transmission of rainfall and river flow data to the direction and guiding of people in emergencies. Many organizations lack the basic mechanism for fair, impartial, and efficient development, as signified by the habits of bribery and kickbacks in the execution of budgets and selection of venders. Official development assistance (ODA) is also often spoiled by a culture of extortion, undermining the ability to achieve expected results.

On the other hand, problems in developed countries include the soaring of the amount of economic damage, the need for an enormous amount of fund for mitigation, and the difficulty in forming social agreement regarding the selection and execution of plans. It is extremely difficult to maintain or expand the investment in water management as has been conducted in the past. For this reason, it is clear that we need to make a shift toward water disaster management focusing on harmonious coexistence with nature, including the coexistence with floods, but we face a difficulty in finding an acceptable combination of land use and disaster prevention measures. The threat of large-scale meteorological disasters is expected to grow, and the need for measures against such disasters is well recognized, including those regarding the maintenance of economic activities and citizens' living and the relief for socially weak people. However, it is also extremely difficult to achieve an agreement regarding the choice of solutions. The central themes are the restoration of nature in dams and rivers and the restriction on land use. In considering this situation, we need to be aware that the populations in developed countries are not only aged but also have turned from stabilization to decrease. In a sense, this situation may be regarded as an ideal opportunity for the reconstruction of a coexisting relationship between humans and nature.

3. What Should Be the Adaptation Options

In this situation, we consider what should be the measures for adaptation to global warming. Adaptation options must be consistent with mitigation measures at the roots. In addition, this can be achieved only through the construction of a sustainable society based on scientific means and strategies. This basic principle is common to developed countries and developing countries. However, no adaptation options clearly following this principle have been implemented yet. Discussions are made almost exclusively in developed countries. As a starting point, we review in the following the specific adaptation options described in the reports of OECD and IPCC, as well as the strategy adopted by River Bureau of Japan.

3.1 Adaptation Options in Various Countries

OECD Report

The OECD report "Progress on Adaptation to Climate Change in Developed Countries" (Gagnon-Lebrun and Agrawala, 2006) presents the result of analysis on activities for adaptation to climate change in various countries based on the review of National Communications (Nos. 1-3), which member countries must submit regularly, and other material. The study was conducted by the Organization for Economic Cooperation and Development (OECD) in 2005-2006, covering 30 OECD member countries and 41 UNFCCC member countries, totaling to 43 countries (mostly consisting of developed countries and former USSR countries).

This report points out that the interest in the effect of global warming and measures for adaptation to it is limited as compared with the political discussion on greenhouse gas reduction. Only very few countries reported the implementation of specific adaptation options. The following lists some of concrete examples described in the report. Many of these are measures against sea-level rise.

- In New Jersey, where relative sea level is rising approximately one inch (2.5 cm) every six years, $15 million is now set aside each year for shore protection, and the state discourages construction that would later require sea walls.
- Maine, Rhode Island, South Carolina, and Massachusetts have implemented various forms of “rolling easement” policies to ensure that wetlands and beaches can migrate inland as sea level rises, and that coastal landowners and conservation agencies can purchase the required easements.
- A 2001 assessment concluded that the water supply of New York City is vulnerable to changes in climate parameters – such as temperature and precipitation, as well as sea-level rise and extreme events. On the basis of this assessment, the New York City Department of Environmental Protection initiated work to identify adaptation options, including the tightening of drought regulations, the construction of floodwalls around low-lying wastewater treatment plants, and the integration of the New York City system with other regional systems to alleviate the impacts of temporary disruption in some facilities as a result of inland flooding or of variations in water supply.
- A new sewage treatment plant was built in 1998 by the Massachusetts Water Resource Authority on Deer Island within Boston Harbor. Expecting future sea-level rise, this plant was sited at a level higher than the original plan by 1 m. While the short term costs of pumping untreated sewage up to the plant would have been lower had the plant been built at lower level, engineers attached more importance to the need for future construction of a protective wall and the cost of carrying water over the wall.

Fig. 2.1 Maeslantkering Storm Surge Barrier near Rotterdam, the Netherlands. Completed in June 1997

- The Thames Barrier was originally built over a 30-year period, following the 1953 storm surge in the North Sea, to protect London. While even the original design complied with high standards (generally one-in-a-1000-year flooding event), it did not explicitly take climate change into account at that time. The combination of rising sea level, due to climate change, and rapid housing development within the tidal flood plain is expected to increase the flood risk; it is estimated that by the year 2030 modifications to the barrier will be required. A Flood Risk Management Plan is therefore currently being developed to protect London and the Thames Estuary for the next 100 years. A multi-faceted study of adaptation options is currently underway and is assessing, among others, a) 337 kilometers of coastal defenses (including nine major flood control barriers); b) the evolution of the socioeconomic context throughout the Thames estuary; and c) the influence of political and other drivers on the choice of specific options.

- In the Netherlands, the Flooding Defense Act came into force in 1996. This act mentions, the safety standards for all water defenses varying from one in 10,000 to one in 1250 years (Note by author: The former applies to coasts, the latter to rivers). Every five years the Minister has to determine the decisive water levels matching to these frequencies. Since these decisive levels will determine the height of the embankments, the most recent knowledge on climate change can be incorporated every 5 years into the design of the flood defense.
- In 1995, the Technical Advisory Committee on Water Defense has recommended reserving space in the dune area to guarantee safety for the next 200 years, with a worst-case scenario of 85 cm sea-level rise and a 10% per century increase in storms.
- In the Netherlands, the design of (unavoidable) new engineering works with a long lifetime, like storm surge barriers and dams, will incorporate an expected sea-level rise of 50 cm. The first structure of this kind is the storm surge barrier near Rotterdam (Fig. 2.1), which opened in 1997.
- South Australian Government planning principles now require that coastal developments be safe for a 30-centimeter rise in sea level, or one meter in special circumstances. Developments must also be safe for, or capable of being protected against, 100 years of coastal erosion, with allowance made for the erosion resulting from a sea level rise of 30 centimeters.
- In New South Wales, the National Parks and Wildlife Service has developed a biodiversity strategy that recognizes the potential role of environmentally managed ‘corridors’ in enabling species migration in response to climate change.
- The Confederation Bridge in Canada (linking New Brunswick and Prince Edward Island) was completed in 1997. To accommodate for the potential sea-level rise over the 100-year lifespan, the vertical clearance planned to allow for the navigation of ocean-going vessels has been increased by one meter (Fig. 2.2).

Fig. 2.2 Confederation Bridge in Canada. Completed in May 1997. Length 12.9km, 60 m high navigation span (including 1 m allowance for sea-level rise).

Although few in number, these adaptation options testify that concrete actions to cope with sea-level rise has begun. If the problem of speed is set aside, sea-level rise is a simple issue and its impact and needed countermeasures are relatively obvious. Governments are tackling this problem based on the political judgment that they should begin with what they can. In contrast, the impact of global warming on floods and debris flow has not been clarified quantitatively. Many problems remain in the field of these disasters, and goals have not been achieved. Governments must first endeavor to solve the present problems. The impact of global warming is a burden imposed in addition to present problems.

Japan described no adaptation options in the National Communications to OECD. The only countries that did not mention adaptation options other than Japan were Slovenia, Estonia, Lithuania, and Mexico.

IPCC2007 WGII Report

Similar endeavors are also described in the report of IPCC 2007 WGII (Parry et al. eds., 2007), but there are few concrete descriptions. The following is the excerpt from Chapter 3 "Freshwater Resources and Their Management."

- The Metropolitan Water District of Southern California recently concluded a 35-year option contract (under which a buyer has a right to buy products on his/her will, and a seller has to sell products according to the buyer's need) with Palo Verde Irrigation District. Under the arrangement, the district's landowners have agreed not to irrigate up to 29% of the valley's farm land at Metropolitan's request, thereby creating a water supply of up to 137 Mm^3 for Metropolitan. In exchange, landowners receive a one-time payment per hectare allocated, and additional annual payments for each hectare not irrigated under the program in that year.
- Improved seasonal forecasting was shown to offset the effects of climate change on hydropower generation from Folsom Lake, California.
- In the UK, design flood magnitudes can be increased by 20% to reflect the possible effects of climate change.
- Measures to cope with the increase of the design discharge for the Rhine in the Netherlands from 15,000 to 16,000 m^3/s must be implemented by 2015, and it is planned to increase the design discharge to 18,000 m^3/s in the longer term, due to climate change.

Actions of the River Bureau of Japan

Although there have been no cases of adaptation options implemented in Japan, the River Bureau has established various committees under the River Section of Social Capital Development Council to study various measures for water-related disaster management. Following the storm and flood disasters in 2004 (10 typhoons hit Japan in this year), the General Policy Committee on Heavy Rain Disaster compiled "On the Promotion of Comprehensive Measures against Heavy Rain Disaster (Proposal)" (April 2005). After the record-breaking heavy rain in Miyazaki Prefecture and other areas due to Typhoon No. 14 in September 2005, the Study Committee on Large-scale Rain Disaster issued "Damage Minimization on Flood Disaster and Landslide Disaster" (December 2005). In response to the attack of hurricane Katrina on New Orleans in August 2005, the Zero-meter Zone Storm Surge Study Committee developed "Future Storm Surge Management in Zero-meter Zone" (January 2006).

While these committees addressed the problems with an eye to climate change, adaptation to climate change was not a direct focus in their activities. The Subcommittee on Flood Measures was therefore established to discuss "Flood Measures Adapting to Climate Change" (1st meeting on August 27, 2007). The basic understanding and the directions of adaptation options proposed by the subcommittee are, in terms of writer’s interpretation, as summarized below.
(http://www.mlit.go.jp/river/shinngikai/flood_measure/index.html)

Basic Understanding:

1. Approximately one-half of the national population and three-fourths of total assets are concentrated in alluvial plains occupying 10% of national land area, and there are zero-meter zones along the 3 bays in crucial areas (Tokyo Bay, Ise Bay, and Osaka Bay). The current degree of achievement in river improvement is about 60% of the short-term goals (1/30 to 1/40 for large rivers and 1/5 to 1/10 for small and medium rivers). In this situation, sea-level rise and intensification of heavy rain and typhoon disasters are expected to occur due to climate change. Therefore, prompt planning of adaptation options is needed.
2. Adaptation and mitigation must be promoted side by side.
3. Even though there are ambiguities and uncertainties, the state government must fulfill its responsibility as the administrator of water management policies by indicating appropriate adaptation options before it is too late.
4. In this process, attention must be paid to the present state and future prospects of water management policies, including the consideration of the change in social conditions such as the decrease in population, less children and population aging, and the change in land use, as well as the state of investment capacity, facility improvement, and past water management plans.
5. Japan must make use of its successful experiences, programs, and technologies for the sake of international contribution.

Basic Directions of Adaptation Options:

Water management is a process of improvement works in long-term plans, and adaptation options responding to the change in hazard need to be incorporated in this process. The basic directions are the revision of facilities and social structure aiming at damage minimization on one hand and emergency disaster responses on the other.

Revision of Facilities and Social Structure

- Ensuring the reliability of facilities against the change of external factors (including inspections and other activities), full utilization and service-life elongation of existing facilities, and construction of new

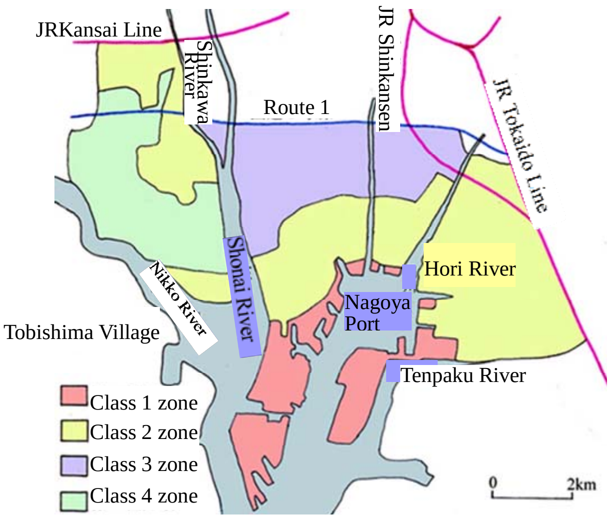

Fig. 2.3 Disaster Hazard Zones in Nagoya City (1961), designated following the Isewan typhoon in 1959.

facilities.

- In addition to the improvement of disaster prevention facilities and risk management measures, adaptation must include the revision of social structure such as alteration of land use and housing (e.g., the designation of class 1 to 4 disaster hazard zones in Nagoya City, 1961 (Fig. 2.3)).

Emergency Disaster Responses

- In addition to the state-operated wide-area disaster support system and disaster response network, collaboration with communities will be developed to achieve the capability and system to respond to large-scale disasters, including emergency responses and draining of floodwater in the event of embankment collapse and flooding.
- Assuming the increase in frequency and magnitude of hazard due to climate change, new scenarios will be developed and used in various non-structural measures combined with construction and improvement of structural facilities to support flood management, evacuation, rescue, restoration, and the construction of safe communities.

Methods to Implement Adaptation Options

- Investment will be concentrated on preventive measures in facilities and areas expected to be particularly vulnerable, as well as areas with high accumulation of population, assets, and central functions.
- As there are uncertainties in the prediction of climate change, it is necessary to use an adaptive approach in which scenarios will be modified according to future observation data and findings.
- Through collaboration of industry, academia, and government, new impact assessment methods and adaptation technologies will be developed. In addition, the experience, programs, and technologies of Japan will be made widely available for international contribution such as providing support to developing countries.
- Research and study will be promoted in collaboration with universities and research organizations, and the results will be reflected in water management plans.

These discussions are all reasonable as a starting point. It is highly valued that the government considers mitigation and adaptation as the two wheels of a cart and states "Even though there are ambiguities and uncertainties, the state government must fulfill its responsibility as the administrator of water management policies by indicating appropriate adaptation options before it is too late" in the Basic Understanding section. The recognition of the need for international contribution through disaster management technologies, as a part of Japanese foreign policy based on science and technology, should also be appreciated highly.

The Basic Directions section contains many proposals that are considered highly desirable, such as the full utilization and service-life elongation of existing facilities, the designation of disaster hazard zones, the emphasis on emergency responses and research, and prioritized investment in vulnerable areas. The River Bureau emphasizes the concept of adaptive measures and states "Water management is a process of improvement works in long-term plans, and adaptation options responding to the change in hazard need to be incorporated in this process" in the beginning. This seems to reflect the judgment of the administrative authorities that there should be no other practical ways. The key question is how far adaptation options can be promoted when the government plans to introduce them while continuing the present process of water management. This needs to be addressed in future discussions.

3.2 Water Disaster Prevention in Sustainable Development

The Best Mix of Mitigation and Adaptation

We have reviewed the present state through the OECD study, the IPCC report, and the proposals of the River Bureau. The actions of developed countries are clearly the extension to what they are doing at the present, mainly consisting of adjustment to the situation at hand. Measures such as raising storm surge barriers, increasing the height of bridges over estuaries, and "rolling easement" in wetlands all illustrate how humans are running about trying to escape from invading sea. It is natural that people take actions in such ways in the early stage of response, but we need something more to win.

On August 20 this year, the Cabinet Office organized the 1st Symposium on Climate Change "Optimization of Mitigation and Adaptation to Cope with Climate Change – Defining Comprehensive Measures against Global Warming." The theme of this symposium was the best mix of mitigation and adaptation. The purpose was to be able to overcome the changes in centuries to come by using the best mix of measures to mitigate global warming through greenhouse gas reduction and adaptation to climate change.

According to the report of IPCC 2007 WGI (IPCC, 2007), the A1FI scenario (very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies; a substantial reduction in regional differences in per capita income; fossil-intensive energy sources) would cause a temperature rise of 2.4-6.4 degrees (4 in average) by the end of the 21st century. The B1 scenario (the same global population as in A1; rapid change in economic structures toward a service and information economy, with reductions in material intensity and introduction of clean and resource-efficient technologies; global solutions to economic, social and environmental sustainability, including improved equity) would cause a temperature rise of 1.1-2.9 degrees (1.8 in average).

Mitigation measures to limit the temperature rise within 2 degrees must be rigorous. The strategy needed involves the introduction of energy-saving technologies and the realization of a sustainable recycling society through a shift away from mass production, mass consumption, and mass disposal throughout the world. Lifestyle change is an essential prerequisite for the shift from profuse use of materials and the realization of economic, social, and environmental sustainability. According to the presentation made by Mr. Shuzo Nishioka at the above-mentioned 1st Symposium on Climate Change, Japanese people need to reduce emissions by as much as 90% relative to the emissions in 1990, if a 50% global reduction were to be achieved by 2050 and all people in the world were to have equal share in emissions. This is a matter of ethics. Because the population and living standards in developing countries should continue to grow, developed countries need to attain reduction much larger than 50% to limit the temperature rise within 2 degrees. The Stern Review Report (2006), however, predicts that the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year through the use of science and political leadership. Considering the stance of political leaders in the present world, including Al Gore Ex-Vice-President of the USA and Prime Minister Abe in Japan, the realization of this prediction seems to be possible, but it nevertheless requires a paradigm shift in society. If it is needed for mitigation, it also is needed for adaptation. This means the need for adaptation within the framework of sustainable development. We need to choose a way of living supporting harmonious coexistence with nature, rather than megastructures imposing much environmental burden.

Water-related Disaster Prevention in Harmonious Coexistence with Nature

Speaking of the choices in the way of living, we first need to base our discussion on the fact that water environment is established in the quasi-equilibrium of interactions among climate, land, and people. In such a system, a change in any of these elements must be responded with the change in all other elements toward a new state of equilibrium. It is a well-known fact that the failure of humans in accommodating to changes has resulted in the collapse of many civilizations in the history. The same applies to the present-day megalopolis civilization located in flood plains.

Flood plains have been developed for human activities because of various benefits they provide. We cannot and need not to give up the benefits. However, when a fundamental change takes place in natural conditions, we cannot forcefully hold back such change with physical structures and maintain our present way of living for a long time. We need to change our way of living and relocate activities so that we can attain a solution achieving the optimal use of land. We not only need to find a way to minimize damage under the existing conditions, but also move the place of living to the best locations under the new conditions. In short, we should avoid living in disaster-threatened areas as much as possible.

The population of Japan is expected to drop to 100 million by 2050 from the present 127.7 million. This means a decrease of approximately 30 million. Japanese regard this decrease as a great opportunity for choosing a new way of living and reconsidering harmonious coexistence with nature.

There are many measures to support water-related disaster prevention in harmonious coexistence with nature. Physical measures include dams, banks, soil-erosion control works, improvement of river channels, infiltration and storage facilities, drainage facilities, and water-resistant buildings. Non-physical measures include forecasting and warning, hazard maps, evacuation, land use regulation, flood prevention activities, and education and practice. All of these are indispensable measures and need to function in the best possible way. The problem is the specific contents and roles of these measures. It is important first to ensure the practice of basic watershed management, including the maintenance of the reservoir function of rice fields, preservation of the adjustment function of forests, basin-wide measures to stabilize sand and soil flow, and prevention of land subsidence through pumping restrictions.

In many developing countries and elsewhere in the world, the need to address emergencies at hand is impeding the development of responses based on long-term plans. In addition, problems are aggravating in many places due to the further concentration of population, land subsidence, illegal occupation of land, and other factors. In such areas, climate change may act as a force to compel people to move out of certain disaster-threatened areas.

4. International Contribution of Japan

Developing strong international relations in science and technology has long been a basic desire of Japan. In fact, Japan has been taking remarkable leadership in international contribution regarding environmental issues and disaster prevention. Notable examples in the environmental field are the Tokyo Declaration of "sustainable development" made by the World Committee on Environment and Development in 1987 and the adoption of the Kyoto Protocol in 1997. In the field of disaster prevention, the adoption of the Yokohama Strategy at the World Conference on Natural Disaster Reduction in 1994 and the adoption of the Hyogo

Framework for Action (HFA) at the UN World Conference on Disaster Reduction in 2005 are the most important developments. The HFA is now serving as the international guidelines for disaster management strategies. These will undoubtedly continue to play important roles in the adaptation to global warming.

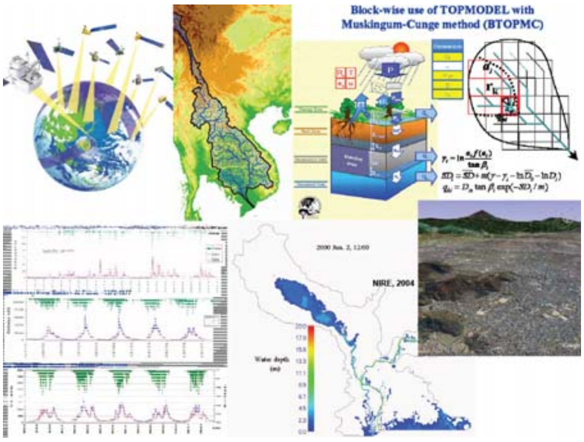

Fig. 3 Flood Forecasting and Warning System Proposed by ICHARM (Conceptual Illustration)

ICHARM, the Only Global Center for Water Disaster Management in the World

The International Center for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO is a category II center by UNESCO hosted by Public Works Research Institute, established in March 2006 under the agreement among UNESCO, the Japanese government, and Public Works Research Institute. ICHARM is the world's only research and educational organization specializing in water-related disaster reduction with a global view. Japan has a history of tackling severe water-related disasters and achieving remarkable development. The international contribution based on such experience and technical expertise is expected to be valuable.

In alliance with various organizations and initiatives sharing the similar aims and activities in the world, ICHARM aims to provide and assist implementation of best practicable strategies to deduce water-related disaster risk in the globe, nations, regions and localities. At the first stage, the focus is on flood-related disasters and accordingly, contribution to Asia and the Pacific is in the highest priority. The present activities at ICHARM are focused on prediction of the change in disaster risk due to global warming, flood forecasting and warning based on high technologies including satellites, advanced models and many IT tools, and the support to education, training, and local community activities. .

Because the adaptation to global warming must begin with the management of water-related disasters, the system for flood forecasting and warning is an indispensable adaptation technology. Similar to the Indian Ocean Tsunami forecasting and dissemination system, ICHARM is aspiring to be able to provide such warning also for floods. Fig. 3 shows the conceptual illustration of a system for flood warning.

In education and training, ICHARM is conducting long-established programs for training in dam and river management, as well as flood hazard mapping training. A comprehensive training program on tsunami disaster is also planned to begin next year under the ISDR framework. It is notable that a masters' course in water disasters opened in October jointly with the National Graduate Institute for Policy Studies (GRIPS) and JICA. The course started with 11 students in the first year. The target students are the practitioners in disaster management with engineering background. To foster the solution and practice oriented engineers who can work for the nation and with local communities is the objective of education. Education is truly the foundation for sustainable development of nations.

Practical support to local communities is the most difficult challenge. Planning of specific measures has begun with the participation of highly motivated people from Nepal and Malaysia.

To ensure the success of ICHARM, it is working with many partners in the world such as UNESCO, WMO, ISDR, UNU and other universities, research institutes, professional associations, ADB, JICA and other funding agencies and many related programs and initiatives such as WWAP, WWF, APWF, Sentinel Asia, GEOSS, International Flood Initiative (IFI), etc. For IFI, ICHARM is serving as a secretariat. Especially the national institute in charge of public works in each country is the most important partner. Needless to say, domestic supports by Ministry of Land, Infrastructure and Transport, Ministry of Foreign Affairs, Ministry of Education, Culture, Sports, Science and Technology, and other relevant government organizations are working together.

5. Conclusion

Large-scale meteorological disasters are occurring in the world at an unprecedented frequently in recent years, but the temperature rise in the past 100 years has been only 0.5 degrees. A further increase of at least 2 degrees in the coming 100 years is considered unavoidable, even if we make desperate efforts to take mitigation measures. Although we are only at the entrance of a new experience, it is easily imaginable that such an extent of temperature rise would cause tremendous intensification of heavy rain, typhoons, and droughts. Furthermore, global population is expected to grow until the middle of the 21st century, and urbanization and industrialization continue to accelerate. The adaptation to climate change is the problem of how we can manage the disaster risk resulting form this situation.

Our only resources are science and technology, and wisdom. However well we can sophisticate observation, forecasting, and warning, and however well we can manage large engineering structures, it is technically and economically impossible to solve everything by science and technology. There is no upper limit to the intensification of disasters. Then, we must use our wisdom. Using wisdom, we need to choose how we dwell and how we live. We need to reconstruct the way we live in harmonious coexistence with nature.

The same applies to the mitigation of climate change. We have no other choices than suppressing energy consumption, suppressing production, consumption, and disposal of goods, and suppressing environmental impacts to achieve the goal of a recycling society. Again, the only means for achieving this goal are science and wisdom. This wisdom pertains to how humans use nature and settle in a state of quasi-equilibrium in the harmonious coexistence with nature. It is not the matter of regarding economy and institutions as fetters, but of considering how we can use them to achieve a solution. In the end, it is the matter of the governance of the human species. The problem of governance is not the issue in developing countries alone.

Mitigation and adaptation measures to cope with climate change are the largest problem for human beings in the 21st century, and this problem is the axis of socioeconomic changes in the years to come. Like it or not, it will emerge in the mainstream of policy making. How science and technology, and politics and economy can address this problem in nation’s development and work as a team in international collaboration will decisively determine the future of any country.

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Ⅷ-2　Predicted Effect of Global Climate Change on precipitation

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Predicted Effect of Global Climate Change on Precipitation Characteristics in Japan and related Research Activities in NILIM

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Abstract: Since Japan's precipitation is heavily influenced by local topography, grid intervals of models, the fourth IPCC report refer to, are too large to realize the precipitation. In this situation, Japan Metrological Agency/Metrological Research Institute Japan has developed 20Km models of grid interval. This paper introduces the analyses of 20Km models' results from the view point of flood disaster. The analyses are required to discuss rainfall intensity of long return-periods, because of the lack of long term results of models in the same climate. Outline of the project study of NILIM concerning adaptation to flood change by warming, which includes rainfall analyses, is also introduced in this paper.

1. Introduction

After the publication of the fourth IPCC report, public concern with global warming problem has been aroused more, also in Japan. Until now, most of the concerns tend toward the mitigation issues, which impressed by Kyoto protocol (1997), Declaration of Heiligendamm Summit (2007), etc. and adaptation issues are not so much interested in. Analysis of National Communications' report, required by UNFCCC, categorized Japan as the country that has greater coverage of climate change concerning issues, but focuses almost entirely on assessment of impacts (OECD, 2006). The analysis indicated Japan's activities for adaptation were insufficient. As a matter of fact, Japan has not submitted any comment of adaptation issues to NCs in spite of the many reports of assessment activities.

The assessment of impacts is, however, very important for the examinations of adaptation measures. Appropriate adaptation plans cannot be formed without accurate and quantitative projections. With regard to flood disaster control, projection of rainfall variation, which is executed through numerical simulation using climate model, is the most fundamental information. Though plural model-results are employed in the fourth IPCC report for the climate projections and future temperature is quantitatively discussed, we cannot obtain quantitative conclusions for future precipitation from the report. Reason of this may be insufficient accuracy of the simulations about precipitation.

Since the climate models require enormous amount of calculations, computer capacity as well as complex and very unstable characteristics of precipitation phenomena can limit the accuracy of estimations. The shortest horizontal interval of grids used in the fourth IPCC models is grater than 100Km. This interval is not short enough especially for Japan's precipitation where the area of the country is not so large and precipitation is heavily influenced by the land configuration. In order to

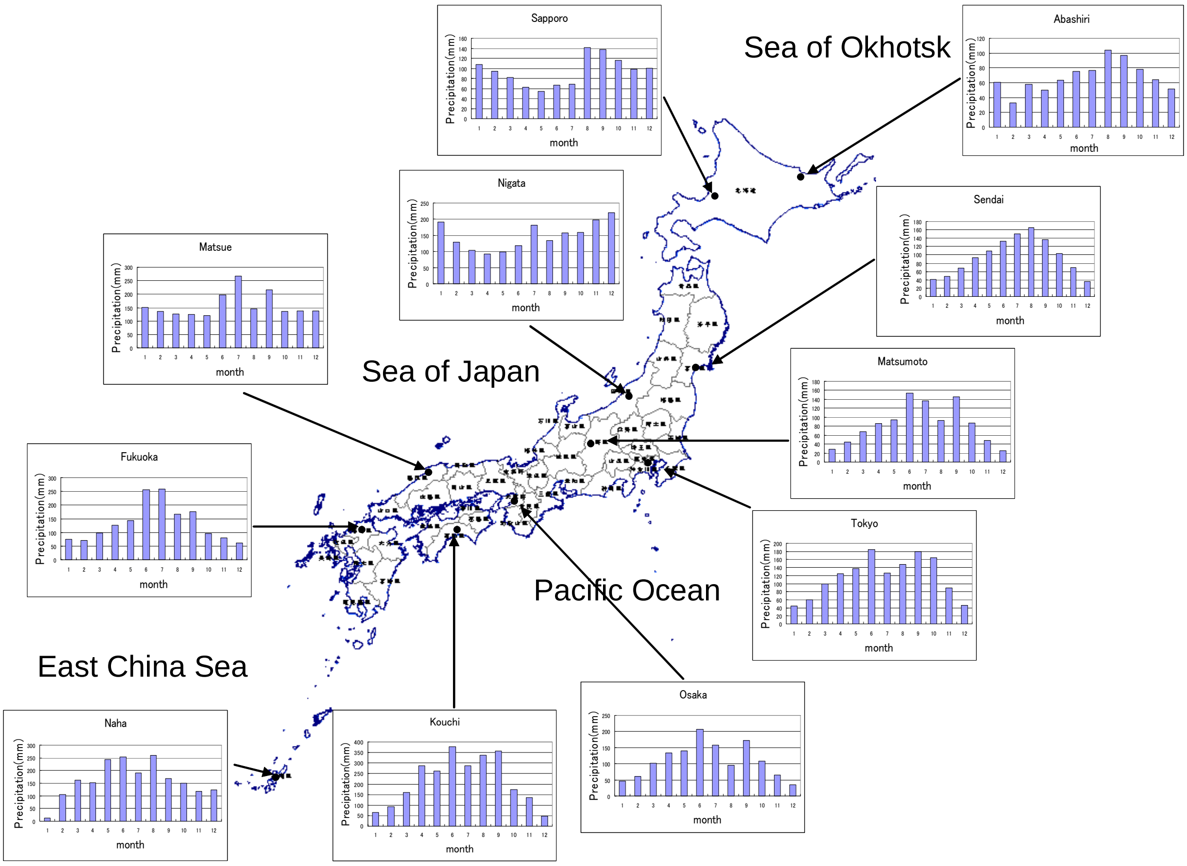


Figure-1 Monthly precipitations (average of 1961 to 1990) at representative points in Japan

obtain more accurate future precipitation projections of Japan's surrounding area, Japan Meteorological Agency/Meteorological Research Institute Japan have been trying to simulate using shouter interval grids.

This paper introduces calculation results of 20Km grid model, examined from the viewpoint of flood disaster control. They executed two 20Km grid model simulations; down-scaling regional model (RCM20) for A2 gas emission scenario and global model (GCM20) for A1B scenario. This paper mainly introduces the results of the global model. The global model results of other areas' could be expected to have the same accuracy as Japan's precipitation. The examination of the model results is a part of NIRIM's project study concerning adaptations to climate change effects. General of the project study is also introduced in this paper.

2. Japan's precipitation characteristics

Figure-1 shows the monthly precipitations (average of 1961 to 1990) of representative observatories in Japan. Though the area of Japan is not so large, Japan's land covers wide area in north to south direction. The topography including steep mountains is very complex. Also, Japan is located in the east coast of the Asian Continent where the climate is easily affected by the Continent and the Ocean. By above reasons, seasonal variation pattern of precipitation is considerably different by each region in Japan.

The rainy season in Japan is generally characterized by the phenomena of "baiu" front, "akisame" front and typhoon. "Baiu" front usually forms from June to July when the moist air over the Pacific Ocean meets the cooler continental air mass. When the warm air mass of Pacific Ocean weakens in autumn, the front comes back from north as “akisame” front (from September to October). Typhoons usually approach Japan from June to October. About three typhoons land annually on an average. Typhoon and “baiu/akisame” front sometimes act on each other and sometimes cause extreme rainfall.

Japan Sea side areas have somewhat large precipitation from November to February. The seasonal north-western wind caused by typical atmospheric pressure distribution in winter (west-high, east-low distribution) and mountains bring snowfall to those areas.

3. Outline of climate models

As mentioned before, the grid intervals of models, the fourth IPCC report refer to, are too large to the accurate projection of Japan’s precipitation. Japan Meteorological Agency (JMA) and Meteorological Research Institute Japan (MRI) presented two kinds of 20Km grid model (GCM20 and RCM20) for the precipitation change projection.

GCM20 and RCM20 is atmospheric model. Both models do not solve the interaction effects between atmosphere and sea. Sea surface is treated as the boundary conditions given by CGCM model’s results. CGCM model series are also developed by JMA and MRI and solve the interaction effects. IPCC reports refer to CGCM’s results. The horizontal grid interval of CGCM is about 280Km and the number of vertical layer is 30.

Table-1 shows the simulation conditions of GCM20 and RCM20. Because of the enormous amount of output data of GCM20, upper side data from surface were not stocked. We can use only surface data of GCM20.

Results of GCM20 will be mainly discussed in this paper. Though, the superiority of the models’ accuracy cannot be decided at this point, RCM20 generally shows somewhat larger results than GCM20’ results and observed precipitations.

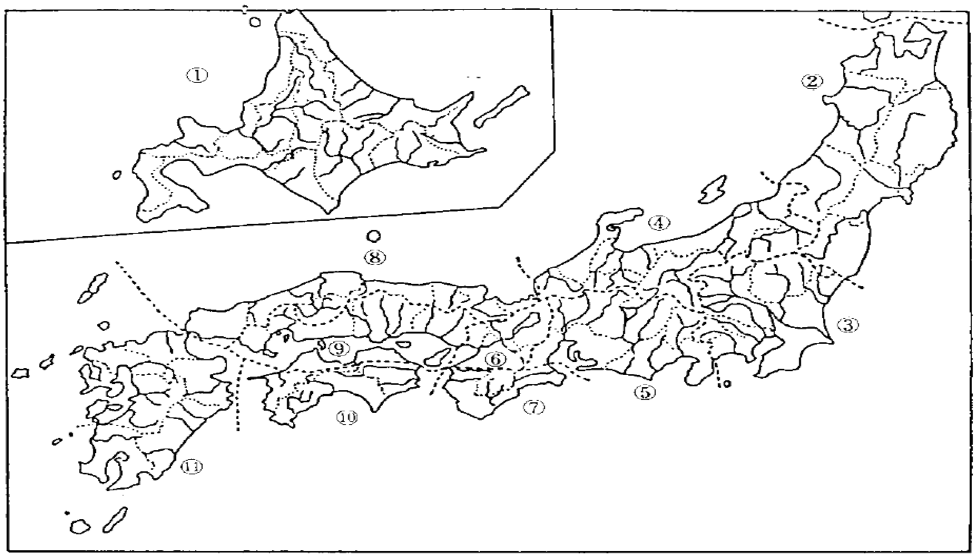
Table-1 Simulation conditions of GCM20 and RCM20

	Model	
	GCM20(General Circulation Model)	RCM20(Regional Climate Model)
Area	Global	Surrounding are of Japan
Horizontal resolution	Grid interval: about 20Km	Grid interval: about 20Km
	Number of grid: 1920x960	Number of grid: 129x129
Number of vertical layer	60 layers	36 layers
Condition of side boundary	—	Climate model of Asia area （Grid interval: about 60Km, 36 layers)
Gas emission scenario	A1B	A2
Interval of Calculation	Present: 1979－1998 Future: 2080－2099	Present: 1981－2000 Future: 2031－2050 and 2081－2100

4. Comparison between GCM20 with observed precipitation

Since the precipitation pattern considerably varies in each region, analyses introduced in this paper are executed in each region shown in **Figure-2**. The regional division of Figure-2 is decided by considering similarity of meteorology and run-off process, which used for one of the reference materials for design flood examination of dams.

Figure-3 shows the ratio of GCM20’s average daily precipitation to the observed one during 1979 to 1998 (20years) in each region. Average and standard deviation of the ratio in a region is shown in



NO	Region	NO	Region
①	Hokkaido	⑦	Kii-nambu
②	Tohoku	⑧	Sanin
③	Kanto	⑨	Setouchi
④	Hokuriku	⑩	Shikoku-nambu
⑤	Chubu	⑪	Kyushu・Okinawa
⑥	Kinki		

Figure-2 Regional division considering similarity of meteorology and run-off process

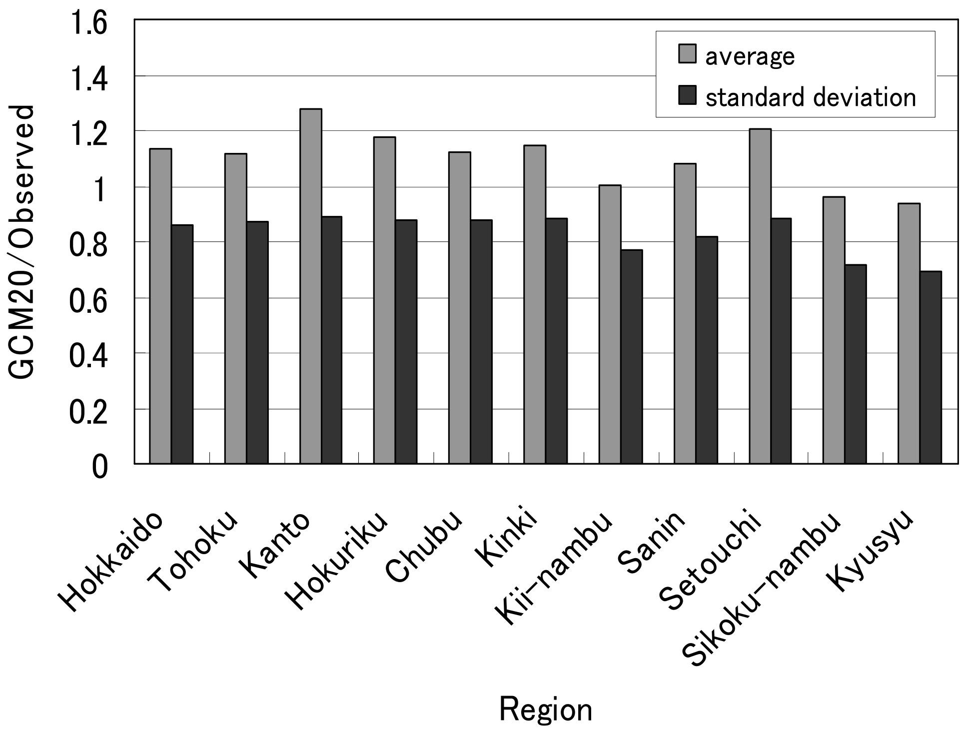


Figure-3 Ratio of GCM20' results to the observation regarding average daily precipitation

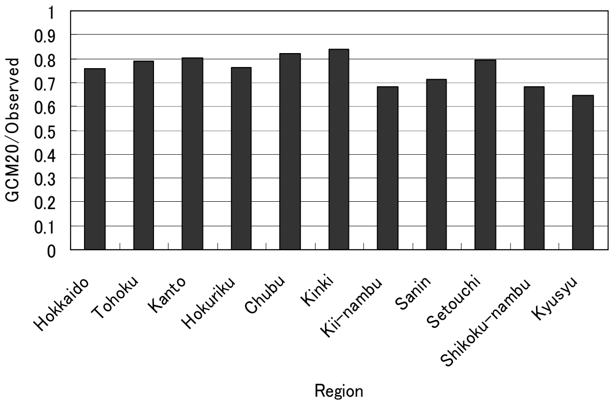


Figure-4 Ratio of GCM20's results to the observation concerning average annual maximum one-day rainfall

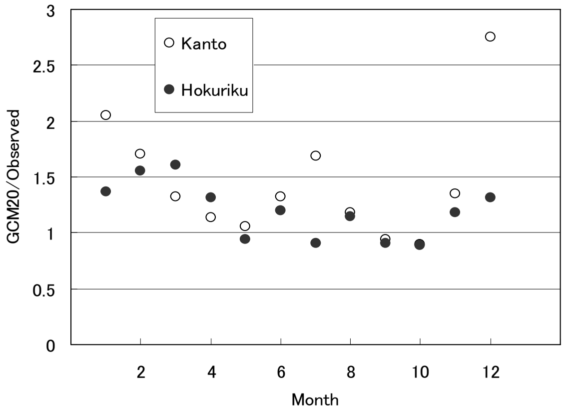


Figure-5 Examples of the ratio of average monthly precipitation of GCM20's results to the observation

the figure. AMeDAS (Automated Meteorological Data System) data of Japan Meteorological Agency are used for observed data, which has 1,300 observatories over Japan's land.

The average ratio is grater than 1 in eastern or Japan Sea side regions and less than 1 in west-southern regions. GCM20 has this regional tendency, but the average ratios are distributed near 1, from 0.94 to 1.28. So the regional average precipitation could be evaluated with comparative accuracy. On the other hand, all of the ratios of standard deviations are less than 1. They are from 0.69 to 0.89. This means variation of GCM20's precipitation is smaller than actual phenomena. **Figure-4** shows the ratio of GCM20's results to observed results concerning annual maximum one-day rainfall in each region. The ratio is the average ratio of 20 years in a region. While the values of ratios are nearly the same as the standard deviations of average daily precipitation, they are smaller in all of the regions. This may indicate that 20Km of grid interval is not small enough to realize extreme rainfalls of typhoons and fronts.

Figure-5 shows the examples of the ratios of average monthly precipitation of GCM20 to that of the observation. Kanto is a relatively large example of a ratio variation, and Hokuriku is a relatively small example. While the value is different especially in winter season, both show the concave variation pattern in the relation with month. This tendency is common to all regions, so GCM20 has the bias of larger winter precipitation

5. Precipitation variation at the end of 21st century

5.1 Averaged precipitation

The simulation results of GCM20 have the seasonal bias. Also they give smaller extreme rainfalls. They however, realize the fundamental seasonal precipitation characteristic of each region; give 64-84% of extreme rainfall intensity. Future change of precipitation could be discussed by the ratio of the precipitation in future duration (2080-2099) to present duration (1979-1998).

Figure-6 indicates the ratio of the future average daily precipitation to present in each region. The figure also indicates the ratio of deviation. The ratios of average are almost 1 (range is 0.94-1.09), so the average precipitation of future is nearly the same as present. While the ratios of standard deviation also indicate the value of nearly 1, all of them are grater than 1. Also they are grater than the ratios of average. These mean the larger variation of the future precipitation.

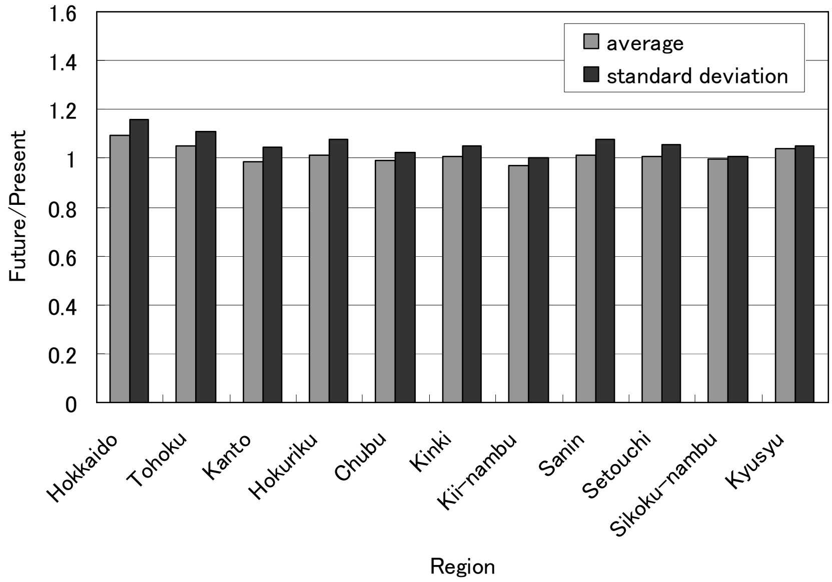


Figure-6 Ratio of future average daily precipitation to present （GCM20)

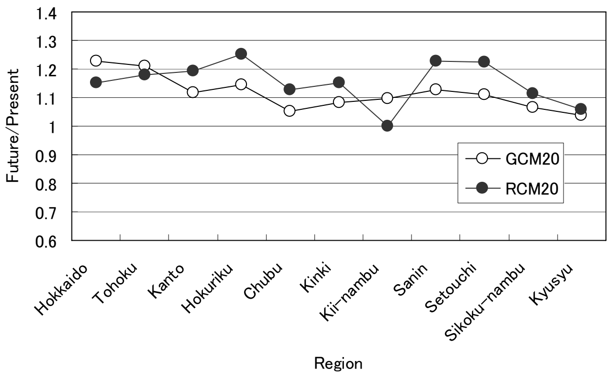


Figure-7 Future to present ratio regarding average annual maximum one-day rainfall

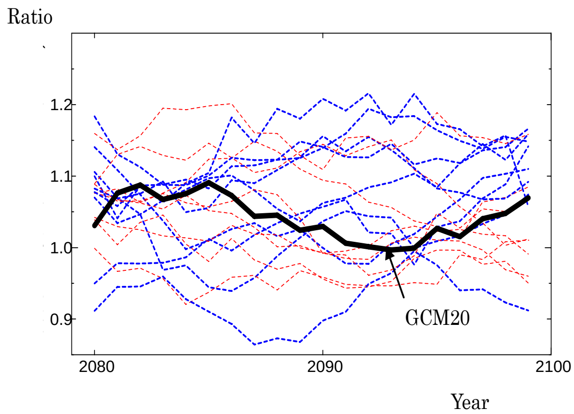


Figure-8 Change of average daily precipitation in surrounding area of Japan by GCM20 and IPCC models (average of 1979-1998 =1, A1B scenario)

Figure-7 shows the ratios of future average annual maximum one-day rainfall to present. RCM20's results are also plotted in the figure. The range of the ratios of GCM20 is from 1.04 to 1.23, and East or Japan Sea side regions' are larger than others. While the ratios of RCM20 are larger than GCM20 and the regional tendency of RCM20 is somewhat different from GCM20, both ratios indicate the almost same range and the same tendency of larger value in eastern or Japan Sea side regions. The range of the ratios of RCM20 is from 1.0 to 1.25.

Figure-8 shows the changes of average daily precipitations of IPCC's models compared with GCM20. The figure shows the ratios to the average of 1979-1998 precipitation of models. Since IPCC's models use long grid intervals, areas include surrounding seas as well as Japan's land. While 27 climate models are employed by IPCC, 14 models of them are plotted in the figure because the other results were not accessible at that time. From the figure, GCM20' results are within the variation of IPCC models' results.

5.2 Subject for rainfall intensity analysis of storm

5.2.1 Fundamental problems

For the examination of flood prevention plans, rainfall intensity of long return-period is important. But, there are problems to estimate this kind of extreme rainfall.

First problem is the effects of uncertainty and bias tendency of the simulation results. Considering this, ratio of future to present is selected as the parameter to evaluate the future precipitation change in 5.1; this parameter selection is from the idea of reducing the effects of uncertainty and bias tendency. But the effects can still remain, and the most serious problem is that there is no way to exam the effects.

Model results employed by IPCC are equally treated. There is no examination of accuracy superiority or result tendency of the models. The fourth IPCC report only shows the range and the average of future temperature and sea level, which calculated by whole model simulations. These are unusual situation in engineering scene, and may suggest analysis difficulties concerning climate phenomena. Although simulation measures have been remarkably developed recently, river engineers should know present level and characteristics of climate change simulation. Fortunately, GCM20 and RCM20 indicate similar results of future precipitation ratio to the present.

Another problem is a matter of hydrologic issues; this problem remains even a climate model has sufficient accuracy. Precipitation has large natural variation without climate change effects. The deviation of annual maximum rainfall, for example, must be much larger than the increased rainfall by climate change. Although average parameters of plural years and regional data may pick up the trend effects as shown in 5.1, rainfall intensity at a certain return-period cannot be discussed by average parameters alone. We should analyze the natural variation to discuss the probability of rainfall intensity, which requires long time rainfall data without climate change effects. On the contrary, as a matter of cause, the climate models aim at evaluating the future climate change by greenhouse gas emission, simulation results always reflect the conditions of greenhouse gas concentration at the point of time. Backgrounds of climate always change in the simulations. Add to this, the duration of GCM20/RCM20 future and present simulation is 20 years.

It must be very hard to pick up the natural rainfall variation at the point of time from the simulation results with continuous climate change conditions. Considering this, the assumption that the climate change effects are negligible in respective 20years of future and present is applied in this paper. From the view point of river engineer, long term calculation in fixed greenhouse gas concentration of each stage is desirable; computer environment, however, might limit the execution of this kind of calculation.

5.2.2 Scatter of annual maximum one-day rainfall

Rain fall intensity of long term return-period is usually examined by fitting distribution function to observed data plotted by an appropriate plotting method of probability. So the tendency of future to present ratios wiyh the rank of annual maximum rainfall should be discussed.

Figure-9 shows regional examples of ratio scatter at each rank (rank1 is the largest, rank20 is the smallest) of annual maximum one-day rainfall. Cover rate (%) means the rate of the number of points in the region, which ratios are less than the plotting ratio. In Hokuriku region, the figure shows the small change of 50% cover rate ratios, the concave and the convex shape of more than and less than

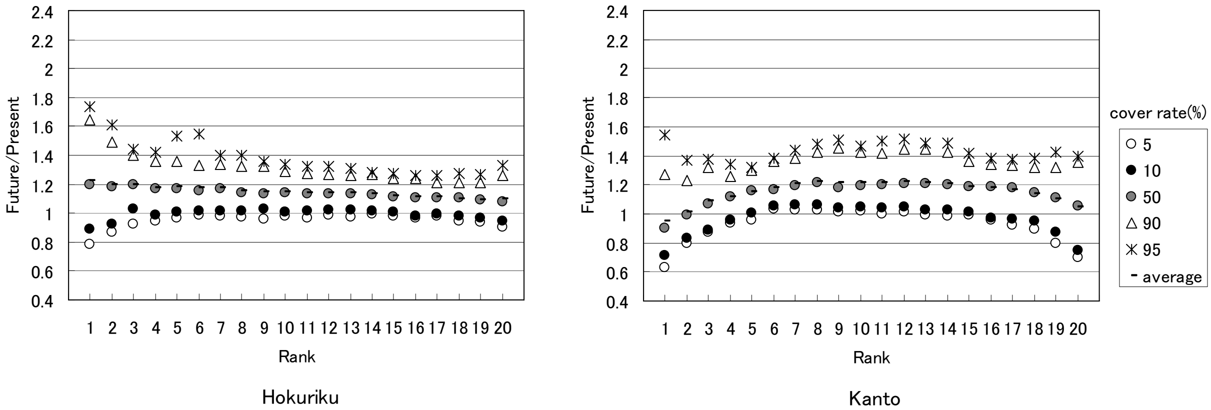


Figure-9 Examples of ratios of future annual maximum one-day rainfall to present in each rank (cover rate =the number of points less than the plotting ratio/the number of total points in a region (%))

50% cover rate ratios respectively. The concave and the convex shape mean larger scatter toward both edges of rank, especially rank1 side. Although Kanto region also has the similar characteristic with respect to the scatter tendency, 50% cover rate ratios change; not constant. They form the concave shape.

The scatter tendency in other regions is similar to both regions. Changes of 50% cover rate, however, show different patterns, gradual or rapid increase toward smaller number rank, rapid decrease toward smaller number rank and wave etc. In order to discuss the long term return-period rainfall, fundamental characteristics of these results should be appropriately understood.

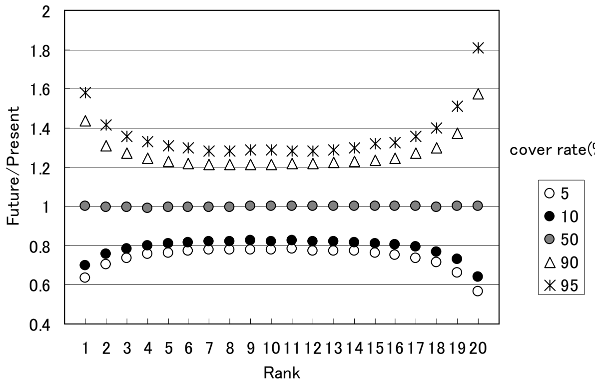
Figure-10 is obtained by Monte Carlo simulation in the condition of the same future and present distribution function (the ratio of the same nonexceedance probability is 1). Gumbel distribution is used for the simulation, which is one of the most general distribution functions for the analyses of extreme rainfall, and characterized by the parameter of σ/μ (σ: standard deviation, μ: mean). From the GCM20's simulation results in each region, the range of σ/μ is 0.35-0.5 and the figure shows the result of σ/μ=0.4.

The number of year of Monte Calro trial is 20, GCM20's simulation duration, and the number of points in a region is sufficiently large number of 5000. So the scatter in the figure is caused only by the short duration of 20 years. We can comprehend the general effects on ratio scatter of short 20 years simulation by the figure. **Figure-10** indicates the scatters in **Figure-9** can be generated only by the effect of short term simulation.

Because of the function characteristic near zero nonexceedance probability, the scatter of rank20 side in **Figure-10** is larger than that in **Figure-9**. Since the value of the Gumbel function probability reaches to $-\infty$ near zero nonexceedance probability, minimum value of 0.001 is set in the simulation. Actual minimum rainfall seems to be grater than this.

Figure-11 indicates the influence of σ/μ on ratio scatter. 5% and 95% cover rate ratios in rank1 and 10 are plotted. The ratio scatter increases as σ/μ increases, and the change of ratio scatter is relative large within σ/μ interval of GCM20 simulation results in each region.

Here, return to **Figure-10**, 50% cover rate ratios show the constant value of 1, a true value. Therefore, it may be possible to detect the tendency of the relationship between the rainfall intensity and the occurrence probability from 50% cover rate ratios analyses. But the relationship between the



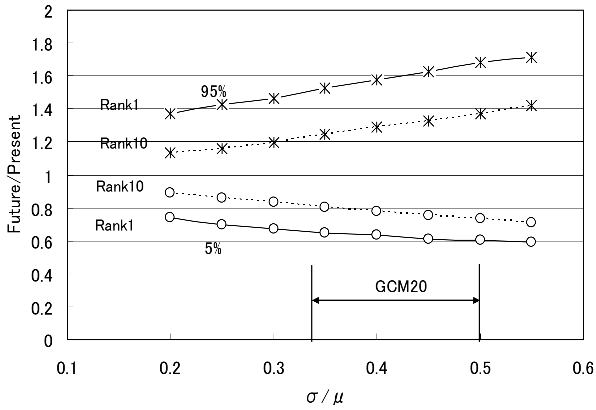


Figure-10 Scatter of ratios in the same Gumbel distribution of future and present (σ/μ=0.4, 20 years, 5000 points)

Figure-11 Influence of σ / μ on ratio scattering in the same Gumbel distribution of future and present (20 years, 5000 points)

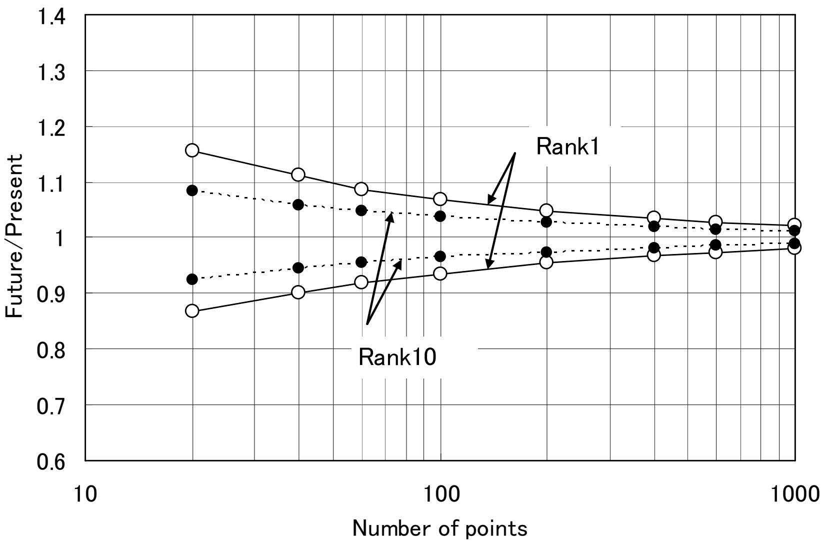


Figure-12 Relationship between 95% confidence interval of 50% coverage and the number of points in the same Gumbel distribution (σ/μ=0.4, 5000 Monte Carlo trials)

future to present ratio and the rank, obtained from GCM20's results, irregularly changes with regions, as exampled in **Figure-9**. One of the reason of this, small number of points in a region can be supposed.

Figure-12 shows the influence of the number of points on 50% cover rate variation in the condition of σ/μ=0.4. The 95% confidence interval of rank1 and rank10, obtained by 5000 times Monte Calro simulation trial, is plotted. The range of the number of points of GCM20 in each region is about 30-250, and the variation of 50% cover rate is considerable large in this range. The dimension of variation is smaller than some GCM20's results to some extent. However, the variation is influenced by several factors such as σ/μ, distribution function and the ratio of future to present mean rainfall. Here, therefore, the conclusion is limited to indicate that 50% cover rate can be varied by the small number of points in a region.

5.3 Trial for rainfall intensity projections at the end of 21st century

The examination of 5.2 shows the considerable large scatter characteristic of 20 years and 20Km grid interval simulation results. In order to reduce the scatter dimension, if it can be, the number of data of year or point required to be increased. One of the methods for this, using obtained GCM20's results, is to count a year and a point as the same element of occurrence probability. This can be done if following assumptions are adequate.

① data in a region are independent of each other.

② data in a region possess similar characteristics of dimension and distribution.

The cumulative distribution function of probability can be obtained for each region by above assumptions. All of future and present annual maximum one-day rainfall data in a region are ranked by their dimensions respectively, and plotted on a nonexceedance probability-data dimension graph.

Plotting results indicate that the relationship between future and present distribution function in each region reflects the variation characteristic of 50% cover rate introduced in 5.2.2. The results seem to indicate the short of the number of data in each region; distribution functions may still considerably include the scatter effect.

Average distribution function of all regions is obtained for the interaction of the scatter effect of each region. In order to obtain the average function, annual maximum one-day rainfall data are divided by mean value of each region. **Figure-13** shows the future and the present average distribution function. Both functions completely overlap each other. This means the future to present ratio dose not vary with nonexceedance probability, i.e. return-period, and decided by the ratio of mean value. Gumbel distribution is also shown in the figure. Although Gumbel distribution is very similar to the average distribution functions, there are tendencies of larger variation rate in small probability area and smaller variation rate in large probability area.

In order to ascertain above, i.e. to ascertain the independent relation between future to present ratio

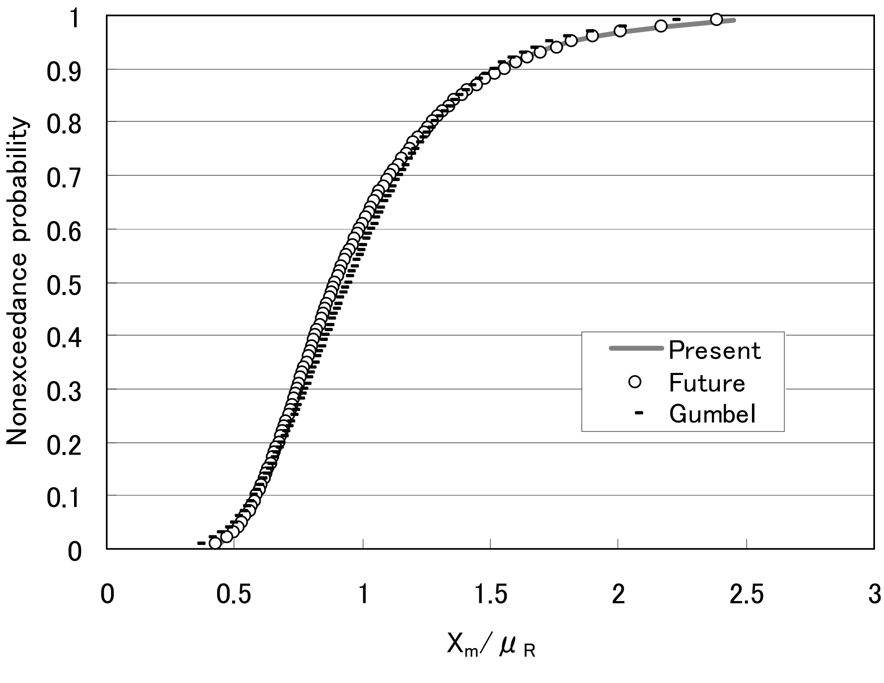


Figure-13 Averaged probability distribution (X_m: annual maximum one-day rainfall, μ_R: mean of each region; GCM20)

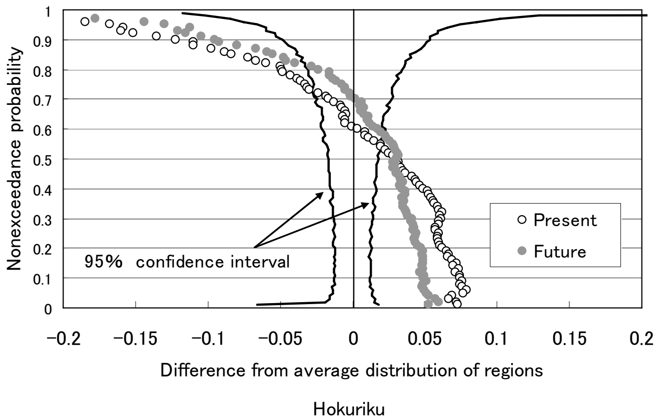


Figure-14 Example of the relationship between 95% confidence area and simulation results based on average distribution of regions (5000 Monte Carlo trials, GCM20)

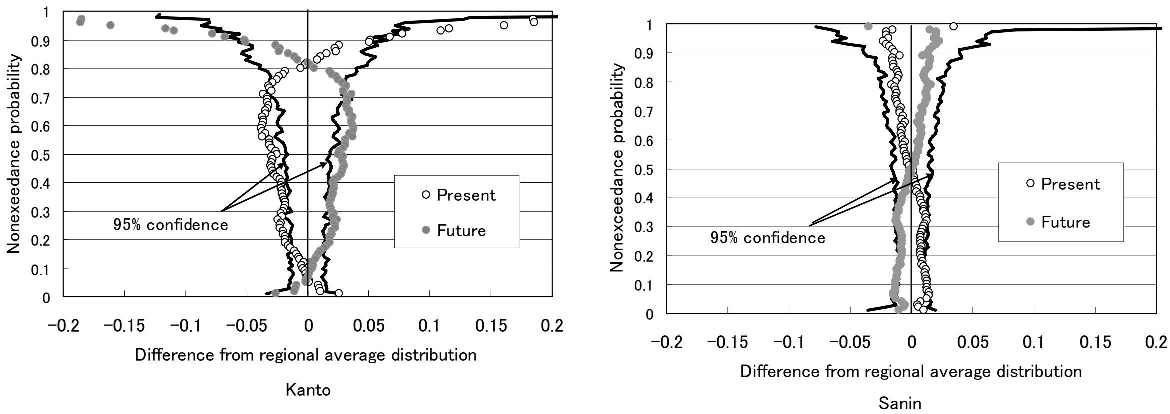


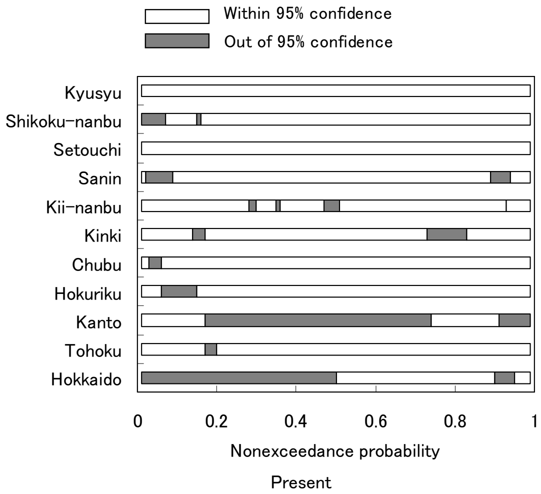
Figure-15 Examples of the relationship between 95% confidence area and simulation results based on regional average distribution (5000 Monte Carlo trials, GCM20)

and nonexceedance provability, Monte Calro simulations are executed with the assumption of the same future and present distribution function (basic distribution function, hereinafter). The number of data in the simulation is 20×(number of points in a region), and trialed 5000 times to obtain 95% confidence interval. The future to present function of each region, obtained by GCM20's simulation results, is compared with the 95% confidence interval to check the accuracy of the assumption.

Figure-14 shows the example of the results, using the average function of future and present function in **Figure-13** as the basic distribution function. The differences from the basic distribution function are shown in the figure, and large part of the GCM20's results is out of 95% confidence area. Also, a certain tendency of the GCM20 results can be recognized.

Above result suggests that the basic distribution function is different from each other region, and then the average of future and present distribution function of each region is used for basic distribution function. Examples of this simulation results are shown in **Figure-15**. Almost all GCM20's results located inside of 95% confidence area in Sanin region. On the contrary, large part is out of 95% confidence area in Kanto region. However, differences between the results and 95% c onfidence boundaries are much smaller than the former case exampled in **Figure-14**.

In **Figure-16**, nonexceedance probability is divided into within and out of 95% confidence interval.



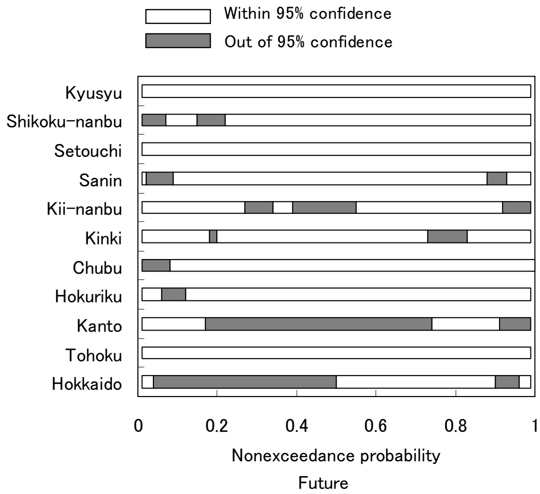


Figure-16 Within and out of 95% confidence interval divisions of noneexceedance probability based on regional average distribution (5000 Monte Carlo trials, GCM20)

White bars indicate the within part, while gray bars indicate the out of part. The figure shows that all or almost GCM20's results located within 95% confidence interval in almost region except Kanto and Hokkaido region. Correctly to say, data locations within 95% confidence interval dose not directly mean the same distribution function of future and present. However, the same distribution function can be mentioned for GCM20's results because the difference between the future and the present distribution function can be introduced by the same function in almost regions, also the average future and present function of all regions overlap each other. Therefore, the ratio of future to present one-day rainfall intensity is shown in **Figure-7**, 1.04-1.23 by GCM20, 1.06-1.25 by using larger value of GCM20 and RCM20.

Regional division of Kanto and Hokkaido should be improved. Southern part of Kanto is largest plane in Japan and may have different rainfall intensity from northern mountainous area. Rainfall in Hokkaido may be influenced by Okhotsk Sea, Japan Sea and the Pacific Ocean. These are subjects that should be examined in the near future.

6. NIRIM's studies concerning adaptation against stronger rainfall intensity

6.1 Outline of the project study

NIRIM executes many study subjects concerning technology for river management. As a matter of course, all of them relate to the adaptation against flood disaster to a certain extent, this paper introduces the project study titled 'Study on the river and coast management concerning adaptation against climate change'. The examination introduced in chapter 5 is a part of this project study.

Figure-17 shows the outline of the project study. Though the study includes issues related with drought and flood tide, flood disaster will be mainly introduced in this paper; issues of drought and flood tide are omitted in the figure.

Main goals in each stage of the project study are as follows.

①to project river discharge change caused by rainfall intensity change.

②to improve estimation methods of flood damage for reflecting influences of increased frequency and dimension of over planning discharge rate.

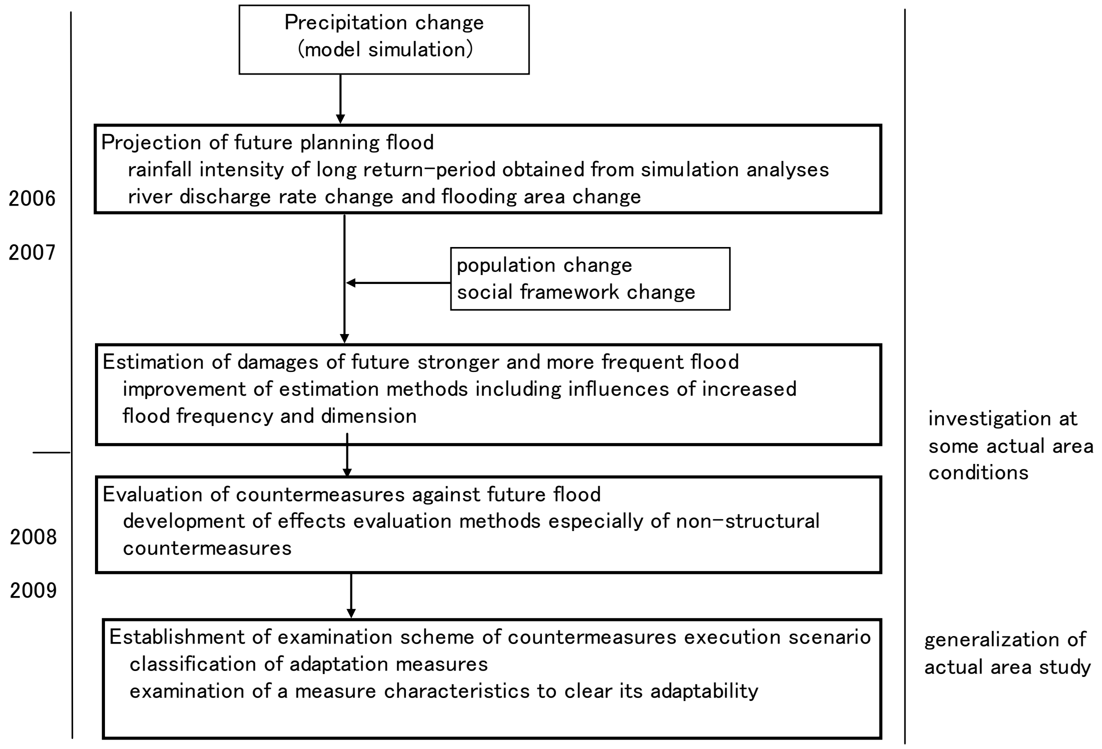


Figure-17 Study flow of 'Study on the river and coast management concerning adaptation against climate change' (part of adaptation to flood change)

③to develop effects evaluation methods of non-structural countermeasures that reduce flood damage.

④to classify adaptation measures including both of structural and non-structural measures and present examination scheme of execution scenario.

With respect to river discharge rate, trial calculations for several river show that future to present ratio is larger than that of the rainfall intensity because of the initial losses in ran-off process, etc. Future rainfall intensity may increase 10% to 30% or more by GCM20's results. And the return period of 100 years reduces to 20-40 years by 20% rainfall intensity increase for example. Also, the completion of embankment requires many year construction activities even for present planning level. So, off course the importance of the stable embankment construction is unchanged, non-structural countermeasures should be much noted and appropriately evaluated.

The changes of rainfall intensity and river discharge rate have been being examined in the project study and results that have obtained are already mentioned. The other items are introduced hereinafter. Since almost examinations concerning the items start in this or next fiscal year, general perspective of the study will be introduced in this paper.

6.2 Flood damage estimation and effects evaluation of countermeasures

Cost and benefit is usually estimated in the examination of flood prevention structural projects. **Table-2** shows the general items for damage estimation used for benefit estimation in Japan.

The loss of flood damages is calculated based on actual results obtained by field investigations and so on. And the actual damages are usually assumed as independent phenomena until now; i.e.

independent of former damages, also independent of other area’s damages. The larger frequency and scale of flood requires the appropriate estimation of former damage or other area’s effects.

As for former damages effects, continuous characteristic of damage effects has been investigated by post field survey of experienced serious disasters in Japan, including earthquake, flood and so on, recently. With regard to the effects of other area’s damages, recent activities of companies and other organizations become closely and complexly related with each other over wide regions. In this year, many factories of plural famous car production companies were forced to stop their production line for some days. This occurred by the earthquake damage of the factory of parts production company in Kashiwazaki city. Indirect effects, include other damage in **Table-2**, should be considered in the estimation of disaster damage loss.

Also, social effects of flood damage such as regional community cutting should be considered. New conceptions and methods are required to evaluate social effects, knowledge and technique of wide field specialists should be instilled into this project study. Closer connection with university or other organizations are also very important for the evaluation of economical effects. However, arrangements for this connection have not been established yet. They are just under examination.

With regard to non-structural measures such as warning and evacuation activities, land use regulation and multiuse space setting for water storage, the relationship between a countermeasure and a kind of damage loss reduced by the measure should be cleared in the first, then the extent of the reduction and effects should be evaluated.

Table-2 General items of damage estimation for B/C examination

Estimation methods		
Indicated		Not indicated (trial allowed by each project)
Direct damage	Indirect damage	Other damage
・house, building ・household articles ・house repayment and stock assets of business ・house repayment and stock assets of firming and fishery ・firm products ・public works etc.	・business suspension ・domestic emergency measure ・business emergency measure	・obstruction of ordinary activities at home ・emergency measures by national or local government ・influences of traffic stoppage ・influences of lifeline cutting ・influences of business suspension to surrounding areas' ・human life etc. ・underground market ・risk premium ・highly developed effects of land

6.3 Fundamental course for adaptation study

The propriety of adaptation measures are examined from various view points such as the efficiency (relationship between load weights of a measure execution and effects of reducing damage loss by the measure), the extent of the difficulty of realization and the required duration for realization.

Figure-18 shows one of the images of countermeasure executions considering the required duration for completion. The longitudinal axis of the figure is an additional load by climate change, and is assumed to rise upwards with time. Adaptational countermeasures are categorized in on-site countermeasures, water-shed countermeasures and regulation/support countermeasures, and considered longer duration will be required by the latter category.

The study concerning above will be executed for some actual areas chosen by vulnerability, regional typical or special conditions of the matter of rainfall, run-off and river condition, development situation of water-shed, economic and social condition, topology and so on. Results of actual areas will be generalized through analyses with multiple views. The study will be pursued in cooperation with government office and organizations mentioned in 6.2.

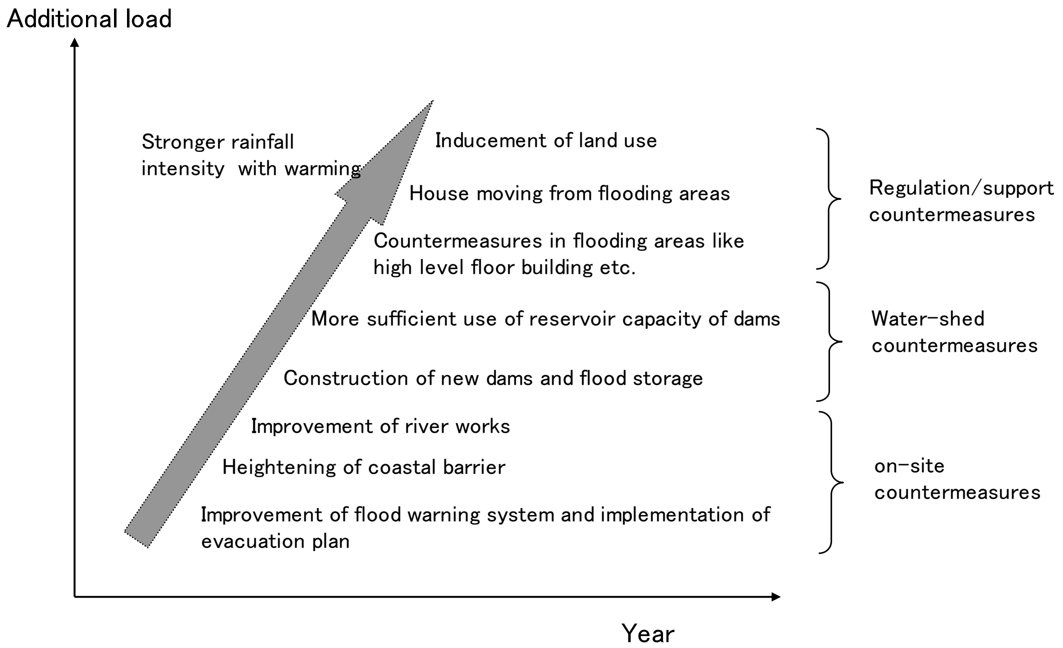


Figure-18 Image of countermeasure execution considering the required duration

7. Conclusions

Future rainfall intensity varied by grovel warming in Japan is discussed from a view point of flood disaster. Also, the general of the project study of adaptation in NILIM is introduced. Main conclusions are as follows.

1) Though the simulation results of GCM20 have the seasonal bias and smaller extreme rainfalls, future change of rainfall can be discussed by the ratio of future to present rainfalls.
2) Since the background condition is always changed in climate model simulation, and the calculation term is short in GCM20/RCM20, analyses for long return-period rainfall intensity have a fundamental problem of the lack of long data in the same climate condition.
3) Appropriate regional division can be expected to make up the lack of long data assuming independence and similar characteristics of data in a region. From GCM20 results, the ratio of future to present non-dimensional rainfall (divided by mean) in each region, dose not vary with return-period and represented by the ratio of mean value. The range of the future to present ratio of annual maximum one-day rainfall is 1.04-1.23 by GCM20, 1.06-1.25 by RCM20 in JAPAN.
4) NILIM has the project study program concerning adaptation to warming. Subjects of the study will include developing evaluation methods of effects of structural and non-structural countermeasures, and indicating examination scheme of execution scenario of them.

Ⅷ-3 The Investigation on the Drought Risk Assessment in Japan Due to Global Warming

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The Investigation on the Drought Risk Assessment in Japan Due to Global Warming

November 29, 2007

National Institute for Land and Infrastructure Management

Nario YASUDA, Head, Water Management and Dam Division, River Department

Tomokazu TADA, Senior Researcher, Water Management and Dam Division, River Department

Study on the Soundness Index of a Basin Water Cycle System

Table 1. Example Composition of Soundness Index of a Basin Water Cycle System

	Driving force	Pressure	State	Impact	Response
Water Use	Population in watershed Climate change	Precipitation Water usage Water intake from rivers and other sources Water conveyance out of watershed	Frequency of droughts Duration of droughts Flow conditions (river flow rate, interruption of stream flow) Water resource reserves	Shortage of water for urban use Wildlife habitats	Storage of water with dam and other facilities
Flood Control	Land use in watershed Climate change	Precipitation Flood flow rate Frequency of floods	Inundation and flooding	Amount of damage from water disasters	Various water control measures Flood control with dams and other facilities
Water Quality	Population in watershed Economic and productive activities Climate change	Generation of pollution load Inflow of pollution load	River water quality Water quality in lakes and dam reservoirs	Quality of drinking water Recreation Odor Wildlife habitats Crop growth and quality	Development of sewerage system Use of septic tanks and other facilities Measures against eutrophication

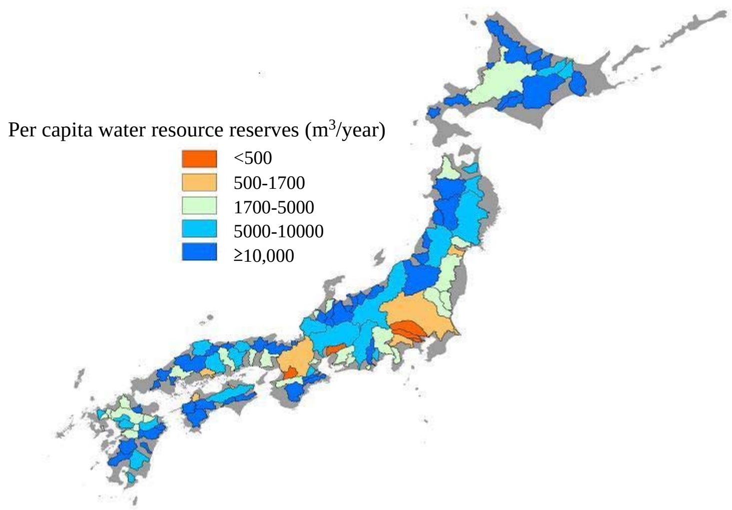

Fig. 2. Per Capita Water Resource Reserves

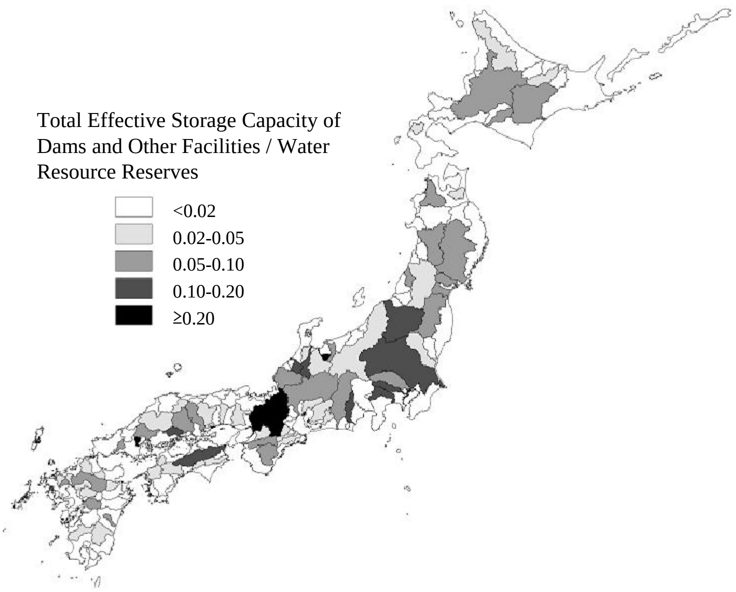

Fig. 3. Ratio of Total Effective Storage Capacity of Dams and Other Facilities to Water Resource Reserves in Each River System

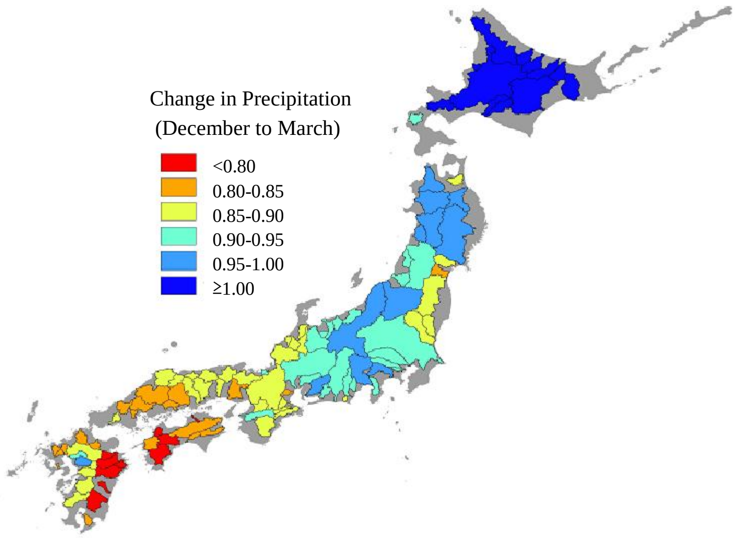

Fig. 4. Change in Precipitation Due to Global Warming in Each Drainage System (December to March)

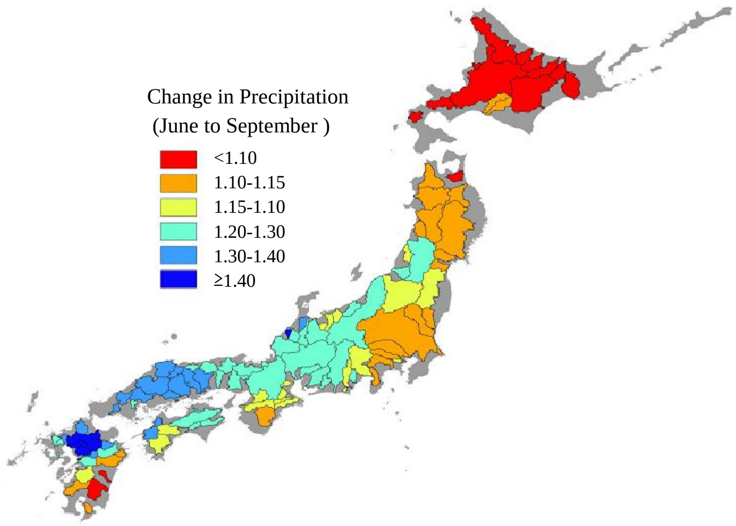

Fig. 5. Change in Precipitation Due to Global Warming in Each Drainage System (June to September)

Study on the Effect of Climate Change on Water Resources in Tone River Watershed

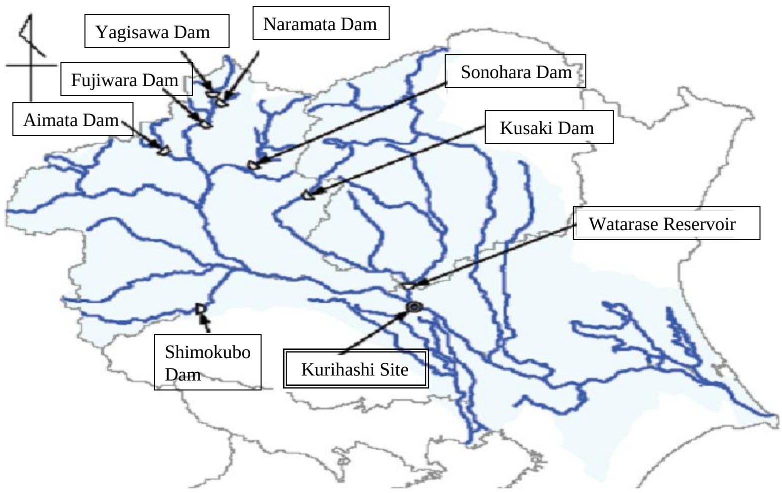

Fig. 6. The Site and Dams in Tone River Basin Examined in This Study

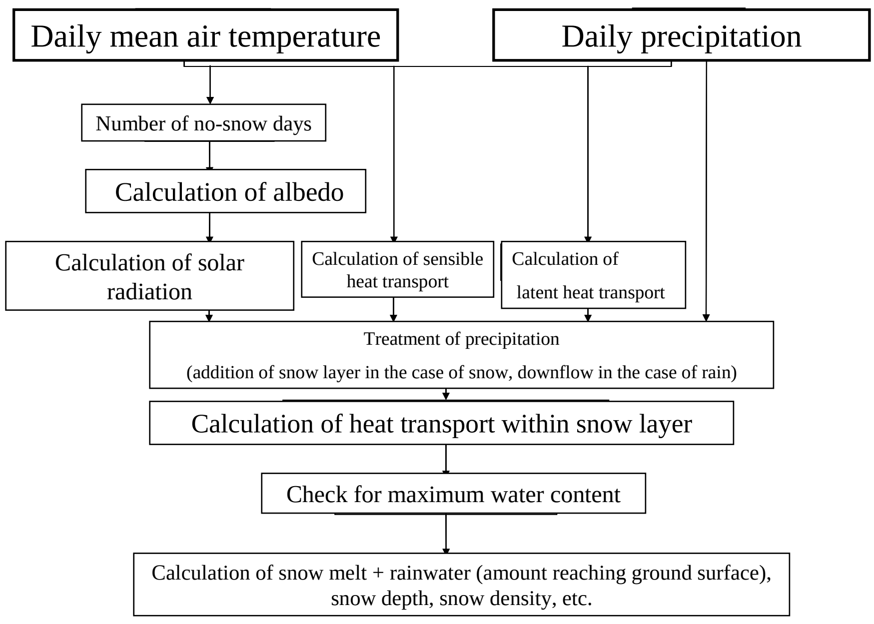

Fig. 7. Flow Chart of Calculation of Show Accumulation and Snow Melt

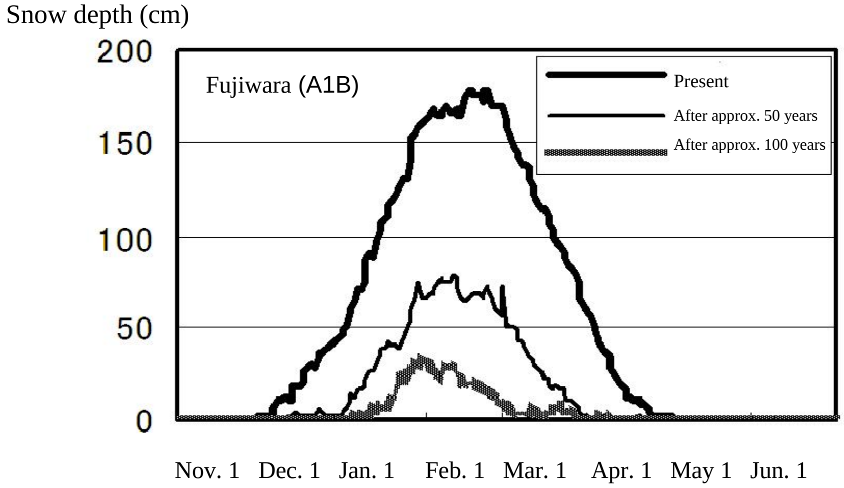

Fig. 8. Future Changes in Snow Depth (Fujiwara A1B)

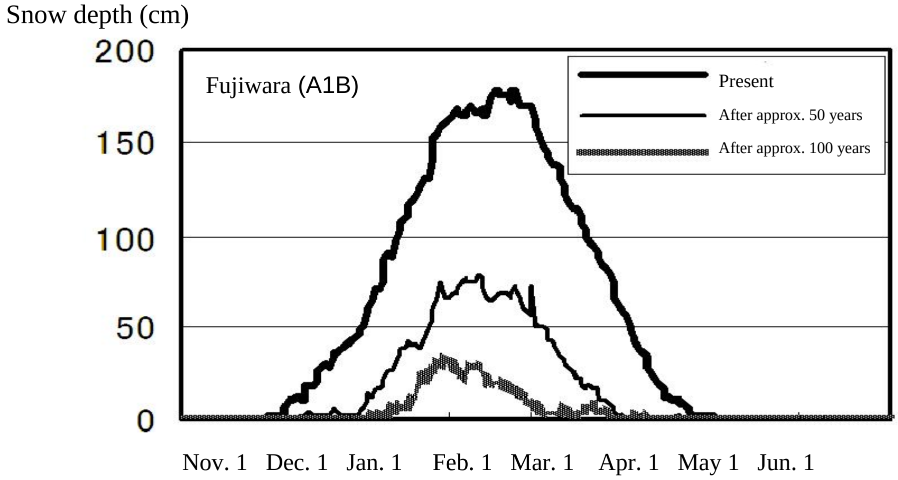

Fig. 9. Future Changes in Snow Depth (Fujiwara B1)

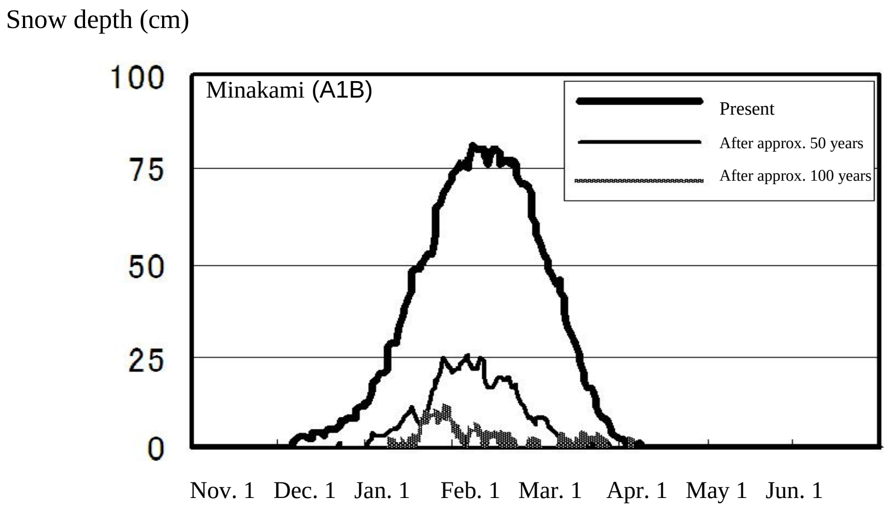

Fig. 10. Future Changes in Snow Depth (Minakami A1B)

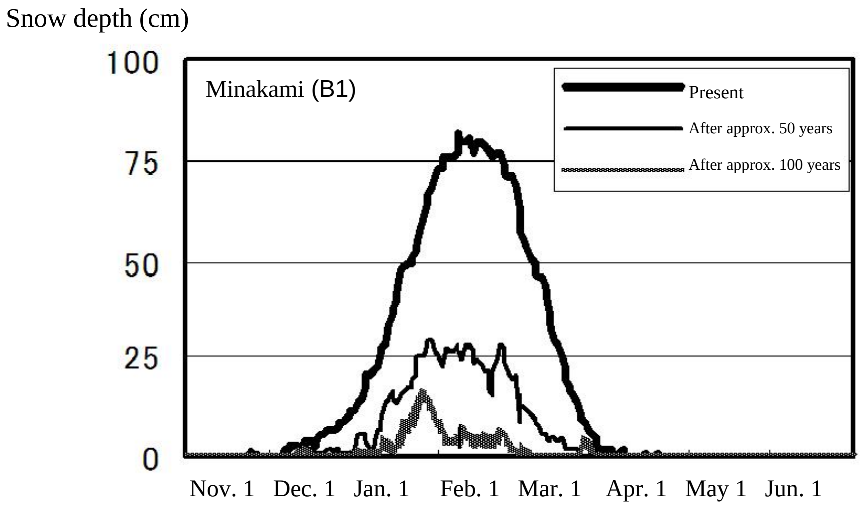

Fig. 11. Future Changes in Snow Depth (Minakami B1)

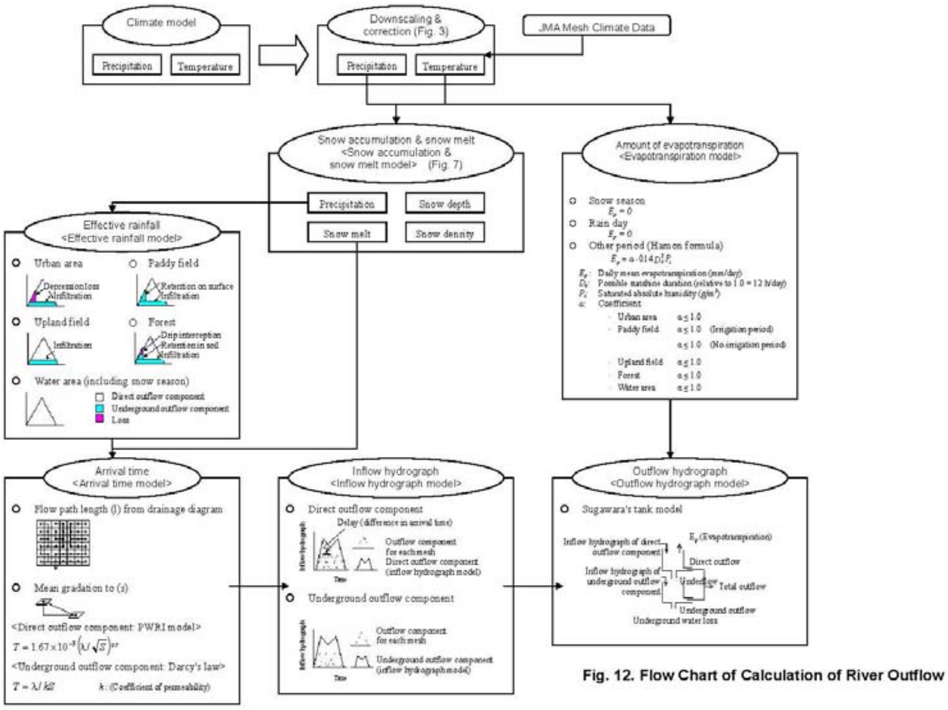

Fig. 12. Flow Chart of Calculation of River Outflow

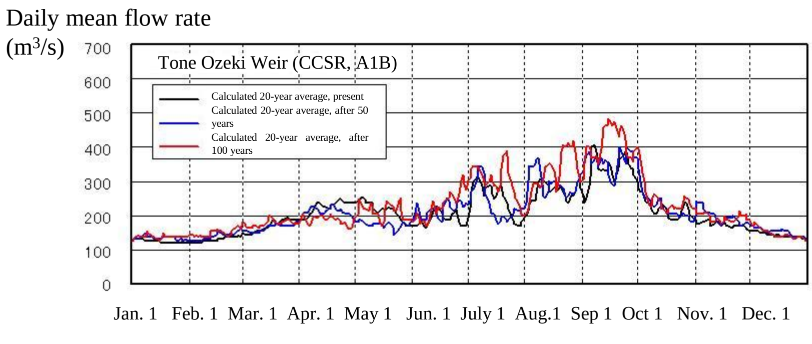

Fig. 13. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Tone Ozeki Weir) A1B

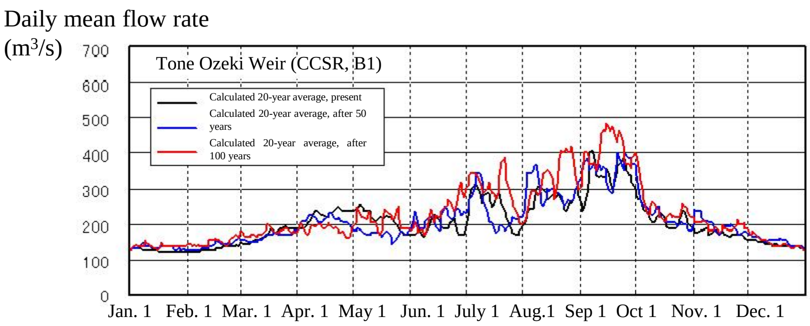

Fig. 14. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Tone Ozeki Weir) B1

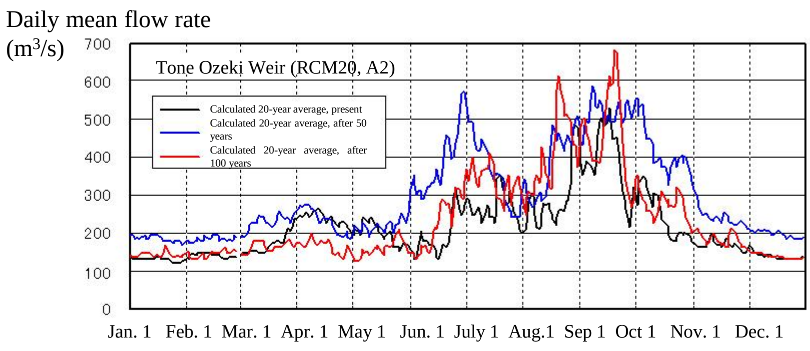

Fig. 15. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Tone Ozeki Weir) A2

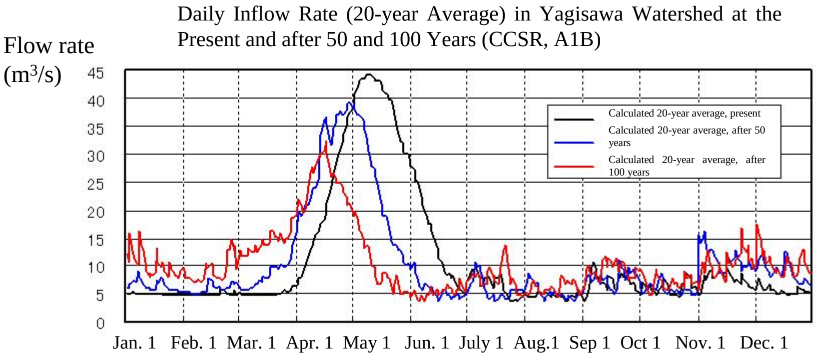

Fig. 16. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Yagisawa) A1B

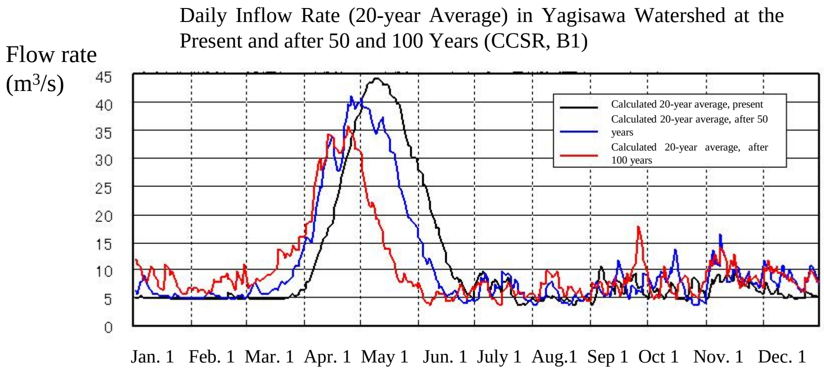

Fig. 17. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Yagisawa) B1

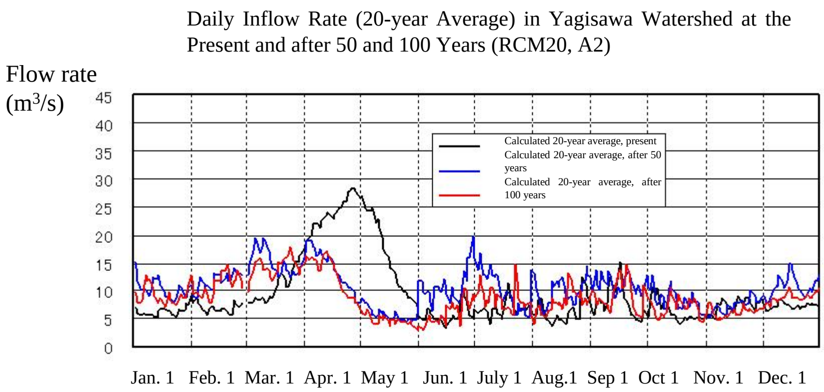

Fig. 18. Calculated 20-year Average Flow Rate at the Present and after 50 and 100 Years (Yagisawa) A2

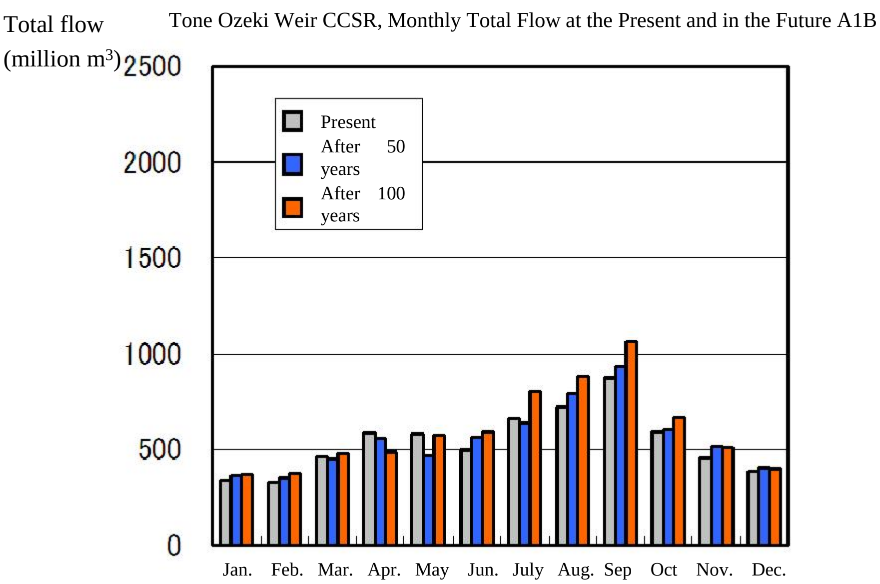

Fig. 19. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Tone Ozeki Weir) A1B

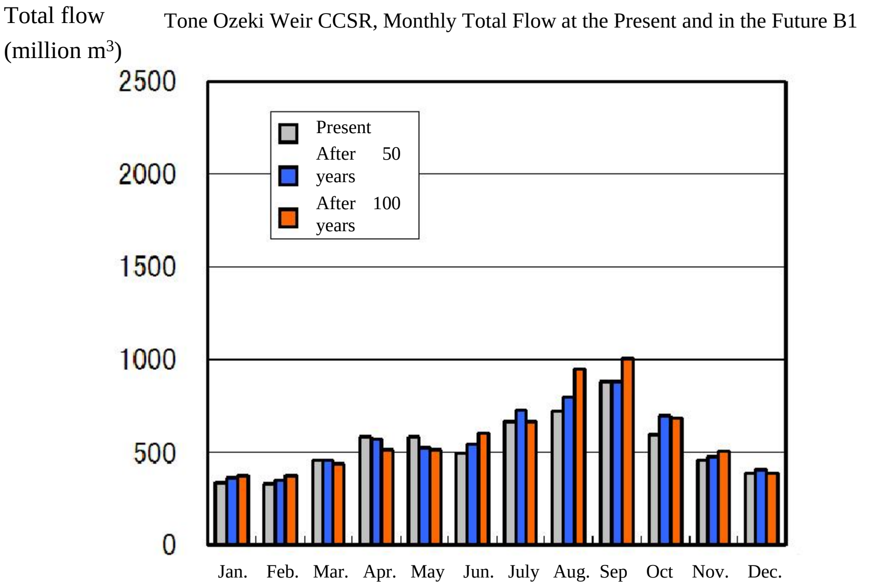

Fig. 20. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Tone Ozeki Weir) B1

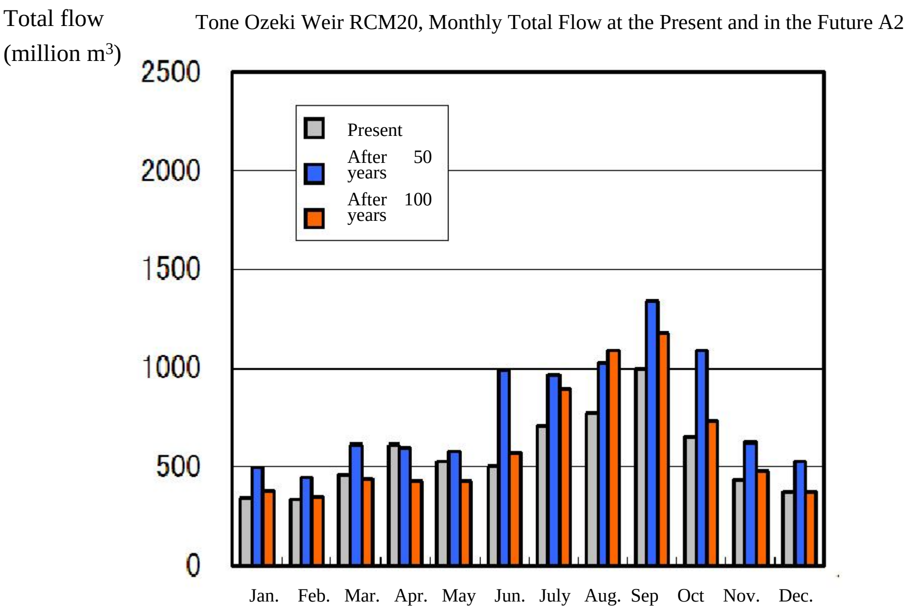

Fig. 21. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Tone Ozeki Weir) A2

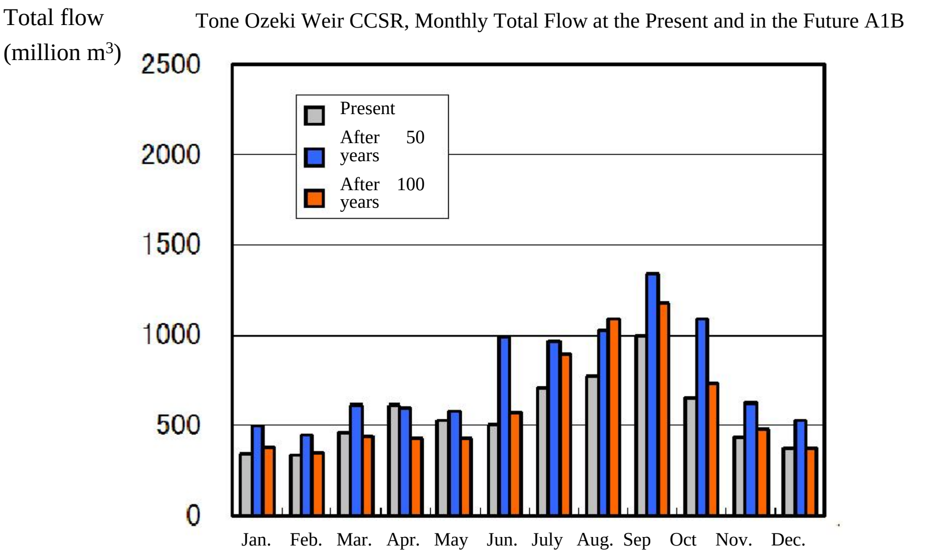

Fig. 22. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Yagisawa) A1B

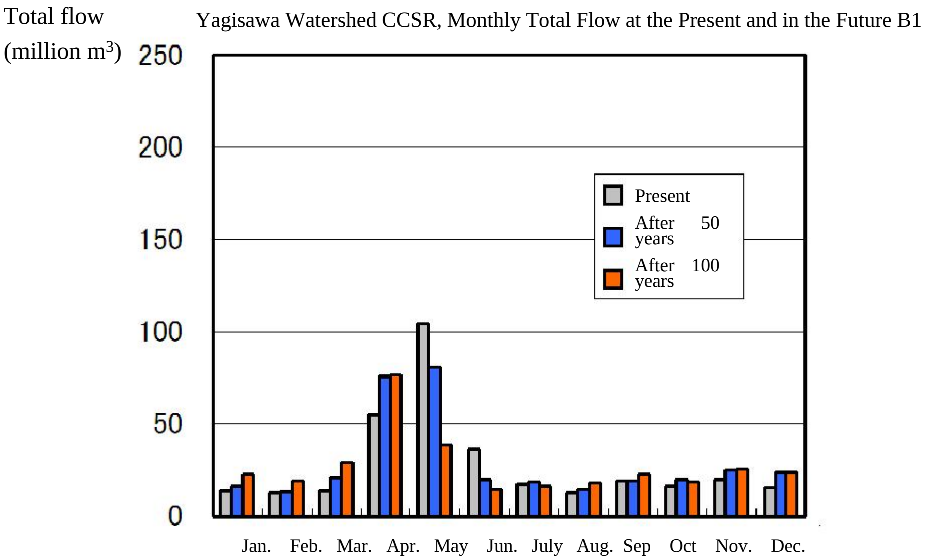

Fig. 23. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Yagisawa) B1

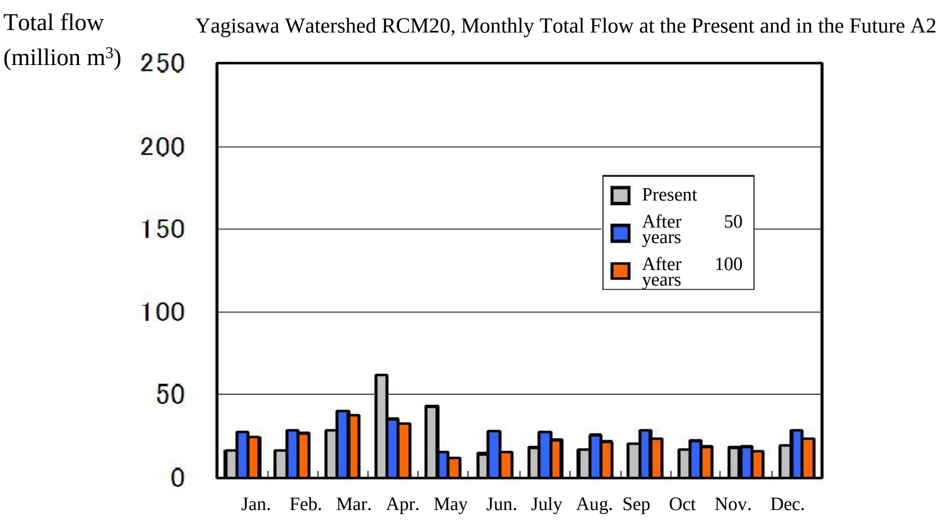

Fig. 24. Calculated 20-year Average Monthly Total Flow at the Present and after 50 and 100 Years (Yagisawa) A2

Table 2. Storage Capacity for Water Utilization Assigned to Dam Groups in the Upper Courses of Tone River

	Non-flood Season (Oct. 1 to Jun. 30 next year) (million m^3)	Flood Season (Jul. 1 to Sep. 30) (million m^3)
Watarase Dam Group	76.90	42.70
Shimokubo Dam	120.00	85.00
Okutone Dam Group	302.93	253.99

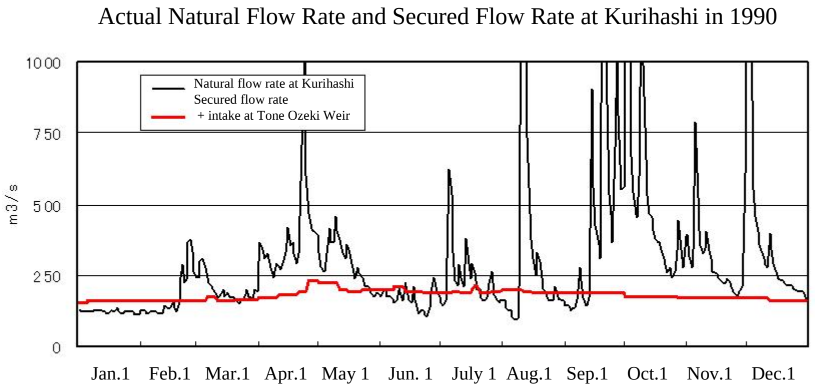

Fig. 25. Actual Natural Flow Rate and Secured Flow Rate at Kurihashi (Example Data for 1990)

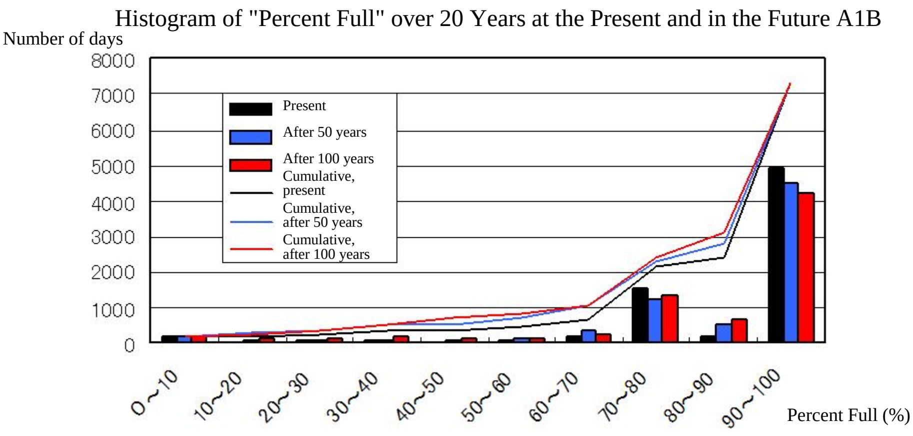

Fig. 26. Histogram of Overall “Percent Full” of 8 Dams at the Present and after 50 and 100 Years, A1B

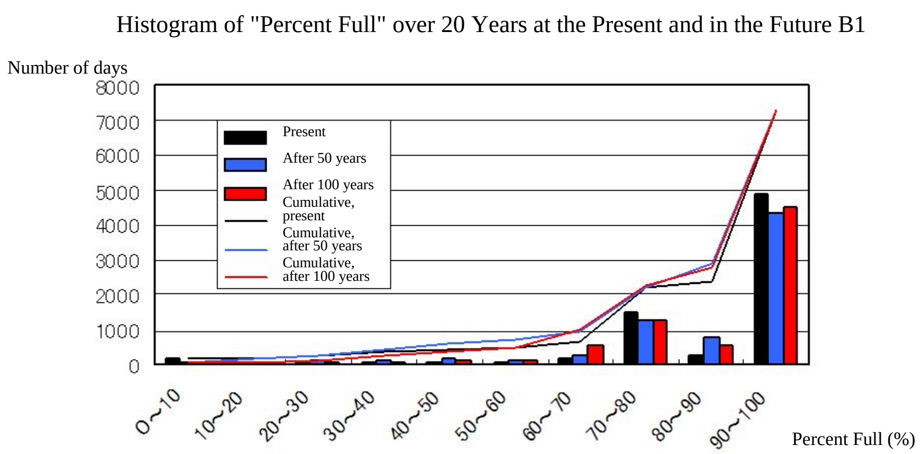

Fig. 27. Histogram of Overall “Percent Full” of 8 Dams
at the Present and after 50 and 100 Years, B1

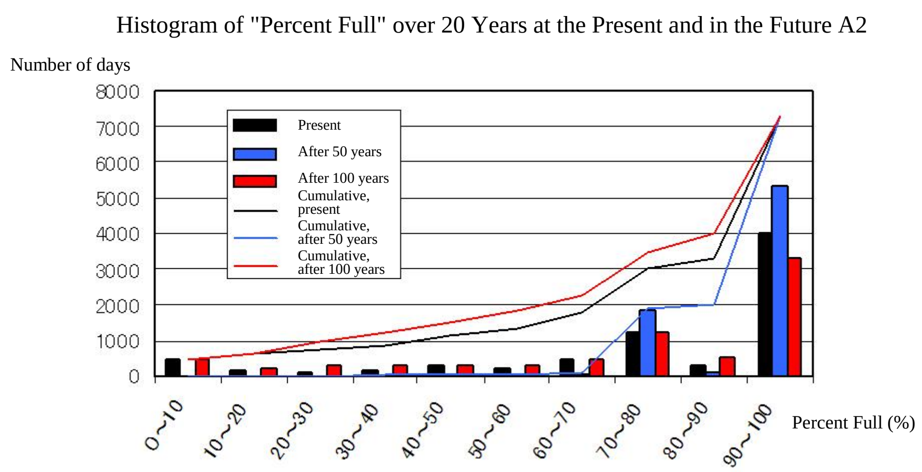

Fig. 26. Histogram of Overall “Percent Full” of 8 Dams
at the Present and after 50 and 100 Years, A2

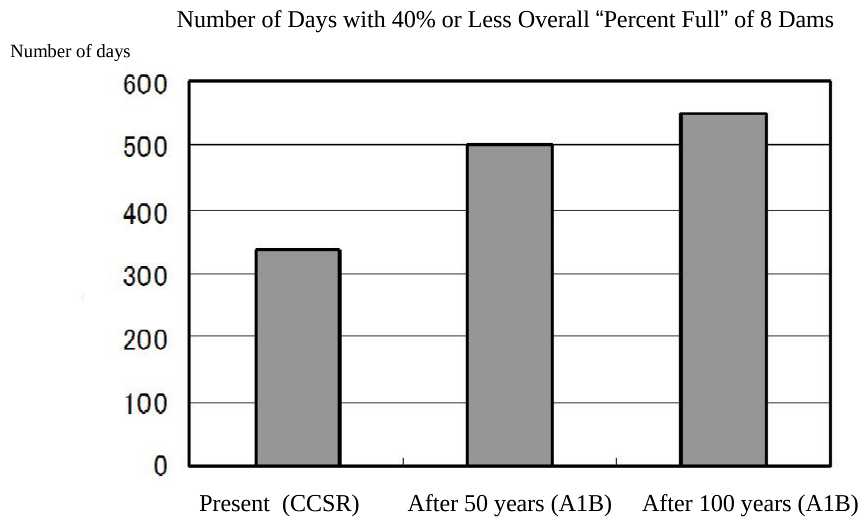

Fig. 29. Number of Days with 40% or Less Overall “Percent Full”
of 8 Dams at the Present and after 50 and 100 Years, A1B

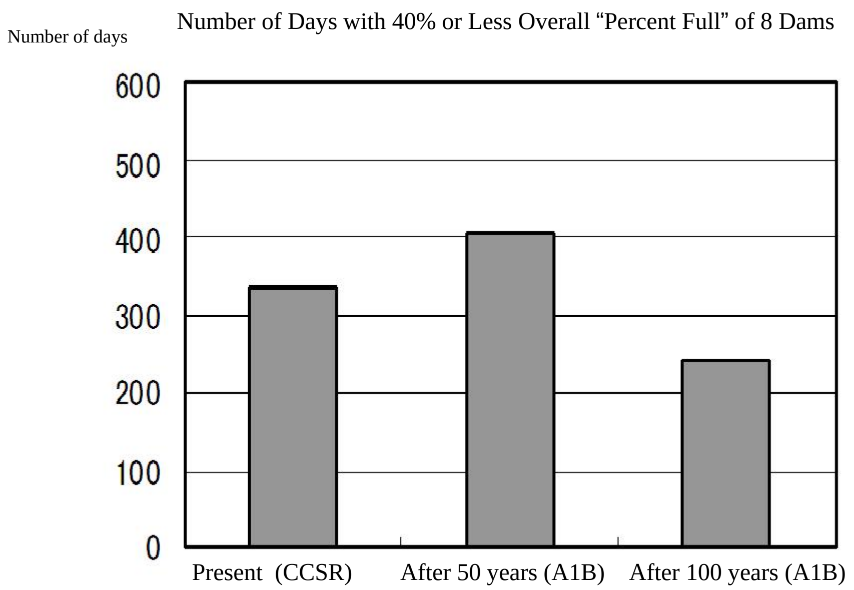

Fig. 30. Number of Days with 40% or Less Overall “Percent Full”
of 8 Dams at the Present and after 50 and 100 Years, B1

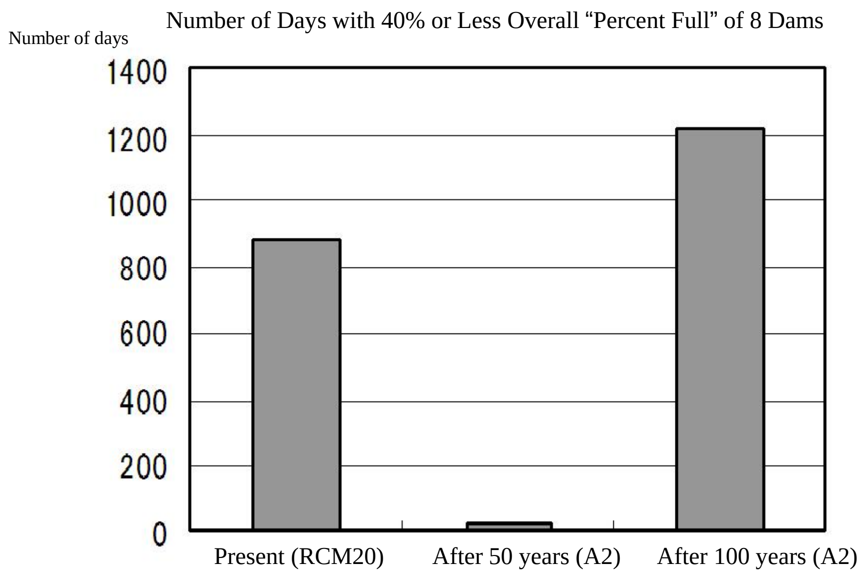

Fig. 31. Number of Days with 40% or Less Overall “Percent Full” of 8 Dams at the Present and after 50 and 100 Years, A2

Actions for the Future

Research on River and Coast Management in Response to Climate Change

2006 - 2009

[Outline of Study]

・To realize a safer society through prevention and mitigation of water disasters, the study focuses on the prediction of the time- and region-specific impacts of climate change on river and coast management, and considers measures for each stage of impacts.

・For the impacts that are already felt at the present (abnormal heavy rain, abnormal small rainfall, etc.), the study considers readily applicable practical measures making the best use of precipitation prediction information from Japan Meteorological Agency.

・For the impacts expected in the future (temperature rise, change in precipitation, sea-level rise, etc.), the study considers a wide range of measures based on the results of calculation for climate predictions, anticipating future social changes and assuming damage from flooding and droughts.

[Content of Study]

I. Next-generation Water Management Using Precipitation Prediction Information

(1) Study on flood prediction using precipitation prediction information

(2) Study on damage mitigation against predicted flooding

(3) Study on flexible dam operation using precipitation prediction information

II. Impacts of Global Warming on Rivers and Coasts and Response Measures

(1) Study on river management responding to global warming

(2) Study on the effect of sea-level rise and increase in heavy rain on the safety of flood-prone areas and response measures

(3) Study on the impacts on water management and response measures

(4) Study on coast protection measures anticipating future changes

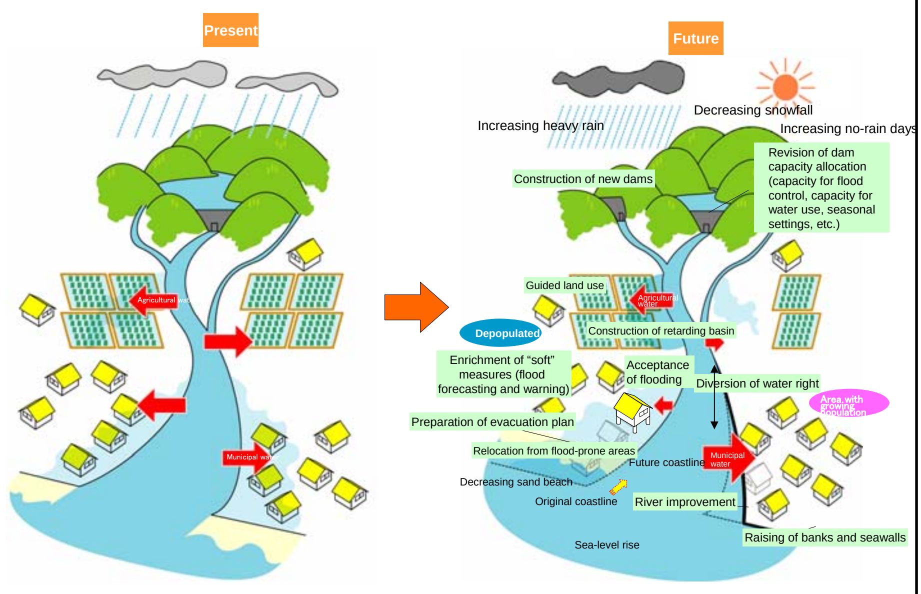

Fig. 32. Impacts of Global Warming on Rivers and Coasts and Examples of Response Measures

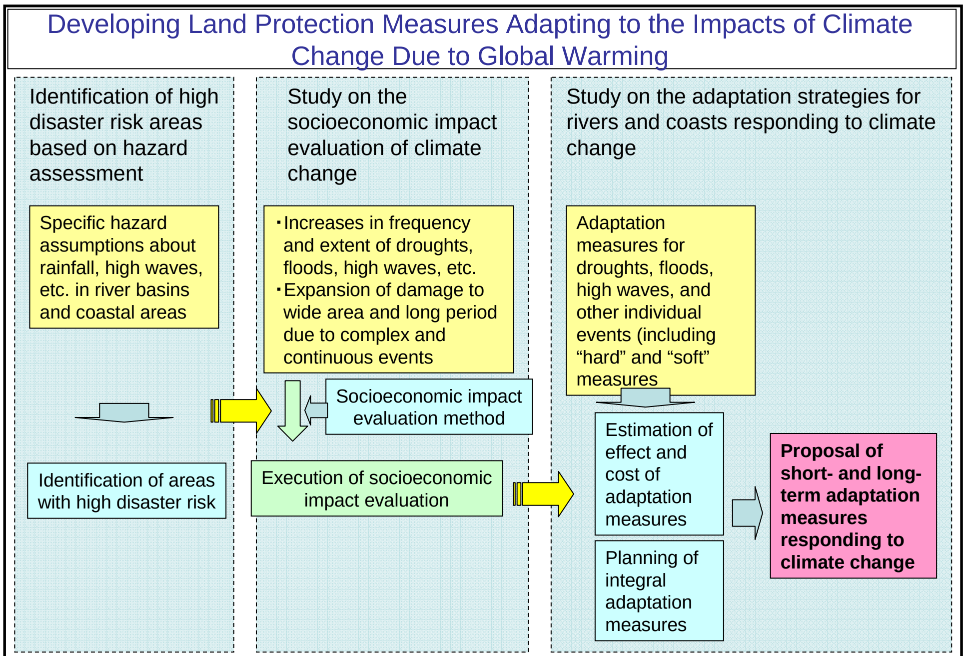

Fig. 32. Flow of Study

Study on Advanced Water Management Using Water Circulation Simulator（2008-2010）

Purpose

・Future global climate change is expected to cause further increase in damage from droughts.

・This study evaluates drought control measures that are implemented in various forms, and proposes and refines optimal drought control menus.

Content of Study

・To propose and evaluate optimal drought control menus responding to local conditions (water use management, sea water desalination, underground dams, reuse of highly treated sewage, dam-to-dam transfer, etc.)

・To design programs for implementation of drought control menus.

・To examine the effectiveness in controlling droughts due to future climate change

Goals

•Proposal of optimal drought control menus responding to the conditions of individual watersheds (water use management to prevent droughts, sea water desalination, underground dams, use of bottom water, use of gray water, recovery and use of industrial water, reuse of treated sewage, rainwater storage in cities, marine transport of water, dam-to-dam transfer, etc.)

•Evaluation of drought control menus

•Identification of institutional frameworks that need to be modified for implementation of optimal drought control measures

•Evaluation and proposal of low flow observation sites needed for advanced water resource

•Evaluation and proposal of drought control measures to meet future change in water supply and demand

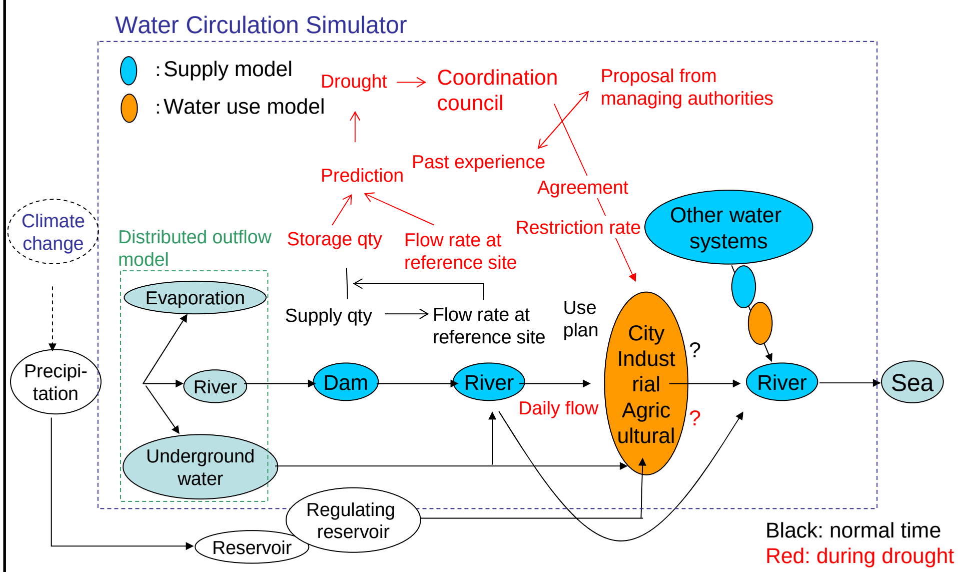

Fig. 33. Concept of Water Circulation Simulator

Ⅷ-4 Policy Making and Implementation Processes for Securing

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Head, River Environment Division,
Environmental Department, NILIM

Policy Making and Implementation Processes for Securing Water Resources in the Tokyo Metropolitan Area to Cope with the Rapid Population Growth

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Environment Department,
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Ministry of Land, Infrastructure and Transport (MLIT)

Abstract

In the Tokyo metropolitan area have shown rapid population growth and urbanization especially during the period of high economic growth, and diverse water policies on flood control, water utilization, and environmental protection have been taken. These are easy-to-understand examples demonstrating the relationship between an external force of population growth and responses to the force. In this study, the structures of response systems, which were assumed to exist between the external force of population growth and responses, were investigated to extract useful knowledge from the experiences in Japan and to process the information for facilitating the water policies to be drawn up for watersheds in Monsoon Asia.

Key Words : *water policy, water resources development, Tokyo metropolitan area, rapid population growth, water shortage, integrated water resources management, environmental impact*

1. Introduction

It is predicted that Monsoon Asia will face serious water issues, such as frequent floods, shortages of water supply, and deterioration of water quality, as a result of rapid population growth in the cities. In Japan, population had converged to Tokyo and neighboring metropolitan areas causing rapid urbanization to occur, especially during the period of high economic growth beginning in the late 1950s, and the implementation of various water policies on flood control, water utilization, and environmental protection have been effective to a certain degree. This process may be useful for solving the above-mentioned water issues in other areas of Monsoon Asia. However, even if the problems are similarly attributable to rapid population growth, policies effective in one region may not be effective in another area or at different times; therefore, the universality, commonality, and individuality of case experiences should be analyzed to establish a structured “knowledge”.

Recognizing these aspects, this study conducts the following analyses. Firstly, the policies in Japan were analyzed by interpreting the afore-mentioned Japanese experiences as being the response to an “external force” of rapid population growth. This external force and the increase in the demand for city water were reviewed, and the relative magnitude of the external force was evaluated against the available water resources. Secondly, the time sequence of water shortages caused by the external force was reviewed. Furthermore, the time series variation of the population’s awareness on water shortage problems, which relates to the driving force of policy promotion, was quantified by searching for newspaper articles. The transition of and the mutual relationship between the various water policies were summarized by time series since 1930s, and the correlation with the most important output - the additional water intake from the Tone River - was determined. Finally, the responses to land subsidence and water pollution, as well as the flow rate of the

Tone River, were examined as the possible factors promoting or inhibiting the policy implementation. By taking a panoramic view of the results of these analyses, the influence of the external force, the structure of response system in the application of water policy application, the effects and the governing parameters were studied.

There are many studies (individual references are made in the text) that summarize and analyze the progress of policies related to water resource development or management of water environment, and the general direction of the future water policies have also been discussed. However, studies that analyze the implementation process of various policies with a panoramic view are rare. By focusing on a predominant external force, such as the population growth in the Tokyo metropolitan area, and the characteristic responses of human/ecological system, being the securing of water resource, it is expected to enhance the understanding of the systems concerned in the water policy formulation.

2. Rapid Population Growth as an

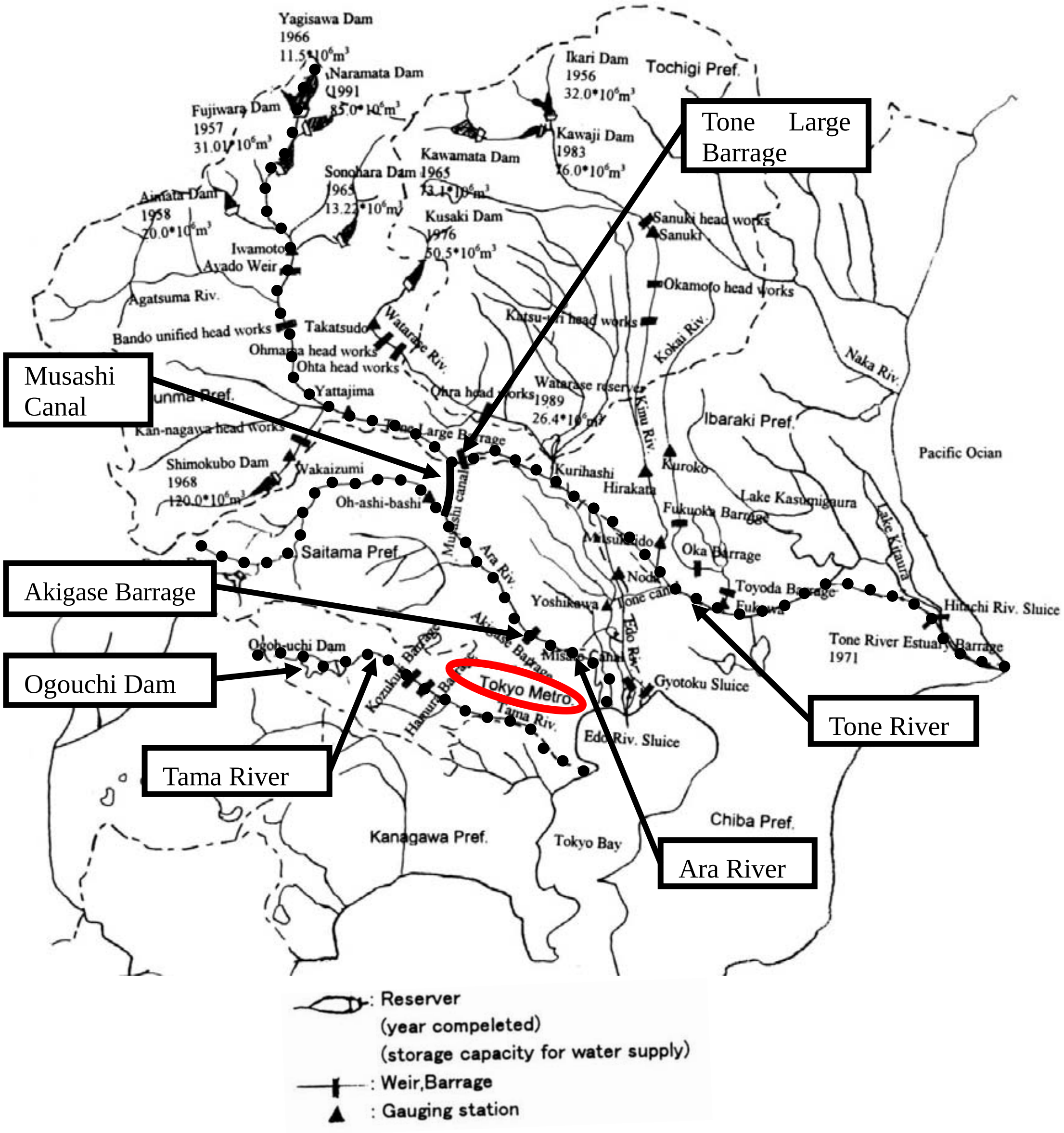

Figure 1 Rivers and basins in the Tokyo Metropolitan area and facilities for water resources development (River Bureau, Ministry of Construction (Supervised) (1997). Drought Conciliation and Water Rights, Infrastructure Development Institute – Japan, pp.II-3.)

External Force

(1) Increased demand for public-supply water use

Figure 2 shows the demographic changes in the Tokyo metropolitan area: Tokyo and the five prefectures, excluding Kanagawa prefecture that is less dependent on the Tone River (throughout the study, the analyses are done on Tokyo and the five prefectures, unless otherwise stated). The population had increased from approximately 15 million in the pre-war period to 22 million in 1965, and had reached 31 million by 1990.

The relationship between the population growth and the increased demand for city water is shown in **Figures 3** and **4**. Based on the two graphs, it can be calculated that, when the volume of water required per person is assumed to be approximately 400 liters, 1 billion m^3 per year of additional water withdrawal was required to respond to the population growth of 7 million from pre-war period to 1965, and additional 2.3 billion m^3 per year for the population growth of 16 million by 1990. In **Figure 4**, there is an increase of approximately 2 billion m^3 for the annual water supply between 1967 and 1990, which exceeds the estimation described above (2.3 - 1.0 = 1.3 billion m^3). This is probably attributable to increased water consumption per person, and the transition from groundwater use to public-supply water use. As indicated in **Figure 5**, during the period 1965 to 1990, the increase in population served by the public-supply water in Tokyo and the five prefectures was 14 million, 5 million people more than the population increase in the same period.

Therefore, it can be said that in addition to population growth being the major factor, the transition towards the use of public-supply water, and the increased water consumption per person have resulted in at least 3 billion m^3 per year of additional demand for city water.

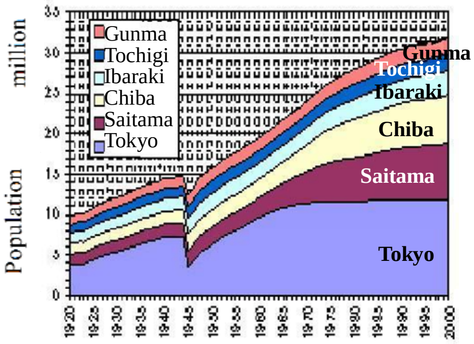

Figure 2 Demographic changes in the Tokyo metropolitan area (Tokyo and 5 prefectures).

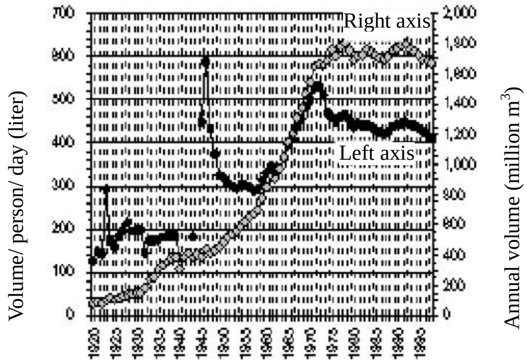

Figure 3 Transition of daily water-distribution volume per person and the annual water-distribution volume for public-supply use by year, in Tokyo.

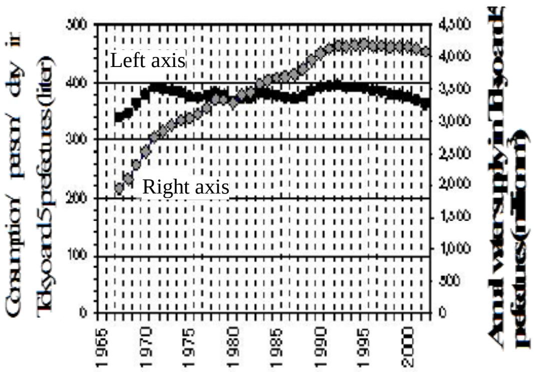

Figure 4 Transition of daily consumption per person and the annual water consumption of public-supply water by year, in Tokyo and 5 prefectures.

(2) Increased industrial water use due to the convergence and expansion of industrial activities in the Metropolitan area

Synchronization of rapid population growth and the convergence/ expansion of industrial activities also resulted in a sharp increase in the demand for industrial water, although the rising demand did not directly lead to an increased supply. As seen in **Figure 6**, this can be explained by the drastic improvement in the recycling & reuse rate of industrial water from the mid 1960s to 1970s. The volume of industrial water supply was

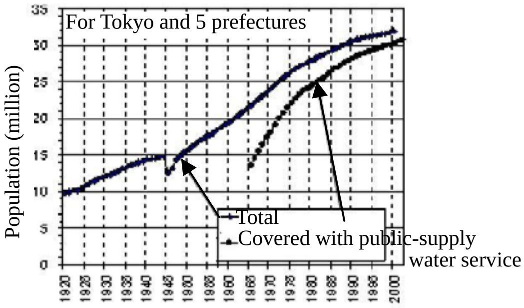

Figure 5 Transition of the population in Tokyo and 5 prefectures and the population covered with public-supply water service by year.

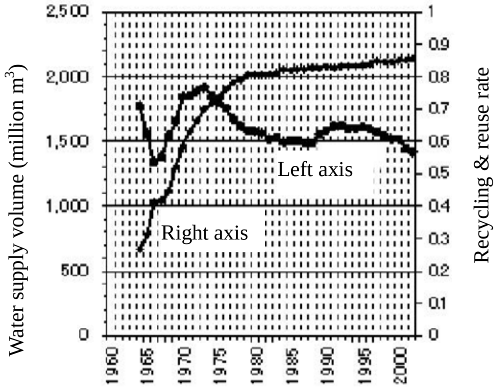

Figure 6 Transition of industrial water supply and recycling & reuse rate by year, in Tokyo and 5 prefectures.

approximately 1.5 billion m^3 in the early 1960s, almost equal to the previously mentioned demand for public-supply water use, but has not greatly changed until today. It can be assumed that the pressure to increase the supply of industrial water was at its peak between the 1950s and the early 1960s.

Assuming that the recycling & reuse rate had remained at about the same level as in the mid 1960s, i.e. 25%, and if 85% was taken as the actual rate, the calculation would give the increased quantity beyond the latter half of 1960s to be approximately 6 billion m^3 per year. If the volume increase before that period was also included, it would amount up to 7 billion m^3. Hence, together with the volume of public-supply water, the total increase that resulted from the population growth and the convergence/ expansion of industrial activities is estimated to be in the order of 9 to 10 billion m^3 per year.

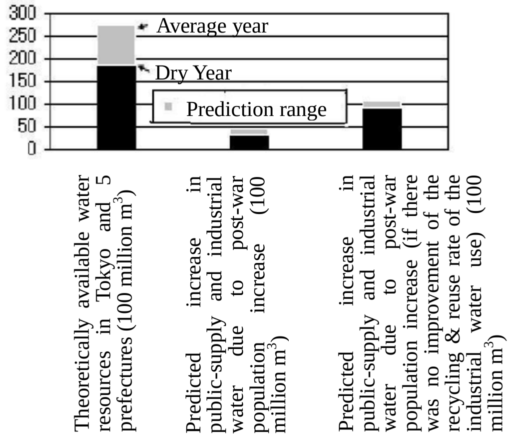

Figure 7 The impact of the increasing demand for public-supply and industrial water use accompanying the post-war population growth in comparison with theoretically available water resources.

(3) The impact of increased demand for public-supply and industrial water on the river basins of the Tokyo metropolitan area

The left bar chart of **Figure 7** shows the theoretically available water resource in Tokyo and the five prefectures. The other two bar charts on its right include, as a comparison, the prediction of increased demand for public-supply and industrial water use due to population growth (based on (1) and (2) described above). If there is no improvement of recycling & reuse rate, about half of the available water resources would be required to cover the additional volume of public-supply and industrial water required, and considering the proportion of water resources that can be used as public-supply and industrial water, it is evident that the increased demand would have acted as a serious external force on the river basins in question. Therefore, it can be said that the improvement of industrial water recycling & reuse rate had played an important role in adapting to the external force.

3. Water shortage problems induced by an external force of rapid population growth

(1) Overview of water shortages

What had mainly occurred as the direct result of rapid population growth acting as an external force, were shortages of public-supply water. The water shortages that had occurred intermittently between 1961 and 1964 in Tokyo, especially the so-called "Olympic water shortage" of the summer of 1964, had made a serious impact by causing water rationing and also suspension of water supply lasting for hours. The overview of these incidents can be summarized as follows. It should be noted, that the public-supply water of Tokyo at that time was withdrawn from Tama River system, and the water shortages concerned the Tama River system (see **Figure 1**).

a) Restriction of water supply in 1961 to 1962

In 1961, the precipitation in the Kanto region was substantially lower than the average in the past 22 years, with Tokyo marking a precipitation of 37mm in September, a mere 1/6 of the average year. Meanwhile, the water in the Ogouchi Dam (see **Figure 1**) had continued to decrease from its full capacity since June 1959, and the water level had decreased to approximately a 1/3 of the full capacity in early October. From 20th October, level 1 restriction of water supply was imposed on 545 thousand households in the 17 districts served by the dam, with a cut-back target of 20% (restriction hours lasted from 22:00 to 5:00).

The situation had still not improved by 1962, and the water restriction was scaled-up to level 2 on 16th April (cut-back target of 30%). The influence of water restriction expanded to a larger scale, which led to the establishment of "Provisional Task Force for the Water Shortage in Tokyo" on 1st May 1962. On 7th May, water restriction level 3 (cut-back target of 35%) was implemented, which included day-time rationing. Substantial alleviation of the restriction (back to level 1) was only realized in September, when the reservoir storage was recovered after considerable amount of precipitation.

b) Restriction of water supply in 1964

In autumn 1962, the water level of the Ogouchi Dam continued to decrease because of insufficient precipitation. Water restriction level 2 (cut-back target of 25%) was imposed again on 21st November, which continued almost throughout 1963. The strengthening and alleviation of water restriction continued to be repeated until July 1964. Finally in June 1964, with urgent withdrawals of 400 thousand m^3/day from the Naka and the Edo Rivers, the water restriction was alleviated back to level 1 (cut-back target of 15%) for the first time in 18 months.

However, the precipitation in May, June and July of 1964 was 261mm, approximately 50% of an average year, and water restriction was scaled-up to level 2 on 9th July. On 17th July, "Provisional Task Force for the Water Shortage in Tokyo" was re-established in order to respond to the emergency situation. Water restriction was strengthen to level 3 on 21st July (cut-back target of 35%, restriction hours from 23:00 to 5:00, and from 11:00 to 16:00), and to level 4 on 6th August (cut-back target of 45%, restriction hours from 22:00 to 5:00, and from 10:00 to 17:00). On 15th August, level 4 restriction was strengthened further (cut-back target of 50%, severe restriction including suspension of water supply during day-time). The restriction was imposed on 600 thousand households served by the reservoir, and the water shortage had a serious influence on the life of the citizens.

On 20th August, the water level of the Ogouchi Dam marked a record low of 1.6% of the full capacity. In addition, the river flow in the downstream of the Tama River also decreased considerably, and restriction of water supply was extremely strengthened in the areas served by the downstream water purification plants such as Tamagawa, Kinuta-kami, Kinuta-shimo, and Komae, and in the areas served by Nagasawa water purification plant that has the water diverted from Kanagawa as its source (376 thousand households in Shinjuku, Ohta, Shinagawa, Meguro, Setagaya, Suginami, and Nakano districts). Under the restriction, the water supply to the areas was limited to only 5 to 10 hours per day. The restriction started on 4th August and continued until the situation of the Tama River was improved by the torrential rain on 20th August.

c) From 1965 onwards

In the Tokyo metropolitan area, water shortages have continued to occur relatively frequently even after 1964. However, restrictions have mainly been on withdrawals and the socio-economic impact has been minimal in comparison to the water shortages described in the previous sections (a) and (b). "Withdrawal restriction" is a restriction imposed on water supply corporations for their water withdrawals. For example in the capital city of Tokyo, water withdrawal restriction can be overcome without restricting the water supply (water consumption), if the level of withdrawal restriction was not severe, by managing the water utilization or by requesting the citizen's cooperation in water-saving. On the other hand, if restriction is imposed on the water supply, various steps will be taken that will directly affect the end-users, such as the lowering of pressure of water supplied from purification plants, and adjustments on the valves of water pipes.

Despite rapid population growth and frequent water shortages that continued beyond mid-1960s, they never lead to a large-scale restriction on water supply as in the first half of 1960s, owing, to a large extent, to the implementation of policies for securing water resources, described later in section 4. The first half of 1960s can be described as a period where the combined influence of climatic variation and population growth had become apparent, and overcoming such difficulties was a crucial stage in the implementation of water policies for coping with the rapid population growth.

(2) Changing awareness of the population

How these water shortage problems are viewed by the local/ national population, is one of the important factors to consider in policy formulation. The transition in the number of related newspaper headlines was studied as one of the means to quantify such awareness. The Asahi Shimbun Post-War Headlines Database 1945 – 1999 was used as a database for this analysis. Local edition articles of Tokyo are also included. The calculation method is summarized below.

The analysis was carried out for the period between 1945 and 1999. The total number of article headlines, excluding those classified as international articles, such as diplomatic issues, foreign affairs, and global topics, was taken as the total number of domestic article headlines. With this total as the denominator, the proportion of headlines that include a certain key word was calculated, as an indicator to measure the level of interest in that particular topic. During the applicable period, the annual total number of domestic article headlines had increased from 14 thousand to 74 thousand. The selected key words were "water shortage or drought or water famine", "water supply and restriction", and "water supply suspension". All headlines that were extracted using a key word search function were checked, and those that were clearly irrelevant to the purpose of the study were omitted (e.g. water stoppage due to accidents or power cut of the purification plant etc.). Articles which were area-specific and unrelated to the Tokyo metropolitan area (e.g. Fukuoka water stoppage, water shortage in Hachijo-island, water shortages abroad etc.) were also excluded.

The results obtained are summarized in **Figure 8**, together with the information of the major water shortage years. The graphs show an increase in the number of headlines from the late 1950s, with a large peak in the earlier half of 1960s. As previously described, this was the time when serious problem of public-supply water shortage came to surface in Tokyo, ahead of other regions in the country, and the sharp rise in the number of articles reflects the sensitivity of the society on this topic. Although the number of headlines decreases after that, it can be observed that large number of headlines appear in the years matching the occurrence of water shortage, and this pattern continues until today. However, while the number of headlines including the word "water supply suspension" almost equaled the number of articles related to water shortage in general (water shortage or drought or water famine) in the earlier stage, a greater decrease of the former in comparison to the latter can be observed in the later stage. This trend may signify that there were fewer or more localized situations where direct damages were caused by water shortages.

Therefore, it can be said that the recognition of public-supply water shortage among local/ national population had become wide-spread in the latter half of 1950s and had peaked in early 1960s, and that this corresponds well

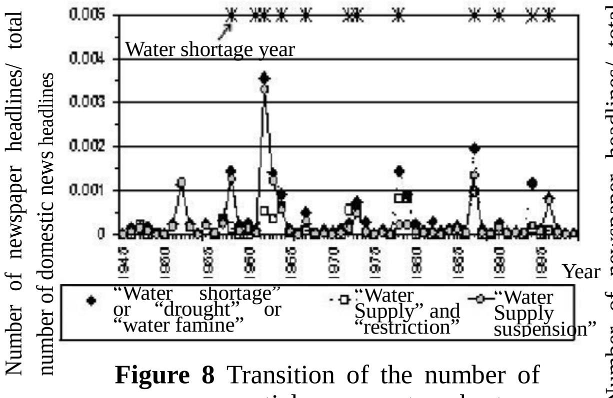

Figure 8 Transition of the number of newspaper articles on water shortage (Asahi Shimbun Post-War Headline Database 1945-1999).

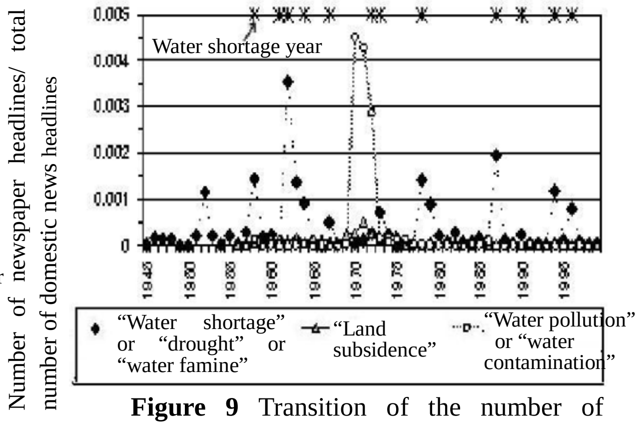

Figure 9 Transition of the number of newspaper articles on land subsidence and water pollution (Asahi Shimbun Post-War Headline Database 1945-1999).

with the years of serious damages caused by water shortages.

Figure 9 shows the transition in the number of headlines related to land subsidence and water pollution, calculated in the same method as above, as well as the number of headlines related to water shortage in general. Regarding the water pollution, the graph shows a major peak in the early 1970s, indicating a strong awareness of the issue among the population. Meanwhile, the peaks of the headlines concerning land subsidence is lower in comparison to the peaks of water shortage or water pollution; however, there are recurring peaks over the whole period starting from the late 1950s, with a slightly higher peak also in the early 1970s. It can be assumed that the phenomenon does not have a fluctuating nature that would result in sharp peaks, but the awareness of the problem had been fostered and maintained over the years. The relationship between these two phenomena and the policies for securing water resources will be discussed in section 5.

4. Effective policies for water shortage management and the outputs

(1) Overview of the policies

The policies that have been effective in the management of water shortages are listed and reviewed below. Please refer to **Figure 10**, which summarizes the whole picture.

a) Policies following "the basin-scale river water control concept", the germ of comprehensive river development

The concept of utilizing dams for flood control, hydraulic power generation, agricultural and public-supply water supply had emerged in around 1930s. The plan to construct the Ikari dam, the first multipurpose dam in Japan, had been formulated in 1925, and the construction of the dam started in 1950. In 1937, a survey of the most upstream Tone river basin for a river water control project had started, and the plans to construct the Yagisawa dam and other multipurpose dams with the purpose of securing public water supply and hydraulic power generation for Tokyo were formulated by 1939.

b) Post-war reconstruction and flood control policies immediately after the end of World War II

Around 1950s, flood control in response to frequent occurrence of devastating disasters, increase of food production and securing energy for post-war reconstruction were some of the top priority agenda of the country. Multipurpose dams that can be used to secure agricultural water and generate hydraulic power in addition to its main purpose of flood control, attracted a lot of attention, leading to the following section (c).

c) Tone River Specified Area Comprehensive Development Plan as part of the National Land Development Plan

In 1949, the Flood Control Investigation Committee decided upon the river improvement plan of the ten major river systems, including large-scale flood flow regulation by the multipurpose retarding basin. For the Tone River system, the basic principle was to control the floods with the upstream dams (Numata, Fujiwara, Sonohara, Aimata, Sakahara, and Yatsuba). In 1950, the formulation of a Comprehensive Development Plan for Specified Areas was decided under the Comprehensive National Land Development Act, and Tone River was designated as a specified area in 1951. In response, the 10-year Tone River Specified Area Comprehensive Development Plan was endorsed by the Cabinet in 1957. Hence, land conservation based on flood control plan consistent for the whole river system, which promotes water utilization for agricultural development, secures electrical power generation, and strengthens industrial development, became the policy direction. Furthermore, the "Comprehensive River Development" that uses multipurpose dams as concrete tools, came to occupy an important position in the National Land Development Plan.

d) Comprehensive River Development of the Tone River

As the result of the above-mentioned process, the constructions of several dams including Ikari, Fijiwara, Aimata, Sonohara, Yagisawa, Shimokubo, Kusaki, and Kawaji were sequentially completed and placed in service. The time-scale from the survey to the completion of each dam is indicated in **Figure 10**. "FNAWIP" in the diagram refers to the different purposes of dams (F: Flood control / disaster prevention of agricultural land, N: water for unspecified use / river maintenance flow, A: Irrigation water, W: Public-supply water, I: Industrial water, P: Hydraulic power generation).

e) Specified Multipurpose Dam Law (1957)

The law was enacted to ensure the unification of planning, construction, management of dams, to establish the rights to use a dam, and to ensure the smooth and effective use of dams.

f) Laws concerning water resources development (Water Resources Development Promotion Law, 1961 /

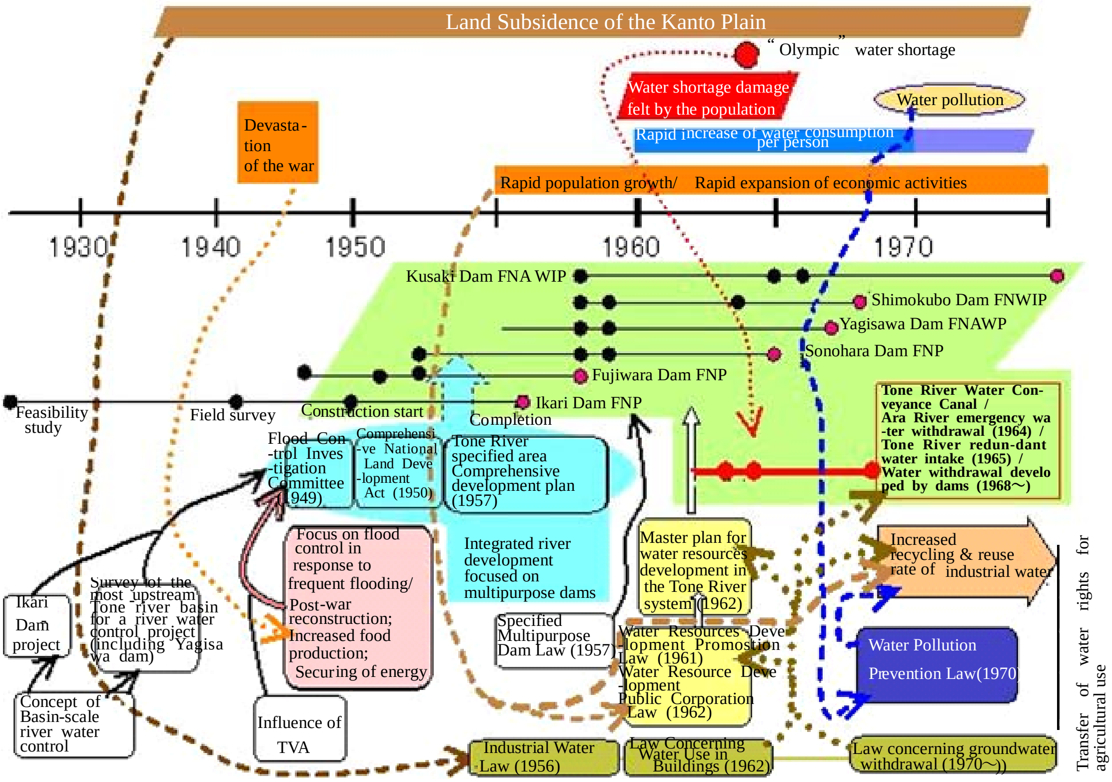

Figure 10 Time sequence of events and implemented policies relevant to water resources management to cope with the rapid population growth (the arrows show relationships or presumable influence).

Water Resources Development Public Corporation Law, 1962)

With the systems that existed previously, there were problems such as difficulty to utilize lake waters, unclear role of channels, lack of means to use investment and loan funds, difficulties for broad-based or advance development, and formulation of plans by each individual corporation. Moreover, while rapid population growth and industrial development had lead to a sharp increase in the demand for water in the Tokyo metropolitan area, the transition of groundwater use to surface water became an important issue because of land subsidence. The issue of securing public-supply water was particularly pressing for the Tokyo area, where there was narrow possibility for new water resource development in the Tama River system.

Under such circumstances, these legal systems were established based on the principle that the water resource development would play an important part in the country's economic plan, thus requiring a broad-based and a systematic approach. As a response, the Tone River and the Yodo River were designated as the river systems for water resource development in 1962, and a Water Bureau was created within the Economic Planning Agency.

g) Tone River Water Conveyance Canal Project

Even before the war, the municipal government of Tokyo has had the idea of withdrawing the high quality water in the upstream of the Tone River for the purpose of public water supply. A plan based on the idea (conveying the water from Yagisawa and Shimokubo dams to Higashi-murayama purification plant, via a tunnel in the western region of Saitama prefecture) was taken up by the Ministry of Construction as a Water Resources Development Public Corporation project (hereinafter referred to as the Public Corporation). The Ministry of Agriculture and Fisheries was against the withdrawal of water from a position that is further upstream than the withdrawal position for agricultural use. Therefore, the Ministry of Agriculture and Fisheries proposed a plan with a combined canal for agricultural and public-supply purposes. Both the Ministry of Health and Welfare and the Ministry of International Trade and Industry also proposed other Public Corporation projects respectively.

Despite the strong request from the municipal government of Tokyo, the implementation method of new water withdrawal was still not established in 1962, when the Master Plan for Water Resources Development in the Tone River System was formulated. Therefore the Public Corporation urgently designed a plan with the combined canal, and the construction was initiated in 1963. The goals of the Projects were i) to convey the public-supply water developed from the dams in the upper stream of Tone River to Tokyo and Saitama prefecture, through Musashi Canal and Ara River, ii) to provide stable supply of irrigation water to 29,000ha of rice fields in the Tone River middle reach, iii) to urgently but provisionally provide the Tone River's surplus water for the purpose of Sumida River purification.

The whole Tone River Water Conveyance Canal Project (Akigase Barrage, Asaka Canal, Tone Large Barrage, and Musashi Canal) was completed in March 1968. In order to respond to the occasional water shortages in Tokyo during the construction period between 1963 and 1968, provisional functioning was effectuated as emergency measures. First, in August 1964, together with the Olympic water shortage, the crisis had forced a rush construction work to realize partial water flow (Ara River emergency water withdrawal). Furthermore, after the completion of the Musashi Canal in March 1965, the surplus water of Tone River has been able to flow. Thus, such emergency measures in addition to the whole Project, have been important in responding to the crisis situations.

h) Others

The continuous efforts made by all the concerned parties in the transfer of water rights from agricultural use to public-supply water, has played a role to a certain degree. Moreover, institutional improvements were made on the various measures for minimizing the impacts of dam and reservoir construction on communities around the site.

(2) Output of policy implementation: Changes in withdrawals

The easiest way to quantitatively determine the overall achievements of various policies would be to examine the changes in the volume of withdrawals and their breakdown. Given that the industrial water supply had not increased greatly beyond late 1960s due to the improvement in recycling & reuse rate, as described in section 2(2), this study focused on the public-supply water, because it can be assumed the use of the public-supply water would be the direct reflection of the measures against rapid population growth. The withdrawals and their breakdown were calculated by employing the following method.

First, based on the statistical data on water supply, the total public-supply water withdrawals for Tokyo and the five prefectures were examined by year. Next, also based on the statistical data on water supply, the ratio of the volume of water rights from the Tone River as well as from the Tone River dams, were calculated against the total volume of water rights. Since the total volume of withdrawals includes the water that is not within the scope of water rights, the calculation was done by using only those to which water rights are applicable (surface water, lake water and river-bed water) and multiplied by the above-mentioned ratios of water rights to determine the breakdown of withdrawals from the Tone River system including the dams (for every 5-year period). In reality, the water rights are not necessarily equal to actual withdrawals; therefore, the calculation will have inherent margin of error. However, it was considered to be an effective means of assessing the situation with a broad perspective.

The results of the above, together with the data on demographic changes, are indicated in **Figure 11**. From the graphs, it can be observed that the majority of the 2.5 billion m^3 additional withdrawals during the period of 1965 to 1990, was covered by the withdrawals from the Tone River system (approximately 2.3 billion m^3). If the required volume per person was 400 liters, this would correspond to a water supply for 16 million people, which greatly exceeds the population increase of 9 million from 1965. As mentioned in the section 2(1), this is probably attributable to the increased water consumption per person and the transition from groundwater use to public water service. Furthermore, it is possible that industrial water is partially included.

Also from **Figure 11**, it can be observed that the ratio of withdrawals premised on the dams of the Tone River system (described as "withdrawals from the dams on the Tone River system" on the graph) is large against the additional withdrawals from the Tone

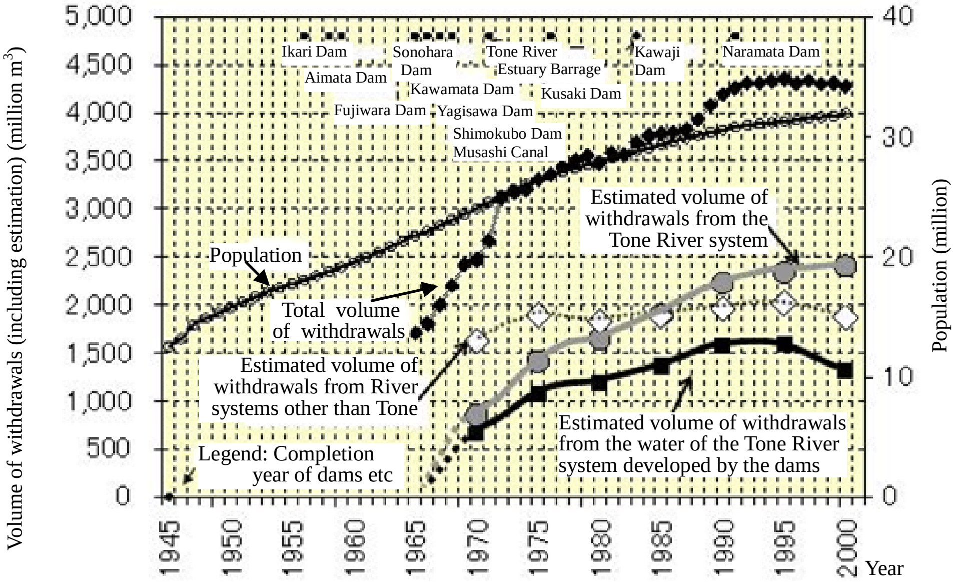

Figure 11 Transition of population and the volumes of public-supply water withdrawals by year, in the Tokyo metropolitan area (Tokyo and 5 prefectures).

River system. This signifies an important role played by the increased volume of water rights, in line with the new water resource development by dam construction.

For example, when the Tone River Water Conveyance Canal Project was completed in 1968, the rights for public-supply water use from the Tone Large Barrage were for the newly constructed Yagisawa Dam and Shimokubo Dam. Although there have been occasions where time-lags have emerged between new water resources development and the increase in public-supply water demand, the framework of linking new water resources development with the increase of withdrawals has been maintained.

5. Analysis of other factors related to the implementation of policies

(1) Related incidences and policies that influenced the policies for securing water resources

Here, land subsidence and water pollution that are thought to have exerted significant influence on the policy making processes, will be examined. Reference should be made to **Figure 10**.

Land subsidence occurs mainly as a result of excessive withdrawal of groundwater, for the purpose of industrial use. In Koto district of Tokyo, it is known to have started back in the mid 1920s. Public awareness on land subsidence, as explained in the section 3(2) and with **Figure 9**, is evident from the number of newspaper articles appearing continuously from the late 1950s and peaking in the early 1970s. Countermeasures have started in the late 1950s, and the Industrial Water Law was enacted in 1956, followed by the so-called law concerning water use in buildings which was enacted in 1962. In 1970, regulatory measures were applied on groundwater based on Chiba Prefecture's environmental pollution prevention ordinance, followed by Saitama, Tokyo, Ibaraki, and 49 other municipalities.

The implementation of these measures coincides with the period where water shortage due to rapid population growth surfaced and drastic measures were in demand. Therefore, it is possible to assume that increasing the groundwater use would not have been a practical option to respond to the population growth and rising demand for industrial water. There is also a possibility that this functioned as a "secondary external force" that raised the industrial water recycling & reuse rate.

On the other hand, it is evident from **Figure 9** that water pollution became a major interest of the population around about 1970, and the Water Pollution Prevention Law was enacted in 1970, in addition to the existing Water Quality Preservation Law and the Industrial Waste Water Regulation Law. The population's strong request for water quality preservation became one of the important factors that encouraged the rationalization of industrial water usage, in other words the improvement in the recycling & reuse rate. According to Aya and Matsumoto, the campaign for the rationalization of industrial water, run by the Industrial Water Association, had been highly effective in strengthening the increase of production without depending on new water resources and by reducing the speed of land subsidence. They continue to suggest that the decrease in supplementary water signifies effluent reduction, allowing small quantity of highly concentrated effluent to be purified and discharged. They point out that the rationalization of industrial water had made water quality preservation possible with a surprisingly small amount of investment, and that the campaign had in fact stressed that the rationalization of industrial water would be the most economical means to clear the regulations of Water Quality Preservation Law.

Therefore, it can be said that the awareness for land subsidence and water pollution together with the implementation of policies for coping with them had functioned as important promoting factors in solving the problems related to the securing of water resources, by creating a structure where an increased demand for industrial water is overcome by an improved recycling & reuse rate.

(2) Analysis on the environmental impact induced by the implementation of policies

As another factor, incidences related to possible environmental impacts induced by the policies for securing water resources will be examined.

Figure 12 shows the transition by year, of the 185-day low flow in the Tone River at points upstream and downstream of the Tone Large Barrage (diversion weir to the Musashi Canal) (the data are from the annual Flow Rate Chronology). These points are Yattajima, Futto, Tone Large Barrage, Kawamata, the confluence of the Watarase River, and Kurihashi, from upstream downwards. It can be seen from the graph, that the low flow at Kawamata which was approximately equal to that at Futto in 1968, drops from then onwards in the order of 50m^3/s. This also corresponds to the actual withdrawal volume from the Tone Large Barrage (1.87 billion m^3 in 2001, the breakdown being 730 million m^3 for agricultural water, 1.09 billion m^3 for public-supply water, and 50 million m^3 for river water purification. The annual total flow of the Tone River in the reach is 6.29 billion m^3). In other words, the Tone Large Barrage had caused reduction of discharge in the channel downstream of the barrage. The influence of this reduction becomes apparent at times of the year when the flow is low, and after 1968, the 355-day low flow at Kawamata is halved. It is also clear from the above-mentioned breakdown, that the decrease is not only attributable to public-supply water use but also to agricultural water use.

Next, assessment of the influence of additional water intake on water quality was conducted by applying the watershed-scale hydrological and material cycle simulation model that incorporates all the major river systems flowing into the Tokyo Bay. The discharge and the water quality at some of the major points on the Tone River and the Ara River for years 2001, 1976 and 1970 have been reconstructed almost to the level of actual measurements, by using this model. With 1976 taken as the target year, under the social conditions such as population and land use, the meteorological conditions such as rainfall, and the actual loading, the discharges was calculated with the actual withdrawal volume to the Tone River Conveyance Canal as case 1, and with no withdrawal from the Tone Large Barrage as case 2. For the case 2, the water intake from Akigase Barrage on the Ara River is also

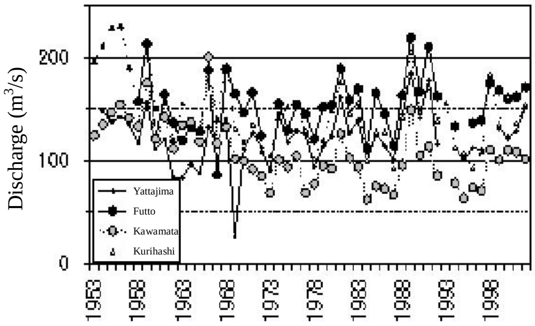

Figure 12 185-day low flows in the Tone River upstream and at points downstream of the Tone Large Barrage

considered to be zero, as no water is channeled from the Tone River to the Ara River (see **Figure 1**).

The results of the analyses are shown in **Figures 13** to **16**, from which the following observations on the impact of water conveyance (the result of case 1 in comparison to case 2) can be made. Naturally, the discharges at Kurihashi (Tone River) downstream of the Tone Large Barrage decreased, but the discharges at Sasamebashi (Ara River) downstream of the Akigase Barrage did not change greatly since the conveyed water is withdrawn at this point. The water quality indicated by BOD, hardly changed at Kurihashi, but decreased slightly in Sasamebashi depending on the season. This can be explained by the fact that while there is no major source of burden that would affect the concentration in the downstream of the Tone Large Barrage, the inflow of water in the Ara River may have a slight dilution effect depending on the season.

Therefore, it is assumed that the withdrawal from the Tone Large Barrage did not have a major effect on BOD, for both the Tone River and the Ara River. Regarding the flow required to be left in the river even during drought period for maintaining river environment and ecology, it is stated as “the maintenance flow” in the draft proposal for the Technical Guideline for River Works, issued in 1977, and it is highly probable that such concept existed in the 1960s. However, apart from the specific areas or cases where the problems induced by discharge reduction are clear, such as salt water intrusion in estuaries, it was probably not necessary at the time to specify the maintenance flow throughout a whole river reach. In fact, even

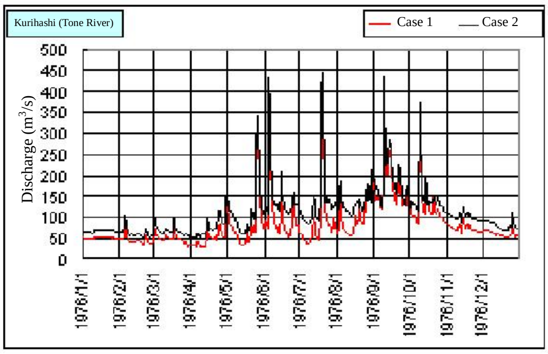

Figure13 Comparison of discharge at Kurihashi (Tone River)

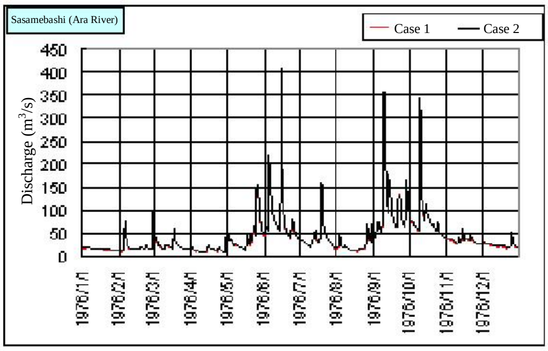

Figure 14 Comparison of discharge at Sasamebashi (Ara River)

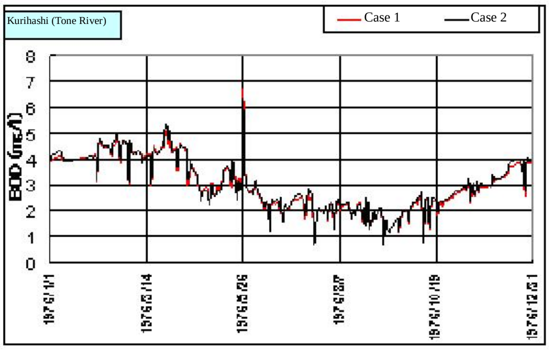

Figure 15 Comparison of water quality at Kurihashi (Tone River)

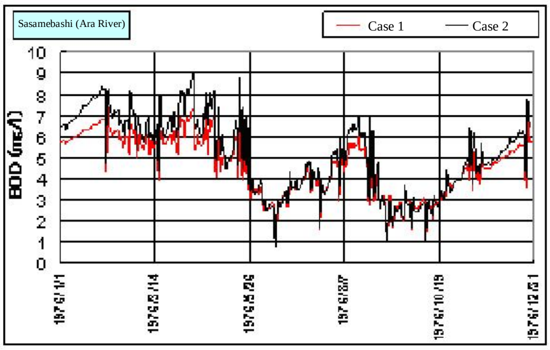

Figure 16 Comparison of water quality at Sasamebashi (Ara River)

for the Tone River Water Conveyance Canal Project, the maintenance flow is not specified in the lower reach immediately after the Tone Large Barrage.

Thus, if we look at the environmental impact based on the evaluation standards of those days, it is unlikely that the environmental concerns could have been the inhibiting factor for the implementation of the water intake from the Tone River to the Tone River Conveyance Canal.

6. Discussion

The policies to cope with the rapid population increase in the Tokyo metropolitan area will be easily understood if they are divided into four categories: (i) new public-supply water development relying on the Tone River system, (ii) improvement in the industrial water recycling & reuse rate, (iii) transfer of water usage (from agricultural water use to public-supply water use), and (iv) economizing of domestic water use. It can be said that the two formers largely and practically contributed to solving problems. Regarding (i), as it can be reconfirmed in **Figure 10**, the Tone Water Conveyance Canal has allowed the initiation of a large-scale water intake from the Tone River dams in 1968. This is only 4 years after the Tokyo Olympic water shortage in 1964, and based on the usual time-scale of infrastructure development, this time-lag can be considered to be short.

When reviewing the reasons why it was possible to successfully respond to the convergence of population and economic activities that became increasingly evident in the late 1950s, the following points may be considered. The direct and the most important contributing factor is the fact that the various emergency measures employed to overcome the early-60s critical situation were eventually and smoothly followed by the full-scale control measures such as (i) and (ii) mentioned above. As for (i), the Tone Water Conveyance Canal would not have functioned on its own but was made possible by "the Master Plan of Water Resources Development in Tone River System", a framework that had been formulated just beforehand (1962), which allowed the fundamental conditions for the Tone River water intake to be developed. In addition, based on the National Development Plan which had been formulated ten years in advance with post-war reconstruction and flood control as the core purposes, the comprehensive river development plan had already begun in practical terms. As the construction of multipurpose dams was the main focus of the river development plan, rapid response to the external force was made possible. Meanwhile, in terms of significant improvement in the industrial water recycling & reuse rate mentioned in (ii), external forces such as the regulation on groundwater withdrawals for the alleviation of land subsidence, or the effluent regulation for water pollution prevention, induced recycling & reuse rate improvements rather than relying on the increase in water supply.

Figure 17 attempts to summarize the structure of policies taken to meet the rapid population growth in the Tokyo metropolitan area. Here, the developmental stages from the exertion of external force to the output (achievements) of policy application are classified into issues recognition, forces encouraging investigations and execution of the policies (and the strength of responses of each player), the tools for policy implementation, and external factors related to policy implementation (sub-divided into interaction with policies with other purposes, consensus among interested parties, environmental impacts, and geographical conditions). The powers each of these categories may exert on various policies have been qualitatively indicated on the table: promoting power (arrows to the right), impeding power (arrows to the left) and neutral power (straight vertical line). Furthermore, if application in another region is being considered today, the level of contemporariness and universality should be re-considered for the policies and factors which have been shaded.

Figure 17 shows that emphasis had been placed on infrastructure construction and

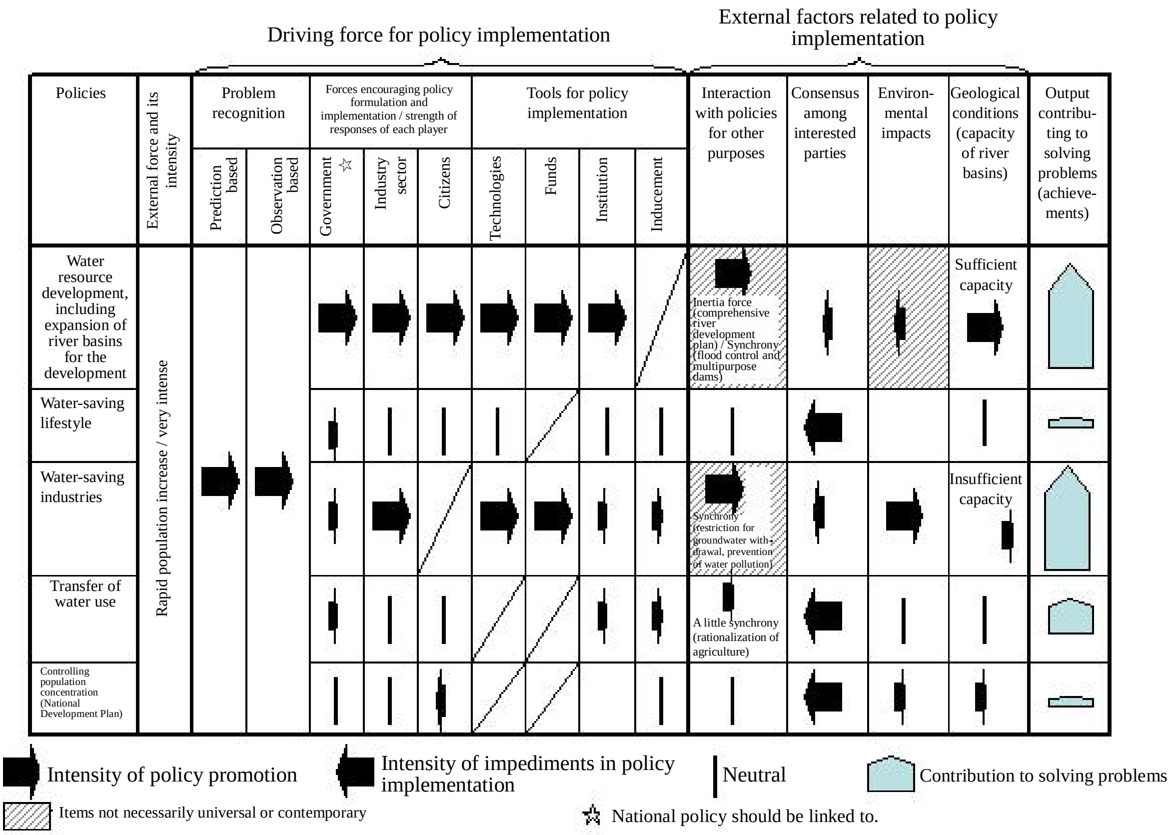

Figure 17 Structure of the formulation and implementation of policies taken to meet the rapid population growth in the Tokyo metropolitan area

firm-based policies. The synchrony among flood control measures, restrictions on groundwater collection, and measures against water pollution, which existed then, would have played an important role in the policy promotion in those days. Furthermore, the Comprehensive River Development Plan of the Tone River basin with a core focus on the construction of multipurpose dams mainly for flood control, had been developed over a long period of time, and such prior policies (inertia force) had greatly contributed in the resolution of the problems. Therefore, the favorable interactions with policies for other purposes being in a “win-win” situation, and to what extent they can be applied or expanded, would also be a valid point of discussion when considering the application of the experiences summarized in **Figure 10** in another region today. For example, a combined application of the effluent regulation for water quality preservation and the policies related to the improvement of industrial water recycling & reuse rate may be a useful proposal for a comprehensive water policy of today.

The other shaded area is related to environmental impact, which is more emphasized today than at that time. Depending on the relationship between the capacity of the target river basins and the pressure of population increase, there may be cases where the management of environmental impacts of the policies becomes an important issue. For the policies implemented in the past, one may simulate the possible development of events by assuming that the level of knowledge and the demand for the environmental protection in those days had been as high as they are today. This process would help to determine whether the policies would be applicable today, and to consider substantial methods to expand them. Environmental considerations on the maintenance flow, flow regime, frequency of disturbances of a river could be some of the examples.

7. Concluding Remarks

In Japan, various policies related to the securing of water resources have been formulated in the past, in response to the rapid population growth in the Tokyo metropolitan area experienced mainly during the period of high economic growth. Various aspects of the external force (rapid population growth), events induced, problem recognition, policy implementation and its outputs, and other related factors have been examined, and by analyzing them from a panoramic perspective, an overview of the interactions between various events and policies could be summarized as seen in **Figure 10**. Furthermore, a conceptual framework of the developmental process, from the exertion of external force to the outputs of policy implementation, has been presented in **Figure 17**. They will be of assistance in analyzing the universality and the individuality in the formulation process of each water policy, and may be used to objectively consider how an experience in a particular point in time and in particular region can be applied to a different case in another region and in different pointing time.

Ⅷ-5　The Evaluation of Flood Risk and Prevention of Flood Disaster

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The evaluation of flood risk and prevention of flood disaster

National Institute for Land and
Infrastructure Management

Research, Evaluation, and Publication of River Improvement Status Focusing on Small and Medium Size Rivers

(Regarding the Use of Laser
Profiler Measurement)

Purpose and Outline

○Recent rash of water-related disasters across Japan

Severe damage along small and medium size rivers that are susceptible to the impact of localized heavy rain.

Levee Breach in 2004

July, heavy rain in Niigata and Fukushima	Niigata	Igarashi R., Kariyata R.
July, heavy rain in Fukui	Fukui	Asuwa R.
Sep., typhoon No. 23	Hyogo	Maruyama R., Izushi R.

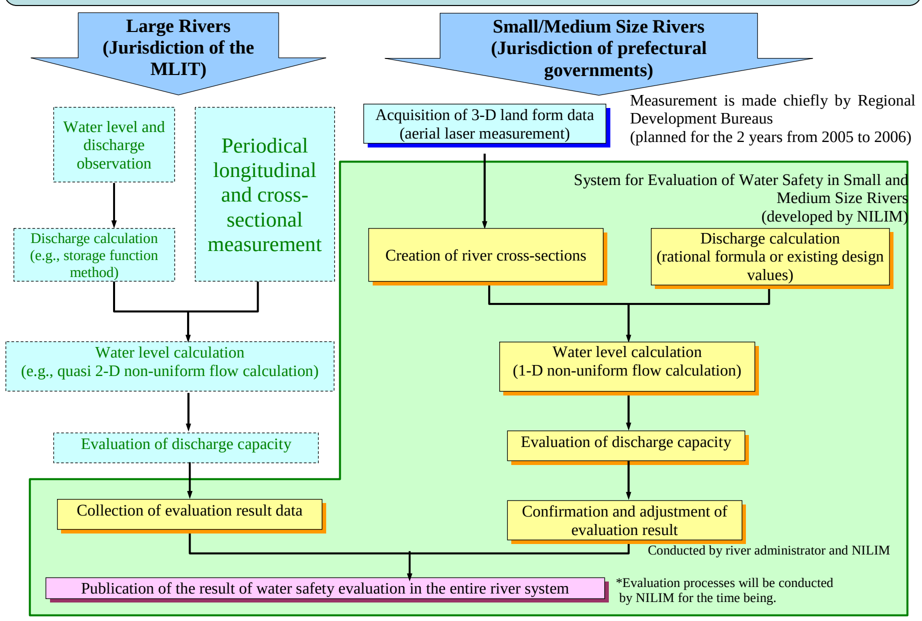
①Promotion of efficient and effective flood control
②Practical crisis management in the event of disaster
③Enhancement of inhabitants' awareness of risk

⇨ Based on discharge capacity and other data, the status of river improvement must be grasped, evaluated, and publicized.

However,
the data on discharge capacity and other basic important parameters are often missing due to the lack of longitudinal and cross-sectional measurement of river channels, as well as monitoring of water levels and discharges, in many stretches of small and medium size rivers.

Water safety evaluation covering small and medium size rivers in the watersheds of class A rivers across Japan will be conducted using simple methods and unified standards instead of traditional data collection and analytic procedures.

Flow Chart of Survey, Evaluation, and Publication of the State of River Improvement in Class A River Systems



Scope of Evaluation and Coverage of Aerial Laser Measurement

1. Scope of Evaluation

River section under the jurisdiction of MLIT and prefectural governments requiring improvement within class A river systems

River section under the jurisdiction of MLIT in class A river systems: approx. 10,500 km
River section under the jurisdiction of prefectural governments in class A river systems: approx. 32,000 km
(Total length of river section under the jurisdiction of prefectural governments is approx. 77,000 km)

2. Coverage of Aerial Laser Measurement

River channels and flood regions related to river section under the jurisdiction of MLIT and prefectural governments state-managed segments and prefecture-managed segments requiring improvement within class A river systems

(Approx. 120,000 km² including mountainous areas covered by the measurement using fixed-wing airplanes)

●Data acquisition is conducted by Regional Development Bureaus

●Data acquisition schedule: Measurement of all areas is planned to be completed in 2006.

●Types of data sets to be obtained:

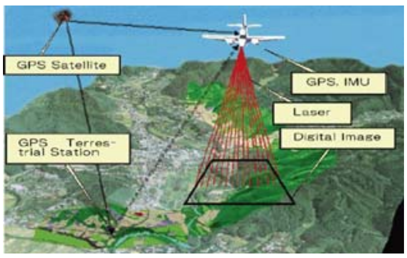
①Original data (river channels and flood plains) Accuracy: horizontal ±30 cm, vertical ±15 cm

②Ground data (river channels: approx. 20-m zone inward from the toe of slope behind embankment)
* Ground data are generated by filtering original data to remove unnecessary features.

③Aerial photos (orthophoto images) (river channels and flood plains)

Outline of Aerial Laser Measurement

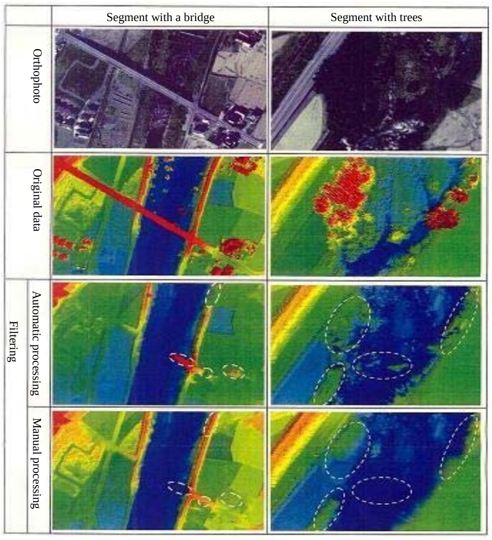
Outline of Aerial Laser Measurement



Major Filtering Items

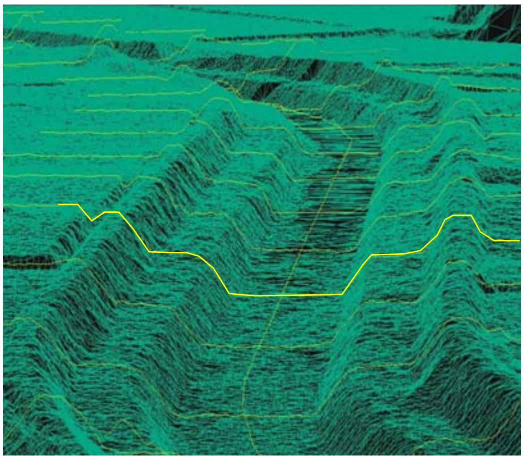
Transportation facilities	Road facilities, etc.	Road bridge (length 5 m or longer)
		Overhead pass, pedestrian overpass
	Railway facilities	Railway bridge (length 5 m or longer)
		Overhead pass (including overhead monorail lines), link-line bridges
Foliage		Trees, bamboo forests

Filtering of the Data from Aerial Laser Measurement



Grasping the Present State of River Channel

○A triangulated irregular network (TIN) model is generated from the acquired ground data, and used as the basis for generation of river channel cross-sections at regular intervals.
(Automatic generation using the software developed at NILIM)



Errors in River Channel Cross-sections

- ・Accuracy of aerial laser measurement (horizontal ±30 cm, vertical ±15 cm)
- ・Errors from the spatial resolution of laser data
- ・Errors from the filtering of features
- ・Errors from the inability to measure underwater features

⇩

- ○Using mostly winter measurements that are not so badly affected by foliage growth
- ○Carrying out accuracy checks, correction and interpolation with the use of river channel measurement cross-sections when they are available

Discharge Flow Calculation

Considering the present state of data collection and analysis in small and medium size rivers and aiming at quickly and simply establishing a minimal ability for consistent calculation of the discharge capacity of small and medium rivers nationwide, we uniformly apply the inexpensive, efficient, and simple method using rational runoff formula instead of traditional procedures.

$$Q_P = \frac{1}{3.6} frA$$

Qp: flow at the peak of flooding (m^3/s), f: runoff coefficient, r: precipitation intensity within the time of flood concentration (mm/hr), A: area of flow region (km^2)

・Flow coefficient (f):

- ・Weighted average of the flow coefficient for each land use region (related to the area of each region)
- ・0.7 for mountainous areas, 0.8 for flat areas

・Precipitation intensity within the time of flood concentration (r):

・This uses the AMeDAS Probable Precipitation Calculation Program developed by the Public Works Research Institute.

This program creates the precipitation intensity equation (Fair formula) based on precipitation recorded between 1971 and 2000 in 748 of the approximately 1,300 Japan Meteorological Agency's AMeDAS measurement locations positioned throughout the entire country. (http://www.pwri.go.jp/jpn/tech_inf/amedas/top.htm)

$$r_t^T = \frac{bT^m}{(t+a)^n}$$

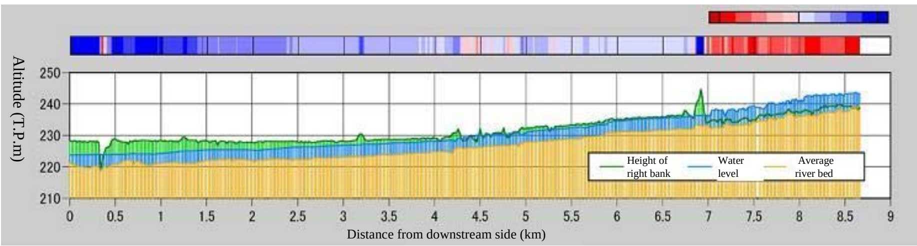
r_t^T : Probable amount of rainfall (mm/hr)
T : Return period (year)
a,b,m,n : Parameters of Fair formula
t : The time a flood is likely to occur (either Kraven formula, Kadoya formula, or Doken formula)

Water Level Calculation

○ Considering the present state of data collection and analysis in small and medium size rivers and aiming at quickly and simply establishing a minimal ability for consistent calculation of the discharge capacity of small and medium rivers nationwide, we uniformly apply the inexpensive, efficient, and simple method using 1-dimensional non-uniform flow calculation instead of traditional procedures.

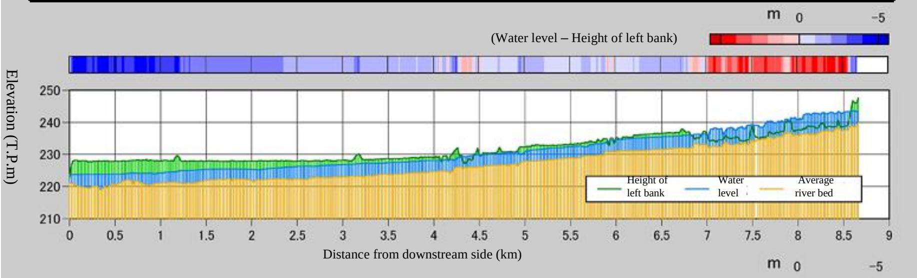
* Roughness Coefficient

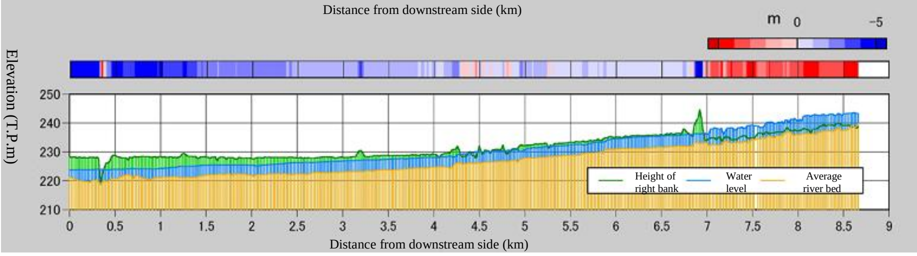
・The value of n=0.033 is used based on the analysis of trends in the roughness coefficient in 58 small and medium size rivers, where the roughness coefficient has been studied in detail from actual measurement and other sources.



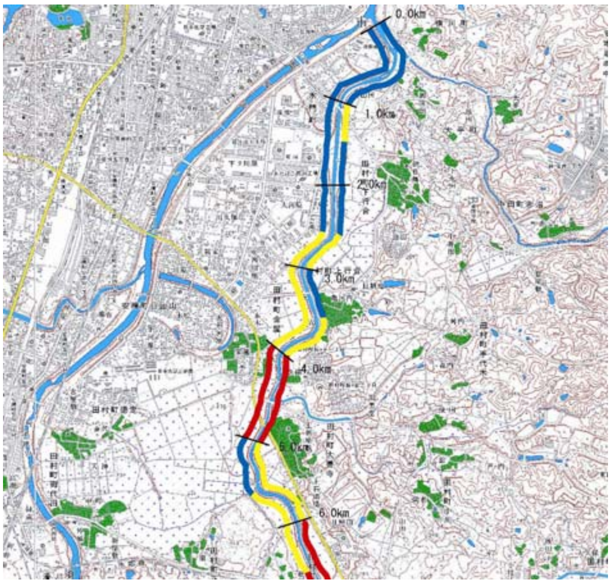
Output of Evaluation Results (1) Discharge Capacity Evaluation Chart Showing Water Level and Bank Profile

River Name	Calculated Length	Probability Scale	Probable Precipitation	Probable Flow	% of Satisfactory Parts on Left Bank	% of Satisfactory Parts on Right Bank
A River	8.6 km	1/10	47 mm/60 min	400 m³/s	78%	85%





Output of Evaluation Results (2) Water Safety Evaluation on Plan Map



The degree of water safety is evaluated as the minimal discharge capacity in each segment (500-m pitch).

Legend	
Blue line	Segment that can withstand floods expected to occur once in 30 years. (Segment with a discharge capacity of 600 m^3/s or more) (Segment with a risk of flooding caused by a rainfall of 50 mm/h or more)
Yellow line	Segment that can withstand floods expected to occur once in 10-30 years (Segment with a discharge capacity of 480m^3/s - 600m^3/s or more) (Segment with a risk of flooding caused by a rainfall of 30 mm/h or more)
Red line	Segment that cannot withstand floods expected to occur once in 10 years (Segment with a discharge capacity of 480m^3/s or less) (Segment that cannot withstand a rainfall of 30 mm/h)

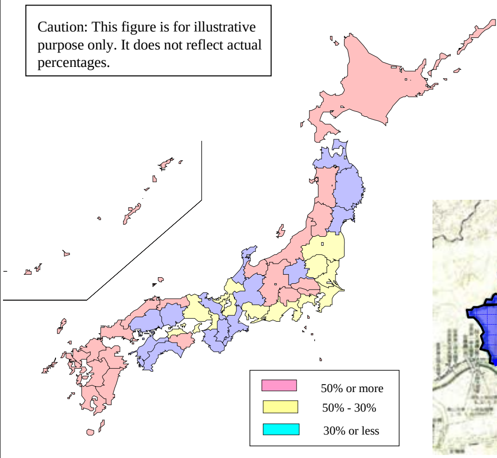
The largest past flooding in this river (year __, month __)
Approx. 1/20, 550 m^3/s, 40 mm/h

- Thresholds and segmentation (500-m pitch in this figure) require further refinement considering other cases.

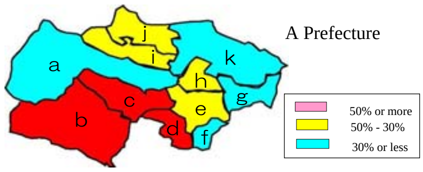
Output of Evaluation Results (3)
Average % of Safe River in Each Prefecture and Each Municipality

Average % in Each Prefecture
The percentage of river stretches that cannot withstand floods expected to occur once in 30 years.

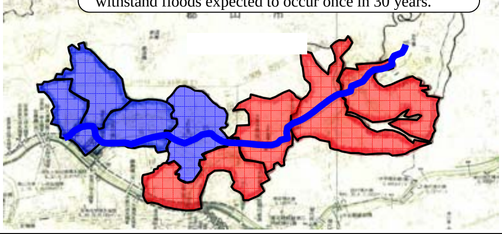
Caution: This figure is for illustrative purpose only. It does not reflect actual percentages.



Average % in Each Municipality
The percentage of river stretches that cannot withstand floods expected to occur once in 30 years



Average % in Each District
The percentage of river stretches that cannot withstand floods expected to occur once in 30 years.



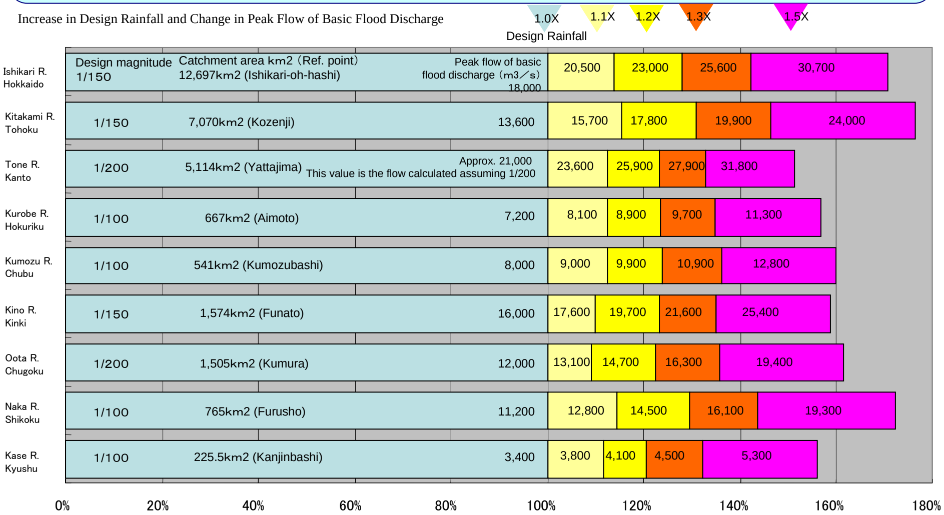
These figures are for illustrative purpose only. We need further discussion as to how evaluation results should be publicized.

Adaptation Measures to Flood Disaster

Impact of Climate Change on Peak Flow of Basic Flood Discharge

The rainfall in various prediction studies is generally in the range from 1.0 to 1.2 times; 1.3 times in some regions and 1.5 times at the maximum.
Therefore, we selected 9 class A rivers where design rainfall is set on a daily basis and estimated the peak flow of basic flood discharge assuming the design rainfall of **(1) 1.1, (2) 1.2, (3) 1.3, and (4) 1.5 times**.

Increase in Design Rainfall and Change in Peak Flow of Basic Flood Discharge



*Estimation using the flow model in the Fundamental Policy assuming the design rainfall increased by factors from 1.1 to 1.5

Prepared by River Bureau

Lowering of Water Safety Due to Future Increase in Rainfall

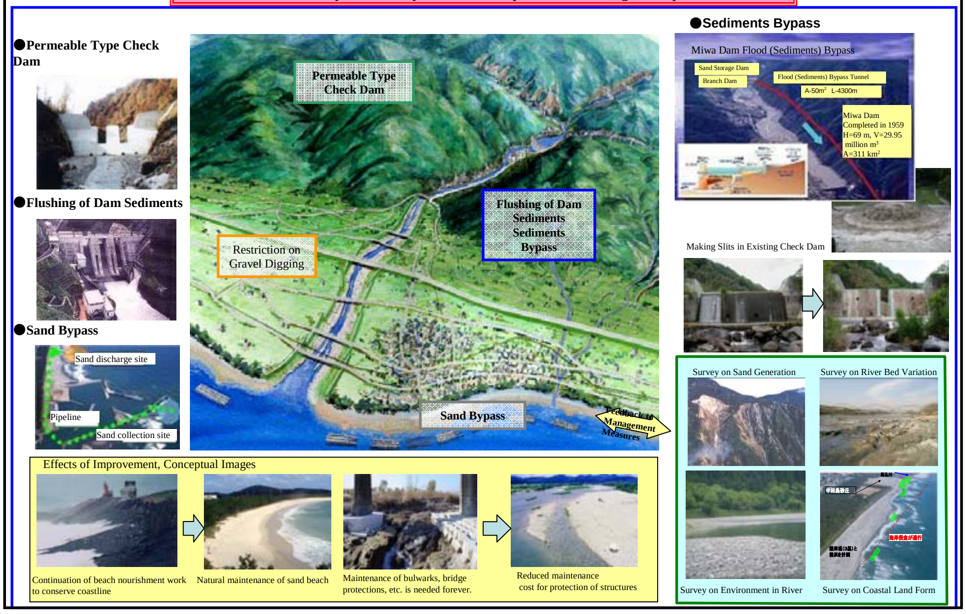
River Name	Expanded Design Rainfall (Upper: Rainfall, Lower: Probability (Years) *1) (Unit)		1.1X	1.2X	1.3X	1.5X	Lowering of Water Safety Due to Future Increase in Rainfall (Probability (Years)*2) Design Scale	1.1X	1.2X	1.3X	1.5X
Ishikari R.(Hokkaido)	260	mm/3d	286	312	338	390	150	100	80	60	35
	150		350	500	700	1,300					
Kitakami R.(Tohoku)	200	mm/2d	220	240	260	300	150	70	40	23	10
	150		350	720	1,400	2,900					
Tone R.(Kanto)	319	mm/3d	351	383	415	479	200	100	55	35	15
	200		430	910	2,000	8,900					
Kurobe R.(Hokuriku)	455	mm/2d	501	546	592	683	100	50	30	20	10
	100		200	400	700	2,500					
Kumozu R.(Chubu)	358	mm/d	394	430	465	537	100	50	30	20	10
	100		200	400	800	3,300					
Kino R.(Kinki)	440	mm/2d	484	528	572	660	150	70	40	25	12
	150		570	1,200	2,300	8,700					
Ota R.(Chugoku)	396	mm/2d	436	475	515	594	200	100	55	35	15
	200		450	990	2,200	11,000					
Naka R.(Shikoku)	640	mm/2d	704	768	832	960	100	45	22	12	6
	100		270	740	2,000	16,000					
Kawse R.(Kyushu)	615	mm/2d	677	738	800	923	100	60	35	23	12
	100		170	340	560	1,800					

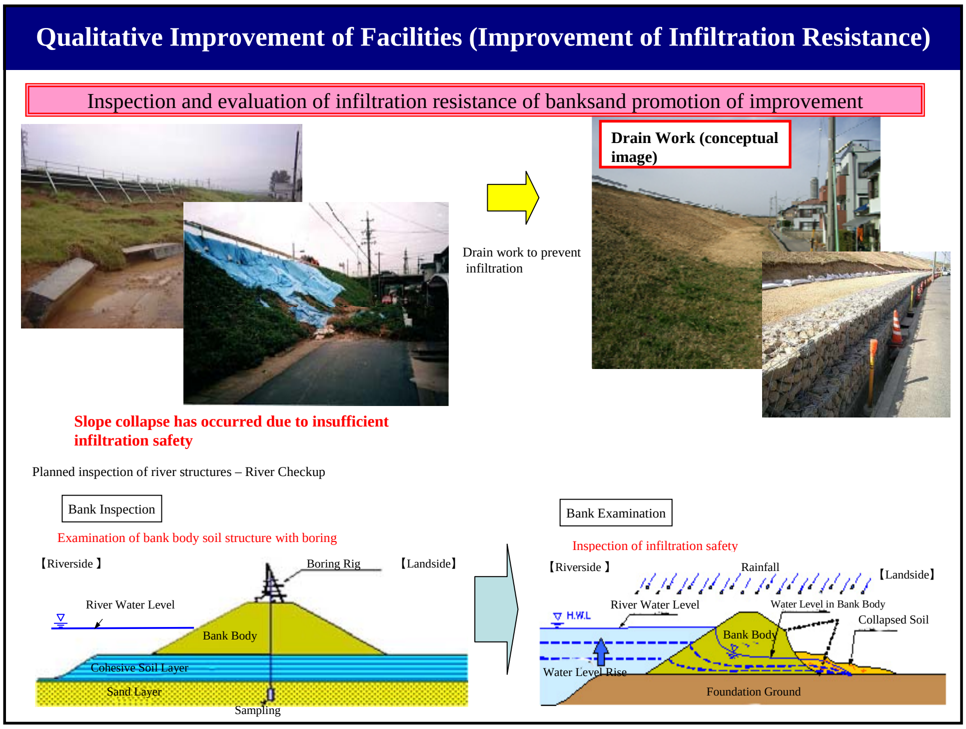
*1 Determined by extrapolation from present probability distribution
*2 Values read from probability paper

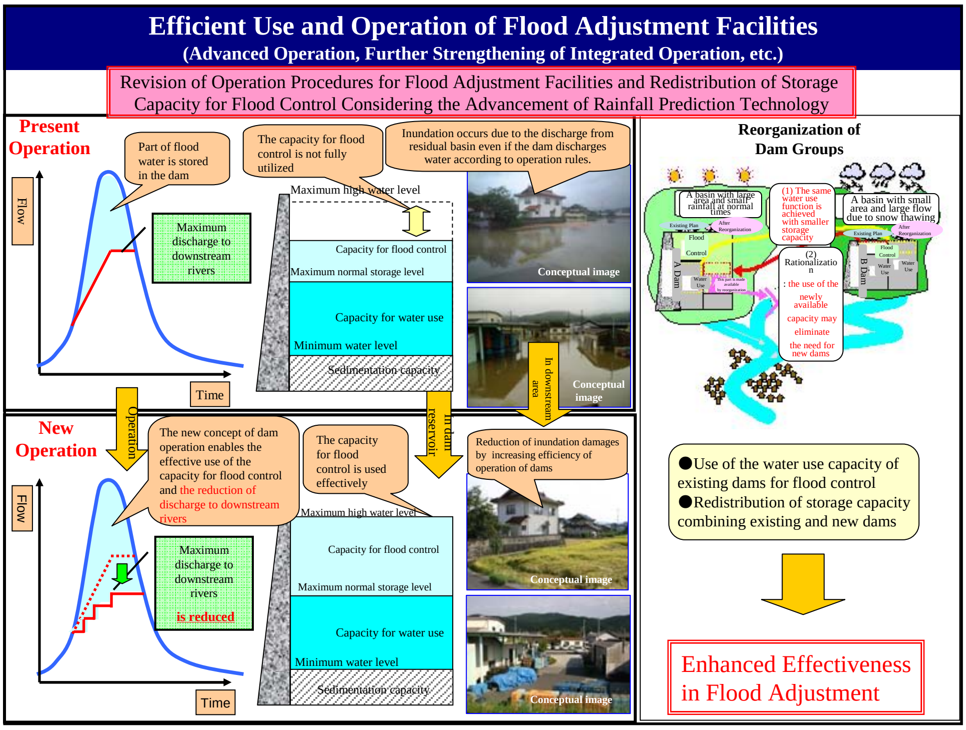
Prepared by River Bureau

Strengthening of River Bed Stabilization and Other Measures

Measures against river bed variation, soil erosion, dam sedimentation, and coastal erosion are conducted systematically based on comprehensive management plans.

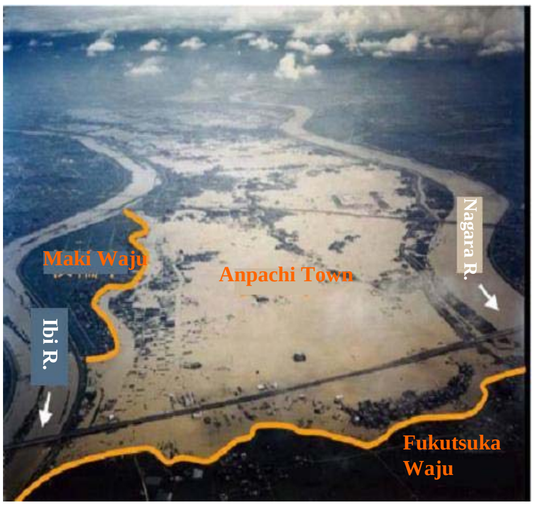



Qualitative Improvement of Facilities (Improvement of Infiltration Resistance)
Inspection and evaluation of infiltration resistance of banksand promotion of improvement
Drain Work (conceptual image)
Drain work to prevent infiltration
Slope collapse has occurred due to insufficient infiltration safety
Planned inspection of river structures – River Checkup
Bank Inspection
Examination of bank body soil structure with boring
【Riverside】
Boring Rig
【Landside】
River Water Level
Bank Body
Cohesive Soil Layer
Sand Layer
Sampling
Bank Examination
Inspection of infiltration safety
【Riverside】
Rainfall
【Landside】
H.W.L
River Water Level
Water Level in Bank Body
Collapsed Soil
Bank Body
Water Level Rise
Foundation Ground


Efficient Use and Operation of Flood Adjustment Facilities
(Advanced Operation, Further Strengthening of Integrated Operation, etc.)
Revision of Operation Procedures for Flood Adjustment Facilities and Redistribution of Storage Capacity for Flood Control Considering the Advancement of Rainfall Prediction Technology
Present Operation
Part of flood water is stored in the dam
The capacity for flood control is not fully utilized
Inundation occurs due to the discharge from residual basin even if the dam discharges water according to operation rules.
Flow
Maximum discharge to downstream rivers
Time
Maximum high water level
Capacity for flood control
Maximum normal storage level
Capacity for water use
Minimum water level
Sedimentation capacity
Conceptual image
In downstream area
Operation
In dam reservoir
New Operation
The new concept of dam operation enables the effective use of the capacity for flood control and the reduction of discharge to downstream rivers
The capacity for flood control is used effectively
Reduction of inundation damages by increasing efficiency of operation of dams
Maximum discharge to downstream rivers is reduced
Reorganization of Dam Groups
A basin with small area and large flow due to snow thawing
(1) The same water use function is achieved with smaller storage capacity
(2) Rationalization
A Dam
B Dam
●Use of the water use capacity of existing dams for flood control
●Redistribution of storage capacity combining existing and new dams
Enhanced Effectiveness in Flood Adjustment

Measures in Flood Areas (Flood Flow Control Using Ring Levees)

Implementation of Flood Flow Control to Prevent the Expansion of Disaster Area Using Ring Levees and other Means

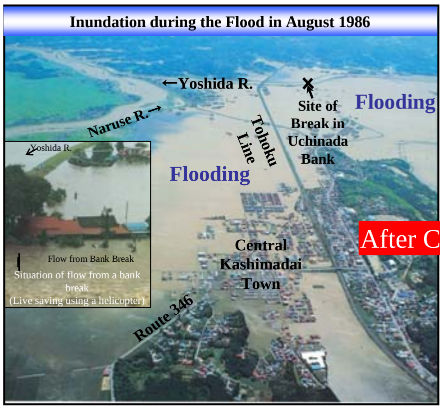


- During the flood in September 1976, a bank break occurred on right bank in the middle stretch of Nagara River.
- The flood was stopped by the ring levee, and the expansion of flood flow was prevented. This contributed to the minimization of damage.

Condition of the Ring Levee (Fukutsuka Waju)

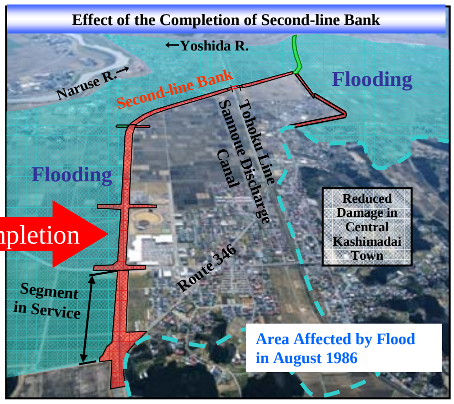
Measures in Flood Areas (Flood Flow Control Using Second-line Banks)

Implementation of Flood Flow Control to Prevent the Expansion of Disaster Area Using Second-line Banks and other Means



The bank breaks in 4 locations submerged 3,060 ha of land and 1,510 houses (above the floor). Inundation continued for 12 days in some low-lying areas.

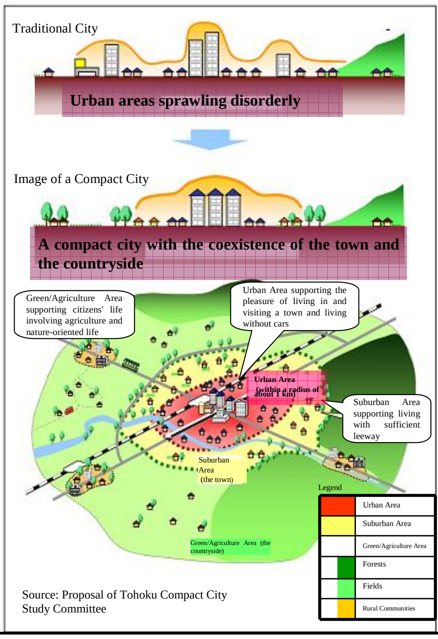
After Completion



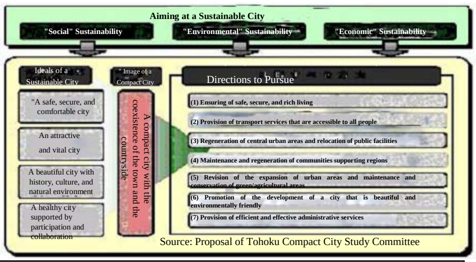
The construction of second-line bank in this district is promoted combined with a road project (bypass construction).

Measures in Flood Areas (Water Management Combined with Urban Development, a Compact City)

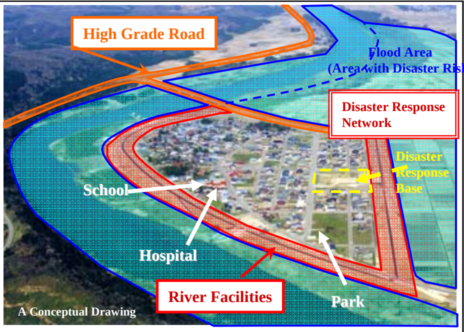
■ Concept of a Compact City Assuming "a Small/Medium City in Tohoku"



Source: Proposal of Tohoku Compact City Study Committee



Source: Proposal of Tohoku Compact City Study Committee



By surrounding the town with a ring levee, disaster response functions were improved while preserving existing local communities.

Measures in Flood Areas (Changing Land Use and Dwelling)

Changing Land Use and Dwelling in Flood-prone Areas and Areas with the Risk of Landslide Disasters

Promotion of Building Structures That Can Cope with Flooding

Yokohama Rapport

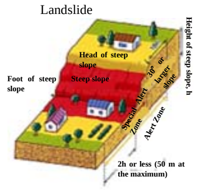
▲Because the site is located in the multi-purpose retarding basin of Tsurumi River, a piloti structure was employed so that the facility can be used at the time of a flood.

▲Using the past experience in living near Tsurumi River, the owner chose a piloti structure to avoid damage from floods.

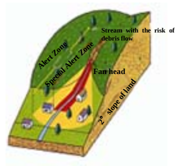
Designation of Landslide Disaster Alert Zones (Enactment of the Landslide Disaster Prevention Law in 2000)

Dangerous sites are indicated by zoning
→ Establishment of alert and evacuation systems, restriction on land use, restriction on building structures, recommendation for relocation of existing houses

Landslide



Debris Flow

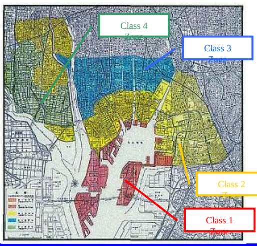


Disaster Risk Zones under the Building Standards Act

Excerpt from the Building Standards Act (Disaster Risk Zone)

Article 39. Local governments may designate in ordinances the areas with significant risk of damage from tsunami, storm surge, flooding, etc. as disaster risk zones.

2. The prohibition of construction of buildings for residential use and other restrictions regarding construction of buildings within a disaster risk zone shall be defined in the ordinances mentioned in the previous item.



Map of Disaster Management Zones in Seaside Area of Nagoya City

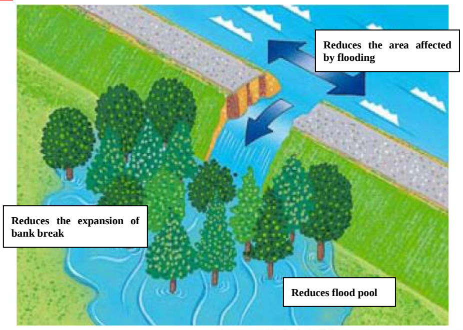
Example of Restrictions under Ordinance (Nagoya City)

		Floor Height of 1st Story	Structural Restrictions	Illustration	
Class 1 Zone	Urbanization Zone	N・P (+) 4 m or more	Wooden buildings are prohibited	Floor height of 1st story	* Prohibition of construction of buildings Scope: Areas located within 50 m from a coastline or a river bank and specified by the Mayor. Restrictions: Buildings with rooms for human occupation, hospitals, child welfare facilities, etc. may not be constructed. Non-wooden buildings may be constructed if the floor height of the rooms for human occupation is N・P (+) 5.5 m or more.
Class 2 Zone	Urban Zone	N・P (+) 1 m or more	Rooms for human occupation must be on the 2nd or higher stories. Exemption: For buildings with the total floor area is 100 m² or less, this requirement may be replaced with the provision of s refuge room and refuge facilities.	Floor height of 1st story	* Restrictions on public buildings (Class 2 to 4 Zones) Scope: Schools, hospitals, meeting places, public offices, child welfare facilities, etc. and similar public buildings. Restrictions: Floor height of the 1st story must be N・P (+) 2 m or more, and rooms for human occupation with N・P (+) 3.5 m or more must be provided.
Class 3 Zone	Urban Zone	N・P (+) 1 m or more	―	Floor height of 1st story	
Class 4 Zone	Urban Zone	N・P (+) 1 m or more	Rooms for human occupation must be on the 2nd or higher stories.	Floor height of 1st story	

Measures in Flood Areas
(Flood Flow Control Using Flood Prevention Forests and Green Belts)

Implementation of Flood Flow Control Using Flood Prevention Forests, Green Belts, etc.

Flood Prevention Forest



Uses of Green Belts

Green belts serve multiple purposes not only for flood flow control but also for providing good environment in urban areas, use as parks, and prevention of fire expansion.

Condition of the site of a bank break

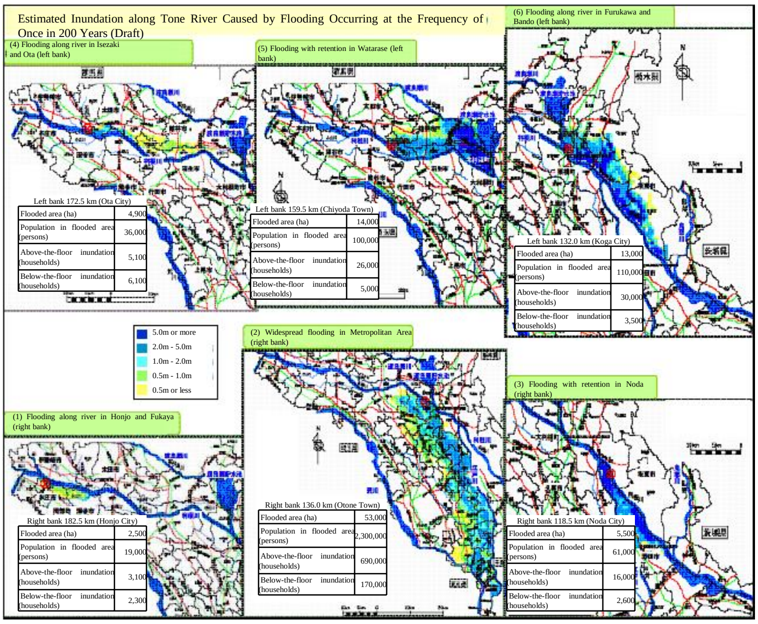
Prevention of soil flow into the area behind the bank

Example of an existing green belt along Ara River in Abukuma River System.

Measures in Flood Areas (Classification by the Type of Flooding)

Classification by the Type of Flooding

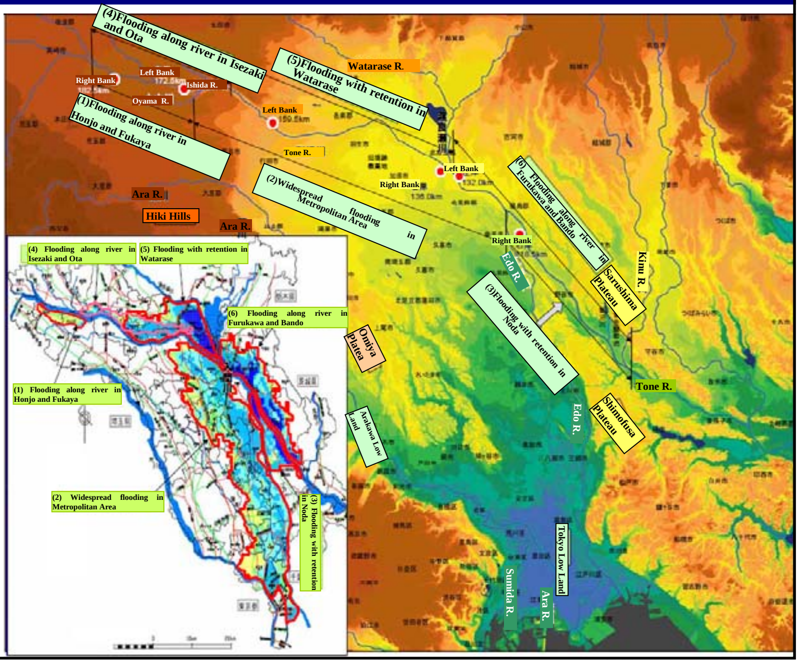
Category Disaster scenarios are prepared for each classification



Source: Material for the 5th Special Study Meeting on Large-scale Water Disaster Management, the Cabinet Office

Measures in Flood Areas (Classification by the Type of Flooding)

Based on detailed analysis of topography, regional classification categories are assigned according to the type of flooding.



Measures in Flood Areas (Evaluation of Flood Controlling Structures)

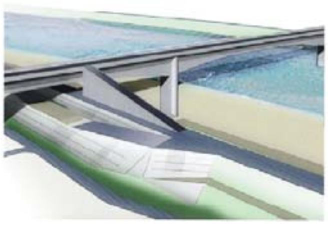
Evaluation of Embankments of Roads, Railroads, etc.

Location of Continuous Embankments in the Lower Stretches of Ara River

Source: Material for the 5th Special Study Meeting on Large-scale Water Disaster Management, the Cabinet Office

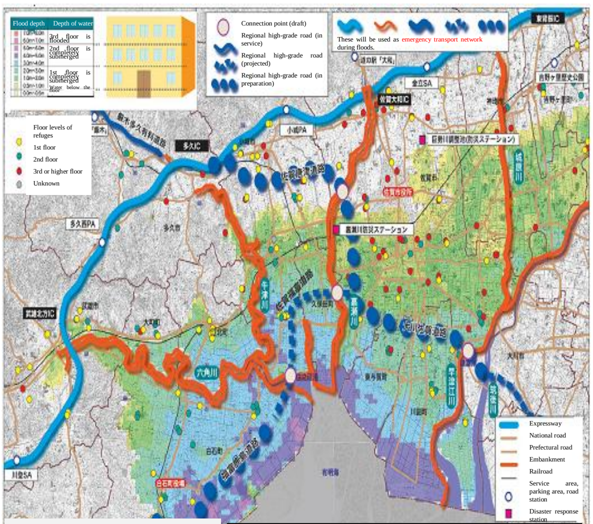
Wide-area Disaster Response and Crisis Management (Construction of Wide-area Disaster Response Network)

Construction of Wide-area Disaster Response Network
through the Utilization of Banks, Emergency Roads in Riverbeds, Elevated Roads, etc.
in Combination with Wide-area Disaster Response Bases



Conceptual drawing of the connection between a road and a river embankment

Flooding of R34 in the July 1990 flood

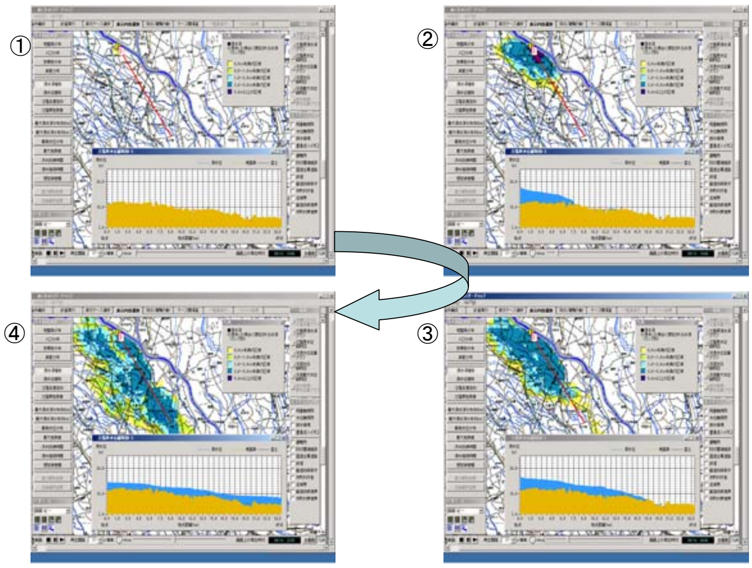


Flood depth at the estuary weir of Rokkaku River at the maximum tidal level of 4.7m in the typhoon in September, 2006.

Concept of the Networking of Roads and River Embankments

Hazard Maps and Other Software Measures (Moving Hazard Maps)

Monitoring of flood flow and moving hazard maps showing over-time development of flood flow:
These are used for guiding people in evacuation and providing suppor to disaster response activities.



Disaster Management Information (Interactive River Information Platform)

Interactive River Information Platform

Use of real time data, various stock data, the Internet, etc.
Construction of an information platform enabling GIS-based compilation and analysis of information from local inhabitants and other sources

River Manager

・Provision of disaster management information
・Provision of hydrological information on rivers
・Provision of environmental information on rivers
・Publication of flood hazard maps
etc.

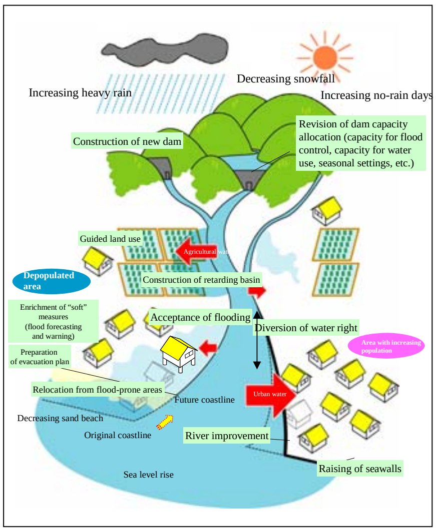
Information Provision/Collection through a Geographical Information Platform

Inhabitants

・Information from disaster management NPOs
・Information from environmental NPOs
・Information from administrative agencies
・Information from local inhabitants
etc.

Labor saving and centralization in river management **at normal times**
Advanced crisis management **in emergencies**

Study of National Land Conservation Adaptation Measures to the Impact of Climate Change Due to Global Warming



Changes in hazard such as sea level rise, droughts, floods, and storm surges associated with climate change

Study on the impact of climate change

Study on direct impacts
・More frequent and severer droughts, floods, storm surges, etc.
・Lowered reliability of river and coastal facilities
・Increased coastal erosion due to sea level rise

Study on indirect impacts
・Impact on land use and social structure
・Impact on flood control scenarios and facility operation rules

Case study high-risk areas based on hazard assumptions

○Identification of high-risk areas based on hazard assumptions
Based on specific assumptions of rainfall, storm surge, and other hazard, model areas are identified considering the future changes in population and industry structures in the areas.

○Study on the evaluation of social and economic impacts of climate change
Development of the methods for evaluating direct and indirect economic impacts of disasters, including general damage to assets and the damage from interruption of distribution of goods due to transport disruption, as well as social impacts resulting from the breaking of local communities and prolonged living in refuges

Study on strategies responding to climate change in rivers and coasts

○Study on concrete adaptation measures combining structural and non-structural measures

○Economic evaluation of various adaptation measures and proposal of appropriate short- and long-term adaptation strategies

Utilization of Results

Proposal of adaptation measures for short- and long-term social and economical impacts responding to climate change ➡ **○Building a resilient country that can cope with future disasters**

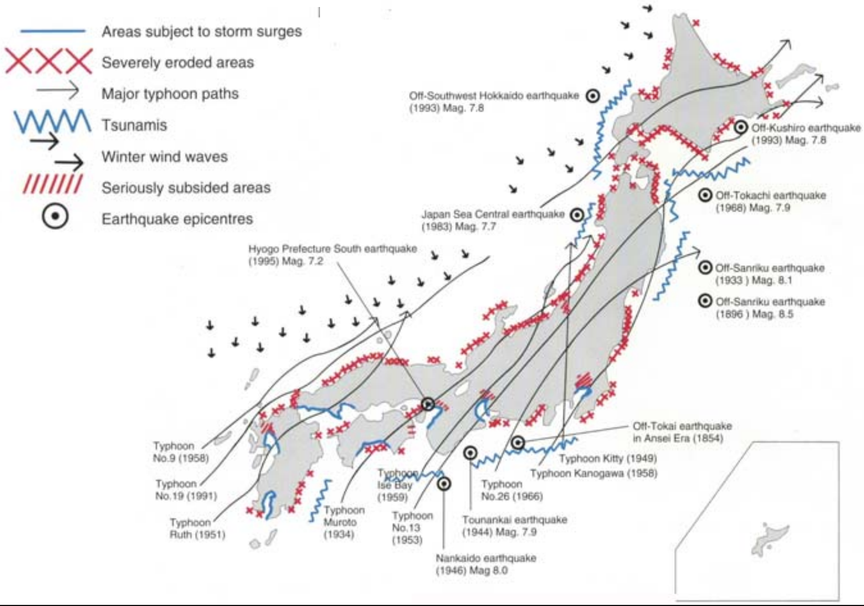
Ⅷ-6 Storm Surge Forecast System for Floodfighting Warning

Mr. Masaya FUKUHAMA
Head, Coast Division, River Department,
NILIM

Storm Surge Forecast System for Floodfighting Warnings

Masaya Fukuhama
Coast Division, River Department
National Institute for Land and Infrastructure Management

Coastal Disasters in Japan



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)

Measures against Storm Surge

'Hard' Measures

'Soft' Measures

Detached Breakwaters

Coastal dike

Hazard map

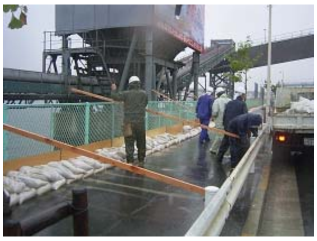
Warning system

Evacuation drill etc.

Floodfighting on Coasts

Patrolling

Sandbagging



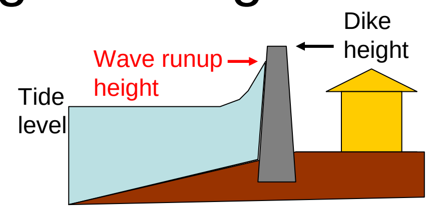
Closing water gates

(Tokyo Port Disaster Prevention office)

Draining

Wave Runup Forecast for Floodfighting Warning

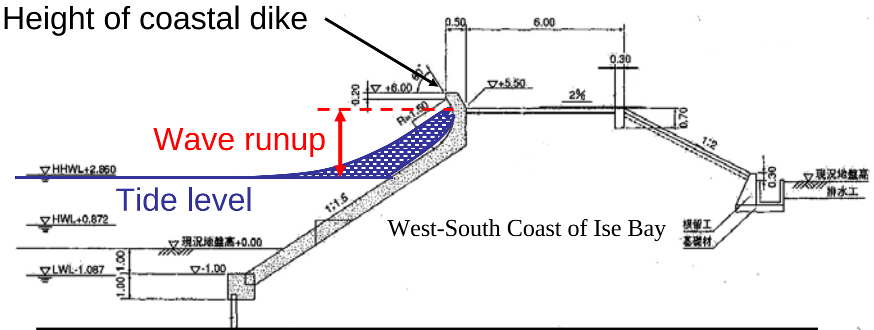
Wave runup on each coast will be forecasted before a typhoon approach, and transmitted to prefectures for issuing flood-fighting warnings on the coast.



JMA		MLIT		Prefectures		Floodfighting administrators (mayors etc.)
Prediction of typhoons, storm surges, and waves	→ Tide level, wave	Prediction of wave runup heights	→ Wave runup height	Issue of floodfighting warnings	→ Floodfighting warning	Floodfighting activities

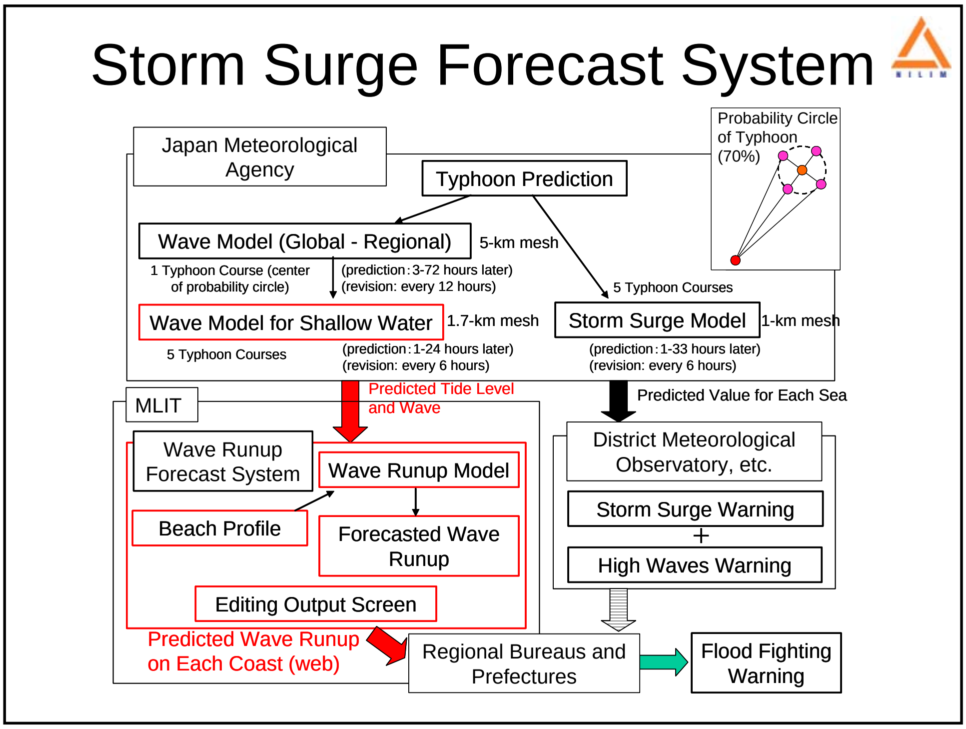
(123 coasts is designated for floodfighting warnings.)

Design of Coastal Dike Height

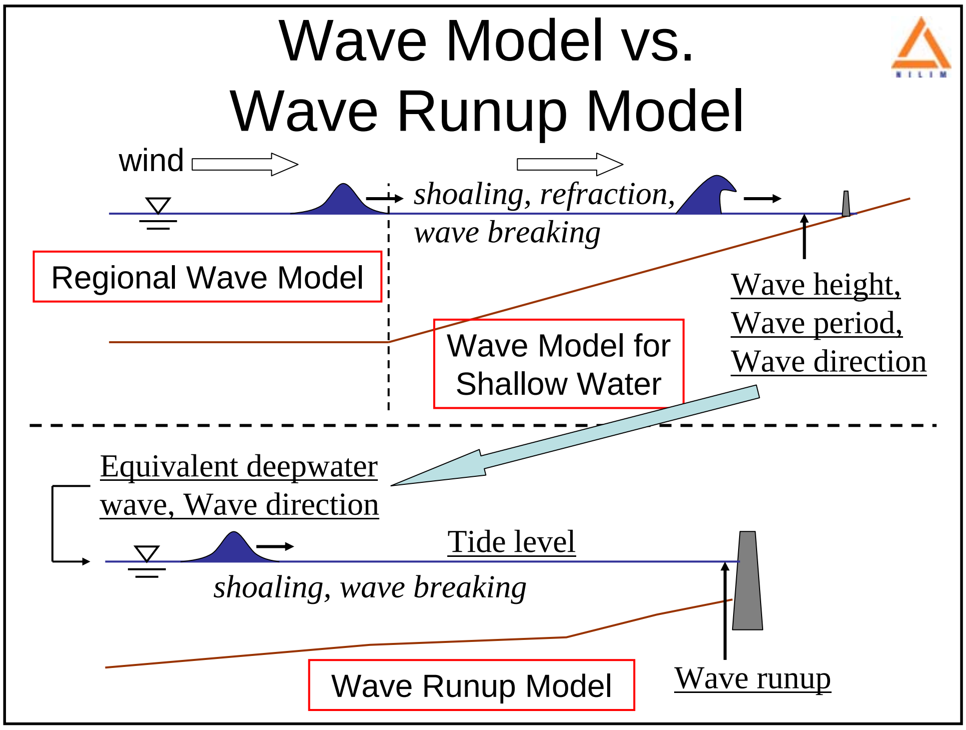


Height of coastal dike is set considering wave runup. Therefore, storm surge forecasts do not indicate whether major wave overtopping will occur or not.

Wave runup as well as tide level should be forecasted.

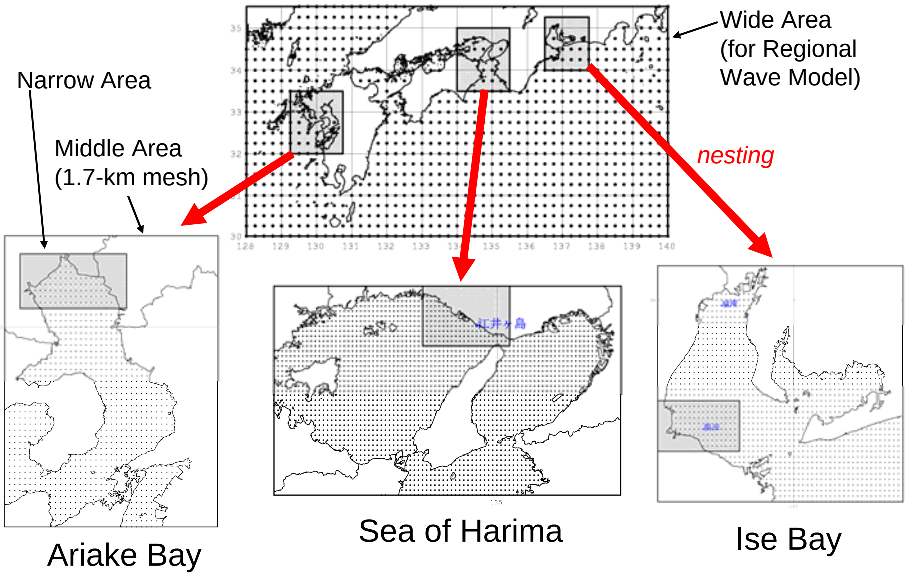


Storm Surge Forecast System
Japan Meteorological Agency
Typhoon Prediction
Probability Circle of Typhoon (70%)
Wave Model (Global - Regional)
5-km mesh
1 Typhoon Course (center of probability circle)
(prediction: 3-72 hours later)
(revision: every 12 hours)
5 Typhoon Courses
Wave Model for Shallow Water
1.7-km mesh
Storm Surge Model
1-km mesh
5 Typhoon Courses
(prediction: 1-24 hours later)
(revision: every 6 hours)
(prediction: 1-33 hours later)
(revision: every 6 hours)
Predicted Tide Level and Wave
Predicted Value for Each Sea
MLIT
Wave Runup Forecast System
Wave Runup Model
Beach Profile
Forecasted Wave Runup
Editing Output Screen
District Meteorological Observatory, etc.
Storm Surge Warning
+
High Waves Warning
Predicted Wave Runup on Each Coast (web)
Regional Bureaus and Prefectures
Flood Fighting Warning



Wave Model vs.
Wave Runup Model
wind
shoaling, refraction,
wave breaking
Regional Wave Model
Wave Model for Shallow Water
Wave height,
Wave period,
Wave direction
Equivalent deepwater wave, Wave direction
Tide level
shoaling, wave breaking
Wave Runup Model
Wave runup

Seas for Model Examination



Review of Wave Forecasting Model

Wave hindcasting was conducted for major typhoons in 1997-2004.

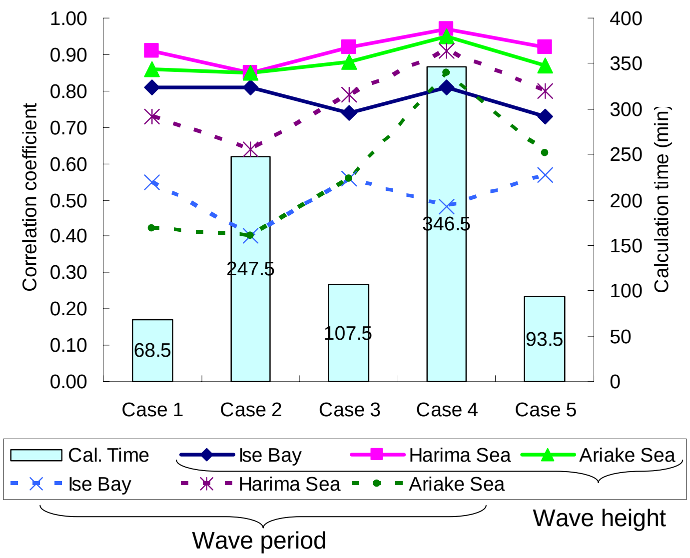
Case	Middle Area (bay scale)	Narrow Area (coast scale)
1	WAM	WAM
2	WAM	SWAN
3	WAM	Wave transformation model
4	SWAN	SWAN
5	-	Wave transformation model

Review points:

- Preciseness of hindcasting

- Necessary time of hindcasting

Results of Model Comparison



Improvement of Wave Forecast Model

- WAM does not consider the effects of wave breaking.
- Astronomical tide are so large in inner seas that time variation of water depth may influence waves.

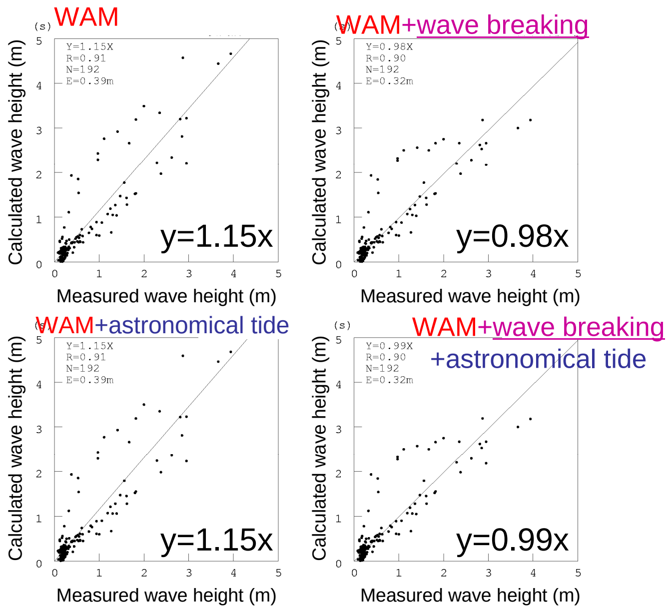
↓

- Combining WAM with the bore model used for SWAN, and considering water depth change by using the ocean tide model (NAO.99b)

↓

- Review of the improved model by hindcasting waves for recent major typhoons.

Results of Wave Simulation



Conclusion

An improved WAM that considers wave breaking and tides can forecast waves in inner seas with good precision in real time. Information for proper floodfighting warning can be supplied by combining this system with the forecast system for wave runup at each coast.

The system will start soon!

- This system will be operated in Tokyo Bay, Ise Bay, Osaka Bay and Harima Sea, and the Ariake Sea.
- Test operation for one typhoon course started in September 2007.
- After solving operating problems, we will begin full-scale operation for five typhoon courses in August 2008.

Ⅷ-7 Support for Evaluation Ahead of Sediment Disasters

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Support for Evacuation Ahead of Sediment Disasters

– Using Rainfall Indices to Predict the Danger of Sediment Disasters –

Erosion and Sediment Control Division, Research Center for Disaster Risk Management

1. Introduction

Mountainous and hilly regions that cover approximately 70% of the land of Japan provide us with a rich natural environment, but many sediment disasters occur in these regions every year. Because sediment disasters not only occur without warning but also have extremely large destructive force, they cause severe destruction when they occur.

It is difficult to say that measures to prevent them have been adequately taken. At locations with topography that clearly indicates a high risk of debris flows for example, a total of 183,863 torrents have been designated as debris flow danger torrents (announced in 2002).

Sediment check dams or other protective structures have been constructed to provide a certain degree of safety in only about 20% of the total of 89,518 torrents with five or more homes and where the occurrence of a debris flow would cause severe damage. But it will be difficult to construct such structures rapidly considering Japan's present financial circumstances. And even in cases where they have been constructed, because they are designed hypothesizing a specified scale of rainfall, they are not completely safe when a natural phenomenon that exceeds the hypothetical scale has actually occurred.

It is important for people to evacuate before a sediment disaster occurs in order to protect themselves. And in order for residents to evacuate at the correct time, the time and place of danger, the method of informing people of the danger, the evacuation method, and evacuation site must be decided in advance. In order to predict the time and place of danger, the Erosion and Sediment Control Division is conducting research on the prediction of the danger of occurrence of debris flows.

2. Concept of CL

When the object of a prediction is inundation of land by river water, directly observing levee height and water level provides information needed to judge the time and place of occurrence, but in the case of a sediment disaster, it is difficult to directly observe a slope because (1) the object of the observation is underground and (2) the range that should be observed spreads over a wide area. Therefore, rainfall that is one factor influencing sediment disasters is monitored to indirectly predict the degree of danger.

Specifically, rainfalls that caused sediment disasters (occurrence rainfalls) and rainfalls that did not cause sediment disasters (non-occurrence rainfalls) are indicated together on a map and the range where many occurrence rainfalls are distributed is classified as the danger range and the range where non-occurrence rainfalls are distributed is classified as the safe range. The occurrence of a sediment disaster is predicted depending on whether or not a line that links rainfall that is now falling in a time series (snake curve) crosses the boundary line between two ranges: a line is called the sediment disaster occurrence danger critical line (Critical Line: below "CL") (Fig. 1). This critical line is prepared for each specified district (often a range that includes one or a number of municipalities) based on the topography, geology, rainfall properties, etc. In a range where long-term rainfall is less frequent than short-term rainfall, the range that is theoretically unobtainable (Unreal Area) is shown in black on the figure.

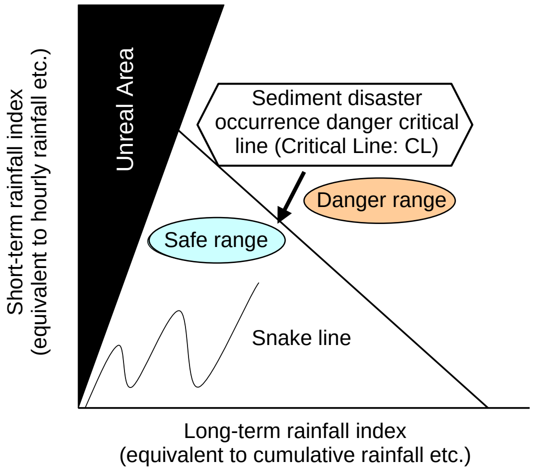


Figure 1. Method of Using CL to Predict Occurrence

3. The conventional method and its shortcomings

Starting from the position that long-term rainfall such as intensive rainfall of the June – July seasonal rain front (cumulative rainfall for example) and short-term rainfall such as squalls (hourly rainfall for example) should be treated as the forms of rainfall that causes sediment disasters, these two indices are used to determine the boundary line (see Figure 1). To improve the precision of the boundary line when using this method, it is necessary to collect more rainfall data. But although approximately 1,000 sediment disasters occur annually throughout Japan, by region, adequate quantities of rainfall data have not necessarily been obtained. But, even a small number of rainfall data do not accurately clarify the occurrence time because the occurrence location and rainfall occurrence locations are separate, and in many regions, it is impossible to ensure the reliability of the timing that is essential to predict the danger of occurrence.

The boundary is uniformly drawn as a straight line regardless of the regional characteristics of rainfall, it is difficult to decide on the way to draw it (Fig. 2), and one standard must cover a wide area of at least a city, town, or village. As a result, the frequency of the announcement of false warnings increases.

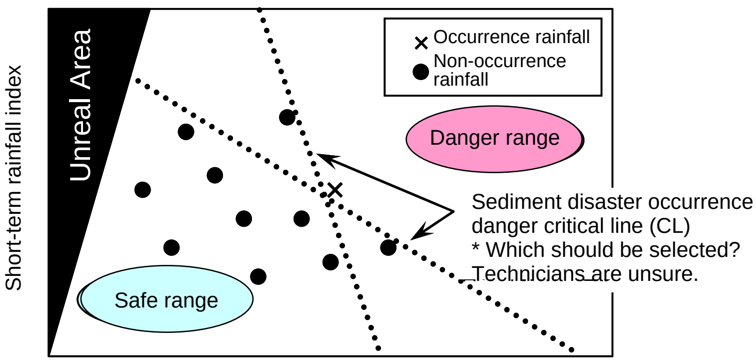


Figure 2. Example of Uncertainty when Setting by the Conventional Method

4. The newly developed method

In order to resolve problems with the conventional method, it is necessary that (1) a boundary line can be drawn, even for a region with small number of occurrence rainfall data, (2) the method of determining the boundary line is rational and reproducible (the result is the same, no matter who does it). In regards to (2) in particular, a method should be established allowing a non-linear boundary line to be drawn; not only a straight line, according to the distribution of rainfall data under constant rules. And to set them in ranges smaller than city, town, or village units (or each hamlet or each danger location), it will inevitably be necessary to set far more lines than in the past, requiring that the work be done more efficiently.

As a measure to resolve these problems, a method of determining the boundary line using an RBF Network (Radial Basis Function Network) that is a kind of neural network has been developed.

An RBFN is a hierarchical structure that models a brain and nervous system, and its calculation process is done by three layers: input layer (n elements), middle layer (m elements), and output layers (1 element) (Fig. 3).

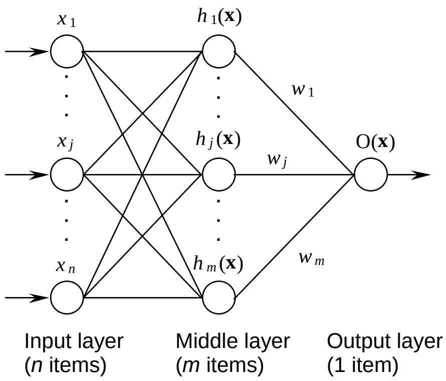


Figure 3. RBFN Concept

In simple terms, as rainfalls that have actually been observed (input layer) are listed and the positional relationship of the rainfall data (distance, quantity) are compared (medium layer), they are calculated as a scale of occurrence probability (output layer). Normally when a person draws a line to enclose an entire range that is an aggregate of points, the person draws a boundary that seems appropriate while observing the way the points are distributed (Fig. 4(a)). When doing this, the person makes a mental judgment that widely separated individual points “should be eliminated because they rarely occur.” It is now possible to draw lines using the results of calculations in order to invest this work with objectivity and reproducibility (Fig. 4(b)).

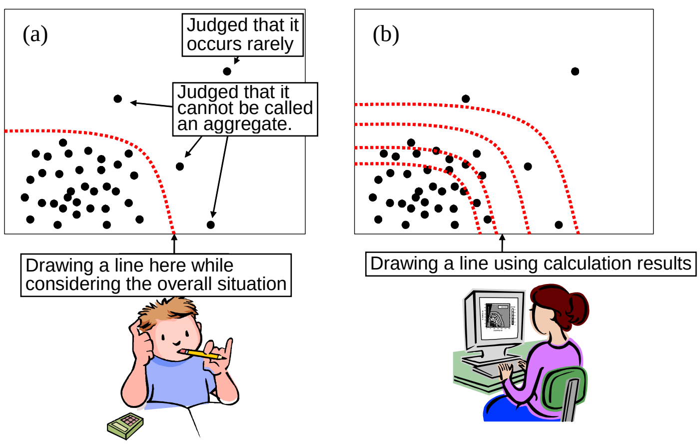


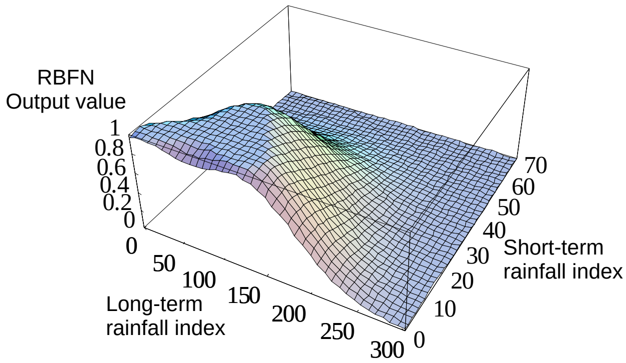
Figure 4. Image of Task of Preparing the Range of the Aggregate of Points

The position and shape of boundary lines that technologists subjectively set based on their experience can now be set objectively and efficiently under fixed rules by using this method.

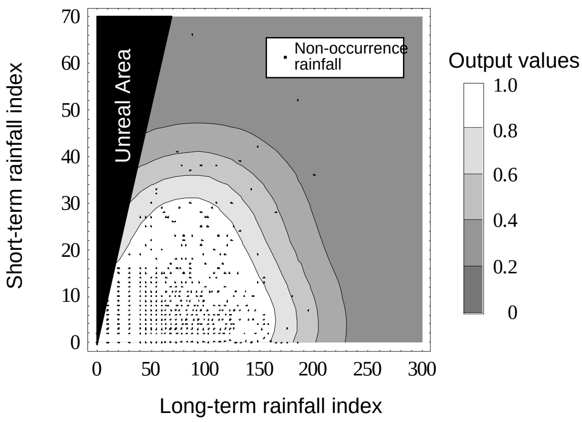
And the replacement of the conventional method that is “seeking the boundary of the safe range and the danger range” with the method, “seeking the outer edge of the safe range”, permits the determination regardless of whether a sediment disaster occurs or not, because the rainfall data that is used is limited to non-occurrence rainfall.

5. Setting CL using RBFN

This method starts with setting a curve that represents values that express the degree of the probability of rainfall occurring at an optional point on a plane map with the long-term rainfall index and the short-term rainfall index as the *x* axis and the *y* axis respectively by teaching the input value of non-occurrence rainfall as 1 (Fig. 5).



(a)



(b)

Figure 5. Example of Setting Curves

The long-term rainfall index and the short-term rainfall index used were the soil rainfall index and the Radar Amedasu Analysis rainfall that are each provided by the Meteorological Agency assuming that they are combinations of the soil rainfall index [Note 1] and the sixty minute cumulative rainfall considering ease of operation while maintaining a specified precision. Figure 5(a) shows that in parts with high output values, the probability of non-occurrence rainfall is high, in other words, it is a region where many rainfalls that

[Note 1]
It is assumed that if the index is obtained based on the total of the storage height of a line of three tank models and is a high value, the danger of a sediment disaster is high. Many have heard TV weather announcers give warnings such as, “the danger of sediment disasters is higher than it has been for the past several years,” but those were judgments based on this index.

cause almost no sediment disasters are observed, so it is called a safe range. And parts where the output value is low are, inversely, the range where the probability of a sediment disaster occurring is high. Figure 5(b) shows the same figure in two dimensions, and the white range near the origin point is the range where there is a high probability of non-occurrence rainfall. In this figure, a total of 4 boundary lines are shown at output value 0.2 intervals, but it is necessary to focus on one of the lines in order to set a standard for predicting the danger of a sediment disaster. In this case, if the boundary is on the inside, the capture precision is high, but inversely, the standard is achieved more frequently. It is necessary to consider balancing, “can it be appropriately captured?” with “will the standard be achieved too often?” in order to use it to smoothly issue evacuation advisories etc., and as a rule, 1 line is selected from among a total of 9 candidate lines drawn at intervals of 0.1.

The curve that was set is corrected so that it will not contradict actual phenomena (Fig. 6). In the ranges enclosed by the dotted lines in the figure, the inclination of the tangent is positive, but this occurs because when setting such a boundary line, regardless of the same short-term rainfall index, the longer long-term rainfall index is the safe range (inside the boundary line) and the shorter long-term rainfall index is the danger range.

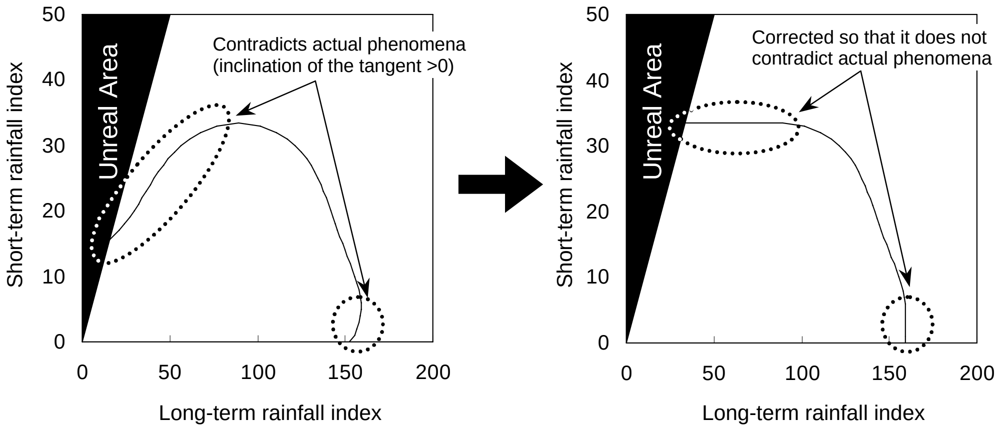


Figure 6. Correction of Contradiction with Actual Phenomena

6. Even if the rainfall properties change…..

Using this method, the more rainfall data available, the more closely the curve that is formed reflects actual rainfall properties. After CL has been set, it is important to add new rainfall data and to continue to verify whether or not the disasters that occurred were appropriately captured. This is assumed to be a method that allows this revision work to be done easily. By continuing revisions it is possible to revise the boundary line to support appropriate advance evacuations even when, presumably as a result of climate change, short-term rainfall or long-term rainfall never previously experienced occurs.

7. Conclusion

A new initiative to announce warning information concerning sediment disasters began in Kagoshima Prefecture in September 2005. The Kagoshima Regional Meteorological Observatory and the Sabo Division of Kagoshima Prefecture jointly predict the occurrence of sediment disasters, then announce the results to the public and to the municipalities through the mass media etc. The announcements include information that is expected to help people begin evacuating before a sediment disaster occurs.

This initiative in Kagoshima Prefecture was the first of its kind to begin operating in Japan, but when, shortly after its introduction, Typhoon No. 14 approached and reached the land, a number of problems with the warning information that was announced at that time were discovered. The minimum range where warnings were issued were municipalities, but because people could not distinguish the specific locations of greater danger, the announcements were not sufficient for them to evacuate appropriately in advance. Figure 7 shows a method that will provide residents with warning information so that it is easily understood. At this time, information is presented only for each municipality, but it is now necessary to devise methods of dividing these into smaller areas and using radar rainfall so that the state of rainfall can be understood over a wide area and to devise ways to permit both the area to be evacuated and the degree of urgency (classified as preparation for evacuation, evacuation advisory, evacuation order) of its evacuation to be understood at a glance.

This sediment disaster claimed many victims, but we must learn from this disaster and reflect this important lesson in future information provision, and we wish to provide technological support to achieve this goal.

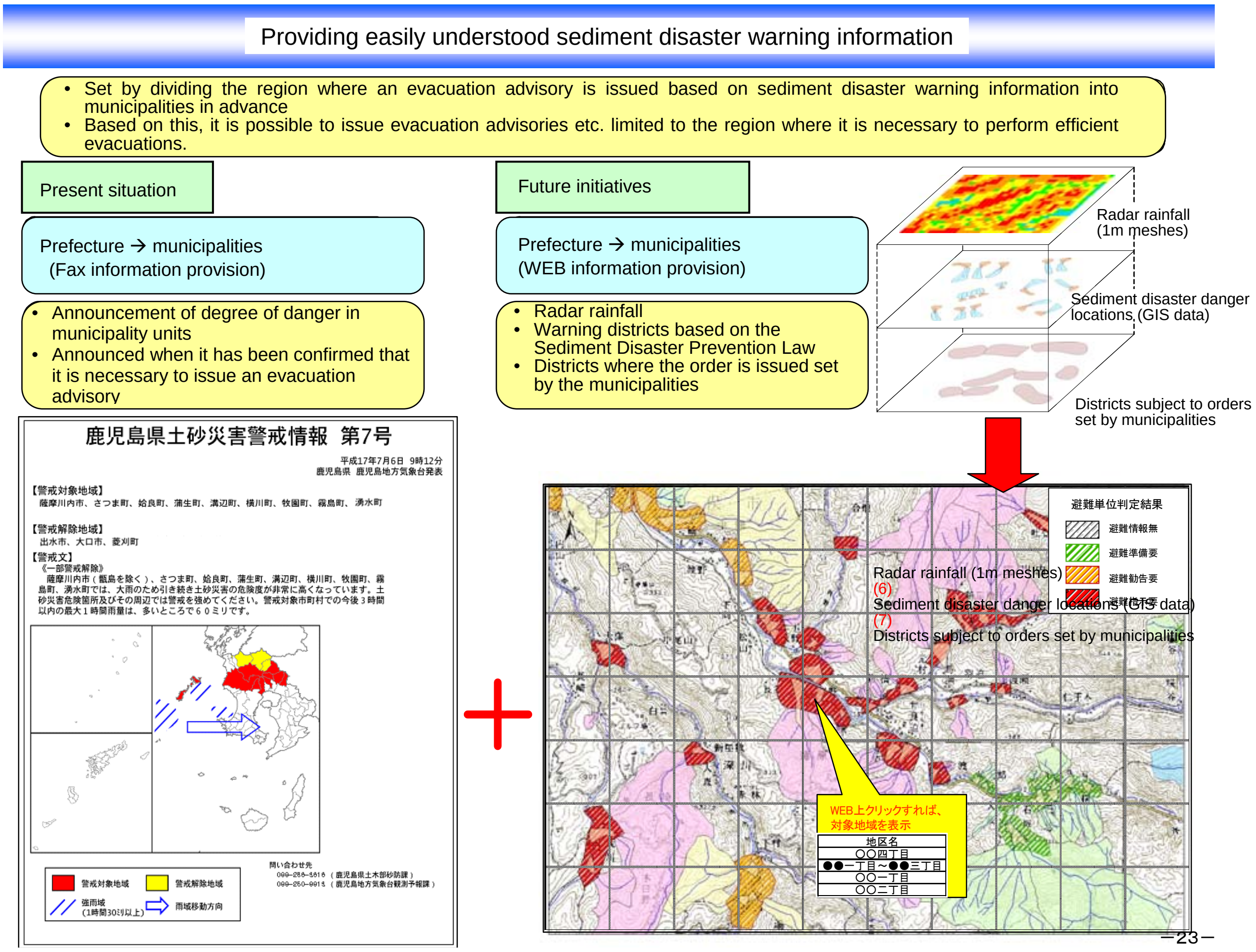


Figure 7. Easily Understood Warning Information Approach
(Partial Revision of a Document from the Large Scale Rainfall Disaster Study Committee, Sediment Disaster Subcommittee (Third)

Ⅷ-8 Planning Adaptation Programs for Future Climate Change

Mr. Junichi YOSHITANI
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ICHARM, PWRI

Planning adaptation programs for future climate change

Junichi Yoshitan and Seyed Ali Chavoshian
International Centre for Water Hazard and Risk Management
Public Works Research Institute

1. Background

In response to more reliable scientific prediction on impacts of unavoidable climate change on extreme events and policy shift to adaptation, River Bureau of MLIT has started flood control policy making to adapt to the future climate change from August 2007. This note summarizes facts and issues raised at on-going discussion in the process of policy-making efforts.

2. Possible climate change impact observed and responses

Besides series of the OECD (For example, Progress on adaptation to climate change in developed countries, May 2006) and fourth IPCC reports, ICHARM has found the following historical hydrologic change observations that show trends of frequent or bigger extreme flood events. These observations are used in various reports or brochures to demonstrate climate change.

However, the trends do not necessarily attribute to climate change but other factors such as land subsidence and urbanism. Statistical significance may be tested either in some reports. Moreover, it is noted that frequent and bigger flood prediction is based on numerical simulation result of climate science research activities. The resulted trends are widely used to attract public attention as well as remarkable impact of climate change.

2.1. Japan

Refer to the other reports of this conference.

2.2. Republic of Korea

Typhoon Rusa of 2002 and typhoon Maemi of 2003 caused biggest damage to the nation as shown in Figures 1 and 2. Typhoon Rusa brought record-breaking daily precipitation of 870mm that exceeds the PMP (probable maximum precipitation). There is observation of the frequent record-breaking precipitation as a climate change issue.

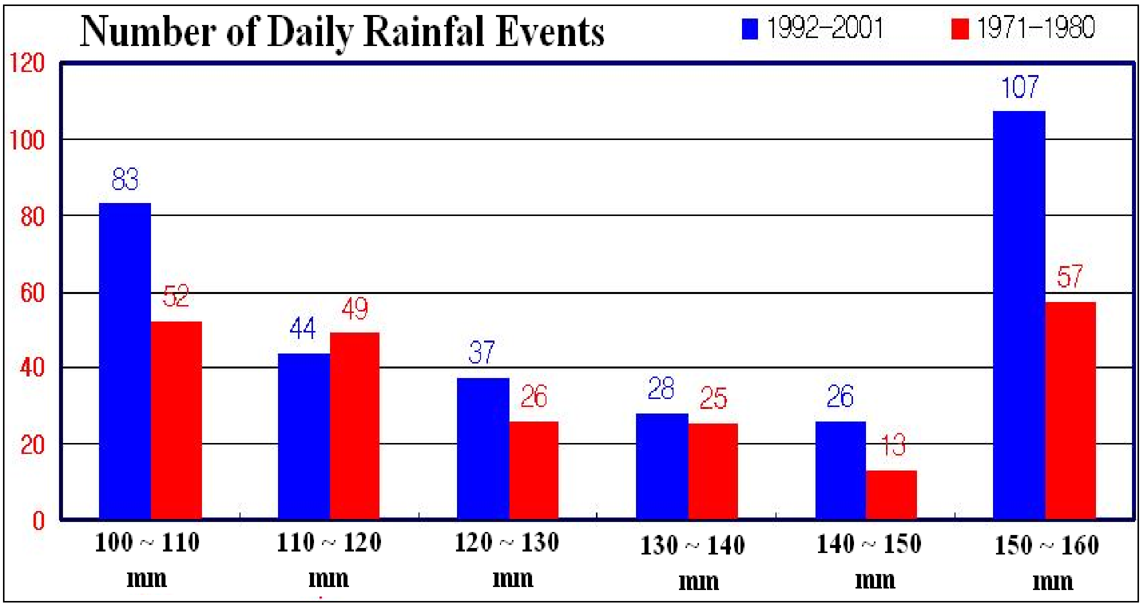


Figure 1. Increased rainfall intensity in S. Korea (*Source: Dr. Kim Sung, 2004*)

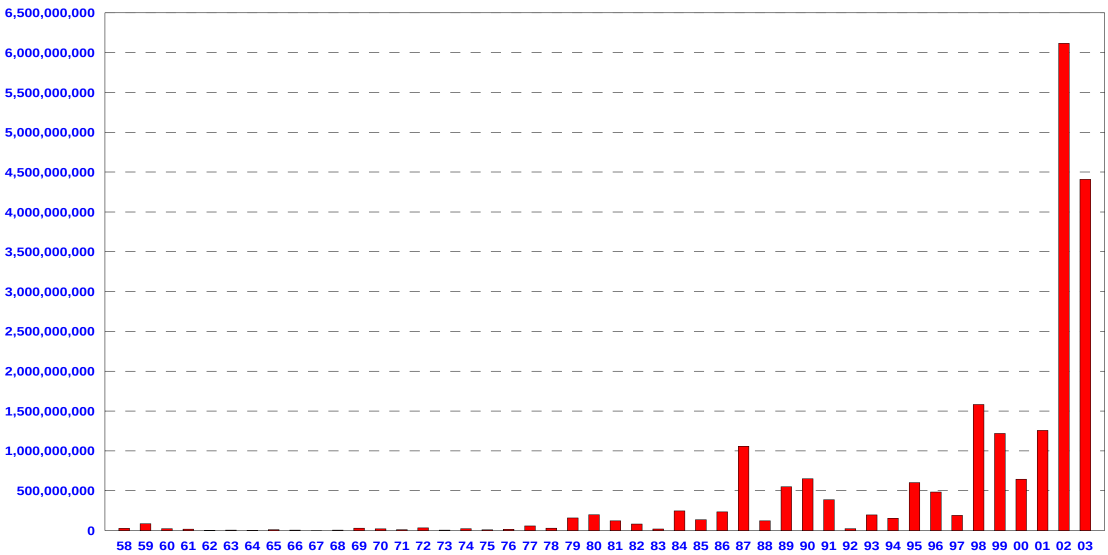


Figure 2. Total Damages in S. Korea by Natural Disaster in thousand Won during 1958-2003 period (*Source: Dr.Kim Sung, 2004*)

2.3. California , USA

California Water Plan Updated in 2005 has acknowledged rising in sea level and reducing snowmelt in the past century as shown in Figures 3 and 4.

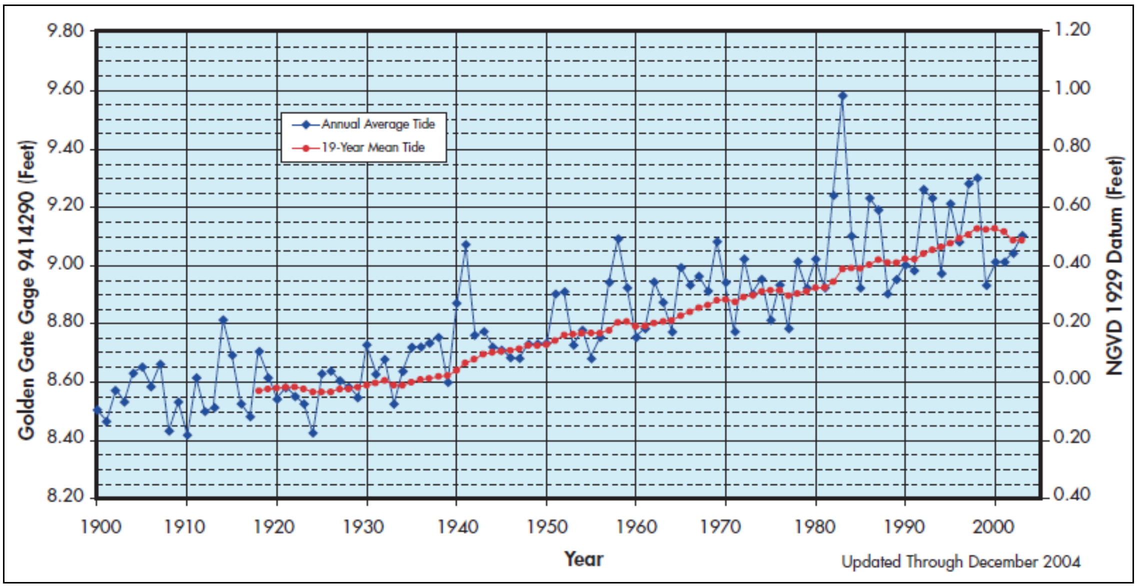


Figure 3. Sea level rise at Golden Gate Gorge, California, USA
(*Source: California Water Plan Update 2005 Volume 1*)

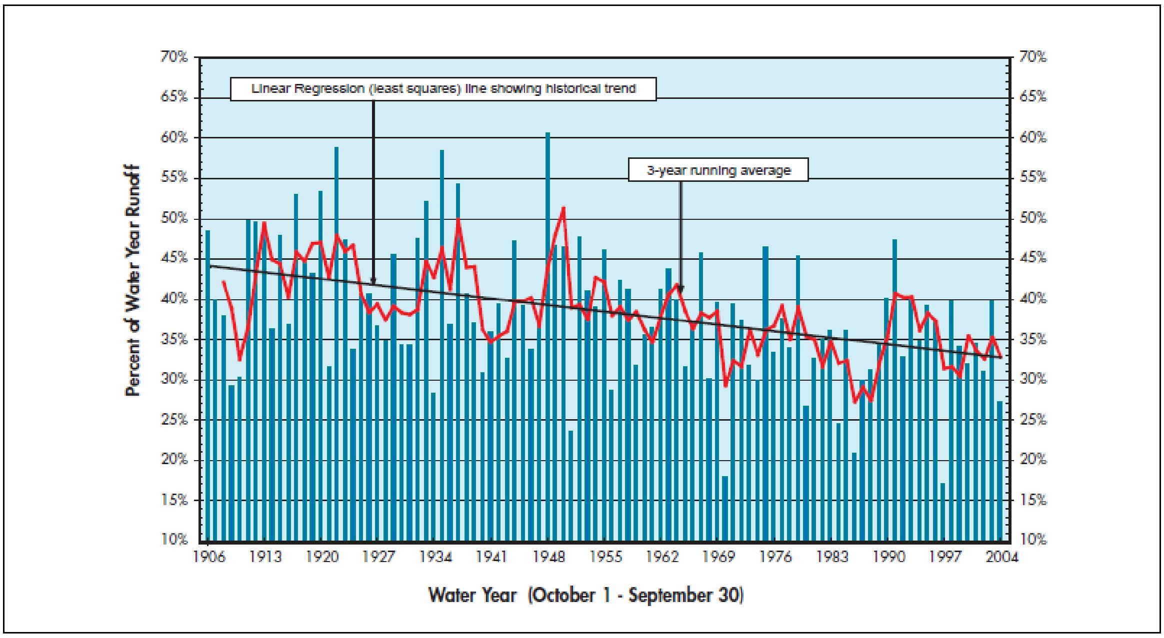


Figure 4. Reduced snowmelt runoff at Sacramento River, California, USA
(*Source: California Water Plan Update 2005 Volume 1*)

2.4. England and Wales

"Climate Change" section of Environmental Agency homepage has published a trend of drier summers and more wet winters (Indicator: Rainfall of summer and winter). It is shown in figure 5 and it can be considered as an example of climate change impact on increasing extreme hydrological events. Figure 6 is an example of bigger flood trend quoted in Environmental Agency's brochure under the title of "The climate is changing; time to get ready (2005)"

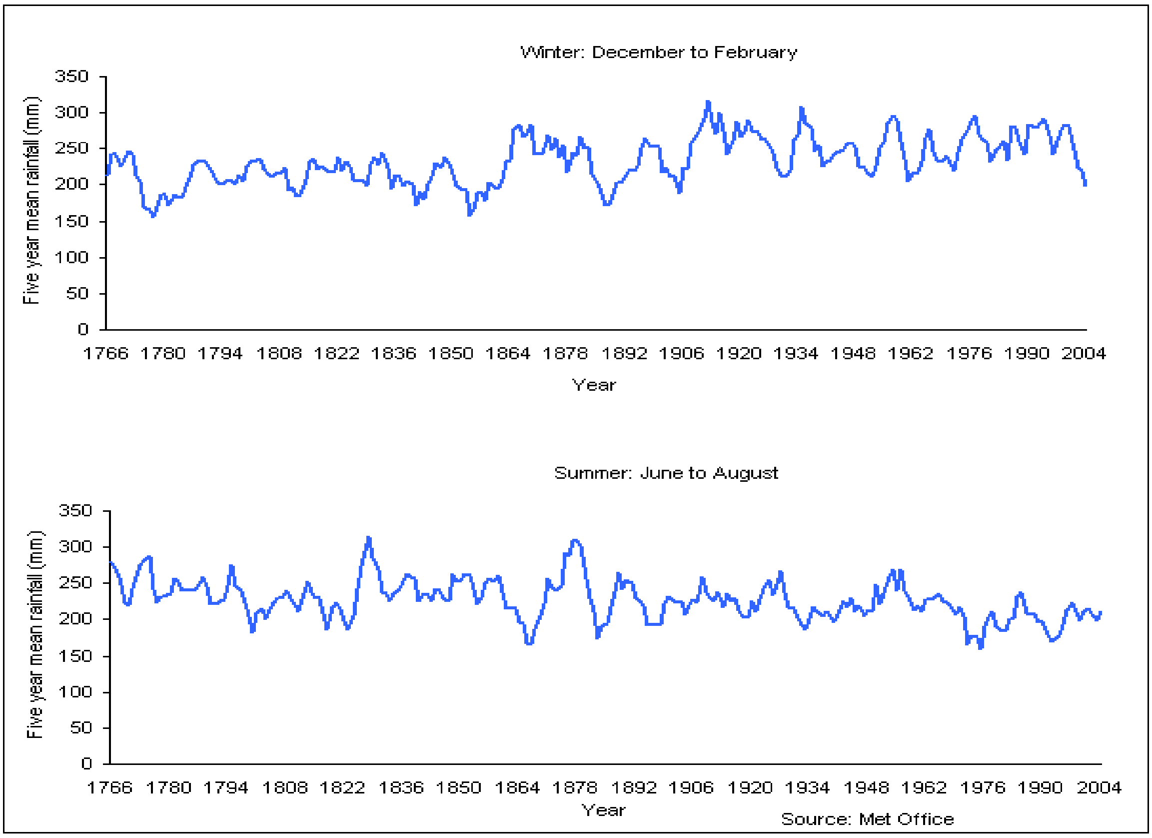


Figure 5. Rainfall in winter (up) and summer (down) in England and Wales

(*Source: http://www.environment-agency.gov.uk*)

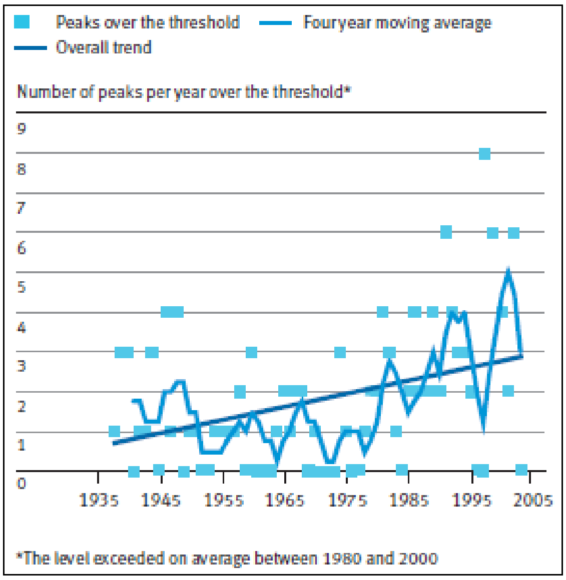


Figure 6. Number of peaks over the threshold in the River Wye, Wales

(*Source: the climate is changing, Environmental Agency, 2005*)

2.5. The Netherlands

Prof. Hugo Coops from RIZA of the Netherlands in his lecture on River Rhine Flood Control Plan at PWRI in June 2005 reported sea level rise at the rate of 20cm per 100 years in the past (Figure 7)

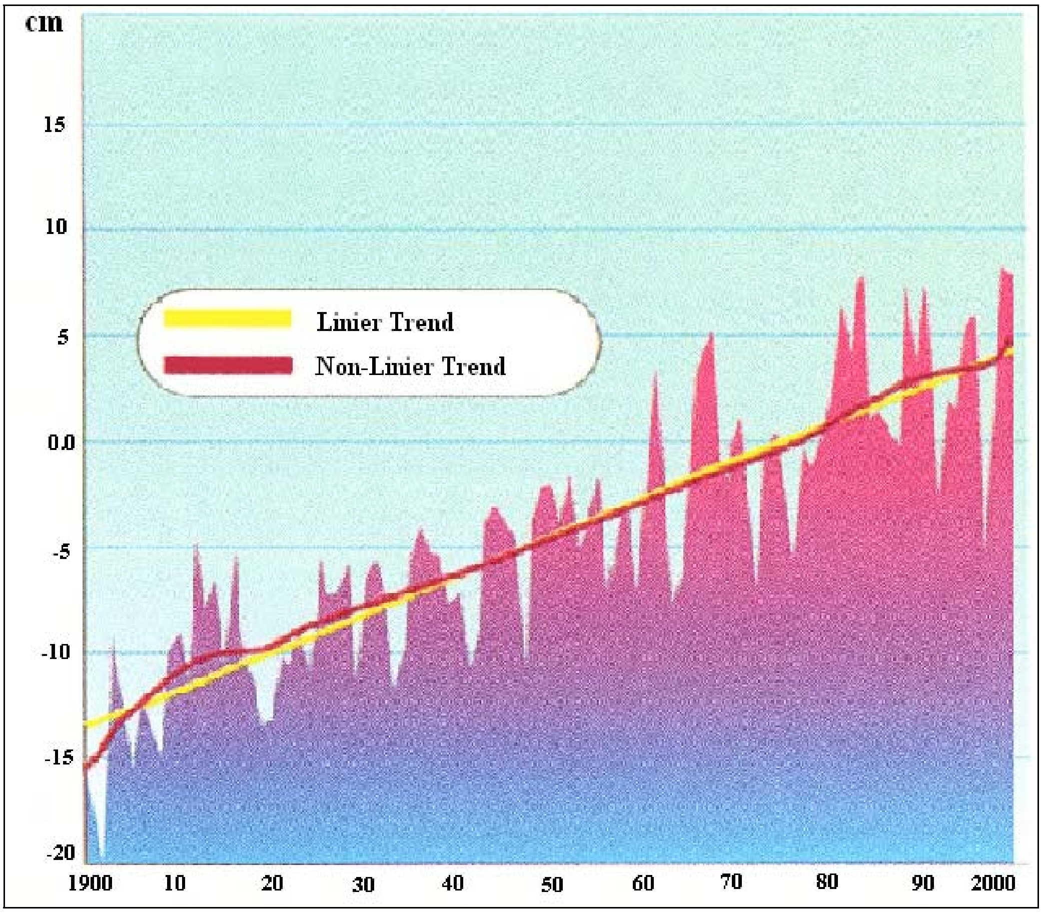
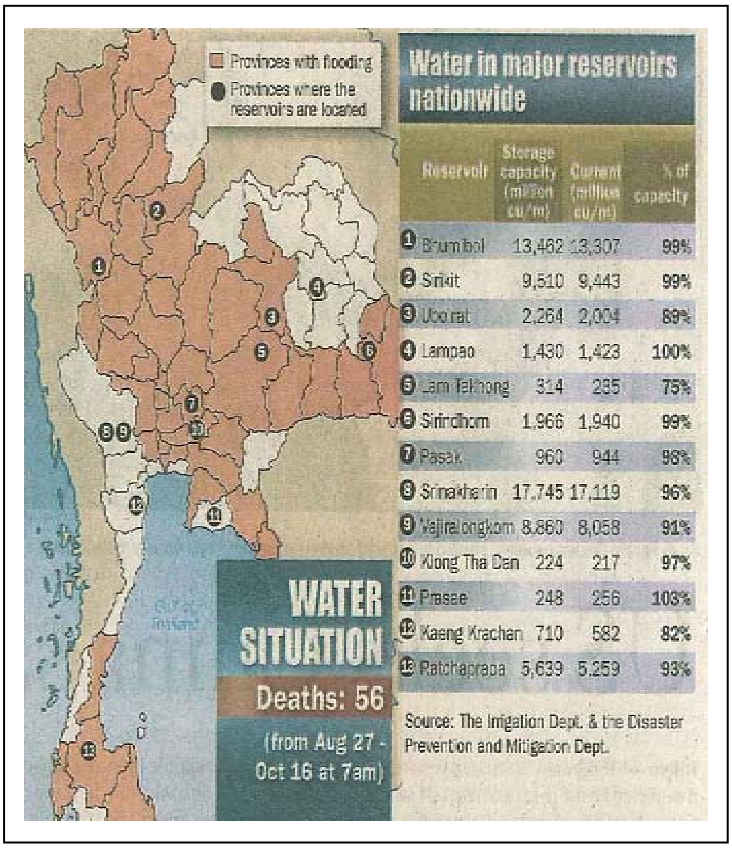


Figure 7. Sea level rise in the Netherland in the past 100 years

2.6. Thailand

Major large-scale reservoirs in Thailand were hardly become full due to large capacity compare with inflows to reservoirs. Then, primarily operation for irrigation did not conflict with flood control since there was always enough space to control floods. However, for the first time in Thai history, all reservoirs became full in the middle of flood season of 2006 as shown in Figure 8.

Despite so far, there is no article or any other reports written in English on this issue, It is heard in a scientific workshop from Thai hydrologists that they need to consider seriously need of adaptation measures for the possible climate change. Some of them claimed to promote a dam construction plan while environmental movement is suspending.



Reservoir	Storage capacity (million cu/m)	Current (million cu/m)	% of capacity
1 Bhumibol	13,462	13,307	99%
2 Sirikit	9,510	9,443	99%
3 Ubolrat	2,264	2,004	89%
4 Lampao	1,430	1,423	100%
5 Lam Takhong	314	235	75%
6 Sirindhorn	1,966	1,940	99%
7 Pasak	960	944	98%
8 Srinakharin	17,745	17,119	96%
9 Vajiralongkorn	8,860	8,058	91%
10 Klong Tha Dan	224	217	97%
11 Prasae	248	256	103%
12 Kaeng Krachan	710	582	82%
13 Ratchaprapa	5,639	5,259	93%

Figure 8. Water storage in major reservoirs in Thailand, October 16, 2006
(*Source: Expert urges formal compensation plan, Bangkok Post, October 17, 2006*)

3. Climate change adaptation plans and implementation

National Adaptation Programs for Action (NAPAs) under the United Nation Framework Convention on Climate Change provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change (excerpt from http://unfccc.int/adaptation/napas/items/2679.php). In Asia, Bangladesh, Bhutan and Cambodia already have country-wide NAPAs.

Besides NAPAs, series of OECE and IPCC reports, there is some more climate change adaptation plans or climate change related actions as follows. Some of them are governmental or official and some other are only initiative or research activity.

3.1. Japan

River Bureau in Ministry of Land Infrastructure and Transport has formed a sub-committee on climate change adaptation for flood control under Panel on Infrastructure Development's River Sectional Committee from summer 2007. Members are consisting of 13 academic experts in the field of hydrology, water resources, atmospheric science, planning, media, disaster management, coast engineering, and environment. Major opinions raised in the meetings up to now (Late October 2007) are:

- Before start of any new policy making, we should recognize that the current safety level of flood control is far behind the planned one. This is because of geomorphologic and climate factors in Japan as well as some other Asian countries:
  (1) Geomorphologic factor: many people are living in flood plain
  (2) Climate factor: extreme rainfall events are very high
  The above factors causing huge investment required for flood control plans. Therefore, flood control plans in Japan are behind of the similar plans in the US or Europe due to huge investment required (see Figure 9).
- A 20% increase in designed rainfall (multiply it by 1.2) is changing 100-year return period of exceeding level of designed peak discharge to once in every 30 or 40 years. It is not feasible to stick on 100-year return period since there is little hope to receive extra funds in order to develop necessary infrastructures for adaptation. Therefore, the adaptation directions should be sharp and narrow-focused such as basin management rather than river system management and priority protection rather than equitable protection. It will also helps for the purpose of attracting public and media's attention.

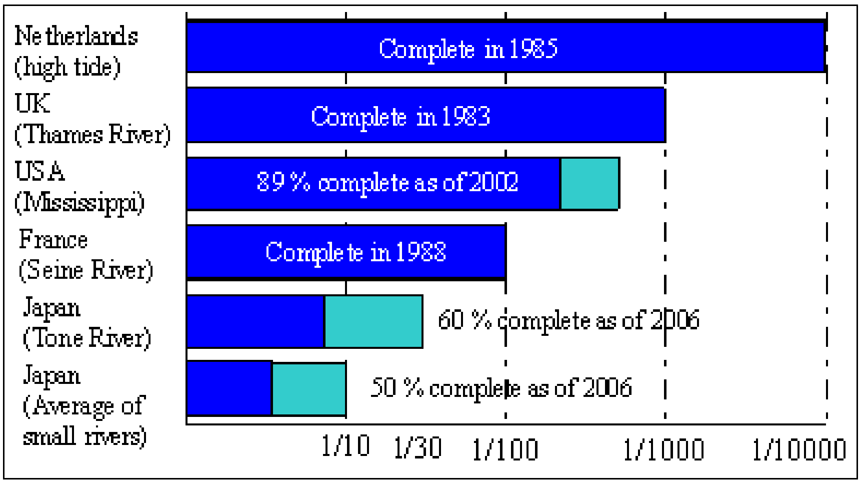


Figure 9. Safety level of Flood Control Plan and Progress
(after Climate Change Adaptation Subcommittee)

3.2. Republic of Korea

Korean Ministry of Construction and Transportation (MOCT) is convinced by frequent observation of the record-breaking precipitation to do a necessary revision on dam safety guideline. According to an emergency action plan, studied by Korean Water Resources Corporation, there are several dams that need the following enhancement and adaptation alternatives:

Spillway improvement; gate installation; increasing level of dam crest; restricted water level lowering; change in reservoir operation rule, etc.

The MOCT's press release in August 2007 has stated that 23 dams are identified for kind of enhancement project in order to secure safety in the context of **Global Warming, El Niño and La Niña**. The improvement projects of two dam have already completed and 13 out of 23 dams are under improvement works. The spillway improvement and gate installation of Yeong-cheon will be completed by October 2007.

3.3. The Netherlands

The Dutch Cabinet has launched a package of measures called the Spatial Planning Key Decision "Room for the River". The main objectives are flood protection of the Rhine River delta without any rise in river flow level (no levee heightening) and promoting overall environmental quality by 2015 with a budget of 2.2 billion Euros. Adaptation to climate change is also included to this plan.

The designed discharge of Rhine River flood control plan for 1/1250 probability was set to 15,000 m3/s at Lobith, where the river cross the border of the Netherlands. The designed discharge is increased to 16,000 m^3/s after a reanalysis considering new flood events. The river should have safe capacity of carrying out discharge flow of 16,000 m^3/s by the year 2015 using several measures. The measures are including lowering of river foreland, removal of obstacles, lowering of groins, dike setback and de-polder, deepening base flow course and flood by-pass. The river should have safe capacity of carrying out discharge flow of 18,000 m^3/s by the end of 21st century. It is not clear from literatures whether the accommodating 18,000 m^3/s is feasible by these alternatives or not.

References of above information are:

Dutch Ministry of Transport, Public Works and Water Management (V&W), Spatial Planning Key Decision 'Room for the River' Investing in the safety and vitality of the Dutch river basin region, September 2006;

Wim Silva, Frans Klijn, and Jos Sijkman: Room for the Rhine Branches in the Netherlands, October 2001; and

Lecture by Hugo Coops at PWRI in June 2005

3.4. UK

UK Environmental Agency proposed a new Planning Policy Statement called PPS25 for the Thames Region. This policy aims to make sure that flood risk is taken into account at all stages in the planning process and include stopping inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk in a long run. (Managing flood risk, Thames Region Catchment Flood, Management Plan, summary document Consultation, January 2007)

3.5. Iran

Trans-basin water transfer is considered as a counter measure for climate change adaptation in water sector. Result of a study in Zayandeh Rud basin in the Central part of Iran has shown that climate change will confront the basin with more sever water scarcity that makes proper water management at basin level more crucial. Transfer of water from the neighboring basins to the Zayandeh Rud was considered an essential adaptation measure. Two tunnels are presently under construction and will be operational before 2010. This water diversion can supply deficit in water resources of basin in order to adopt with water scarcity due to climate change. Moreover, another tunnel for water transfer is under study and it is considered as a supplementary plan for more severe climate change impact scenario in future.

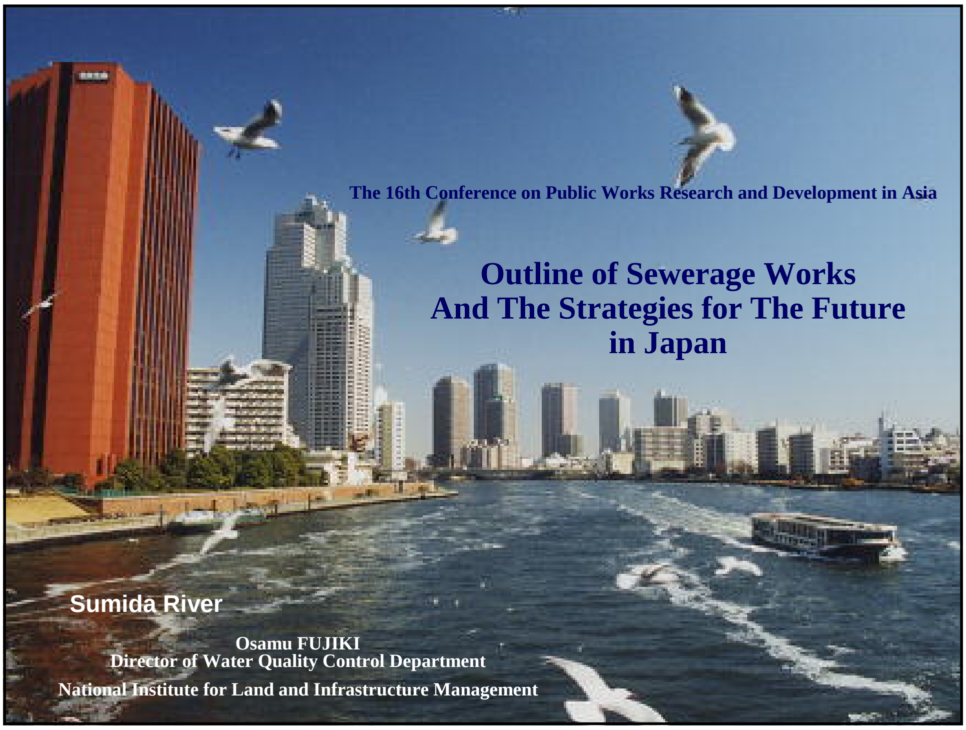
4. Recommended Actions to the Asian Research Institutes

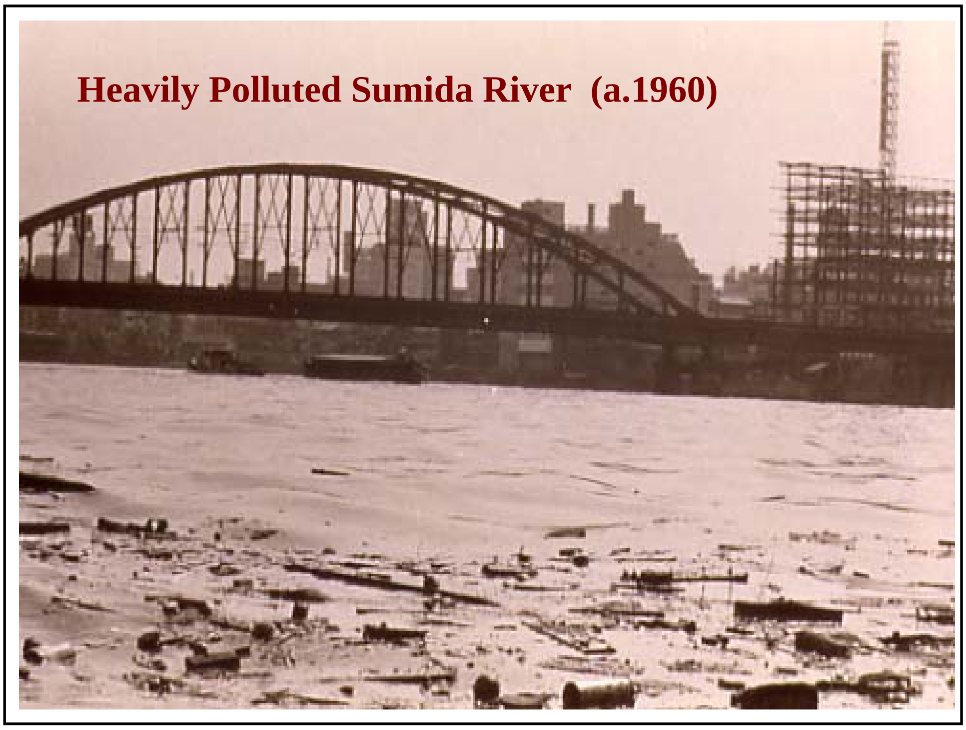
The following are some action proposal for the Asian Research Institutes.

- Highlight climate change impact phenomena of Asian region and its different compare with other regions of the world. It is important to show, in both international and national level, reason of slow start of adaptation programs for flood control in Asian countries due to different social and natural condition. This can be resulted by inter-comparison of the following factors in Asia and other region: current safety level and target level, attainability of the goal in terms of financing and consensus building of public and politicians, severity of extreme events, vulnerability and future change due to population growth, past investment and necessary cost and special social concerns.
- Study on methods and actions to speed up and promote climate change impact adaptation measure in Asian countries. This can be done by pay more attention to more realistic Benefit/Cots (B/C) analysis of climate change adaptation measures as well as compatibility of the suggested methods to the socio-economic condition.
- Sharing information and experiences among Asian Research Institutes and build up a platform for information sharing.
- Joint-research activities on climate change adaption measures with focus on regional climate change impacts and trans-boundary river basins.

Ⅷ-9　Outline of Sewerage Works and The Strategies for The Future in Japan

Mr. Osamu FUJIKI
Director,
Water Quality Control Department,
NILIM


The 16th Conference on Public Works Research and Development in Asia
Outline of Sewerage Works
And The Strategies for The Future
in Japan
Sumida River
Osamu FUJIKI
Director of Water Quality Control Department
National Institute for Land and Infrastructure Management

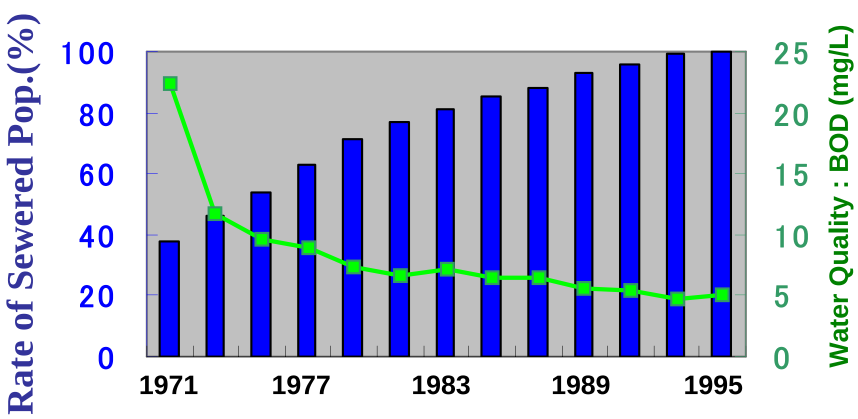

Heavily Polluted Sumida River (a.1960)

Regatta of University Students in Sumida River

The student regatta of Waseda and Keio Universities., which was given up because of the terrible water environment in 1962, was resumed in 1978.

Impact of Sewerage

The Relationship Between Water Quality And the Rate of Population Served with Sewerage

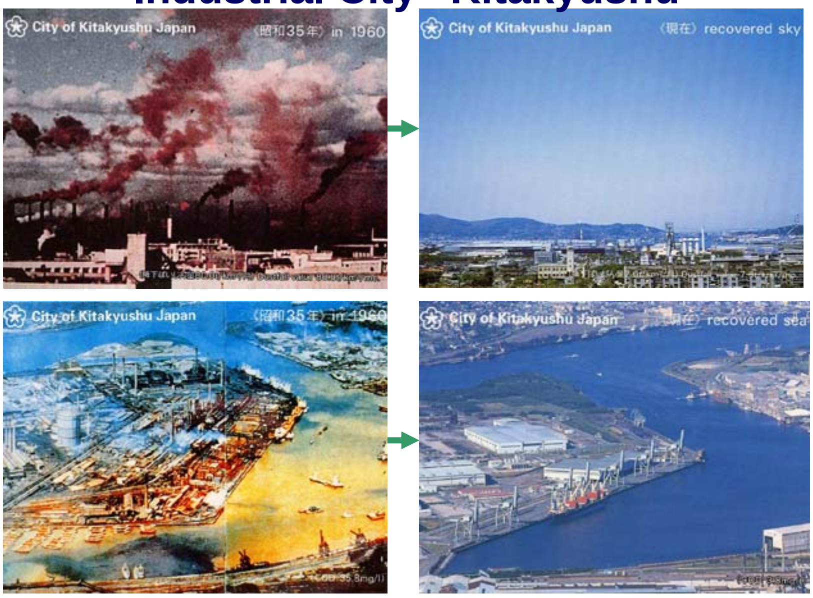


Sumida Firework

The Sumida Firework Festival was also resumed after the river water restoration in 1978.

Another Example

Industrial City “Kitakyushu”



Overview of Sewage Works in Japan

Overview of Japan

- Japan is an archipelago stretching over a great distance from north to south with a vast range of climatic zones
- About 80% of the territory is either mountain or forested land

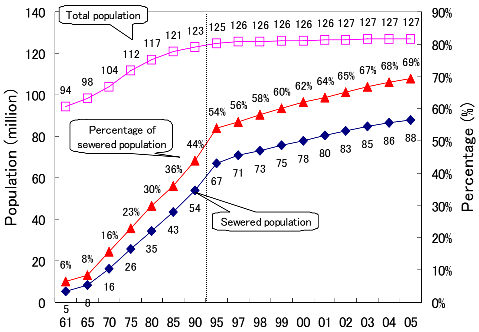
Comparison between India and Japan

	India	Japan
Population (million)	1,080	128 (12%)
Area (billion m2)	3,287	377 (11%)

Progress in Public Sanitary Sewerage System

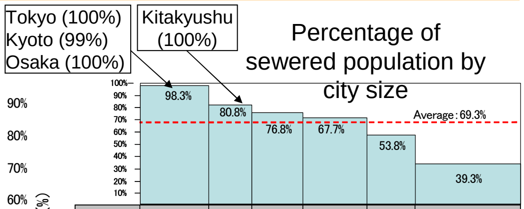
- Sewage work in Japan was developed rapidly since 1960's
- Regional divide is one of the distinguishing characteristics of sewage works in Japan
- Narrowing the gap of regional divide remains a major challenge

Percentage of
sewered population



Increasing constantly
(1.5 points par a year)
since 1960's

Percentage of
sewered population by
city size

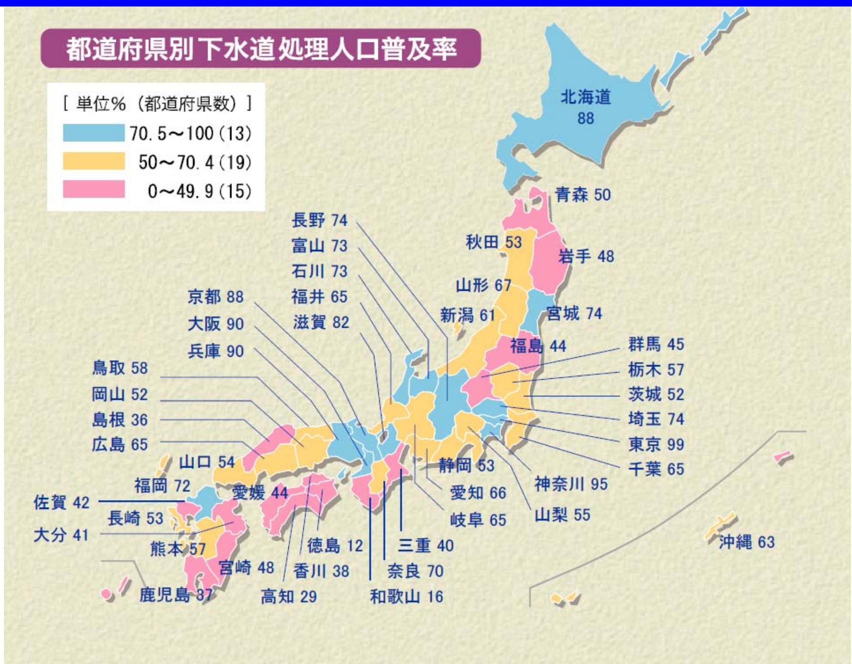


Population (thousand)	Over 1,000	500～1,000	300～500	100～300	50～100	Less than 50
Total number of cities	11	15	46	189	282	1,279
Total population (million)	26.19	10.76	17.79	30.45	19.62	22.25
Sewered population (million)	25.76	8.69	13.66	20.62	10.56	8.74

24 million
people are
not sewered

Sewered ratio is only 39%
among the cities with
population less than 50
thousand

Rate of Sewered Population in Each Prefecture



Institutional System of Sewage Works in Japan

Coverage Rate of Appropriate Sewage System 82.4%

As of the end of FY 2006

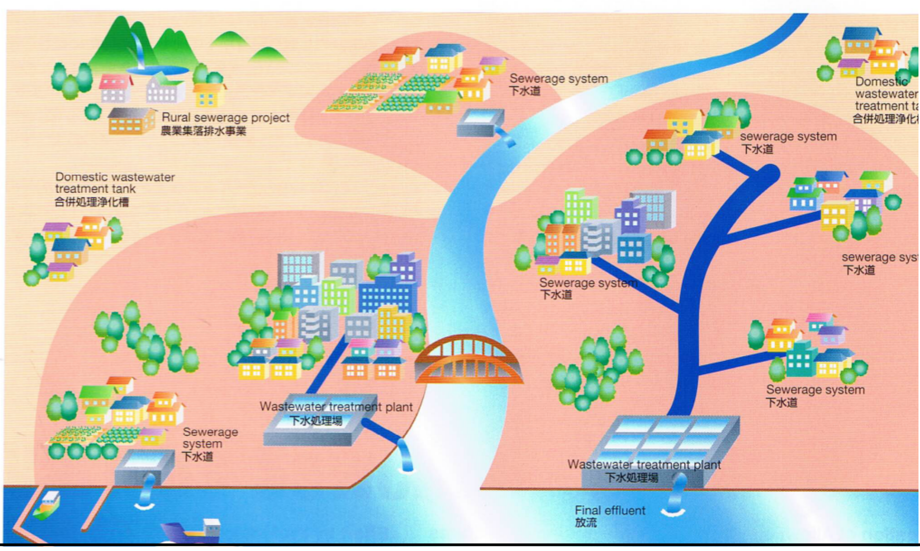
	Sewerage system	Rural sewerage system	Domestic wastewater treatment tank	Flush toilet wastewater treatment	Toilet with storage tank
Share	70.5%	2.8%	9.0%	17.6%	
Construction and Maintenance	Local-Governmental		Private or Local-Governmental	Private	
Law	Sewerage Law	Domestic Wastewater Treatment Tank Law			Waste Disposal and Public Cleansing Law
Ministry Responsible for Jurisdiction	Ministry of Land, Infrastructure and Transport	Ministry of Agriculture, Forestry and Fisheries	Ministry of the Environment		
National Treasury Subsidy	With			Without	

Right System in the Right Place (1)

Different Measures between Urban and Country Areas

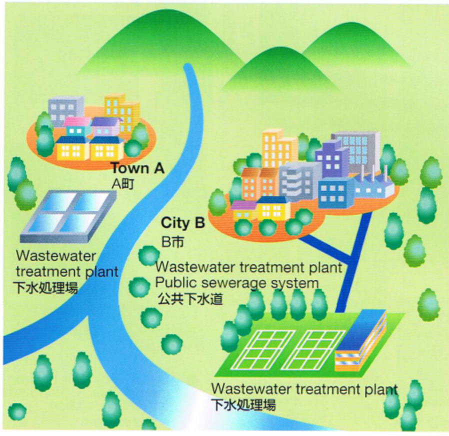
Effective Sewerage System Construction and Imprementation Meaures

効率的な下水道整備と事業実施方法



Right System in the Right Place (2)
The Role of Prefecture Government

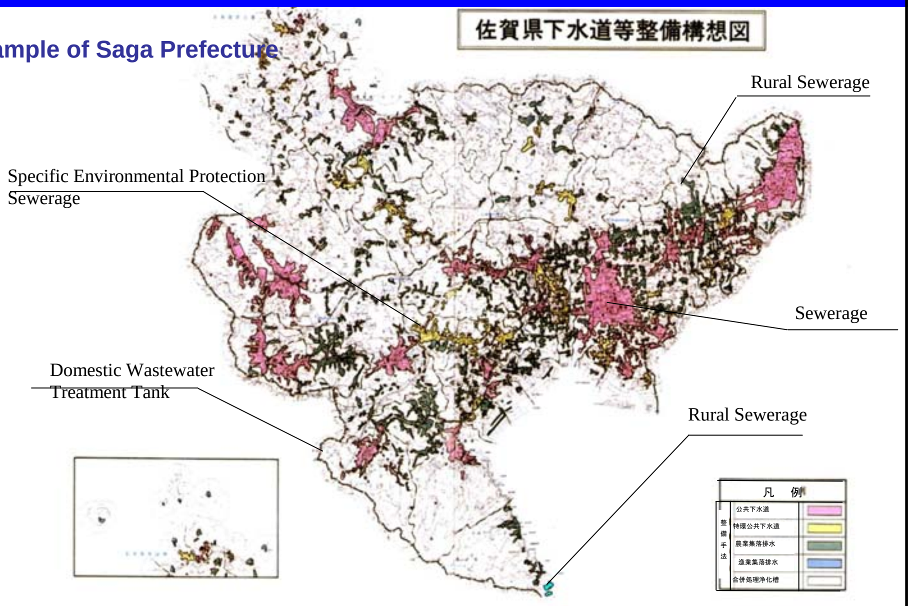
Public Sewerage Systems
公共下水道



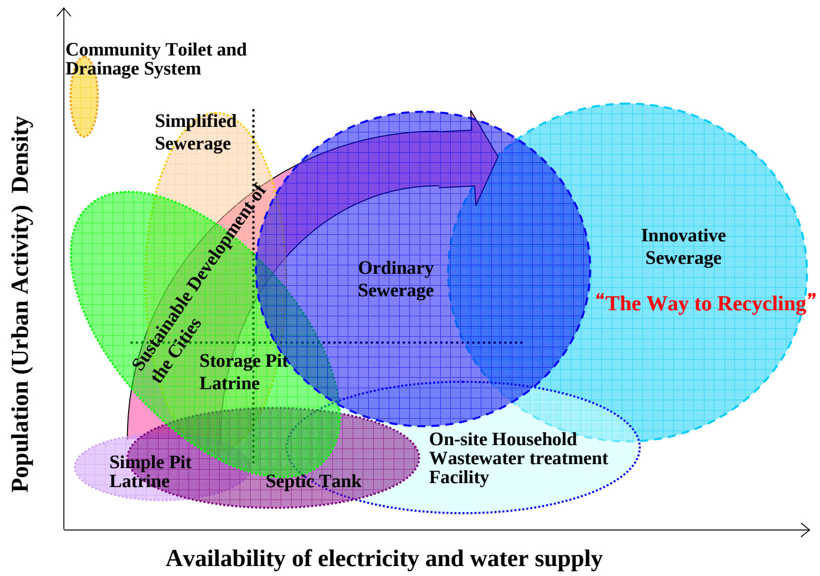
Regional Sewerage Systems
流域下水道

Right System in the Right Place (3)
Prefecture-wide Sewerage Map

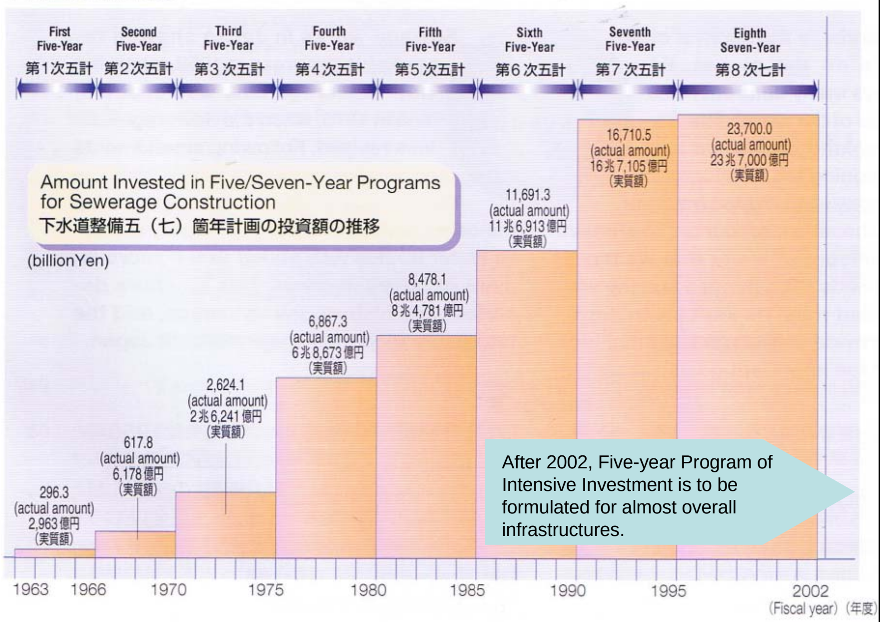
Example of Saga Prefecture



Right System in the Right Place and in the Right Time
Evolution of Sewage System



Progress of Investment in Sewerage Construction
(Five-year Program of Sewerage Construction)



Resources for Public Sewerage Construction

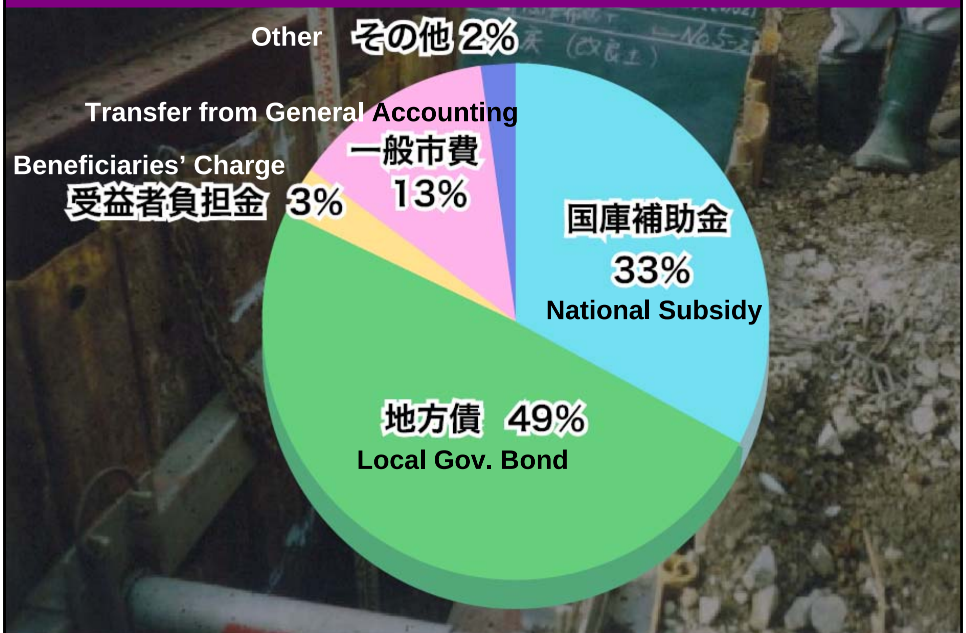
Public sewerage system

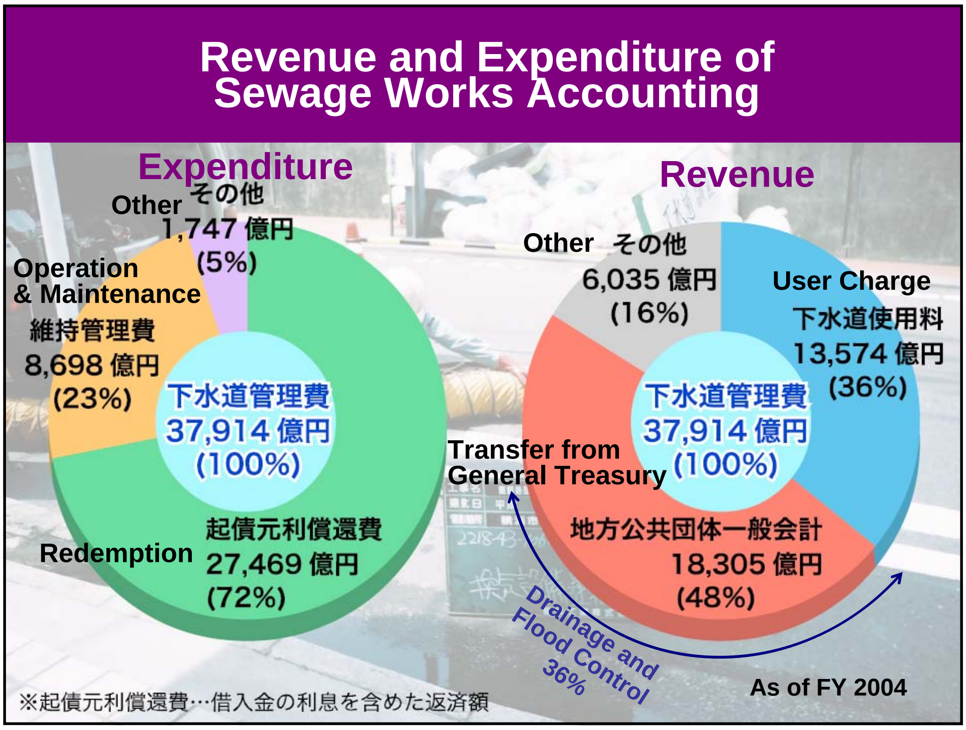
- National Subsidy (national treasury subsidy)
- Local spending
  - Local government bonds
  - Beneficiary’s charge etc.

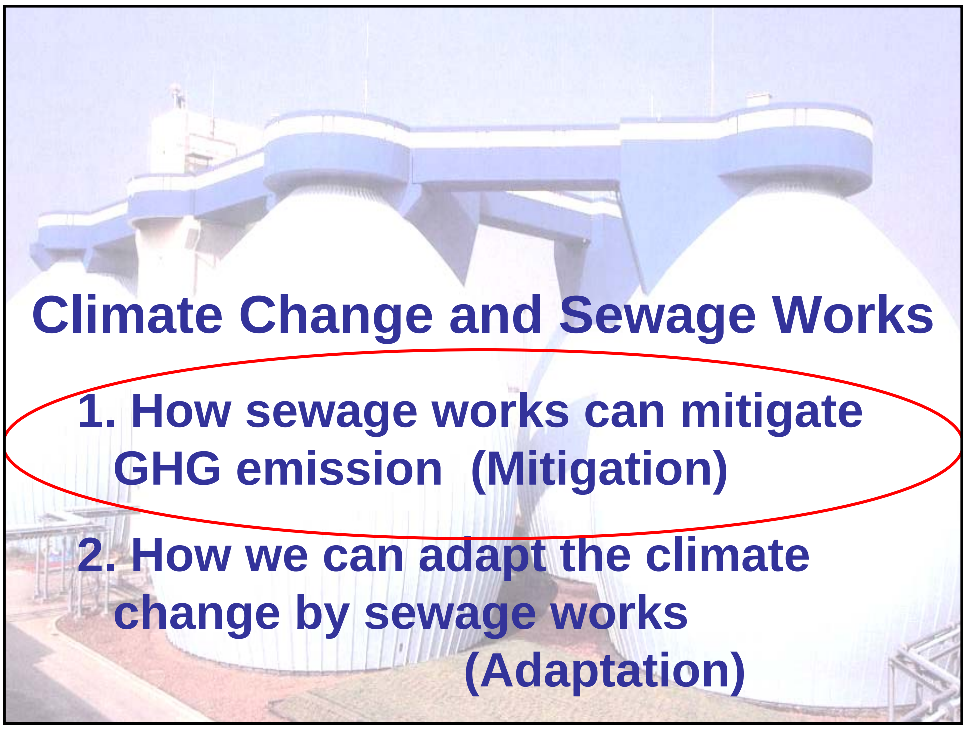
Storm-water channel

- National spending (national treasury subsidy)
- Local spending
  - General local government expenditure
  - Local government bonds etc.

Resources for Developing Public Sewerage



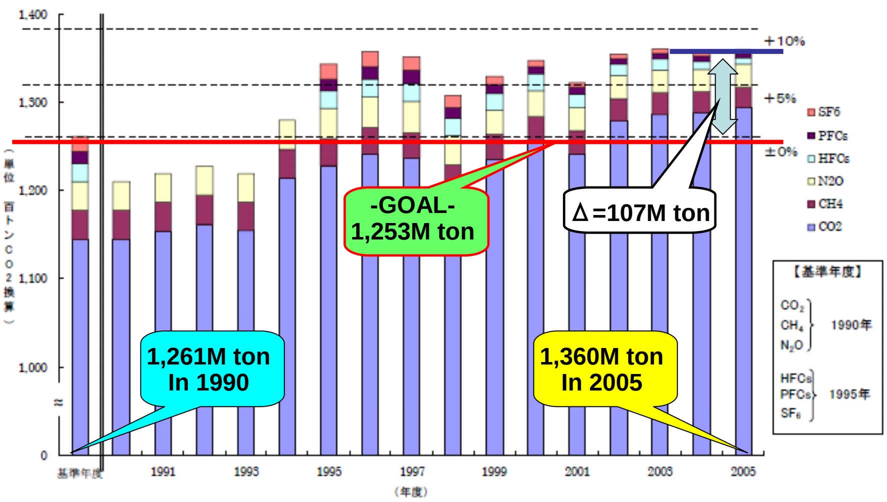

Revenue and Expenditure of
Sewage Works Accounting
Expenditure
Other その他
1,747 億円
(5%)
Operation
& Maintenance
維持管理費
8,698 億円
(23%)
下水道管理費
37,914 億円
(100%)
Redemption
起債元利償還費
27,469 億円
(72%)
Revenue
Other その他
6,035 億円
(16%)
User Charge
下水道使用料
13,574 億円
(36%)
下水道管理費
37,914 億円
(100%)
Transfer from
General Treasury
地方公共団体一般会計
18,305 億円
(48%)
Drainage and
Flood Control
36%
As of FY 2004
※起債元利償還費…借入金の利息を含めた返済額


Climate Change and Sewage Works
1. How sewage works can mitigate
GHG emission (Mitigation)
2. How we can adapt the climate
change by sewage works
(Adaptation)

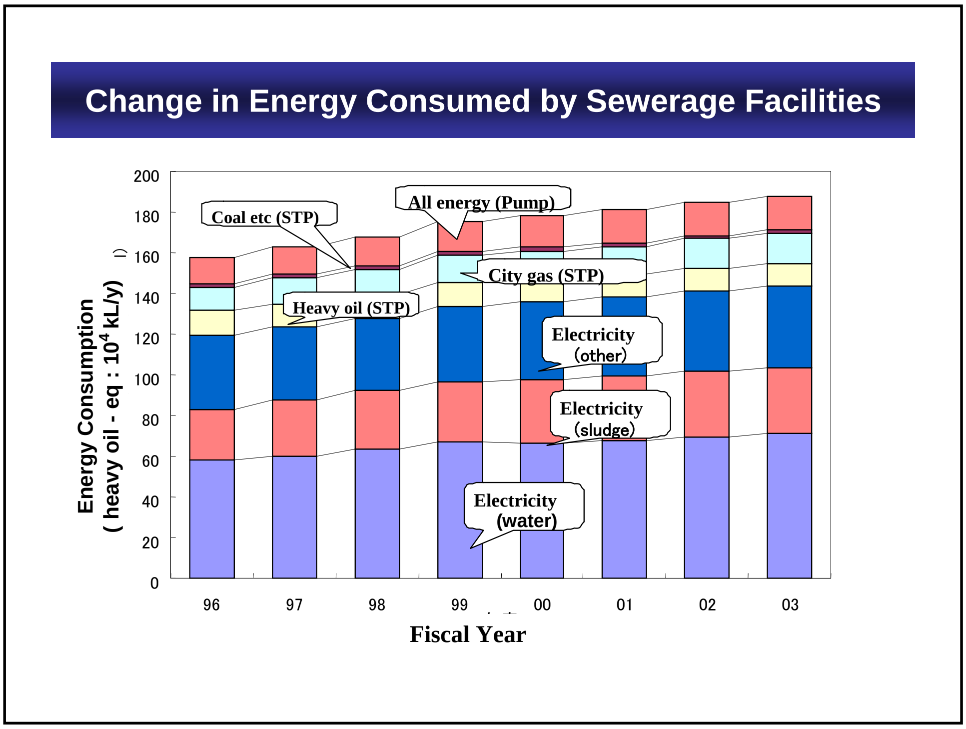
How Sewage Works can mitigate GHG emission

1. Mitigation of N_2O emission from incinerator
2. Mitigation of CO_2 emission by energy saving
3. Producing carbon-neutral fuel from sludge
   Biogases
   Sludge charcoal through dryer or carbonization
4. Alternative energy
   Utilization of sewage energy by heat pump
   Wind power, Solar energy, Effluent waterpower, etc.
5. Battery energy storage system

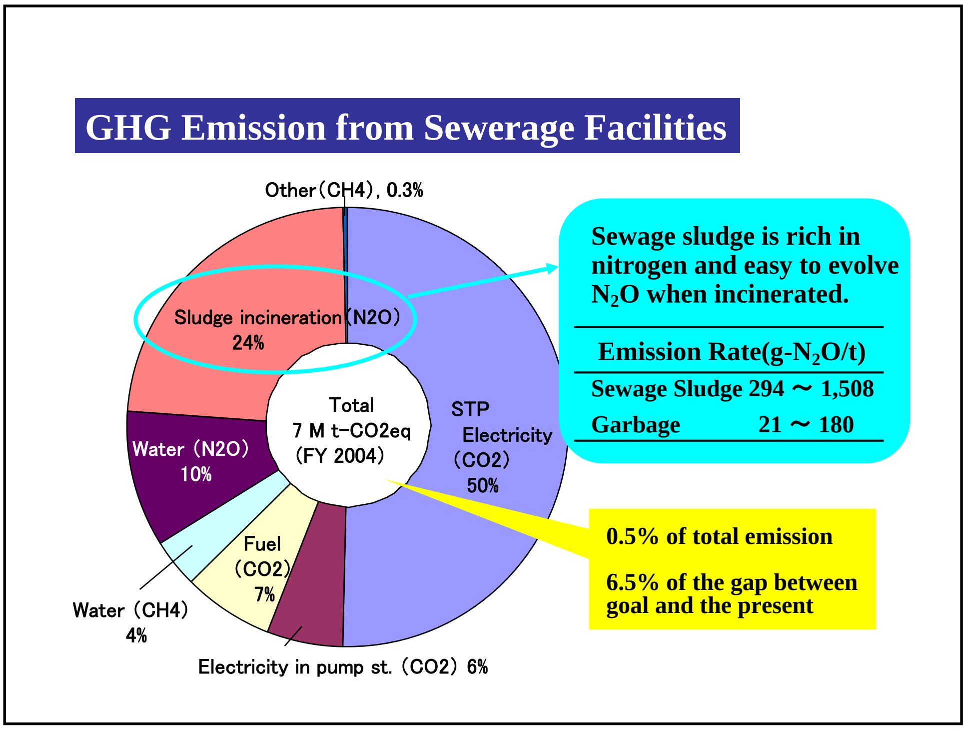
GHG emission in FY 2005 amounts to 1,360 million t-CO_2, which exceeds that of 1990 by 7.8%.



Change in GHG Emission in Japan

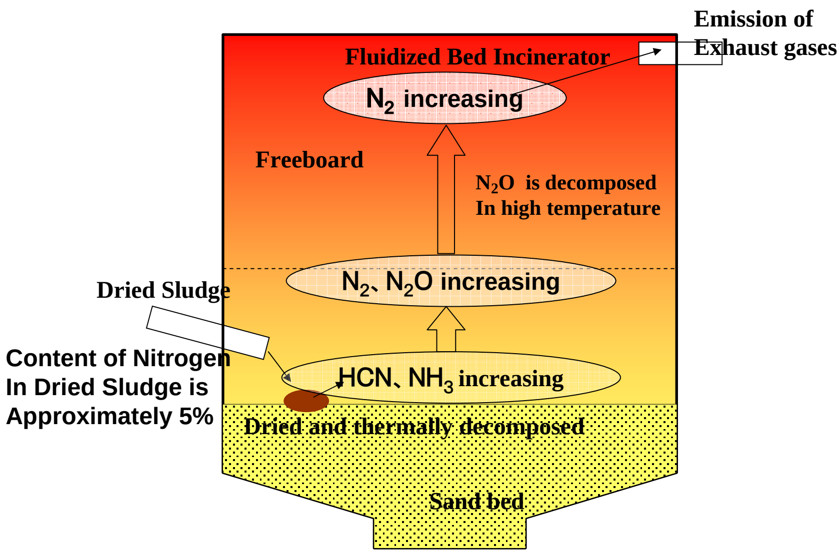


Change in Energy Consumed by Sewerage Facilities
Energy Consumption
(heavy oil - eq : 10⁴ kL/y)
200
180
160
140
120
100
80
60
40
20
0
Coal etc (STP)
All energy (Pump)
City gas (STP)
Heavy oil (STP)
Electricity (other)
Electricity (sludge)
Electricity (water)
96
97
98
99
00
01
02
03
Fiscal Year

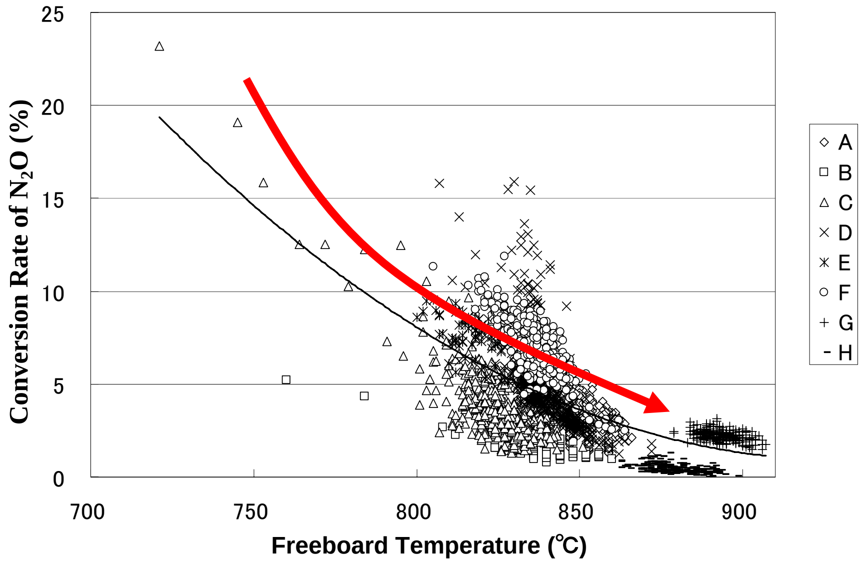


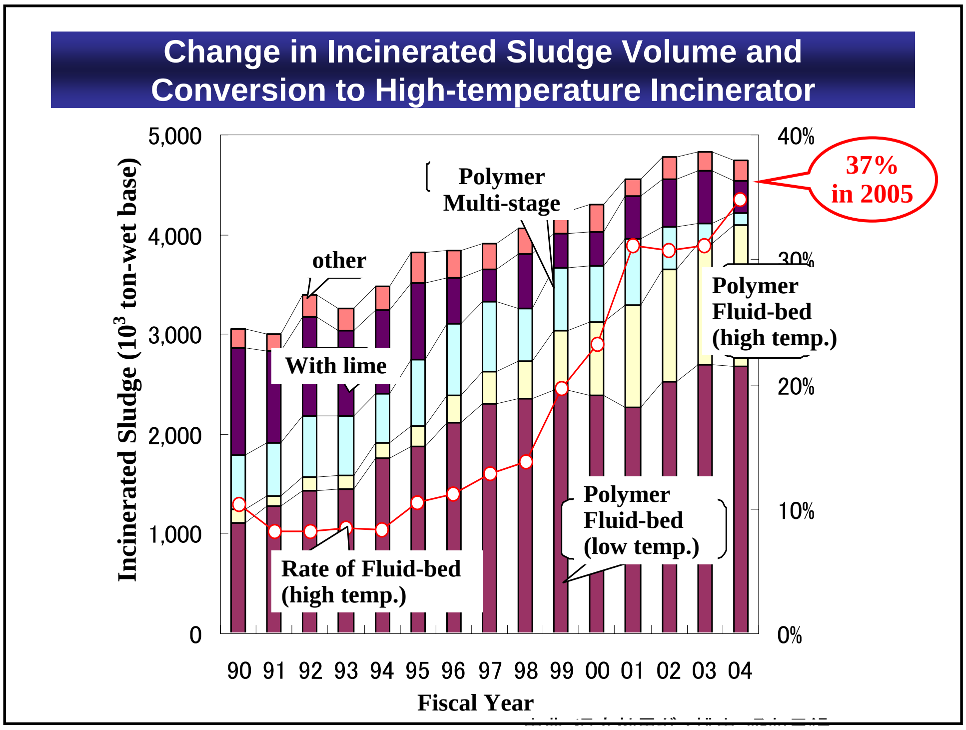
GHG Emission from Sewerage Facilities
Other(CH4), 0.3%
Sludge incineration(N2O) 24%
Total 7 M t-CO2eq (FY 2004)
STP Electricity (CO2) 50%
Water (N2O) 10%
Fuel (CO2) 7%
Water (CH4) 4%
Electricity in pump st. (CO2) 6%
Sewage sludge is rich in nitrogen and easy to evolve N2O when incinerated.
Emission Rate(g-N2O/t)
Sewage Sludge 294 ~ 1,508
Garbage 21 ~ 180
0.5% of total emission
6.5% of the gap between goal and the present

N_2O Composed in Sludge Incinerator

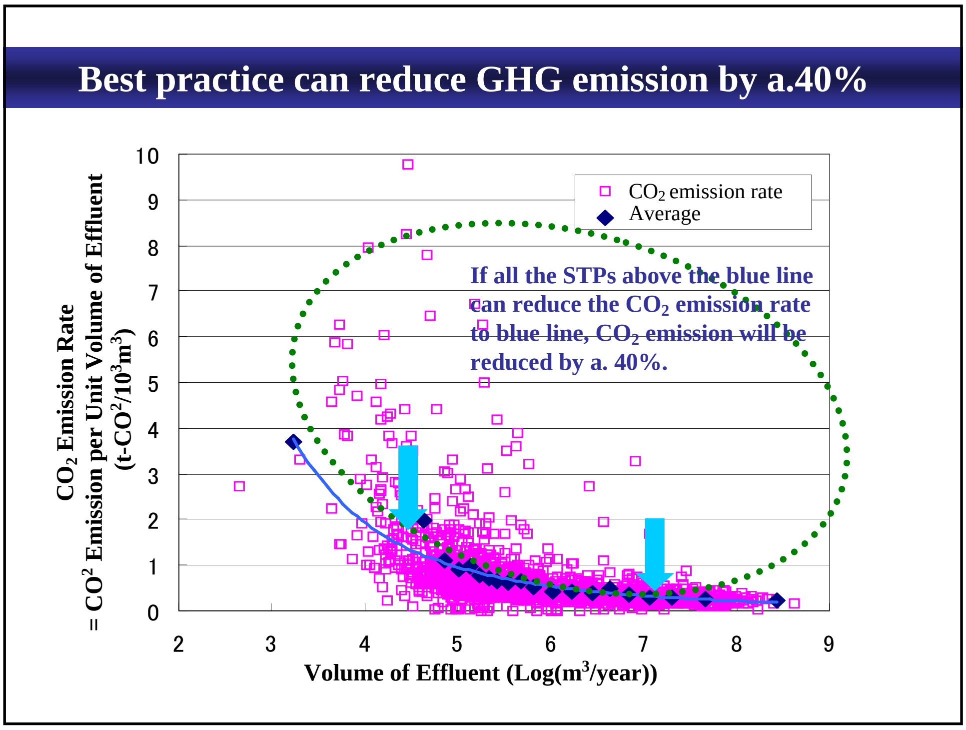


Relation between N_2O Conversion Rate and the Freeboard Temperature in Sludge Incinerator

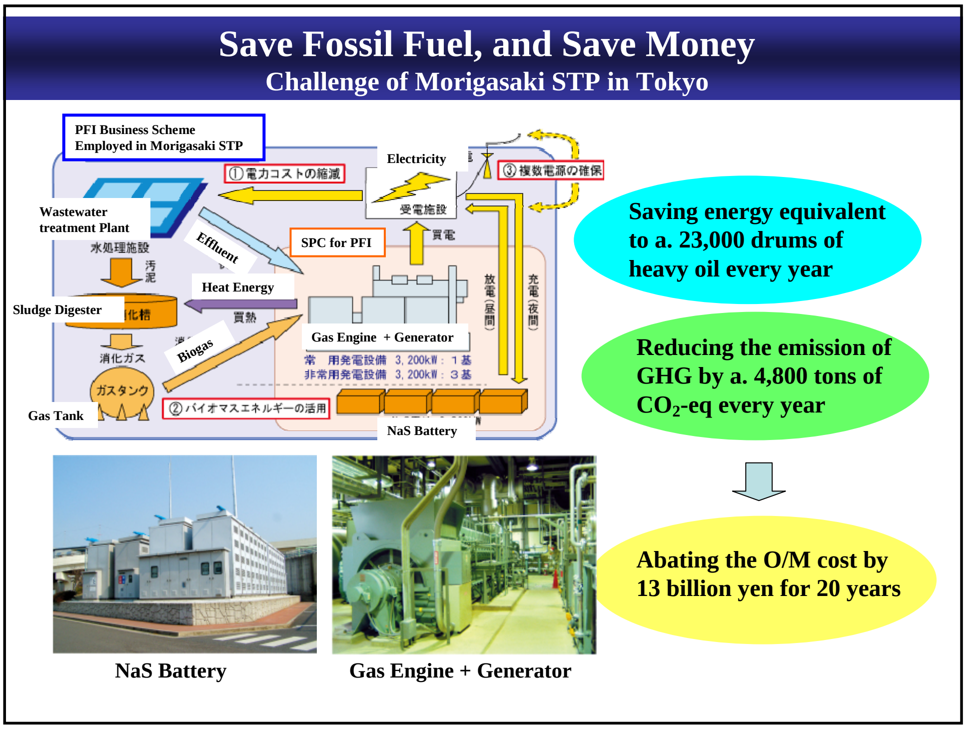


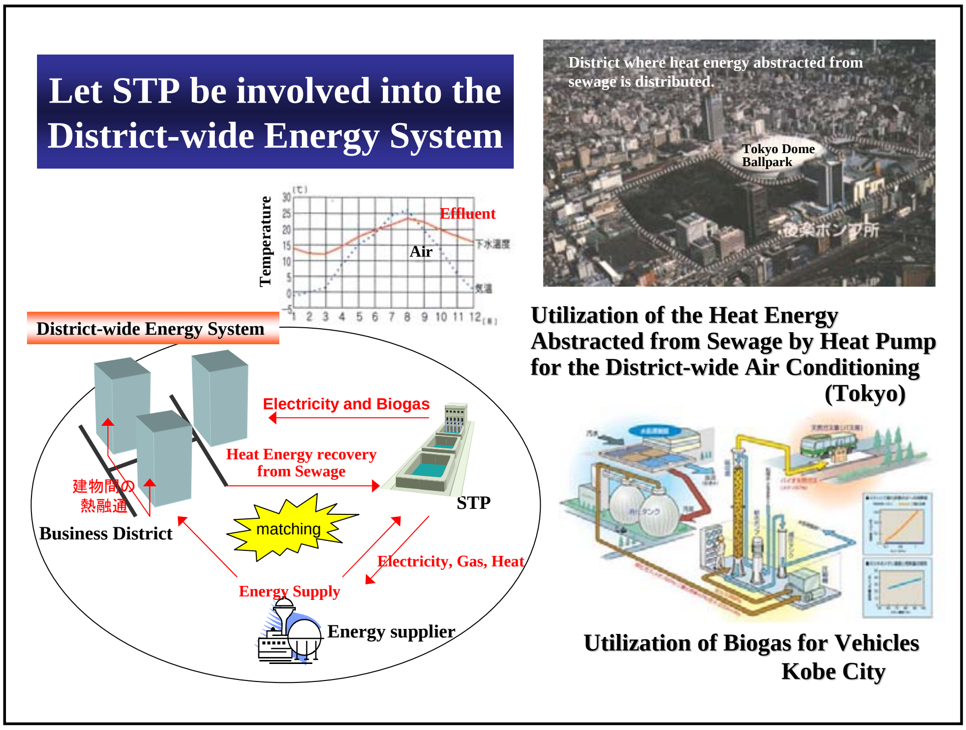


Change in Incinerated Sludge Volume and Conversion to High-temperature Incinerator
Incinerated Sludge (10^3 ton-wet base)
5,000
4,000
3,000
2,000
1,000
0
40%
30%
20%
10%
0%
37% in 2005
Polymer Multi-stage
other
With lime
Polymer Fluid-bed (high temp.)
Polymer Fluid-bed (low temp.)
Rate of Fluid-bed (high temp.)
90 91 92 93 94 95 96 97 98 99 00 01 02 03 04
Fiscal Year



Best practice can reduce GHG emission by a.40%
CO2 Emission Rate
= CO2 Emission per Unit Volume of Effluent
(t-CO2/10^3m^3)
10
9
8
7
6
5
4
3
2
1
0
CO2 emission rate
Average
If all the STPs above the blue line can reduce the CO2 emission rate to blue line, CO2 emission will be reduced by a. 40%.
2 3 4 5 6 7 8 9
Volume of Effluent (Log(m^3/year))


Save Fossil Fuel, and Save Money
Challenge of Morigasaki STP in Tokyo
PFI Business Scheme Employed in Morigasaki STP
①電力コストの縮減
Electricity
③複数電源の確保
受電施設
Wastewater treatment Plant
水処理施設
Effluent
SPC for PFI
買電
Heat Energy
Sludge Digester
Biogas
Gas Engine + Generator
消化ガス
ガスタンク
Gas Tank
②バイオマスエネルギーの活用
NaS Battery
Saving energy equivalent to a. 23,000 drums of heavy oil every year
Reducing the emission of GHG by a. 4,800 tons of CO2-eq every year
Abating the O/M cost by 13 billion yen for 20 years
NaS Battery
Gas Engine + Generator

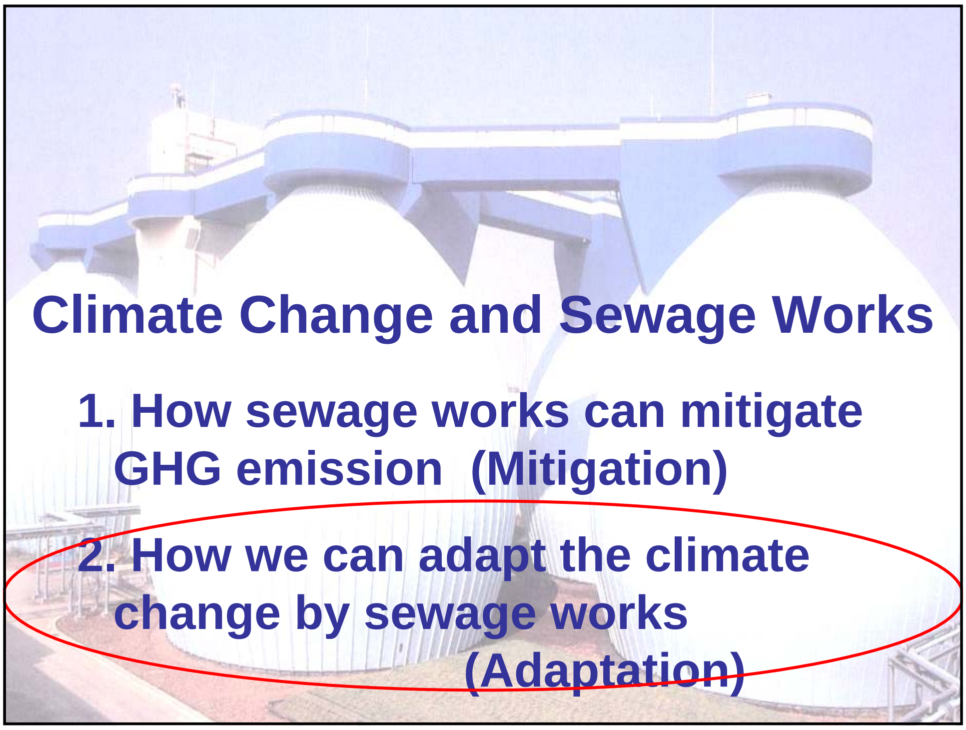

Let STP be involved into the District-wide Energy System
Temperature
Effluent
Air
District-wide Energy System
Electricity and Biogas
Heat Energy recovery from Sewage
STP
Business District
matching
Electricity, Gas, Heat
Energy Supply
Energy supplier
District where heat energy abstracted from sewage is distributed.
Tokyo Dome Ballpark
Utilization of the Heat Energy Abstracted from Sewage by Heat Pump for the District-wide Air Conditioning (Tokyo)
Utilization of Biogas for Vehicles Kobe City

APEC Action Agenda

SYDNEY APEC LEADERS' DECLARATION
ON CLIMATE CHANGE,ENERGY SECURITY AND CLEAN DEVELOPMENT
Sydney, Australia, 9 September 2007

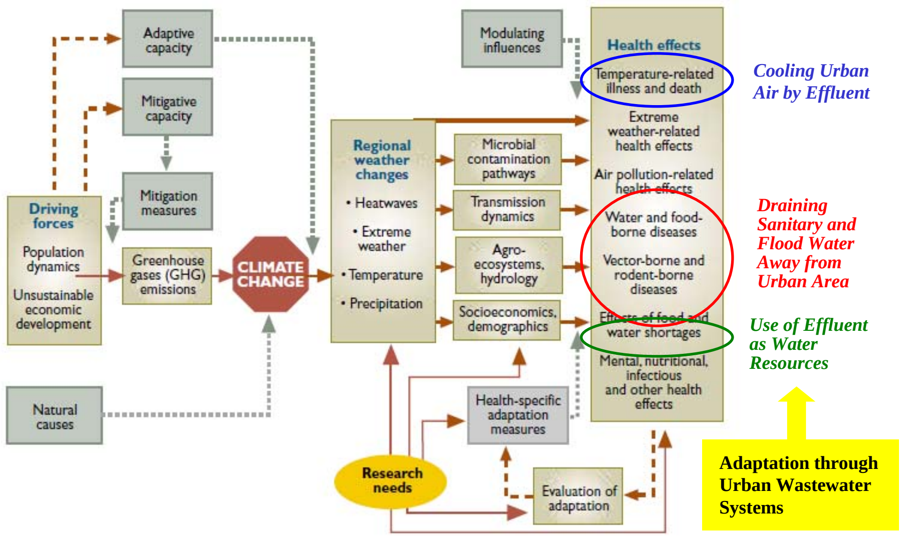
We have decided to:

highlight the importance of <u>improving energy efficiency</u> by working towards achieving an APEC-wide regional aspirational goal of a <u>reduction in energy intensity of at least 25 per cent by 2030</u> (with 2005 as the base year);



Climate change and health: pathway from driving forces, through exposures to potential health impacts. Arrows under research needs represent input required by the health sector

(Modified from "Climate change and human health : risks and responses", WHO 2003)

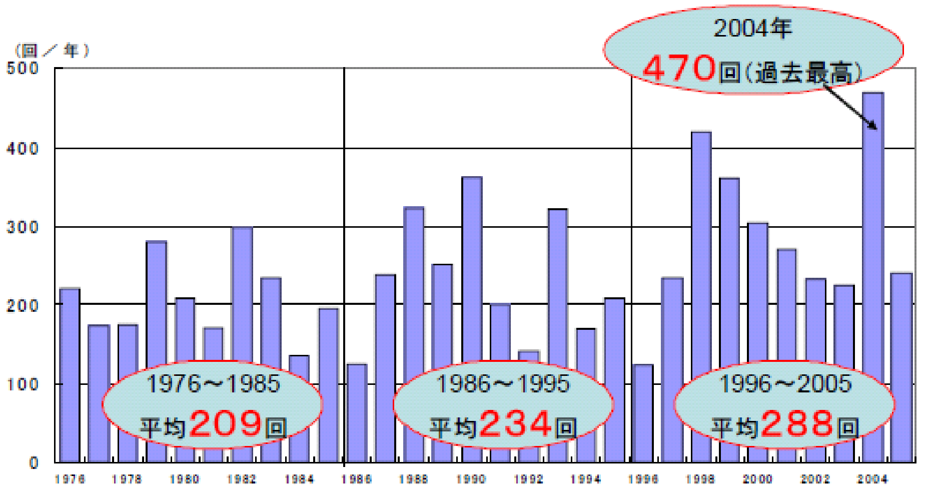


Inundation Caused by Intensive Rainfalls

Hibiya, Tokyo (2000)

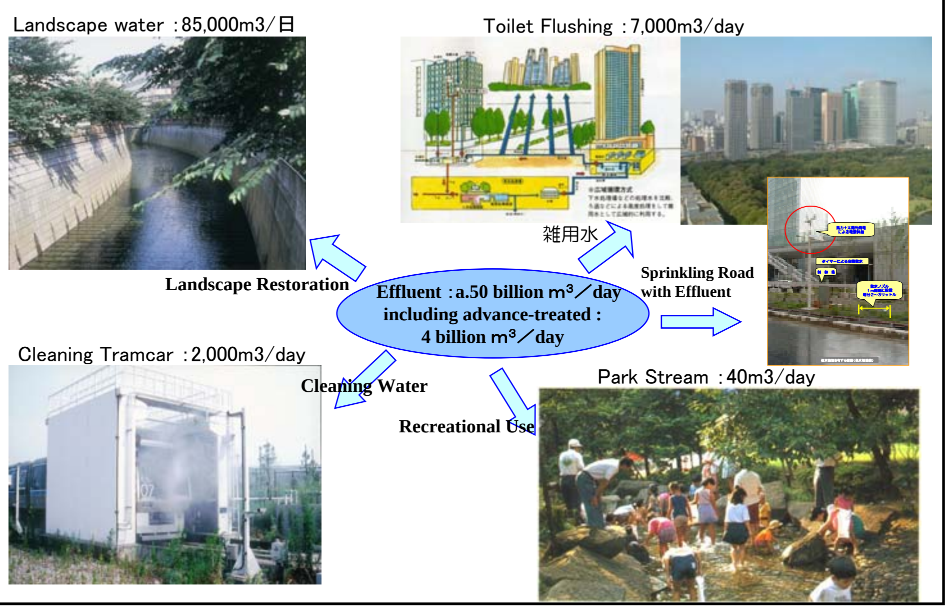
Fukuoka, (1999)

Frequency of Extreme Event of Rainfall (more than 50mm/hour)

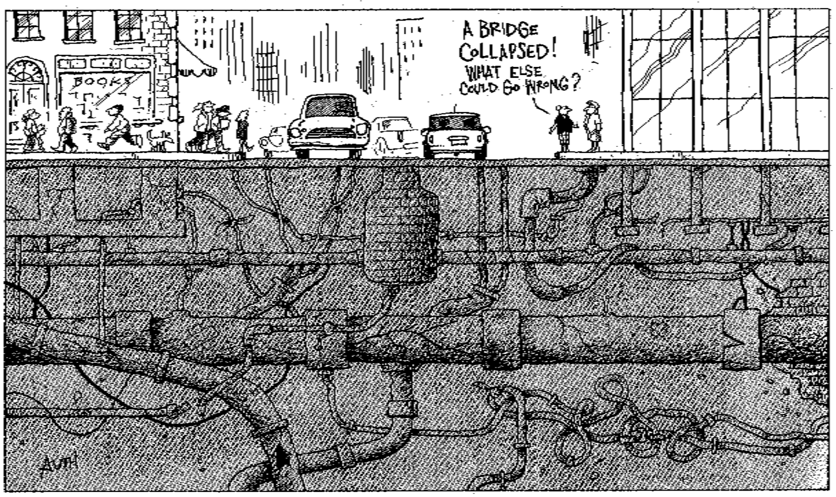


Utilization of Effluent

Example of Tokyo Metropolitan Government



How Should We Manage the Aging Facilities ?

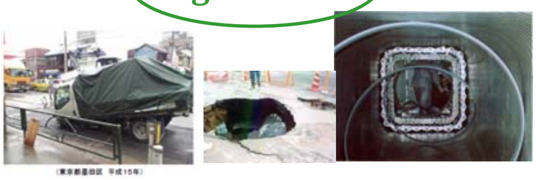


New Concept of Sewage Works
“The Way to Recycling”

The way to New Water

The way to Resources

Regeneration




Thank you

Ⅷ-10　Urban Stormwater Management

Mr. Takashi SAKAKIBARA
Head, Wastewater System Division,
Water Quality Control Department, NILIM

The 16th Conference on Public Works Research and Development in Asia

Urban Stormwater Management

Takashi SAKAKIBARA

Jun ENDO

Norihide TAMOTO

Wastewater System Division,

Water Quality Control Department,

National Institute for Land and Infrastructure Management (NILIM),

Ministry of Land, Infrastructure and Transport(MLIT)

Urban Stormwater Management-Topics

1.Backgournd

2.Current Status

3.Plan

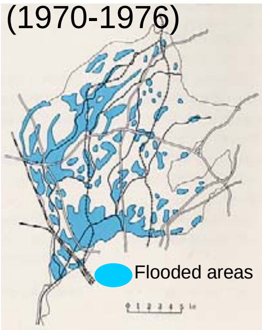
4.Countermeasures

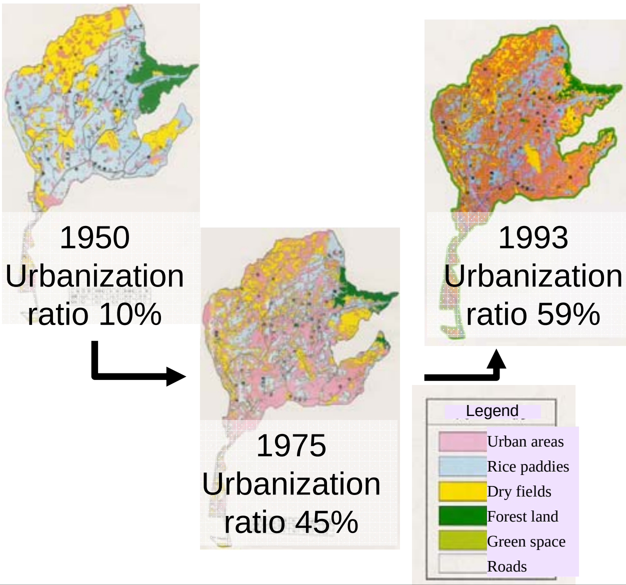
5.Combined Sewer Overflow Problem &Control

6.Toward the Global Warming Problem &Control

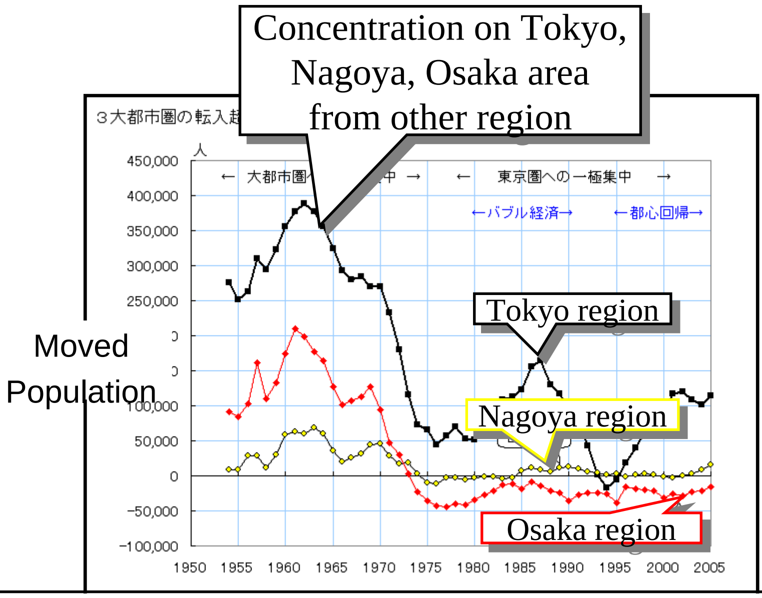
1. Background

Shinkawa (Aichi Prefecture)
Flood history (1970-1976)

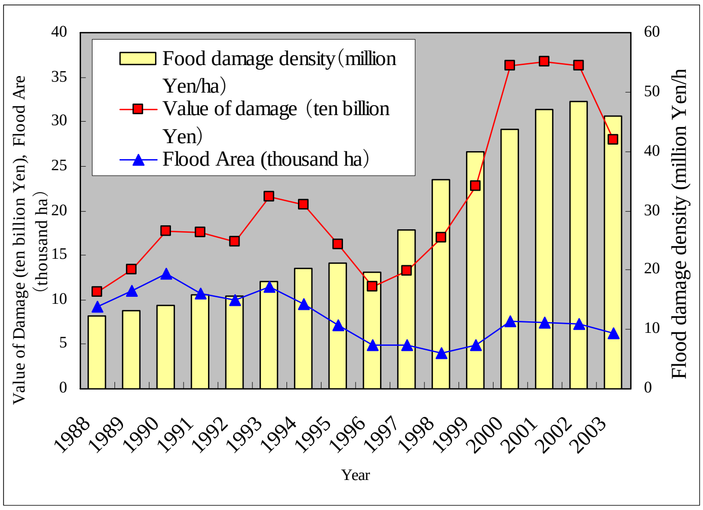




Population Migration



Urbanization & Flood Damage



Note: The data are the average figures for a five-year period.

Source: Flood Damage Statistics compiled by the Ministry of Land, Infrastructure and Transport, Japan

2. Inner Water Damage in Japan

Kochi city (1998)

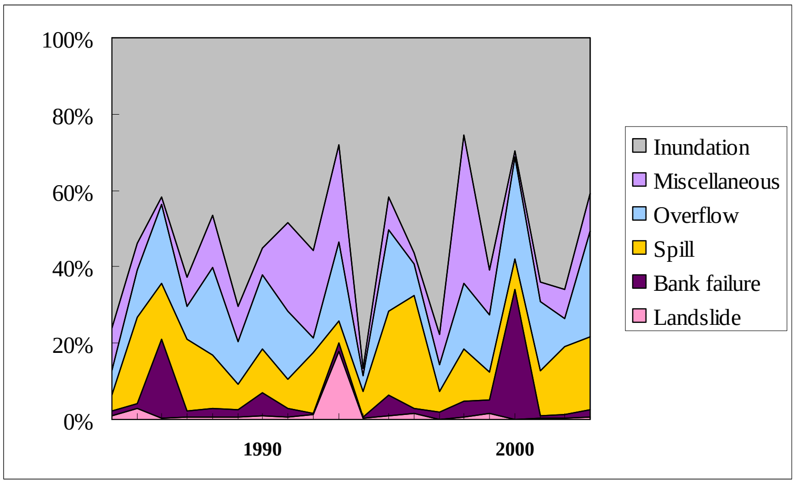
Fukuoka city (1999)

Nagoya city (2000)

cf. Flooding in Kand River,Tokyo

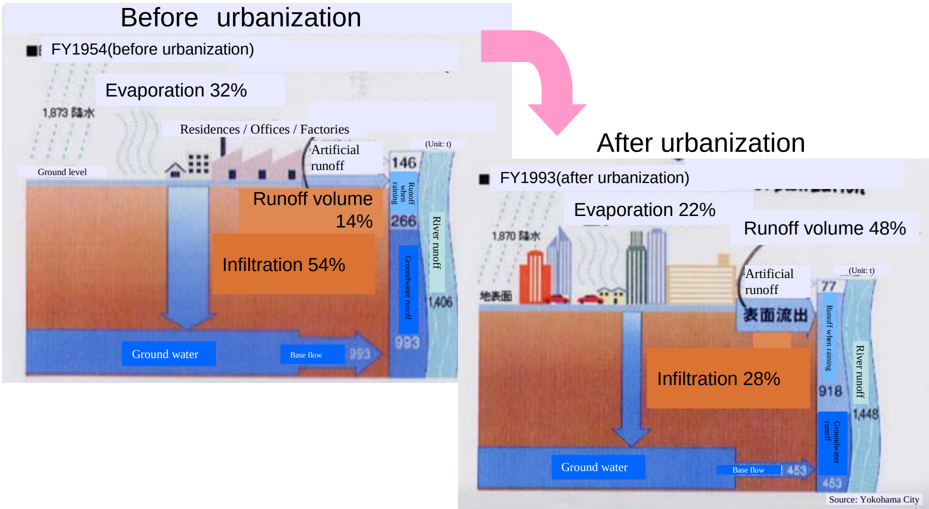
Breakdown of Inner Water Damage Amounts

(About region of Tokyo, Nagoya and Osaka)



Rate of flood damage by cause

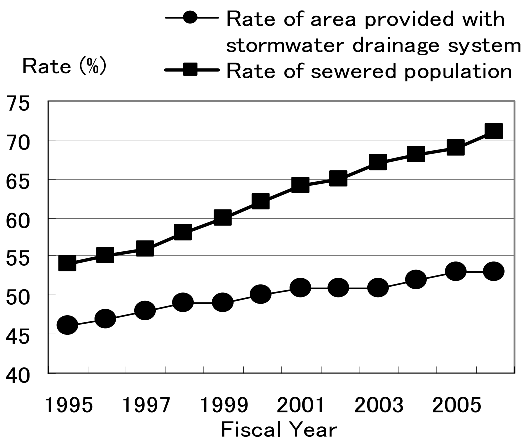
Increase of Outflow by Urbanization



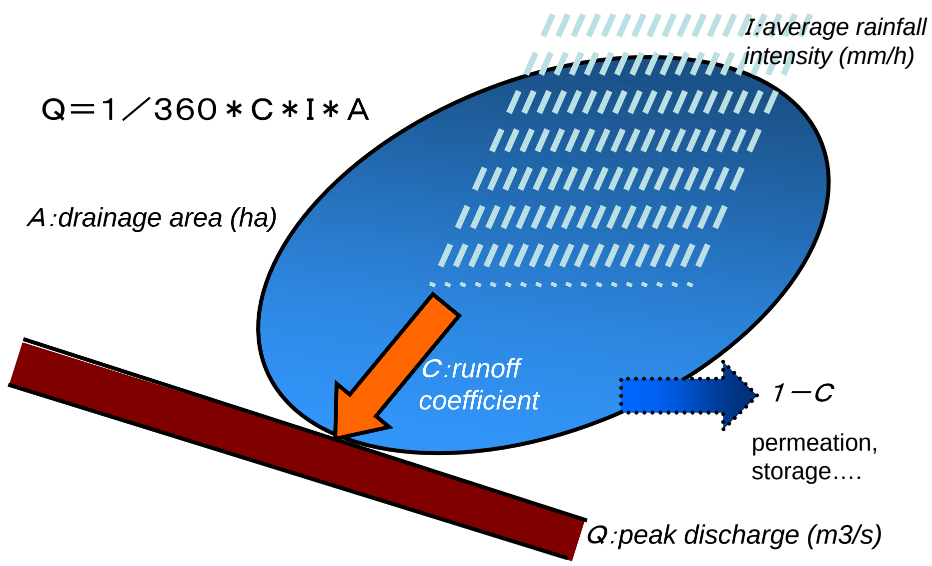
3. Plan for Urban Inner Water Drainage

Sewerage for Storm Water Falls Behind in Japan

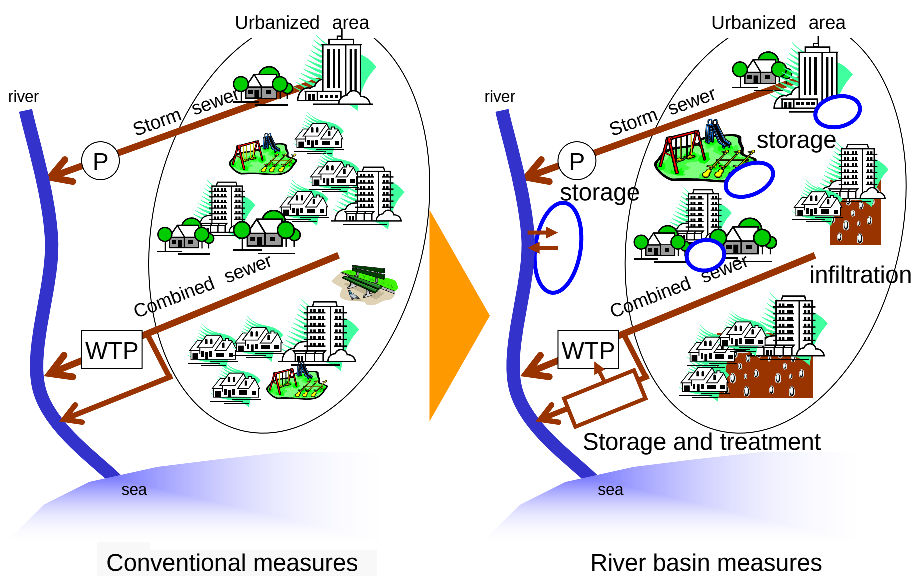
Situation of sewerage in Japan



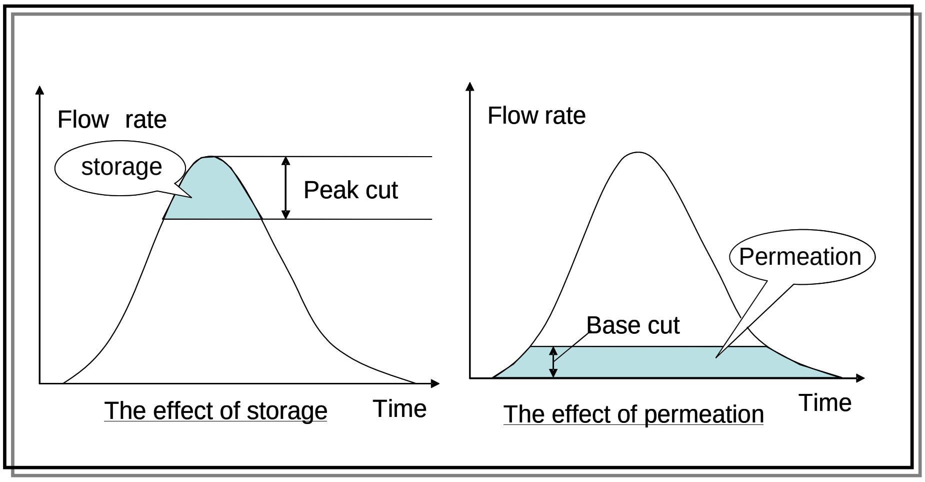
Calculation method for stormwater volume



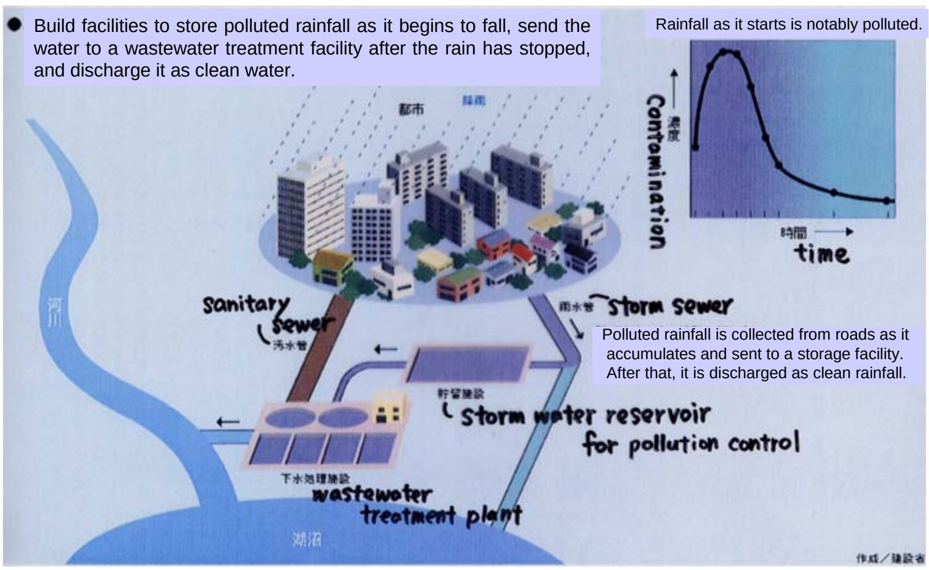
Considering Storage and Permeation Facilities' Effect



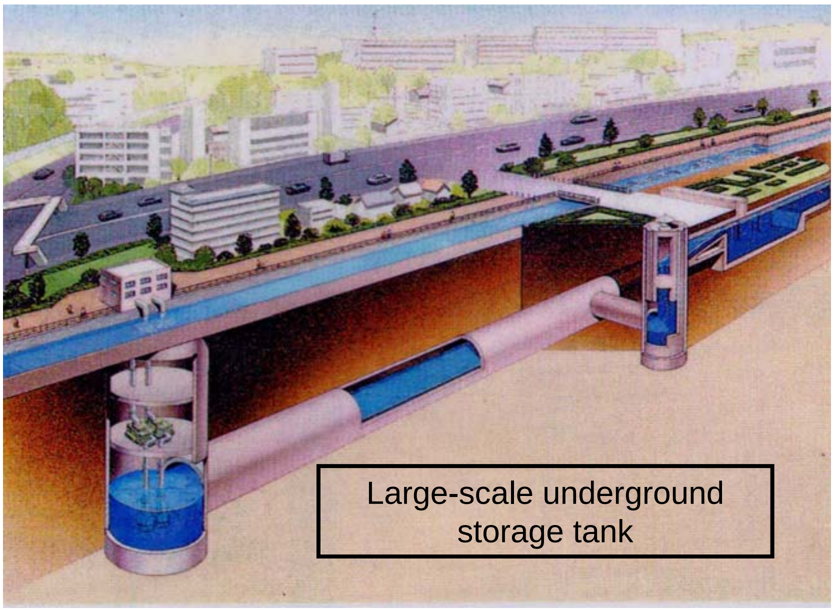
Peak Cut & Base Cut



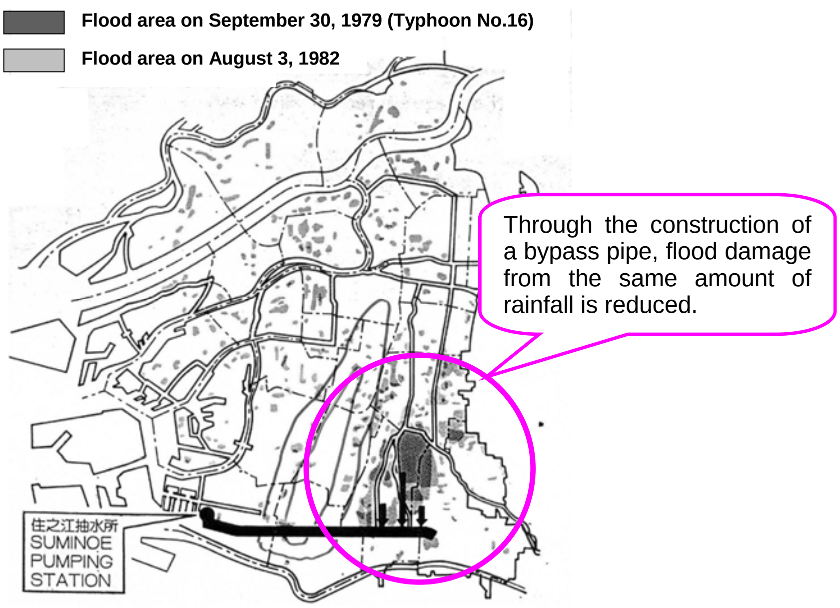
To Reserve First Runoff of Rain Water



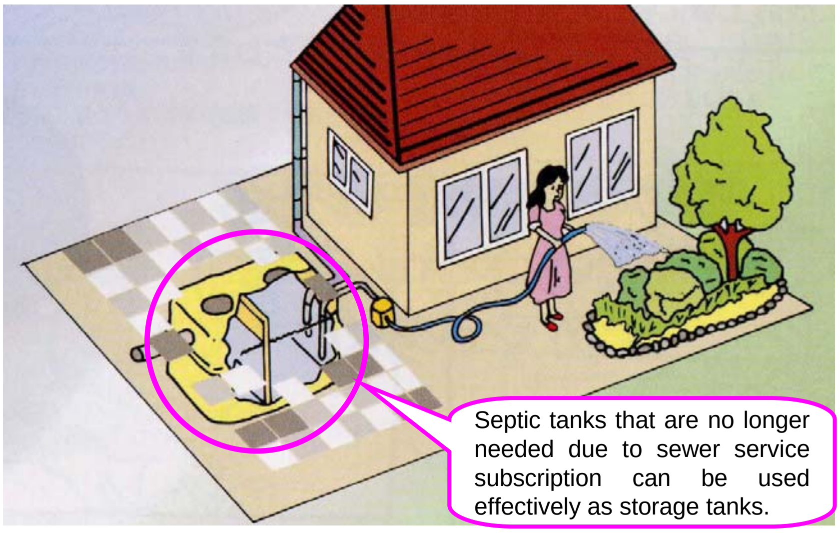
4. Examples of Sewerage in Japan



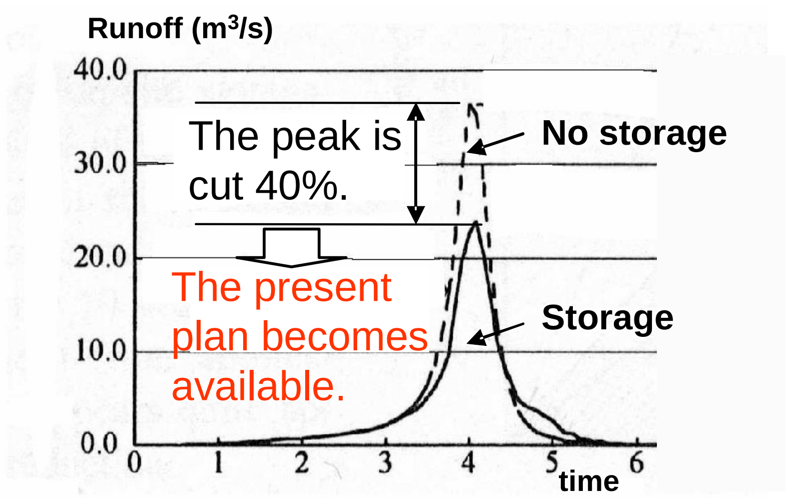
Bypass Pipe in Osaka



Residential Storage

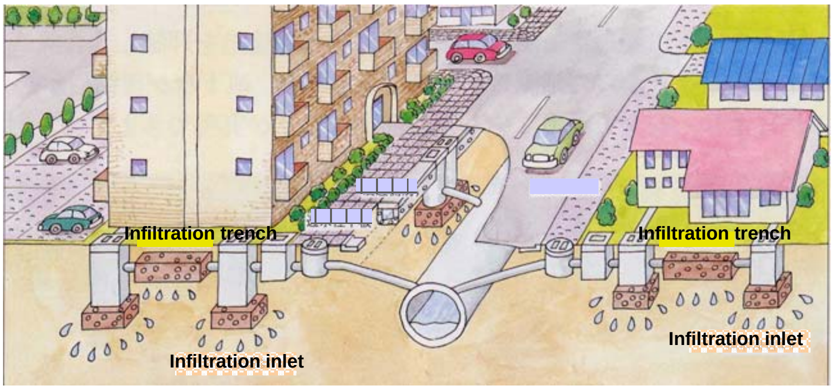


Simulation of the Effect of Storage Facilities

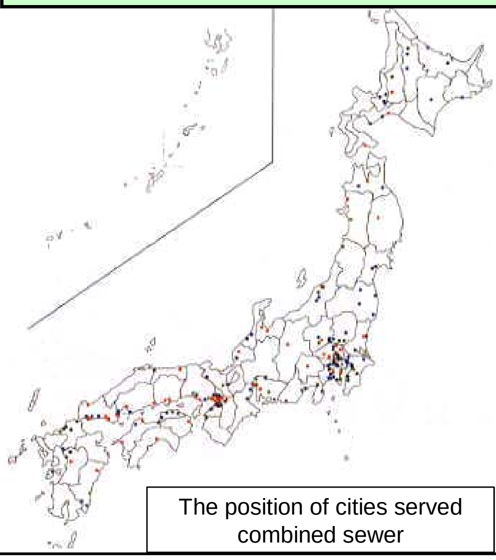


Simulation of storage effect

Infiltration Trench

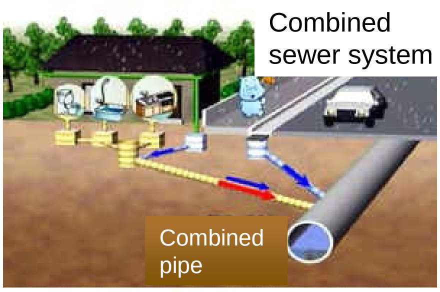


5. Challenges of Sewerage in Japan -Combined Sewer Overflow Problem & Control

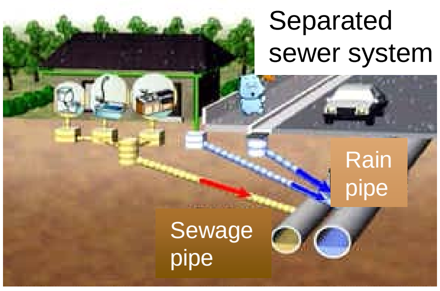


The position of cities served combined sewer

"Combined" and "Separate" Sewer Systems

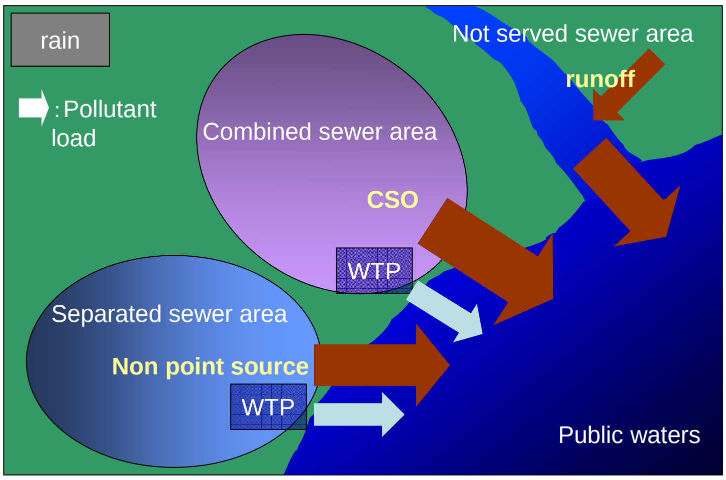


Not expensive but problem of CSO



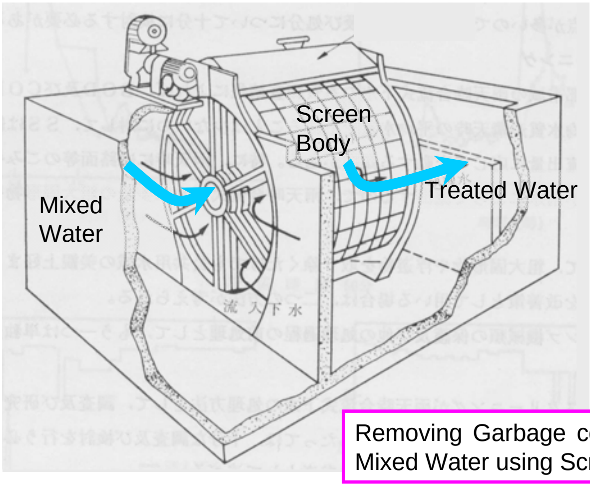
No problem of CSO but expensive

Problem of Combined Sewer System



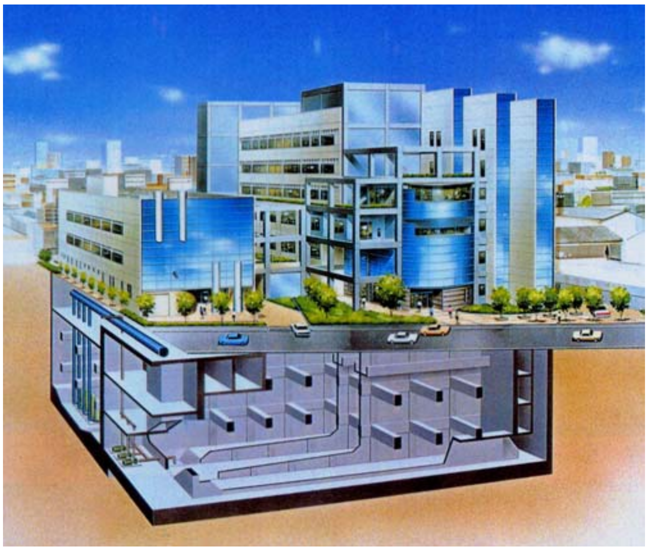
Combined Sewer Improvement

- Reduce pollution load
- Reduce overflow times
- Remove garbage from mixed water



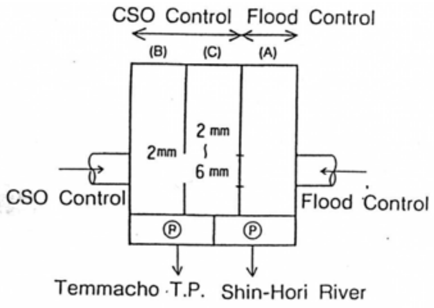
Removing Garbage contained in Mixed Water using Screens

Storage Tank under Building in Nagoya

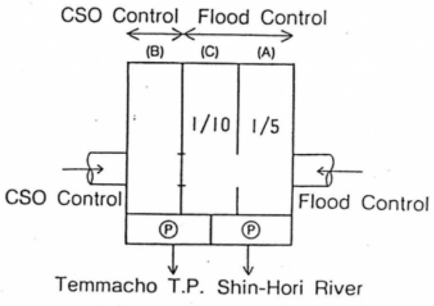


Fukue rain water storage facility

One Facility has Two Functions

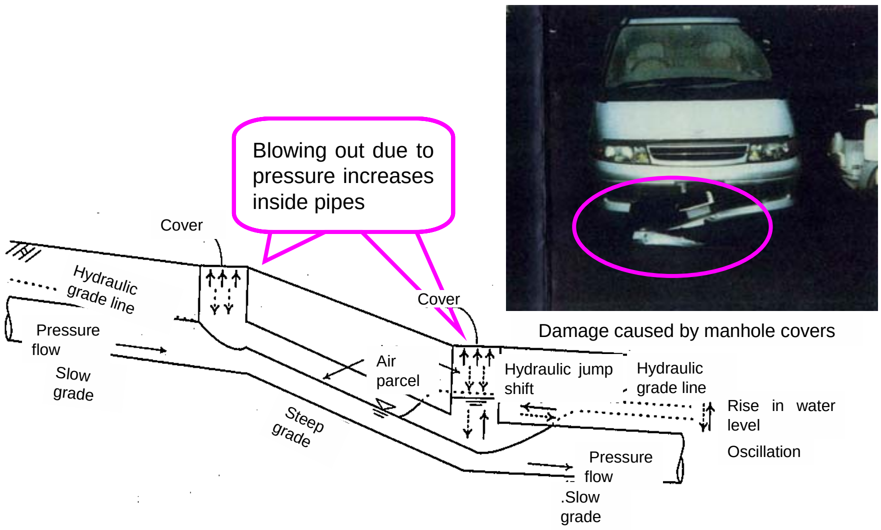


1) Tank C is used for CSO control



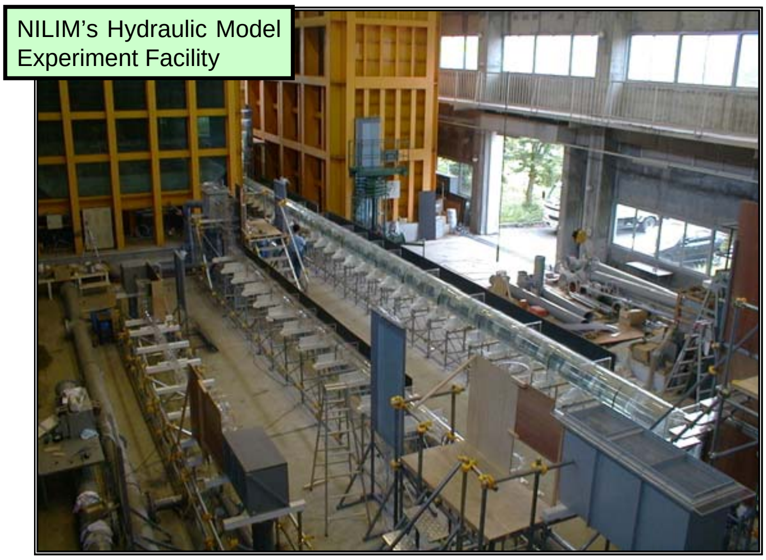
2) Tank C is used for flood control

Manhole Cover Blown Up by Heavy Rain



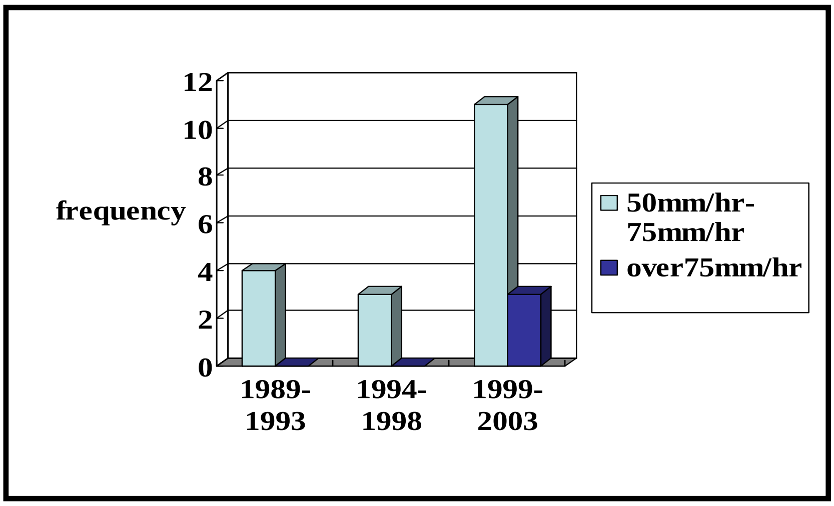
Damage caused by manhole covers

NILIM Experiment Facility

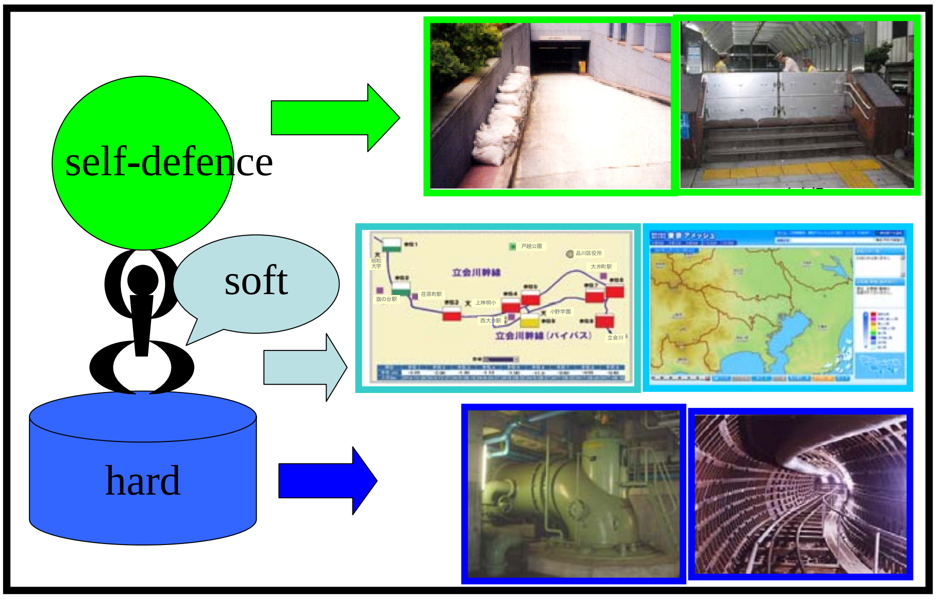


Frequency of heavy rainfall intensity -from Amedas* data in Tokyo

*Automated Meteorological Data Acquisition System



Strategy for Urban Stormwater Management



Ⅷ-11 Utilization of Reclaimed Wastewater

Mr. Mizuhiko MINAMIYAMA
Head,
Wastewater and Sludge Management Division,
Water Quality Control Department,
NILIM

3. Utilization of Reclaimed Wastewater

A. TAJIMA*, M. YOSHIZAWA**, K. SAKURAI, H. YAMAGATA, A. MIYAMOTO, and M. MINAMIYAMA

Wastewater and Sludge Management Division,
Water Quality Control Department,
National Institute for Land and Infrastructure Management (NILIM),
Ministry of Land, Infrastructure and Transport (MLIT)

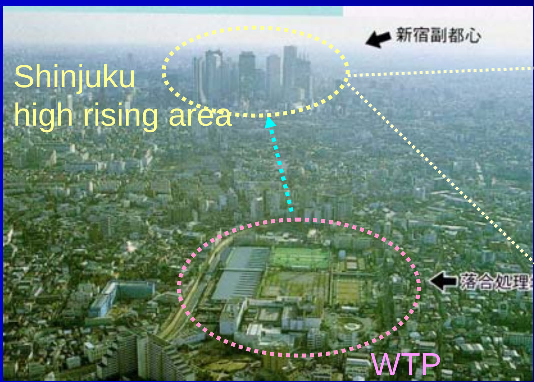
(Recent Position: * Sewerage and Wastewater Management Department, MLIT, ** Shiga Prefectural Government)

Water Reuse

- Treated Wastewater Utilization in Japan
- Guidelines for the Utilization of Reclaimed Water

2

Reuse of treated wastewater to flush toilet



Shinjuku area in Tokyo since 1984

3

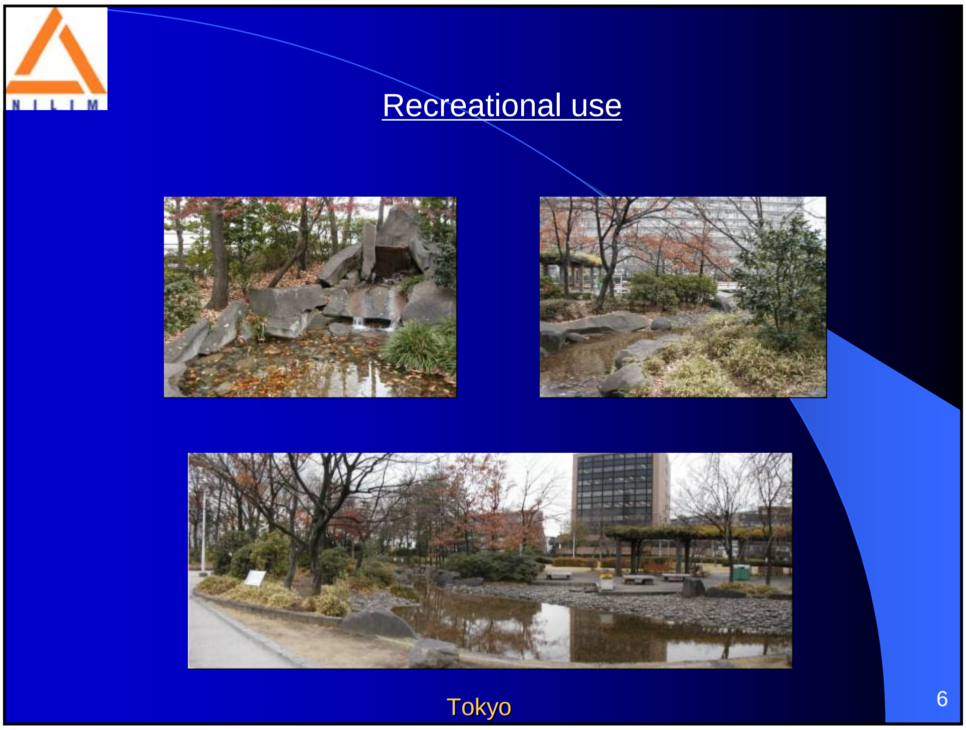
Landscape use

Kobe city

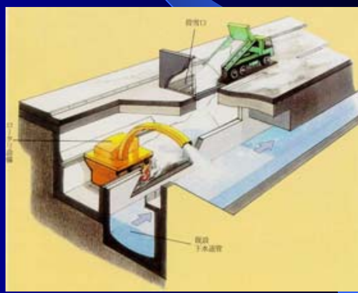
Yokohama city

4


Landscape / recreational use
Kobe city
5


Recreational use
Tokyo
6

Reuse for melting snow through snow damping ditches or tanks or road spray

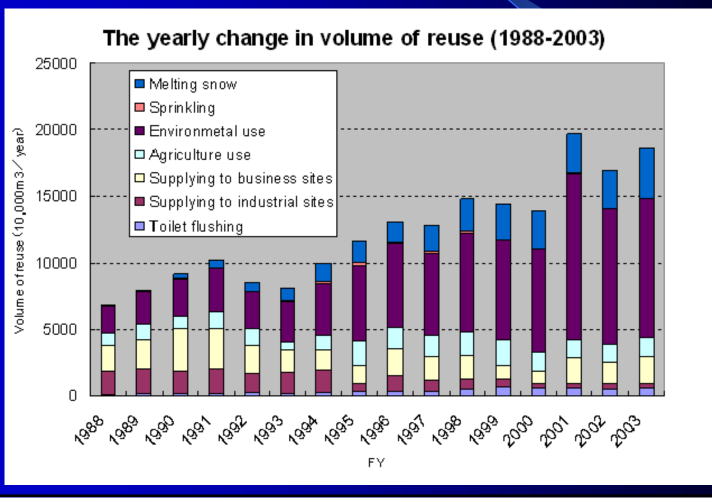


In Sapporo city since 1990

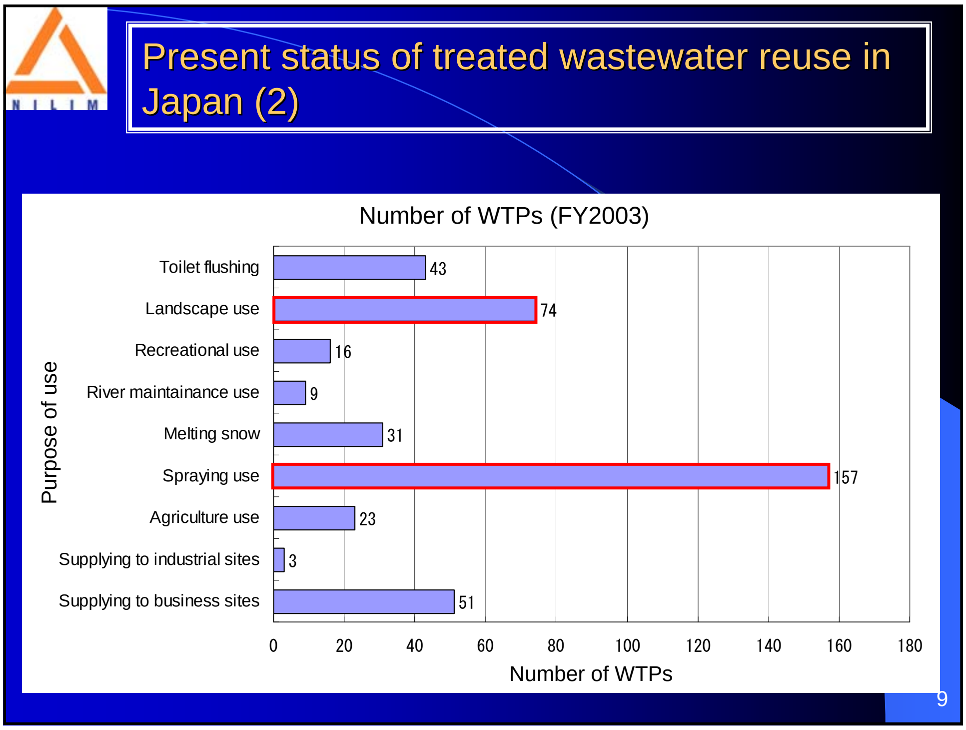
7

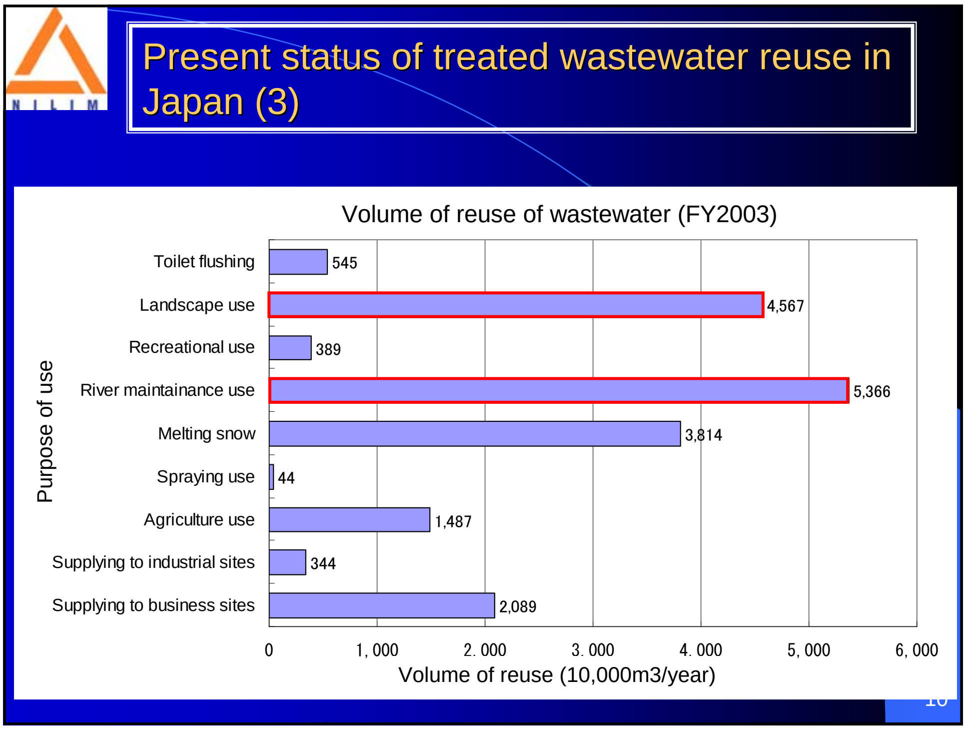
Present status of treated wastewater reuse in Japan (1)

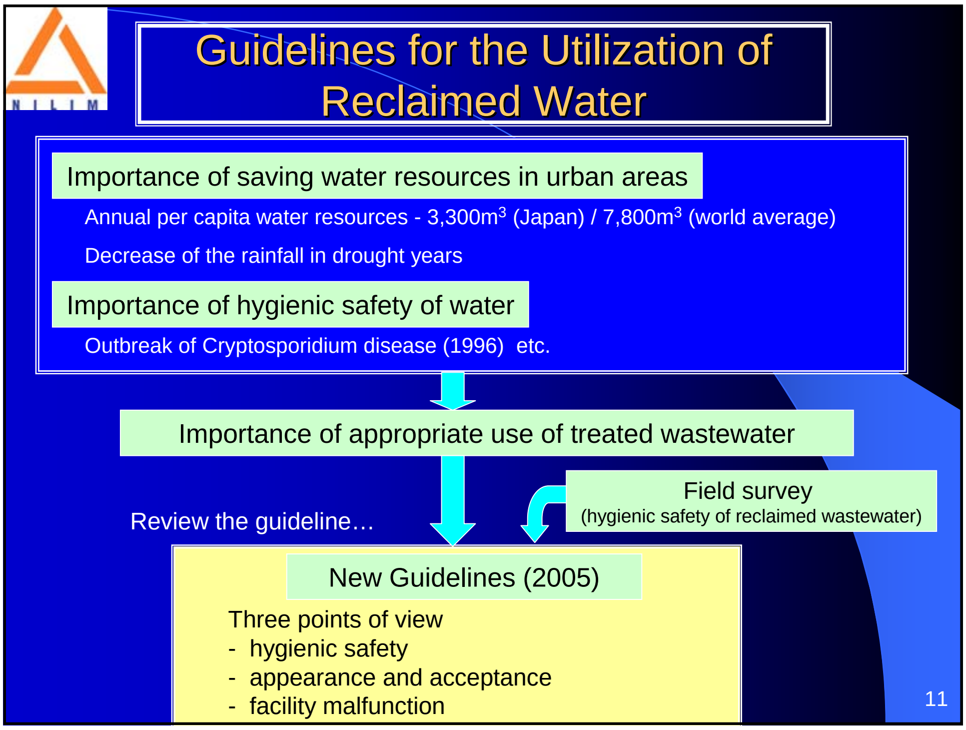
186 million m³ (FY2003) = 1.4% of the total treated wastewater
246 WTPs (FY2003) = 13% of the total WTPs

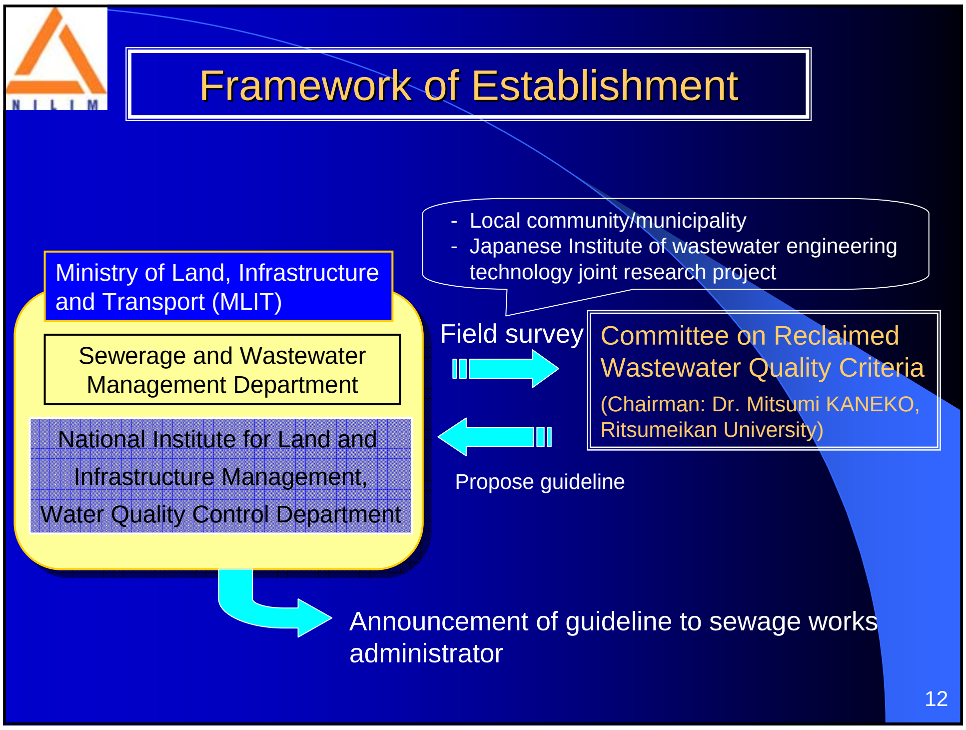


8


Present status of treated wastewater reuse in Japan (2)
Number of WTPs (FY2003)
Purpose of use
Toilet flushing
43
Landscape use
74
Recreational use
16
River maintainance use
9
Melting snow
31
Spraying use
157
Agriculture use
23
Supplying to industrial sites
3
Supplying to business sites
51
0
20
40
60
80
100
120
140
160
180
Number of WTPs
9


Present status of treated wastewater reuse in Japan (3)
Volume of reuse of wastewater (FY2003)
Purpose of use
Toilet flushing
545
Landscape use
4,567
Recreational use
389
River maintainance use
5,366
Melting snow
3,814
Spraying use
44
Agriculture use
1,487
Supplying to industrial sites
344
Supplying to business sites
2,089
0
1, 000
2. 000
3. 000
4. 000
5, 000
6, 000
Volume of reuse (10,000m3/year)


Guidelines for the Utilization of Reclaimed Water
Importance of saving water resources in urban areas
Annual per capita water resources - 3,300m3 (Japan) / 7,800m3 (world average)
Decrease of the rainfall in drought years
Importance of hygienic safety of water
Outbreak of Cryptosporidium disease (1996) etc.
Importance of appropriate use of treated wastewater
Review the guideline…
Field survey
(hygienic safety of reclaimed wastewater)
New Guidelines (2005)
Three points of view
- hygienic safety
- appearance and acceptance
- facility malfunction
11


Framework of Establishment
Ministry of Land, Infrastructure and Transport (MLIT)
Sewerage and Wastewater Management Department
National Institute for Land and Infrastructure Management, Water Quality Control Department
- Local community/municipality
- Japanese Institute of wastewater engineering technology joint research project
Field survey
Committee on Reclaimed Wastewater Quality Criteria
(Chairman: Dr. Mitsumi KANEKO, Ritsumeikan University)
Propose guideline
Announcement of guideline to sewage works administrator
12

Scope of application (1)

- Applications pertain to a large number of unspecified persons
- Reclaimed wastewater that was distributed directly from WTPs

Toilet flushing

Sprinkling

(trees, plants, lawns, road flushing)

13

Scope of application (2)

Landscape use

(Environmental use (untouchable))

Recreational use

(Environmental use)

* Including large-scale waterfalls or fountains that may produce aerosol

14

Previous guidelines/standards for treated wastewater use (Reference)

	Japan Sewage Works Association (proposed in 1981)			Working group composed of Ministry of Construction and some big cities (proposed in 1990)	
	Toilet flushing	Sprinkling	Landscape use	Landscape use**	Recreational use***
Coliform group	≤10 (CFU/mL)	N.D.	N.D.	≤1000 (CFU/100mL)	≤50 (CFU/100mL)
Residual Chlorine (mg/L) *	Trace amount	≥ 0.4	-	-	-
Appearance	Not unpleasant	Not unpleasant	Not unpleasant	-	-
Color (color unit)	-	-	-	≤ 40	≤ 10
Turbidity (mg-kaolin equivalent/L)	-	-	≤ 10	≤ 10	≤ 5
Odor	Not unpleasant	Not unpleasant	Not unpleasant	Not unpleasant	Not unpleasant
pH	5.8 – 8.6	5.8 – 8.6	5.8 – 8.6	5.8 – 8.6	5.8 – 8.6
BOD (mg/L)	-	-	≤ 10	≤ 10	≤ 3

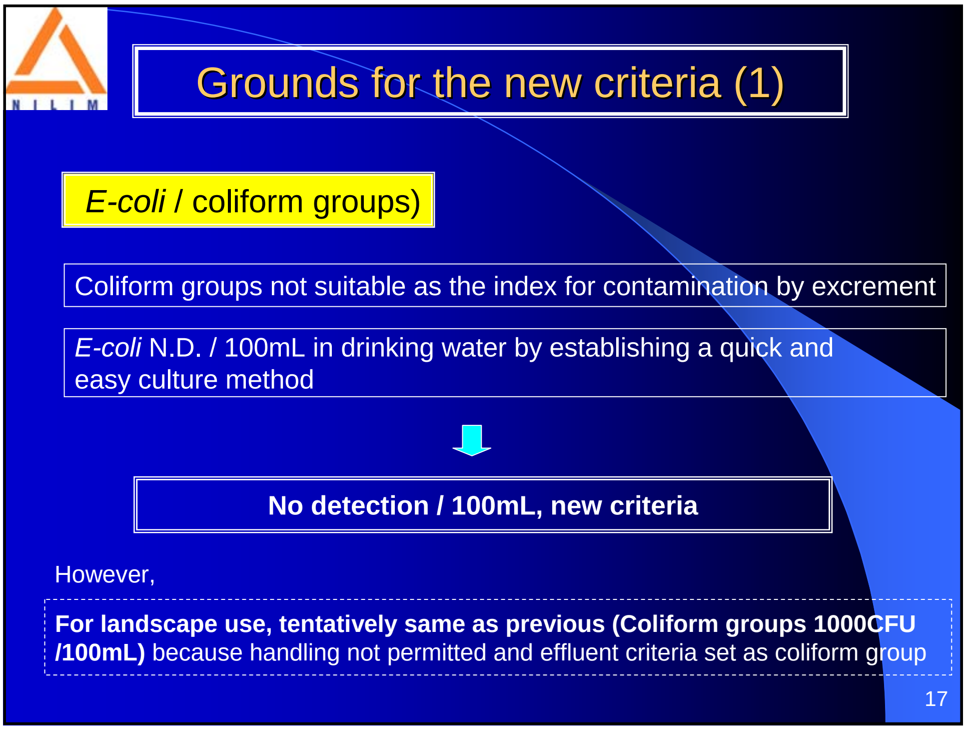
Note: * combined residual chlorine, **restricted human contact, ***limited human contact

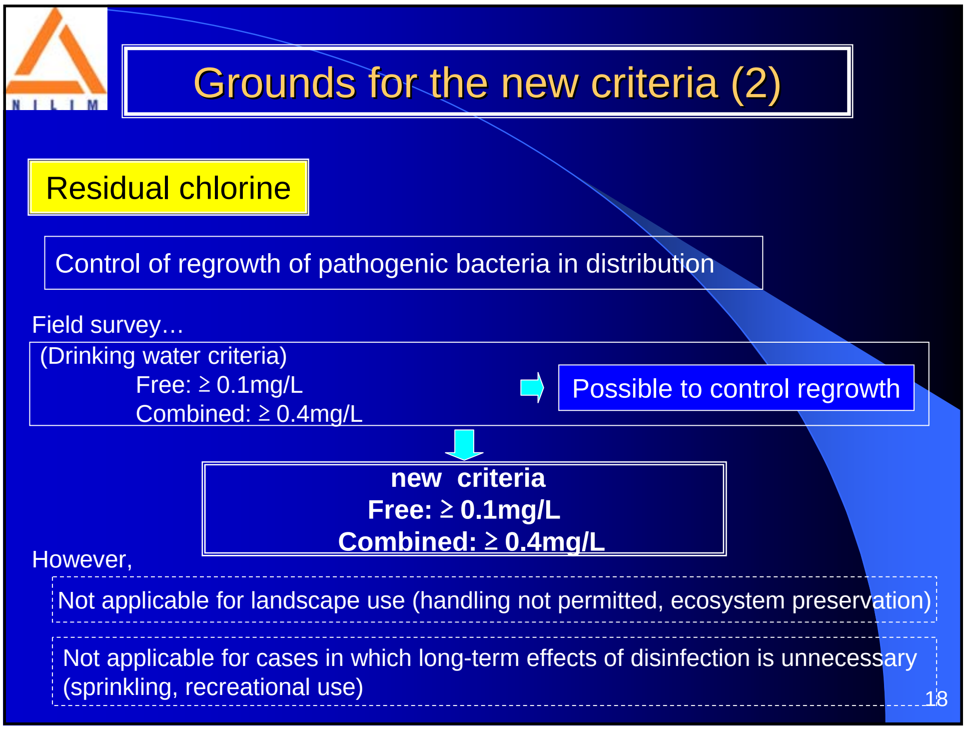
15

New criteria for the reuse of treated wastewater

	Toilet flushing	Sprinkling	Landscape use	Recreational use
E.coli	N.D./100mL	N.D./100mL	≤1000 CFU /100mL as Coliform groups 1)	N.D./100mL
Appearance	Not unpleasant			
Turbidity	≤ 2 (target value) 2)			≤ 2 2)
Color			≤ 40 units	≤ 10 units
Odor	Not unpleasant			
pH	5.8 - 8.6			
Residual chlorine (target value)	≥ free: 0.1mg/L or combined: 0.4mg/L	≥ free: 0.1mg/L or combined: 0.4mg/L 3)		≥ free: 0.1mg/L or combined: 0.4mg/L 3)
Treatment	Sand filtration or equivalent			Chemical precipitation + sand filtration or equivalent
Notes	1) Provisional value 2) Unit: mg-kaolin equivalent/L 3) Not applicable for cases in which long-term effects of disinfection is unnecessary			

16


Grounds for the new criteria (1)
E-coli / coliform groups)
Coliform groups not suitable as the index for contamination by excrement
E-coli N.D. / 100mL in drinking water by establishing a quick and easy culture method
No detection / 100mL, new criteria
However,
For landscape use, tentatively same as previous (Coliform groups 1000CFU /100mL) because handling not permitted and effluent criteria set as coliform group
17


Grounds for the new criteria (2)
Residual chlorine
Control of regrowth of pathogenic bacteria in distribution
Field survey…
(Drinking water criteria)
Free: ≥ 0.1mg/L
Combined: ≥ 0.4mg/L
Possible to control regrowth
new criteria
Free: ≥ 0.1mg/L
Combined: ≥ 0.4mg/L
However,
Not applicable for landscape use (handling not permitted, ecosystem preservation)
Not applicable for cases in which long-term effects of disinfection is unnecessary (sprinkling, recreational use)
18

Grounds for the new criteria (3)

Treatments / Turbidity

Against facility malfunction

- No blockage, **sand filtration** should be added
- **Turbidity of 2 or less as target value** to ensure effective treatment

Against protozoa (recreational use)

- **Chemical precipitation and sand filtration** should be added
- **Turbidity of 2 or less as value to be observed at all times** to ensure effective treatment

19

Grounds for the new criteria (4)

pH

Corrosion control / same as previous (**pH: 5.8 - 8.6**)

Appearance / Color / Odor

Appeal and acceptance / same as previous
(Appearance, Odor: Not unpleasant
Color: ≤ 40 units (Landscape use),
≤ 10 units (Recreational use))

However,

It is preferable to give criteria considering the wishes of regional users

20

Consideration for treated wastewater reuse

Hygienic safety

1. Loss of residual chlorine in the distribution system
2. Cross-connection
3. Accidental intake
4. Deterioration of the quality of reclaimed wastewater

Appeal and acceptance

1. Red water, colorless, cloud
2. Growth of algae (Landscape use, Recreational use)
3. Outbreak of Chirnomid (imago/larva) (toilet flushing)

facility malfunction

1. Corrosion and blockage of pipes and other equipment

21

Prevention of cross connection

Place signs on or color-code pipes and other equipment

Example of distinction by color-coding the pipes
(Yellow is reclaimed wastewater, blue is drinking water)

22

Prevention of accidental intake (1)

1) Posting of notices to users that reclaimed wastewater is used

Example of posting of notices that reclaimed wastewater is used and not for drink

23

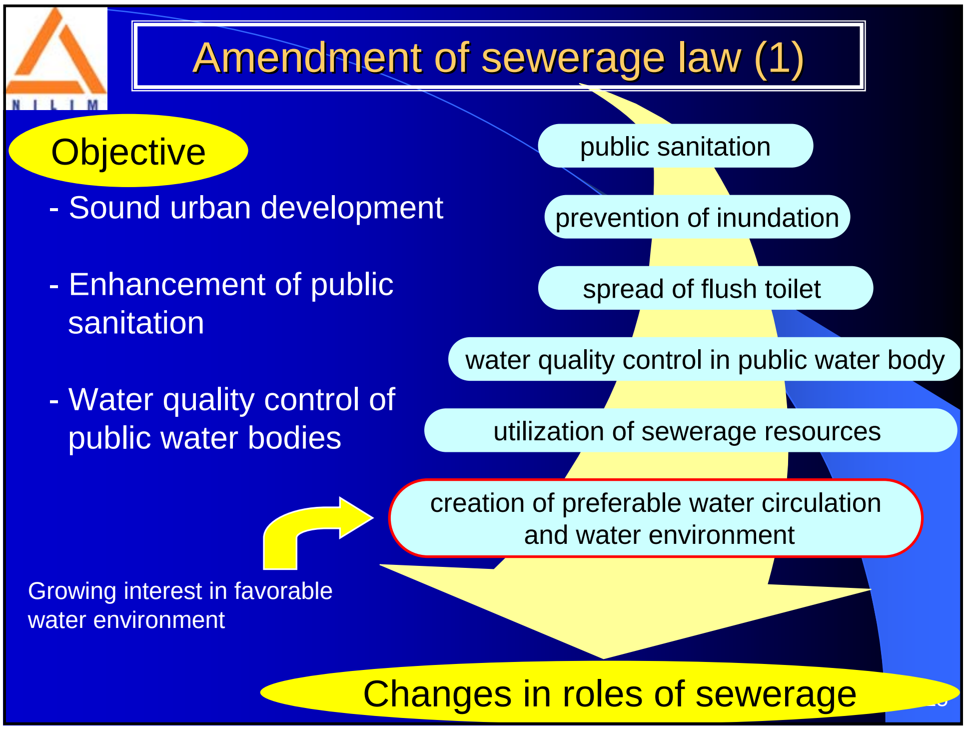
Prevention of accidental intake (2)

2) Prevention of accidental intake of aerosol (watering use)

Reclaimed wastewater flow in tube

Example of watering use that is hard to produce aerosol

24


Amendment of sewerage law (1)
Objective
- Sound urban development
- Enhancement of public sanitation
- Water quality control of public water bodies
public sanitation
prevention of inundation
spread of flush toilet
water quality control in public water body
utilization of sewerage resources
creation of preferable water circulation and water environment
Growing interest in favorable water environment
Changes in roles of sewerage


Amendment of sewerage law (2)
Structural standards
Shielding, fences etc. must be installed to prevent entry to the facilities
- Culvert
- Recreational use facilities
NEW
Quality standards for final effluent
E.coli N.D./100mL
Turbidity of less than 2mg-kaolin equivalent/L
- …
Amendment in October 2005
Suitable reuse of treated wastewater
Recovery of good quality waterside spaces in urban areas

Future task

1. Study on the criteria for viruses
2. Study on the ingestion scenario
3. Improvement of analysis methods of pathogens
4. Development of cheap and advanced wastewater treatment
5. Study on the possibility of application to new purpose of use

27

Extension of reclaimed water utilization is needed in Japan

Annual water reserves per capita is less than half of the world average

Rainfall in draught years show a decreasing tendency

Reclaimed water is...
- available even in summer
- stable in quality

Sprinkling on roads for heat island mitigation is a new way of using.

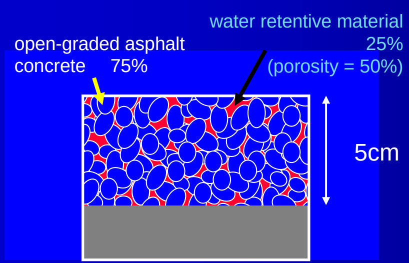
28

Facility for road sprinkling

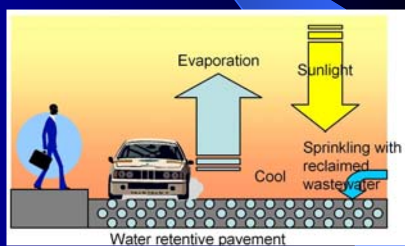
29

water retentive pavement mitigates the heat island

Water stored in the pavement evaporates slowly and lowers the temperature by vaporization



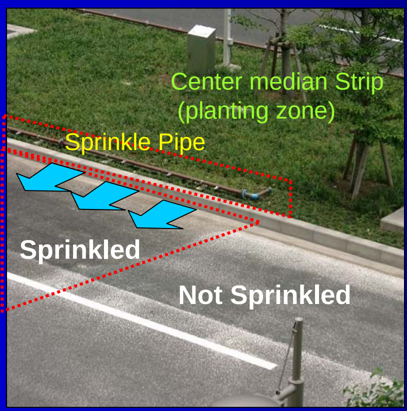
water retentive pavement

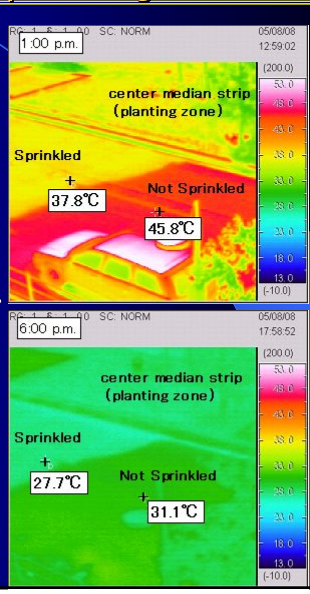


340,902m^2 is paved with this method (FY1994 to 2005)

30

Road surface temperature was decreased as same as that on planting zones





The road surface temperature distribution measured by thermography

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Acknowledgement

The new criteria and considerations were proposed by the Committee on Reclaimed Wastewater Quality Criteria. We express our deep appreciation to the members of the committee who extensive effort into developing and proposing the guidelines.

32

16th International Symposium on National Land Development and Civil Engineering in Asia: Integrated Water Resource Management Adapting to the Global Climate Change

Utilization of Reclaimed Wastewater

Thank you very much for your attention !

Ⅷ-12 Beneficial Use of Biomass at Wastewater Treatment Plants

Mr. Masaaki OZAKI
Team Leader,
Recycling Research Team,
Material and Geotechnical Management,
PWRI

Beneficial Use of Biomass at Wastewater Treatment Plants

Masaaki OZAKI
Recycling Research Team

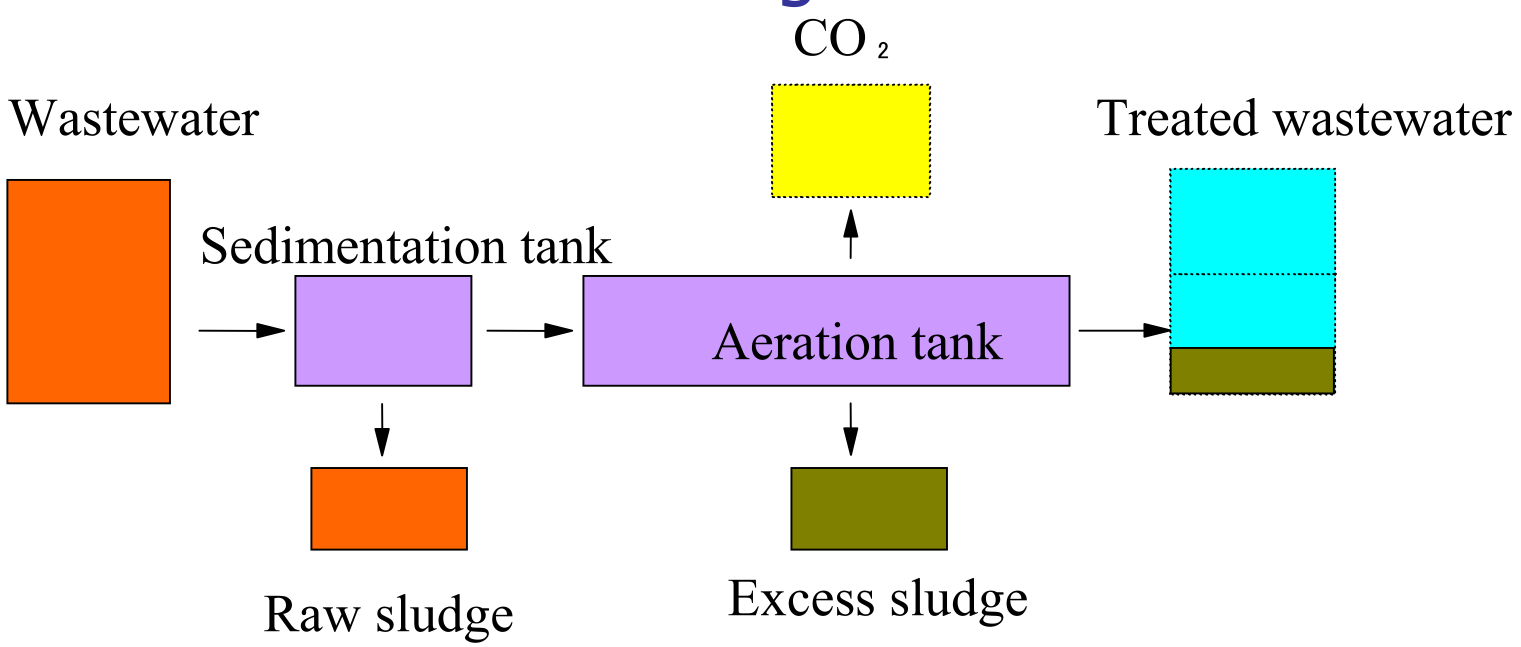
Contents

1. Bio-solids treatment
2. Beneficial use of bio-solids
3. Increase of bio-gas production
4. And the bio-gas utilization
5. Others

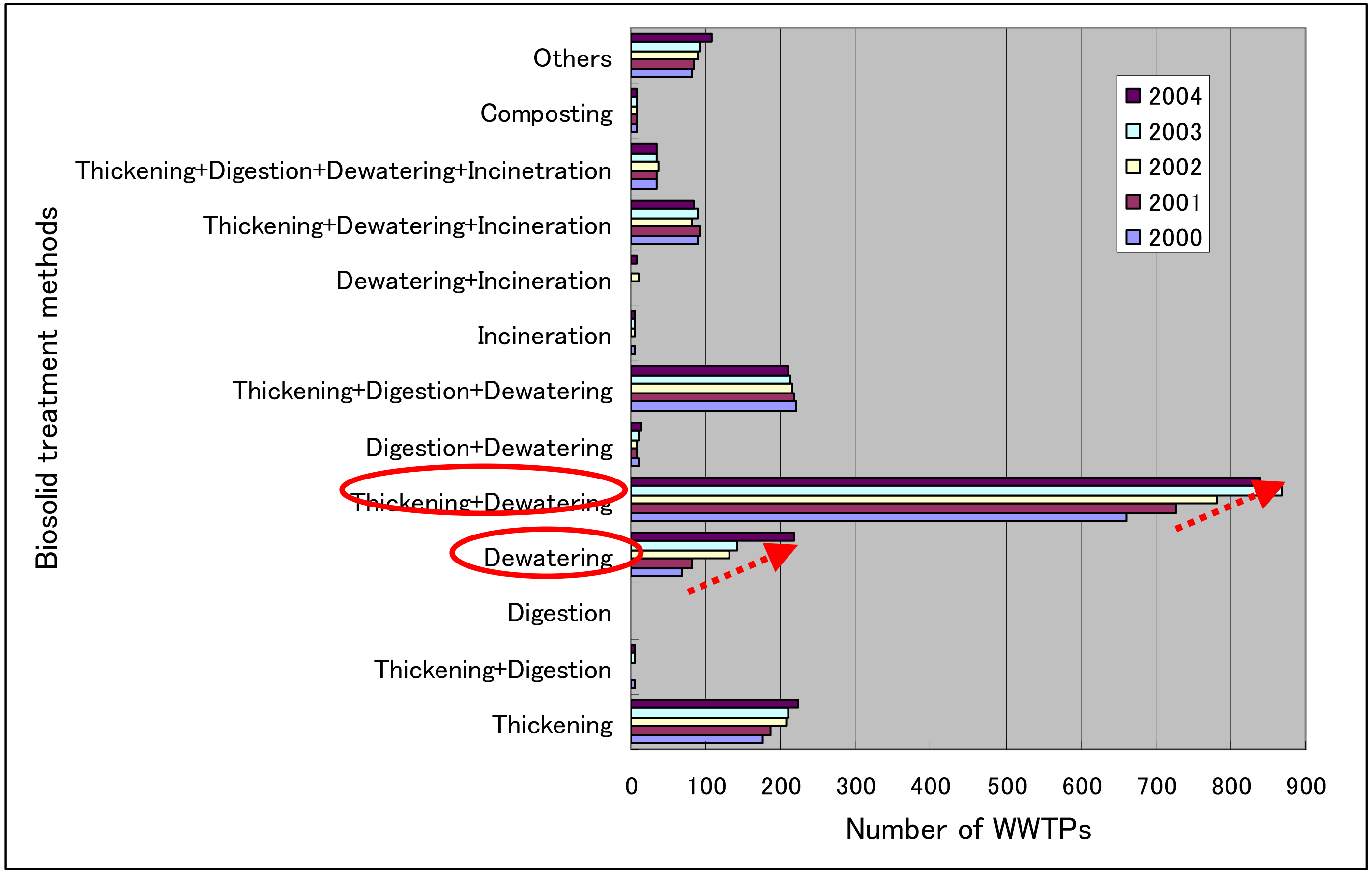
1.Bio-solids treatment

Production of Bio-solids

Balance of organic material



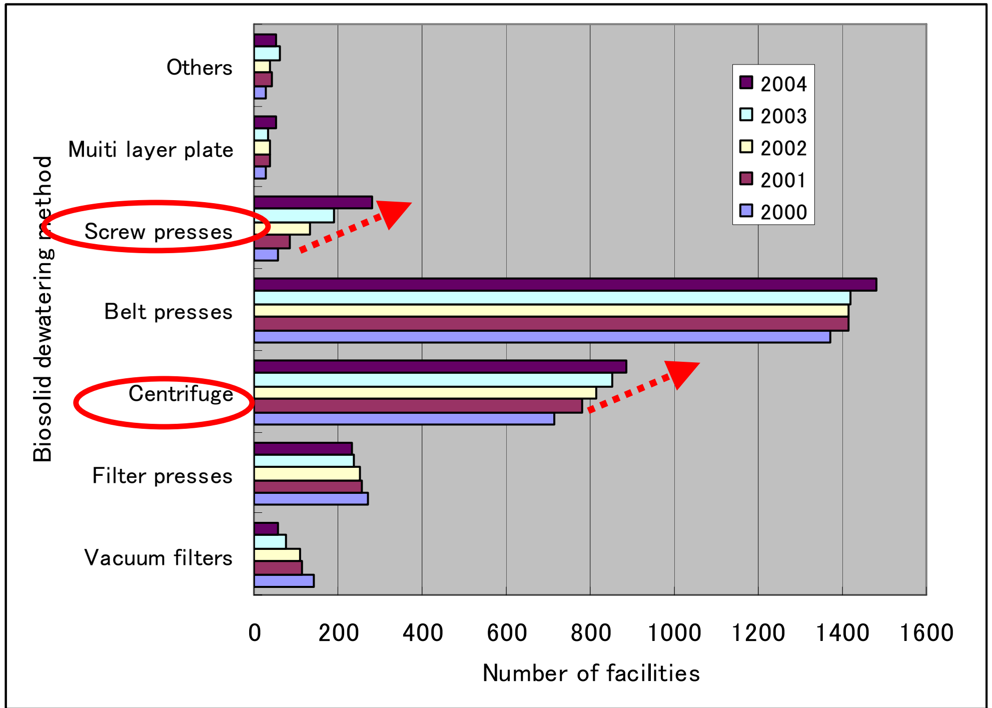
Bio-solids treatment in Japan (1)



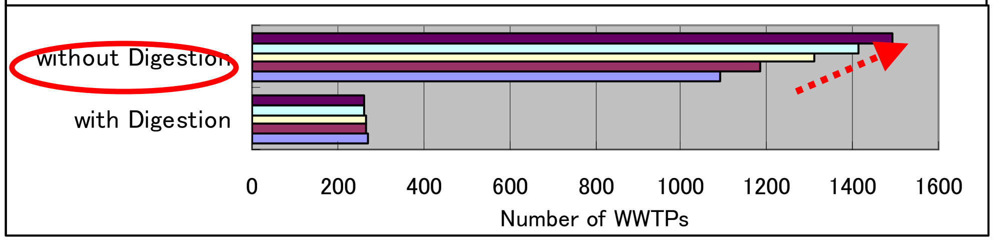
Statistics of sewage works by JWSA

Bio-solids treatment in Japan (2)

Dewatering

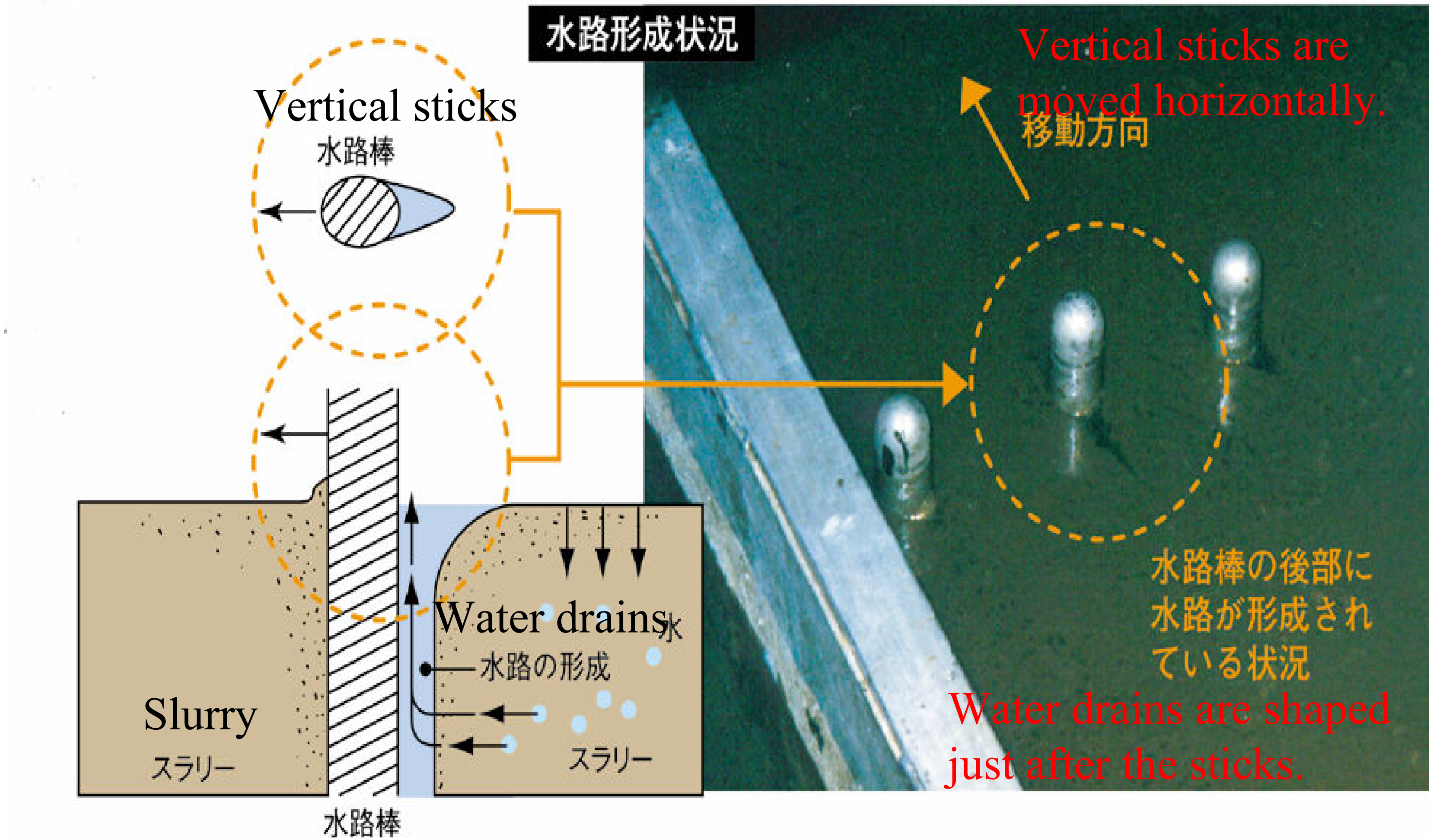


Digestion

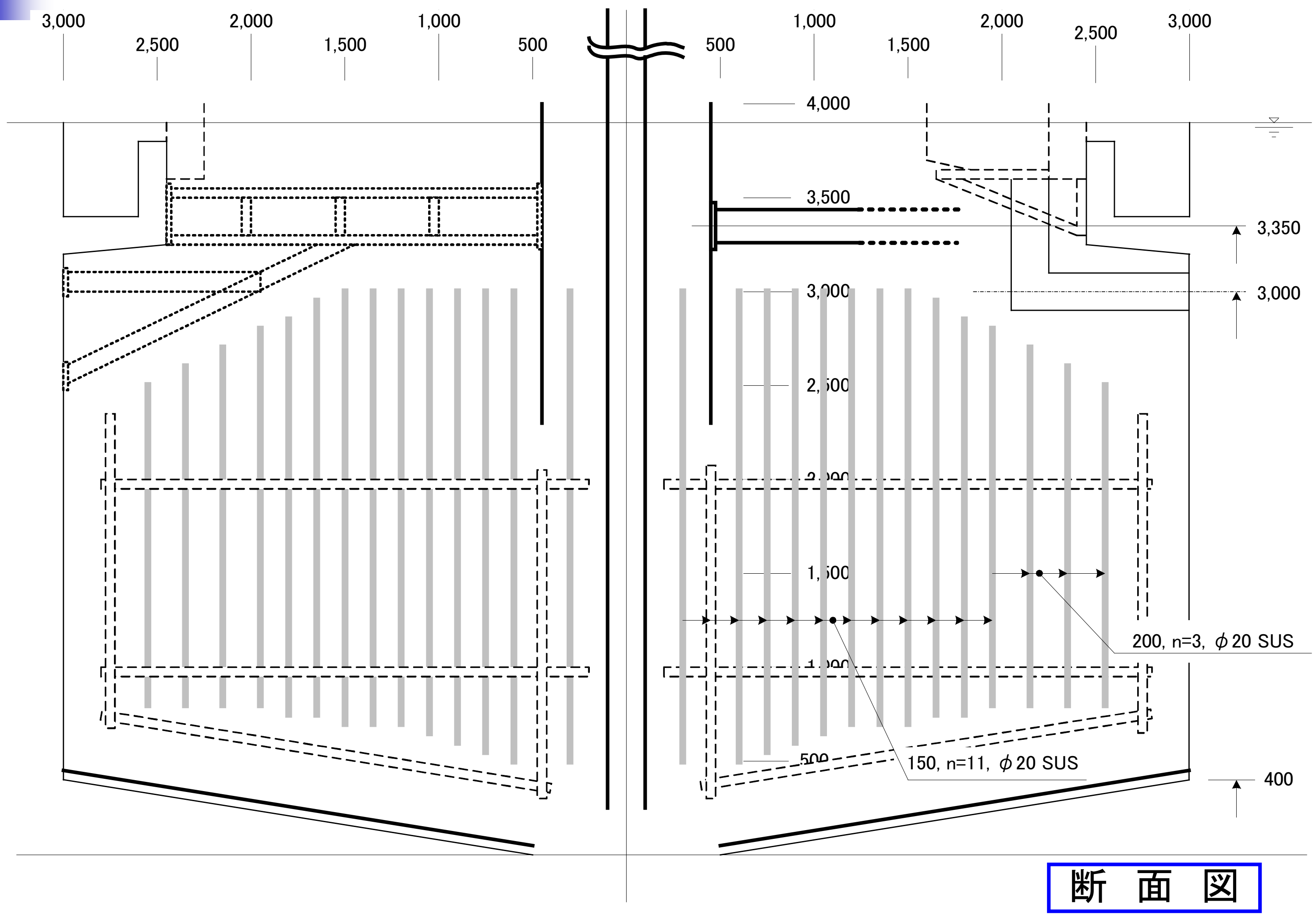


Statistics of sewage works by JWSA

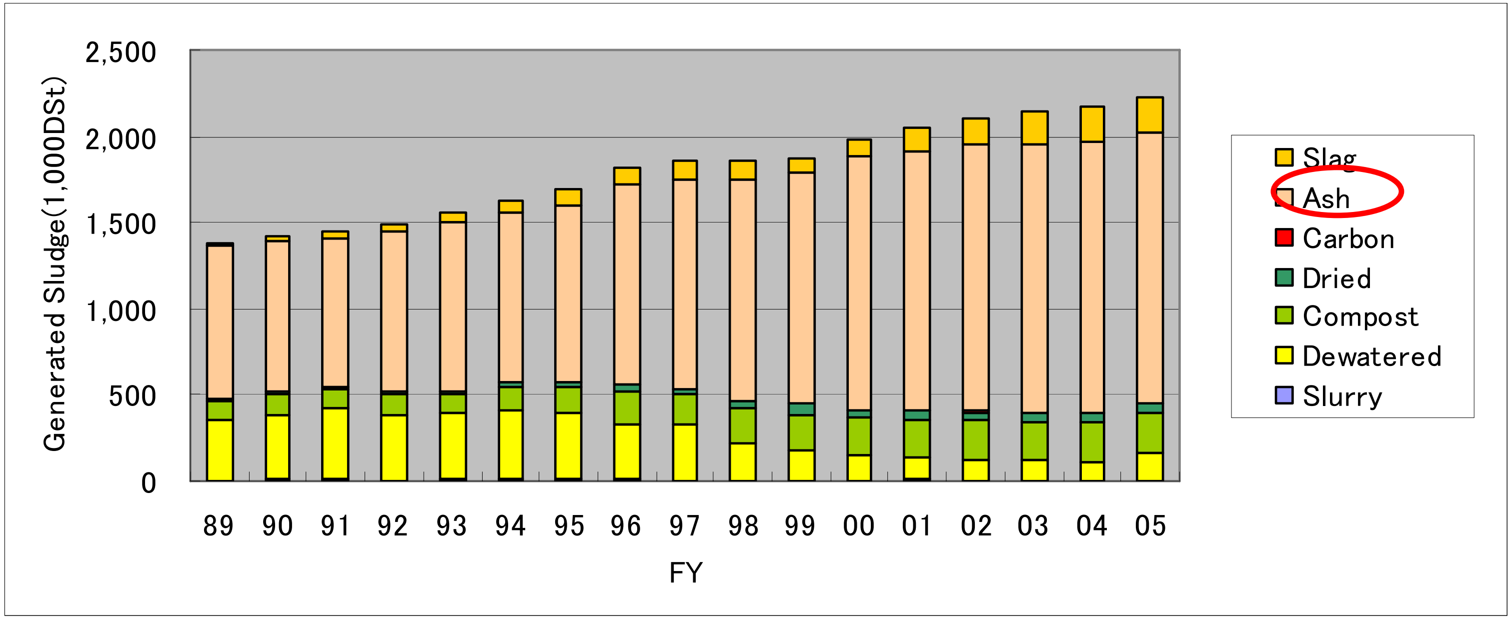
Gravity thickening technology (1)



Gravity thickening technology (2)

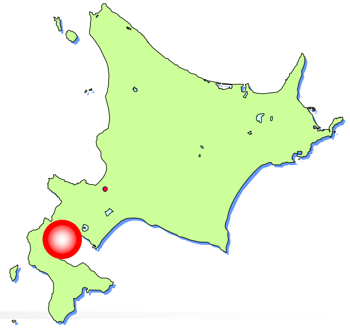


Transition of generated bio-solid

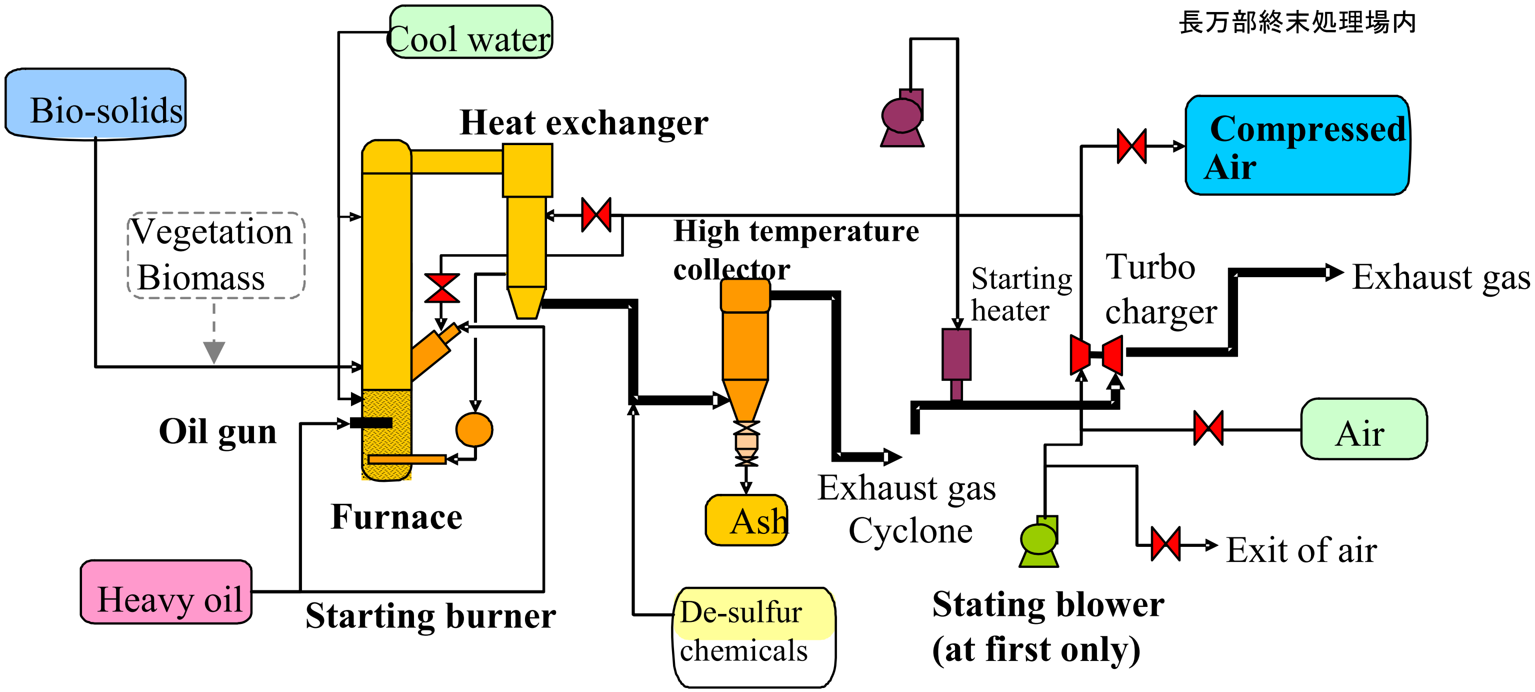


Approximately 70% of bio-solids was incinerated in Japan.

Energy saving fluidized-bed incineration system (1)



設置場所：北海道山越郡長万部町字旭浜４番地の８
長万部終末処理場内



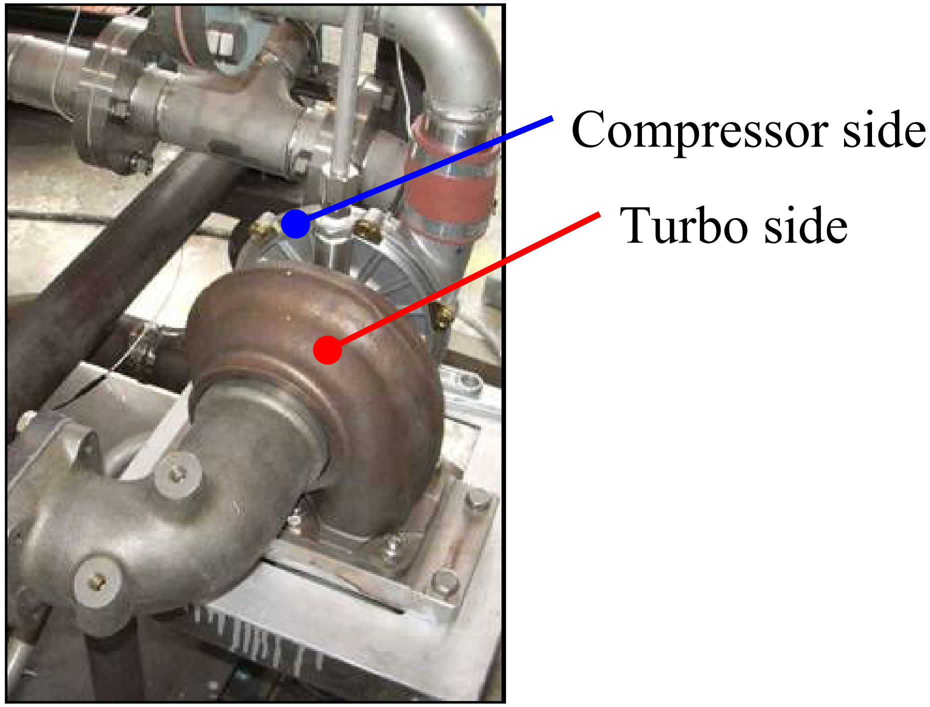
Pilot plant at Oshamanbe WWTP in Hokkaido

Energy saving fluidized-bed incineration system (2)

<Incineration furnace>

4.3t-dewatered sludge/day

ϕ1,200(ϕ700)×H9,200



<Turbo charger>

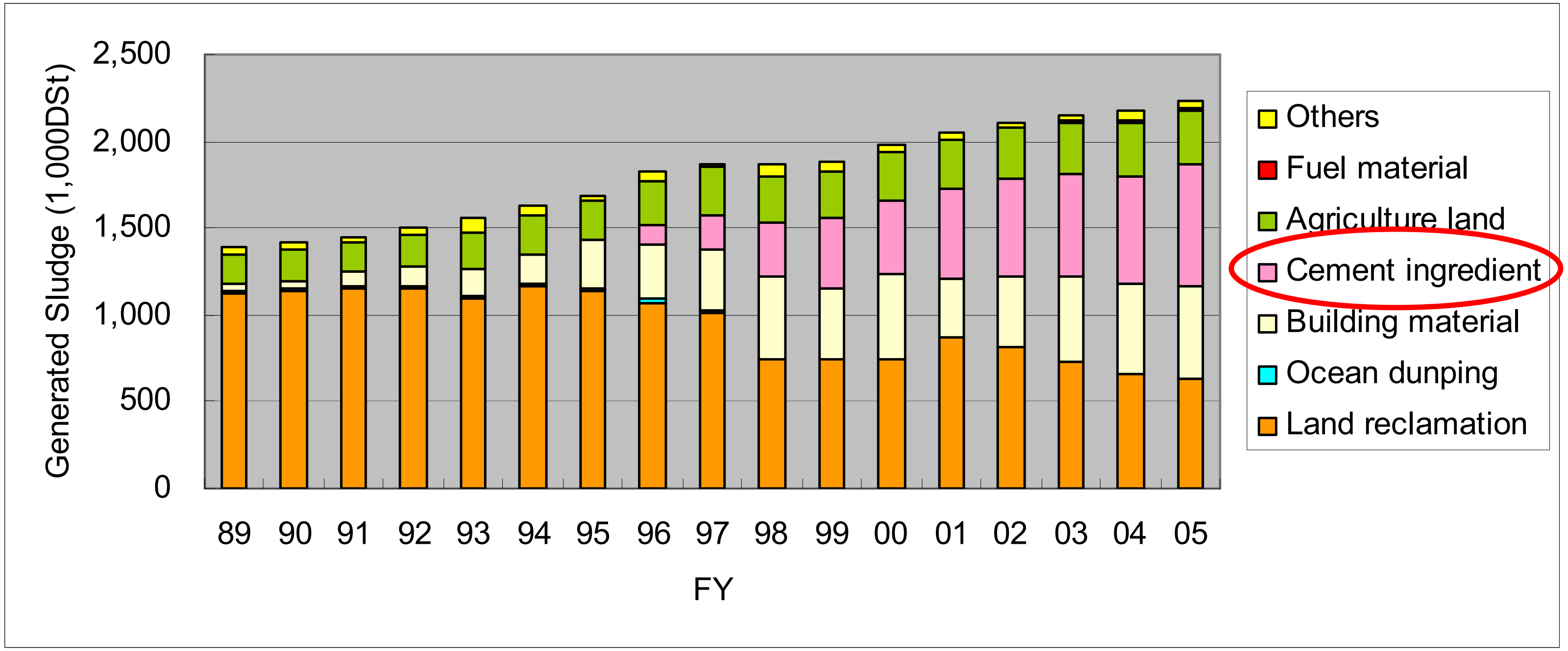
ϕ300mm×400mm

2. Beneficial use of bio-solids

Category for utilization

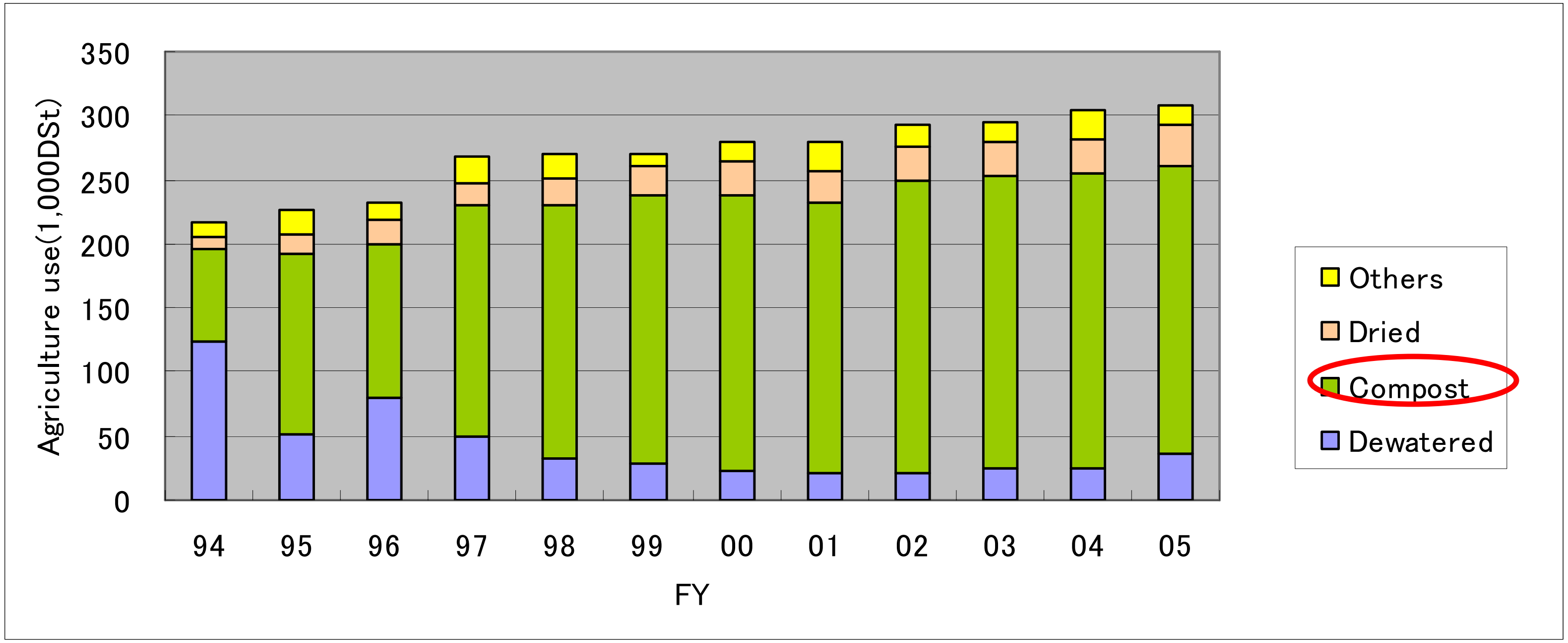
- Agriculture land
- Construction material
  - Incinerated ash
  - Melt-solidified slag
- Energy utilization
  - Bio-gas
  - Solid fuel for Coal Power Plant

Transition of utilized bio-solid



Approximately 70% of bio-solids was utilized in Japan.

Agriculture Utilization

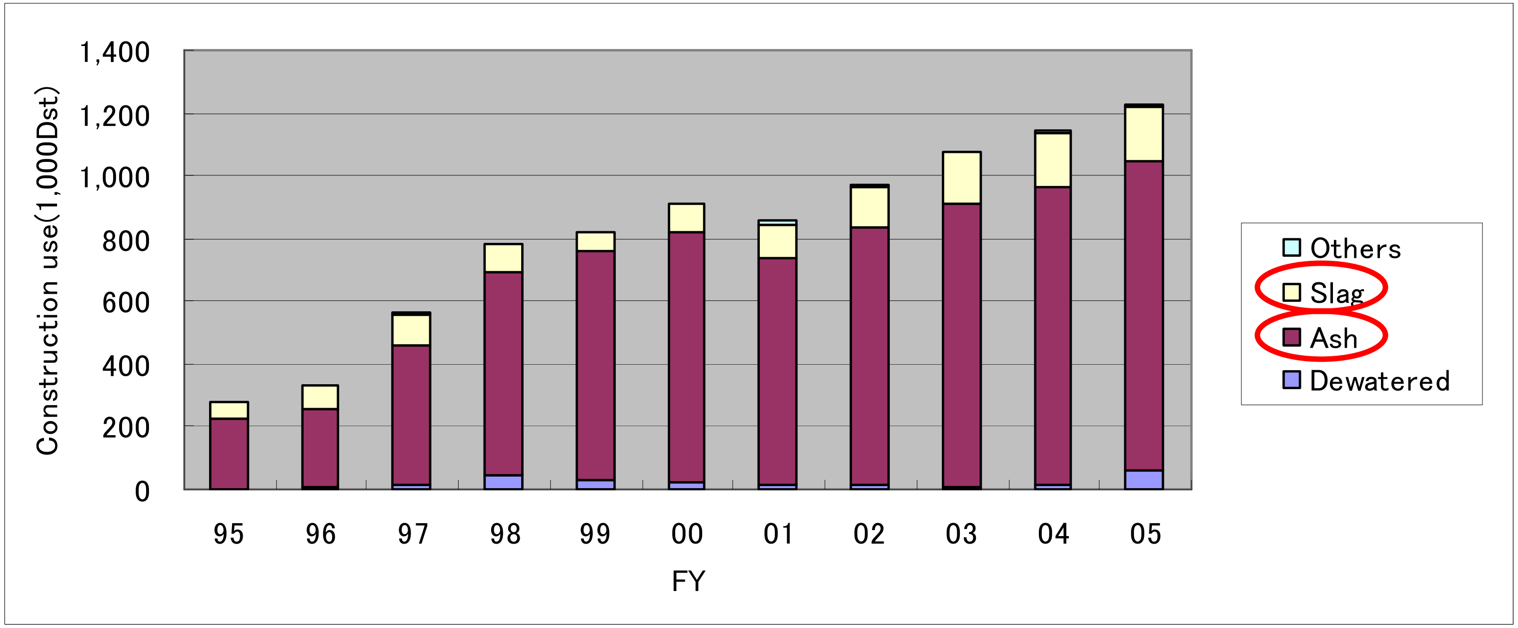


Fusion compost with cow feces

Bio-solids: Nitrogen and Phosphorus rich
Potassium shortage

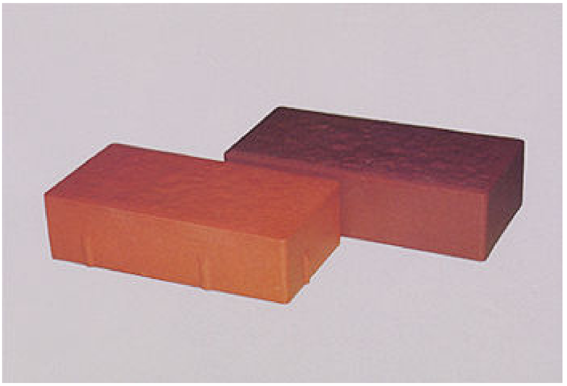
Cow feces: C/N balance and Potassium rich

Construction materials



Construction materials made of ash

Ash products from WWTPs



"Haikara" brick made of ash at Gifu city

Bricks made of 100% ash.

Control office at Kinu-ura Tobu WWTP in Aich pre.

Building materials such as wall and roof with tiles made of ash.

Slag products at Hyogo pref.

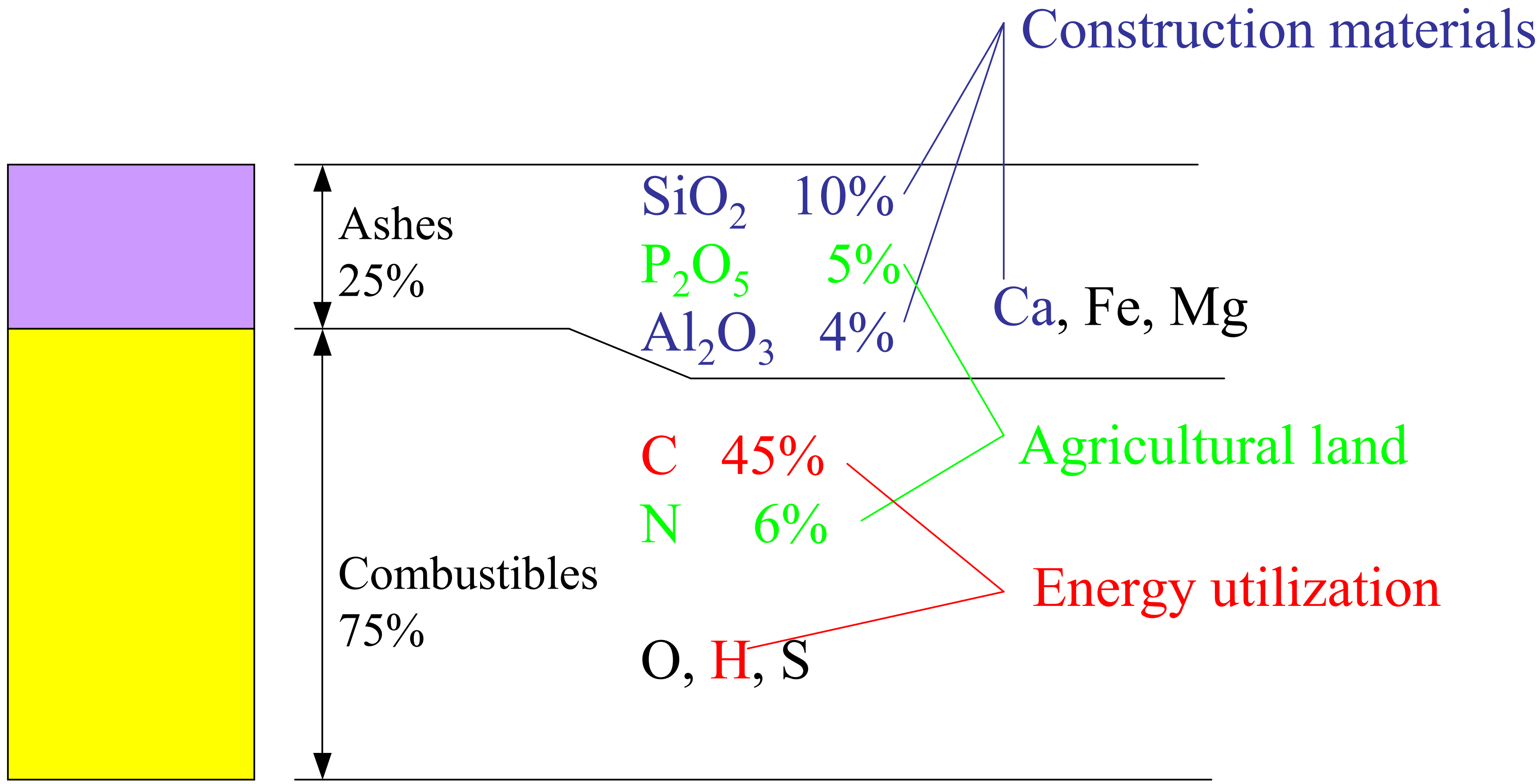
Slag products from WTP

Asphalt paving

Concrete factory products

[Asphalt paving]
2004~
Road construction works
[Concrete factory products]
2007~
Road construction materials

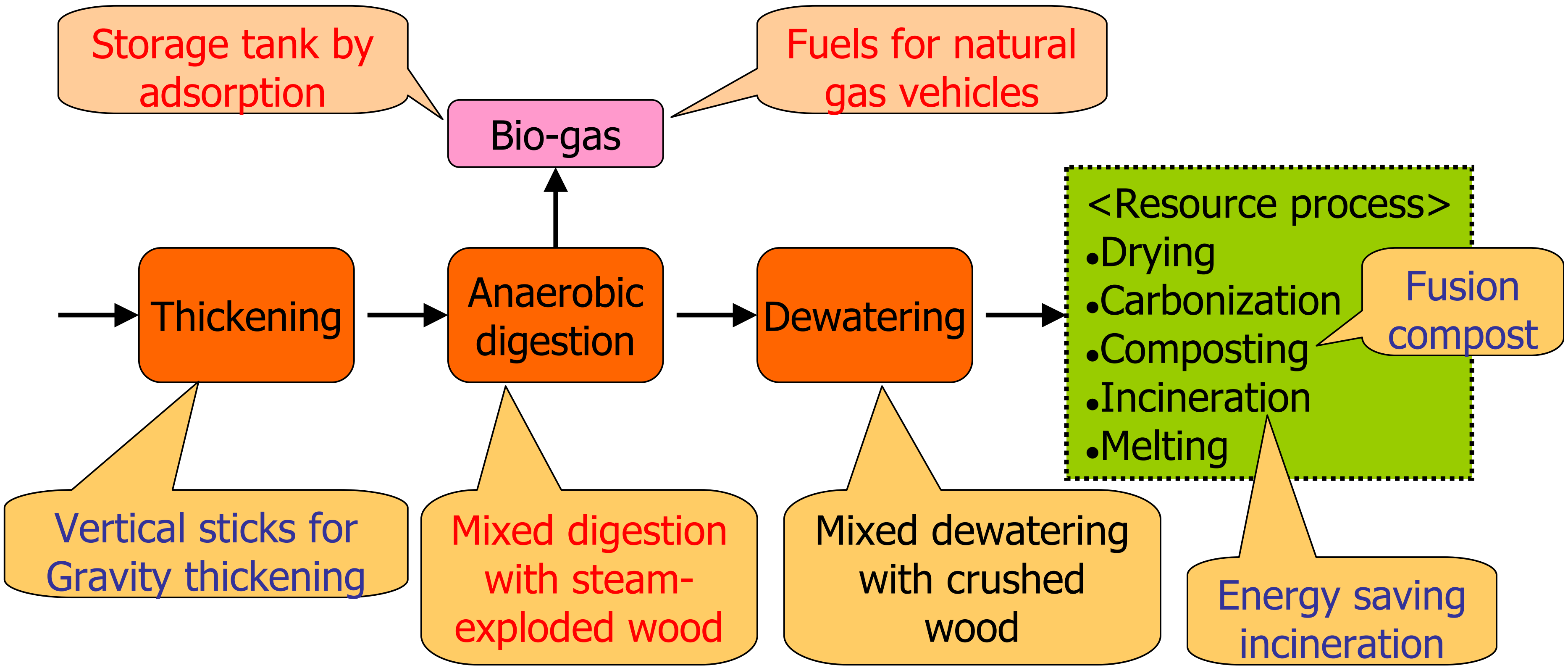
Components of bio-solids



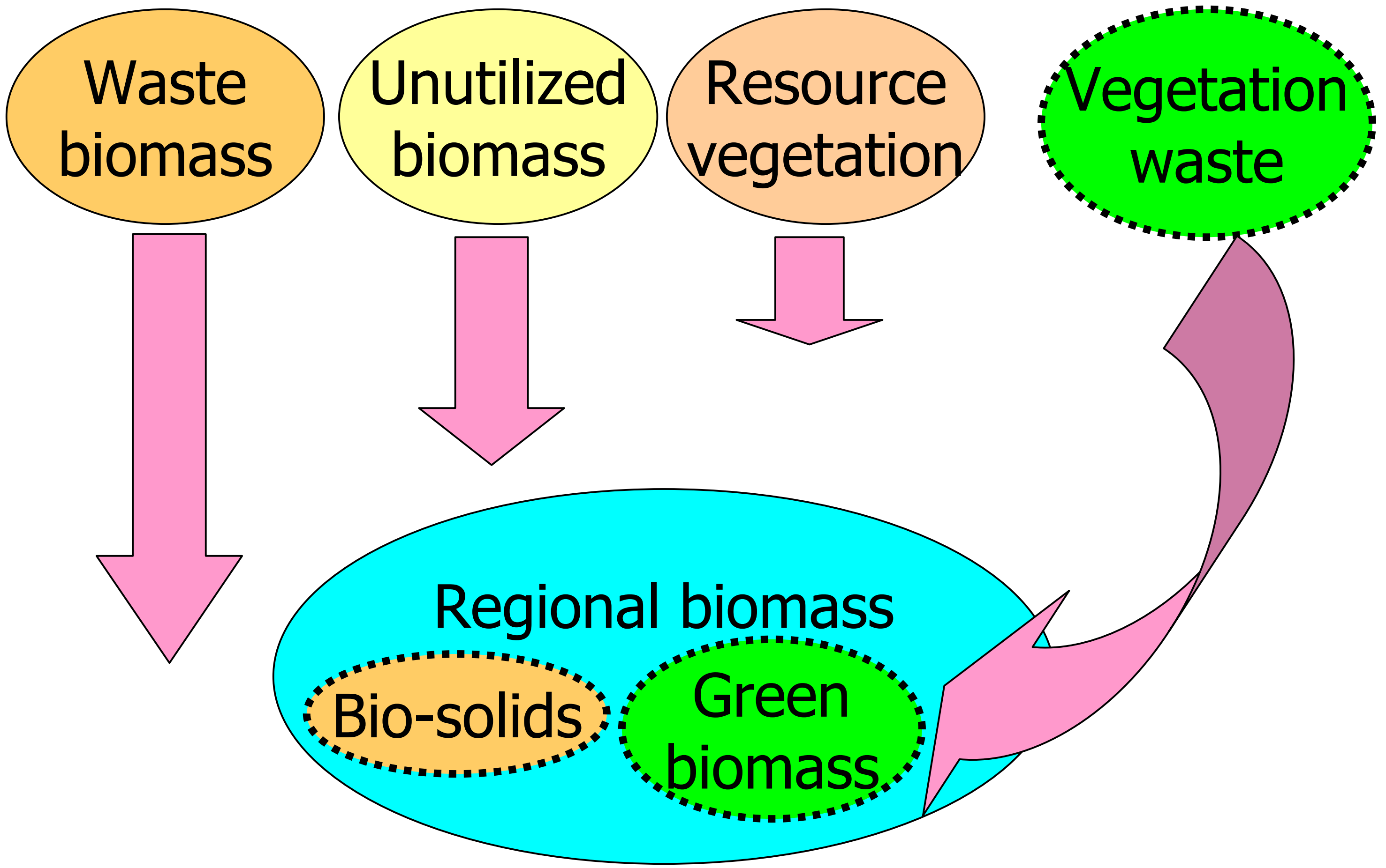
3. Increase of bio-gas production

Bio-solids treatment process

Essential technologies for energy utilization



Regional biomass



Green biomass from public works

Once cut per year

Storage on riverbed
for utilization
as litter at orchard

Kagetsu river, Chikugo-gawa river office

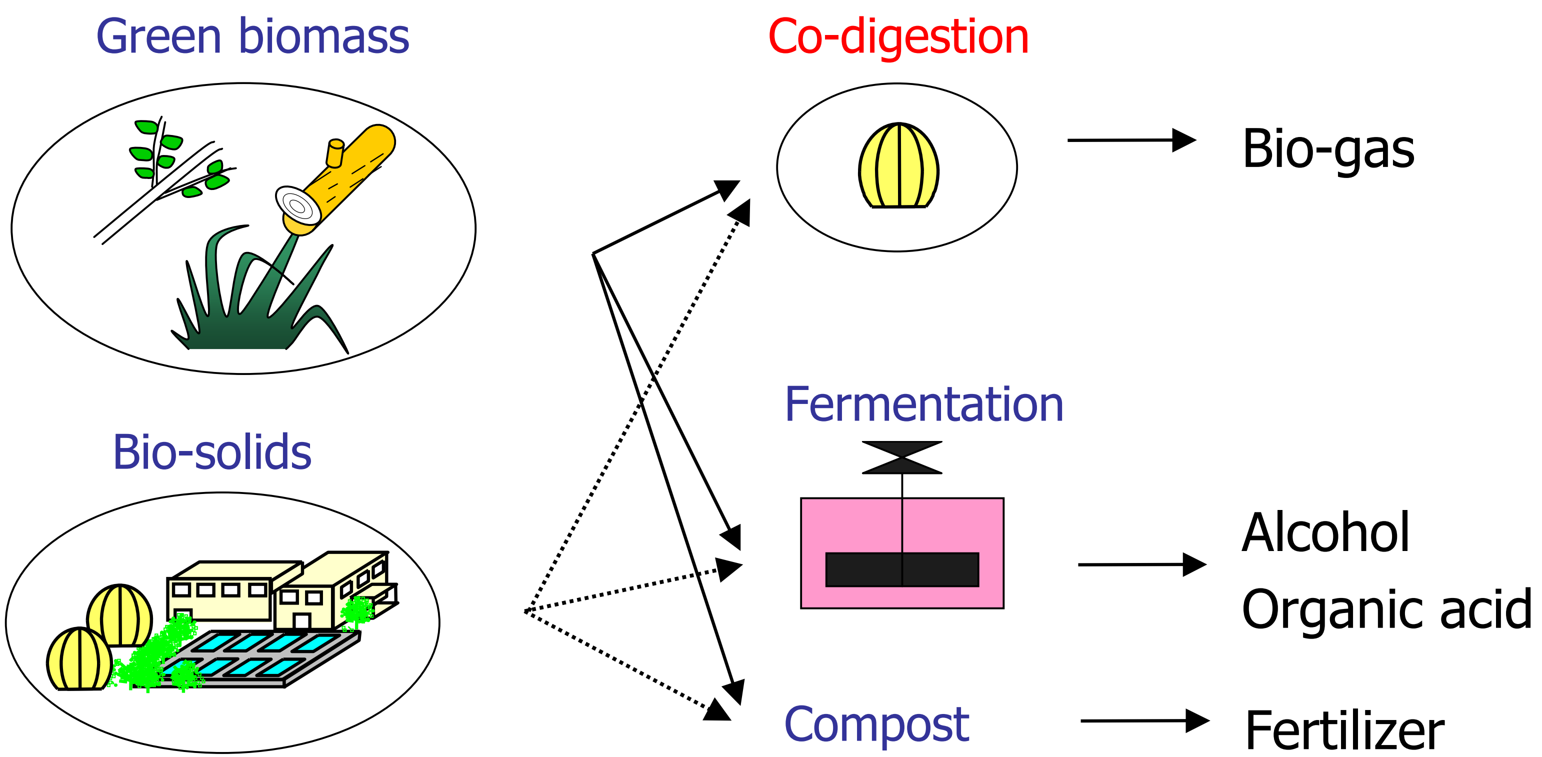
Once cut Twice cut

Transport to MWS* combustion

MWS*:
Municipal Solid Waste

Rout 3, Kita-kyushu road office

Recycling technology for organic waste



Recycling and utilizing biomass from public works

Data base for biomass

Driftwood into dam reservoirs

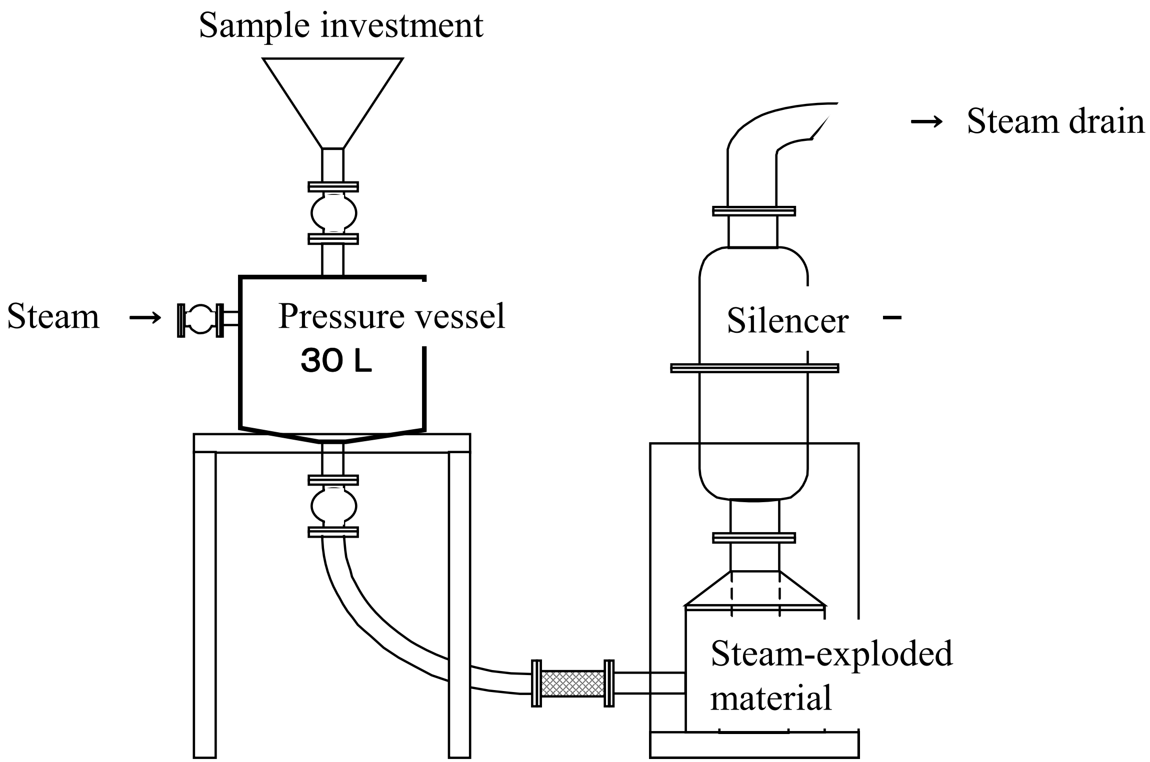
Develop the system which provides and manages the data base of biomass from each public work.

Technologies for recycling

Alternative material of peat moss
(Thick layer basic materials spaying)

Pilot works for practical use about the developing and existing useful technologies

Steam-explosion device

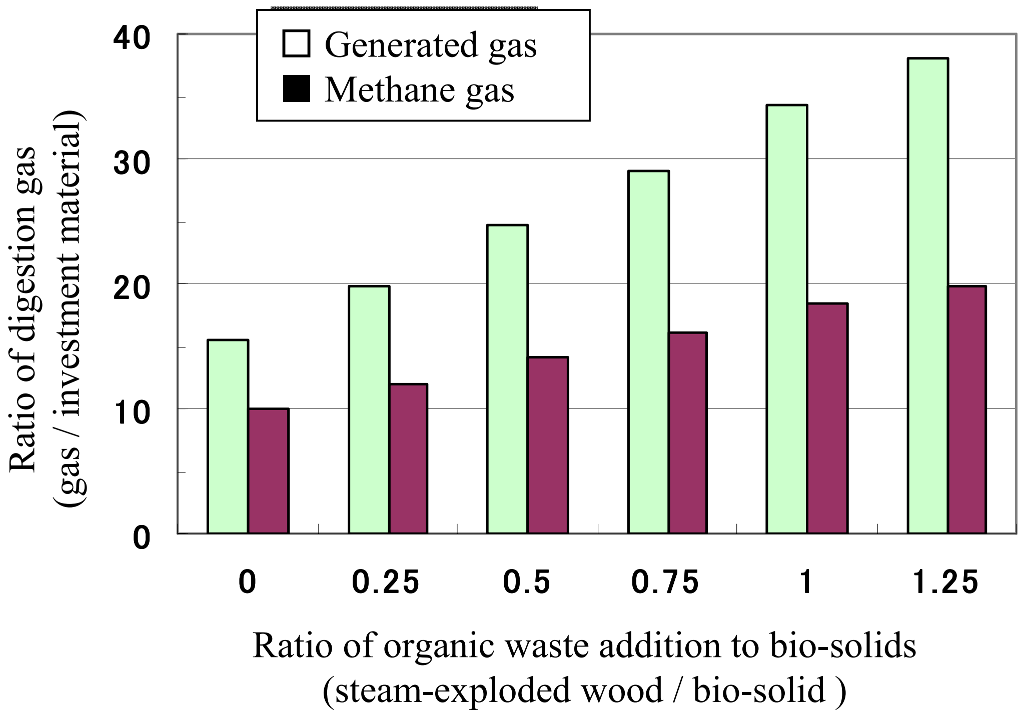


Sequential methane fermentation experiment

Steam-exploded broadleaf tree chips prepared under pressure of 2MPa for 15 minuets.

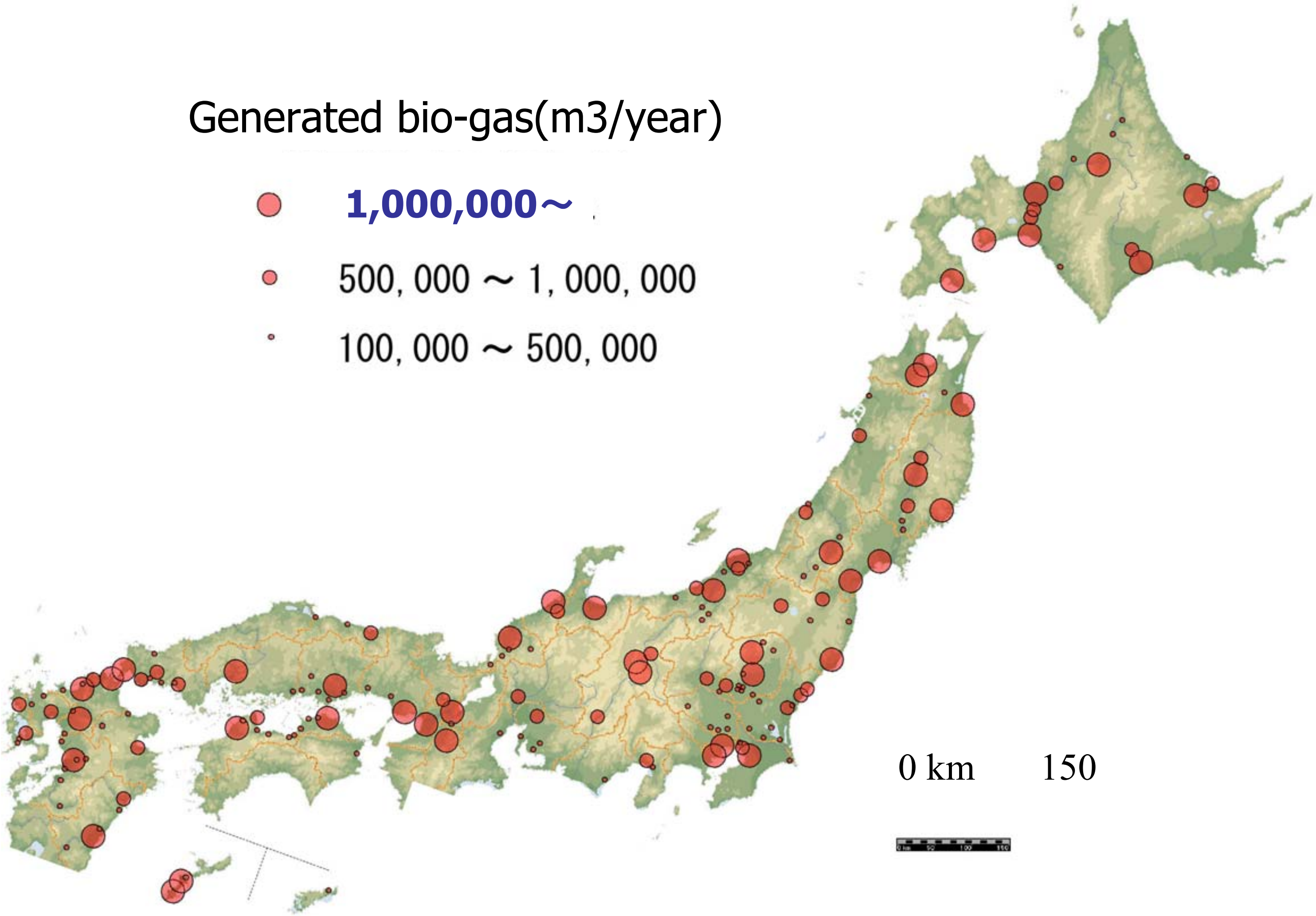
Inserting and removing samples once per day at 35 degrees for 50 days, while varying the ratio of the added plant waste to the bio-solids.

Recovery of methane gas from steam-exploded wood

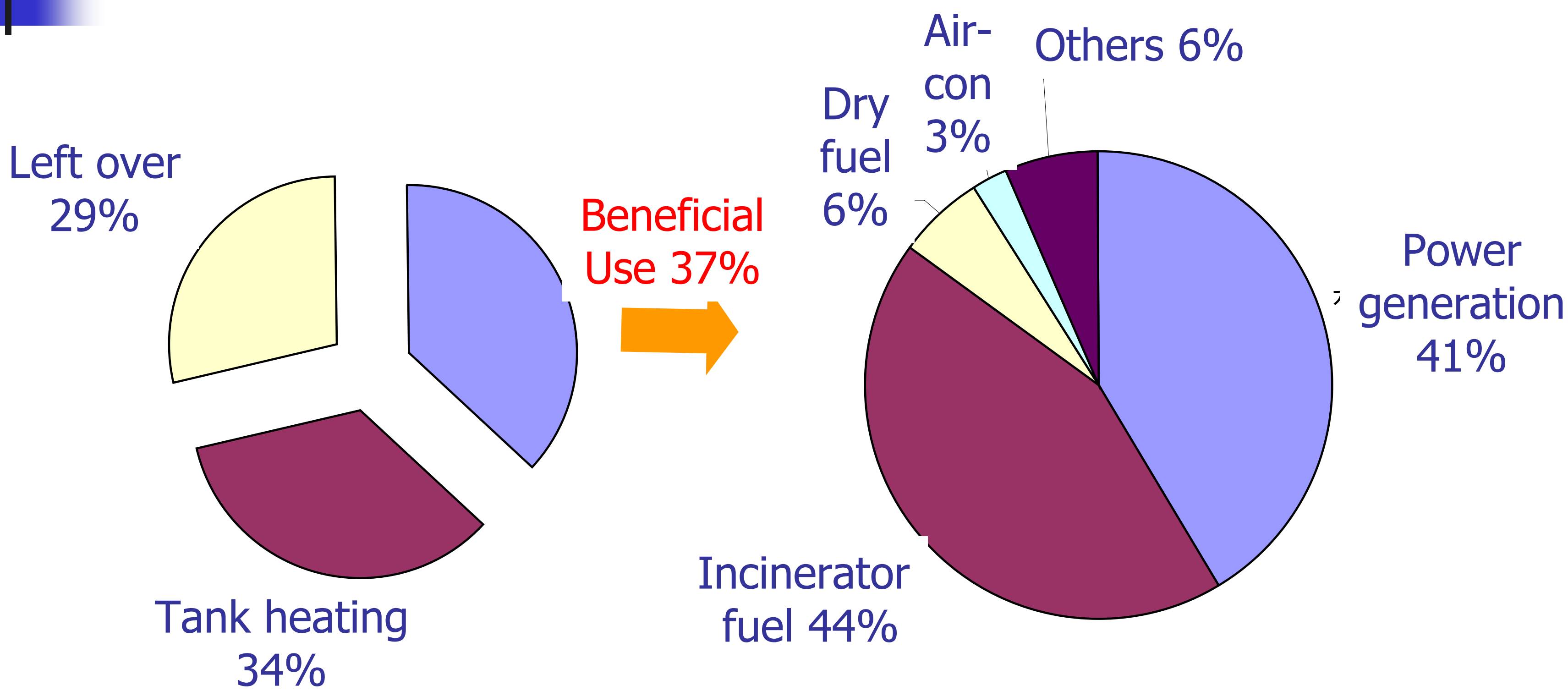


Methane gas production increased in proportion to the ratio of added steam-exploded wood to the bio-solids.

4. And the bio-gas utilization
Distribution of digestion facilities



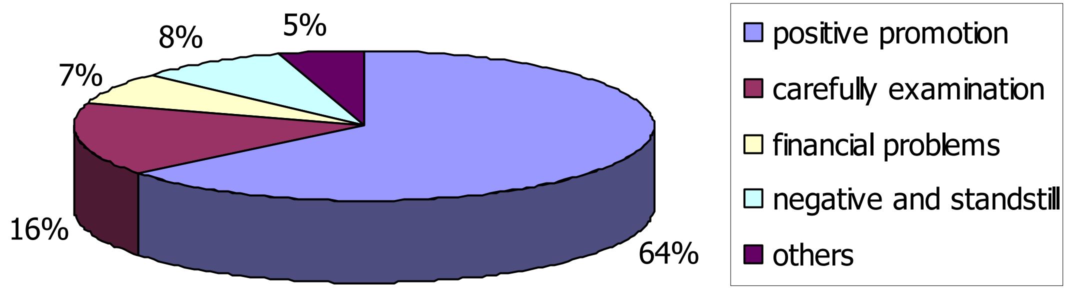
Utilization of biogas (1)



Bio-gas was generated 280 million m^3 per year in Japan.
And approximately 30% is left over and burned off

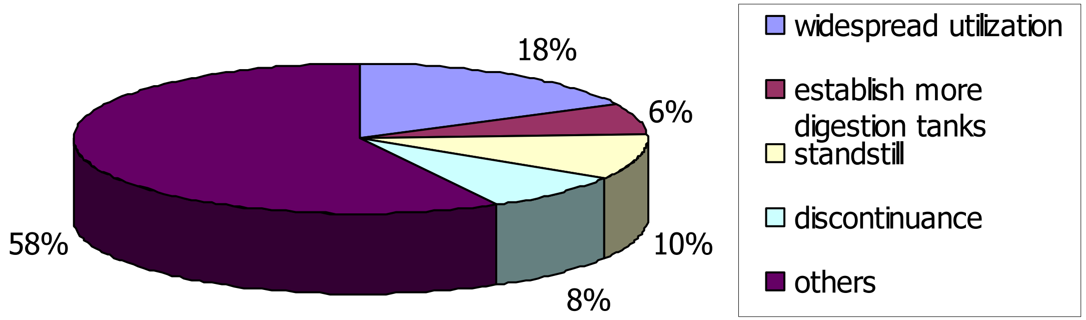
Utilization of biogas (2)

Questionnaire about digestion (FY2006)



Opinion for bio-gas utilization

Opinion about "positive promotion " is about 64%.

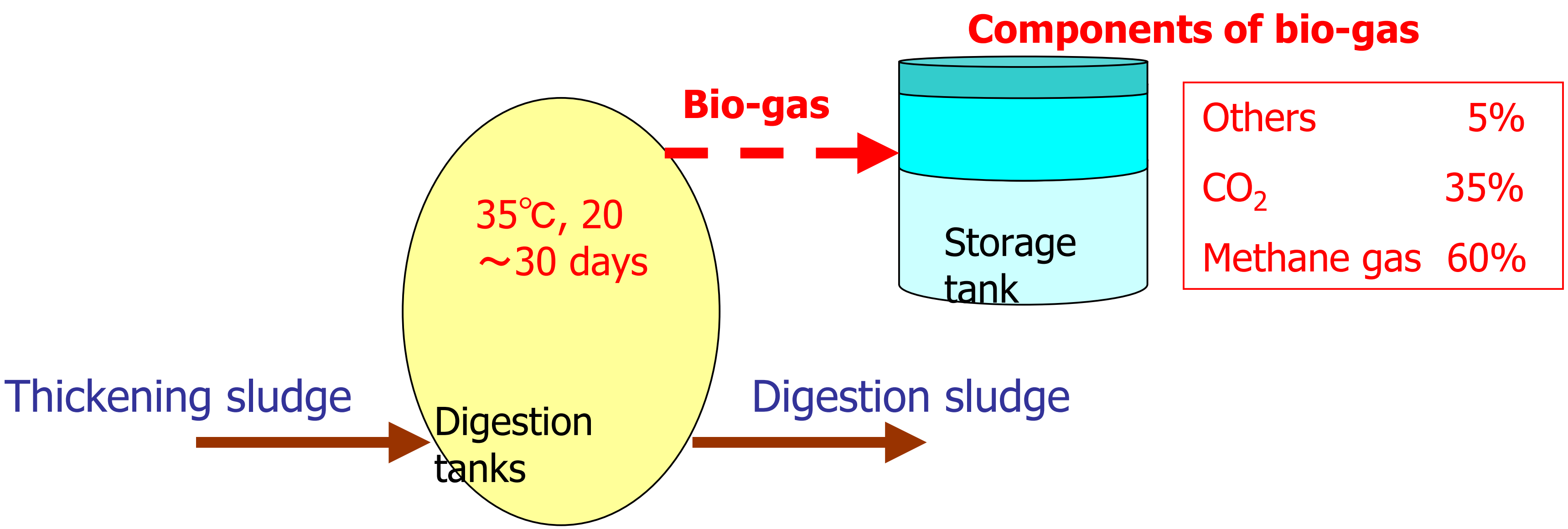


Action for bio-gas utilization

But it seems expectations, because 58% of cities does not have an actual action program for bio-gas utilization.

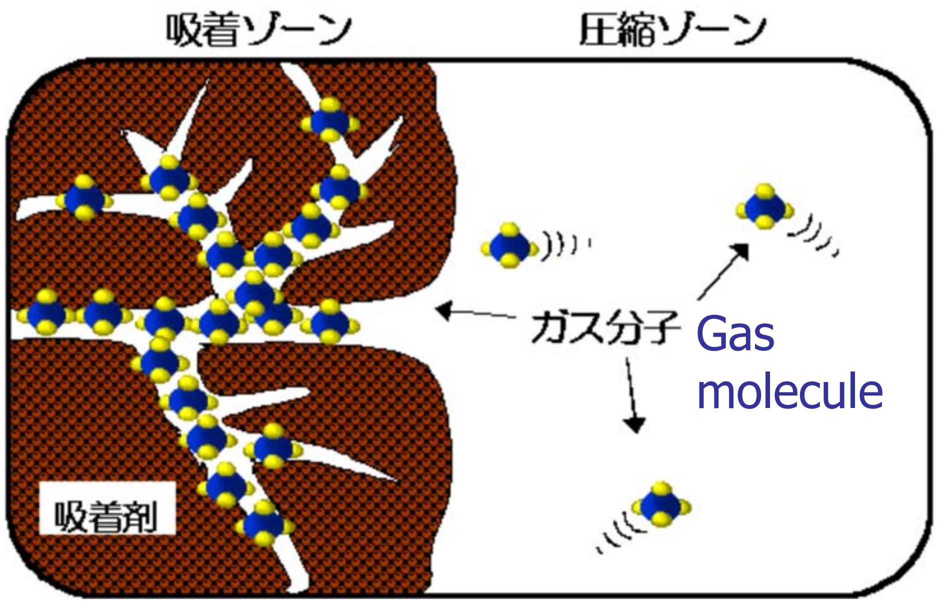
Components of bio-gas

- Reduce organic materials into low-molecule and liquefy or gasify them, by anaerobic micro-organism
- Decrease organic materials by 40-60%



Biogas adsorption system

Adsorption zone Compression zone

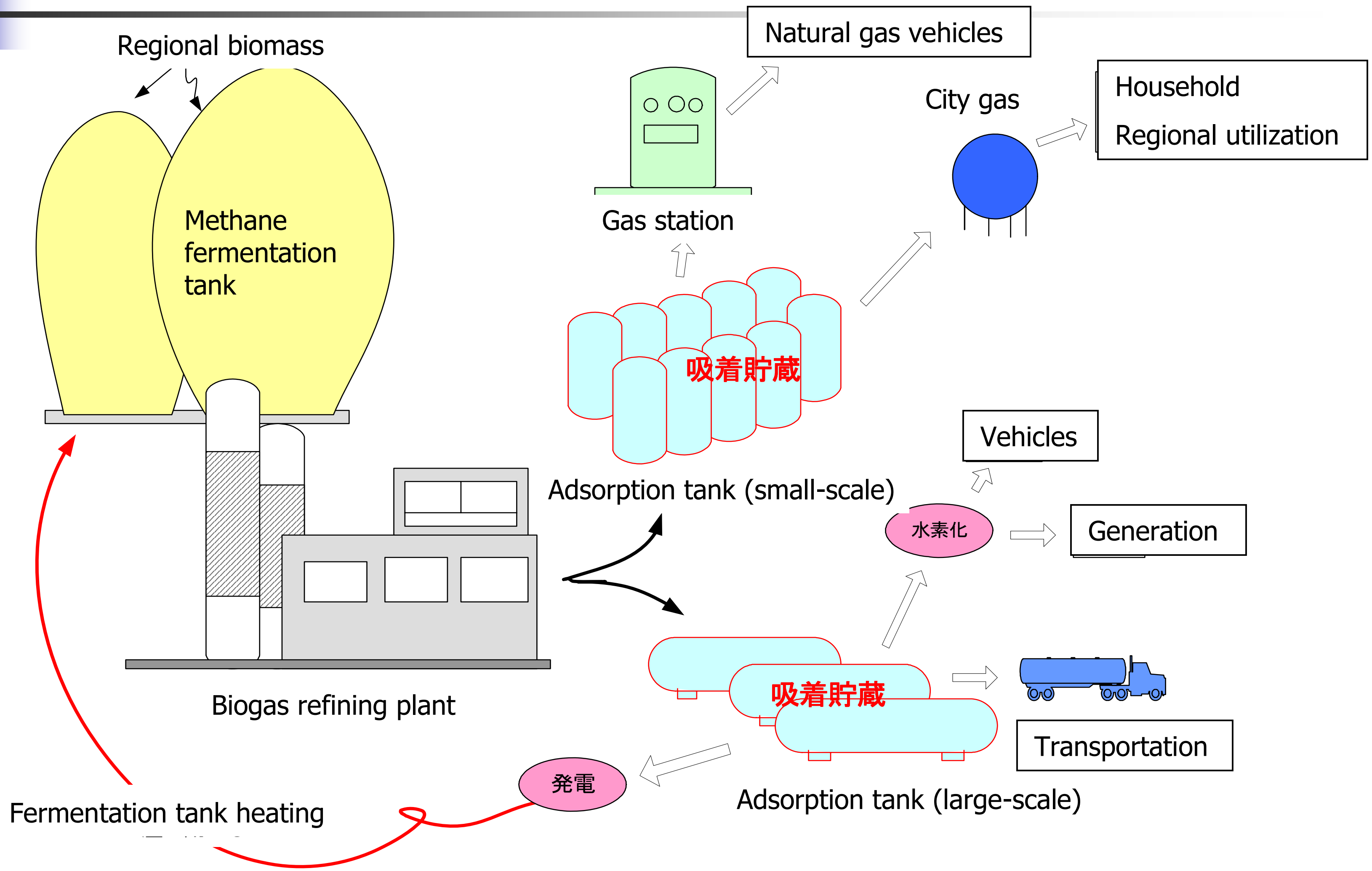


Adsorption media

Gas storage tank by adsorption (e.g. Tsuruoka city)

Left small tank: adsorption type
Right big tank: usual type

Biogas utilization project

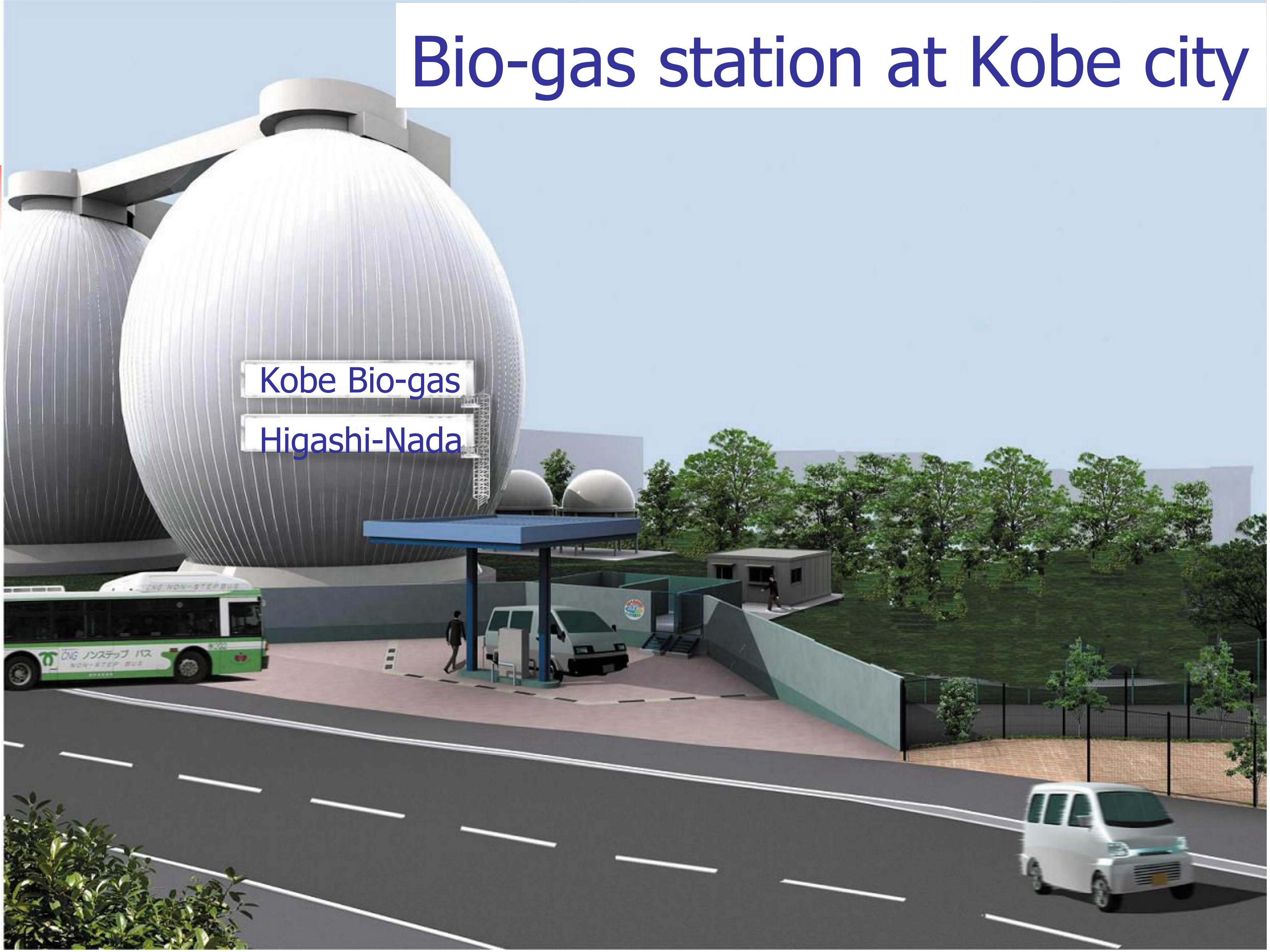


Kobe biogas

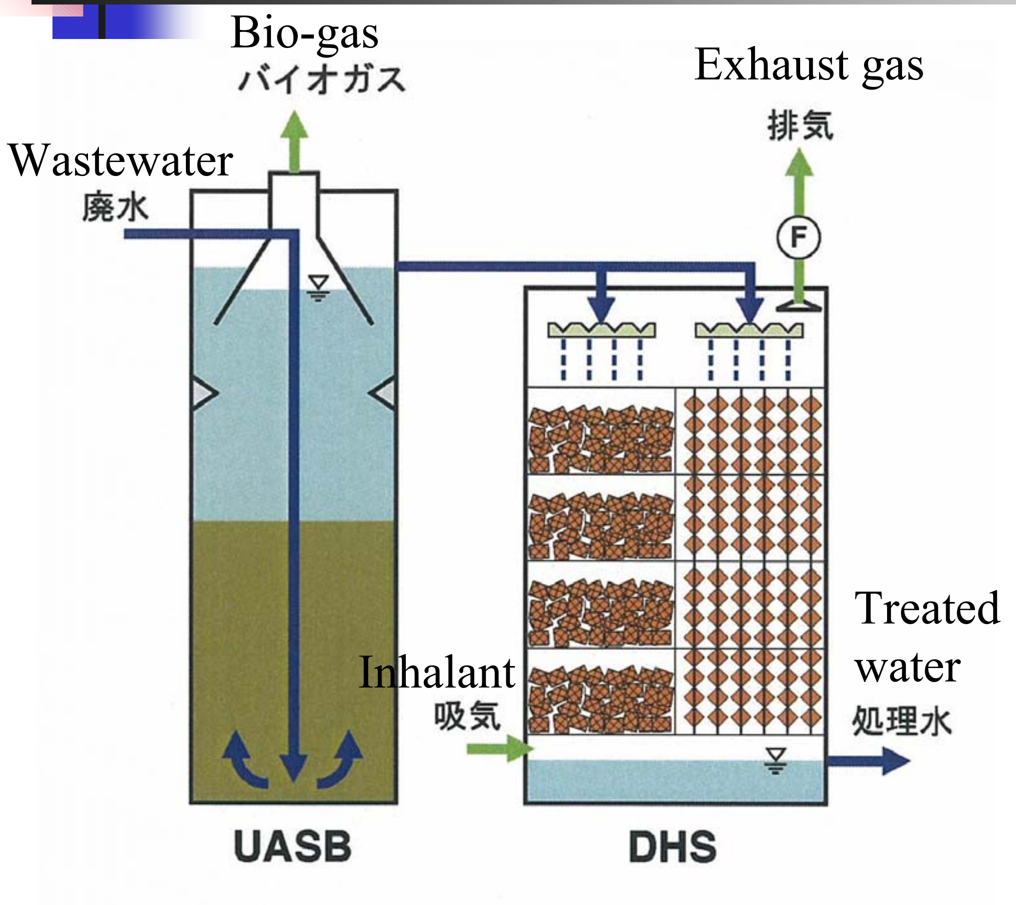
- Kobe biogas
  - Refined biogas = 98% methane gas
  - Kobe city bus opened the business from 2nd October, 2006
- Full-scale plant
  - Spring 2008 open
  - 2,000m^3/day
  - 40 buses (50km/day)

(PWRI, Kobe City, KOBELCO ECO-SOLUTIONS CO.)

Bio-gas station at Kobe city



5. Others
Energy saving water treatment (1)



Flow sheet of the system

UASB: Upflow Anaerobic Sludge Blanket

Applicable to the wastewater which has low content of organic materials. Energy saving, no heating and reduce the generated sludge.

DHS: Downflow Hanging Sponge

Treatment by the micro-organism fixed in sponge. No need aeration system and save much energy.

Energy saving water treatment (2)

Target for technology development

- Energy saving: 70% of Active Sludge Treatment (AST)
- Decrease CO_2 emission: 70% of AST
- Decrease the amount of generated sludge: 70% of AST
- Quality of treated water (BOD, SS, Total coliform): equal to AST

Pilot plant at Kokubu-Hayato WWTP in Kirishima City, Kagoshima pre.

Summary

- Bio-solids treatment
  - Mechanical dewatering, without digestion
- Beneficial use of bio-solids
  - Cement ingredient
  - Construction materials (ash and slag)
- Increase of bio-gas production
  - Co-digestion with green biomass
  - Biogas vehicles system

Thank you very much
for your kind attention.

PWRI

IX SYMPOSIUM PAPERS

Ⅸ-1 Program

The 16th International Symposium
on National Land Development and Civil Engineering in Asia

"Integrated Water Resource Management
Adapting to the Global Climate Change in Asia"

Monday December 3, 2007
13:00-17:10

Hotel Shiragiku

National Institute of Land and Infrastructure Management (NILIM)
Ministry of Land, Infrastructure and Transport(MLIT)

[Contents]

13:00-13:15	Opening Address	Mr. Shin TSUBOKA Director General, NILIM
	Address	Mr. Hiroaki TANIGUCHI Vice Minister for Engineering Affairs, Ministry of Land, Infrastructure and Transport (MLIT)
	Address	Representative of Overseas Participants

13:15- 14:15 Lecture

"Integrated Water Management under the Global Warming Scenario
–Case Study of Northern Kyusyu with Scarce Water Resources–"

Dr. Kenji JINNO
Professor, Faculty of Engineering, Kyushu University

Global warming is believed to be the one of the major causes of the abnormal climate at present. Beside the regulation of the emission of warming gas, the countermeasures against the threat of flood and drought need to be taken simultaneously. The role of central and local governments which are responsible for the infrastructure management is increasing than before. It is expected for them to take practical and appropriate counteractions.

On the other hand, the water environment in megacities where a half of the world people live is also another concern. Frequent flooding, inappropriate waste water management, and insufficient water resources are mostly related to the negative impact of rapid urbanization. In order to conquer the above subjects caused by both abnormal climate and urbanization, the concrete measures need to be initiated in a river basin or regional scale integrating various water users and residents living there.

In the present speech, the state of art for the relationship between the *potential threat of global warming and the impact of rapid urbanization will be discussed.*

14:15-17:00 Presentation and Discussion
（Chair : Mr. Kazunori ODAIRA, Director, River Dept., NILIM）

14:15-15:45 Presentation of Case Study

(14:15-14:25) Mr. Shin TSUBOKA
Director General, NILIM

(14:25-14:35) Mr. Yoshinori ASHIDA
Director, Planning Dept., Kyusyu Regional Bureau, MLIT

(14:35-14:45) Mr. Dhinadhayalan MURUGESAN
Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development
India

(14:45-14:55) Dr. Seok-Young YOON
Director, Policy research Division , Korea Institute of Construction Technology, Republic of Korea

(14:55-15:05) Mr. Wan Abd Rahim Bin WAN ABDULLAH
Director, Sewerage Services Dept.,
Ministry of Energy, Water & Communication, Malaysia

(15:05-15:15) Dr. Judy Famoso SESE
Director III, Bureau of Research & Standards,
Dept. of Public Works and Highways,
Republic of the Philippines

(15:15-15:25) Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Deputy General Manager,
National Water Supply & Drainage Board
Democratic Socialist Republic of Sri Lanka

(15:25-15:35) Ms. DANG Anh Thu
Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction, Socialist Republic of Vietnam

15:35-15:50 Break

15:50-17:00 Question and Answer Session / Panel Discussion

(PANELISTS)

1. Dr. Kenji JINNO, Professor, Faculty of Engineering, Kyushu University

2. Mr. Shin TSUBOKA, Director General, NILIM

3. Mr. Yoshinori ASHIDA, Director, Planning Dept.,
Kyusyu Regional Bureau, MLIT

4. Mr. Dhinadhayalan MURUGESAN, India

5. Dr. Seok-Young YOON, Republic of Korea

6. Mr. Wan Abd Rahim Bin WAN ABDULLAH, Malaysia

7. Dr. Judy Famoso SESE , Republic of the Philippines

8. Ms. Paniyanduwage Nalanie Sriyalatha YAPA,
   Democratic Socialist Republic of Sri Lanka

9. Ms. DANG Anh Thu, Socialist Republic of Vietnam

17:00-17:10 Closing Address
Mr. Katsumune SUZUKI
Director General, Kyusyu Regional Bureau, MLIT

17:30-19:00 Reception
(Venue : Banquet room, Hotel Shiragiku)

Host Vice Minister for Engineering Affairs, MLIT
Guests Director General, Kyusyu Regional Bureau, MLIT

Accommodations: Hotel Shiragiku
16-36, Kamitanoyu-machi, Beppu, Oita 874-0908, Japan
TEL. +81-97-721-2111, FAX: 81-97-721-5633

IX-2) Lectures

"Integrated Water Management under the Global Warming Scenario –Case Study of Northern Kyusyu with Scarce Water Resources–"

Dr. Kenji JINNO

Professor,

Faculty of Engineering, Kyushu University

Integrated Water Management under the Global Warming Scenario

- *Case Study of Northern Kyushu with Scarce Water Resources* -

Kyushu University, Fukuoka, Japan
Kenji Jinno

1. Introduction
2. Global warming scenario and required tasks
3. Effect of urbanization on water
4. Integrated water management at a basin scale
5. Cooperation of government and residents
6. Evaluation
7. Conclusion

keywords ; flood, water resources, environment, IPCC, monthly precipitation, drought, surface water, groundwater, land subsidence, multiple water resources, spring, change of water source, roles of government, participation of expertise and local people, competition amongst municipalities,・・・・・

1． Introduction

Climate change ！, ?

Normal Probability Level :
Strategic planning
Expectable outcomes
Investable cost, etc.

There are many text books to learn from the experienced regions.

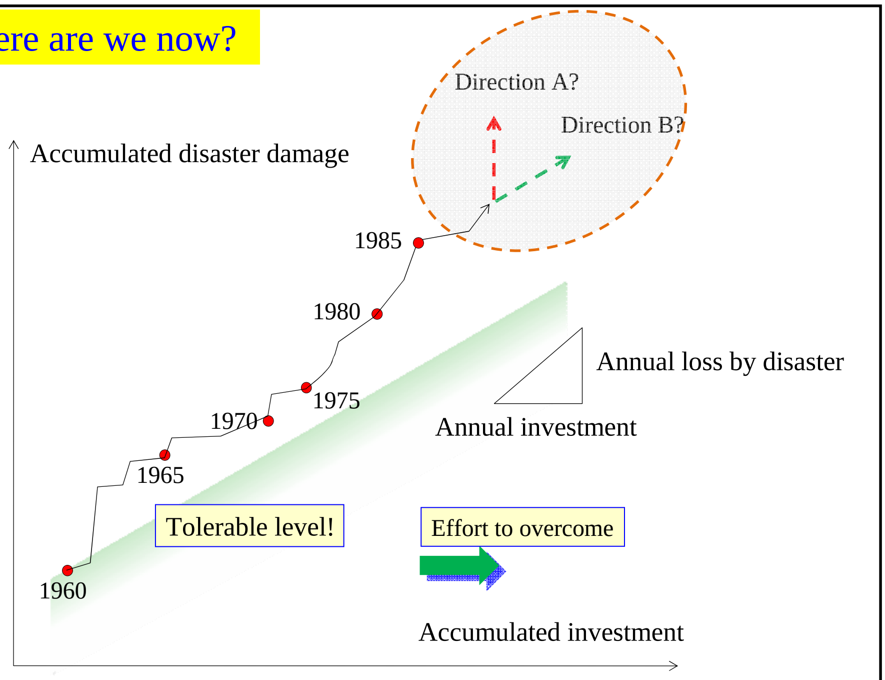
Flood prevention, Stable water resources development, Safe water supply, Environment conservation and Restoration

Bewildering situation?

Are there any experiences to overcome ?

Is the global warming "Out of the Normal Probability Level ?":
Attackable planning ?
How long will it take time ?
Are there any text books, etc. ?

Where are we now?




西日本新聞 2003年(平成15年)7月20日 日曜日

九州北部豪雨、混乱続く

地下鉄一部は終日運休

温暖化進み亜熱

強い積乱雲頻発
局地的にドカ雨

Flooded water in the subway, Fukuoka City

- Northern Kyushu, Japan
  July 20, 2003, 99mm/hr
- Subway stopped all day long

It is written in this article:

- **Changes to the subtropical climatic regime caused by global warming**

Very frequent news from the world!

Remarks ;

1-1. It is necessary to identify *where we are now in water problems under the scenario of global warming*, in order to shift to the new stage of water issues.

2. Global warming scenario and required tasks

Introduction to the AR4

The Working Group III contribution to the IPCC Fourth **Assessment Report (AR4)** focuses on new literature on the **scientific, technological, environmental, economic and social aspects** of mitigation of climate change, published since the IPCC Third Assessment Report (TAR) and other various reports.

OHP presentation by Dr. R. K. Pachauri, Chairman, IPCC
26th Session of the SBSTA, Bonn, Germany, 12th May 2007

How does IPCC predict the effect of global warming on water?

Fresh water resources and their management;
Drought-affected areas are likely to increase in extent.
Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.

Will these changes take place in your regions?

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Climate Change 2007: The Physical Science Basis

Summary for Policymakers

Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

This Summary for Policymakers was formally approved at the 10th Session of Working Group I of the IPCC, Paris, February 2007.

Note:
Text, tables and figures given here are final but subject to copy-editing.

Corrections made as of February 5th, 2007

Climate Change 2007: The Physical Science Basis, Summary for Policymakers
Contribution of **Working group I** to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change http://www.ipcc.ch/SPM2feb07.pdf

Table SPM-2. Recent trends, assessment of human influence on the trend, and projections for extreme weather events for which there is an observed late 20th century trend.{Tables 3.7, 3.8, 9.4, Sections 3.8, 5.5, 9.7, 11.2-11.9}

Phenomenon [a] and direction of trend	Likelihood that trend occurred in late 20th century(typically post 1960)	Likelihood of human contribution to observed trend [b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely* [c]	*Very likely* [d]	*Virtually certain* [d]
Warmer and more frequent hot days and nights over most land areas	*Very likely* [e]	*Likely* (nights) [d]	*Virtually certain* [d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not* [f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfalls) increase over most areas	*Likely*	*More likely than not* [f]	*Very likely*
Areas affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970s	*More likely than not* [f]	*Likely*
Intense incidence of extreme high sea level (excludes tsunamis) [g]	*Likely*	*More likely than not* [f, h]	*Likely* [i]

When should we take actions?

Do we need the complete and accurate evidence?
Or, should we take the actions now?

Suspecting global warming!

Believing global warming!

Table SPM E.1: *Qualitative definition of uncertainty*[*)]

high ↑ Level of agreement (on a particular finding)	High agreement, limited evidence	High agreement, medium evidence	High agreement, much evidence
	Medium agreement, limited evidence	Medium agreement, medium evidence	Medium agreement, much evidence
	Low agreement, limited evidence	Low agreement, medium evidence	Low agreement, much evidence
	Amount of evidence[50] (number and quality of independent sources) → **much**		

[50] "Evidence" in this report is defined as: Information or signs indicating whether a belief or proposition is true or valid. See Glossary.

*) Source: INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Working Group III contribution to the Intergovernmental Panel on Climate Change, Fourth Assessment Report, Climate Change 2007: Mitigation of Climate Change; *Summary for Policymakers*. p.36

I found several significant opinions;

Climate Change 2007: Observations and Drivers of Climate Change

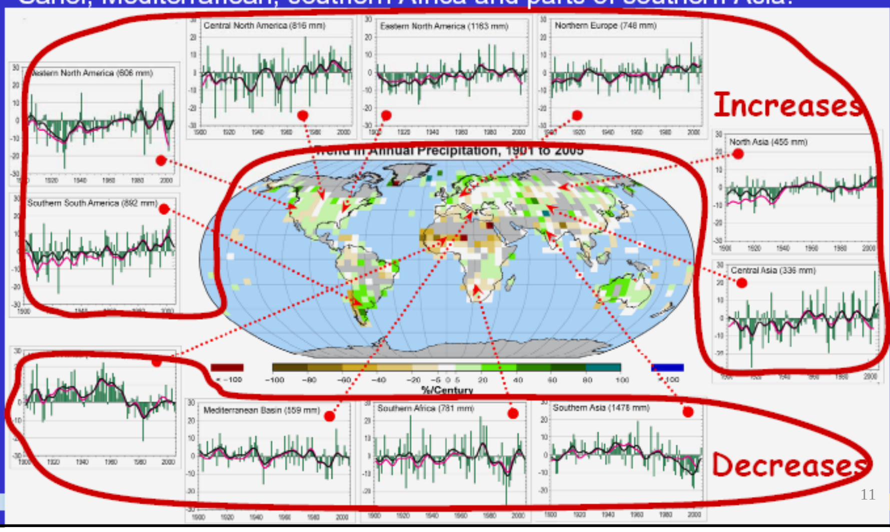
WG 1

Martin Manning
Director, IPCC Working Group I Support Unit

1. Observed climate change
2. Paleoclimatic perspective
3. Drivers of climate change

Precipitation (rain & snow) is variable – but there is evidence for systematic change

Precipitation has increased in eastern parts of North and South America, northern Europe and northern and central Asia – and decreased in the Sahel, Mediterranean, southern Africa and parts of southern Asia.



WG-2

Adaptation to Climate Change and its Inter-Relationships with Mitigation

Richard J.T. Klein
Stockholm Environment Institute

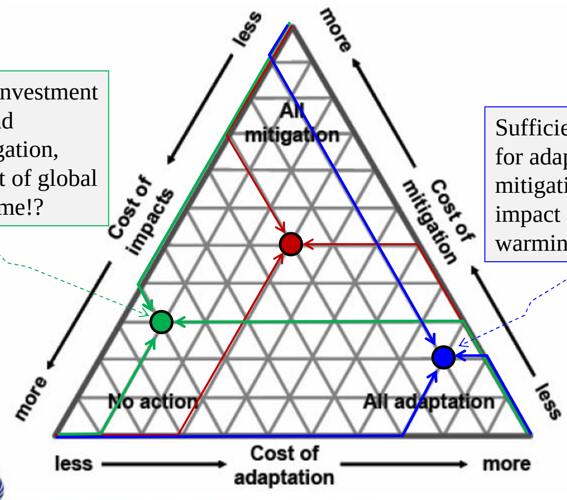
Contributing Author of Chapter WGII-17
Coordinating Lead Author of Chapter WGII-18

WMO UNEP

Schematic diagram for the political decision:

Where are we now and which scenarios are going to take?

Because of less investment for adaptation and insufficient mitigation, then large impact of global warming will come!?



Sufficient investment for adaptation and small mitigation, then less impact of global warming will come!?

It is not yet possible to say whether or not adaptation buys time for mitigation

- Integrated assessment models provide approximate estimates of relative costs and benefits at highly aggregated levels, but only a few models include feedbacks from impacts
- Challenges to making trade-offs beyond the local scale include the different spatial, temporal and institutional scales of options and the different interests, beliefs, value systems and property rights of actors
- An "optimal mix" would reconcile welfare impacts on people living in different places and at different points in time into a global aggregate measure of well-being

I think we have similar subjects like the effect of urbanization.

Also, I think local people and government should initiate.

Yes, common information and understanding based on the scientific analyses need to be shared both at a local and global scale.

We need the people who know their region sufficiently and well organized working teams.

Social and economic development enhances capacity to adapt and mitigate

- Response capacity is often limited by a lack of resources, poor institutions and inadequate infrastructure

- People's vulnerability to climate change can therefore be reduced not only by adaptation and mitigation, but also by development aimed at improving the living conditions and access to resources of those experiencing the impacts

Yes, it is significant to participate in this kind forum it order to exchange ideas.

WMO

Research needs

Yes, find the appropriate direction, based on the integrated expertise.

- Development of a consistent analytical framework to analyse inter-relationships between adaptation and mitigation, including their potential and limitations
- Empirical analysis of each of the four types of inter-relationships, in particular at the regional and sectoral levels, and for specific social and economic groups
- The effect of development pathways on adaptation and mitigation, and vice versa

- Requirements on national and international policy in facilitating decisions on adaptation and mitigation at the relevant institutional levels

Again, share the common understandings.

WMO UNEP

This statement suggests that one of the indispensable adaptations and mitigations is the counteraction for urbanization.

Remarks ;

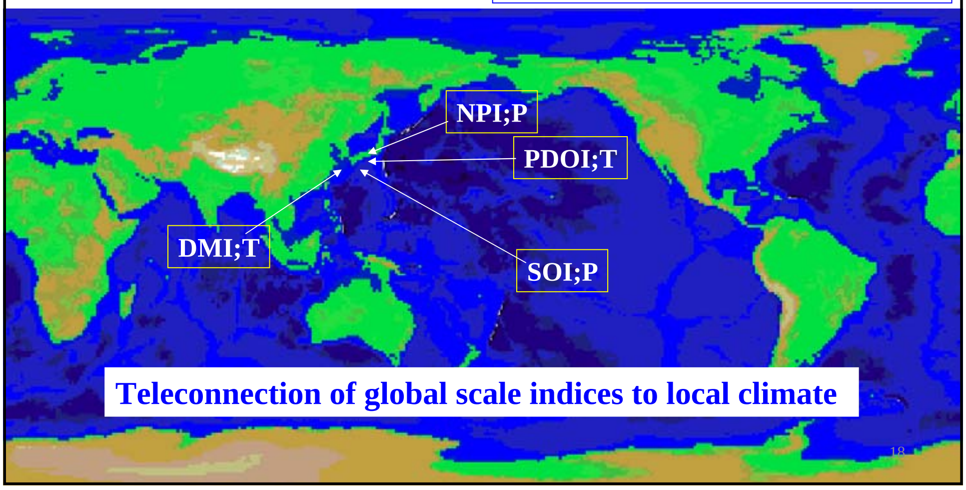
2-1. It seems that policymakers are urged to take necessary countermeasures although the alarm provided by IPCC is not completely finalized(for us, or to me).

2-2. More careful observation of water related indices seems to be necessary in order to take concrete measures *at a different scale.*

Examination of the indices of the global climate change which may affect Fukuoka, northern Kyushu, Japan

102 year record of **Precipitation** and **Temperature** measured at Fukuoka meteorological station

Monthly data of
NPI(*North Pacific Index*); P
PDOI(*Pacific Decadal Oscillation Index*); T
SOI(*Southern Oscillation Index*); P
DMI(*Dipole Mode Index*); T

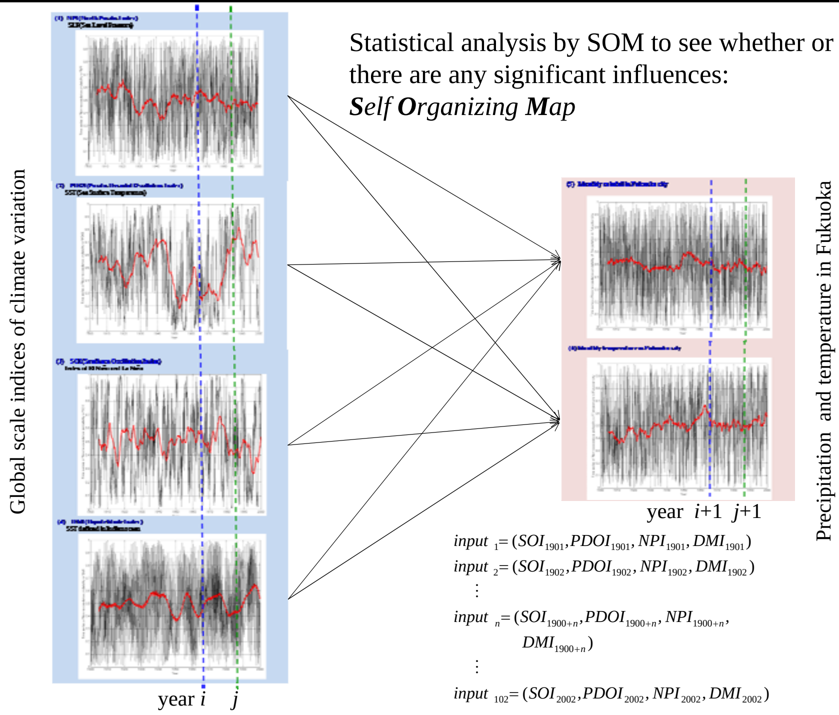


Correlation between the global climatic indices and Fukuoka's climate;

We need to be confident on the possibility of the climatic change caused by global warming.

Indices of global climatic variation(Scaled 0 to 1.0 from their original values)		
Index (Jan. 1900 - Dec. 1999)	High/ Low	Climatic means
NPI :P (North Pacific Index)	High	Weak Aleutian low pressure
	Low	**Strong Aleutian low pressure**
PDOI: T (Pacific Decadal Oscillation Index)	**High**	Low sea surface temperature(SST) anomalies in the central North Pacific Ocean, and **high in the equatorial Pacific Ocean and California coast of USA**
	Low	High SST anomaly in the central North Pacific Ocean, and low in the equatorial Pacific Ocean and California coast of USA
SOI: P (Southern Oscillation Index)	**High**	Strong trade wind=***La ñina***
	Low	Weak trade wind=*El ñino*
DMI: T (Dipole Mode Index)	**High**	High SST anomaly in the **equatorial West Indian Ocean**, low SST anormaly in the equatorial South Eastern Indian Ocean
	Low	Low SST anomalies in the equatorial West Indian Ocean, and high SST anomaly in the equatorial South Eastern Indian Ocean

Statistical analysis by SOM to see whether or not there are any significant influences:
S*elf* ***O****rganizing* ***M****ap*



$input_1 = (SOI_{1901}, PDOI_{1901}, NPI_{1901}, DMI_{1901})$

$input_2 = (SOI_{1902}, PDOI_{1902}, NPI_{1902}, DMI_{1902})$

$\vdots$

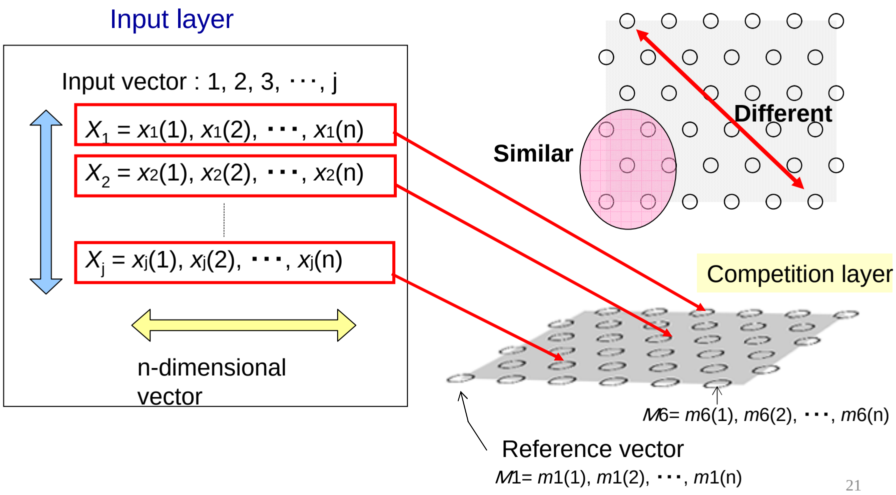
$input_n = (SOI_{1900+n}, PDOI_{1900+n}, NPI_{1900+n}, DMI_{1900+n})$

$\vdots$

$input_{102} = (SOI_{2002}, PDOI_{2002}, NPI_{2002}, DMI_{2002})$

About the Self Organizing Map (SOM)

SOM (Self-Organizing Map) is able to plot the multi-dimensional vector onto the 2-dimensional map called **SOM-map** depending on the vector properties.



Variation of annual precipitation in Japan

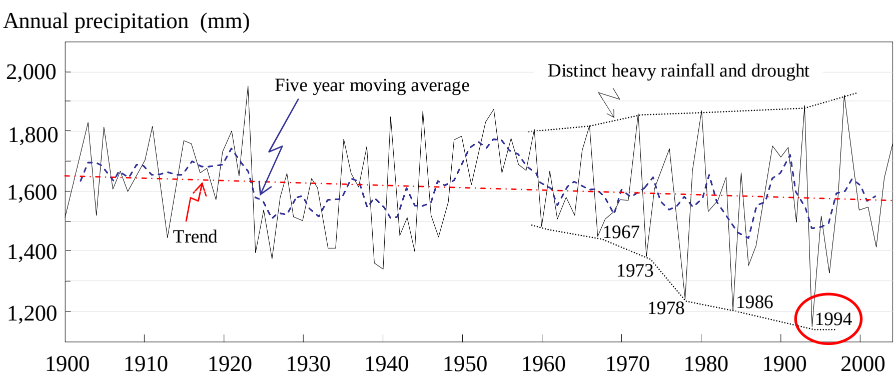


Figure Variation of annual precipitation in Japan. In recent 40 years, heavy rainfall and drought is becoming distinct.

SOM-map; blue numbers indicate the SOM-grid

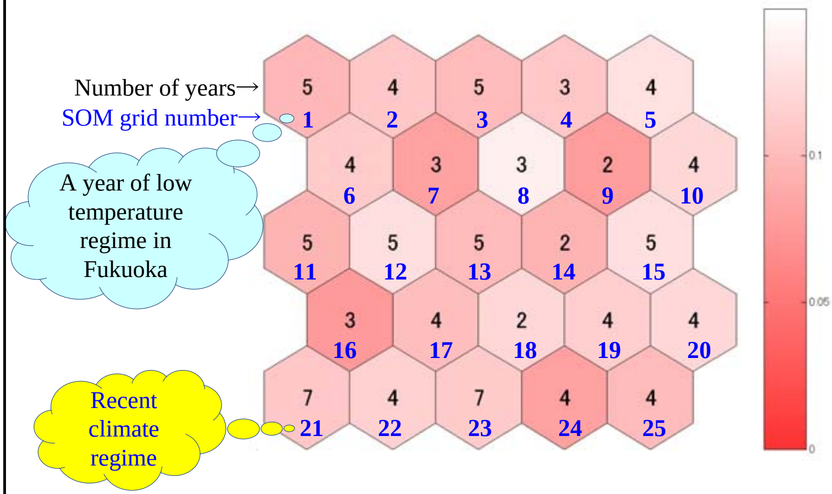


Figure The map obtained by applying SOM for the 102 inputs(years). The number written in each node indicates the number of data classified in the node. Red color bar indicates a low square of deviation(Very similar pattern).

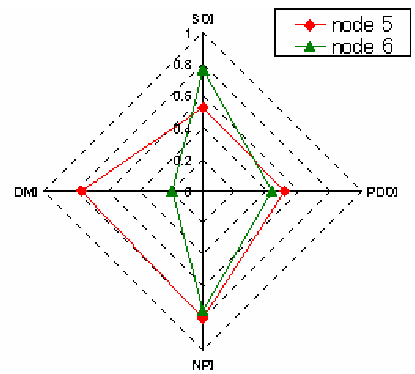
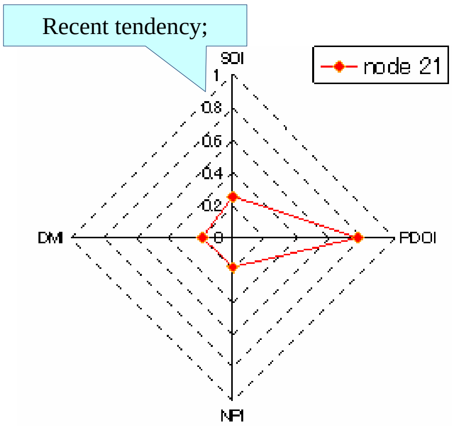


Figure Radar chart of reference vector for the SOM node 5 (red) and for the SOM node 6 (green). Each of the 4 axes shows non-exceedance probabilities of SOI (top), PDOI (right), NPI (bottom) and DMI (left)

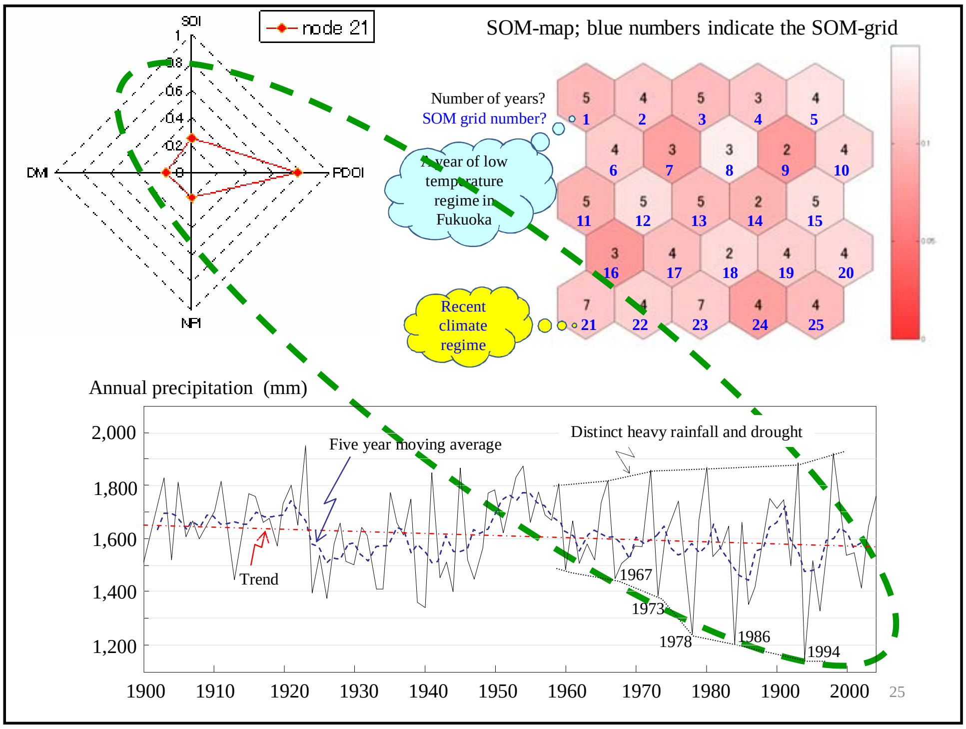


1. **Figure** Radar chart of reference vector for the

SOM node 21:

Low: **SOI** (*El ñino*),
DMI(Low SST anomaly in the equatorial Western Indian Ocean),
NPI(Strong Aleutian low pressure),

High: **PDOI**(High SST anomaly in the equatorial Pacific Ocean and California coast)



Summary of SOM analysis:

1) **The classification of climate indices by SOM** identified the distinct change of the climate patterns which have been observed **since 1960s**.

2) **Fukuoka's temperature from April to September is likely to be low when,**

   SOI is high when **La Niña** occurs,
   PDOI is high,
   NPI is high((Aleutian pressure is weak), and
   DMI is low.

3) **High and low precipitation tend to fluctuate alternately.**

How about is your region?
Won't you check your data whether they show clear correlation or not?

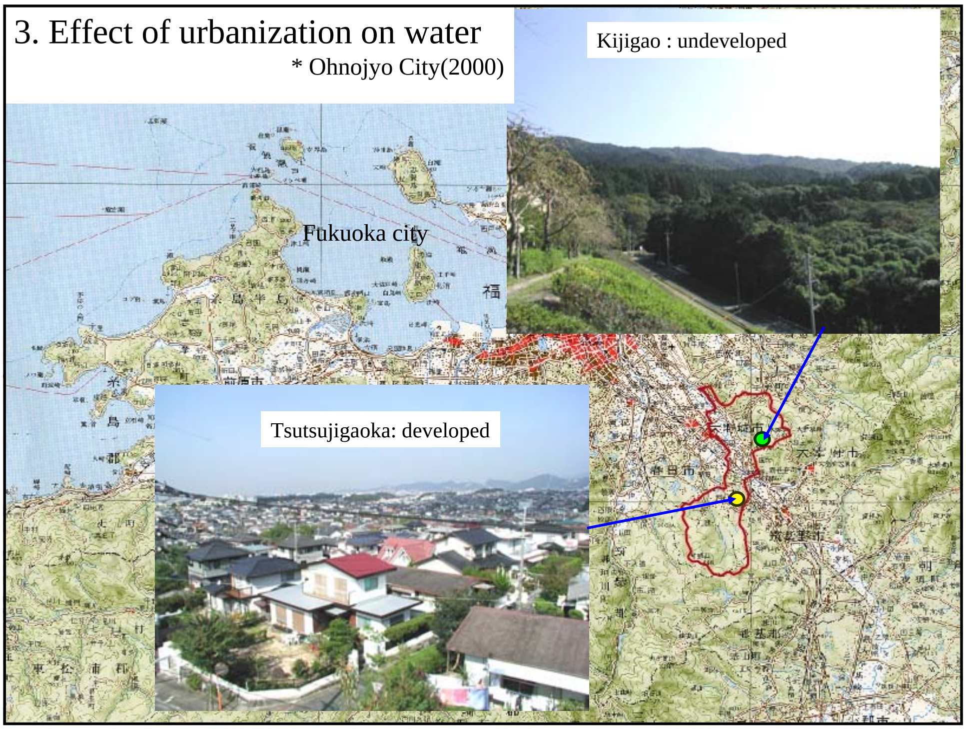
Remarks ;

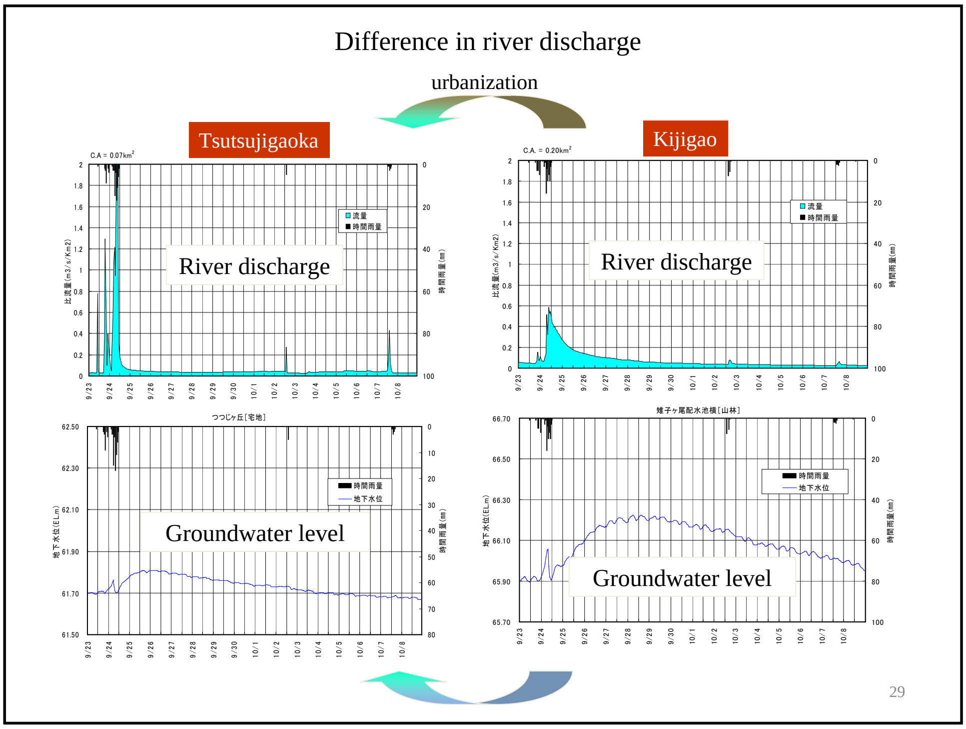
2-3. The fluctuation of the annual precipitation in Fukuoka seems to be correlated with the employed four indices.

2-4. More direct signals may be necessary in Fukuoka region to clearly state the effect of global warming on the scientific level.

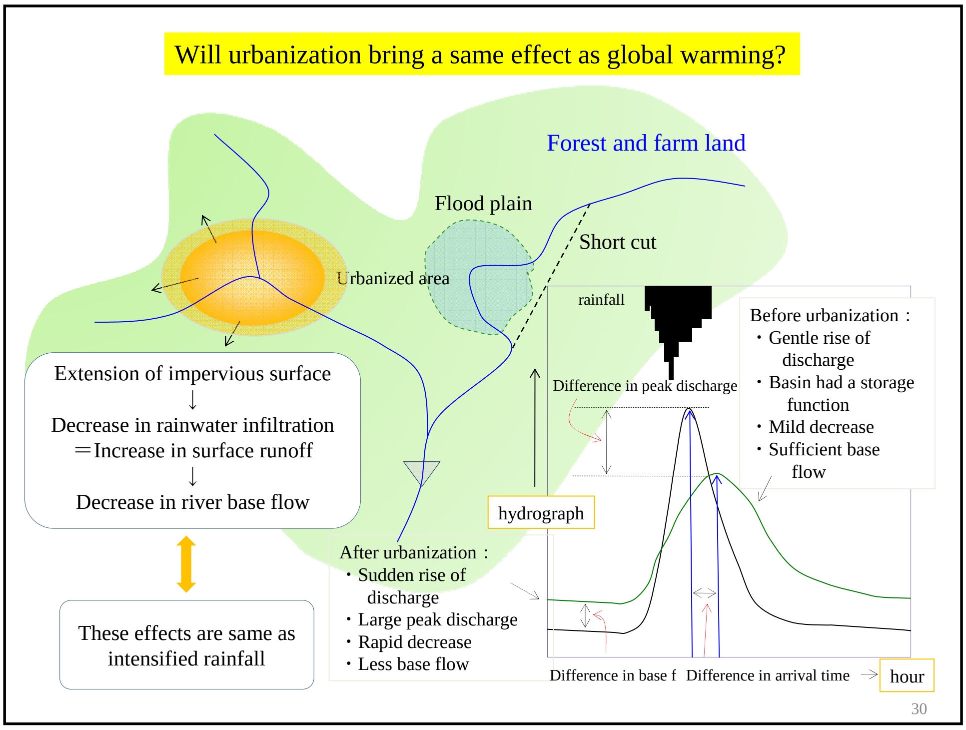
3. Effect of urbanization on water

* Ohnojyo City(2000)

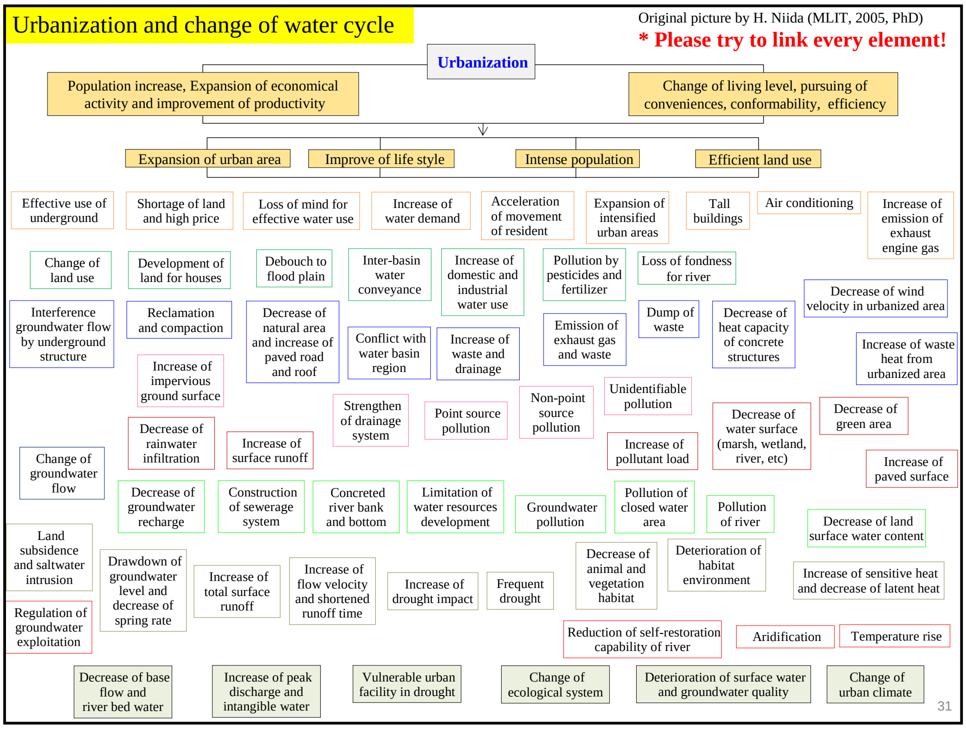


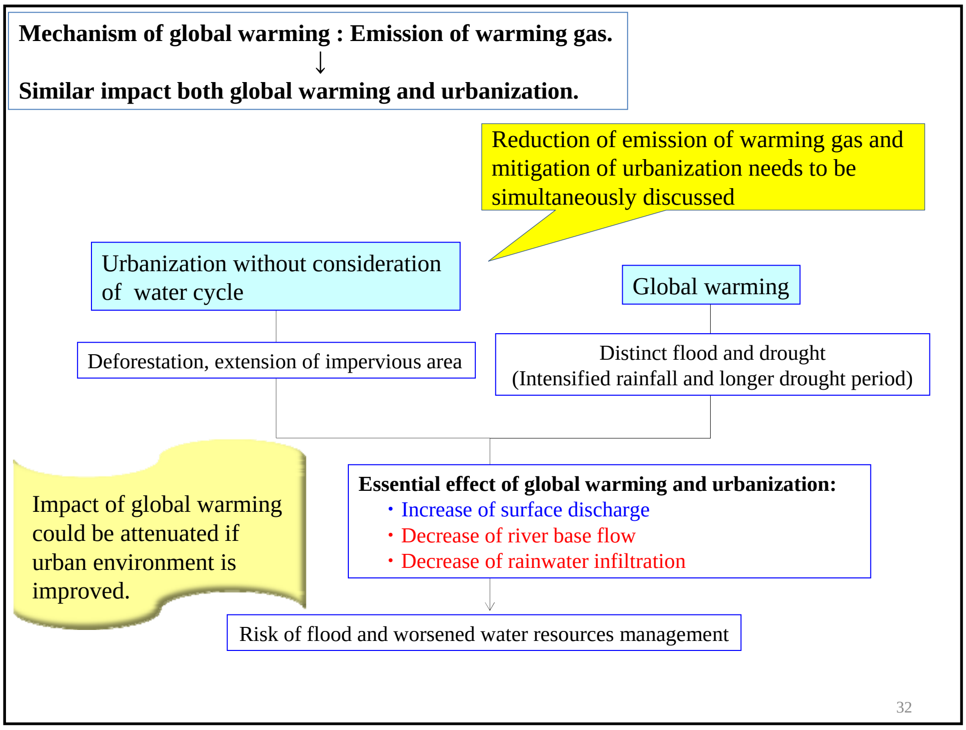


Difference in river discharge
urbanization
Tsutsujigaoka
Kijigao
River discharge
River discharge
Groundwater level
Groundwater level
29



Will urbanization bring a same effect as global warming?
Forest and farm land
Flood plain
Short cut
Urbanized area
rainfall
Before urbanization：
・Gentle rise of discharge
・Basin had a storage function
・Mild decrease
・Sufficient base flow
Difference in peak discharge
Extension of impervious surface
↓
Decrease in rainwater infiltration
＝Increase in surface runoff
↓
Decrease in river base flow
hydrograph
After urbanization：
・Sudden rise of discharge
・Large peak discharge
・Rapid decrease
・Less base flow
These effects are same as intensified rainfall
Difference in base f
Difference in arrival time
hour
30


Urbanization and change of water cycle
Original picture by H. Niida (MLIT, 2005, PhD)
* Please try to link every element!
Urbanization
Population increase, Expansion of economical activity and improvement of productivity
Change of living level, pursuing of conveniences, conformability, efficiency
Expansion of urban area
Improve of life style
Intense population
Efficient land use
Effective use of underground
Shortage of land and high price
Loss of mind for effective water use
Increase of water demand
Acceleration of movement of resident
Expansion of intensified urban areas
Tall buildings
Air conditioning
Increase of emission of exhaust engine gas
Change of land use
Development of land for houses
Debouch to flood plain
Inter-basin water conveyance
Increase of domestic and industrial water use
Pollution by pesticides and fertilizer
Loss of fondness for river
Decrease of wind velocity in urbanized area
Interference groundwater flow by underground structure
Reclamation and compaction
Decrease of natural area and increase of paved road and roof
Conflict with water basin region
Increase of waste and drainage
Emission of exhaust gas and waste
Dump of waste
Decrease of heat capacity of concrete structures
Increase of waste heat from urbanized area
Increase of impervious ground surface
Strengthen of drainage system
Point source pollution
Non-point source pollution
Unidentifiable pollution
Decrease of water surface (marsh, wetland, river, etc)
Decrease of green area
Change of groundwater flow
Decrease of rainwater infiltration
Increase of surface runoff
Increase of pollutant load
Increase of paved surface
Decrease of groundwater recharge
Construction of sewerage system
Concreted river bank and bottom
Limitation of water resources development
Groundwater pollution
Pollution of closed water area
Pollution of river
Decrease of land surface water content
Land subsidence and saltwater intrusion
Drawdown of groundwater level and decrease of spring rate
Increase of total surface runoff
Increase of flow velocity and shortened runoff time
Increase of drought impact
Frequent drought
Decrease of animal and vegetation habitat
Deterioration of habitat environment
Increase of sensitive heat and decrease of latent heat
Regulation of groundwater exploitation
Reduction of self-restoration capability of river
Aridification
Temperature rise
Decrease of base flow and river bed water
Increase of peak discharge and intangible water
Vulnerable urban facility in drought
Change of ecological system
Deterioration of surface water and groundwater quality
Change of urban climate
31


Mechanism of global warming : Emission of warming gas.
↓
Similar impact both global warming and urbanization.
Reduction of emission of warming gas and mitigation of urbanization needs to be simultaneously discussed
Urbanization without consideration of water cycle
Global warming
Deforestation, extension of impervious area
Distinct flood and drought (Intensified rainfall and longer drought period)
Impact of global warming could be attenuated if urban environment is improved.
Essential effect of global warming and urbanization:
・Increase of surface discharge
・Decrease of river base flow
・Decrease of rainwater infiltration
Risk of flood and worsened water resources management
32

Remarks ;

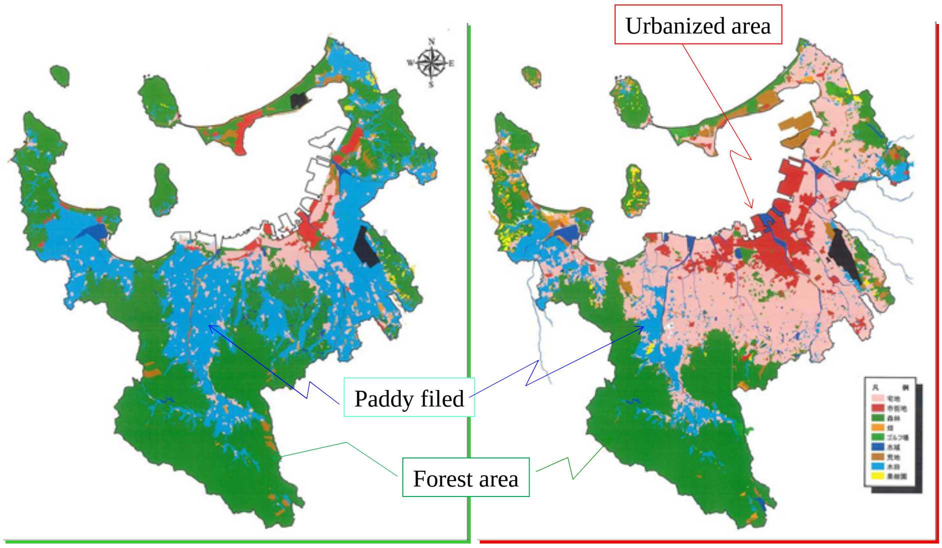
3-1. Urbanization without having proper measures for water management will result in worsened environment.

3-2. If global warming is likely to induce the distinct rainfall pattern, similar water problems which we observe in the urbanized areas at present, will occur.

3-3. Perhaps, both effects are already evident in many urbanized areas of the world.

Example of effect of urbanization of water environment

History of land use alteration of Fukuoka city (by Fukuoka city office)

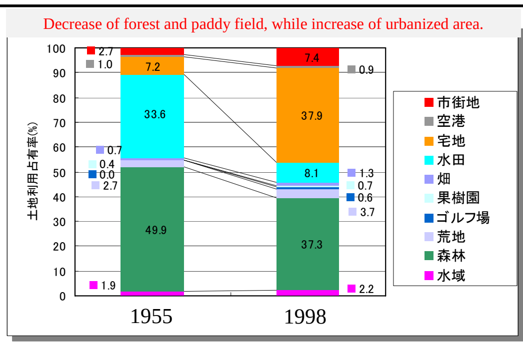


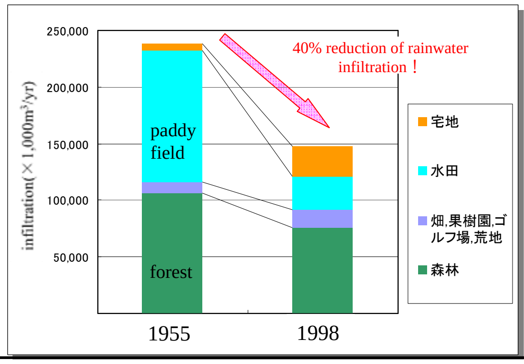
Year 1955 Year 1998

Action plan of *aesthetic water cycle* of Fukuoka city:

[purpose]
Rapid urbanization of Fukuoka metropolitan area has brought the decrease of river base flow and increase of flood peak resulting in deterioration of water quality during drought and heavy rainfall event.

In order to improve such subjects, Fukuoka City declares to take the necessary actions based on the aesthetic water cycle. This means all the water related administrations will cooperate each other.





Remarks；

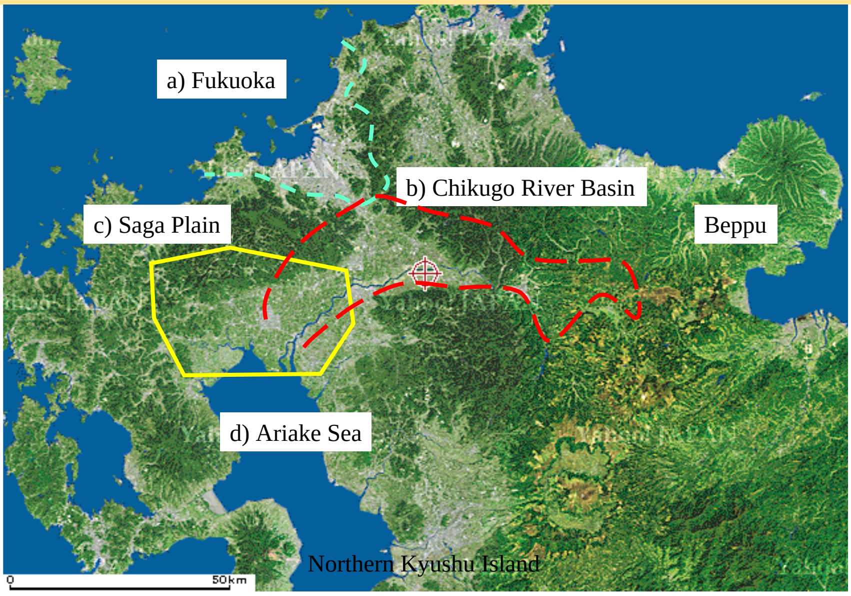
3-3. A concept of “***Aesthetic water cycle***” is not yet sufficiently known.

3-4. The people expect that rainwater infiltrates into ground and create tasty groundwater.

3-5. To achieve the “***Aesthetic water cycle***”,
1) Estimate the amount and movement of surface and groundwater, and
2) Estimate the quality of surface and groundwater, in your region.

4. Integrated water management at a basin scale

Inter-basin subjects, especially when drought happens
- Case of Fukuoka metropolitan area and Chikugo River Basin -

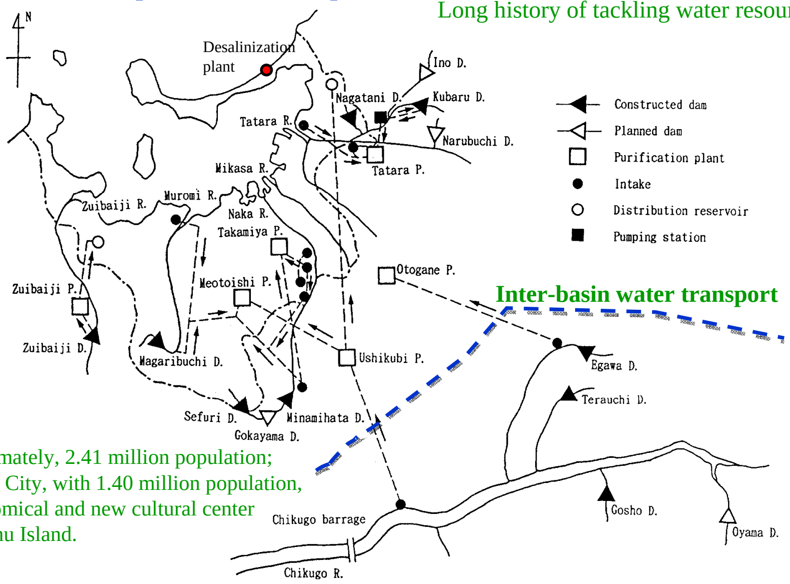


37

a) Fukuoka metropolitan areas→Water resources, aesthetic water cycle

→Department shop of water development

Small watersheds, highly populated area.
Long history of tackling water resources.



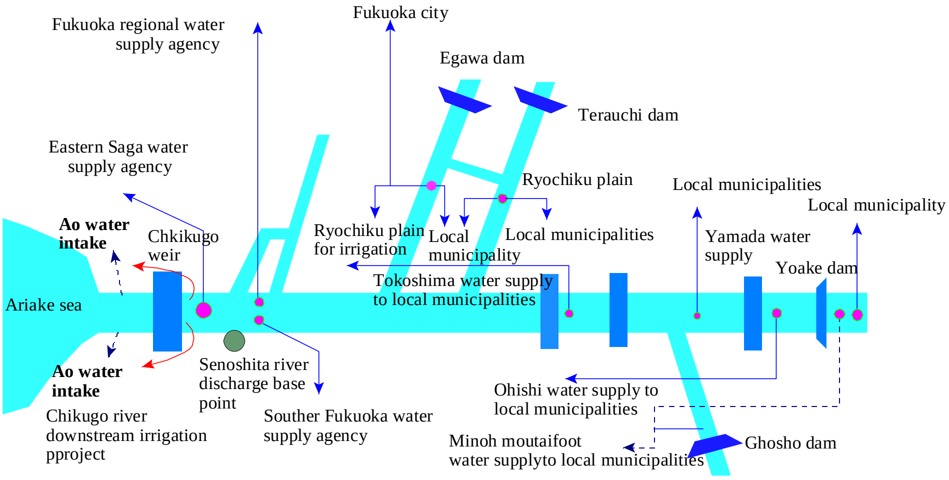
Approximately, 2.41 million population;
Fukuoka City, with 1.40 million population,
an economical and new cultural center
of Kyushu Island.

Waterworks facilities, water sources and conveyance system of Fukuoka City

38

b) Chikugo River Basin→Water resources, extension of sewerage system, and land subsidence

Irrigation, drinking water, river and sea fishery, river environment, flood control are all interrelated in Chikugo River Basin which covers the prefectures from the upstream to the downstream sea. Land subsidence, vulnerable for drought.



Ao: local word meaning of fresh water

Long history of water use of Chikugo River Basin

c) Saga-Chikugo Plain→Land subsidence, replace of groundwater by surface water

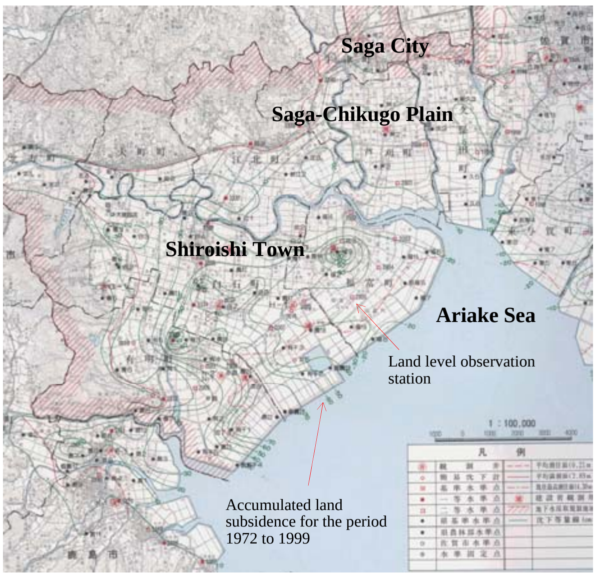


Figure * Total land subsidence for Feb.1942 – Feb. 1999. Lines are the contours of land subsidence, dots are the monitoring stations of groundwater level and ground level (By Saga Prefectural Office, 1999)

d) Ariake Sea→Recovery of the sea environment and basin

There are 8 major rivers which are directly managed by the central government(MLIT) in the Ariake Sea region. The catchment has been used in many ways more than 2,000 years. Recently, remarkable deterioration of sea environment are observed and fishery industries are getting worse. An integrated regional water management in the entire Ariake Sea region is becoming indispensable to improve the situation.

Drought of 1994!

vulnerable of the water resources in this region;

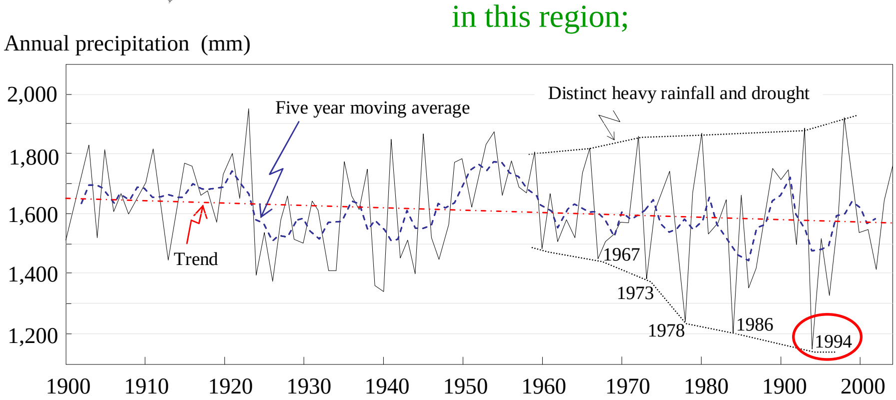


Figure: Variation of annual precipitation in Japan. In recent 40 years, heavy rainfall and drought is becoming distinct.

a) Influence of the 1994 drought in Fukuoka area

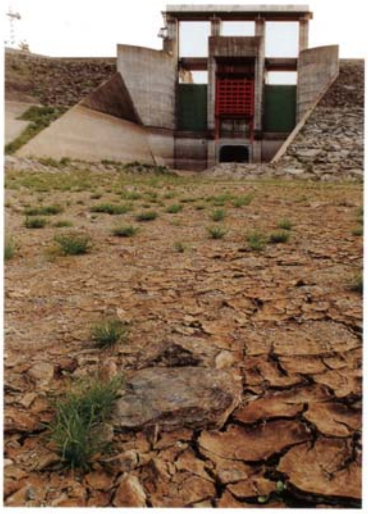
Preparation of drinking water at home,
(photo by Yomiuri News)

（平成6年9月2日掲載）

Street stall of Chinese noodles, "*We have to close when no water*",
(photo by Asahi News)

（平成6年8月5日掲載）

b) Influence of the drought in 1994 to the agricultural area in Chikugo-Saga plains



Dried up Terauchi dam,
(photo by Nishinihon News)

Wilted rice in Saga prefecture,
(photo by Mainichi News)

（平成6年8月21日掲載）

Emergency release of the water stored
in the weir reservoir for irrigation in downstream

筑後大堰から下流アオ地区へ緊急放流
平成6年7月26日撮影

大詫間、大野島地区のアオ緊急取水の状況
平成6年7月26日撮影

クリークの枯渇状況（筑後川流域大詫間地区にて）
平成6年9月2日撮影

田面がひび割れし枯死した稲（筑後川流域大詫間地区にて）
↑ 平成6年9月2日撮影

Dried up rice field with cracks
← Farmers pump up the river water to irrigate
(by Ministry of Land , Infrastructure and Transportation)

c) Influence of the drought in 1994 to the area of land subsidence, Shiroishi Plain, Saga

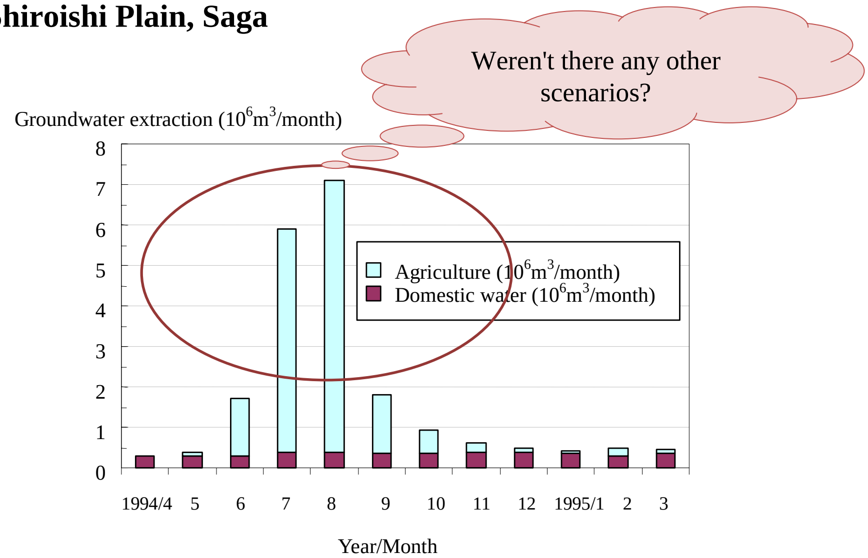


Figure Monthly groundwater extractions in Shiroishi Town
(By Saga Prefecture Office[5]).

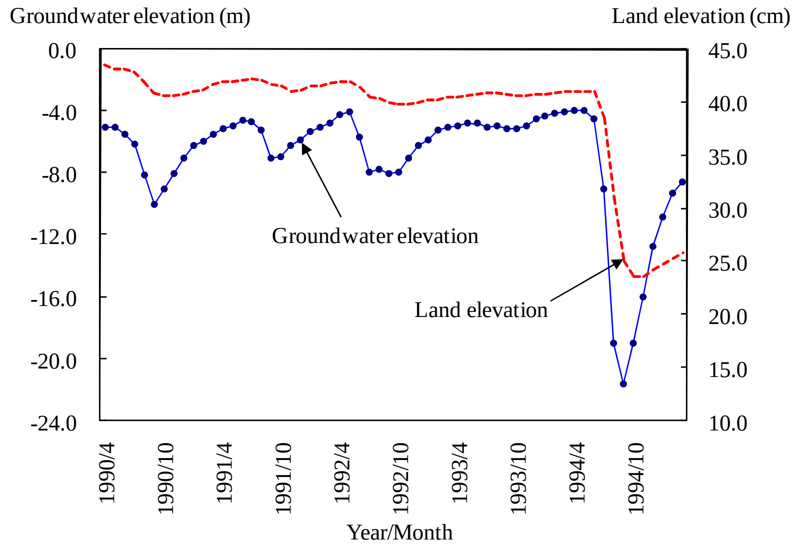
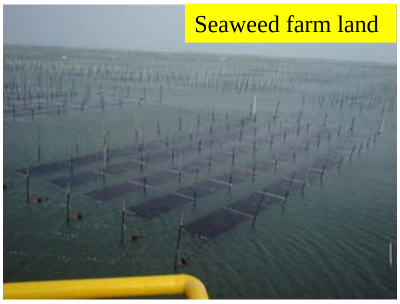


Figure Land subsidence and the variation of groundwater level.
(By Saga Prefecture Office, 1999[6]).

d) Fishery industry in Ariake Sea, its causes are often controversial.



http://contents.kids.yahoo.co.jp/shokuiku/zukan/seaweed/400.html

Remarks ;

4-1. Three regions belong to the different river basins. However, "*water*" has been their common subject.

4-2. Today, they are not independent.

4-3. Controversies arise with drought, low fishery product, and deteriorated sea environment .

5. Cooperation of governments and residents

Region	Subject
Fukuoka metropolitan	Drought, flood, **aesthetic water cycle**[*)], **+ global warming problem as urbanized regions**
Saga-Chikugo Plains	Land subsidence, drought, flood, sewerage system, population decrease in rural areas, forest management, **+ global warming as water source areas**
Ariake Sea	Recovery of fishery products industry, drought, land subsidence, sewerage system, **+ global warming as fishery**

How? Are there any rational strategies?

A view point for an integrated water management is indispensable in order to tackle negative effect of **urbanization** and **global warming**.

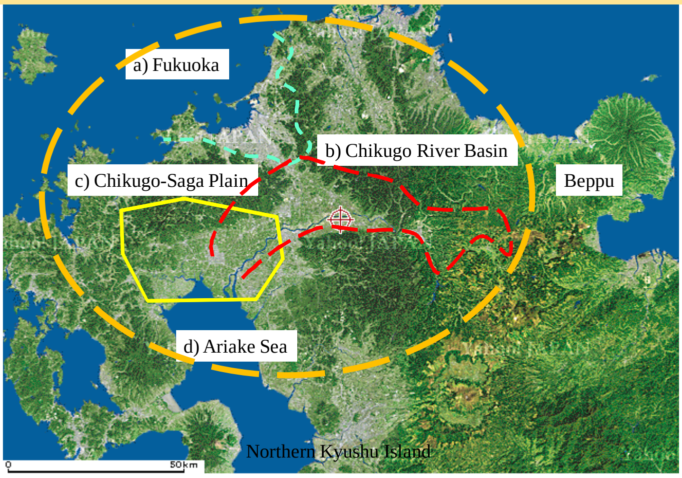
*) Theoretically, an aesthetic water cycle needs to be considered over the water-dependent region, estimating water balance and quality behaviors.

Are there any good examples in this region which can be good lessons?

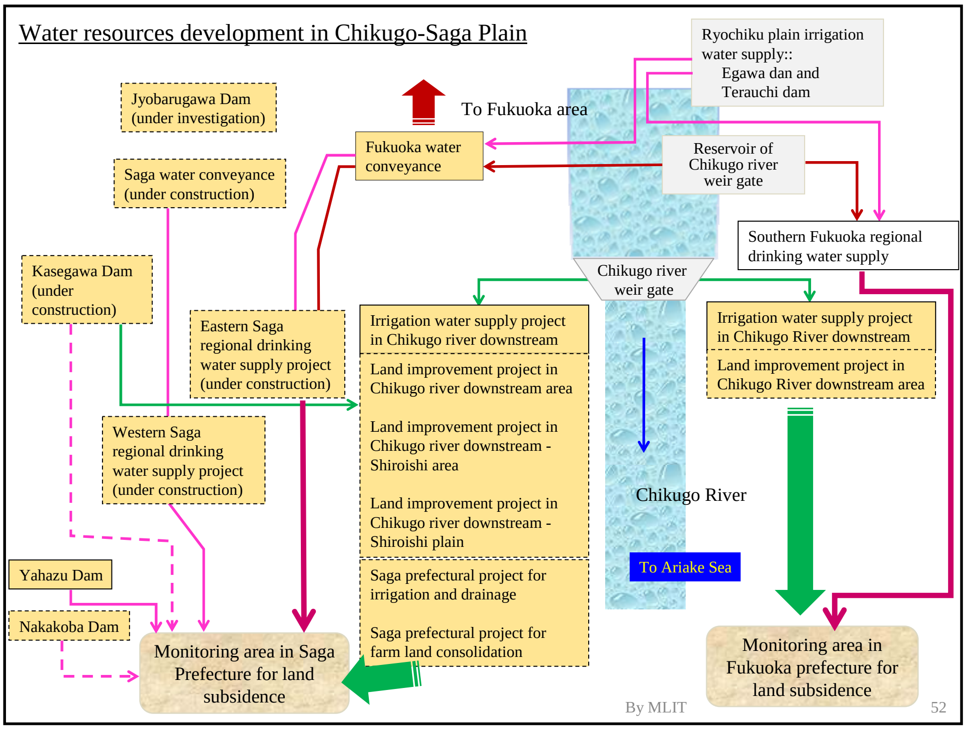
→ Not yet sufficiently, but an integrated view point is likely to be created in this regions, because they can neither be independent on water nor human activities.

Inter-basin subjects, especially when drought happens

- Case of Fukuoka metropolitan area and Chikugo River Basin-



Water resources development in Chikugo-Saga Plain

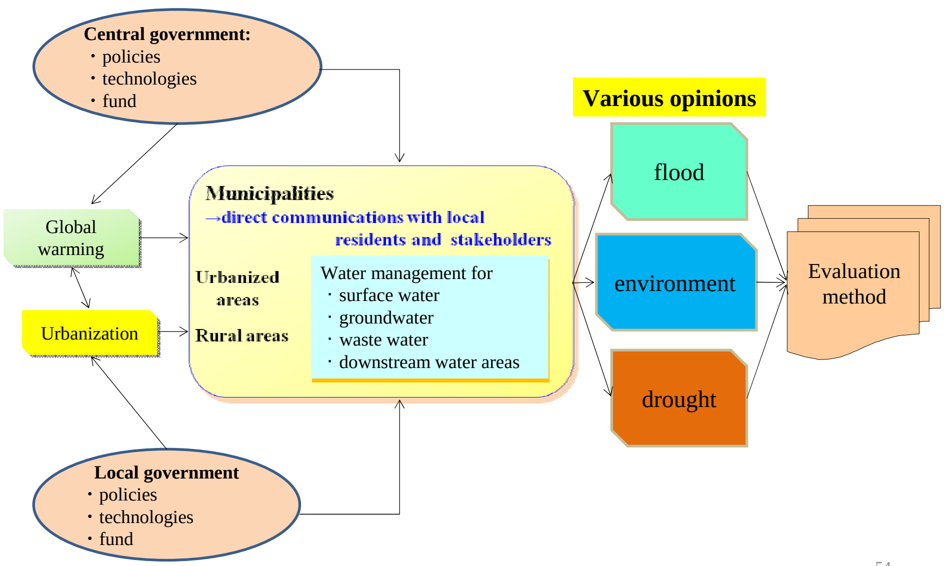


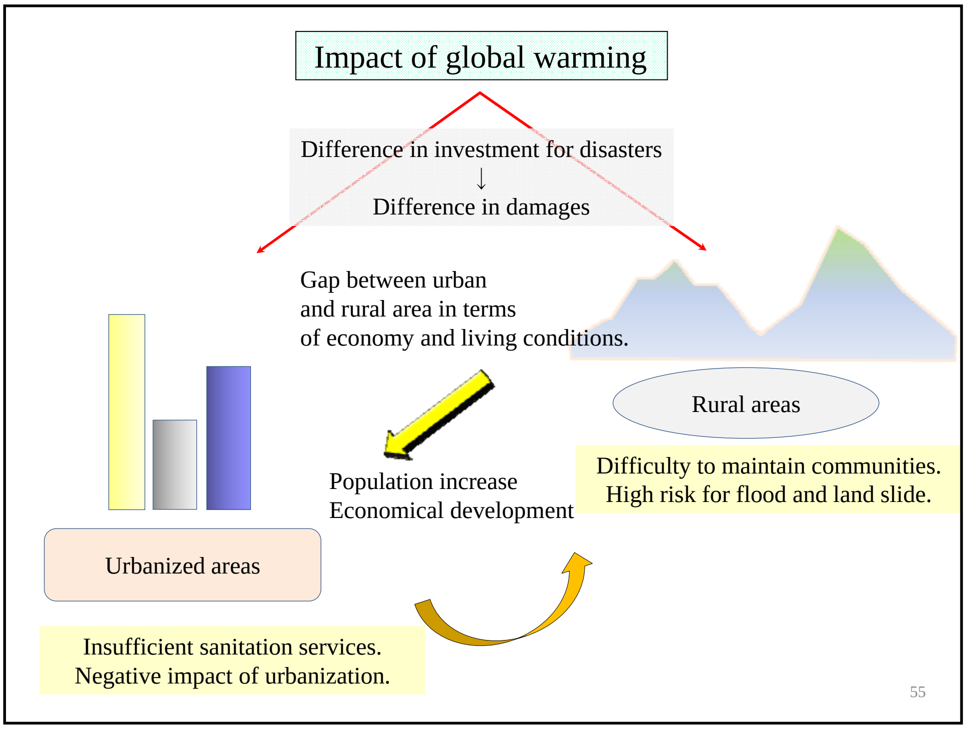
Recovered spring; “*Nui-no-ike*” in Shiroishi Town, Saga.
When it was dried up.

Western Saga regional drinking water supply project replaced groundwater by surface water.

http://shinwa-techno.co.jp/wakimizu/pdf/wakimizu1.pdf

Various view points





Remarks ;

5-1. The present areas needs to cooperate in the field of water, because the areas can not be free from the water subjects.

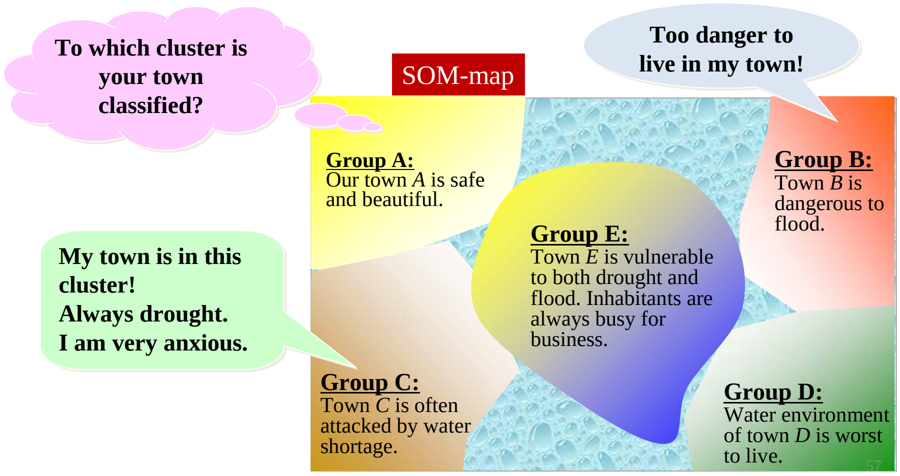
5-2. Movement of people and economical activity can not be stopped; They should cooperate so that both can get benefits from each.

6. Evaluation

To have a competitive spirit

→A driving force to improve situations

Regional campaign : Moderate scale which lead the residents to have a competitive spirit with other regions.



Competitive spirit amongst municipalities

- Do our residents have high awareness for water environment?
- Residents are often motivated by external stimulation!

16 questionnaires;

1. **Does your municipality plan any water related projects?**
2. **Occurrences of inundation, debris flow**
3. **Water use(sufficient or drought?)**
4. **Water environment**

\+

Basic statistics of municipality

1. **Population density**
2. **Forest area size per capita**
3. **Farm land area size per capita**
4. **Rate of water supply propagation**
5. **Rate of sewerage system propagation**
6. **Elevation of municipality**
7. **Available water resources**
8. **Annual precipitation**

These questionnaires were distributed to approximately 300 municipalities in Kyushu Island.

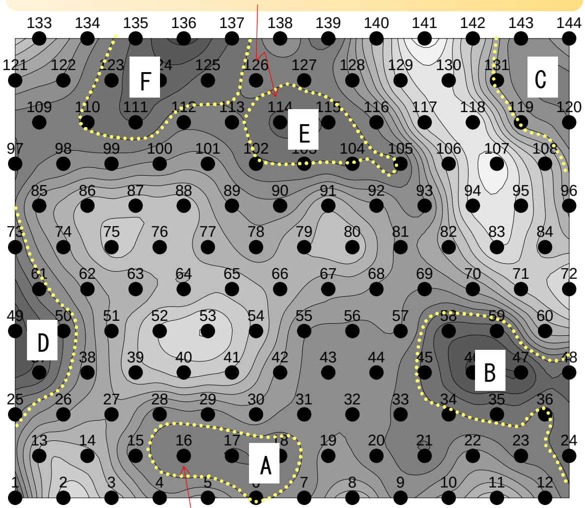
Self Organizing Map-method was applied in order to classify into several clusters of their aesthetic water environment.

Questionnaires

1. Water related subjects of your municipality
   - ① Rapid urbanization: 1. Continuing at present 2. Before but not now 3. No urbanization
   - ② Reduction of forest and farmland: 1. Rapidly decreasing at present 2. Before but not now 3. No
   - ③ Water related problems: 1. Continuing still now 2. Before but not now 3. No
   - ④ Measures for water problems: 1. We take actions at present 2. Before but not now 3. Nothing particular
   - ⑤ Important subject for water issues (multiples replies)
     1. Stable drinking supply 2. Flood control 3. Improve of drinking water quality 4. Creation of water amenity front 5. Conservation of eco-system 6. Others
   - ⑥Activities for aesthetic water cycles: 1. We take action at present 2. Not yet started although it is important 3. Concept of aesthetic water cycle is not clear
   - ⑦ Group or organization for water problems: 1. There are many 2. Some groups and organizations 3. Nothing 4. We do not get any information
   - ⑧ Symposium for water: 1. Frequently held 2. Sometimes 3. Not held
2. Flood, debris flows
   - ① Frequency of river flooding
     1. Every year 2. Once in five years 3 . Once in 10 years 4. Once in 30 years 5. No flood for the last 30 years
   - ② Frequency of inundation
     1. Every year 2. Once in five years 3. Once in 10 years 4. Once in 30 years 5. No inundation for the last 30 years
   - ③ Frequency of debris flow
     1. Every year 2. Once in five years 3. Once in 10 years 4. Once in 30 years 5. No inundation for the last 30 years
3. Water use
   - ①Frequency of water cut
     1. Every year 2. Once in five years 3. Once in 10 years 4. Once in 30 years 5. No inundation for the last 30 years
   - ② Ratio of water use in your municipality
     1. Domestic water>Industrial water>Agricultural water 2. Domestic water>Agricultural water>Industrial water
     3. Industrial water>Domestic water>Agricultural water 4. Industrial water>Agricultural water>Domestic water
     5. Agricultural water>Domestic water>Industrial water 6. Agricultural water>Industrial water>Domestic water
   - ③ Ration of self supply capability: 1. More than 80% 2. 60%-80% 3. 40%-60% 4. 20%-40% 5. Less than 20%
   - ④ Ratio of self water supply between surface water and groundwater
     1. River water more 80% 2. River water 60%-80% 3. River water 40%-60 4.River water 20%-40% 5. River water less than 20%
4. Environmental problems of river water in your municipality
   - ① River discharge
     1. Always plenty except for the drought year 2. Sometimes insufficient discharge
     3. Always less during irrigation period of rice 4. Only sufficient except for the flood period
   - ② River and lake water quality 1. Always good 2. Favorable 3. Normal 4. Unfavorable 5. Wrong
   - ③ Accident of water pollution 1. Frequently happens 2. Sometime 3. Never happened
   - ④ Animals and plants in river, waterways, and lake 1. Many species 2. Normal numbers 3. Seldom observed
   - ⑤ Land subsidence 1. Observed still now 2. In the past 3. Never happened
   - ⑥ Salt water intrusion 1. Observed still now 2. Observed in the past 3. No evidences
5. Water amenity conservation, cultures related to the local water
   - ① Quality of the water amenity front 1. Good 2. So far, good 3. Normal 4. Unfavorable 5. Wrong
   - ② Are there good water amenity fronts? 1. Many 2. So far, we have 3. Normal 4. A bit less 5. No places
   - ③ Cultures related to water 1. Well known water cultures in Japan 2. Locally known cultures 3. Nothing

Result of questionnaires plotted on SOM-map;

My town belongs to this group. Very unhappy, because we are in the same group to which very well known dark town belongs.



My town belongs to this group. Very happy, because we are in the same group to which a famous beautiful town belongs.

Characteristics of group	
A	Flood control, water resources, and environment are favorably maintained in good condition
B	Sufficient water resources but poor for flood control and water amenity
C	Flood control is good, but water resources and environment are very worse. Specifically, ratio of self water supply is extremely low.
D	Almost in good condition for flood control, water resources, and environment. Prevention of land slide needs to be enhanced.
E	Self water supply is very poor and no cooperative water supplying system amongst local municipalities is established. Because of this, water shortage often happens. Both flood control and water amenity are insufficient.
F	Flood control, water resources, and environment are in good condition. However, activity to conserve water culture is low.

Remarks ;

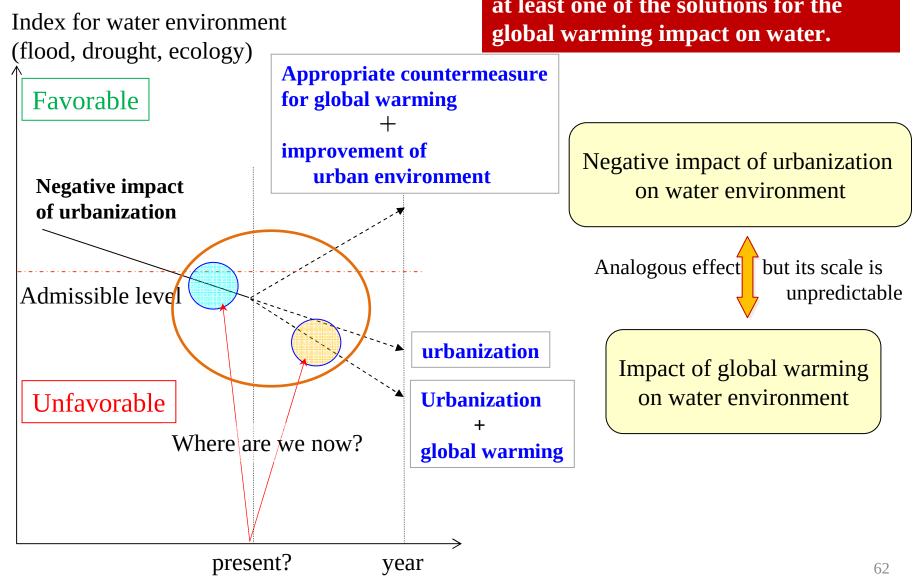
6-1. A competitive spirit could be a driving force which leads the people to be more concerned.

6-2. The people's participation will bring a good result for both the people and governments.

7. Conclusion

Reduce the impacts of global warming and urbanization by integrating surface water and subsurface water systems at a basin scale.

Restoration of urban environment is at least one of the solutions for the global warming impact on water.



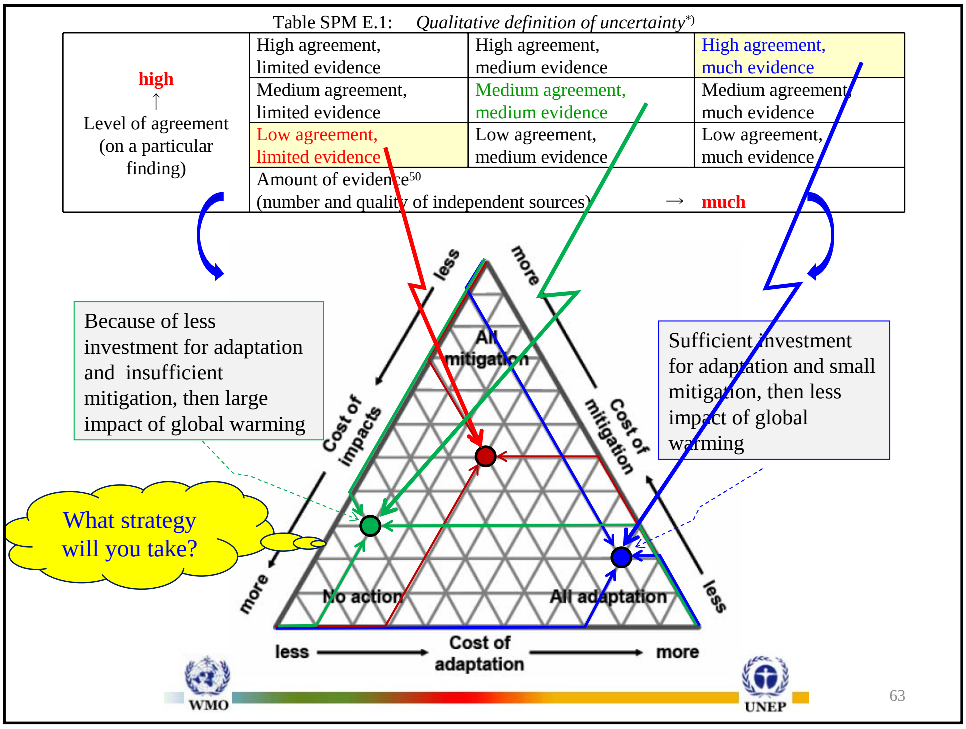
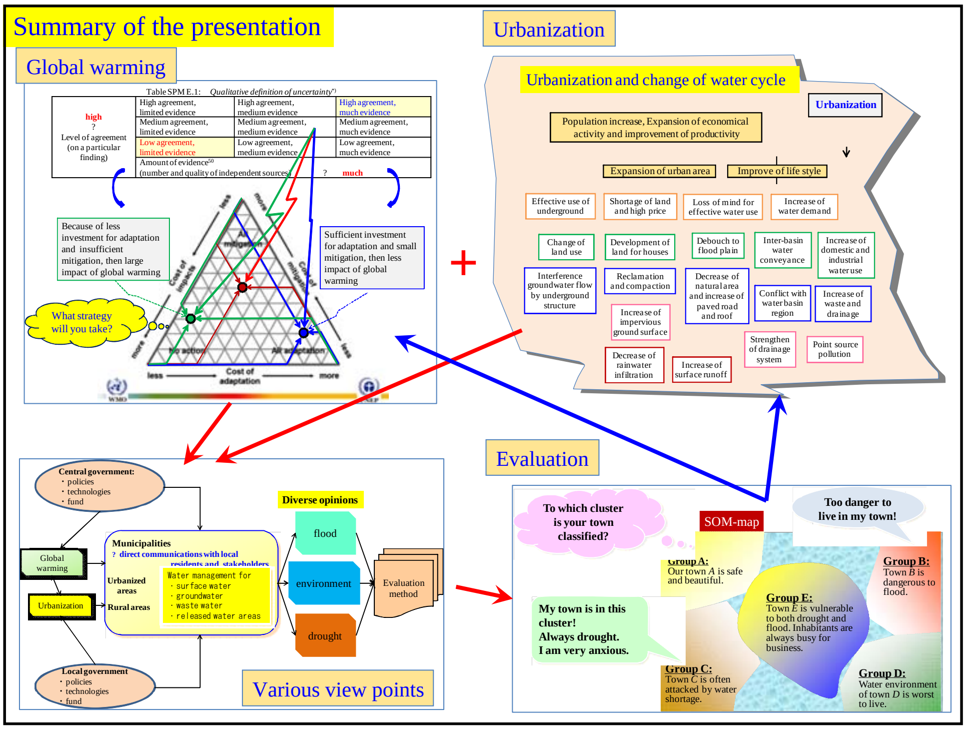


Table SPM E.1: Qualitative definition of uncertainty*)
high
↑
Level of agreement
(on a particular finding)
High agreement, limited evidence
High agreement, medium evidence
High agreement, much evidence
Medium agreement, limited evidence
Medium agreement, medium evidence
Medium agreement, much evidence
Low agreement, limited evidence
Low agreement, medium evidence
Low agreement, much evidence
Amount of evidence50
(number and quality of independent sources) → much
Because of less investment for adaptation and insufficient mitigation, then large impact of global warming
Sufficient investment for adaptation and small mitigation, then less impact of global warming
What strategy will you take?
less
more
All mitigation
Cost of impacts
Cost of mitigation
No action
All adaptation
less
more
less
Cost of adaptation
more
WMO
UNEP
63


Summary of the presentation
Global warming
Urbanization
Urbanization and change of water cycle
Urbanization
Population increase, Expansion of economical activity and improvement of productivity
Expansion of urban area
Improve of life style
Effective use of underground
Shortage of land and high price
Loss of mind for effective water use
Increase of water demand
Change of land use
Development of land for houses
Debouch to flood plain
Inter-basin water conveyance
Increase of domestic and industrial water use
Interference groundwater flow by underground structure
Reclamation and compaction
Decrease of natural area and increase of paved road and roof
Conflict with water basin region
Increase of waste and drainage
Increase of impervious ground surface
Strengthen of drainage system
Point source pollution
Decrease of rainwater infiltration
Increase of surface runoff
+
Evaluation
Central government:
・policies
・technologies
・fund
Global warming
Urbanization
Municipalities
direct communications with local residents and stakeholders
Urbanized areas
Rural areas
Water management for
・surface water
・groundwater
・waste water
・released water areas
Local government
・policies
・technologies
・fund
Diverse opinions
flood
environment
drought
Evaluation method
Various view points
To which cluster is your town classified?
SOM-map
Too danger to live in my town!
Group A: Our town A is safe and beautiful.
Group B: Town B is dangerous to flood.
Group E: Town E is vulnerable to both drought and flood. Inhabitants are always busy for business.
My town is in this cluster! Always drought. I am very anxious.
Group C: Town C is often attacked by water shortage.
Group D: Water environment of town D is worst to live.

The following remarks can be shared by us;

1) We need to pay attention on what is discussed amongst the scientists, specifically the <u>discussions on the impact of the regional scale water environment</u>,

2) At least, <u>negative impact of urbanization on our living condition</u> needs to be improved,

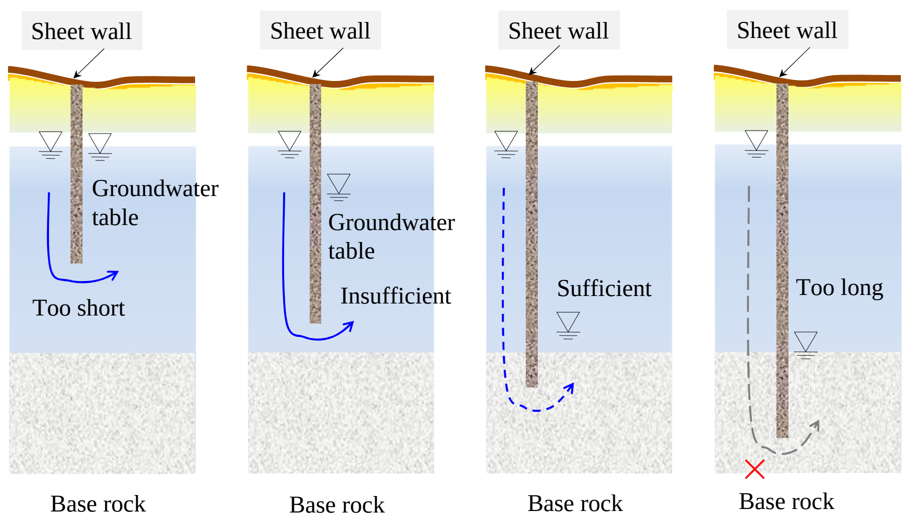
3) <u>Facilities</u> which are owned at present need to be <u>effectively utilized</u> with an integrated manner,

4) <u>Combined water use</u> of surface water, groundwater, rainwater, and recycled water needs to be taken into consideration, and

5) <u>Forums</u> of water environment joined by politicians, engineers, residents, and scientists are necessary <u>at a regional level</u>.

Finally, an appropriate length needs to be designed.

The wall does not need to be constructed using high quality material, but idea of design needs to be optimal for the region.



Thank you for your attention!

Ⅸ-3)　Presentation of Case Study

Ⅸ-3-1)　Japan

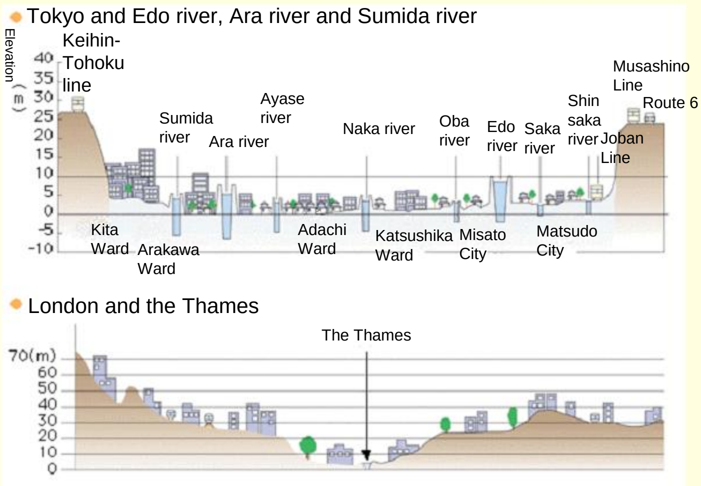
Mr. Shin TSUBOKA
Director General, NILIM

Adaptation to Flood Change Due to Warming in Japan

Shin TSUBOKA
Director General

National Institute for Land and Infrastructure Management

Flood Vulnerability

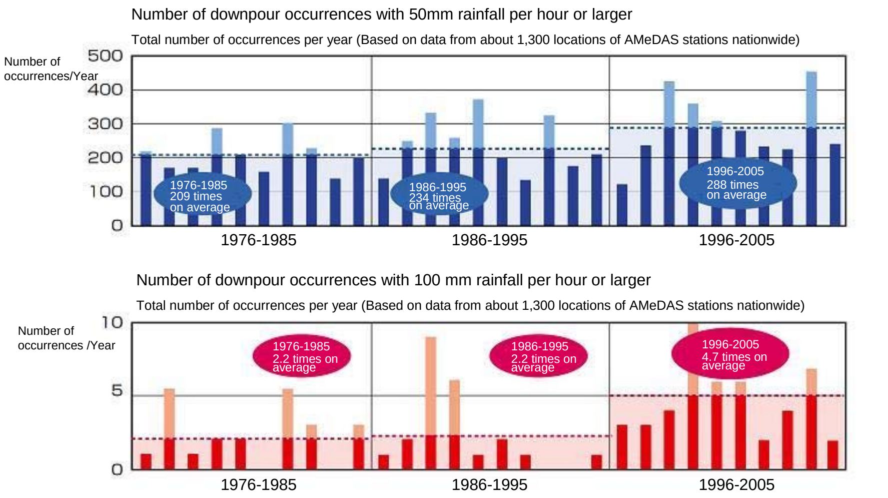


Information provided by MLIT

The relation of grounds and rivers level in Tokyo and London

1

Precipitation change

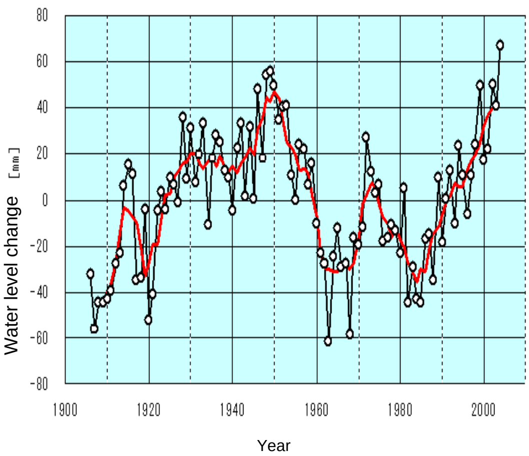


Prepared by MLIT based on data by Japan Meteorological Agency

Recent changes in heavy rain frequency based on AMeDAS data by Japan Meteorological Agency

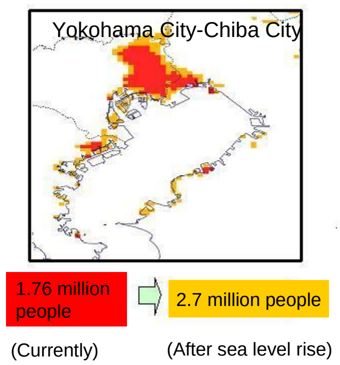
2

Changes in Sea Surface Level and their influences



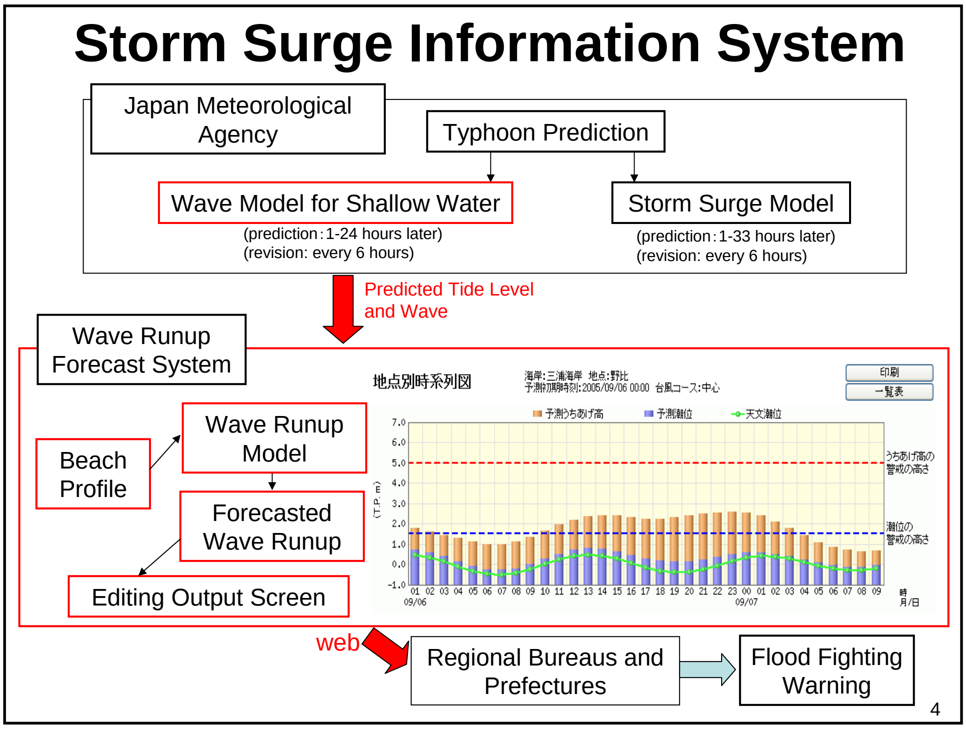
Changes in sea surface in Japan's coastal areas

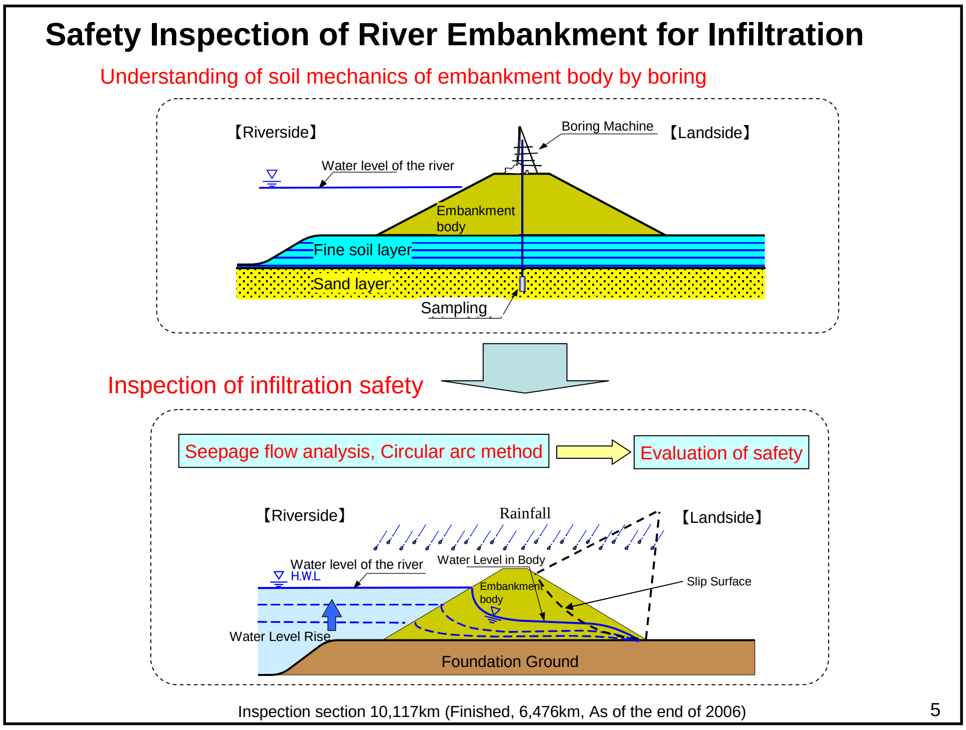
Tokyo Bay



Change in the under sea surface area in Tokyo Bay in the case of rise of 0.59m

3

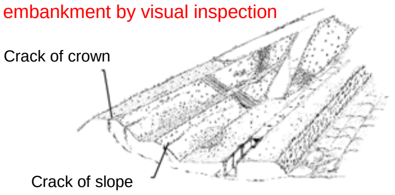

Storm Surge Information System
Japan Meteorological Agency
Typhoon Prediction
Wave Model for Shallow Water
(prediction:1-24 hours later)
(revision: every 6 hours)
Storm Surge Model
(prediction:1-33 hours later)
(revision: every 6 hours)
Predicted Tide Level and Wave
Wave Runup Forecast System
Beach Profile
Wave Runup Model
Forecasted Wave Runup
Editing Output Screen
地点別時系列図
印刷
一覧表
予測うちあげ高
予測潮位
天文潮位
うちあげ高の警戒の高さ
潮位の警戒の高さ
web
Regional Bureaus and Prefectures
Flood Fighting Warning
4


Safety Inspection of River Embankment for Infiltration
Understanding of soil mechanics of embankment body by boring
【Riverside】
Boring Machine
【Landside】
Water level of the river
Embankment body
Fine soil layer
Sand layer
Sampling
Inspection of infiltration safety
Seepage flow analysis, Circular arc method
Evaluation of safety
【Riverside】
Rainfall
【Landside】
Water level of the river
H.W.L
Water Level in Body
Embankment body
Slip Surface
Water Level Rise
Foundation Ground
Inspection section 10,117km (Finished, 6,476km, As of the end of 2006)
5

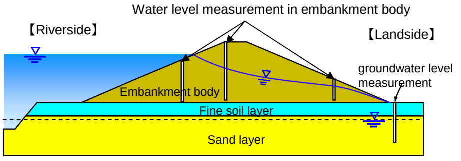
Monitoring and Reliability Evaluation of River Embankment

Monitoring of river embankment

Understanding of deformation of embankment by visual inspection



Observation by measuring equipment



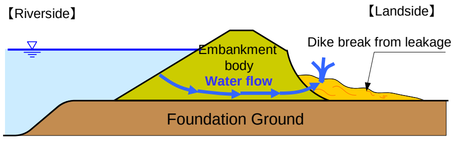
Result of monitoring

Reliability evaluation of river embankment

Accuracy improvement of the safety evaluation method such as Seepage flow analysis / Circular arc method

Dike break mechanism by the piping

Build the analysis model that can reproduce cavitation / flowage of the sandy embankment body by the piping



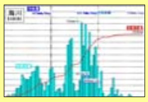
Establishment of reliability evaluation technique based on the dike break mechanism

6

Support system for drawing up flood hazard map

Input Data

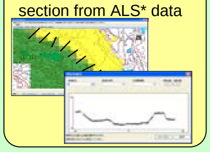
Rainfall data
・text data
・observational data



Topographical data
・Digital Map (elevation)

Sub-basin boundary
・GIS data（shp-file）

River cross section
・Coordinate of river cross section from ALS* data

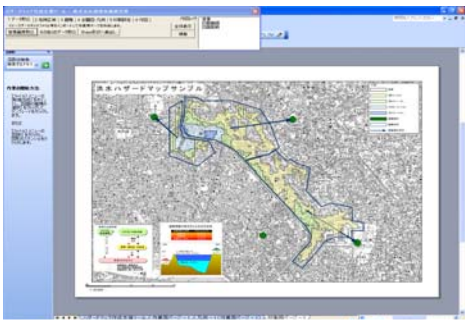


・In this system, it is able to import various data, and to make or correct subset of input data using the interface of this system.

Support system for drawing up flood hazard map

Runoff analysis | Inundation analysis

Water level analysis | Drawing-up hazard map



* ALS data: Airborne Laser Scanning data

7

Conclusion

1) Japan has many cities over alluvial plains and vulnerable structure to flooding.

2) Because of climate change, the difference of the heavy rainfall area and the light rainfall area spreads greatly.

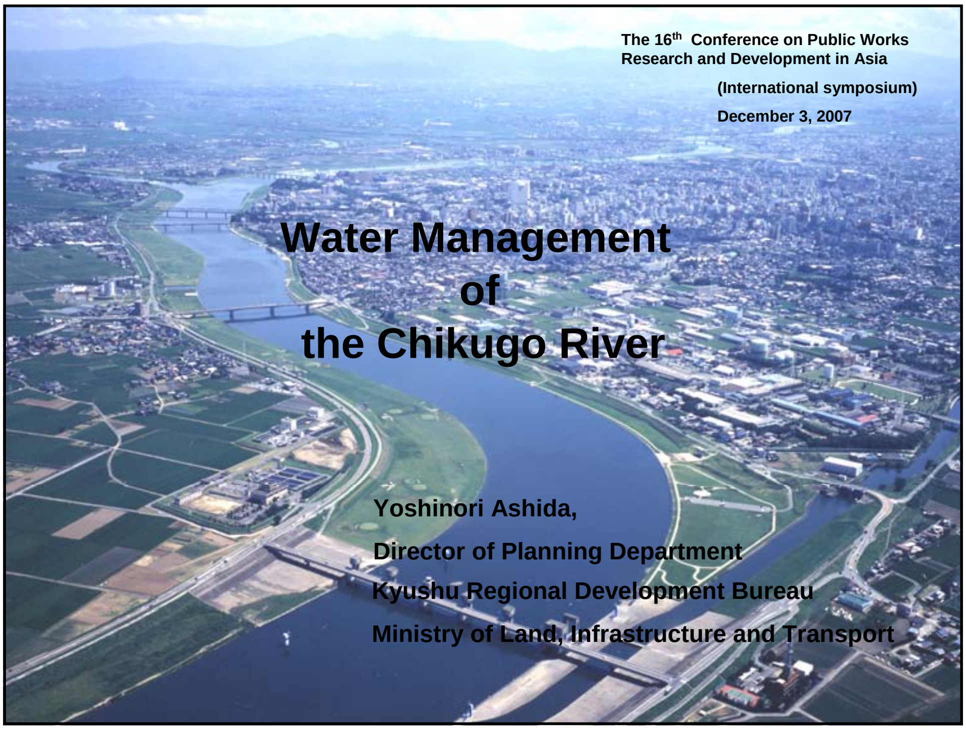
3) As adaptation measures, the followings are necessary.
  - To improve disaster prevention facilities based on vulnerability assessment of the facilities against external forces.
  - To improve residents' power for disaster mitigation by providing and sharing disaster information such as hazard maps.

4) National Institute for Land and Infrastructure Management has the preparation which confronts the threatening of the climate change in promoting the researches for various technical tasks and proceeding with the technology sharing to build a cooperation system with each participating nation.

8

Ⅸ-3-2)　Kyusyu District

Mr. Yoshinori ASHIDA
Director,
Planning Dept.,
Kyusyu Development Regional
Bureau,　MLIT



Brief overview of Kyushu

●Kyushu can be called the window to Asia as it is relatively close to the Korean Peninsula, Shanghai etc.

●Geographically, it is surrounded by sea and has many remote islands and peninsulas. It is also divided east and west by the Kyushu Mountains, which form a large volcanic zone of Aso and Kirishima.

●The natural environment in Kyushu is rich, varied and beautiful. But the region frequently suffers from frequent typhoons and natural disasters such as concentrated heavy rain, earthquakes and volcanic disasters.

●In recent years, as a background of well-developed traffic networks, rich nature and a warm climate, it has been designed to develop the region, and IC, automobile and some other industries have been shifting production to Kyushu. Especially, the North Kyushu centered around the Fukuoka Metropolitan Area has become the central hub of the economy in Kyushu.


Fukuoka Metropolitan Area with a population over 2.4 million.

Recently, Kyushu has frequently experienced abnormal weather.

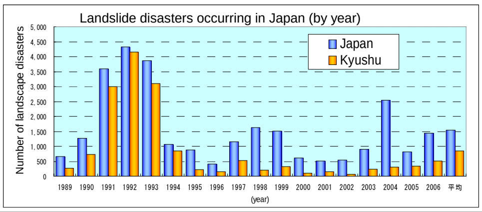
The mean annual rainfall in Japan is approx. 1800mm, twice as much as the world average. In Kyushu, the mean annual rainfall is over 2000mm, even higher than the national average. However, the rivers in the region are fairly small and the water volume is not stable because of concentrated heavy rain in the rainy season and the typhoon season. Moreover, the complex and precipitous topography and the conditions of the rivers make the region most prone to flooding and landslide disasters in Japan. Especially in recent years, large-scale disasters have occurred due to localized torrential rains.

■8 large-scale disasters have occurred in the last 10 years! (1997-2006)

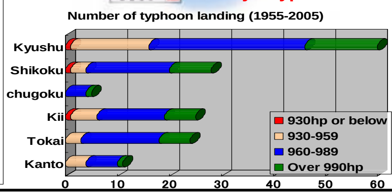
1. Mudflow in Harihara, Izumi city, July 1997
2. Typhoon No. 19 (Kita River, Gokase River System), July 1997
3. Fukuoka flooding (Mikasa River), June 1999
4. Typhoon No. 18 (high tide), September 1999
5. Fukuoka flooding (Mikasa River & Onga River), July 2003
6. Mudflow in Minamata, July 2003
7. Typhoon No. 14 (Gokase River & Ooyodo River), September 2005
8. Sendai River flooding, July 2006

Locations of large-scale disasters that have occurred in the last 10 years

■Most of landslide disasters in Japan occur in Kyushu.



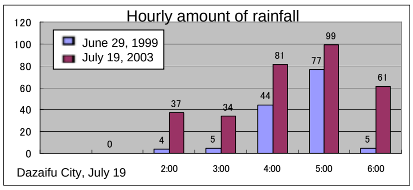
■Kyushu is constantly hit by a typhoon!



Kyushu has been frequently hit by a disaster.

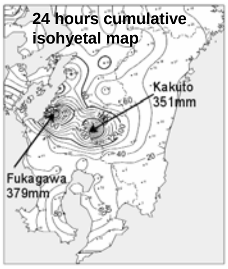
July 2003, Fukuoka flooding (Mikasa River)

In 1999, floods spread to the Hakata Station vicinities and underground malls. The city functions were severely damaged and became paralyzed.



5 hours cumulative amount of rainfall 1999: 147mm, 2003: 312mm

July 2003, mudflow in the city of Minamata

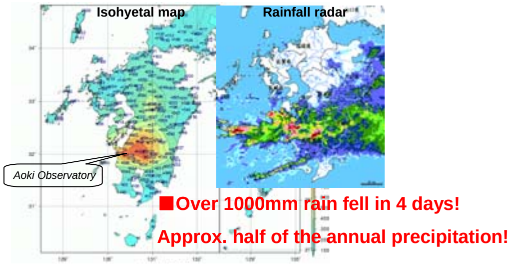


Map of 24 hours cumulative amount of rainfall from 16:00 July 19 to 15:00 July 20, 2003

Approx. 400mm rainfall poured in 24 hours!

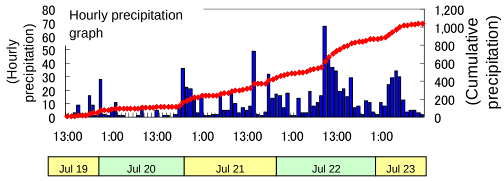
Kyushu has been frequently hit by a disaster.

July 2007, Sendai River flooding (Kagoshima Pref.)



【Aoki Observatory (Sendai River)】

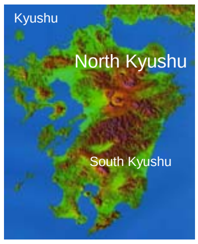
Ookuchi City,Kagaoshima

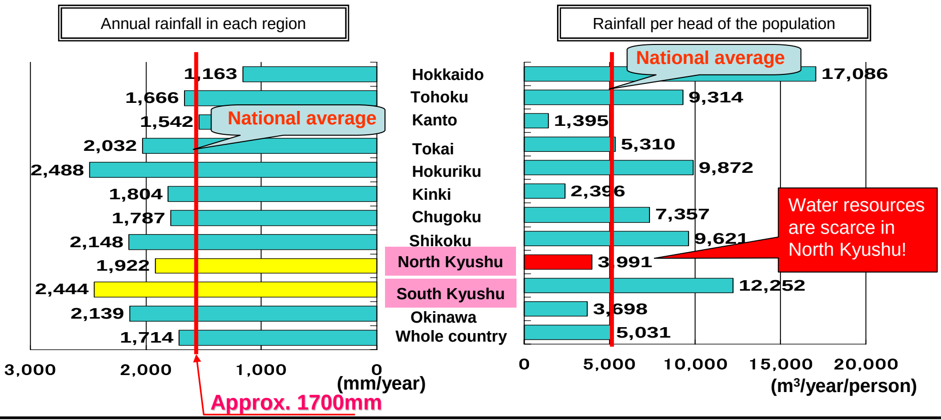


In Kyushu, due to frequent concentrated downpours and expansion of the urban district, the risk of flood disasters is increasing. Therefore, river improvements and other physical improvements are not enough to prevent natural disasters, and, in order to reduce disasters damage, it is necessary to set up non-structured measures such as provision of river information to the residents and establishment of evacuation procedures.

North Kyushu is prone to droughts.

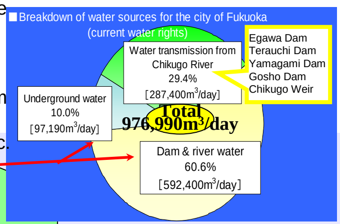
The annual rainfall in the Kyushu Region is over 2000mm. However, the rainfall per head of the population in the North Kyushu falls much below the national average, which makes the area prone to droughts.

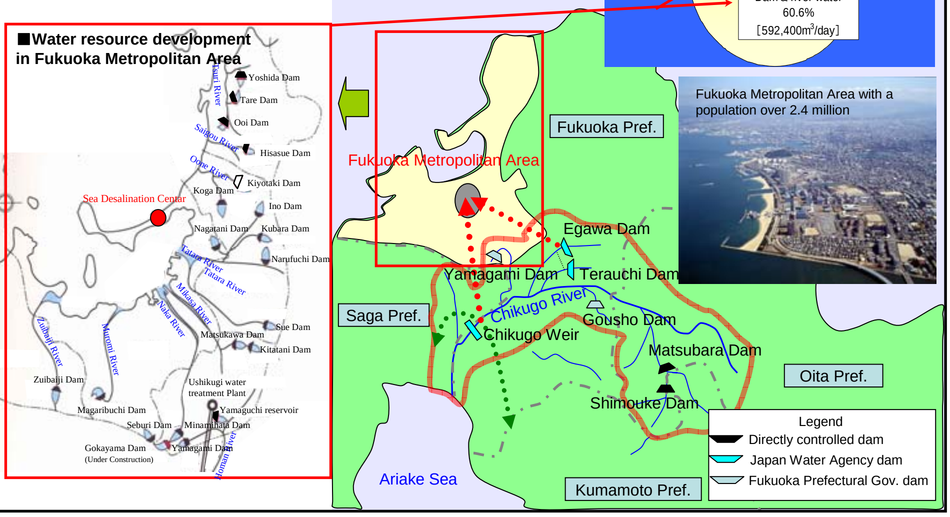




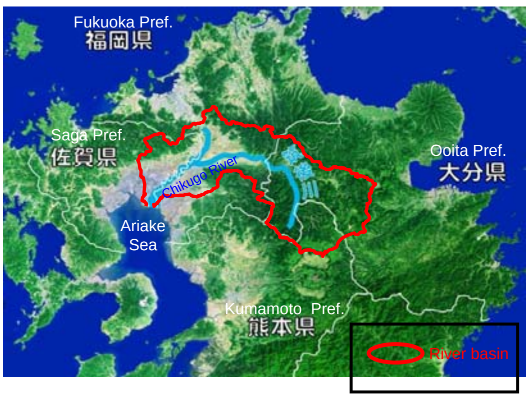
Current status of water use in Fukuoka Metropolitan Area

Regarding the water sources for the Fukuoka Metropolitan Area whose population is approx. 2.4 million, about 60% is secured from its own sources including existing dams, and about 10% is secured from the groundwater. However, the rest has to be obtained from the Chikugo River, which is located outside the area. About 30% is transmitted from the Chikugo River through the Egawa Dam, the Terauchi Dam, the Chikugo Weir, the Gousho Dam, the Fukuoka Water Transmission etc.





Brief overview of Chikugo River basin



The Chikugo River is the biggest first-class river in Kyushu, whose channel is 143km long and basin area is 2,860km².

The basin area extends across 4 prefectures (Kumamoto, Ooita, Fukuoka and Saga), and there is a rich natural environment along the river. The Chikugo River and the surrounding mountains, blending with each other, create a beautiful green landscape, and the downriver basin presents a unique brackish environment. The special beauty of the river landscape also plays a role as a tourism resource.
Moreover, the Chikugo River is an important water source for the economic growth in North Kyushu.


Hot-spring resort in Suikyo Hita

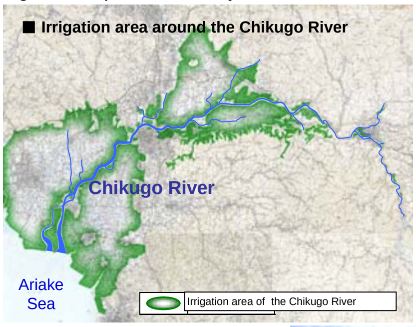

Waterside open space


Rich natural environment

Use of water in the Chikugo River (irrigation and city water)

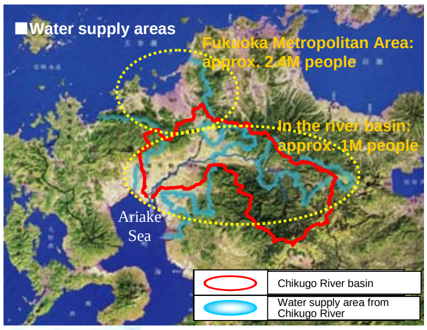
【Irrigation】

Water in the Chikugo River is used for irrigation about 53,000ha in area, for the largest-scale agricultural production in Kyushu.



【City Water】

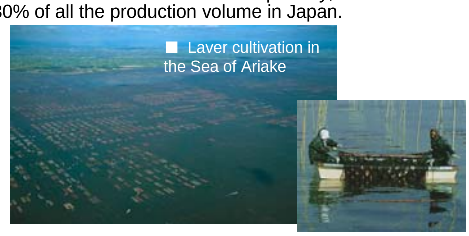
Water in the Chikugo River is currently supplied as daily life water in a large area, for a total of about 3.4million people living in the river basin and the Fukuoka Metropolitan Area.



Use of water in the Chikugo River (fisheries)

The Chikugo River has a rich natural environment and fisheries is a major industry in the area. Ayu (sweetfish) fishing is done in the upper- and mid-stream area and etsu (anchovy) fishing is actively done in the downstream brackish area after the Chikugo Weir. The Sea of Ariake, with the biggest tidal variation in Japan, is famous for various fishery products and laver cultivation. Especially, the laver production in the area accounts for as much as 30% of all the production volume in Japan.

Small fishing boats pulling in a net on the river is a common sight of the Chikugo River from May to July.



In winter ,the Sea of Ariake becomes a vast laver farm with laver supports regularly installed.

Every year many people visit the Chikugo River in June when the ayu season opens.

■Various creatures in the Sea of Ariake

Goggle-eyed goby (overall length: 14cm)
Specialty of the Sea of Ariake. Crawls around the tideland and eats Bacillariophyceaes on the mud surface, shaking its head from side to side. Tasty when broiled or dried.

Tridentiger obscurus (overall length: 10cm)
Called "tobihaze (jumping goby)" because it "jumps" on the water when the tide comes in. Often crawls up to the surface at full tide.

Calling crab (shell: 3.5cm)
Living in a hole dug into a mud flat where the salt content is rather low. One of the two pairs of forceps of male calling crabs is much larger than the other. "Ganizuke", a specialty of Saga, is made of fermented calling crabs.

Odontamblyopus lacepedii (overall length: 30cm)
Specialty of the Sea of Ariake. With rudimentary eyes, living in a hole dug into a tideland. Tasty when used for miso soup or dried.

Red tongue sole (overall length: 30cm)
Also called "kutsuzoko (shoe sole)" as it looks like a shoe sole. Tasty for meuniere or when deep fried.

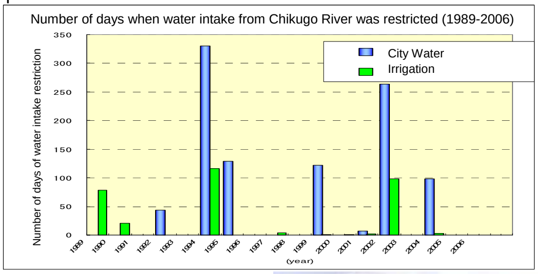
Razor-shell (overall length: 9cm)
Living in a hole vertically dug into a tideland. Can be picked with a curved end of wire. Tasty when sauteed with butter or for soup.

Barnea (Umitakea) dilatata (overall length: 8cm)
Living in soft mud. Can be caught from a boat by entangling its aqueduct with a cross-shaped end of a long stick. Dried or pickled in sake lees.

Green lingual (overall length: 4cm)
Called "mekaja" in the region. Living in sandy mud at the bottom of sea. Also called a living fossil. Used for miso soup and other cooked dishes.

Chronic water shortage (drought status)

There is chronic water shortage around the Chikugo River as the flow condition becomes worse due to the recent dry weathers. Water intake from the river for city water and irrigation is restricted roughly every two years. Especially in summer, water shortage frequently occurs because of river flow depletion. The flow condition needs to be improved.




Depletion of the Terauchi dam reservoir (1994)

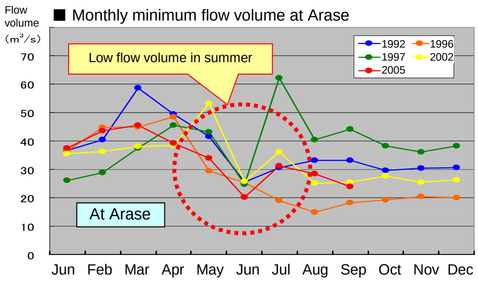
【The Mainichi Newspapers June 28, 2005】


June 28, 2005(at the Ooishi Weir)

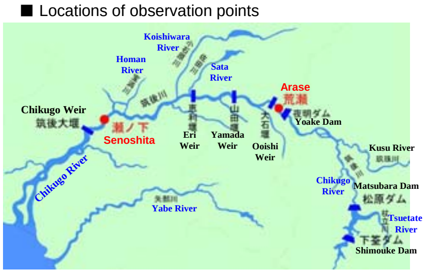
River water volume becomes low in summer.

● Recently, there has often been little rain in the irrigation season when river water for agriculture is taken. In such years, the flow volume became extremely low.

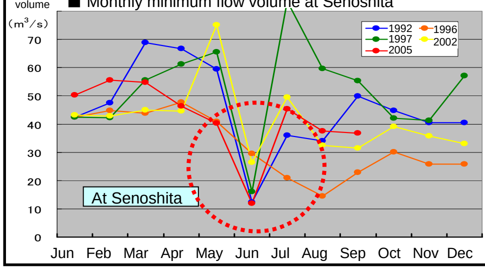
■ Monthly minimum flow volume at Arase



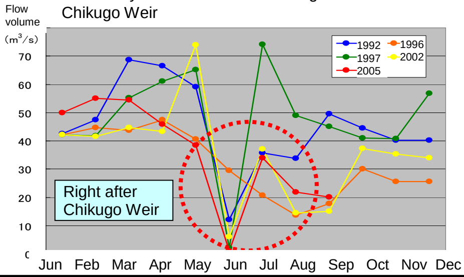
■ Locations of observation points



■ Monthly minimum flow volume at Senoshita



■ Monthly minimum flow volume right after the Chikugo Weir

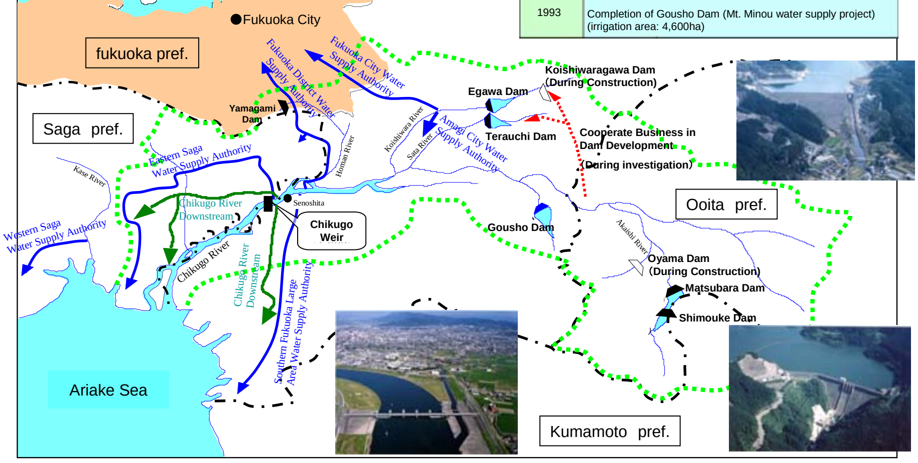


To ensure stable water supply

In order to resolve chronic water shortage problem and ensure stable water supply, we are taking systematic actions to improve water use facilities including the Egawa Dam and the Terauchi Dam so that water supply for irrigation, city water, power generation etc. will be more stable.

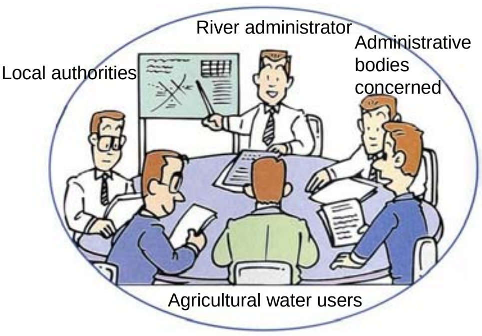
■Recent major actions for water utilization

Year	Plan and Projects
1996	Establishment of the1st water resource development base plan
1975	Completion of Egawa Dam (Ryochiku Plain water supply project)
1978	Completion of Terauchi Dam
1985	Completion of Chikugo Weir (irrigation area: 34,800ha)
1986	Completion of redevelopment of Matsubara Dam and Shimouke Dam
1993	Completion of Gousho Dam (Mt. Minou water supply project) (irrigation area: 4,600ha)



Water management in the future

We will give priority to healthy water circulation and take actions to improve the environment along the Chikugo River. We will also conduct proper water management by paying attention not to affect vested water rights in the downstream side or fisheries and by maintaining the appropriate river flow through use of the existing dams, etc. Thus we will make efforts to contribute to the conservation of the environment in the Sea of Ariake.



Discussion of actions against water shortage

【Water management in the future】

- Improve water facilities in a planned way and effectively utilize the existing dams.
- Effectively utilize water resources by keeping track of such data as river flow and intake volume and by proper dam management.
- Coordinate water use in cooperation with bodies concerned and create opportunities for discussion among water users and other partied concerned including fishermen and farmers.
- Coordinate water intake restrictions at the time of a drought, conduct overall management of water resources development facilities and make other arrangements.

Ⅸ-3-3) India

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MURUGESAN
Assiatant Adviser of Public Health and Environmental Engineering,
Central Public Health and Environmental Engineering Organization,
Ministry of Urban Development

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE IN INDIA

Presented by

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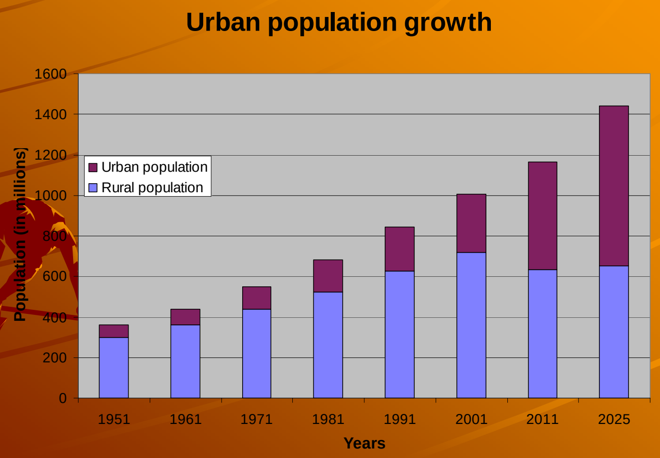
Central Public Health & Environmental Engineering Organization (CPHEEO),
Ministry of Urban Development
Government of India
New Delhi

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE IN INDIA

Population and Urbanization in India

- The total population of India was 1027 million as per 2001 census
- The urban population was about 285 million (27.8%), living in 5161 towns
- Population growth rate is about 3.1% per year
- The total land area is 3.29 Million sq. km
- India Accounts for about 4.5% of the World's fresh water resources and 16% of the World's Population.

Massive growth in urban population as India enters its "urban transition"



Literacy rate	-	64.84%
Life expectancy	-	64.35
Average per capita income	-	US $ 3,300

Climate

India experiences 3 main seasons

- Winter – December to March
- Summer – April to May
- Monsoon – June to November

Rainfall

- Most of the rainfall is from June to September
- Levels of precipitation vary from 100 mm a year to 9,000 mm a year (north-eastern state of Meghalaya).
- The average rainfall over the plain areas is about 1000 mm

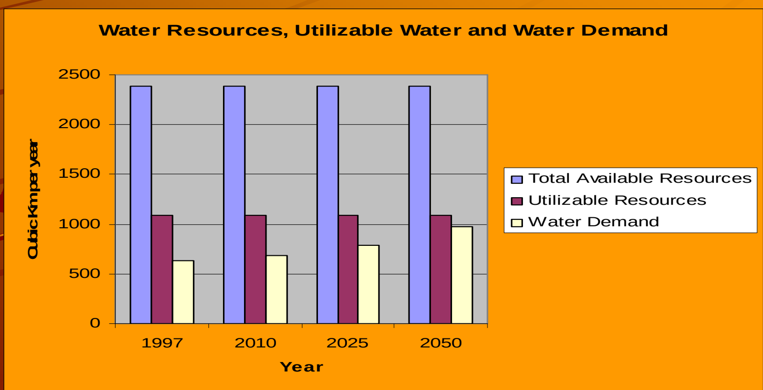
Water Availability and Demand in India

- India receive an average annual rainfall equivalent of about 4,000 billion cubic metres (BCM).
- With 3,000 BCM of rainfall concentrated over the four monsoon months, India's rivers carry 90 percent of water during the period from June-November.
- Thus, only 10 per cent of the river flow is available during the other eight months.

- The total water requirement of the country:
  - 694 BCM in the year 2010,
  - 973 BCM in the year 2050.
- Wide regional disparities in water availability exist.

India has enough utilizable water resources to meet this demand, but much of this is not effectively available

While total utilizable water covers growing demand, additional storage capacity is required to turn this into an effectively available source



Provision of Water Supply & Sanitation Facilities

- Urban Areas
  Water supply coverage -93%
  Sanitation Coverage - 63%
- Rural – 72% population take their drinking water from protected areas.
- The water supply is by and large intermittent (supply hours ranging from 3 hours to 10 hours)

National Water Policy, 2002

- The policy accords top priority to drinking water supply, followed by irrigation, hydropower, navigation and industrial and other uses.
- The policy also addresses issues such as planning of water resource development projects, maximizing water availability, water pricing, water quality, water zoning for proper management of resources and other issues.

IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

- The most significant impact of climate change is expected in respect of availability of water. There are several regions that are already afflicted by water stress.
- Situation could worsen substantially due to changes in precipitation patterns, increasing salinity of ground-water due to increase in sea level and melting of glaciers.
- The IPCC estimates that in South Asia alone perhaps 500 million people would be affected by reduced river flows in the northern part of the subcontinent and about 250 million to China.

IMPACT IN INDIA

Availability of water in the river is expected to decrease

A rise in water level could inundate and erode coastal areas, increase flooding and salt water intrusion

Increase in temperature and seasonal variation in precipitation result rapid recession of Himalayan Glaciars

The Gangotri Glacier is already retreating at a rate of 30m per year

Flood Management

- Floods are the result of the peculiar rainfall pattern.
- The Ganga - Brahmaputra basin, which carries 60 percent of the total river flow in India, is most susceptible to floods.
- Every year, an average of 19 million hectares of land becomes flooded.

Flood Management

- The yearly average loss of life is reported to be 2590
- In order to mitigate the damage from flood, Structural schemes viz., reservoir construction, canal improvement, embankment construction etc are undertaken
- 173 flood forecasting & warning stations have been established in the different parts of the country.

INDIA'S INITIATIVES ON CLIMATE CHANGE

India has undertaken response measures that are contributing to the objective of the united nations frame work convention on climate change

India signed the UNFCCC on 10 June 1992 and ratified it on 1 November 1993.

INDIA'S INITIATIVES

Under the UNFCCC, India do not have binding GHG mitigation commitments in recognition of their small contribution to the greenhouse problem as well as low financial and technical capacities.

The Ministry of Environment and Forests is the nodal agency for climate change issues in India.

It has constituted working groups on the UNFCC and kyoto protocol.

CONCLUSION

- There is going to be a very serious pressure on resources and problem of environmental degradation as the consequent large-scale transformation of the hydrological cycle.
- Reliable, timely and adequate water supply has to be provided for drinking and modernizing the agricultural activities.
- Rapid advances in all spheres have to take place, management of water being a prominent one.
- In India the planning process is guided by the principles of sustainable management

THANKS

Ⅸ-3- 4) Republic of Korea

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Water Resources Management As a Response to Climate Change

Korea Institute of Construction Technology
Director of Policy Research
Seok-yeong Yoon

16th conference on PWRD

Contents

1. 1 Causes of Climate Change

❖ **Natural cause**: Changes in solar energy, changes in earth's orbit of revolution, volcanic activities, topographic activities and natural volatility of the climate system

❖ **Artificial cause**: Greenhouse gas, aerosol, weakened ozone, destruction of forests and changes in environment

1. 1 Causes of Climate Change

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Water Resources Management As a Response to Climate Change

1. 1 Causes of Climate Change

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❖ **Boiled frog syndrome**

- **Change does not occur overnight. It is rather gradual.**
- **The future of humanity can change according to the depth of understanding climate change and how fast the change is responded.**

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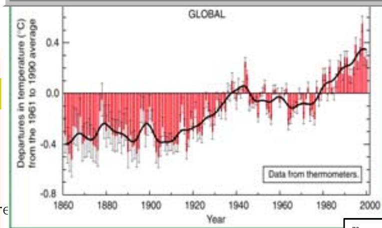
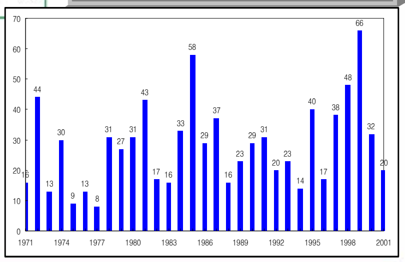
1. 2 Abnormal Climate Caused by Climate Changes

Temperature rise throughout the earth



Number of rainfalls over 100mm



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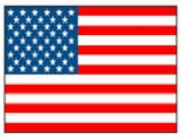
1.2 Climate Change – A Global Issue

War on CO_2

Lower carbon dioxide emission rates through development of new technologies



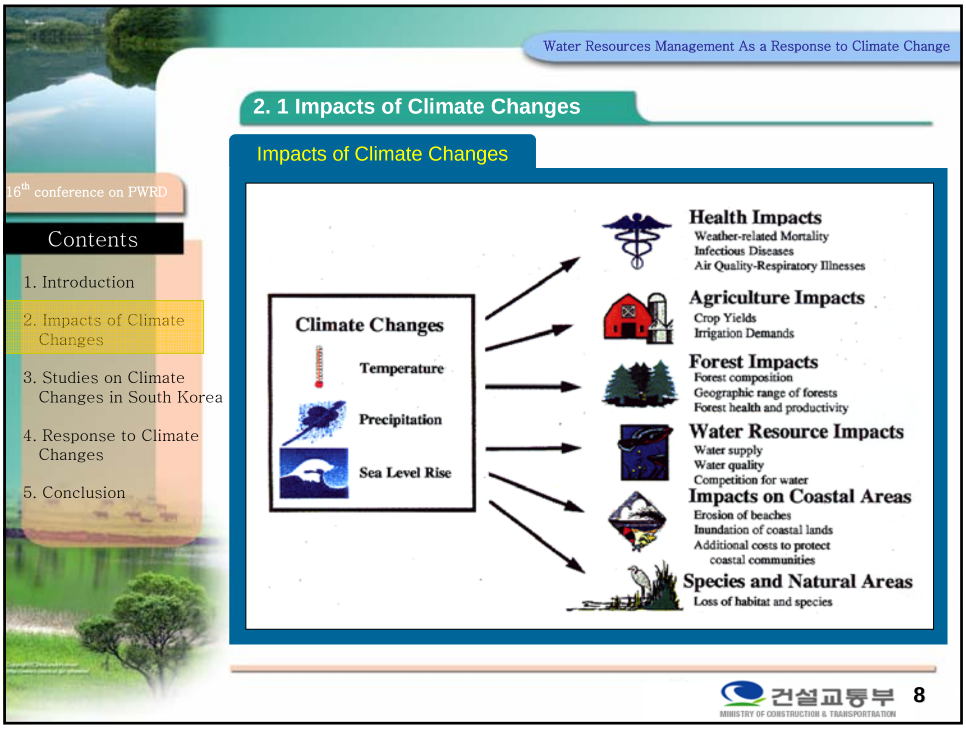
VS

Cut carbon dioxide 20% by 2020

1.2 Climate Change – A Global Issue

1.3 Climate Change in South Korea

- Global climate change is happening as proven by the indicators such as global warming and el nino.
- Climate change is not a controversial issue in South Korea anymore.
- Countries that are part of Kyoto Protocol must reduce greenhouse gas by 5.2% from that of 1990 in 4 years between 2008 and 2012.
- South Korea was recognized as a developing country in 1992 when UN Framework Convention on Climate Change was established therefore is not required to reduce greenhouse gas. However, South Korea is being strongly pressured for greenhouse gas reduction as it has joined OECD in 1996 and is ranked 9th in global carbon dioxide emission and 10th in global energy consumption.
- Climate change is increasing uncertainties associated with water resources plan for stable water supply and also imposing difficulties for preparing appropriate measure for severe natural disasters such as flood and drought.
- With small land and overpopulation, intensity of land and water resources in South Korea is much greater than other countries. Small changes in climate have potential to present significant water resources problem.
- Effect of climate change should no longer be ignored as it has been until now for the lack of scientific basis. It is an urgent subject that must be dealt with by establishing national water resources plan and water resources practice.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Sea Level Rise
Health Impacts
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Infectious Diseases
Air Quality-Respiratory Illnesses
Agriculture Impacts
Crop Yields
Irrigation Demands
Forest Impacts
Forest composition
Geographic range of forests
Forest health and productivity
Water Resource Impacts
Water supply
Water quality
Competition for water
Impacts on Coastal Areas
Erosion of beaches
Inundation of coastal lands
Additional costs to protect coastal communities
Species and Natural Areas
Loss of habitat and species
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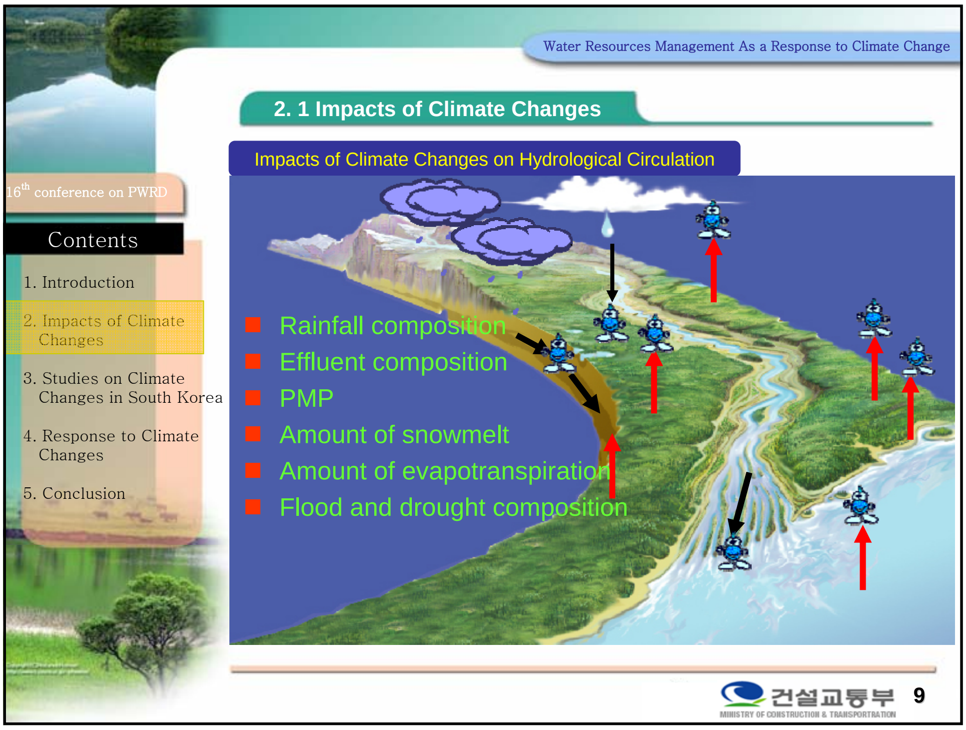
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Effluent composition
PMP
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Amount of evapotranspiration
Flood and drought composition
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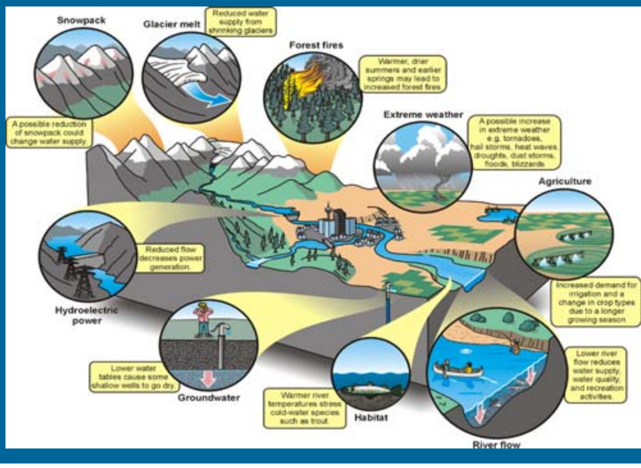

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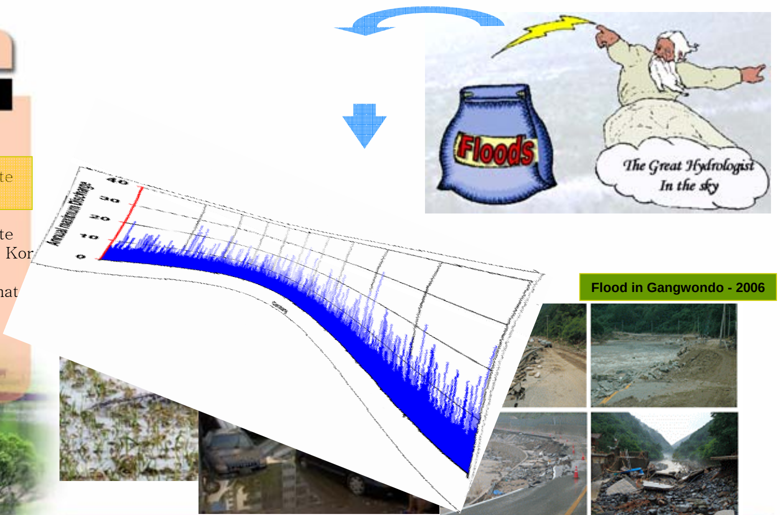

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SPI 가뭄지수 (2001년 5월 – 지속기간 3개월)
NOW THIS IS SOME DROUGHT.
Drought distribution in 2001
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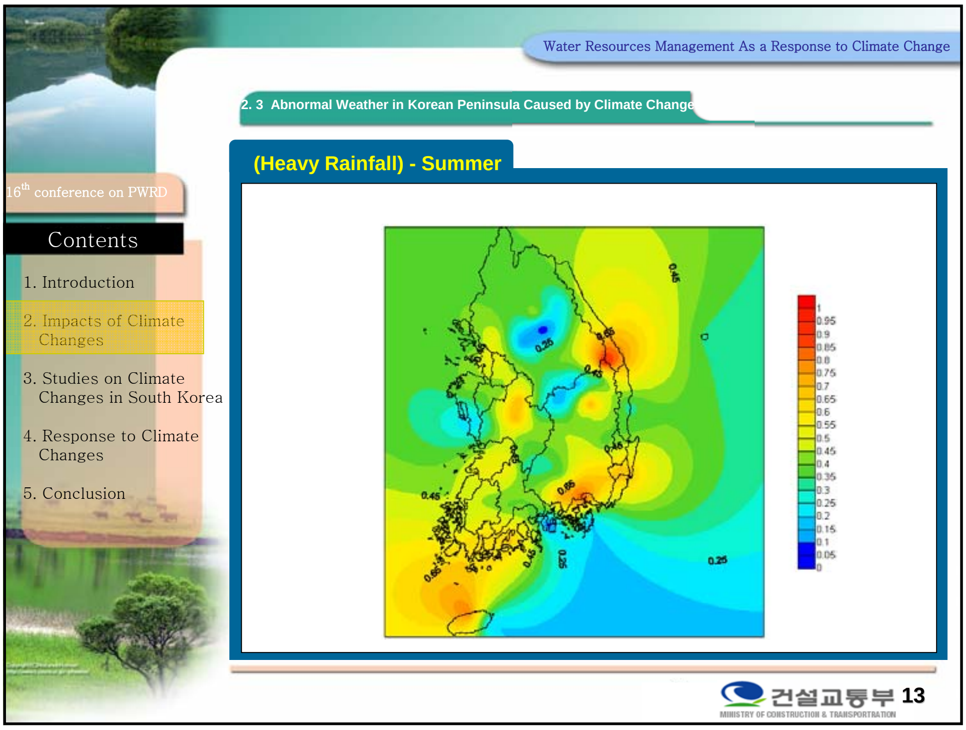

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(Heavy Rainfall) - Summer
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
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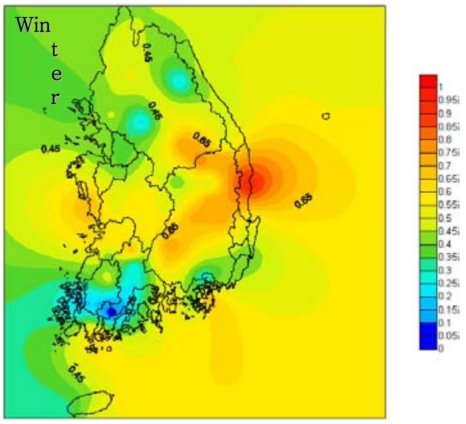
2. 3 Abnormal Weather in Korean Peninsula Caused by Climate Change

Hot-day



Water Resources Management As a Response to Climate Change

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3. 1 Studies on Climate Changes in South Korea

- **Studies on and impact evaluation of climate changes on water resources severely lack in quantitative terms compared to studies on hydrological factors.**
  - **Symposium on Impacts of Climate Changes on Korean Peninsula (Korea Institute of Science and Technology, 1994)**
  - **Study I, II, III on Impact Evaluation of Climate Changes and Digital Image Processing Technology (Ministry of Science and Technology, 1993, 1994b, 1995b)**
  - **Study on Asian Summer Monsoon between El Nino in 1987 and La Nina in 1988 using METRI / YONU GCM (Yonsei University,1999)**
  - **Forecasting on Changes in Drought and Flood Frequency in Korean Peninsula Caused by Global Environmental Changes (1998 IHP Report, Korea University)**
  - **Impact Evaluation of Water Resources Plan following Climate Changes (Korea Institute of Construction Technology, 2000)**
  - **Analysis Technique for Volatility of Water Circulation Structure Caused by Climate Changes (Korea Institute of Construction Technology, 2004)**
  - **Evaluation System for Impacts of Climate Changes on Water Resources (Ministry of Science and Technology, in progress)**

Unfortunately, there are no water resources plans or policies that reflect climate changes until today!

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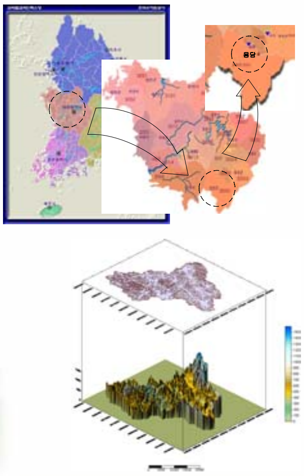
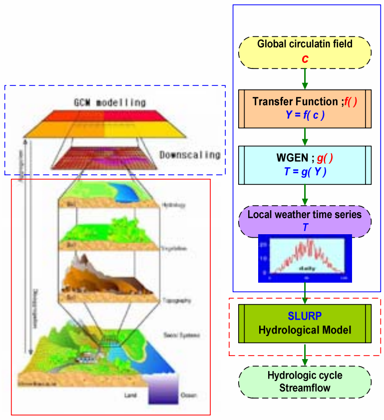
Analysis Technique for Volatility of Water Circulation Structure Caused by Climate Changes (2004)





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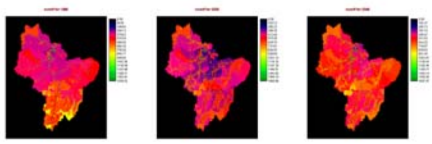
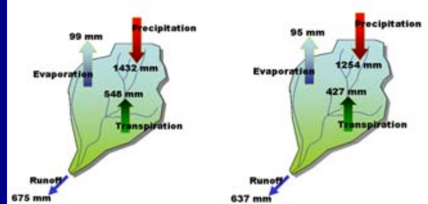
Analysis on Volatility of Water Circulation Structure Caused by Climate Changes

- *temperature*
- *precipitation*
- *storms*
- *evaporation*
- *soil moisture*
- *runoff*
- *floods*
- *snow cover*
- *glacier melting*





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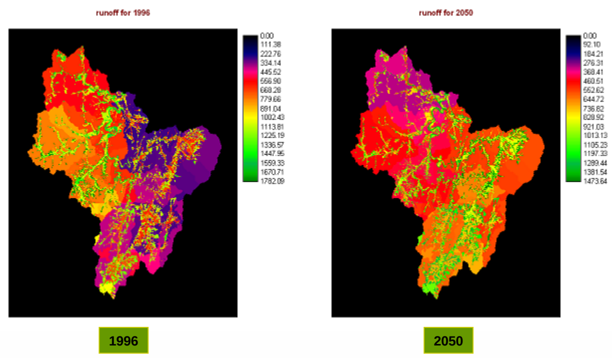
Analysis Technique for Volatility of Water Circulation Structure Caused by Climate Changes (2004)

Distributional Change of Effluent Amounts in Basins



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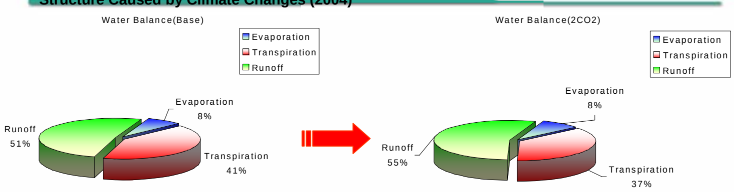

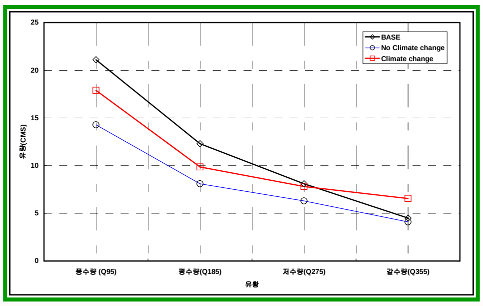

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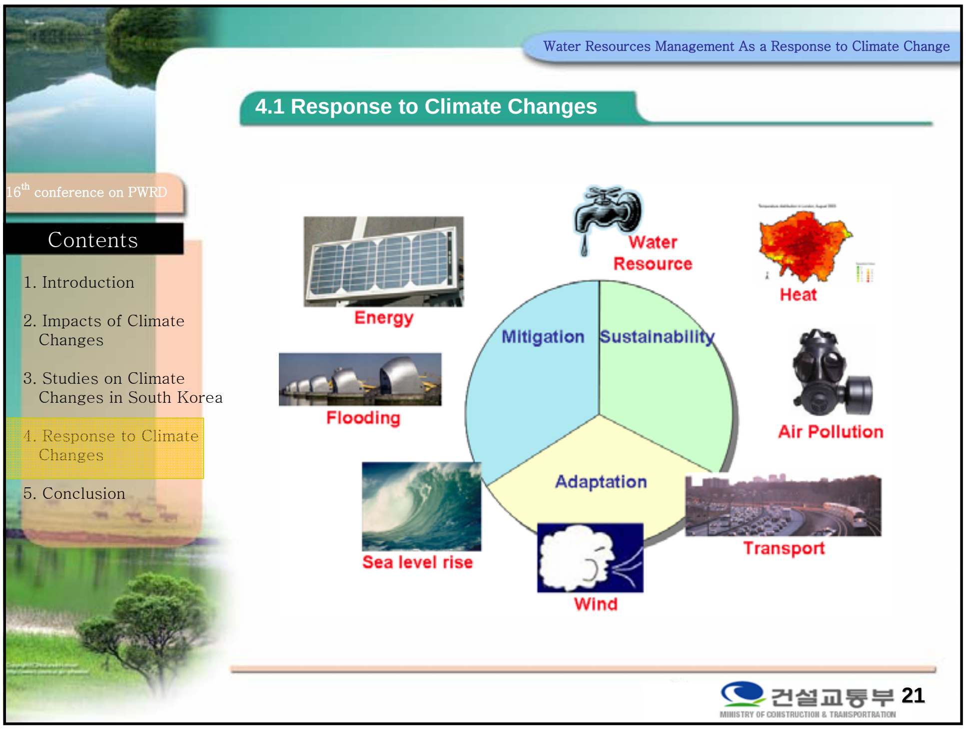
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Adaptation
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4.2 Importance of Response to Impacts of Climate Changes on Water Resou

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- **Due to small land and overpopulation, intensity of land and water resources use in South Korea is much higher than that of other countries. Even a small climate change such as global warming can impose a serious problem to the water resources..**
- **Statistical characteristics of climate are constantly change due to climate change. Frequency analysis using past data is not a valid mean for establishing water resources plan today.**
- **Past records of climate and hydrological phenomena are no longer a valid guideline for the future. Both structural and non-structural design of water resources system must consider potential impacts of climate changes (1991, World Climate Conference).**
- **We strongly advise persons involved with water resources management to reform water demand management and system to effectively respond to uncertainties of climate changes and to systematically review the following aspects of water resources system: Design scope, operation rule, emergency plan and water distribution policy (1996, IPCC).**

4.3 Response to Climatic Impacts on Water Resources

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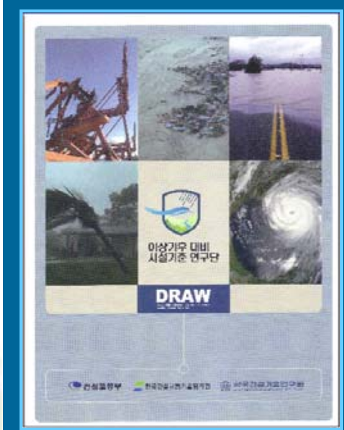

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4.3 Response to Climatic Impacts on Water Resources

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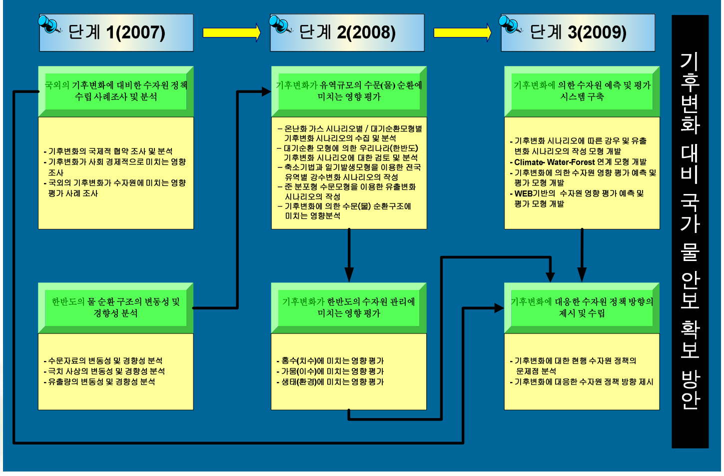

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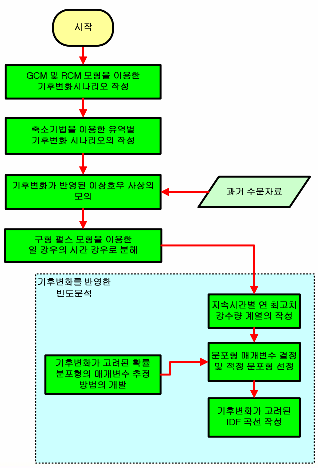
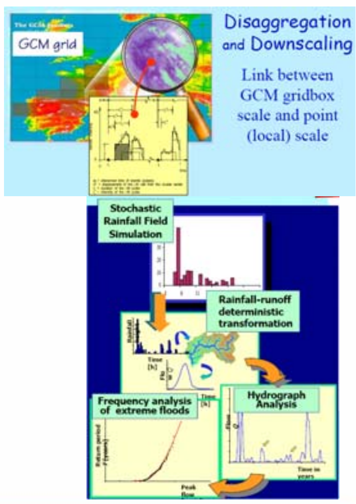
Study on National Water Resources Security for Climate Changes (2007-2009)

Climatic Impacts on Flood (Flood Control)





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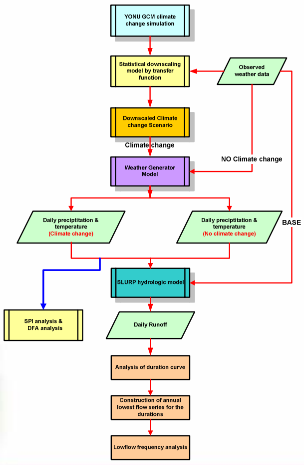
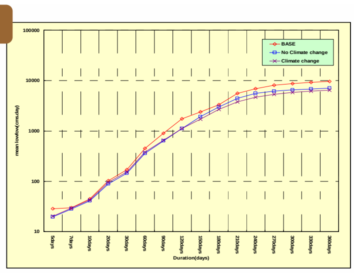
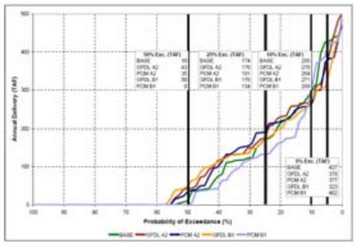
Climatic Impacts on Flood (Irrigation)







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5. Conclusion

(1) Nationwide flood control plan based on national capacity evaluation of flood defense in regard to abnormal flood caused by climate changes

- Evaluate flood defense capacity of existing facilities related to levees, dams, rivers and floods

(2) Selective flood control and IWRM designed for each individual basin

- Establish flood defense strategy and comprehensive basin irrigation plan that considers natural features; retention in upper stream, restraint in middle stream and drainage in lower stream

(3) Improvement of current flood forecasting system (flood forecasting system of a new paradigm)

- System that includes flood forecasting for tributaries
- Forecasting system for unexpected floods
- Flood forecasting system for abnormal rainfall using precipitation radar

(4) Utilization of meteorological techniques for basin control

- Establish three-dimensional weather monitoring system and real-time forecasting system of precipitations in basins that integrates IT

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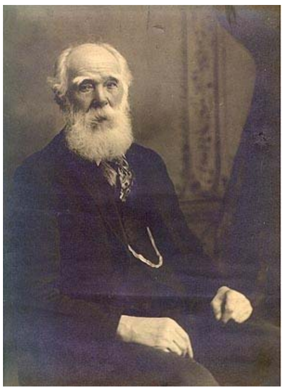
5. Conclusion

(5) Suggestions for reforming water management system suitable for climate changes

- **Consider flexible dam operation that accounts uncertainties of weather conditions caused by climate changes**
- **Review variable restricted water level of dam during flood seasons and overall flood control system**
- **Consider changing the system into the one that can secure water storage throughout the year and can effectively distribute the stored water when necessary**

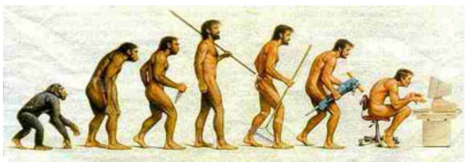
(6) Establishment of evaluation system for climatic impacts on water resources

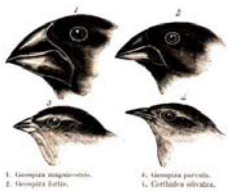
- **Establish system where climate change scenarios written from water resources perspective can be used in creating and analyzing runoff scenarios**



"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change!"

- Charles Darwin -





Q & A

Directions for Water Resources Management for Coping with Climate Change

Seok Young, Yoon[1] / Byung Sik, Kim[2]

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[2] Senior Researcher, Water Resources Research Dept., Korea Institute of Construction Technology, 2311, Daehwa-Dong, Ilsan-Gu, Goyang-Si, Gyeonggi-Do, Korea

1. Introduction

Lab researchers in an American university put a frog into a beaker. The beaker was then heated by an alcohol lamp. The goal of the experiment was to observe the frog's reaction. Because the upper part of the beaker was open, the frog had ample opportunity to escape. The frog, however, was boiled. It was too late when the frog realized the situation. This is so-called "Boiled frog syndrome." Changes are gradual; they do not suddenly arrive at a gigantic scale. Most changes are imperceptible and gradual. "Boiled frog syndrome" occurs when progression of change is not perceived. Responding to climate change necessitates enhanced ability to perceive change. Prompt understanding and responses to climate change are necessary to prevent victimization of human race.

The existence of climate change is no longer disputed. In particular, the field of water resources has been directly affected by climate change. Since the 1990s, frequent floods and droughts in succession have jeopardized water resources management. In particular, Korea's small land area and excessive population necessitate intensive use of land and resources to a greater extent than other countries. As a result, water resources management in Korea is potentially vulnerable to slight climate change caused by global warming. Therefore, lack of sufficient scientific evidence about climate change can be no longer an excuse to ignore or delay revision of national water resources policies, which is urgently need. It is because it may take more than 20 years, which is long enough to aggravate climate situation, from the establishment to actual implementation of water resources policies.

In the 20th century, fossil fuels such as oil were the most important resources. International organizations warn that water may cause international disputes in the 20th century. In particular, Korea, which is classified as a "water stress country," water issue is a crucial problem that has to be solved for enhancing quality of life and maintaining international competitiveness in the 20th century. Threats involving water include drought or localized water shortage, flood, and water pollution. In addition, research on social and economic impact of water issues and provision of legal and institutional framework are necessary for effective management of water. Recently, climate change began to greatly affect hydrological phenomena and made it more difficult for hydraulics engineers to accurately grasp processes of water circulation. Furthermore, climate change has increased uncertainty in the establishment of water resources plans for stable provision of water and extreme natural disasters such as floods and floods have caused greater difficulties in preparing for countermeasures. To cope with climate change, quantitative assessment of changes in water resources should be carried out and apply the findings to national water resources policies.

This paper has carried out comprehensive a review of climate change and its impacts on water resources management. Then, strategies for coping with climate change are proposed. Finally, analyses and discussions for sustainable development are made.

2. Impacts of climate change on hydrological circulation and water resources

Impacts of climate change on water resources and water resources management are direct and fundamental. Development and management of water resources tended to take precedence over efforts to find solutions to climate change. Furthermore, hydrology has developed by focusing on precipitation and seasonal and annual changes in the quantity of flow. Responding to issues involving floods and droughts is the most important responsibility of world's organizations in charge of water. The capacity to deal with climate change and its unpredictability is the decisive factor that determines effective use of water.

It is important to note that even minute climate change can lead to large-scale changes as it undergoes hydrological circulation. This observation is very important for managers of water resources. Table 1 below shows trends in water drought in West Africa in the 1970s and 1980s (Servat et al., 1999). As can be seen in the table, about 25% decrease in precipitation during the period caused about 50% decrease in annual quantity of flow. This means that small temporary changes in precipitation can lead to large-scale changes in water resources.

Table 1 Decreased precipitation in West and Central African countries and reduction of water quantity in rivers (Servat et al., 1998).

Country	Reduction in Precipitation (%)
Cameroon	16
Togo	16
Central African Rep.	17
Benin	19
Ghana	19
Nigeria	19
Guinea	20
Chad	20
Ivory Coast	21
Burkina Faso	22
Guinea Bissau	22
Mali	23
Senegal	25

River	Gauging Station	Reduction of Annual Flow (%)
Comoe	Aniassue	50
Chari	Ndajmena	51
Logone	Lai	39
Niger	Malanville	43
Niger	Niamey	34
Bani	Douna	70
Oueme	Sagon	42
Sassandra	Semien	36
Senegal	Bakel	50
Bakoye	Ouali	66
Black Volta	Dapola	41
Black Volta	Boromo	46
Oubangui	Bangui	30

Table 2. Climate change (a summary) and its impacts on water resources (IPCC, 2001)

Climate change forecast	Climatic change already observed?	To occur in the 21st century?	Effects on water resources
Higher maximum temperatures and more hot days over nearly all land areas	Likely	Very likely	Water resources reduced
Higher minimum temperatures, fewer cold days and frost days, over near all land areas	Very likely	Very likely	Water resources reduced
Diurnal temperature range reduced over most land areas	Very likely	Very likely	
Increase of heat index over land areas	Likely over many areas	Very likely over most areas	Water resources reduced
More intense precipitation events	Likely over many northern hemisphere mid-to-high latitude areas	Very likely over many areas	More frequent and more severe floods
Increased summer continental drying and associated risk of drought	Likely in a few areas	Likely over most mid-latitude continental interiors	More frequent and more severe droughts
Increases in tropical cyclone peak wind intensities	Not observed in the few analyses available	Likely over some areas	More frequent and more severe storm-surge floods
Increases in tropical cyclone mean and peak precipitation intensities	Insufficient data	Likely over some areas	More frequent and more severe floods

Natural disasters caused by climate change are drastically increasing every year. Globally, increased intensity and frequency of floods and droughts and seasonal drying up of rivers caused by global warming have emerged as serious issues. Climate change affects the process of hydrological circulation and this causes changes in water resources. According to a study, average annual precipitation increased by about 7% in a drainage area in Korea under the influence of climate change. Because of decreased duration of dry and wet days, precipitation and frequency of extreme precipitation events have increased. Furthermore, it was found that quantity of water flow increased in winter and autumn although the annual average decreased (Kim Byeong-sik et al., 2004).

Temperature and precipitation are the most important hydrological elements that affect quantity of water flow. The factors can cause vulnerabilities in some aspects of water resources: change in the ecological system of drainage area, changes in capacity to produce electricity, water supply, water quality, flood, and drought. The following figure shows changes in hydrological circulation caused by climate change in a drainage area and their impacts on water resources. It should be noted that date may be different depending upon drainage area because hydrological circulation in specific drainage area reflects local characteristics.

Korea, which is characterized by wide variability in precipitation and high population density, is extremely vulnerable to floods and droughts that are expected to increase under climate change. Increased precipitation under climate change greatly affects large scale facilities such as dams. Because collapse of dams can cause tremendous damage to drainage area, Probable Maximum Precipitation is taken into consideration when dams are designed. Probable Maximum Precipitation is determined by the amount of moisture in the atmosphere and the dew point. In general, 1℃ increase in temperature leads to about 10% increase on Probable Maximum Precipitation. If climate change causes 1-2℃ increase in temperature, more than 10% increase in Probable Maximum Precipitation is very likely.

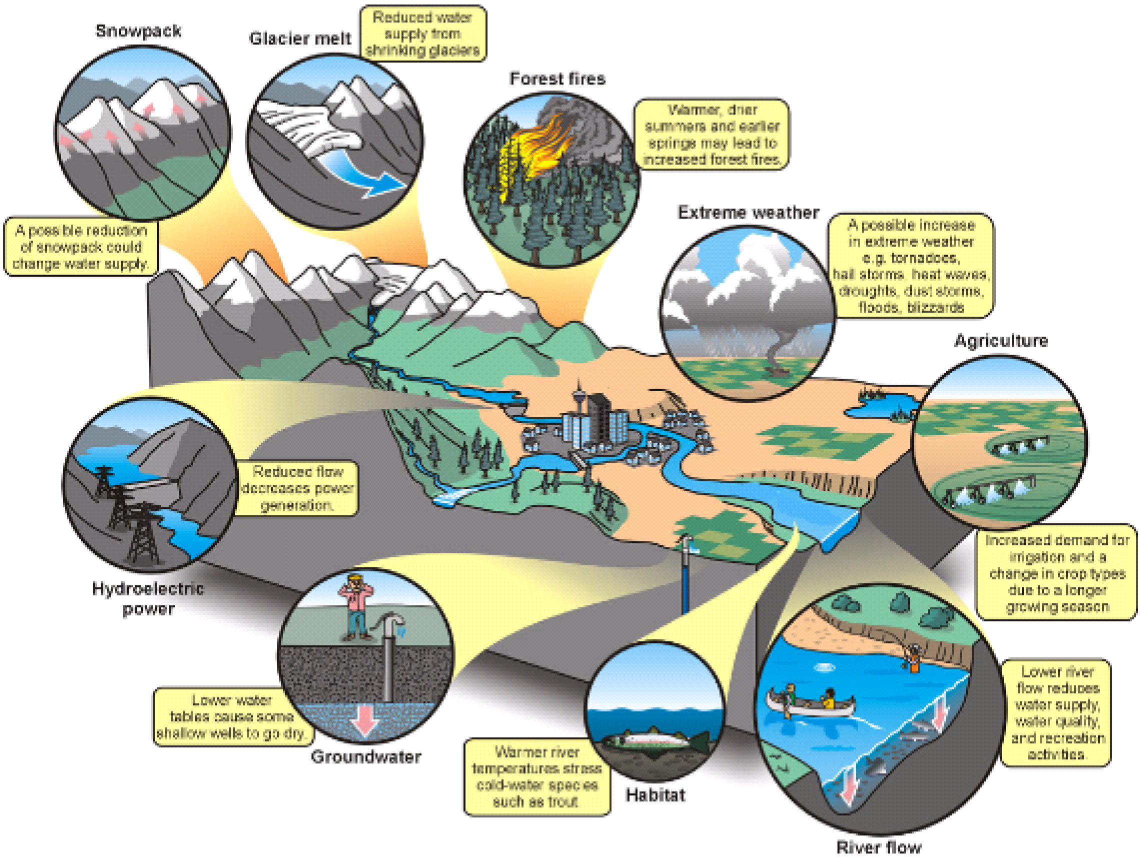


Figure 3. Changes in hydrological cycles caused by climate change and their impacts on water resources

Climate change not only affects quantities of elements of hydrological circulation but also temporal and spatial characteristics of each hydrological element. For instance, the increase of the minimum temperature in winter alters snowfall and snow melting period and may cause drought in spring. Furthermore, many studies predict that the amount and timing of water flow will be changed under the impact of climate change. This will maker planning and management of water resources difficult as they are greatly influenced by temporal and spatial changes in the amount of water flow. Climate change can induce great spill-over effects on the demand for public and industrial water. Changes in the amount of precipitation and evapotranspiration will affect amount of irrigation water and return flow. For stable supply of water resources, efficient long-term planning of water resources is necessary. However, severe changes in water reserves and demands caused by climate change will increase uncertainty in securing water resources.

2.1 Impacts on droughts

Climate change greatly affects human activities. Increased occurrence of droughts is a form of climate change that emerged as a serious threat. Although the danger of droughts cannot be easily recognized, it is true that damage from droughts is occurring. In the case Korea, people are becoming more aware of the crisis caused by droughts and diverse researches on droughts are being carried out. Until now, researches on climate change in Korea have been carried out in diverse fields including water resources, weather, ecology, and environmental aspects. In particular, water utilization studies have been carried out in the field of water resources.

Since the 1960s, droughts in Korea have occurred in five to seven-year cycles. Major droughts in Korea during the period include a nationwide drought in 1968 that centered on Jeolla and Gyeongsang provinces; droughts in 1977, 1982, and 1988; and a drought in 1994 in the central and southern regions. Since the 1990s, small and large-scale droughts depending on the region are occurring every year. In the spring drought of 2001, from March 1 to June 16, lowest level of precipitation was observed in 58 observatories, which is more than 80% of 72 observatories operated by the Meteorological Administration. In some observing points, spring drought was so extreme that frequency of precipitation during the three months from March to May amounted to 50-60 years. Considering that average precipitation at multipurpose dams in 2001 was 919mm, the level was similar to drought condition in 1994. During the period, shortage of water made it necessary to designate emergency water supply areas in 381 eup and myeon administrative units affecting about 300 thousand people. Farmland areas damaged by the drought totaled about 19,000 ha. It is difficult to say that climate change is solely responsible for the decrease in the amount of precipitation and rainfall days. However, the portion of climate change in causing drought is viewed as considerable. It is important to recognize that concentration of population caused by urbanization and industrialization and increase in the amount of direct runoff are also important factors that contribute to the occurrence of droughts.

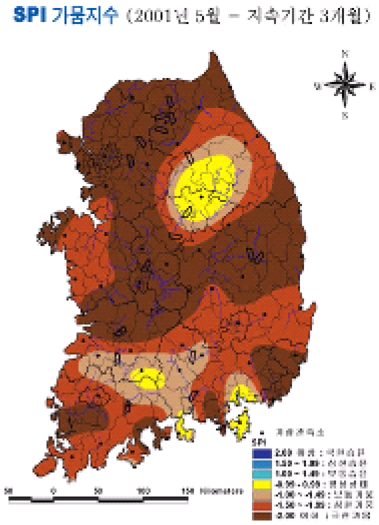
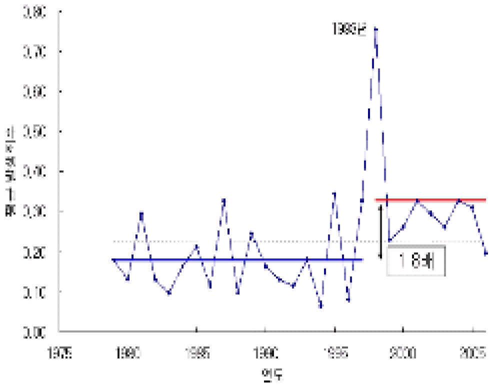


Figure 4. Distribution of drought events in Korea (2001)

2.2 Impacts on torrential rains and floods

Recently, damages from typhoons, hurricanes, and heavy rains are rapidly increasing throughout the world. Since the late 1990s, serious casualties and property damage occurred in Korea: grand floods in 1998 and 1999, typhoon Rusa in 2002, typhoon Maemi in 2003, and torrential rains in 2006. In particular, property damage and restoration expenditures caused by typhoon Rusa and Maemi amounted to about KRW 26 trillion (Ministry of Government Administration and Home Affairs, 2003). In addition, astronomical amount of property damage and restoration expenditure were incurred by the largest rainfall in history that lasted for 46 days in June and July of 2006. A newspaper reported that the amount of damage was KRW 1.8 trillion and that restoration expenditure would reach KRW 3 trillion (Donga Ilbo, July 29, 2006). From sources, we are informed about frequent occurrence of abnormal flood in diverse parts of the world in this century. Such torrential rains and floods are probably not caused by climate change alone. However, it is true that climate change is causing changes in the characteristics of extreme precipitation events in the Korean Peninsula.



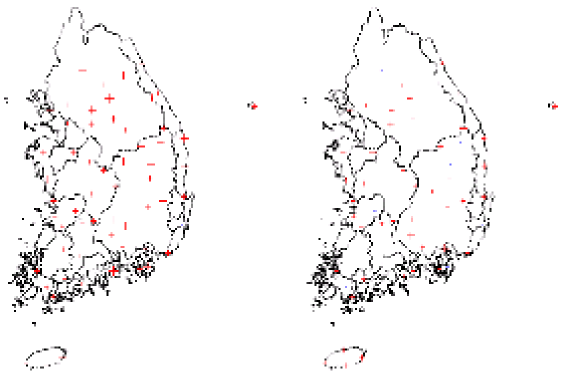
(a). Frequency of 100 mm precipitation events

(b) Flood damage in Gangwon Province in photos (2006)

Figure 5. Flood Impacts on torrential rains and floods

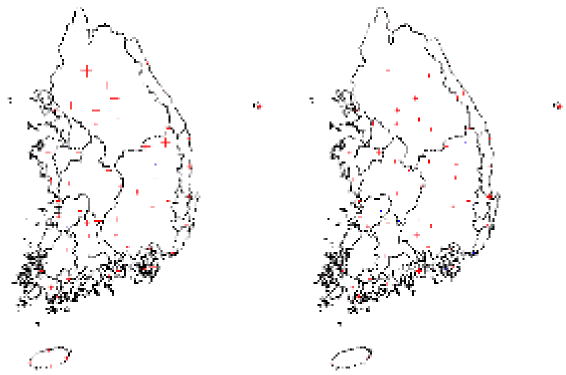
Figure 6 shows the results of an analysis of characteristics of extreme precipitation events recorded by 66 observatories run by Korea's Meteorological Administration. "+" represents an indicator's increasing trend from the past to the present. Larger size the sign means that the corresponding tendency is comparatively more pronounced. Sign "-" represents a decreasing trend. Increasing trends in summer rather than autumn included: (a) critical point of torrential rain, (b) maximum amount of precipitation during five-day period, (c) precipitation intensity in wet days, (e) percentage of torrential rains above the critical point, and (f) the number of occurrence days. It was found that (d) maximum duration of dry days were concentrated in autumn. In the past, precipitation was concentrated during summer because of monsoon, the seasonal rain front. However, from 1998 to 2004 excluding 2001, rainfall increased after the rainy season (Cha Eun-jeong, 2006). As a result, rainfalls occur without interruption in July and August. In the case of (a) the critical point of of torrential rains, the tendency increased in autumn (Sept.-Nov.) rather than in summer (June-August). This phenomenon was observed in Masan, Wando, Jeju-do, Seogwipo, and Taebaek. The administrative units are located in coastal areas rather than the interior. This phenomenon is caused by the size and path of typhoons that moves from Jeju-do to southern coast. In contrast, summer increase of critical point of torrential rain occurred in 55 locations (80%) in the central region of the interior including Cheolwon, Incheon, Seoul, Hongcheon, and Andong. In particular, the tendency in these locations either gradually decreased or were marked with "-" sign. (b) refers maximum amount of precipitation during five-day duration. The value of the indicator clearly increased in locations such as Cheolwon and Hongcheon where the critical point of torrential rains was high as well as in Bonghwa, Yeongju, and Mungyeong. In the case of (e) the rate of occurrence above the critical point of torrential rains, the rate of torrential rainfall occurrence increased in summer rather than autumn. Similar result was found for (f) number of days above the critical point of torrential rains. This means that as in the past rainfall is concentrated in summer in Korea. However, extreme precipitation events are occurring earlier. A long-term trend is that the amount of precipitation is increasing. At the same time, frequency of extreme precipitation events is increasing.

In general, it is in summer that Korea is influenced by precipitation. An analysis that focuses on extreme precipitation events reveals that unlike in the past when precipitation events during rainy season tended to be continuous and regular, today's rainfall tends to be localized, temporary, irregular, and more intensive. Such finding can support other researches: Im Gi-seok et al. (2002) found that torrential rainfall in Korea are characterized by localization and extreme spatial and temporal irregularity whereas Kim Byeong-sik et al. (2003) found that global climate change will cause more frequent torrential rainfall because precipitation intensity will increase in the Korean Peninsula and duration of wet and dry days will be shortened.



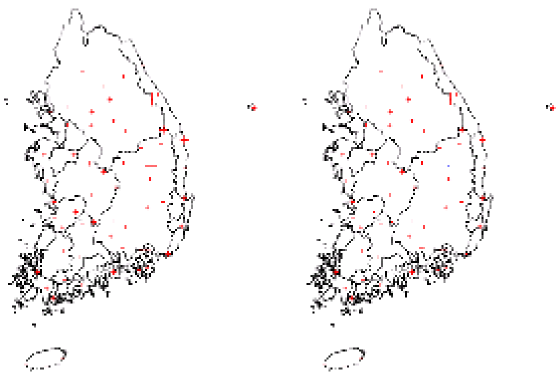
Summer (June-August) Autumn (Sept.-Nov.)

(a) Critical point of torrential rains



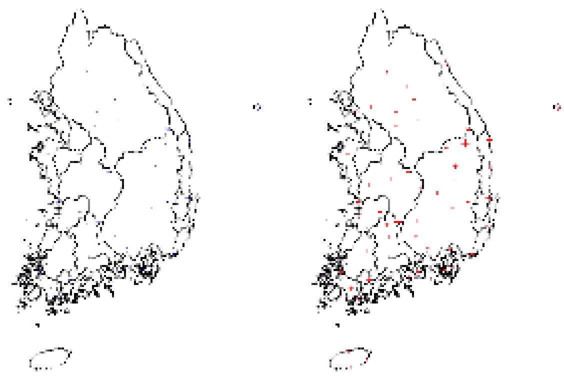
Summer (June-August) Autumn (Sept.-Nov.)

(b) Maximum precipitation of five-day duration



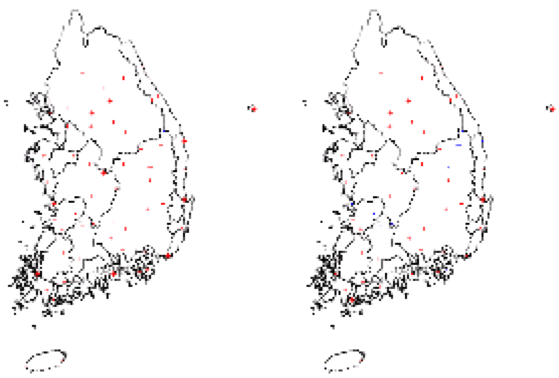
Summer (June-August) Autumn (Sept.-Nov.)

(c) Precipitation intensity in wet and dry days



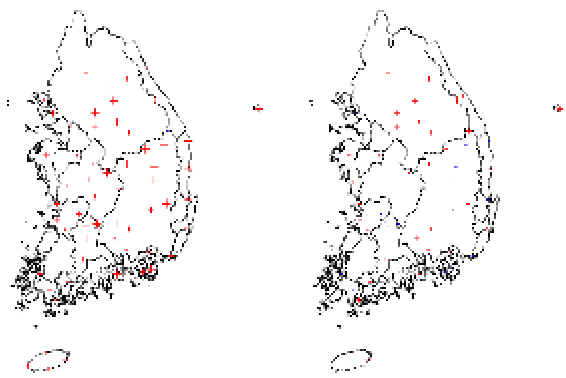
Summer (June-August) Autumn(Sept.-Nov.)

(d) Maximum duration of dryness



Summer (June-August) Autumn(Sept.-Nov.)

(e) Rate of occurrence above the critical point of torrential rains



Summer (June-August) Autumn(Sept.-Nov.)

(f) Occurrence days above the critical point of torrential rains

Figure 6. A comparison of spatial and temporal characteristics of precipitation

4. Responding to impacts of climate change on water resources

Because climate change has caused statistical characteristics of climate, use of past data to interprete frequency is not a rational choice for establishing water resources plans. In 1991, World Climate Conference stated, **"Past record of climate or hydrological phenomena are no longer reliable guidelines for the future and design and management of water resources system have to consider potential impacts of climate change."** To water resources managers, IPCC (1996) strongly recommended systematic review of the design scope of water resources system, operation rules, emergency plans, and water distribution policy and improvements in water demand management and institutional improvement to cope with uncertainties of climate change. For proactive water resources management and planning under the impact of climate change, the Ministry of Construction and Transportation has carried out following measures.

4.1 Research on design criteria for hydrological constructs that can cope with abnormal climate

As mentioned above, water resources planning and designing methods based on past records have to be revised. Methods that consider impacts of past and future climate change must be developed and applied. In particular, optimum design method that maximizes net profit has to be replaced by a design method that can cope with extreme weather conditions. To that end, the Ministry of Construction and Transportation has formed a "research group for strengthening facilities criteria to cope with abnormal climate" inside Korea Institute of Construction and Transportation Technology Evaluation and Planning in September 2005 to carry out diverse related researches.

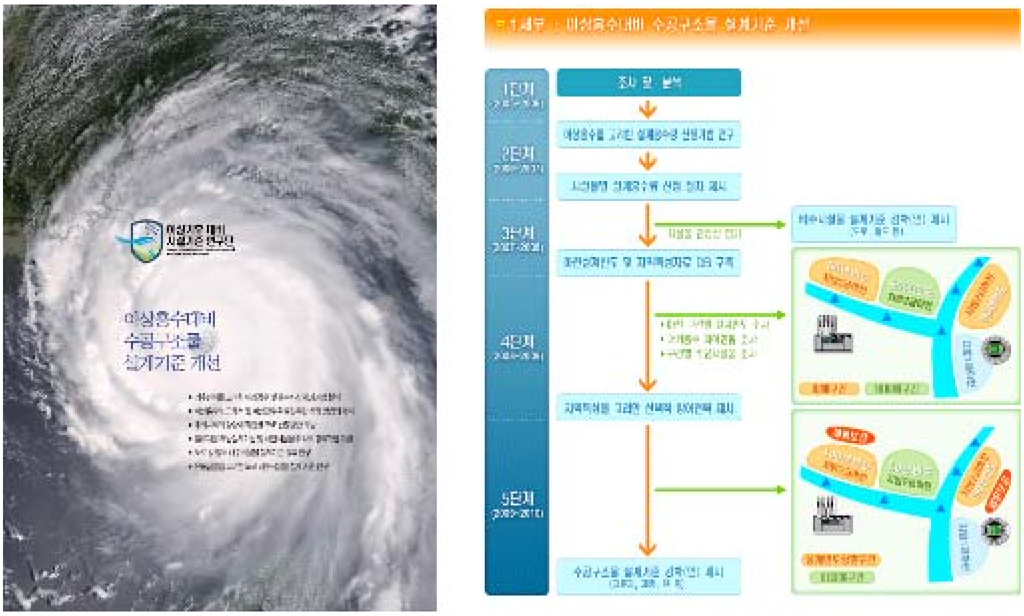


Figure 7. Researches on strengthening of construction criteria for hydrological facilities to prepare for abnormal weather

4.2 Research on water security strategies to cope with climate change

In Korea as well as in other countries, frequent abnormal occurrence of droughts and floods has negatively affected the society and the economy. Researches to cope with abnormal weather have been actively carried out in advanced industrialized countries. In preparation of floods, droughts, and ecological changes caused by future climate change, Water Resources Planning Office of the Ministry of Construction and Transportation has launched in 2007 "National Water Security Planning Against Climate Change" to develop long-term water resources policies and to secure national water security. Currently, the ministry is planning a joint research project with "**Tyndall Centre for climate change**,**"** a world-class climate change research organization in the United Kingdom.

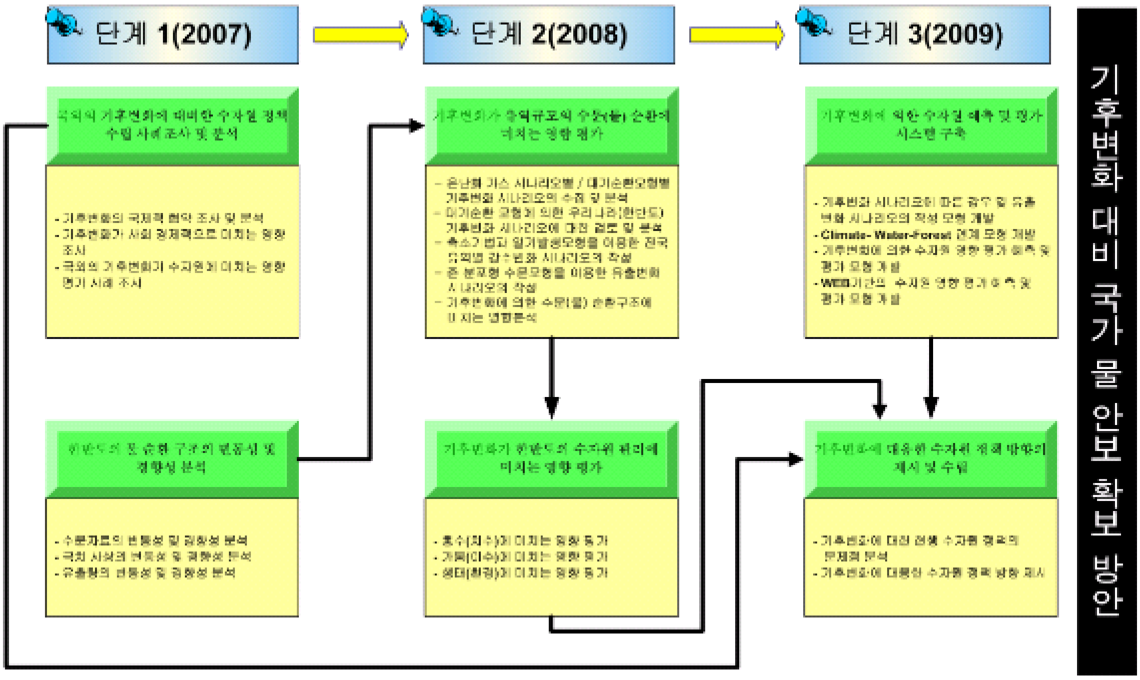


Figure 8. Flow of researches on national water security in preparation for climate change

5. Proposals for overcoming negative impacts of climate change on water resources

5.1 Water resources planning and improvement of its designing method

Since 1965, Korea has established and carried out ten-year comprehensive water resources plans. In 2006, Korea established "Long-term Comprehensive Water Resources Plan (2001-2020). Until recently, however, impacts of climate change were not considered. In establishing and implementing the long-term water resources plan, supply and demand of water resources will be estimated and flood vulnerability of the whole national territory will be analyzed. The findings will be applied to comprehensive dam development plans and drainage area plans. However, statistical analyses are based on past data. Considering that statistical characteristics of the climate have changed by climate change, such approach is not rational. Therefore, it is necessary to develop a design method for water resources planning that can consider climate change.

5.2 Improvement of existing method of system operation

Climate change will create extreme hydrological conditions that will obliterate assumptions behind existing water resources systems and operations. Complexity and difficulty of water resources management will increase. However, countermeasures for climate change consist in finding effective operational method for existing system. Whether existing system can cope with impacts of climate change is reviewed and economic costs are considered. In other words, the best option for system managers is to verify sensibility of a system with expanded scope and develop methods and technologies that can improve operational efficiency.

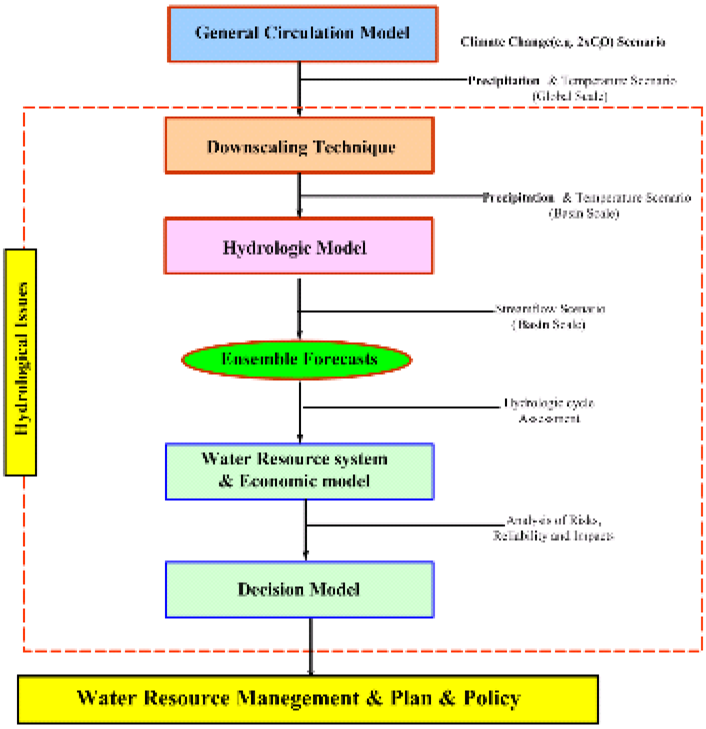


Figure 9. Improvement of water resources planning and system operation methods in consideration of climate change

5.3 Use of weather technology for drainage area management

Recently, climate change has caused abnormal localized torrential rains. As a result, unanticipated floods are occurring frequently and management of drainage area has become more difficult. To cope with the difficulty, it is necessary to secure reliability of precipitation forecast that uses radar precipitation and numerical forecast data. Furthermore, it is necessary to establish a system that can forecast and broadcast precipitation condition in drainage areas.

5.4 Comprehensive review of management of flood in drainage area controlled by dams

Because of changes in the precipitation pattern in the Korean Peninsula, torrential rains can occur earlier or later than in the past. Because of the uncertainty, water level limits in dams must be revised for a more flexible management of dams. The current system, which consists in containing water during summer for use in water shortage season, should be replaced by a more complex water management system for efficient water containment and distribution throughout the year.

5.5 National-level evaluation of the readiness to counter flood situation and drainage area-level countermeasures against flood

Because climate change is causing abnormal floods, capacity of existing flood-related infrastructure—levees, dams, bridges, etc.—have to be re-evaluated. Furthermore, comprehensive flood management by Integrated Water Resources Management (IWRM) of drainage areas is necessary. To minimize damage in drainage area, flow function in the upper stream, containing function in the middle stream, drainage function in the lower stream have to be enhanced.

5.6 Establishment of a system for assessing the impacts of climate change on water

resources

To establish long-term water resources plans that can proactively cope with climate change, drainage area-level climate change scenarios have to be produced. The scenarios must be used to establish a system that can produce outflow scenarios. Furthermore, to enhance forecast and understanding of climate change and to enhance Korea's international status, it is necessary to forge an international system of cooperation in East Asia.

6. Conclusion

Recently, frequent occurrence of abnormal weather events such as droughts and floods in foreign countries has seriously affected the society and the economy. In Korea, water resources problems associated with climate change have appeared in the 1990s. Since the 1980s, advanced industrialized countries have actively carried out researches on climate change and the researches include evaluation of impacts of climate change on water resources. The most representative project in the field of water resources is GEWEX (Global Energy and Water Experiment), which selected five major rivers of the world to monitor and study changes in hydrological phenomena caused by climate change. Furthermore, NWS (National Weather Service) and NASA (National Aeronautics and Space Administration) have heavily invested in the field of water resources. In particular, the state of California in the United States has established a long-term water resources plan in July 2006. In the case of the United Kingdom, barriers will be reconstructed in the lower stream of the Thames in 2100 to fight floods. In the case of water resources management in Korea, no specific measures were taken to impacts of climate change. However, Korea is frequently experiencing extreme flood events that surpass original flood design. Therefore, more active and new approaches and technology development have to be pursued. By carrying out more systematic and in-depth researches for the development of water resources evaluation technology that can counter impacts of climate change, it will be possible to contribute to establish plans and develop policies that can upgrade residents' security and quality of life.

IX-3-5) Malaysia

Mr. Wan Abd Rahim Bin
WAN ABDULLAH
Director, Sewerage Services Dept.,
Ministry of Energy, Water & Communication

Objective

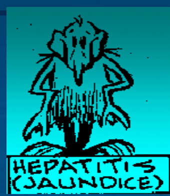
- To present the current status of Sewerage Management in Malaysia
- To conduct sewerage adoption to Integrated Water Resources Management and Global Climate Change

WHY DO WE NEED TO TREAT SEWAGE ?

Water is a major route by which bacteria, Viruses and parasites are transmitted. Engineering of water supplies and waste water management have prevented waterborne diseases.

Need sewage treatment to control:

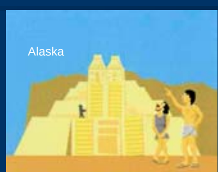
- **Harmful pathogens (Public Health)**
- **Improve water quality (Water Resource)**
- **Enhance environmental values (Environment)**



EVOLUTION OF SEWAGE TREATMENT METHODS OVER THE CENTURIES AROUND THE WORLD

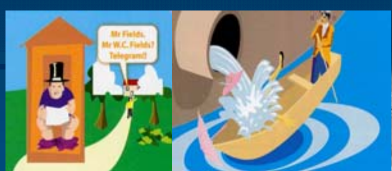
Stone Age
(Sewage not an issue)

Nomadic Age
(Leave as they move)



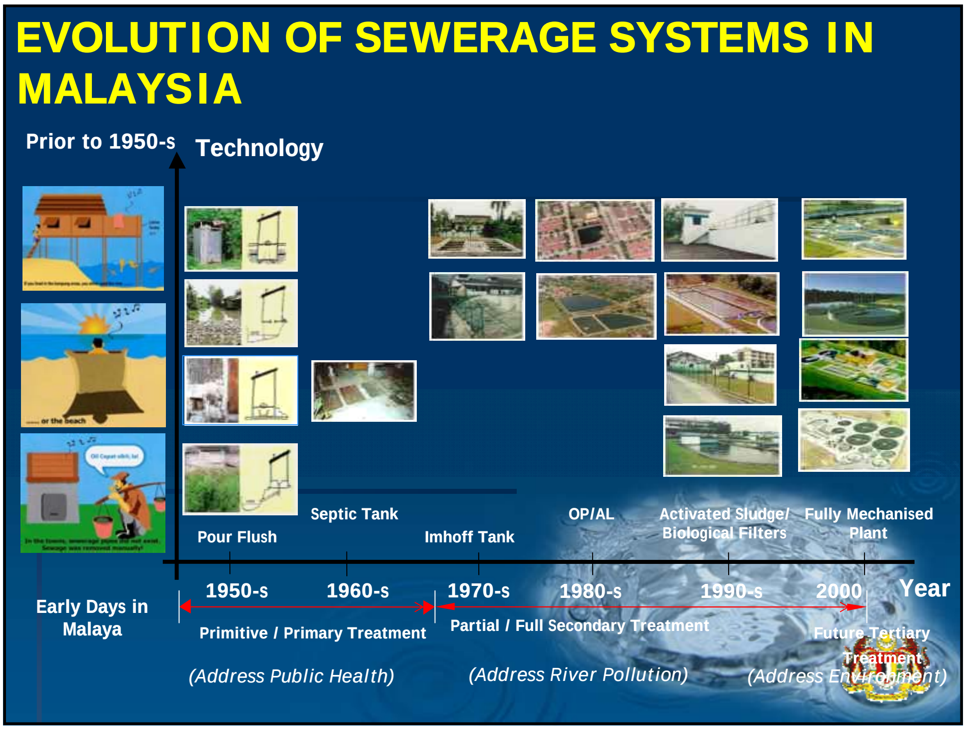
The Growing Sanitation Needs in Early Civilisation
(Need for Sanitation arises)

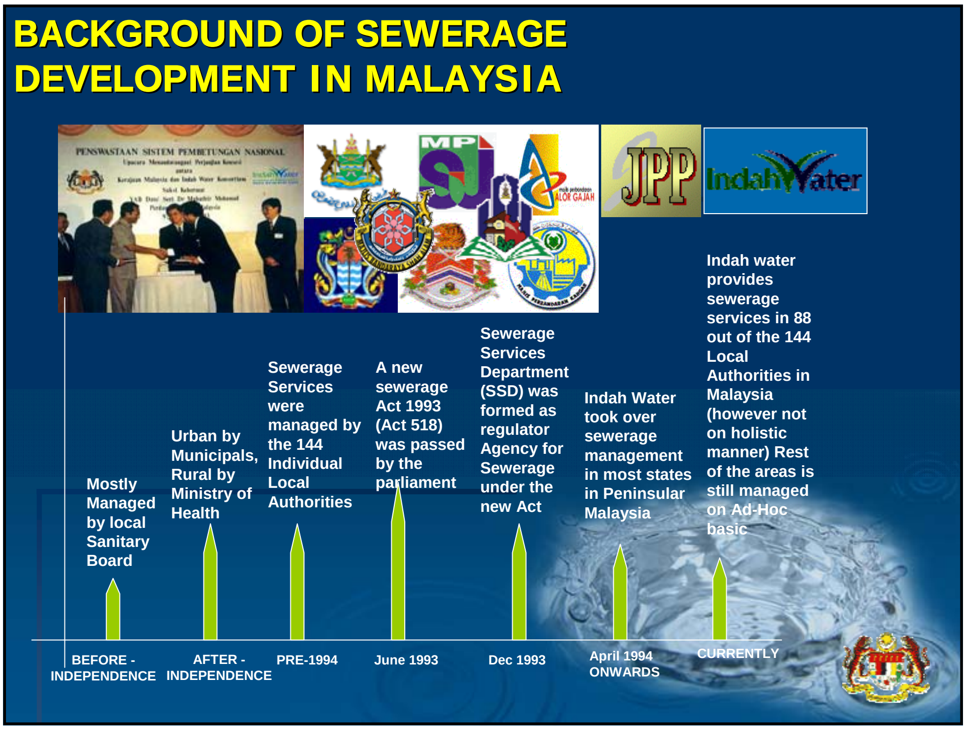
Middle-Ages in Europe
(Collect and throw)



Early 19th Century
(Pour Flush & Sewers to Rivers)

Mid 19th Century
(Existence of Sewage Farms)


EVOLUTION OF SEWERAGE SYSTEMS IN MALAYSIA
Prior to 1950-s
Technology
Pour Flush
Septic Tank
Imhoff Tank
OP/AL
Activated Sludge/ Biological Filters
Fully Mechanised Plant
Year
1950-s
1960-s
1970-s
1980-s
1990-s
2000
Early Days in Malaya
Primitive / Primary Treatment
Partial / Full Secondary Treatment
Future Tertiary Treatment
(Address Public Health)
(Address River Pollution)
(Address Environment)


BACKGROUND OF SEWERAGE DEVELOPMENT IN MALAYSIA
JPP
IndahWater
Mostly Managed by local Sanitary Board
Urban by Municipals, Rural by Ministry of Health
Sewerage Services were managed by the 144 Individual Local Authorities
A new sewerage Act 1993 (Act 518) was passed by the parliament
Sewerage Services Department (SSD) was formed as regulator Agency for Sewerage under the new Act
Indah Water took over sewerage management in most states in Peninsular Malaysia
Indah water provides sewerage services in 88 out of the 144 Local Authorities in Malaysia (however not on holistic manner) Rest of the areas is still managed on Ad-Hoc basic
BEFORE - INDEPENDENCE
AFTER - INDEPENDENCE
PRE-1994
June 1993
Dec 1993
April 1994 ONWARDS
CURRENTLY

CHANGES TO THE SEWERAGE SECTOR AFTER INTRODUCTION OF NEW SEWERAGE SERVICES ACT 1993 (ACT 518)

DEPARTMENT OF SEWERAGE SERVICES

- Regulator Sewerage Services Act, 1993
- Industry / Operational regulator
- Regulates service provider
- Sets industry standards & guidelines
- Oversees Sewerage Developments

DEPARTMENT OF ENVIRONMENT

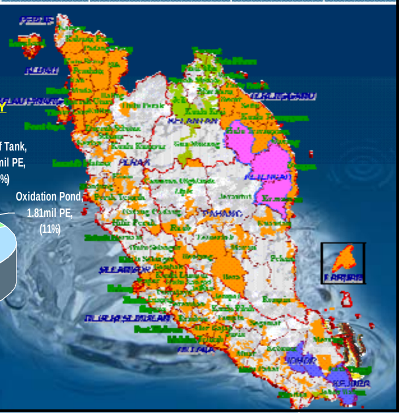
- Regulates Environmental Quality Act, 1974
- Sets standards for environment and Pollution Control
- Enforcement of discharge standards
- Monitoring existing Final Effluent Standard A, where plant is in Water intake Areas and Standard B in other areas
- Drives National Environmental Policies

CONTROL OF SEWAGE POLLUTION ON RIVER BASINS

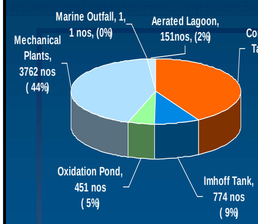
Coverage Area

TYPE OF SERVICE AND POPULATION SERVED				
Type of Service	IWK service areas	Non-IWK service areas	Total	%
Connected	14,799,710	1,371,311	16,171,021	60.6
Septic Tank	4,533,858	355,890	4,889,748	18.3
Pour Flush	2,958,485	512,790	3,471,275	13.0
Unidentified	Nil	2,163,253	2,163,253	8.1
TOTAL	22,292,053	4,403,244	26,695,297	100.0

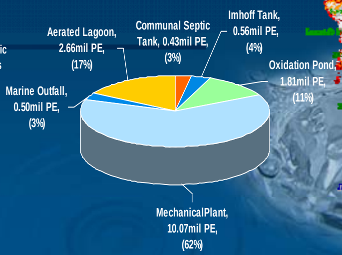
As at JUNE 2007



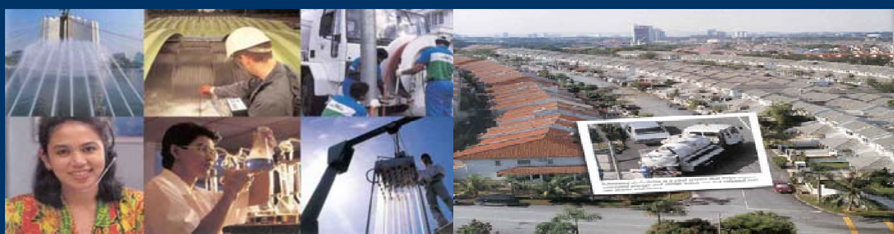
TYPES OF TREATMENT PLANTS JUNE 2007



POPULATION EQUIVALENT CATERED BY TREATMENT PLANTS



SEWERAGE CUSTOMER CATEGORIES



Domestic

eg Houses
Apartments
Govt Qtrs
...etc.

Once Every 6 Months
From RM 2 - RM 8/Month

Commercial

eg. Shopping Complexes
Hotels
Restaurants
...etc.

Monthly
21 Bands Based
on Annual Values
Excess Water Charge > 100 m3

Government

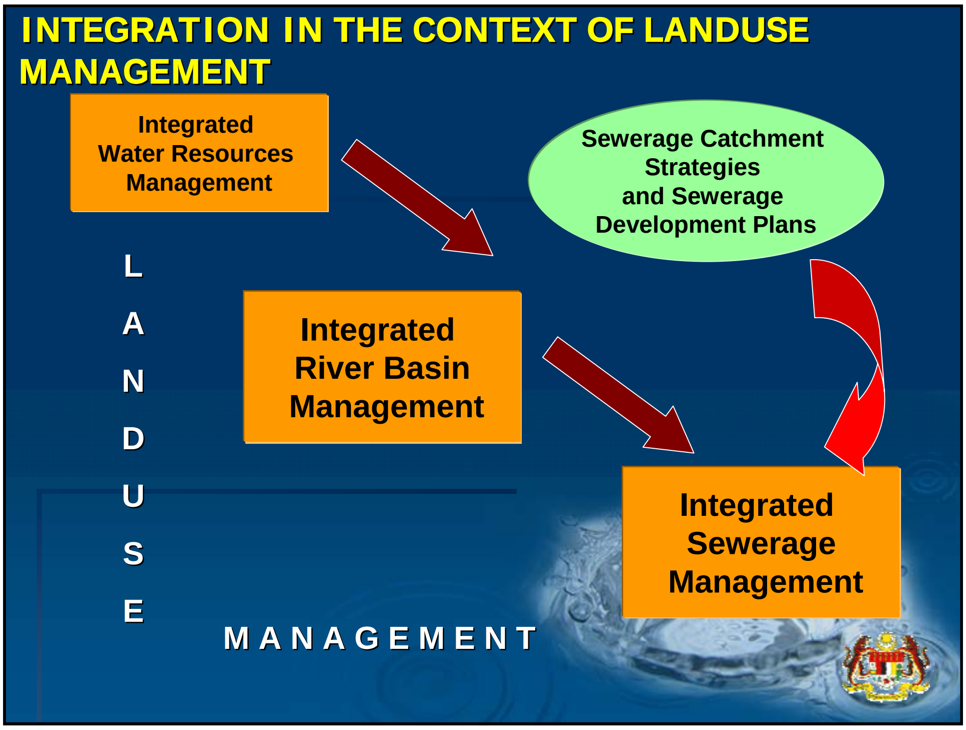
eg. Offices
Hospitals
Schools
...etc.

Basic Charge
RM 25 - RM 40 /Month
Excess Water Charge > 100 m3

Industry

Eg. Factories
...etc.

Monthly
Based on Head Count
RM 2 - RM 2.50 per Head/Month



IWRM Vs IRBM

An Integrated Water Resources Management (IWRM) sets goals and objectives for the management of water resources at a wider scale and includes policies for regions, catchments, shared or transboundary water resources, and inter-basin transfers, all within a single framework. It addresses both the quantity and quality aspects of both surface and groundwater resources and also deals with delivery of water services. It is a dynamic approach often set within a catchment (watershed) framework.

Therefore, the process of policy making for IWRM requires extensive consultation as well as raising the awareness of the importance of integration among policy makers, stakeholders, and the general public. The sustainability of resources and policies should be a central goal.

However, water flows according to natural characteristics and does not respect administrative boundaries – therefore, from pure water resources point of view there might be much logic in managing water according to river basin boundaries. An Integrated River Basin Management (IRBM) describes the framework for management of the water and related land resources in the river basin. The IRBM is a tool that outlines how the concept of integrated water resources management is going to be implemented at the river basin level.

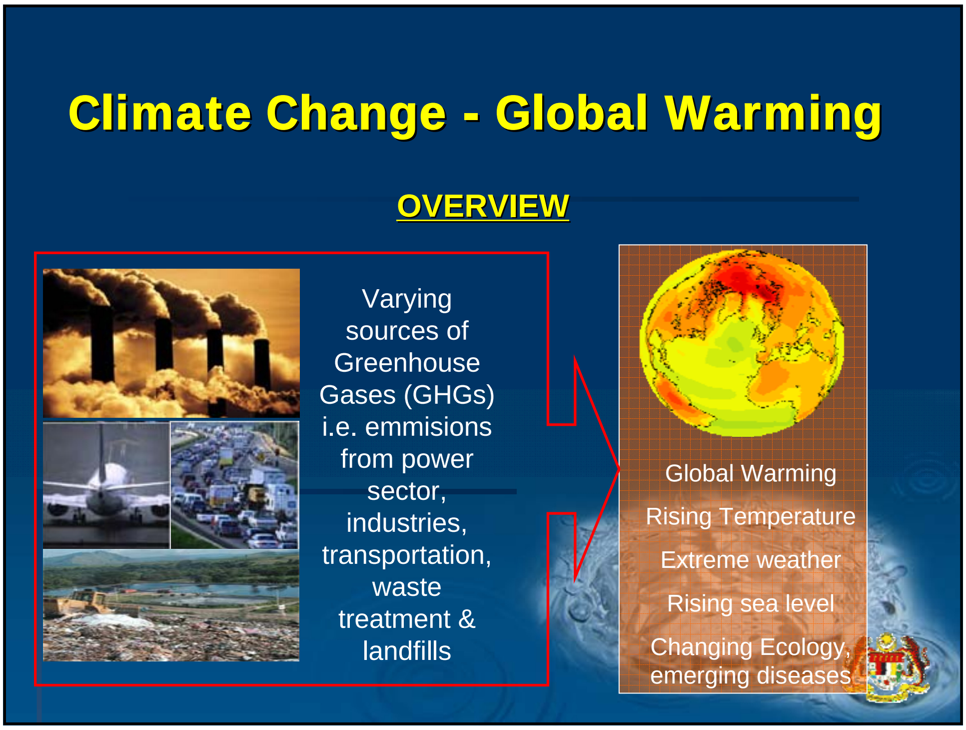
WHAT IWRM AND IRBM ADDRESSES?

They typically address such aspects as :

- Physical description of the basin
- Land use inventories
- Current water availability and demands
- Pollution sources inventories
- Aquatic and terrestrial ecosystem needs
- Vulnerability to floods or extreme meteorological events
- Identification of stakeholders
- Implications of changing land use
- Identifications of priority issues (impact issues or user requirement issues)
- Short and Long term goals for the river basin
- Water related development scenarios, future water demands
- Water allocation and water quality objectives
- Strategy, measures and action plan achievement of goals
- Financing of water use and management
- Responsibility and schedule for implementation
- Mechanisms for monitoring and updating

Organisations with water supply, sewerage, treatment and reuse functions are increasingly driven by the need to make efficiency gains : to do more with less water, to eliminate subsidies, incorporate externalities and minimise impacts, to recover costs of operation, maintenance and replacement of water and wastewater systems, and to transfer the cost of supply and treatment from the provider (usually Government) to the consumer within the IWRM and or IRBM frameworks

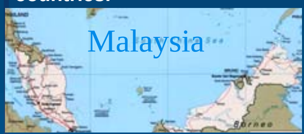

WHAT ARE THE POTENTIAL ENVIRONMENTAL IMPACTS FROM SEWERAGE ACTIVITIES ?
EFFLUENT FROM TREATMENT PLANTS & OVERFLOW DISCHARGES
SLUDGE DISPOSAL
HEALTH AND SAFETY
NOISE FROM PLANTS
VISUAL AND AESTHETICS
BUFFER
ODOUR


Climate Change - Global Warming
OVERVIEW
Varying sources of Greenhouse Gases (GHGs) i.e. emmisions from power sector, industries, transportation, waste treatment & landfills
Global Warming
Rising Temperature
Extreme weather
Rising sea level
Changing Ecology, emerging diseases

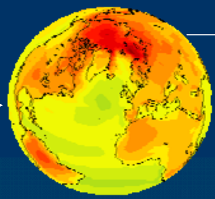
Climate Change - Malaysia

For Malaysia the estimated (in 1994) GHG emissions is 144 million Tonne of CO2 equivalent (or 3.7 per capita) about 2% of total world CO2 equivalent.

Wastewater sector accounts for 0.05% i.e. 73.5kiloTonne of national emissions, relatively insignificant compared to other countries.



Global Warming
Local Context



Disproportionately, the impacts will be felt locally e.g.:

- Water resources (increase in frequency and extent of extreme droughts).
- Extreme flooding and risk to infrastructure.
- Increase energy cost for operating treatment systems.
- Increase need for treatment improvements to protect threaten water resources.

Adaptation & Mitigation Initiatives required

Sewage Treatment and Climate Change
Identify local sources

Sources of GHGs from Sewage and Sludge Treatment Process

Indirect Sources

- Energy Consumption of non-renewable energy that releases CO_2.
- Activities that relies on power from the national grid will contribute indirectly to releases CO_2 i.e :
  - Pumping and aeration of sewage
  - Vehicular movements for desludging works sludge disposal and network services etc.

Direct Sources

- Fugitive Methane from anaerobic process.
- Nitrous Oxides (N2O) from nitrification and denitrification processes.
- Methane from on-site septic systems (ISTs/CSTs)
- Flaring of methane gas or methane combustion will also generate Co_2 and contribute to overall GHGs in the atmosphere
- Methane from sewage sludge disposal sites

Sewage Treatment and Climate Change

Indirect Sources

TNB, the main energy utility in Malaysia relies on a largely fossil based power plants.

Activities that relies on power from the national grid will contribute indirectly to releases CO_2 i.e.:

1)Pumping and aeration of sewage.
2)Vehicular movements for desludging works sludge disposal and network services etc.

Summary & Conclusion

- Sewerage in Malaysia had progressed well over the decade
- Sewerage planning in now looked together in the context of Integrated Water Resources Management for maximum benefits
- Global Climate Change has minimal impacts on sewerage management for now and next era


Water Cycle Should End Here
....
Thank You

Ⅸ-3-6)　Republic of the Philippines

Dr. Judy Famoso SESE
Director Ⅲ, Bureau of Research & Standards,
Dept. of Public Works and Highways

COUNTRY REPORT OF THE PHILIPPINES

Integrated Water Resource Management Adapting to the Global Climate Change

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

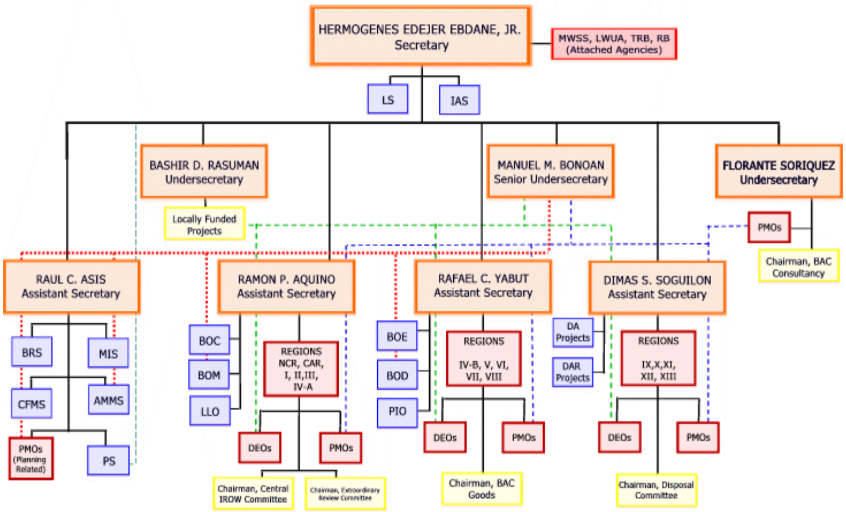
JFY 2007

Dr. JUDY F. SESE
Director III
BUREAU OF RESEARCH AND STANDARDS
Department of Public Works and Highways (DPWH)

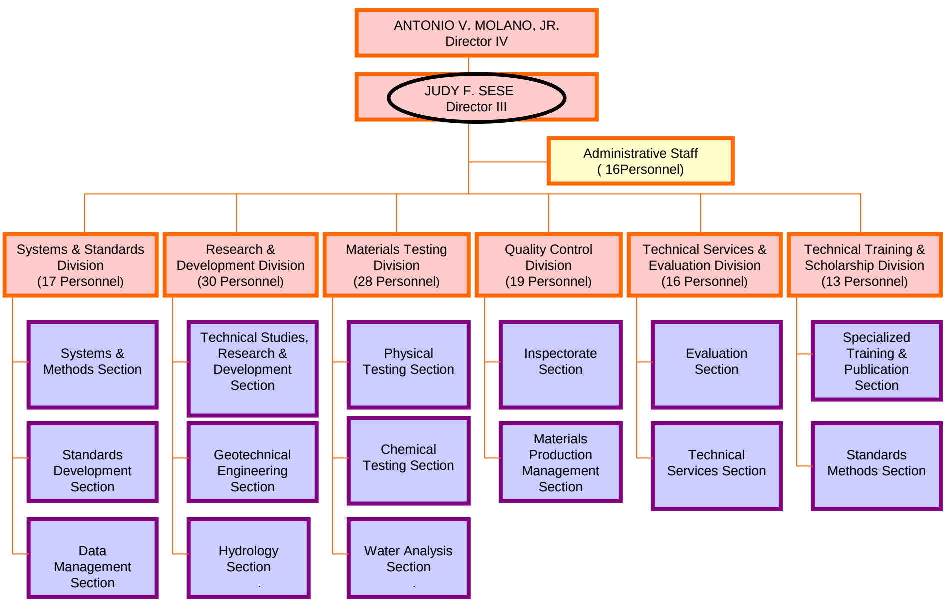
The Department of Public Works and Highways (DPWH), being the country's engineering and construction arm, is responsible for the planning, design, construction and maintenance of infrastructure such as: roads and bridges, flood control systems, water resource development projects and other public works structure.

The DPWH is likewise responsible in the monitoring of National Water Data Collection Program and recognizes the importance of Integrated Water Resources Management (IWRM) to ensure and secure sustainable water for all. This mechanism is also accepted as a way of adapting to the effects of global climate unpredictability.

DPWH ORGANIZATIONAL CHART



BUREAU OF RESEARCH AND STANDARDS ORGANIZATIONAL CHART



Philippines Integrated Water Resource Management (IWRM)

The Philippines has participated in the following IWRM activities:

- January 2006, UNEP assisted IWRM 2005 South East Asia Project
- Formation of Project Steering Committee composed of UP-NHRC and NWRB
- A Multi-Sectoral Task Force (MSTF) undertakes plan preparation represented by key government agencies
- IWRM Southeast Asian Project Meeting in Thailand
- Other workshops and meetings conducted

Series of Key Activities relative to IWRM Plan Framework

- Multi-Sectoral Task Force (MSTF) workshops and conferences
- Consultation-Workshop with Non-Government Organizations and Civil Society Organizations
- Multi-Sectoral Consultation-Workshops on the proposed National IWRM and Water Efficiency Improvement Plans in Visayas and Mindanao

PURPOSE OF PHILIPPINE IWRM PLAN FRAMEWORK

- The IWRM Plan Framework is a directional plan to guide the stakeholders in preparing their respective IWRM plans.
- Take-off in the preparation of regional and local IWRM Operational and Action Plans

PHILIPPINE WATER RESOURCES

a. Land and Water Systems

- Philippines consists of 7,100 islands
- Land Area of 300,000 square kilometers
- 421 Principal River Basins, 20 major river basin (at least 900 sq.km.)
- 15 major lakes (400 hectares and above)
- Total coastline is about 36, 289 kms.
- Average rainfall is about 2,400 mm.

PHILIPPINE WATER RESOURCES

b. Availability of Water Resources: Increasing Water Stress and Potential Scarcity

- Abundant water resources but facing possible water crisis due to rapid population growth, urbanization, industrialization and economic growth
- 1,907 cu.m. availability per capita is second lowest in Southeast Asia
- As of December 2006, about 19, 247 water rights grantees
- Irrigation facilities is about 1,515,347 hectares where 48.4% total irrigable area
- Total water resources production is 5,792,857 liters/sec.

PHILIPPINE WATER RESOURCES

c. Water Quality

- Water quality standards are regulated by the Environment Management Bureau, DENR
- Drinking standards are set by the Department of Health (DOH)
- 36% of rivers are potential source of water for drinking

PHILIPPINE WATER RESOURCES

d. Water Supply: Equity and Sustainability Issues

- Water supplies are provided by Local Government Units and Community-Based Organization

- Types of Facilities:
  - Level I – Point Source System
  - Level II – Communal Faucet System
  - Level III – Individual Household Connection

Philippine Water Resources Situations

e. Water Supply: Equity and Sustainability Issues

- Water supplies are provided by Local Government Units and Community-Based Organization

- Access to safe drinking water, 81.4% in 1999 to 80% in 2002

- Decline due to increasing population

Philippine Water Resources Situations

f. Inadequate Sanitation and Sewerage Services

- In 2000, access to adequate sanitation was estimated to be 74.2%
- Sewerage coverage is less 8% in Metro Manila and urban sewerage is 4% (six cities)

Philippine Water Resources Situations

g. Degradation of Major Ecosystems

- Philippine coral reefs, only 4.0-5.0 % in excellent condition
- More than 70% of mangroves converted to aquaculture, logged or reclaimed
- Beaches and foreshores have problems on erosions, sedimentation and water quality

Philippine Water Resources Situations

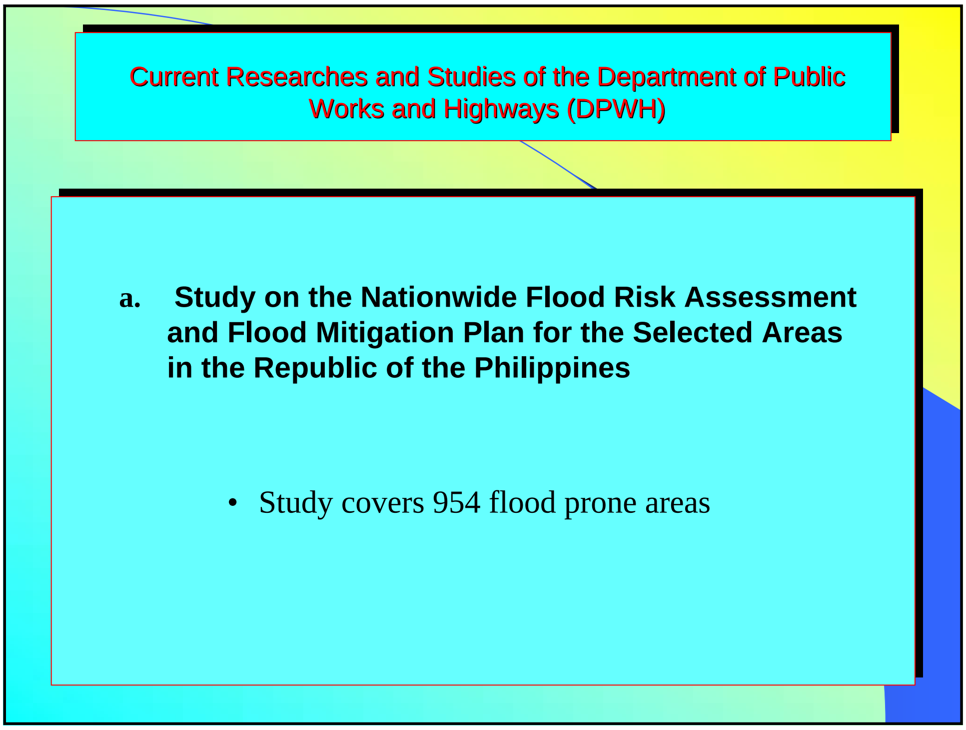
h. Increasing frequency and intensity of extreme climate events and variability

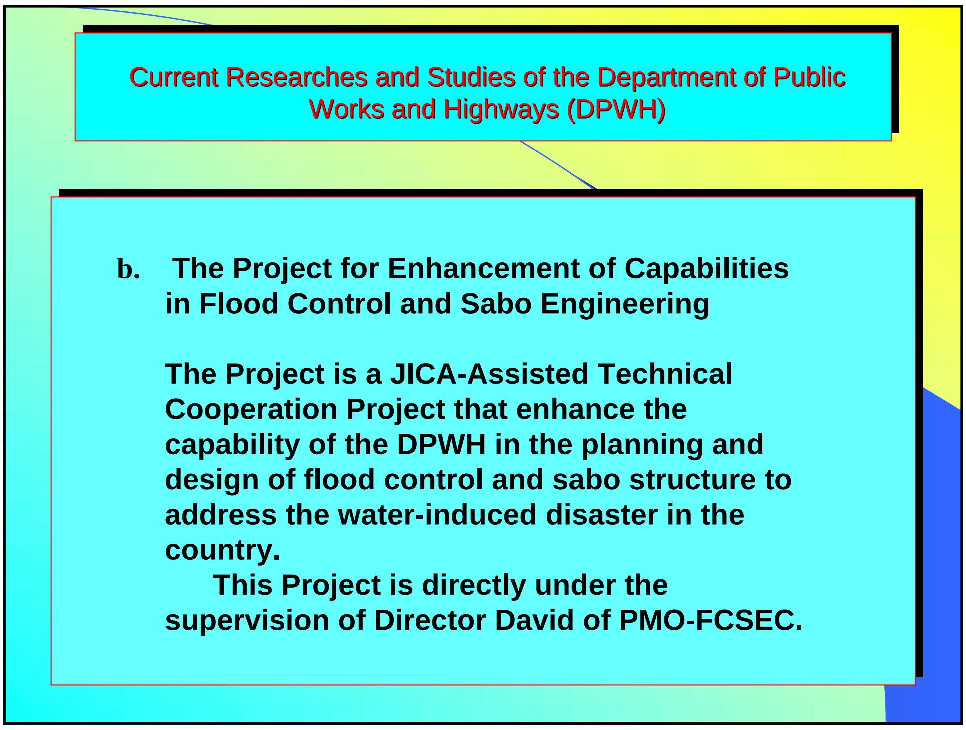
- Increase of floods, droughts, forest fires and tropical cyclones
- 5 La Niña and 7 El Niño episodes from 1970 to 2000 from only 3 La Niña and 2 El Niño in 1950-1970
- Tropical cyclones increased, strongest and very destructive

Philippine Water Resources Situations

i. Water Governance and Regulation: Sectoral Approach

- Water Resources governance is a responsibility of multiple government agencies (30 government agencies)


Current Researches and Studies of the Department of Public Works and Highways (DPWH)
a. Study on the Nationwide Flood Risk Assessment and Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines
• Study covers 954 flood prone areas


Current Researches and Studies of the Department of Public Works and Highways (DPWH)
b. The Project for Enhancement of Capabilities in Flood Control and Sabo Engineering
The Project is a JICA-Assisted Technical Cooperation Project that enhance the capability of the DPWH in the planning and design of flood control and sabo structure to address the water-induced disaster in the country.
This Project is directly under the supervision of Director David of PMO-FCSEC.

POLICIES AND PRACTICES

a. Integrated Water Resources Management Plan Framework

The National IWRM Plan Framework is not just a water plan. There are key differences between this plan and the traditional water plan. The IWRM Plan Framework has the following distinctive features:

1. Broader Focus:

   It looks at water in relation to other dimension needed to achieve larger development goals and meet strategic water related challenges.

Policies and Practices

2. It is Dynamic and Adaptive

   It provides framework for a continuing and adaptive process of strategic, integrated and coordinated action in all levels.

3. It is Integrated and Holistic

   all the different uses of water are considered together. Water allocation and management decisions consider the interrelationships and effects of these various uses. They are not viewed purely from a sectoral or project focus.

SUSTAINABLE OUTCOMES

Four (4) sustainable outcomes were identified. These are the medium to long-term goals that we aspire for our water resources management system. These outcomes reflect our development aspirations for IWRM, and would ensure sustainability for our water resources. These include the following:

Sustainable Outcomes

1. Effective Protection and Regulation for Water Security and Ecosystem Health
2. Sustainable Water Resources and Responsive Services for Present and Future Needs
3. Improved Effectiveness, Accountability and synergy among water-related Institutions and stakeholders
4. Adaptive and Proactive Response ro Emerging Future Challenges.

STRATEGIC THEMES

Each of these sustainable outcomes is supported by nine (9) strategic themes:

1. Ensuring rational, efficient and ecologically sustainable allocation of water
2. Enhancing effectiveness in groundwater management and acquifer protection
3. Achieving clean and healthy water
4. Managing and mitigating risks from climate change events and water related disasters

Strategic Themes

5. Promoting water conservation and improving water use efficiency
6. Expanding access and ensuring availability of affordable and responsive water supply and sanitation services
7. Promoting participatory water governance and supportive enabling environment
8. Strengthening knowledge management and building capacity for IMRM
9. Exploring new pathways to water resources management: Water Sensitive Design and Water Rights Trading.

"MARAMING SALAMAT PO"

(THANK YOU)

Ⅸ-3-7) Democratic Socialist Republic of Sri Lanka

Ms. Paniyanduwage Nalanie Sriyalatha YAPA
Deputy General Manager,
National Water Supply & Drainage Board

AYUBOWAN… …KONNICHI WA

Symposium Presentation

on

Integrated Water Resource Management Adapting to the Global Climate Change in Sri Lanka

Presented by
Eng. (Mrs.) P.N.S Yapa
Deputy General Manager
National Water Supply & Drainage Board
Sri Lanka.

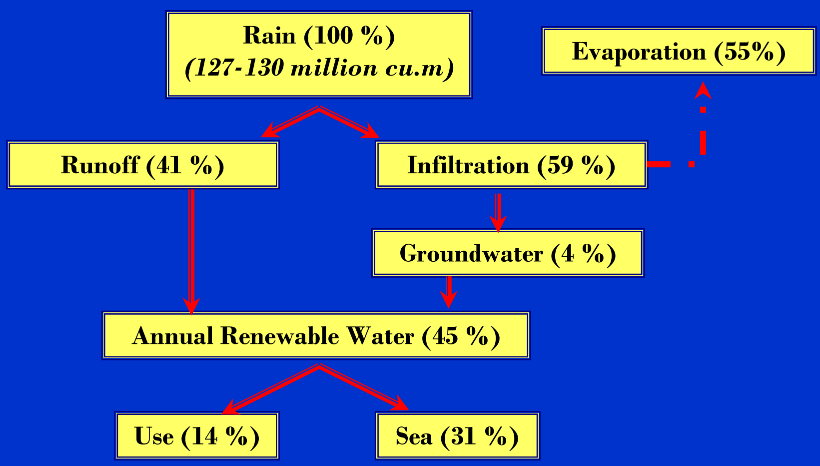
Sri Lanka

Location	Lat: 5 55’ – 9 51’ N
Lon: 79 41’ – 81 33’ E
In Indian Ocean

Geography: Tropical island with central hill country

National Water Balance, Seepage Characteristics and Main Usage Pattern

National Water Balance of Sri Lanka



Main Usage & Demand Pattern

Main Usage

Agricultural usage (in series with hydro-power)		: 96%
Domestic & Industrial usage		: 04%

Access for Domestic Usage

Pipe borne water	Urban	: 70%
(of 30% National Coverage)	Rural	: 15%
Dug wells		: 27%
Tube wells		: 08%
Streams & Lakes		: 35%

Impacts of Climate Change

Vulnerability of

Natural & Human Systems

to Climate Change

in Sri Lanka

Vulnerability on Human Settlements and Health due to Change in Flood, Drought and Cyclonic Pattern

Affects directly & indirectly on

- Natural environment of settlements
- Economic activities
- Building and infrastructure
- Health of resident and commuting population
- Exacerbating existing air pollution, poor waste management and inadequacy of water and sanitation facilities

Vulnerability on Human Settlements… Contd.

Unexpected Extreme Events beyond Natural Expectation in recent past

Year	Event	Extent of Damage
1992	*Drought*	*Tea production reduced by 26%* *Increased production cost by 19%*
1993	*Flood*	*43,000 houses destroyed* *219,870 persons displaced*
1993	*Flood*	*Submerged whole Colombo city (Capital of Sri Lanka)*
1994	*Flood*	*52,900 houses destroyed* *353,000 persons displaced*
1997	*Drought*	*Food insecurity & loss of income rose to 90-99% in Hambantota district*
2001/2002	*Drought*	*Shut down hydro-power generation* *Forced fossil-fuel power generation*
2002	*Cyclone*	*77,000 houses destroyed* *146,190 families affected*
2003	*Flood / Landslide*	*236 deaths* *9,294 houses completely destroyed* *30,360 houses partially destroyed* *138,973 families severely affected*
2006	*Persistent rain/ landslide*	*Forced to shift an entire city called 'Peradeniya' to a safer location*
2006	*Tornado*	*Hit twice over a week and destroyed 1,500 houses in Colombo city*
2006	*Abrupt Heat Wave*	*Wave reached 40^0 C in Colombo city*

Vulnerability on Human Health… Contd.

- Urban squatters in unauthorized make-shifts were exposed to *helminthic* and *protozoal* parasites due to floods and dengue epidemic (*aedes aegeypgy and aeds albopictus*) due to heavy rains (*Wanasinghe 1995*)
- Increased *Malaria, Dengue and Japanese Encephalitis* due to changed climate factors in North-western and increase of *anopheline* mosquitoes in dry North-central due to heavy rainfall and prolonged droughts (*De Alwis et al 2004*)
- Expansion of Malaria transmission from dry zone to areas that are hitherto free and change of its seasonal pattern [current mid year peak would be enhanced while the traditional high transmission season during North – East monsoon (Nov – Feb) extended] (*Dhanapala 1998*)
- Increase and spread of water washed and water borne diseases by floods, landslides and droughts
- Collapse of health infrastructure and displacement of affected persons would bring illnesses, injuries, deaths and physical and physiological trauma as well

Vulnerability of the Coastal Zone due to Sea Level Rise

(Sea level rise of 0.3m in Southwest coast leads to land loss of 06 sq.km and 1.0 m rise would cause 11.5 sq.km)

- 24% of total land area and 32% of population
- 65% of urbanized area
- 80% of tourism related infrastructure
- 65% of industrial output
- 100% commercial ports and fishery harbours and anchorage
- 80% of fish production
- Major highways and infrastructure
- Richest area with biodiversity; coral reefs, lagoons, mangroves, etc. covering 160,000 hectares
- Increased coastal erosion which is 0.3 – 0.35m per year at present

Siltation of Reservoirs

Polgolla Reservoir : 44% storage with 2.8% siltation rate per year

Rantembe Reservoir : 54% storage with 4.3% siltation rate per year

Victoria Reservoir : 0.08 siltation per year

Minor Tanks : 2.4% siltation per year

Importance of Adaptation

In Sri Lanka, poor communities are heavily dependant, directly or indirectly, on natural systems and their behavioral pattern…

…..Thus the poor in the country will be the mostly affected and will find it difficult to recuperate !

Policy Adapted to Minimize the Impact

Policies

- Ratification of 36 Multilateral Environmental Agreements (MEAs) which include the development of National Environment Policy, National Forestry Policy, National Policy on Wildlife Conservation and National Air Quality Management Policy,
- Development and adoption of National Environmental Action Plans (ie: Biodiversity Action Plan, National Climate Action Plan, Coastal 2000 Action Plan, Clean Air 2000 Action Plan and National Forestry Sector Master Plan.)
- Preparation of National Strategy for Clean Development Mechanism to implement the Kyoto Protocol
- Establishment of Climate Change Secretariat, Bio Diversity Secretariat and Ozone Secretariat to strengthen the capacity of implementing agencies

Practices

The environmentally friendly practices that have already benefited the country are;

- Introduction and popularization of fuel efficient stoves that reduce fuel woods
- Introduction of cleaner production technologies among polluting industries
- Installation of mini-hydro power plants as stand-alone and grid connecting system
- Facilitation of rain water harvesting in the dry zones. National Rainwater Harvesting Policy is to be adopted, making rainwater harvesting mandatory
- Identification of cost-effective utility scale wind power development (Young and Vihaure 2003)

Mitigatory and Adaptative Physical Measures

- Recent flood control, water resource development and management projects
- Construction of Salinity Barrier and Dams to prevent salinity intrusion
- Step-land agriculture in Hill country
- Advanced capacity building programme on integrated water resource management under 'Pavithra Ganga' (Clean Rivers) pogramme
- Promotion of Rain Water Harvesting in Dry Zone

Research & Survey

Year	By	Concern
2004	*Nugawela, Rodrigo & Munasinghe*	Increased carbon fixing capacity of Rubber
2004	*Sirisena et al*	Methane emission from paddy fields
2004	*Abeywardana*	Paddy with high responsiveness to elevated carbon for future breeding
2004	*Emmanual*	Urban heat island effect
2004	*Senanayake*	Greenhouse gas emission from Desiccated coconut industry
2004	*Pannilage*	Effect on water yield by land use practice in catchments areas
2004	*Ariyananda*	Type of tanks for rain water harvesting

Mitigatory Actions in Legislation / Water Reforms

The following is a summary of the water 'reform' process in Sri Lanka during the last quarter century

Date	Instrument	Authority	Provisions
1980	*water resources Bill*	*Ministry of Irrigation, Power and Mahaweli Development*	*Bulk water allocation to various sectoral agencies (and further allocation by those agencies) and for the establishment of a National Water Resources Council (this legislation, however, was never submitted to Parliament due to lack of cabinet support).*
1983	*Irrigation Ordinance (amendment)*		*Enable farmers to be prosecuted for non-payment of water taxes.*
1984			*Commencement of charging water taxes from farmers*
1988	*Policy of "Participatory Management of Irrigation Systems"*		*Substantial devolution of authority and responsibility to farmer organizations*
1988	*Irrigation Management Policy Support Activity (IMPSA)*	*International Irrigation Management Institute (IIMI)*	

Mitigatory Actions in Legislation / Water Reforms….Contd.

Date	Instrument	Authority	Provisions
1992	Summary Report IMPSA	International Irrigation Management Institute (IIMI)	Recommendations on land, watershed and water resource management, and that the government should establish a high-level advisory National Water Resource Council and Secretariat.
1992			Proposal to carry out a water resources master plan was presented to external support agencies.
1993	Institutional Assessment for Comprehensive Water Resources Management (IACWRM) Project.		Assess the institutional capacity for water resources management. The action plan of the project focused mainly on the need to develop a National Water Resources Policy, to establish a permanent institutional arrangement for water sector coordination and to prepare and enact" National Water Act'
1994	Irrigation Ordinance was amended by Act No. 13 of 1994		Enable farmer organization to levy charges from the members of the organization for the operation and distribution of water through canal systems.
1995		Cabinet	The implementation of the Strategic Framework and Action Plan for the "Institutional Strengthening for Comprehensive Water Resources Management (ISCWRM) Project.
1996	IACWRM project	Government	Establishment of a Water Resources Council (WRC) and a Water Resources Secretariat (WRS).

Mitigatory Actions in Legislation / Water Reforms….Contd.

Date	Instrument	Authority	Provisions
1996 to early 2000	ISCWRM project		Production of the "National water Resources Policy and Institutional Arrangements" and the " National Water Resources Authority (NWRA) Bill"
28th March 2000		Cabinet of Ministers	Approval of the National Water resources Policy.
Septembe r 2000		Legal draftsmen's department	Release of the Draft National Water Resources Authority Bill. (Government, however, failed to push the Act through the parliament and to establish NWRA).
2001			National Policy on Rural Water Supply and Sanitation was approved.
2001	The '100 day' programme	Ministry of Irrigation and Water Management	Setting up task forces for the implementation of its water management policy at 4 levels; Village Irrigation Committee. Divisional Secretariat Irrigation Committee, District Irrigation Committee and National Irrigation Committee.
2002	PRSP	GOSL	Published the Poverty Reduction Strategy Paper (PRSP) including proposed reforms on water sector.
2002	Regaining Sri Lanka	GOSL	PRSP was incorporated into the policy document " future: Regaining Sri Lanka". Water reform policy was not taken for public discussions.

Mitigatory Actions in Legislation / Water Reforms….Contd.

Date	Instrument	Authority	Provisions
22 nd October 2003	Water Services Reform Bill	GOSL	Presented the " Water Service Reform: A Bill: to privatize pipe borne water supplies in the country in both rural and urban areas and public sewerage services. The Bill refers to drinking water and other sources of water'.
2003 to 2004	Civil action	Supreme Court	Civil Society Organizations and citizens challenged the bill before Supreme Court and a decision against the introduction of the bill was given
August 2004	Basic Policies of Usage, Conservation and Development of Local Water resources (Draft)	Agriculture Livestock, Land and Irrigation Ministry	
September 2004	water Resources Policy (Draft)	Water Resources Secretariat under the Mahaweli and River Basin Development and Rajarata Development Ministry	
22nd November 2004		The cabinet	Decided to amalgamate these two documents and come up with a common one.
24 th November 2004	National Water Resources Policy (Draft)	The special Presidential Task Force	The "common" policy document

Mitigatory Actions in Legislation / Water Reforms….Contd.

Date	Instrument	Authority	Provisions
21st December 2004		The cabinet	The document was discussed, with the versions in Sinhala and English being significantly different from each other.
January 2005		The cabinet	A four-member Cabinet sub committee was formed to come up with new proposals for a water policy.
January 2005	National Rainwater Policy And Strategies	Ministry of Urban Development and Water Supply.	In the light of increasing operational and maintenance costs to, rationalize investments, both by Government and non Government sectors, in the field of pipe borne water supply, drainage, flood control, soil conversation etc.and promote the practice on a Regional Community and family basis, in order to ensure that the 'City of tomorrow' applies Rain water harvesting broadly, by the control of water near its source, in its pursuance of becoming a 'Green city' in the future.
8th September 2005	Draft National Water Resources Management Policy	Presidential Secretariat	Attempt to reconcile the "Basic Policies of Usage, Conservation and Development of Local Water Resources (Draft)" and National Water Resources Policy (Draft)"
17th November 2005			Presidential election. At the opening of the new Parliamentary sessions, the President declares the need for National Water Policy.
2-12 December 2005	Aid-memoir on the proposed National Water Management Improvement (NAWAM) Project.	Agreement between the Cabinet and the World bank.	US$ 70 M loan from the IDA

THANK YOU !

Ⅸ-3-8) Socialist Republic of Vietnam

Ms. DANG Anh Thu
Expert (environmental management and urban planning),
Department of Urban Technical Infrastructure,
Ministry of Construction

16th International symposium on national land development and engineering in Asia

Vietnam
and it's
Integrated water resource management adapting to climate change

Case study

by Dang Anh Thu

Introduction

The rapid economic growth rate following the economic reform policy from 1986 onwards.

Geography background

Socialist Republic of Vietnam

- Forms an "S", located in centre of South East Asia
- Population: 83 million, 26.8% are urban habitant
- Capital City: Hanoi
- Area: 330,000km^{2}, eight special zones
- Coastline of 3,300km
- Bordered by China in North and Laos and Cambodia in West
- Major industries: rice, rubber, food processing, sugar, textiles, chemicals, bags

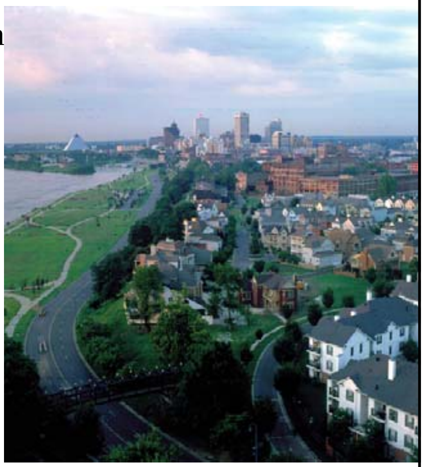
3

Vietnam's water resources

Vietnam has water resources at medium scale in the world and has unsustainable elements.

Vietnam's water resources at medium scale in the world

• Total surface water: 830 billion m3 in which have only 310 billion m3 creating by rainfall
• Sum exploitability of reserves groundwater: 60 billion m3/year.
• Water reserves in preliminary survey stage: 8 billion m3/ year (about 13% Sum reserves)
• Surface water and groundwater: 4400 m3/person in average, (in the world is 7400 m3/capita, year).



5

Vietnam's water resources has degradation tendency by impact of global climate change.

Vietnam is effected by global climate change with two impacts:

• Global climate change will lead to reduce water resources.

Factor	At present	2015	2025	2100
Total of water surface (billion m3)	830	660	627	592
		96%	91%	86%

• Sea level to increase considerably. The WB's research shown that sea - level may be increase more than expected before and Vietnam is one of the countries may be effected impacts strongly. Prediction with each 1 meter of sea- level increase, about 10.8% population of Vietnam 'll be remove them living place.

6

Unsustainable elements of Vietnamese's water resources

- The water capacity from outside of Vietnam has occupied approximately 2/3 of total achieved water volume,
- Allocation of both surface water and groundwater are snatchy.
- Disadvantage of water resource in use and exploitation
- Exhaustion of natural water more and more increase

Case study

Management and development of water resource adapting to impacts of climate change at Huong river in Hue city

8

Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue city

Hue is a central province of VN

- Area: 5.009, 2 km2,
- Coastline of 126 km
- Average precipitation: 2500 mm

The Huong River is most big river, there is 300 km2 catchment area

9

Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue city

Exploitation and utilization of water source at Huong's valley

Water utilization

Total demand of water utilization for all sectors: 444.4 million m3/year in which:

- Piped water: 13.4 million m3/year,
- Industry: 2.0 million m3/year,
- Agriculture: 390 million m3/year,
- Breeding: 3 million m3/year and
- Aquaculture: 36 million m3/year.

10

Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue

Difficulty and Problems

Currently the exploitation system and using of water source at Huong's river were mainly irrigation works

- **Irrigation:** not enough in 8 months of dry season. Reservoir, irrigation works were limited that did not satisfy irrigation purposes and unstable.
- **Water supply**: Source of water supply was not stable and water supply system for urban areas, industry and living purposes were not appropriate.
- **Drainage:** Drainage works were not adequate
- **Anti-flood:** Anti-flood was only carried out in floods and Tieuman at low and evarage intensity

11

Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue

Impacts of climate change for water resources of Huong's river

Scenario of climate change in northern central

Factor	Region	2010	2050	2070
Increase temperature (0C)	Northern central	0.3	1.1	1.5
Sea level (cm)	Coastal	9	33	45

- **For river flow**

In 2070: annual flow will reduce mainly in central region 23 - 40,5% and increase 49% at south central region. Annual flow in Ta Trach river (main branch of Huong river) is only 1.350 mm, reduce 42,9% compared with existing figure of 2.362 mm.

- **For potential evaporation level** in Hue City is correspondent with the scenario of temperature increase of 10C at 3,2% and 2,50C at 8,1% respectively.

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Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue

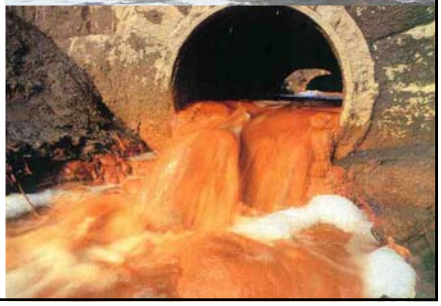
Climate change will impact directly to source of water at Huong basin and caused the following effects:

• Flow at rivers will reduce. Increased temperature and evaporation volume will reduce capacity and water quality at valley.

• Irregular fluctuation of rain intensity, flood and drought for the plant crops will happen regularly.

• Changing of climate with increased temperature, variation of rainfall and sea water will impact to the coastal region and lagoon.

• Sea water encroached on the land will impact to ecosystem of some aquaculture species....



Case study: Management and development of water resource adapting to impacts of climate change at Huong river in Hue

Proposed methods to ensure water demand for long term:

• Reasonable, economic and effective utilization of existing water source

• Renovation policy and improvement of institutional management for water source

• Environmental and ecosystem protection at valley and riverside

• Construction of reservoir works by multi mode and scale

• Development of human resources for management and exploitation of water source

• Propaganda and Community education

Case study of Tien Giang

- **Tiền Giang Province** is a province in the Mekong Delta region of southern Vietnam.
  - Capital: Mỹ Tho
  - Population: 1,635,700
  - Area: 2,367 km²

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Case study of Tien Giang

Difficulty and Problems

- Half of the land area is exposed to annual floods and the other half to saline intrusion.
- Traditional sources of domestic water are naturally polluted by alluvium acidity and salinity
- Water related diseases have been very serious
- Only about half the urban residents had regular access to piped water
- Rural residents developed their own water sources by drilling of wells, but without any resources planning.
- The first real impact was disastrous. The water quality from the shallow wells was so bad that the water was undrinkable.
- Abandoned wells were not closed properly, resulting in aquifer deterioration that affected a widespread area.
- The limited national and provincial budgets prevented rehabilitation and support to these areas.

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Case study of Tien Giang

- The formulation of the National RWSS Strategy (in 1998) provided a good opportunity for the Province to effect changes. After three years, TienGiang Province manages both surface and groundwater resources, ensuring water supply for 50% of rural population. The Province and the communities worked through self-help.
- Key components of the strategy included:

  - A participatory approach, throughout project planning and implementation

  - Technical support from the provincial government

  - Appropriate financial policies for poor and difficult areas

  - Establishment of water user groups, with the legal entity to hold, manages and operates facilities.

  - Training and educating for water user groups so that they have enough ability to make plans choose technology, manage the water resources and the environment. M

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Case study of Tien Giang

- **Lessons learned**

  - RWSS is considered as a useful point of departure for poverty elimination and rural development, and achievements from RWSS help to motivate other social efforts.

  - Information, education and communication (IEC) activities are very important to all levels including communities, local authorities, technical and credit agencies.

  - Water resources for RWSS are of small quantity and dispersed in nature, and mainly related to groundwater, the monitoring of which is still very weak. Therefore this development must be integrated within integrated regional and basin planning, thus avoiding negative impacts to water resources and the environment.

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Case study of Tien Giang

- **Importance of case for IWRM**

  - The case shows how good planning leads to efficient use of water resources, and the integrated approach has led to a harmonious and equitable share of economic and social benefits among communities: all people have clean water for use and improved their life quality by their own contribution.

  - The management of sanitation, domestic waste and rural waste production has contributed to good water quality and preservation of eco-systems.

These ideas are embodied in the concept of integrated water resources management (IWRM).

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Conclusion

Degradation of water resource due to climate change and socio-economic development is clear and remarkable. Overcoming or diminishing measures are only effective when they are comprehensive implementation, unification in action from lower to upper levels, from raising awareness to specific activities, deeds

X REFERENCE

X-1-1 History

X-1-1-1) Conference

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

Duration	October 17, 1994 - October 28, 1994
Place	Public Works Research Institute, MOC
Program	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
	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 "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)
	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)
	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 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 15th Conference on Public Works Research and Development in Asia

Duration	November 6, 2006 - November 17, 2006
Place	National Institute for Land and Infrastructure Management, MLIT Japan International Cooperation Agency, Aichi Art Center
Program	Keynote Lectures (1) Road Policies in Japan – Brief History and Recent Topics – Dr. Haruo ISHIDA Dept. of Social Systems and Management, Tsukuba University
	Lectures (1) Efforts Towards More Accessible And Functional Expressway System Mr. Kenta HAMAYA Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (2)Evaluation of Freight Transport Network Mr. Tatsuo KONO Senior Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (3)Comprehensive Implementation of Road Administration Management in Japan Mr. Tetsuya OWAKI Senior Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (4)An Overiew of Road Traffic Survey in Japan and Utilization for grasping traffic congestion Mr. Shinji ITSUBO Researcher, Traffic Engineering Division, Road Department, National Institute for Land and Infrastructure Management (5)Trend of Road Accidents and Measures in Japan Dr. Susumu TAKAMIYA Senior Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (6)Collection and Utilization of Date on Traffic Accidents Mr. Shinsuke SETOSHITA Senior Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (7)Effects of Traffic safety Measures and Effective Development Methods for Traffic Safety measures Mr. Hiroki HASHIMOTO Researcher, Advance Road Design Safety Division, Road Department, National Institute for Land and Infrastructure Management (8)Environmental Issues of Roads in Japan Mr. Shinri SONE Senior Researcher, Road Environment Division, Environment Department, National Institute for Land and Infrastructure Management (9)Management and System of Road Structures in Japan Mr. Takashi TAMAKOSHI Head, Bridge and structures Division, Environment Department, National Institute for Land and Infrastructure Management (10)General Information on Deterioration of Existing Concrete Structures and Recent Research Topics on The Maintenance Techniques in Japan Mr. Hiroshi WATANABE Team Leader, Structure Management Technology Team, Construction Technology Research Department, Public Works Research Institute

	(11)Maintenance of Steel Bridges Mr. Jun MURAKOSHI Team Leader, Bridge Structure Team,Structures Research Group, Public Works Research Institute (12)Pavement Management Practice in Japan Mr. Kazuyuki KUBO Team Leader, Pavement Team, Road Technology Research Group Public Works Research Institute (13)State of the Art and Future Prospect of Maintenance and Operationof Road Tunnel Dr. Hideto MASHIMO Team Leader, Tunnel Team, Road Technology Research Group Public Works Research Institute (14)Control of Maintenance in Earthworks Dr. Hidetoshi KOHASHI Team Leader, Soil Mechanics Team, Material and Geotechnical Research Group, Public Works Research Institute (15)Capability of ITS for sustainable social infrastructure Dr. Tadashi YOSHIDA ITS deployment strategy Research team, special Committee Team, Japan Society of Civil Engineers
	Subject of Common Interest Session Economic and Social Effects of Road Network Development
	Discussions of Specific Subjects 1)Effect and Evaluation of Road Network Development 2)Road Traffic Safety and Environment a) Road Accidents and Measure b) Effort toward Road Environment 3)Road Structures Management
	Study Tour 1) NILIM and PWRI: Structural Aerodynamics Laboratory, Noise Control Laboratory, Low Noise Pavement and Noise Barrier, Test Track, ITS Laboratory, Pavement Test Field, Vibration Laboratory, Traffic Collision Test Field 2) Tokyo Area: East Tokyo Operation bureau, Harumi Route, Tokyo Wan Aqua-Line, Tokyo Outer Ring Road 3) Chubu Area: Linear motor train Base, Tokai Ring Expressway, Tsutsumi Plant of Toyota Motor Corporation, Nagoya Ring Highway 2, Tobishima Container Terminals
Participants	138

The 16th Conference on Public Works Research and Development in Asia

<table>
<tr><td>Duration</td><td>November 26, 2007 - December 7, 2007</td></tr>
<tr><td>Place</td><td>National Institute for Land and Infrastructure Management, MLIT
Japan International Cooperation Agency, Hotel Shiragiku</td></tr>
<tr><td rowspan="2">Program</td><td>Keynote Lectures
(1) Water-related Disaster Management for Adaptation to Climate Change
Dr. Kuniyoshi TAKEUCHI
Director of the International Centre for Water Hazard and Risk Management (ICHARM), PWRI</td></tr>
<tr><td>Lectures
(1) Predicted Effect of Global Climate Change on precipitation Characteristics in Japan and related research activities in NILIM
Mr. Josuke KASHIWAI
Research Coordinator for Watershed Management, River Department, NILIM
(2) The Investigation on the Drought Risk Assessment in Japan Due to Global Warming
Mr. Nario YASUDA
Head, Water Management and Dam Division, River Department, NILIM
(3) Policy Making and Implementation Processes for Securing Water Resources in the Tokyo Metropolitan Area to Cope with the Rapid Population Growth
Mr. Koichi FUJITA
Head, River Environment Division, Environmental Department, NILIM
(4) The Evaluation of Flood Risk and Prevention of Flood Disaster
Mr. Takayuki ISHIGAMI
Senior Researcher, River Division, River Department, NILIM
(5) Storm Surge Forecast System for Floodfighting Warning
Mr. Masaya FUKUHAMA
Head, Coast Division, River Department, NILIM
(6) Support for Evaluation Ahead of Sediment Disasters
- Using Rainfall Indices to Predict the Danger of Sediment Disasters -
Mr. Kazuya AKIYAMA
Senior Researcher, Erosion and Sediment Control Division,
Research Center for Disaster Risk Management, NILIM
(7) Planning Adaptation Programs for Future Climate Change
Mr. Junichi YOSHITANI
Team Leader, Disaster Prevention Team, ICHARM, PWRI
(8) Outline of Sewerage Works and The Strategies for The Future in Japan
Mr. Osamu FUJIKI
Director, Water Quality Control Department, NILIM
(9) Urban Stormwater Management
Mr. Takashi SAKAKIBARA
Head, Wastewater System Division,
Water Quality Control Department, NILIM
(10) Utilization of Reclaimed Wastewater
Mr. Mizuhiko MINAMIYAMA
Head, Wastewater and Sludge Management Division,
Water Quality Control Department, NILIM
(11) Beneficial Use of Biomass at Wastewater Treatment Plants
Mr. Masaaki OZAKI
Team Leader, Recycling Research Team,
Material and Geotechnical Management, PWRI</td></tr>
</table>

	Subject of Common Interest Session Integrated Water Resource Management Adapting to the Global Climate Change
	Discussions of Specific Subjects 1) Water Resource Management 2) Water Disaster Management 3) Water Environment and Wastewater Management
	Study Tour 1) NILIM and PWRI: Oceanic and Coastal Experimental Facilities, River Hydraulic Experimental Facilities, Dam Hydraulic Experimental Facilities, Water Quality Experimental Facilities 2) Tsukuba Area: The Meteorological Research Institute 3) Kyusyu Area: The Seawater Desalination Center, Chikugo Ohzeki (The Chikugo River Weir), Suigou Yanagawa (River of Yanagawa)
Participants	111

X-1-1 History

X-1-1-2) Symposium

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 Natural 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

The 15th International Symposium on National Land Development and Civil Engineering in Asia

Duration	November 16, 2006
Place	Aichi Arts Center, Nagoya
Host	National Institute for Land and Infrastructure Management
Theme	Economic and Social Effects of Road Network Development in Asia
Program	**Lectures** 1) Automotive Safety Technologies Toward Achieving Sustainable Mobility” Mr. Takashi SHIGEMATSU, Managing Officer, Toyota Motor Corporation 2) Case of Japan Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 3) Case of Chubu District Mr. Toshio SAKAI, Director, Road Department, Chubu Regional Bureau 4) Case of Korea Dr. Weon-Eui KANG, Director of Highway Engineering Research Department, Korea Institute of Construction Technology
	Panel Discussion “Economic and Social Effects of Road Network Development in Asia” - M.C.: Mr. Hiroshi SATO, Director, Road Department, NILIM - Panelists: 1) Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM 2) Mr. Toshio SAKAI Director, Road Department, Chubu Regional Bureau, MLIT 3) Mr. Guang-Tao YIN, Senior Engineer, Vice Director, Urban Transport Institute, China Academy of Urban Planning and Design, People’s Republic of China 4) Mr. Hikmat ISKANDAR, Head, Traffic & Envir. Lab., Research and Development Centre for Road and Bridges, Republic of Indonesia 5) Dr. Weon-Eui KANG, Director, Highway Engineering Research Dept. Korea Institute of Construction Technology, Republic of Korea 6) Mr. Pothong NGONPHACHANH, Deputy Director General, Department of Roads, Ministry of Communication, Transport, Post and Construction, Lao People’s Democratic Republic 7) Mr. Amrullah KAMAL, Deputy Director 3, Public Work Department, Malaysia 8) Mr. Ramesh Raj BISTA, Deputy Director General, Department of Road, Nepal 9) Mr. Bashir AHMED, Director (Roads), Ministry of Communication, Islamic Republic of Pakistan 10) Mr. Raul Conde ASIS, Assistant Secretary, Department of Public Works and High ways, Republic of the Philippines
Participants	120

The 16th International Symposium on National Land Development and Civil Engineering in Asia

Duration	December 3, 2007
Place	Hotel Shiragiku, Beppu
Host	National Institute for Land and Infrastructure Management
Theme	Integrated Water Resource Management Adapting to the Global Climate Change in Asia
Program	**Lectures** 1) Integrated Water Management under the Global Warming Scenario –Case Study of Northern Kyusyu with Scarce Water Resources– Dr. Kenji JINNO Professor, Faculty of Engineering, Kyushu University
	Presentation and Discussion "Integrated Water Resource Management Adapting to the Global Climate Change in Asia" - M.C.: Mr. Kazunori OODAIRA, Director, River Dept., NILIM -Panelists: 1) Dr. Kenji JINNO, Professor, Faculty of Engineering, Kyushu University 2) Mr. Shin TSUBOKA, Director General, NILIM 3) Mr. Yoshinori ASHIDA, Director, Planning Dept.,Kyusyu Regional Bureau, MLIT 4) Mr. Dhinadhayalan MURUGESAN, Assiatant Adviser of Public Health and Environmental Engineering, Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, India 5) Dr. Seok-Young YOON Director, Policy Research Division , Korea Institute of Construction Technology, Republic of Korea 6) Mr. Wan Abd Rahim Bin WAN ABDULLAH, Director, Sewerage Services Dept., Ministry of Energy, Water & Communication, Malaysia 7) Dr. Judy Famoso SESE, Director Ⅲ, Bureau of Research & Standards, Dept. of Public Works and Highways, Republic of the Philippines 8) Ms. Paniyanduwage Nalanie Sriyalatha YAPA, Deputy General Manager, National Water Supply & Drainage Board, Democratic Socialist Republic of Sri Lanka 9) Ms. DANG Anh Thu, Expert (environmental management and urban planning), Department of Urban Technical Infrastructure, Ministry of Construction, Socialist Republic of Vietnam ,
Participants	100

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