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

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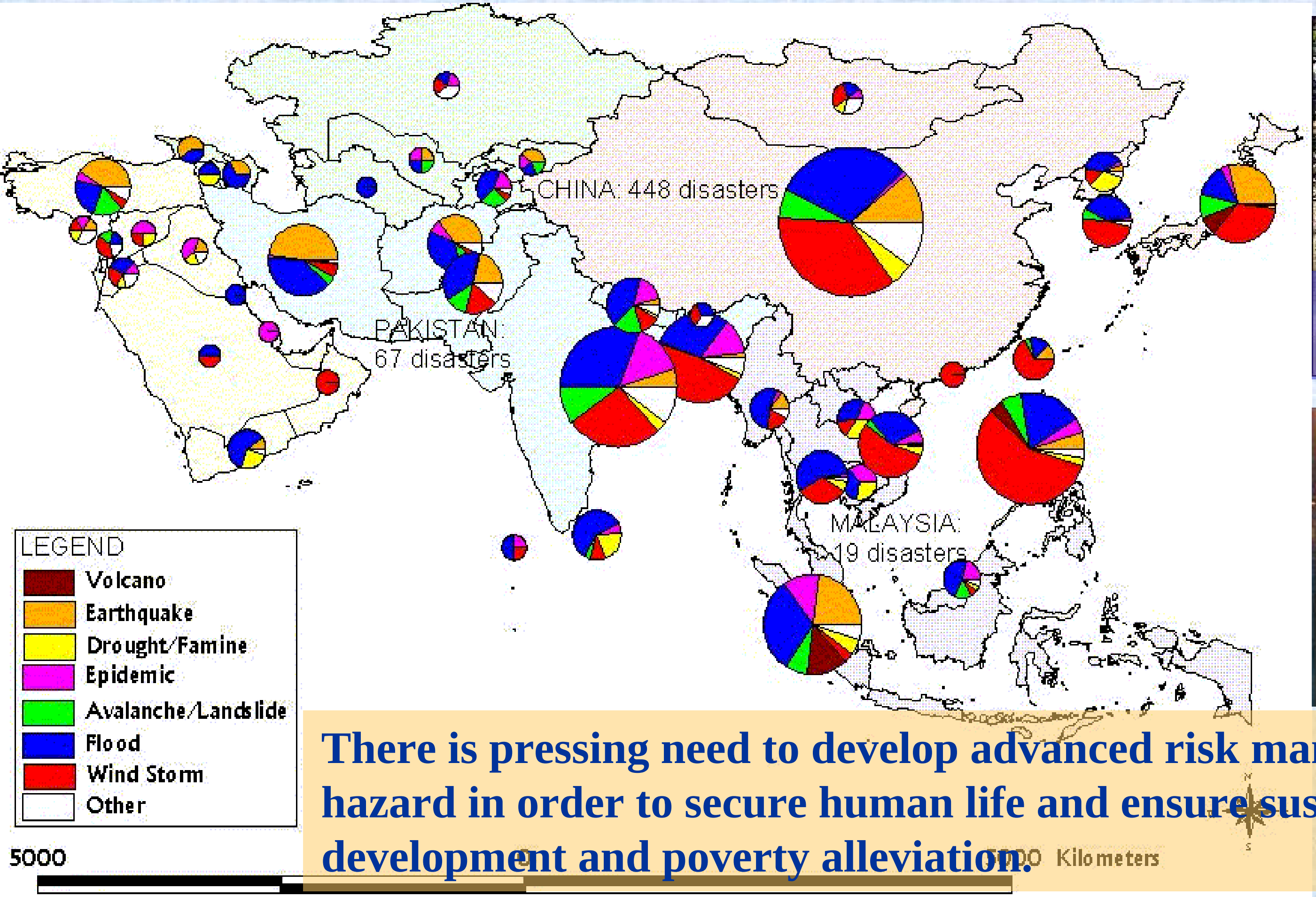
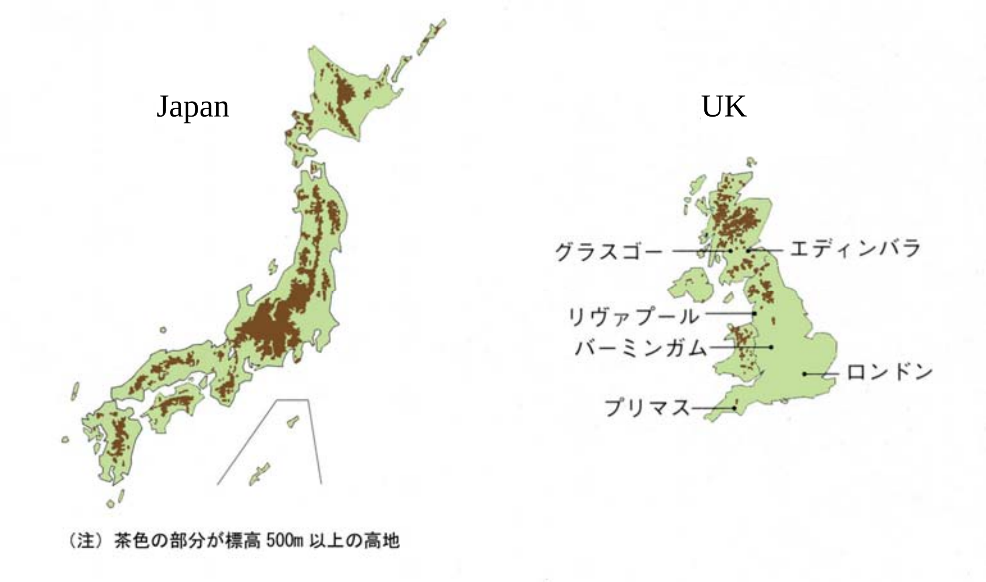
Asia Most Affected by Flood Disasters

People outlook to disasters! Can it make a difference

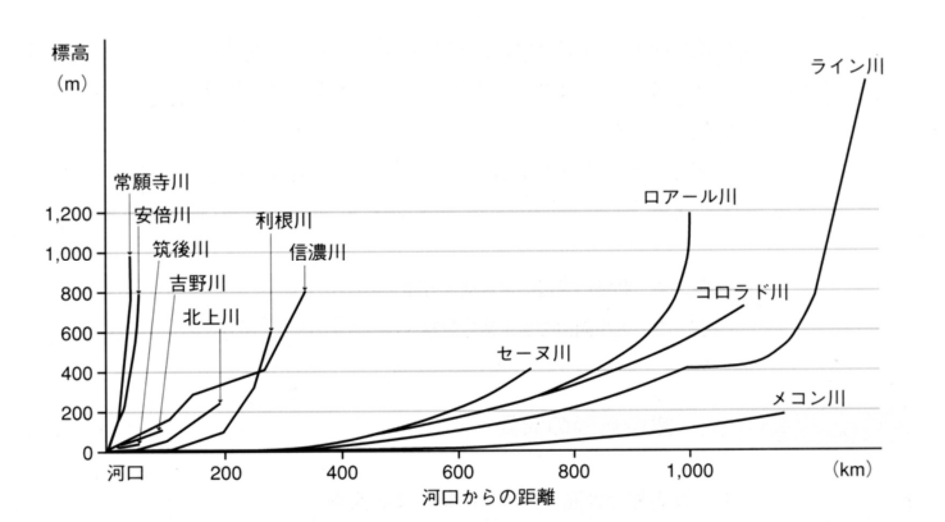


There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.

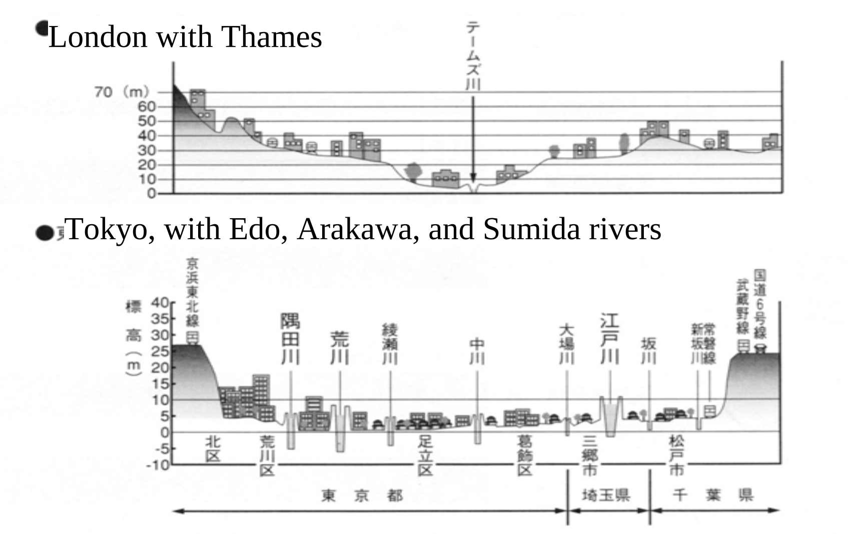
Geographical Features of Japan



Smaller area of level ground (as compared with UK)



Steeply sloping rivers (in terms of longitudinal slope)



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

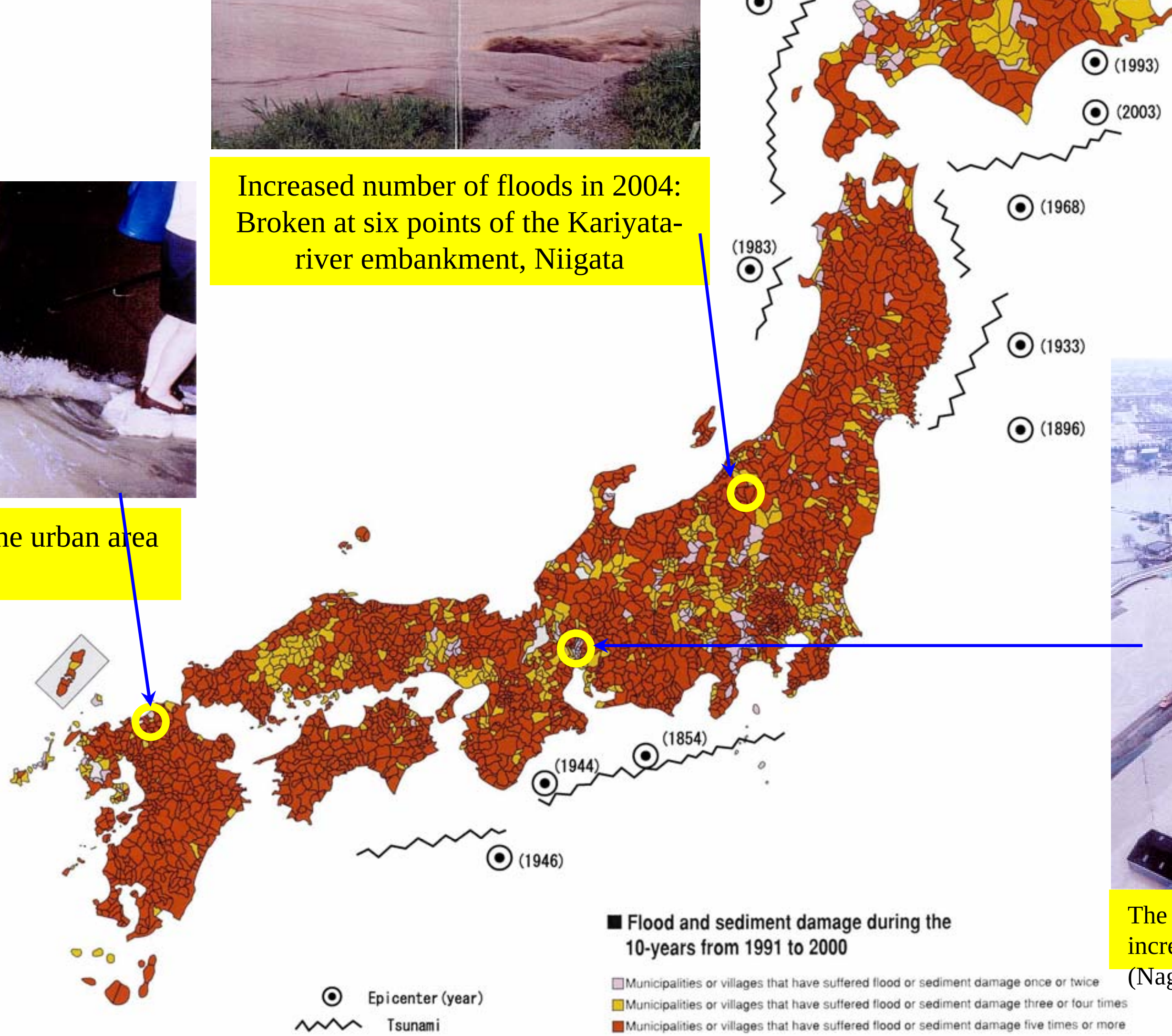
The History of Legislation about Disaster Control

2000	Sediment Disaster Countermeasures for Sediment Disaster Prone Areas Act
1998	Act Concerning Support for Reconstructing Livelihoods of Disaster Victims
1972	*Marine Pollution Prevention Act*
1969	*Act Concerning Prevention of Steep Slope Collapse Disaster*
1964	*River Act (Revised)*
1961	*Disaster Countermeasure Basic Act*
1960	*Soil Conservation and Flood Control Urgent Measure Act*
1958	*Landslide Prevention Act*
1956	*Seashore Act*
1949	*Flood Control Act*
1948	*Fire Service Act*
1897	*Erosion Control (SABO) Act, Forest Act*
1896	*River Act*
1880	*Provision and Saving Act for Natural Disaster*

Characteristics of Recent Flood Damages

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

Underground flood in the urban area (Fukuoka)



The urban flood disaster caused increased damage cost (Nagoya)

Overview and Characteristics of Flood Disasters

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

←Improvement of flood control system and weather information

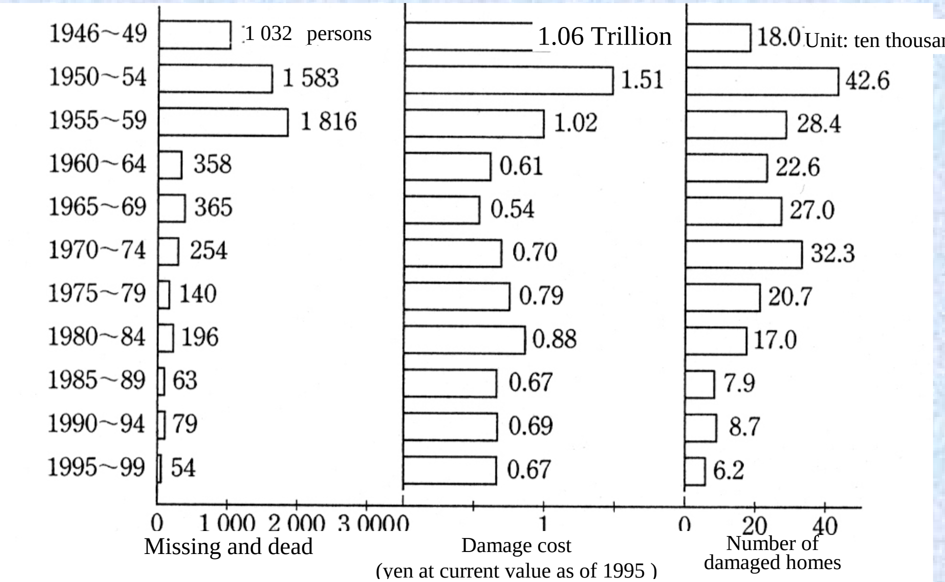
Rate of completed embankment: 38%(1976) →56%(2002)

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

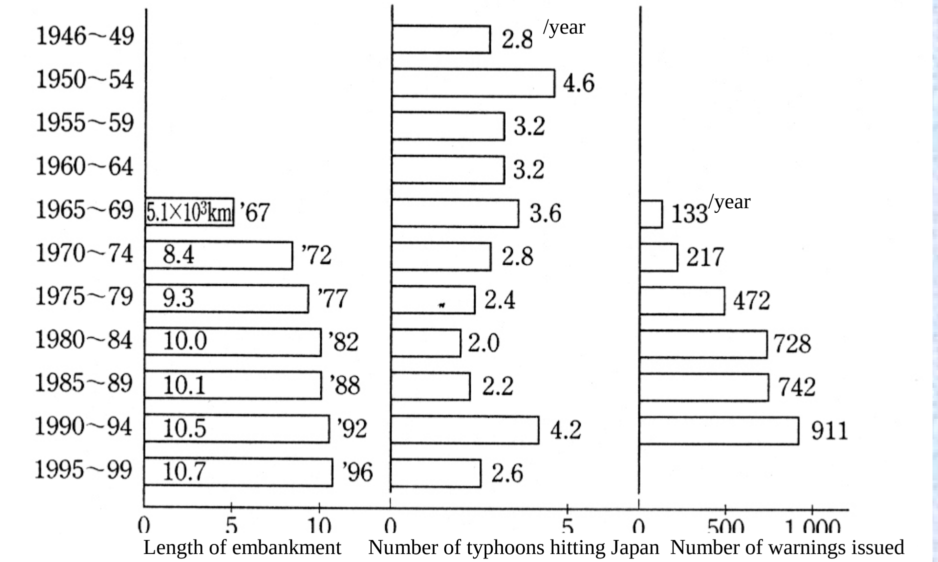
- The monetary amount of damages has remained flat.

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

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



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



(2) Factors contributing to flood disaster prevention

Lessons from and Mitigation Measures against Flood Disasters

Water running over or passing through the embankment.

→ Develop and improve embankment systems

Delay in collection and distribution of information

→ Put rain and water gauge systems in place, and improve the information transmission systems.

No guidelines on issuing evacuation advisories, or delay in issuing.

→ Establish the warning water levels allowing for the rising rate of flood water level.

Improve the information transmission systems

Increased the number of elderly victims

Outline of Flood Disaster Prevention Legal System

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

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

○Basin Flood Prevention Plan

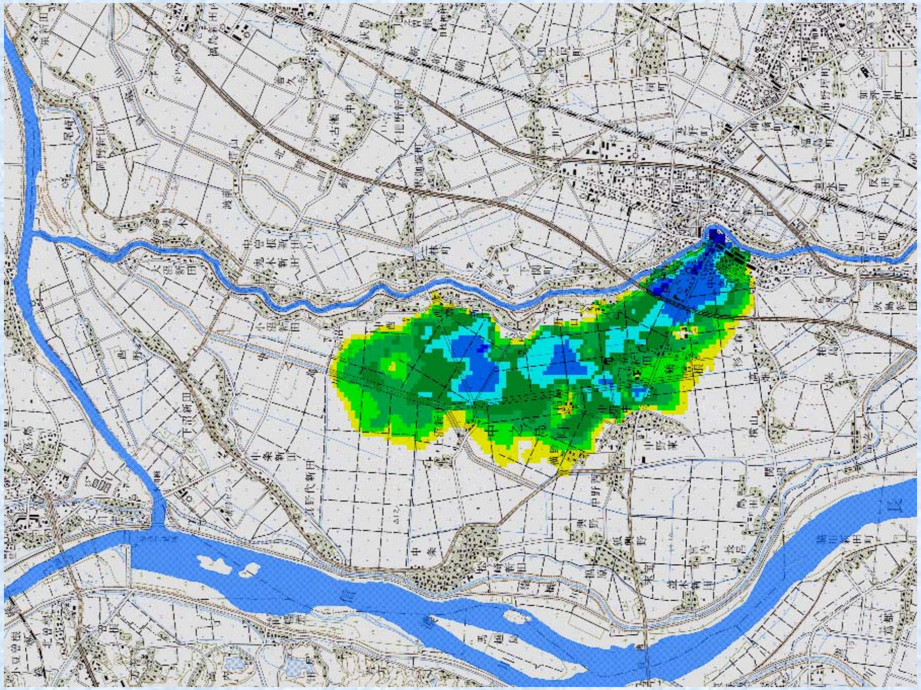
○The flood evacuation plan to be published by underground space administration

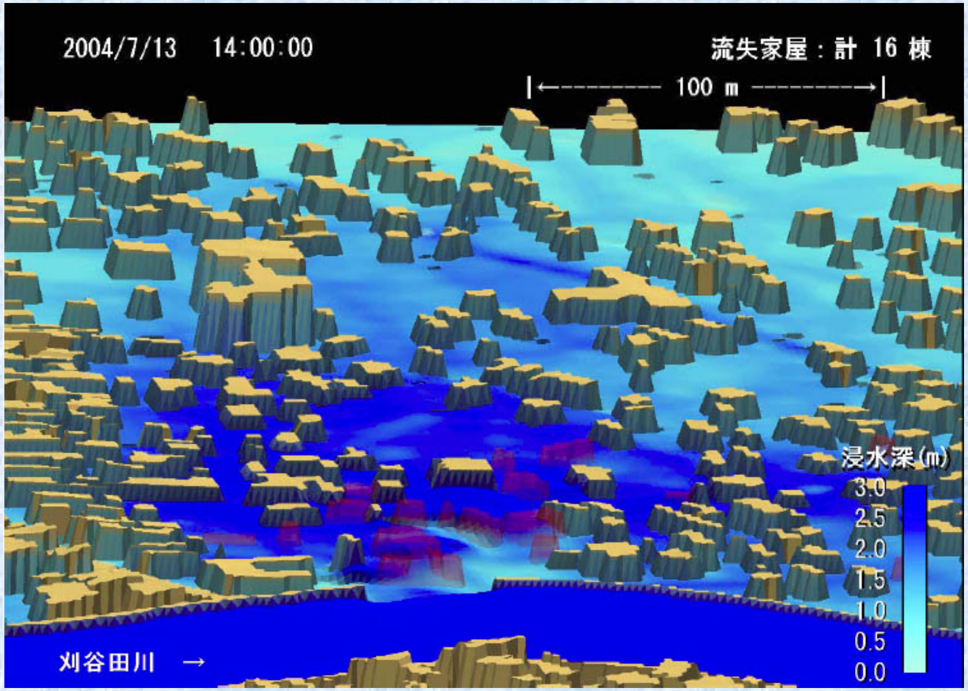
○Post-dike break inundation forecasting by the ministry of Land, Infrastructure and Transport and the Meteorological Agency

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

Enhancement of Flood Simulation Technology

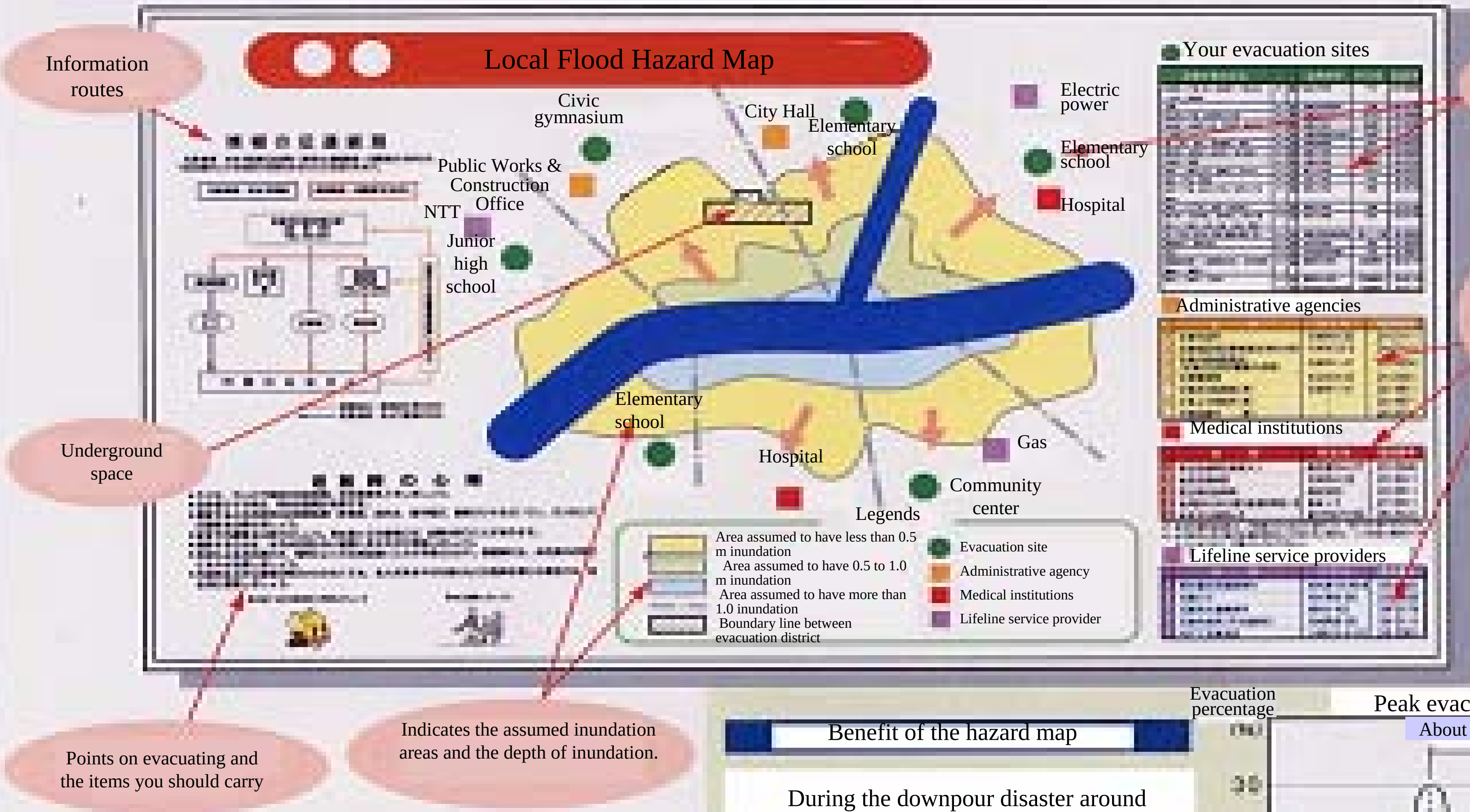
Analysis of the flood and inundation flows in combination by using the Flux Difference Splitting (FDS) Method will reveal the behaviors of inundation flow in the vicinity of the dike break spot and contribute to mitigation of damages.





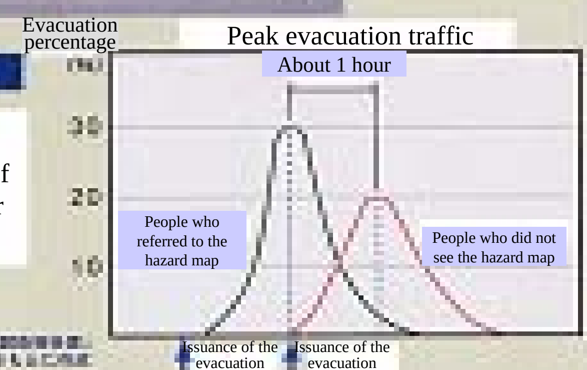
Disaster Risk Management Activities
– Flood Hazard Map -

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



Benefit of the hazard map

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



Disaster Risk Management Activities

– Disaster Drills and Education -

■Training seminars for mayors

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

■Training seminars for river disaster prevention officers

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

■Flood fighting training

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

■Disaster preparedness education

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

Characteristics of Sediment Disasters

Debris flow:

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

Sakurajima, Kagoshima (Sept., 1986)

Landslide:

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

Nagano (Sept., 1986)

Rock fall:

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

Minamata, Kumamoto (Sept., 1997)

Volcanic disaster:

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

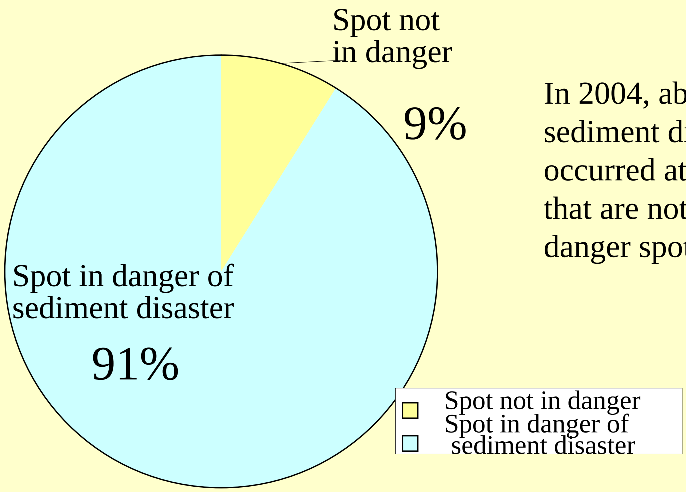
Izu-Oshima, Tokyo (1986)

Avalanche:

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

Obanazawa, Yamagata (1986)

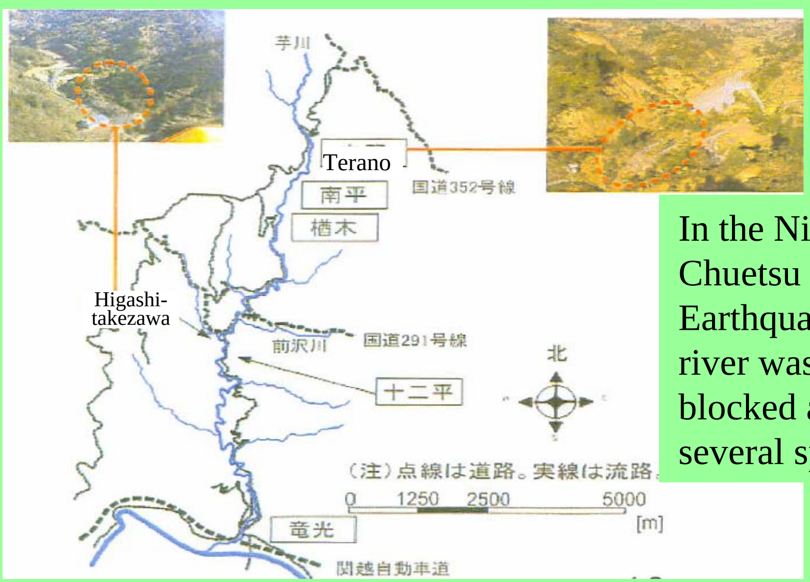
Lessons from and Mitigation Measures against Sediment Disasters



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

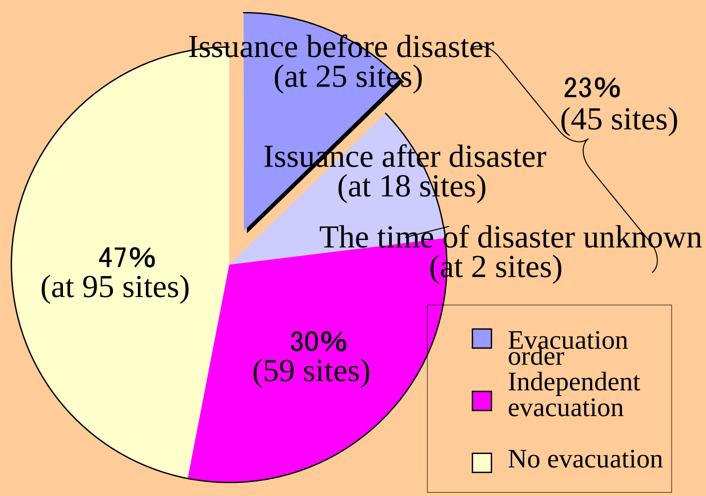
Improve the accuracy of identifying the danger spots.

Install check dams that can trap the logs more efficiently.



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

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



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

Develop the objective guidelines for issuing evacuation orders.

Responses to Sediment Disaster induced by Earthquake

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

EARTHQUAKE

Slope failures and landslides

River channel blockage

Emergency survey


Emergency survey


On-site emergency task force

Emergency measures


Emergency drainage


Removing the sediment blocking the river channels with heavy machinery


Transportation of materials by helicopter

Disaster Risk Management Activities

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

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

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

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

Course of events

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

↓

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

↓

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

↓

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

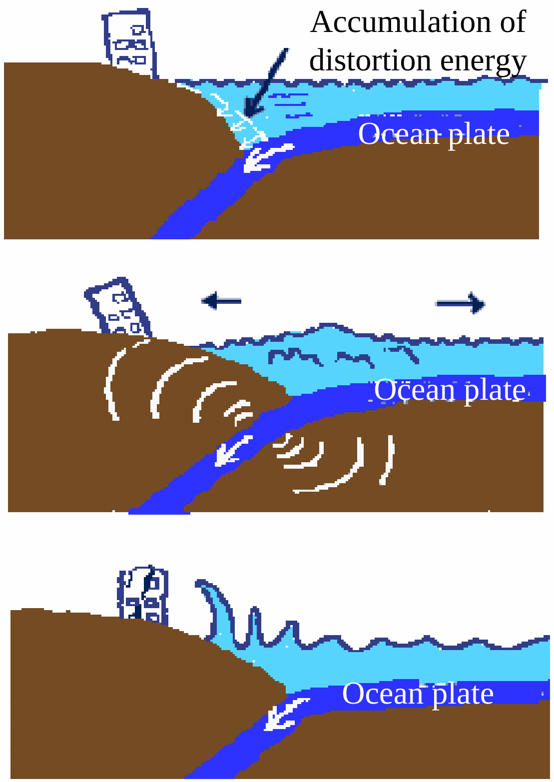
・The expert from P.W.R.I checked if the site conditions allow the rescue party to start their operations.
→Operations started.
・The team determined and advised which rocks could be moved or not.
・The team continued monitoring the operations for the safety of the rescue party .

↓

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

Overview and Characteristics of Tsunami Disaster

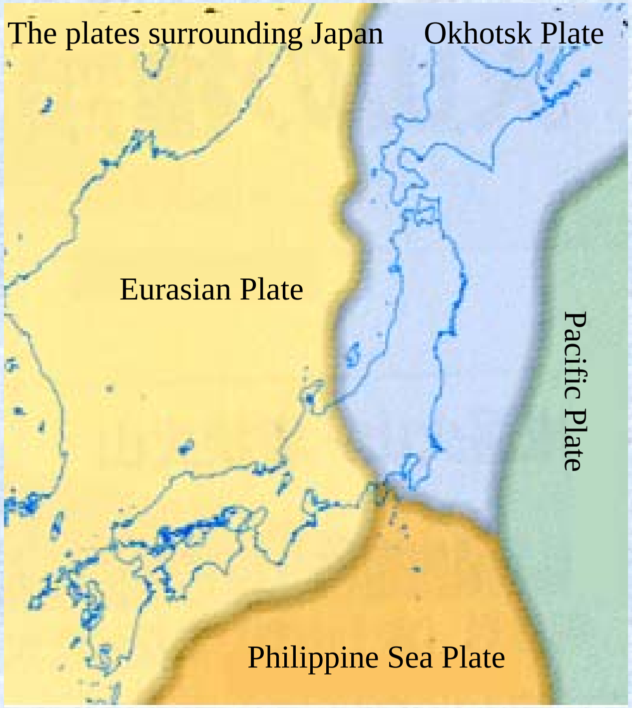
Formation of Tsunami



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

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

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



Data source: the Meteorological Agency

Lessons from and Mitigation Measures against Tsunami Disasters

Floating objects in coastal waters

Recovery of transportation infrastructures

Response to up flow

Disaster Risk Management Activities

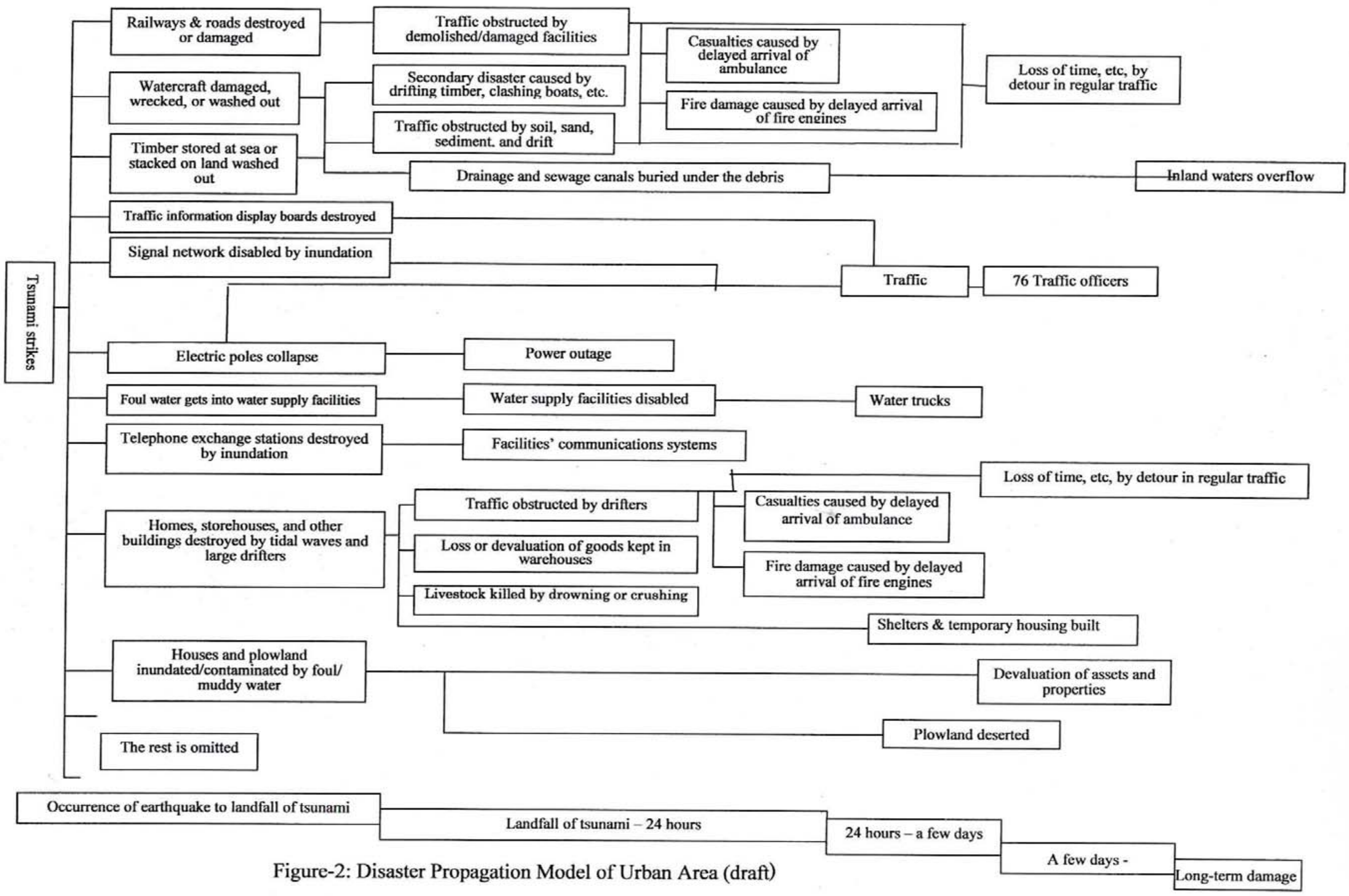


Figure-2: Disaster Propagation Model of Urban Area (draft)

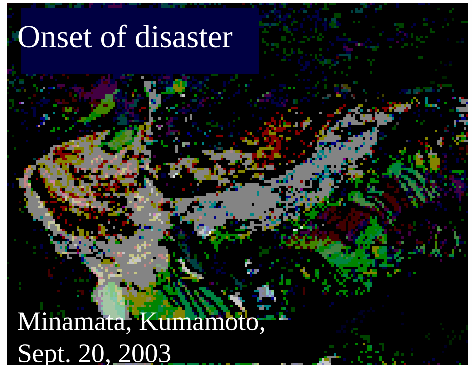
Japan’s Disaster Prevention Scheme

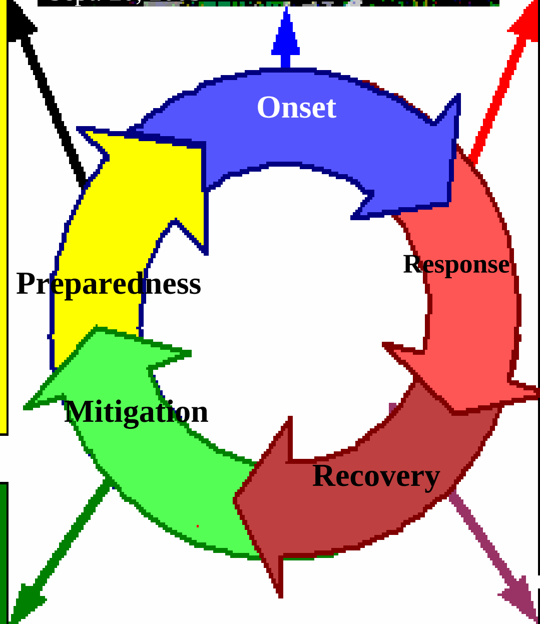
- The Japanese disaster prevention scheme consists of the four phases: Response, Recovery, Mitigation, and Preparedness.
- As part of the designated administrative system, the Ministry of Land, Infrastructure and Transport has worked on development of the anti-disaster operation plan and taken the response,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

Well-planned systematic government administration of disaster prevention

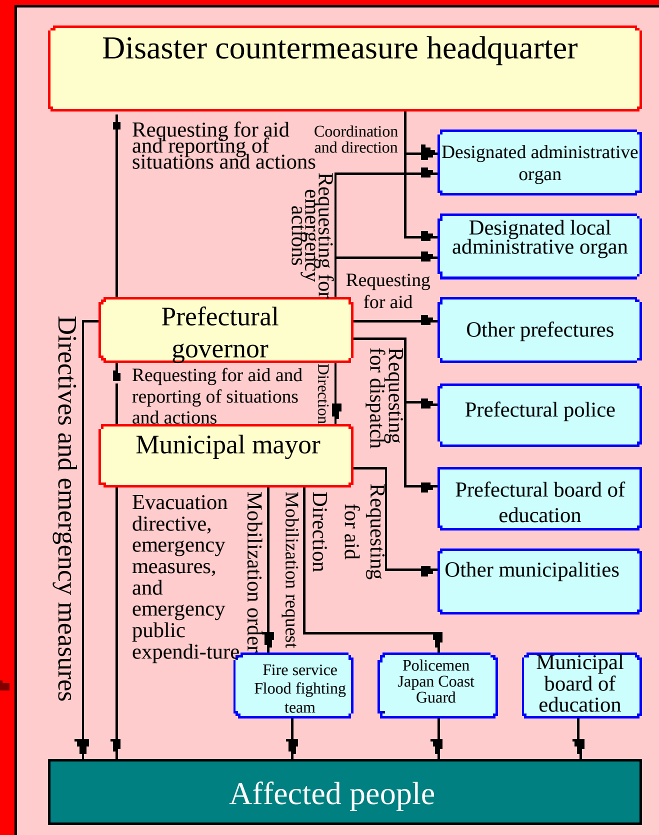
Central Disaster Management Council	Basic Disaster Prevention Planning
Designated administrative organs and public corporations	Disaster Prevention Activities Plan
Prefectural Disaster Management Councils	Basic Disaster Prevention Plan at prefecture level
Municipal Disaster Management Council	Basic Disaster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

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





Division of roles in the emergency responses



Construction or improvement of the preventive structures

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

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

Our Challenges for the Future

Future Directions

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

- To seek effective scheme of involving people in decision process

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

COUNTRY REPORT OF CAMBODIA

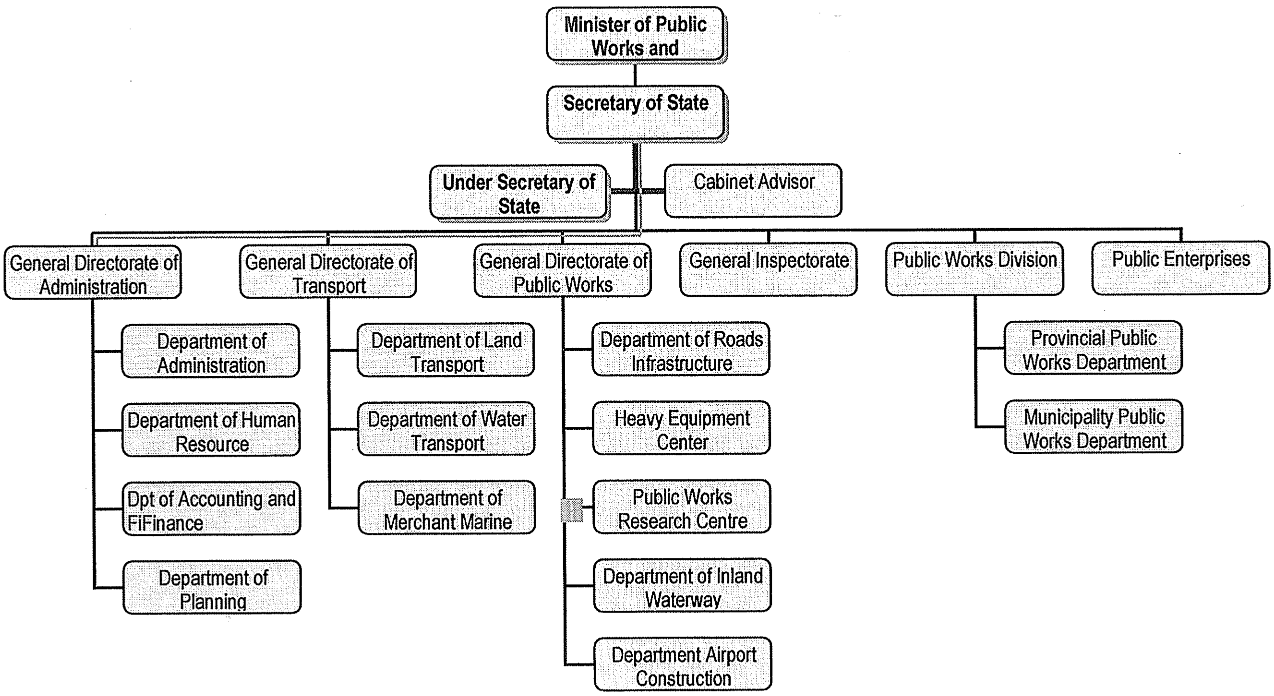
RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT DISASTER

JICA EXECUTIVES'SEMINAR
ON PUBLIC WORKS AND MANAGEMENT
JFY 2005

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

Organization Data

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



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

Personal Data

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

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

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

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

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1. INTRODUCTION

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

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

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

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

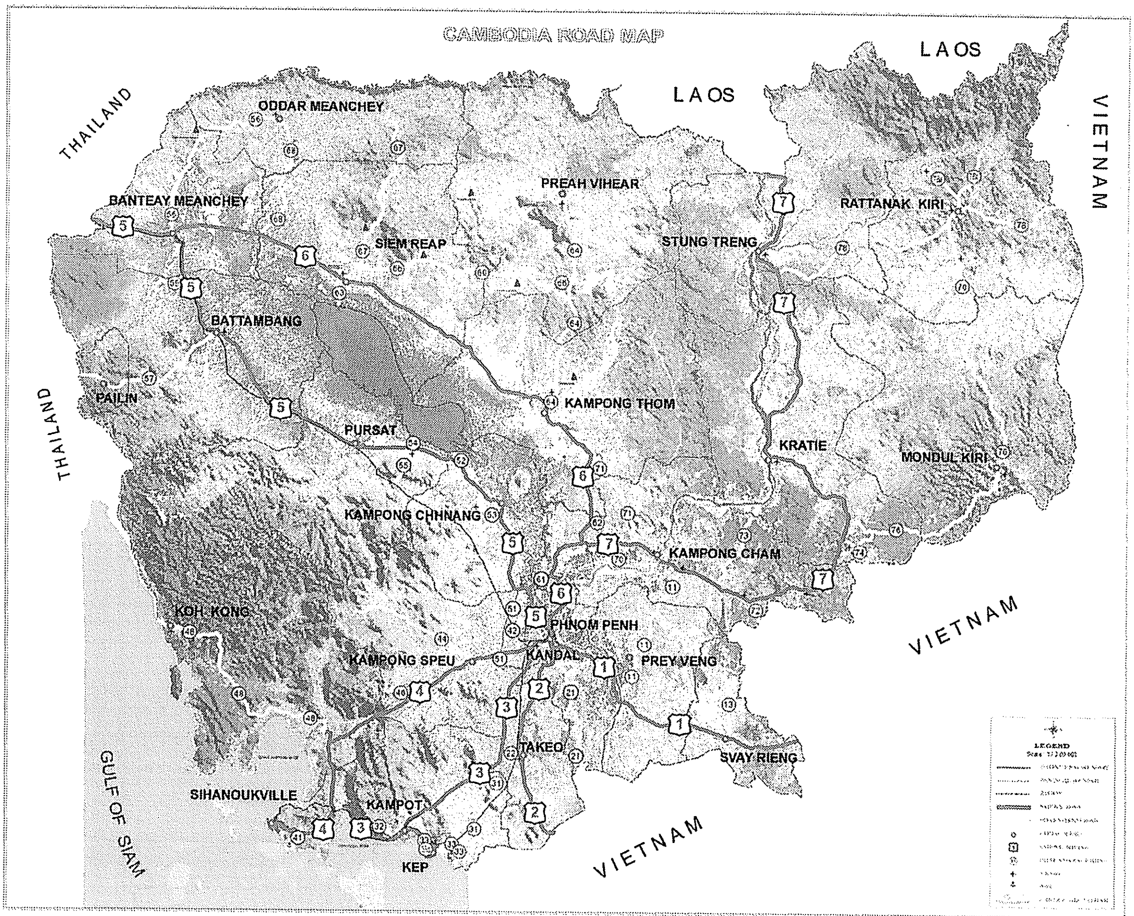


Figure 1. Map of Cambodia.

2. MEKONG FLOOD DISASTER

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

2.1 The 2000 Mekong Flood Disaster

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

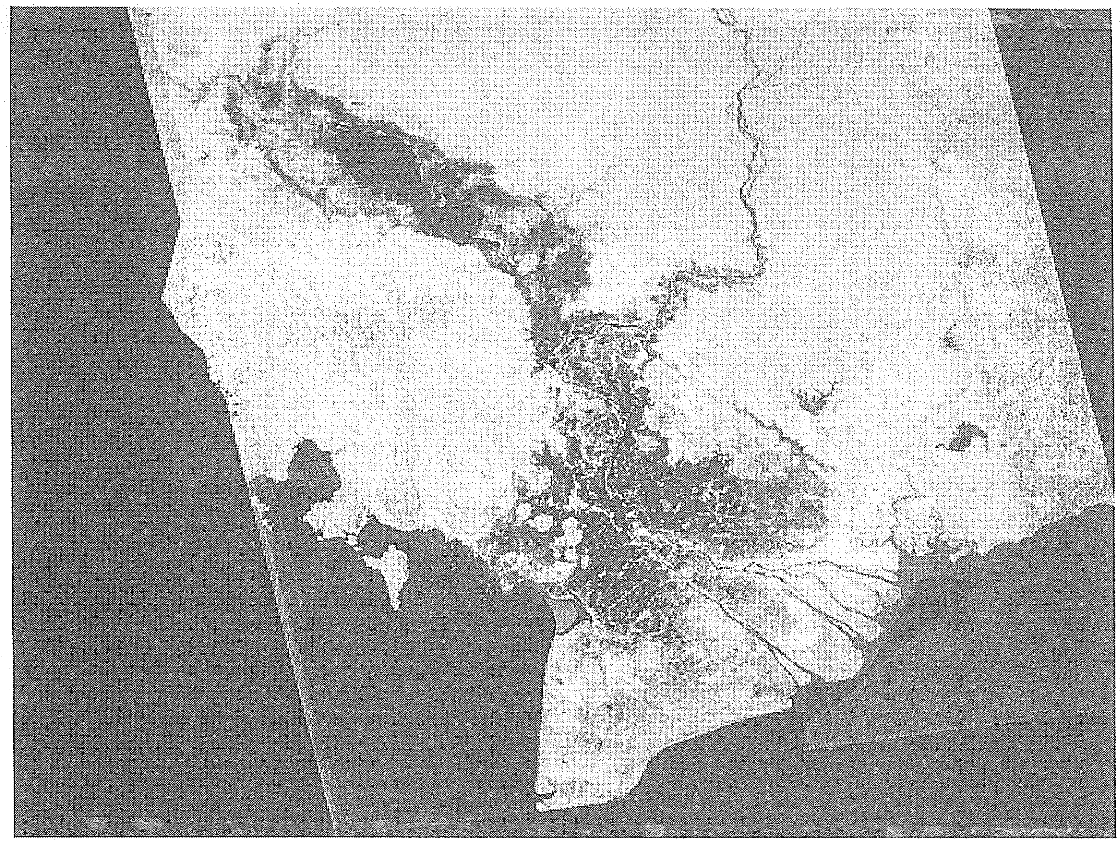


Figure 2. Satellite Photo of Sap and Mekong River Basin

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

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

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

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

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

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

2.2 Flood and Road Infrastructure Disaster

2.2.1 Critical level of Mekong

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

2.2.2 Disaster situation of road infrastructure.

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

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

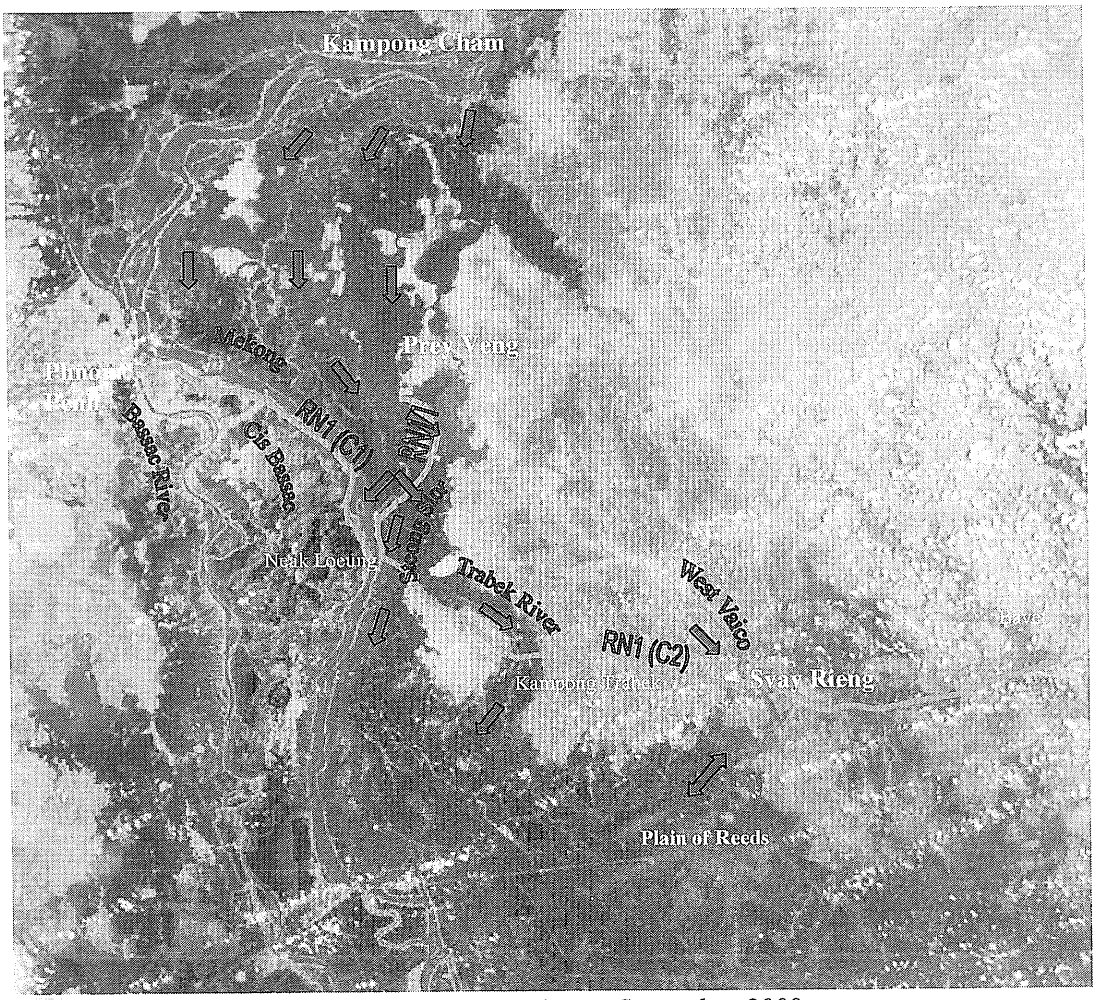


Figure 4. *Inundation of Southern Part during September 2000*

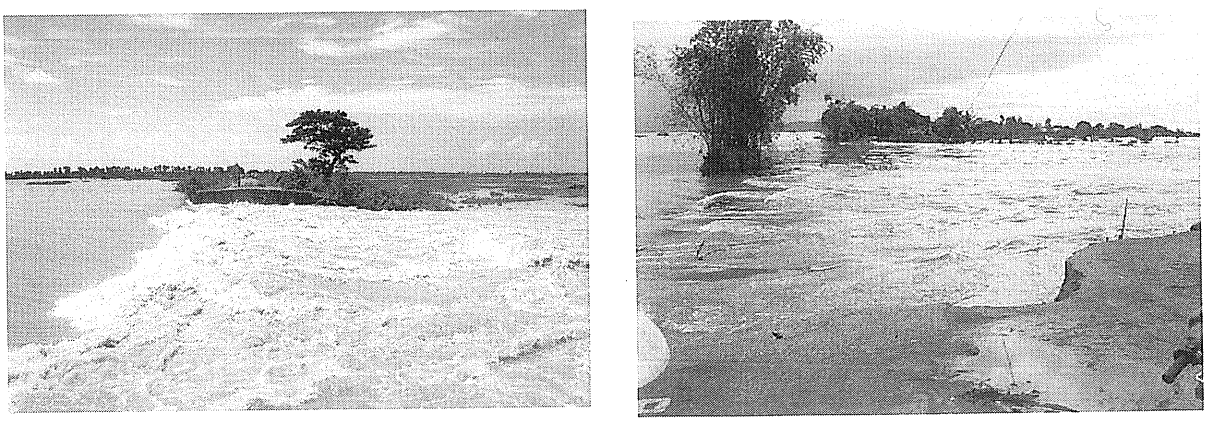


Figure 4a. *Road washed out by Flood*

3. FLOOD MITIGATION IN ROAD INFRASTRUCTURE

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

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

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

Figure 5. Mechanism of Erosion and Embankment

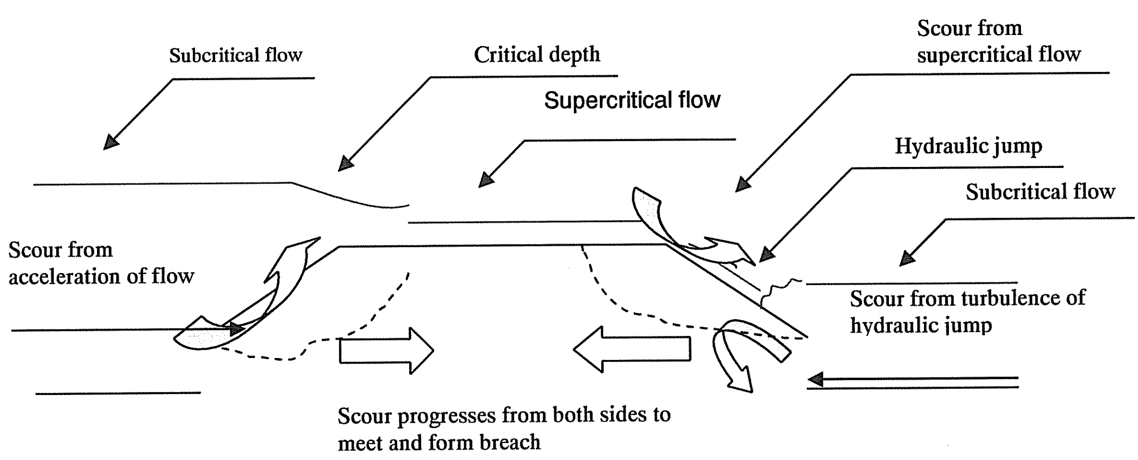
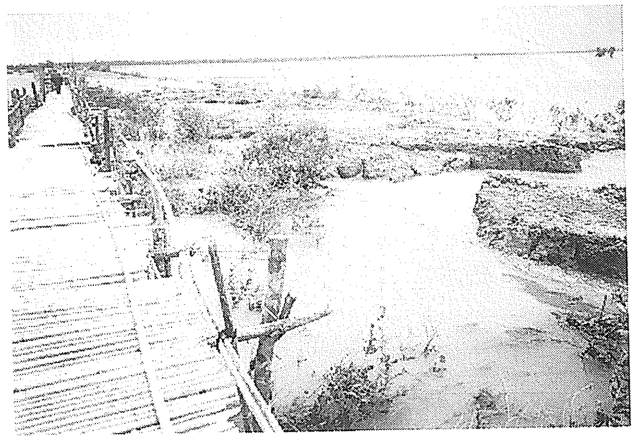


Figure 5a

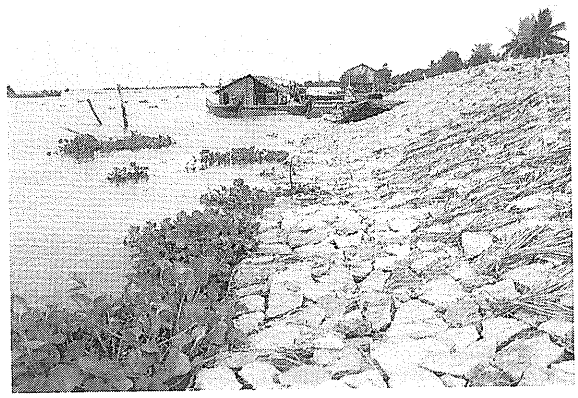


An embankment breach results when overtopping flow continues at sufficient volume for sufficient time. Under such conditions the erosion from upstream and downstream eventually meets and this opens a channel that quickly widens and deepens because of the force of the flow. The breach will eventually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

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

Figure 5b

Floodway, built for overtopping flown water

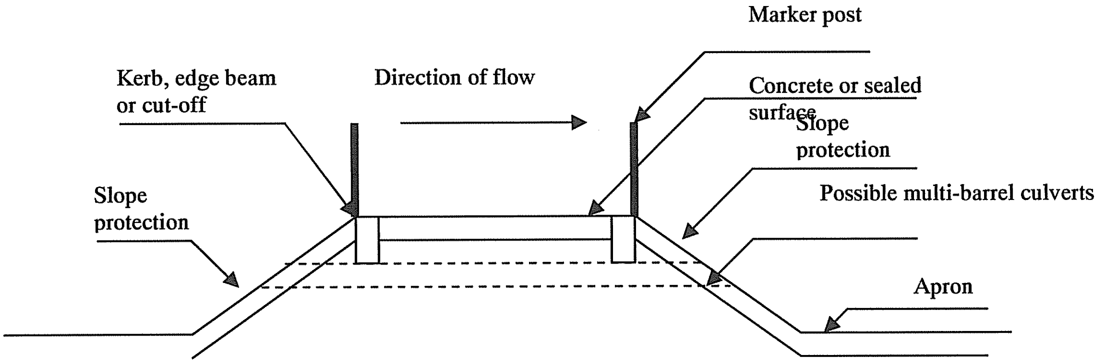


Embankment protection by gabion mattress

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

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

Figure 5.1 Typical Features of a Floodway



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

3.2. Road Design (Embankment) Level

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

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

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

4. RISK MANAGEMENT IN ROAD INFRASTRUCTURE

4.1 General Response to the Flood

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

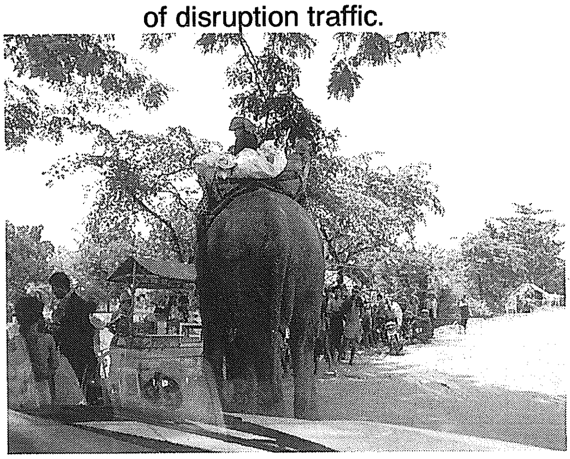
Apart of working effort of NCDM, the government set up a coordinating relief core group that joined by international community as International Federation of the Red Cross and UN Disaster Management Team to close work on emergency relief assistance, food security, health and water sanitation, small scale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

4.2 Improvement Plan

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

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

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



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

COUNTRY REPORT OF INDIA

Risk Management and Mitigation for Flood

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

YEAR 2005

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

1. Organization Data:

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

Minister
Roads & Buildings Department
Government of Gujarat, India

↓

Secretary
Roads & Buildings Department

↓

Chief Engineers & Additional Secretaries
Roads &Building (State & Panchayat),
National Highways, Special Projects, Quality Control

↓

Superintending Engineers
At Circle Level (3 to 4 Districts)

↓

Executive Engineers
At Division Level (For each District)

↓

Dy. Executive Engineers
At Sub-Division Level
(1 to 2 Talukas/Blocks)

2. Personal Data:

(I) Recent Work:

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

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

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3. Risk Management and Mitigation for Flood Disaster

Abstract

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

Introduction

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

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

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

3.1 Present Status of Flood Disaster

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

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

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

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

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

3.2 Structural Measures for mitigation of flood disaster

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

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

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

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

3.3 Non-structural measures for Flood Disaster Mitigation

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

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

Flood Plain Management and Zoning

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

Flood Proofing

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

Flood Forecasting and Warning

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

3.4 Political Administration and Planning for mitigation of flood disaster.

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

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

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

3.5 Conclusions

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

******

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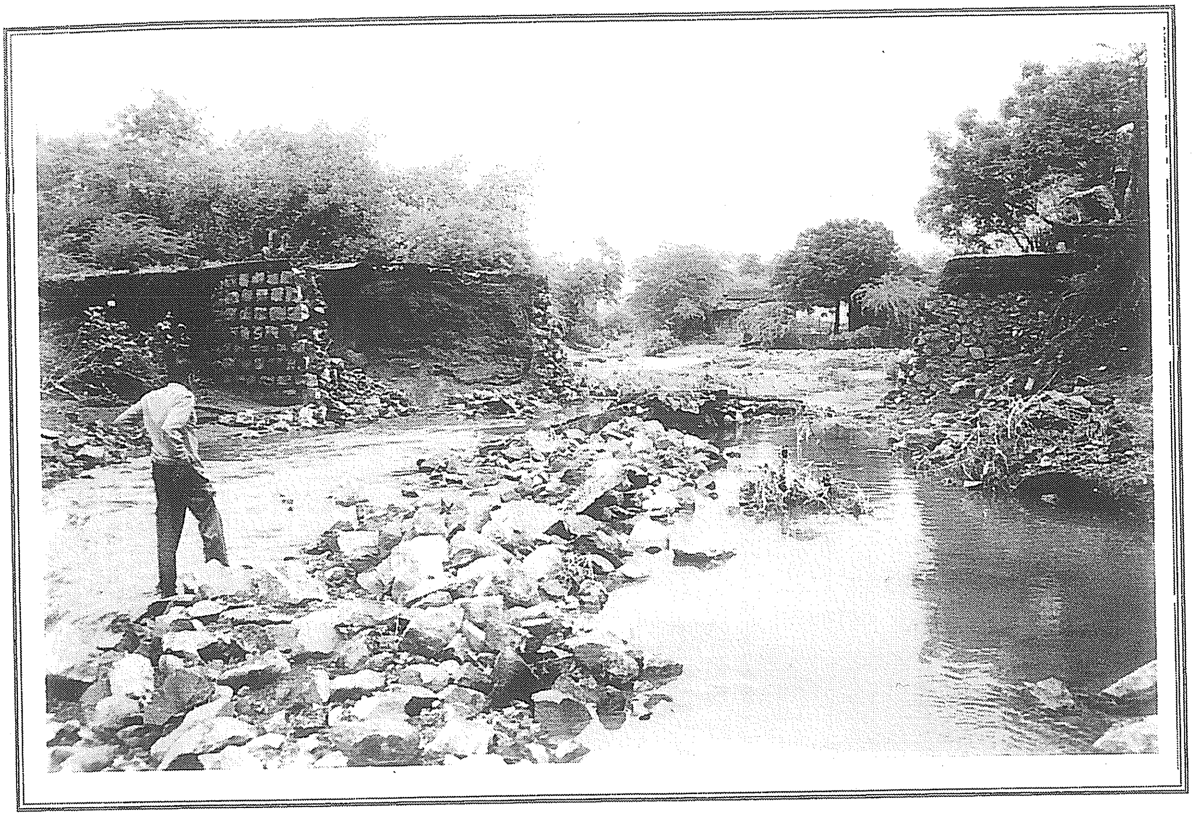
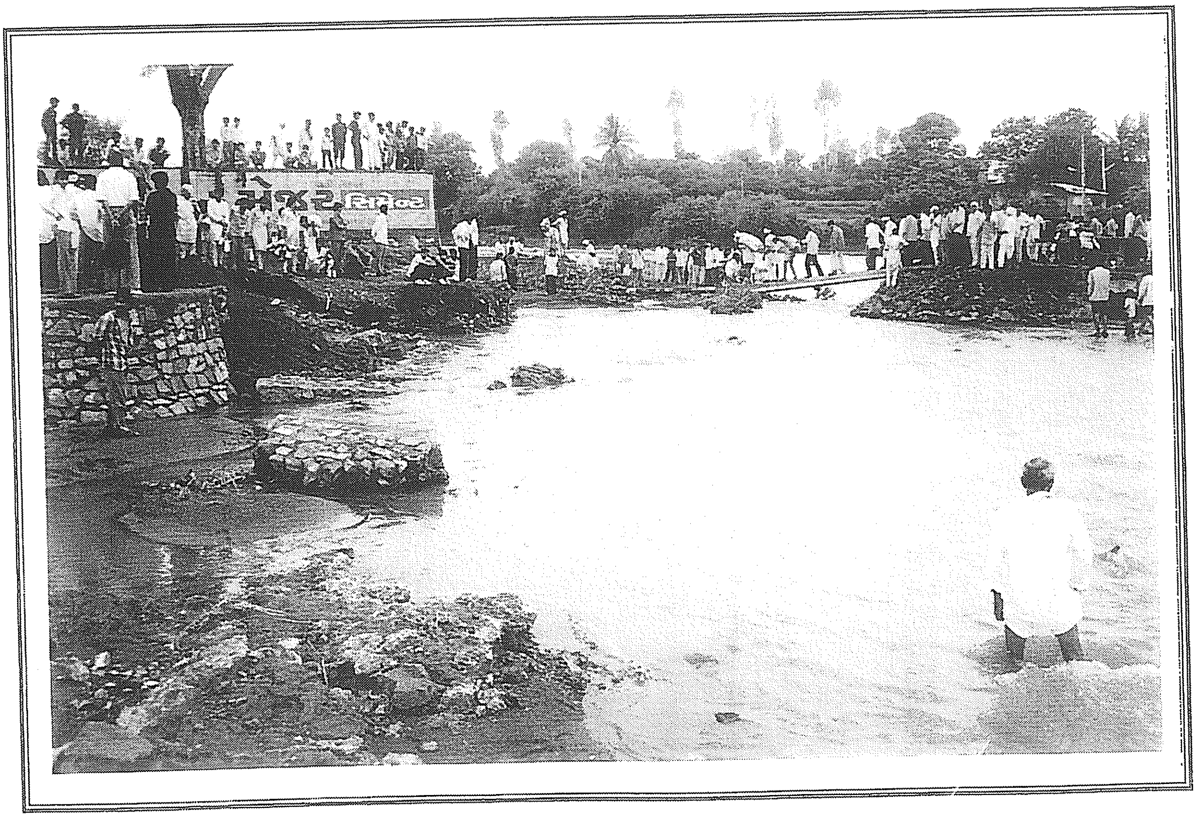
4. Flood Control Operation Policy for Ukai Multi-Purpose Reservoir, Mr. B.J.Parmar, Former Secretary & Mr.B.M.Rao, Chief Engineer (North Gujarat) & Additional Secretary, Narmada, Water Resources and Water Supply Department, Government of Gujarat.



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



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

Plate 1: Photographs of Gujarat Flood, Year 2005

Plate 2: Photographs of Maharashtra Flood, Year 2005

COUNTRY REPORT OF LAO PDR

RISK MANAGEMENT AND MITIGATION FOR FLOOD AND SEDIMENT RELATED DISASTERS

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
JGY 2005

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

I. ORGANIZATION DATA

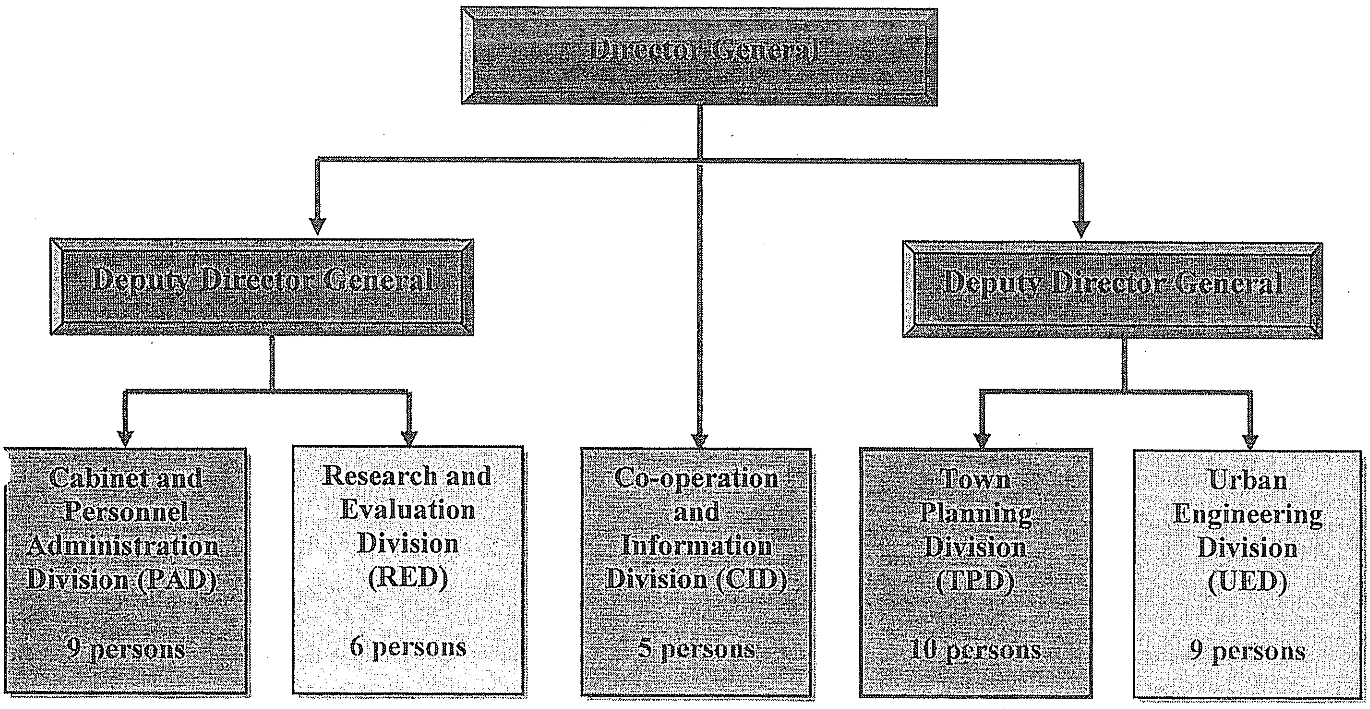
1. Name of Organization:
Urban Research Institute (URI)

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

The major mandates are as bellow:
- Urban Planning
- Survey and Research
- Training

3. Organization Chart

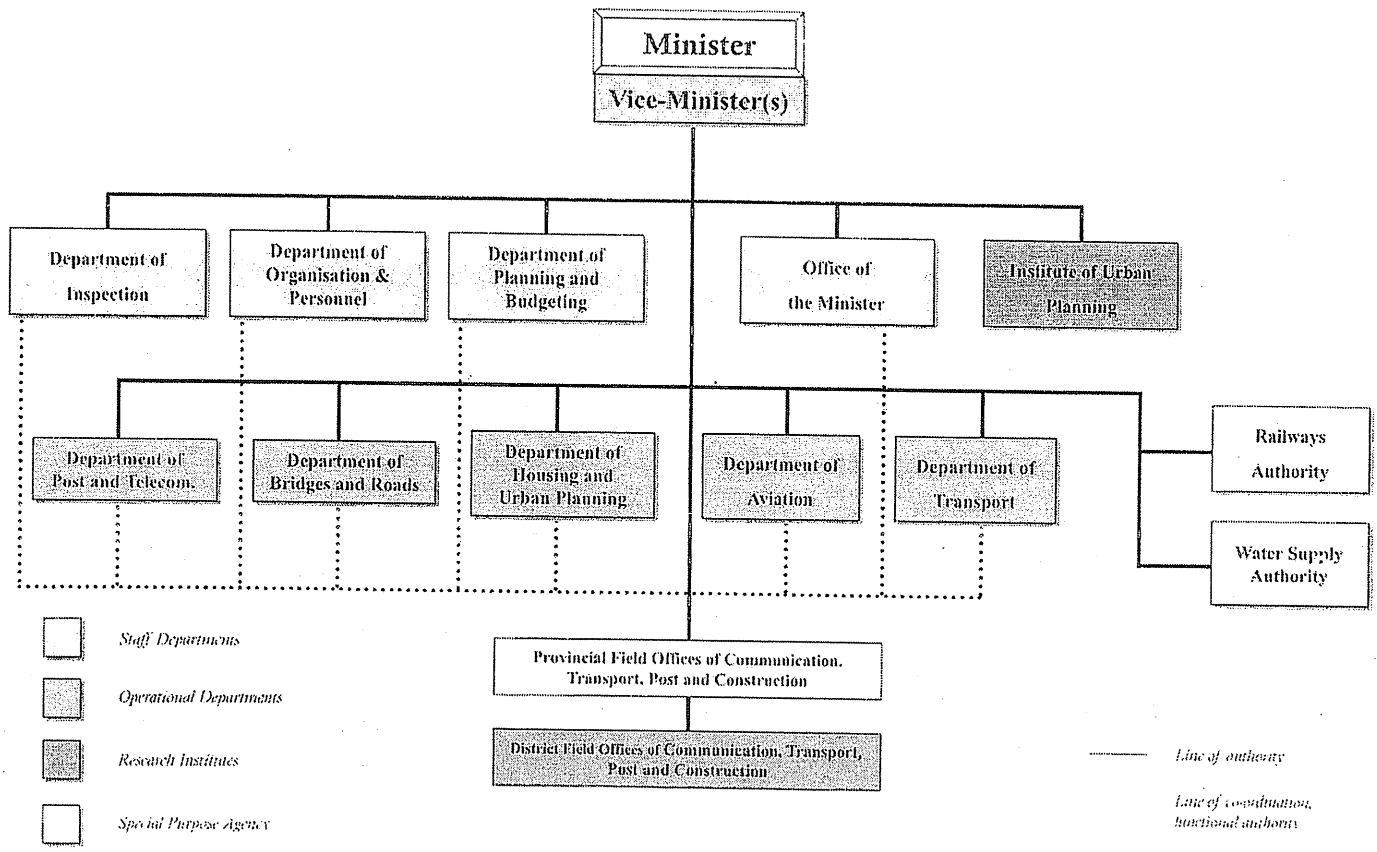
Urban Research Institute Organization Chart



4. Organization's Position in Government

Ministry of Communication, Transportation, Post and Construction Organization Chart

Ministry of Communications, Transport, Post and Construction Organisation Chart



II. PERSONAL DATA

2.1 Recent work for the past three years

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

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

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

2.2 Contact Address:

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Email: aphaylath @yahoo.com

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

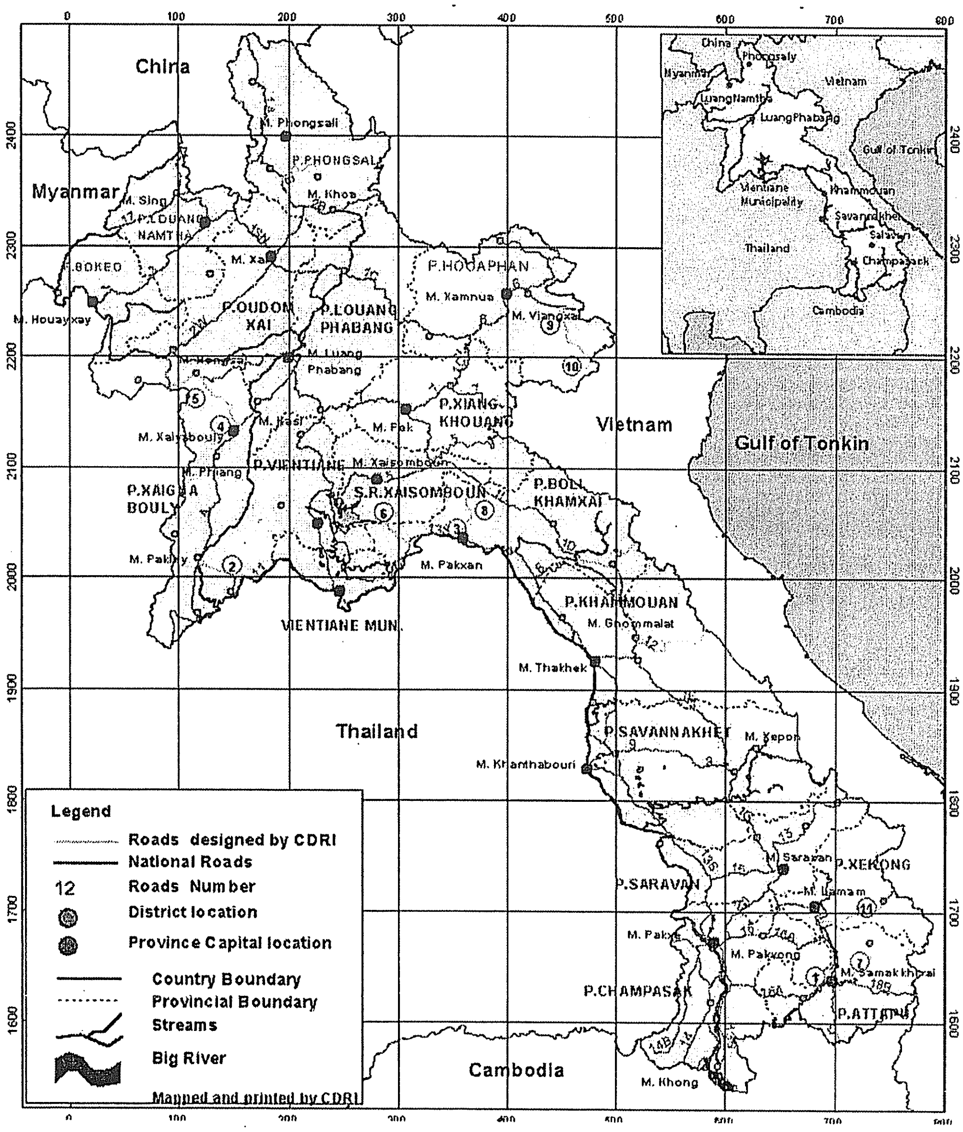
3.1 Current situation and problem

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

Country profile: Lao PDR

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

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



3.2 Disaster problem in Laos

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

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

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

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

3.3 Flood Background

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

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

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

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

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

Table1

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

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

3.4 Latest events

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

Table 2

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

Source: Ministry of Agriculture.

3.5 Flood Management and Mitigation in Lao.PDR

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

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

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

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

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

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

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

3.6 Research / Survey

Flood management options

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

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

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

Options in flood mitigation

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

Flood surveys and management plans

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

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

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

GIS mapping

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

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

Remote sensing of flooding

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

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

Flood monitoring and flood forecasting

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

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

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

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

Flood control works and investments

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

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

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

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

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

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

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

Reservoir management

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

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

TABLE 3: Planned hydropower reservoirs in Laos

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

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

Local preparedness in flood control

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

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

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

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

Irrigation in the dry season

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

National Flood Management Action Plan

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

Flood Management Unit

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

3.7 Government Measures

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

Disaster management policy, planning and practice:

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

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

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

Opportunities and Lessons learned:

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

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

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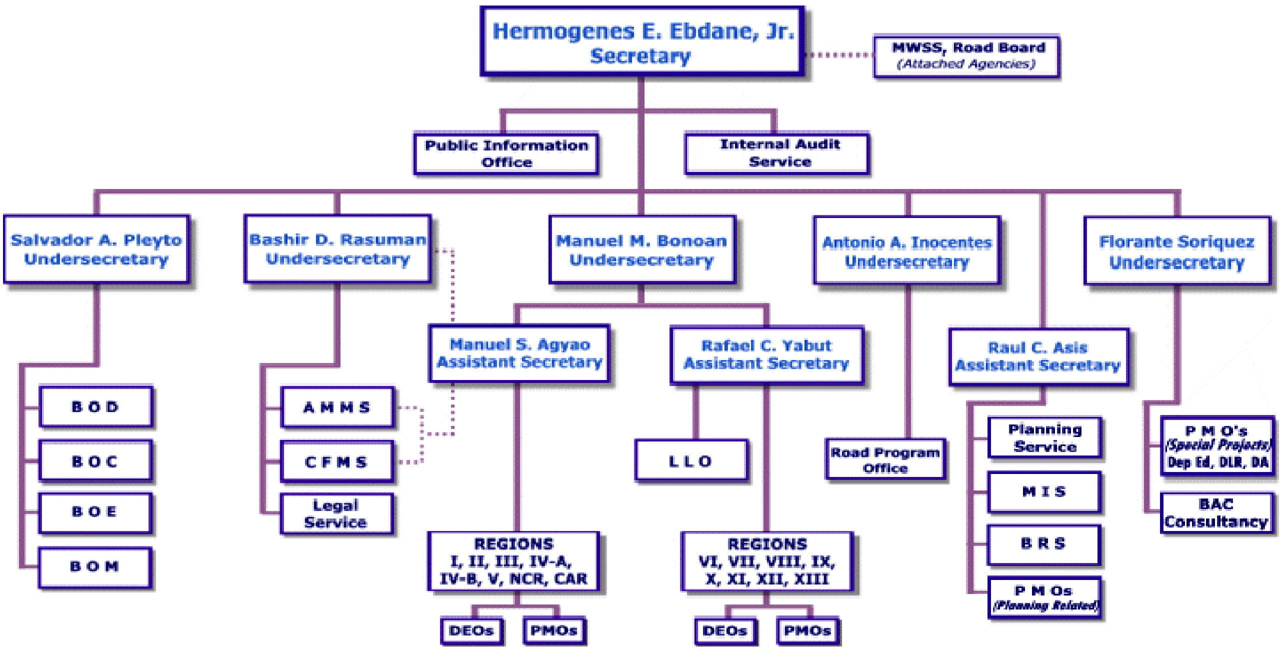
1. ORGANIZATION

1.1 Name of Organization – Department of Public Works and Highways

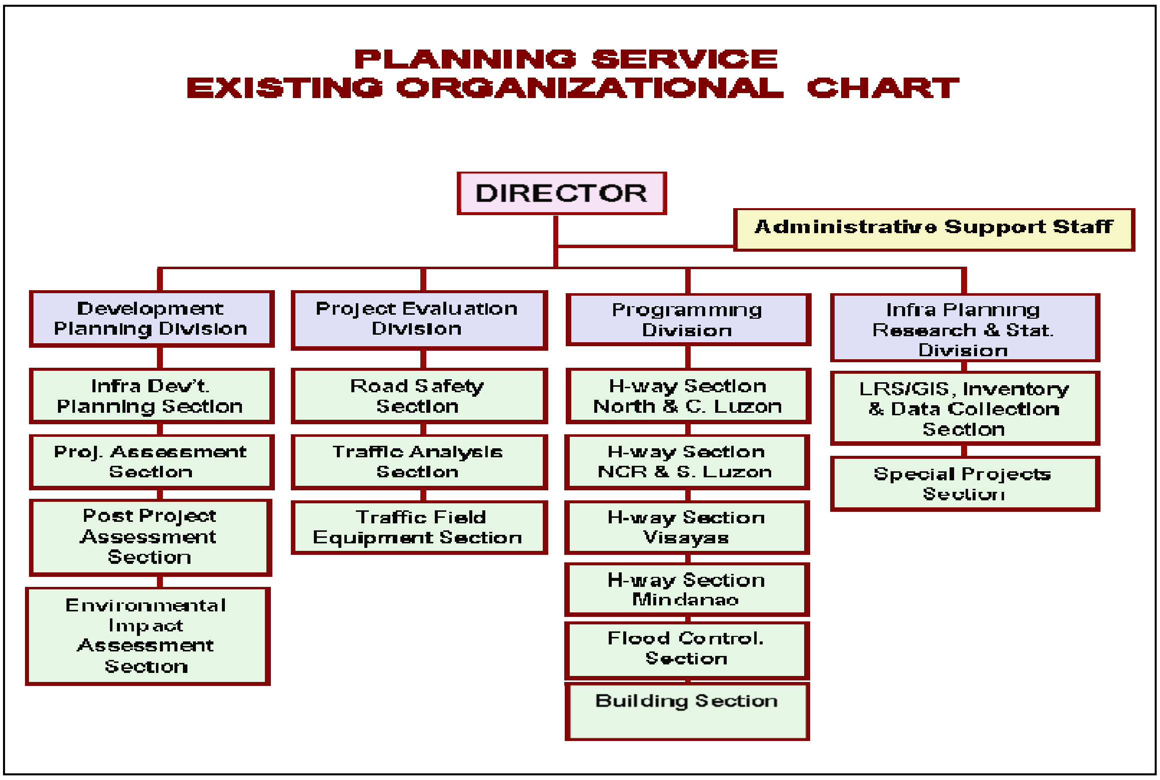
The Department of Public Works and Highways (DPWH) is the engineering arm of the government mandated in the planning, design, construction and maintenance of public works and highways including flood control facilities and structures. DPWH is headed by the Secretary supported by five (5) Undersecretaries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

1.2 DPWH Organizational Chart



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

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



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

1.3 Organization Position in Government

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

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

2. PERSONAL DATA

2.1 Recent Work

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

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

2.2 Contact Address:

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3. Risk Management and Mitigation Flood and Sediment Related Disasters

3.1 Current Situation and Problem

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

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

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

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

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

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

3.2 Government Measures

Policies and Strategies

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

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

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

Structural Mitigation

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

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

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

Non-Structural Mitigation

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

Strategic Objectives

The following are the strategic objectives set by the DPWH:

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

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

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

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

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

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

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

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

3.3 Government Projects for Flood Disasters

Ormoc City Flood Mitigation Projects

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

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

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

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

Project works for Phase I include:

Construction of 4 New Bridges:

1) Alegria Bridge (3 Span PC Type)
2) Osmeña Bridge (3 Span PC Type)
3) Malbasag Bridge (2 Span PC Type)
4) Carlos Tan Bridge (2 Span PC Type)

Construction of 3 New Slit Dams:

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

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

Central Luzon Flood Control Projects

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

The Agno Flood Control Projects

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

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

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

Bugallon Bridge & Short-Cut Channel

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

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

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

3.4 Projects for Sediment-Related Disasters

The Pinatubo Hazard Urgent Mitigation Project

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

The projects include the following:

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

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

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

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

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

4. OBSERVATIONS AND PROACTIVE ACTION

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

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

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

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

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

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

COUNTRY REPORT OF THAILAND

Risk Management and Mitigation

For Flood and Sediment Related Disasters

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

JFY 2005

Prepared by Akkapong Boonmash

Director of Improvement and Maintenance Division

Office of Hydrology and Water Management

Royal Irrigation Department (RID)

THAILAND

COUNTRY REPORT

1. Organization Data

(1) Name of Organization : Royal Irrigation Department

(2) Summary of Organization

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

2.1 Vision

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

2.2 Mission

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

2.3 Administration

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

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

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

2.4 Budget

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

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

(3) Organization Chart

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

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

(4) Organization's Position in government

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

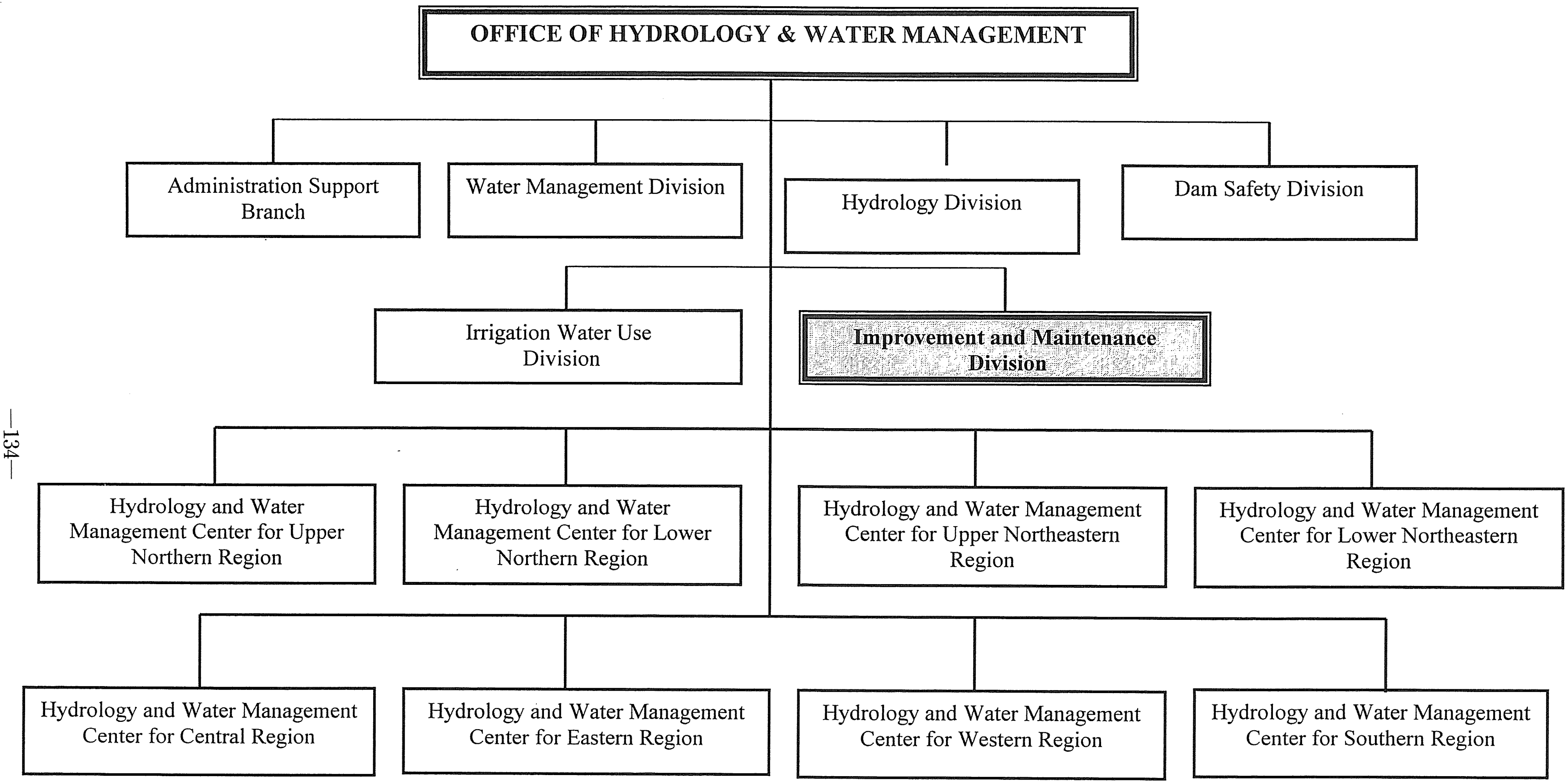

Figure 0-1 : Organization Chart of Office of Hydrology & Water Management

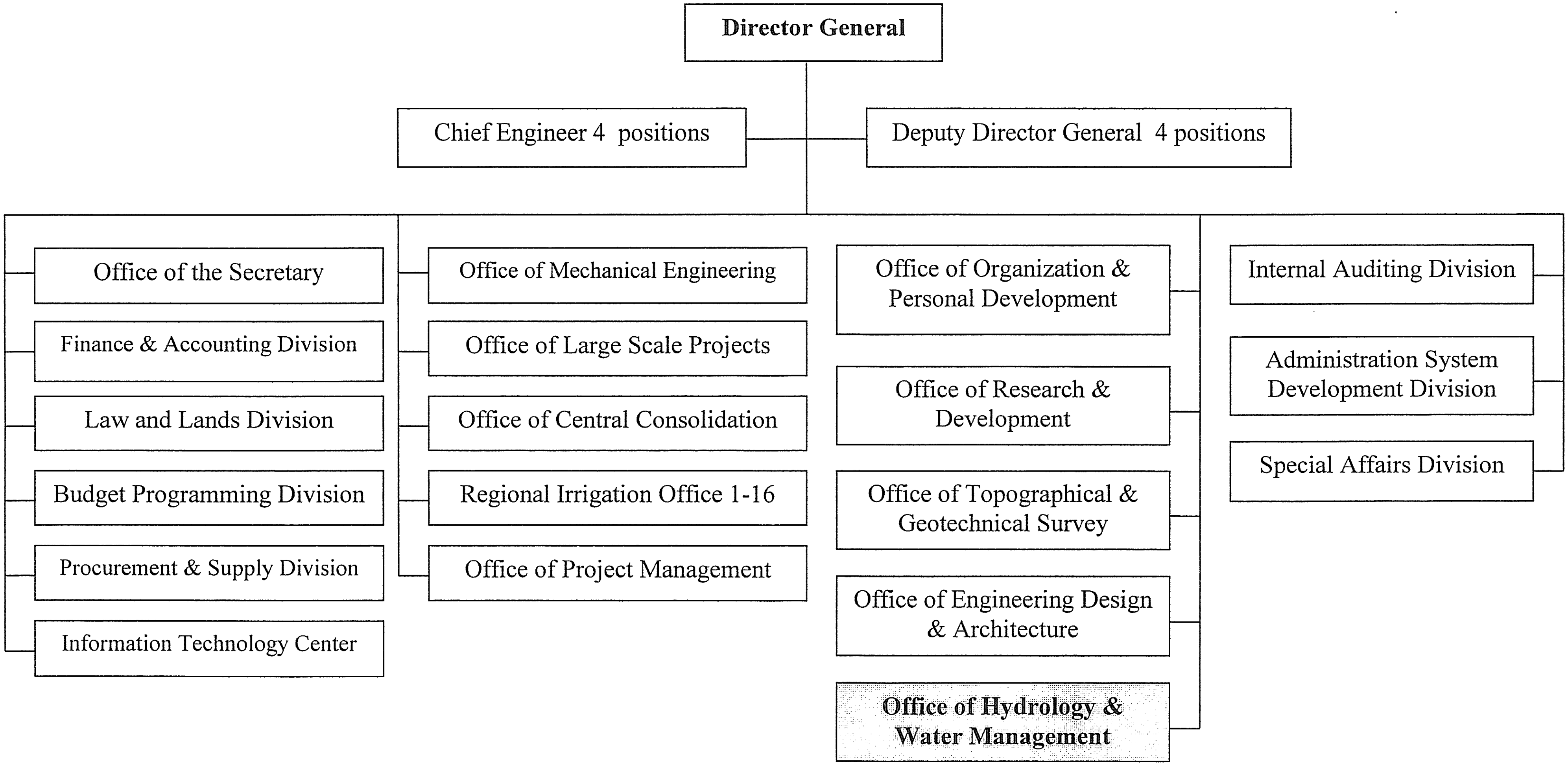

Figure 0-2 : Organization chart of Royal Irrigation Department

Ministry of Agriculture and Cooperative

Organization Chart

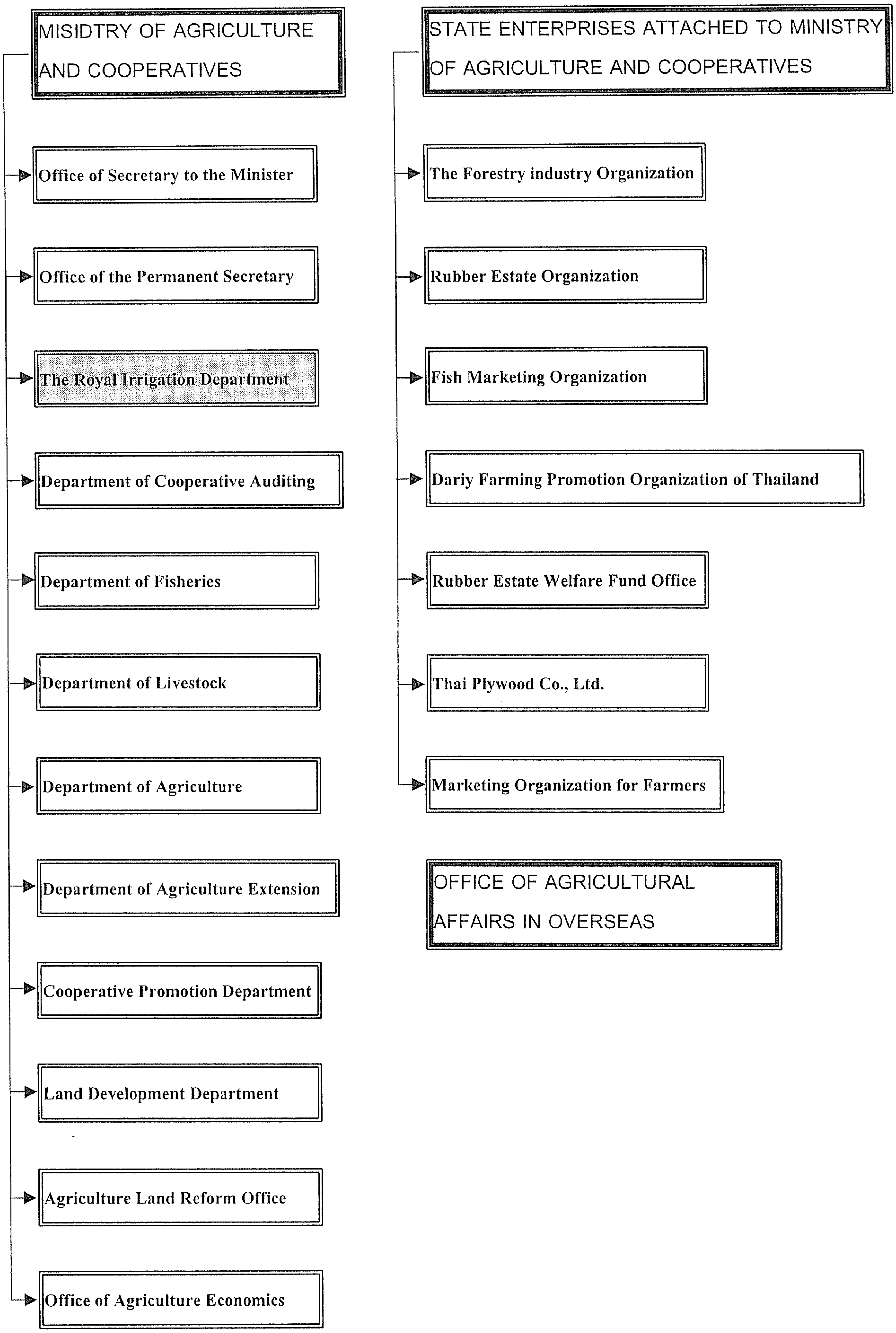

Figure 0-3: Organization Chart Ministry of Agriculture Cooperative

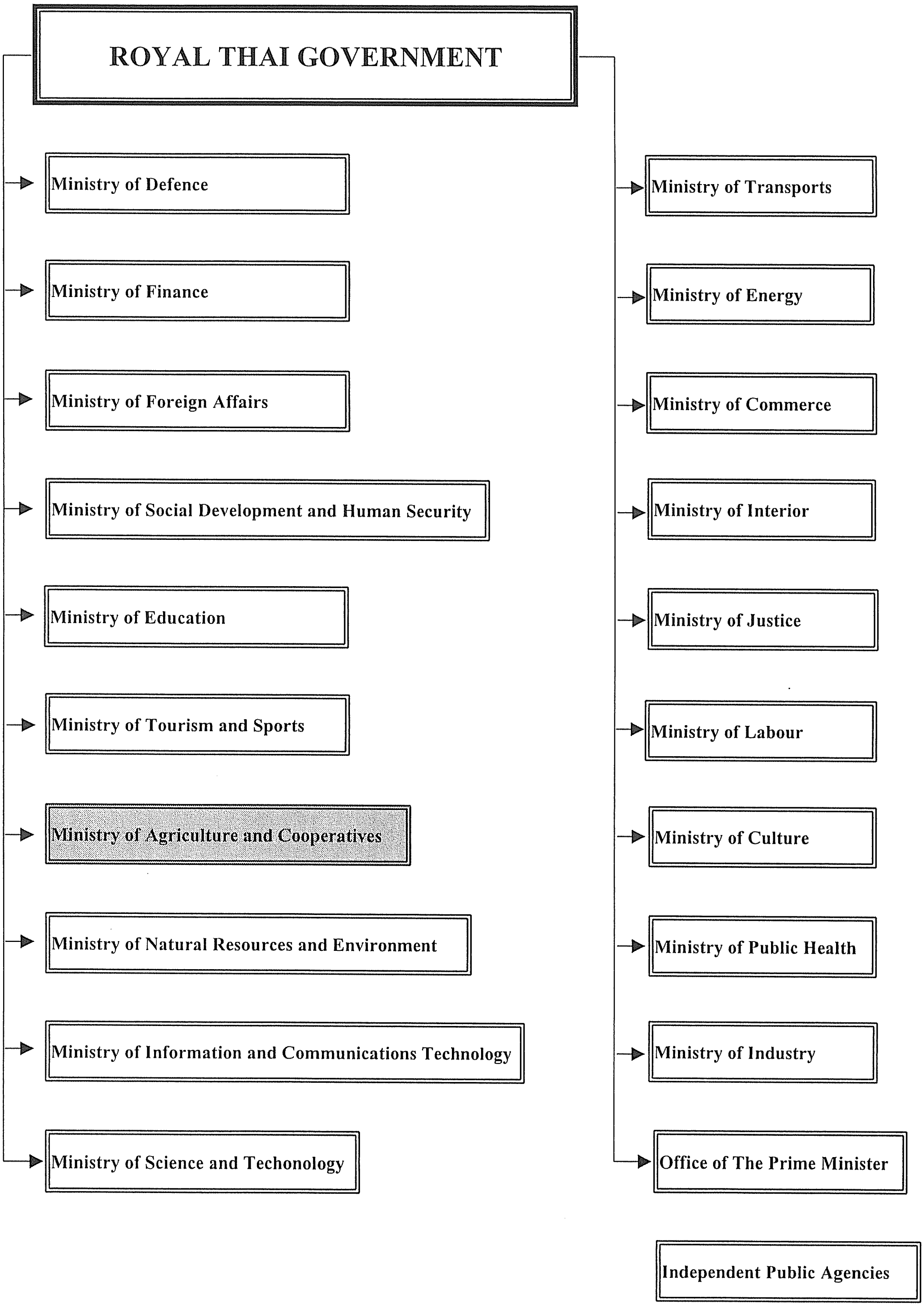

Figure 0-4: Organization Chart Royal Thai Government

2. Personal Data

(1) Recent Work

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

(2) Contact Address

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

3.1 River Basin Condition

3.1.1 General Features of Past Major Floods

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

3.1.2 Main cause of Flood

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

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

3.1.3 Flood Damage Condition

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

3.1.4 Ongoing Flood Mitigation Project by Agencies Concerned

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

- Heightening of flooding barrier at Bangkok Metropolitan Area by MBA

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

3.1.5 Major Issues considered for Flood Mitigation

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

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

3.2 MASTER PLAN STUDY

3.2.1 Basic Concept of Master Plan Formulation

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

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

3.2.2 Measures of the master Plan

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

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

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

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

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

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

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

3.2.2.3 Enhancement of Safety Level against Flood in Agricultural Areas

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

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

3.2.2.4 Institutional Arrangement for Implementation of Measures

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

3.2.3 Economic evaluation of the master Plan

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

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

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

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

3.3 FEASIBILITY STUDY

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

- Nonstructural Measures: Land use control and guidance based on the flood risk map, modification of reservoir operation rule, and institutional and organizational arrangement .
- Structural Measures: River Improvement (Stage 1) for protection of agricultural areas .

3.3.1 Nonstructural Measures

3.3.1.1 Study on the Modification of Reservoir Operation Rule

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

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

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

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

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

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

3.3.1.2 Study on Land Use Control and Guidance

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

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

3.3.1.3 Study on Institutional Arrangement

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

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

3.3.2 Structural Measure (River Improvement)

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

3.3.2.1 Project Scale

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

3.3.2.2 Improvement Works

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

3.3.3 Project Evaluation

3.3.3.1 Economic and Financial Considerations

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

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

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

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

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

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

3.3.3.2 Environmental Impact Assessment

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

3.4 CONCLUSION AND RECOMMENDATION

3.4.1 Conclusion

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

3.4.2 Recommendation

(1) Justification of the Master Plan

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

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

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

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

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

(3) Selection of Alternative Measures

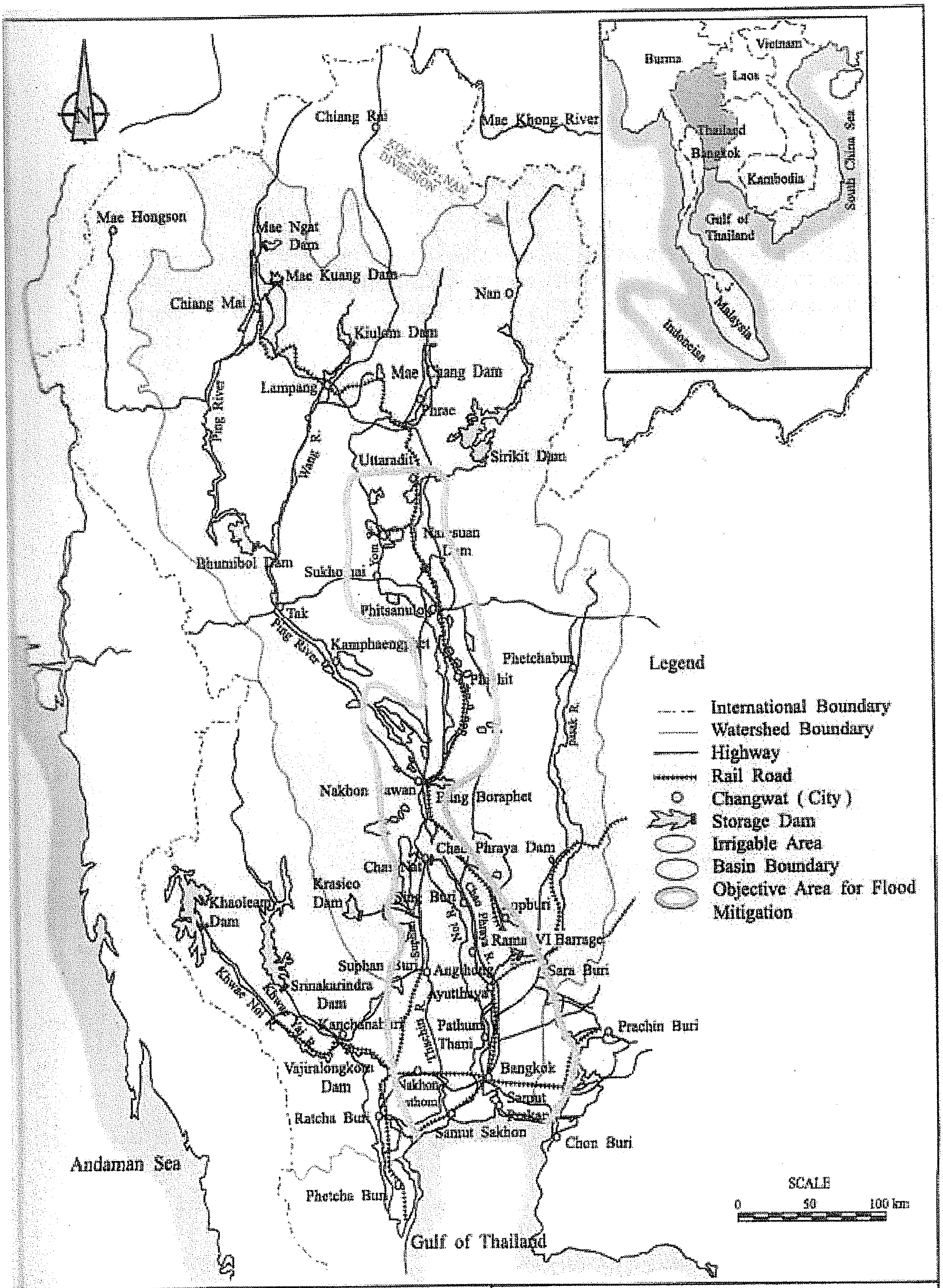
In the Master Plan, alternative measures (Alternative 1, 2-1 and 2-2) have been proposed to assure the safety level of protection for urban areas in the downstream, especially Pathum Thani, Nontaburi and Bangkok. Since t has been difficult to select the most suitable alternative due to significant issues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

(4) Implementation of Priority Projects

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

(5) Further Study on Flood Mitigation in Agricultural Areas

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



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

Fig A-0 GENERAL MAP

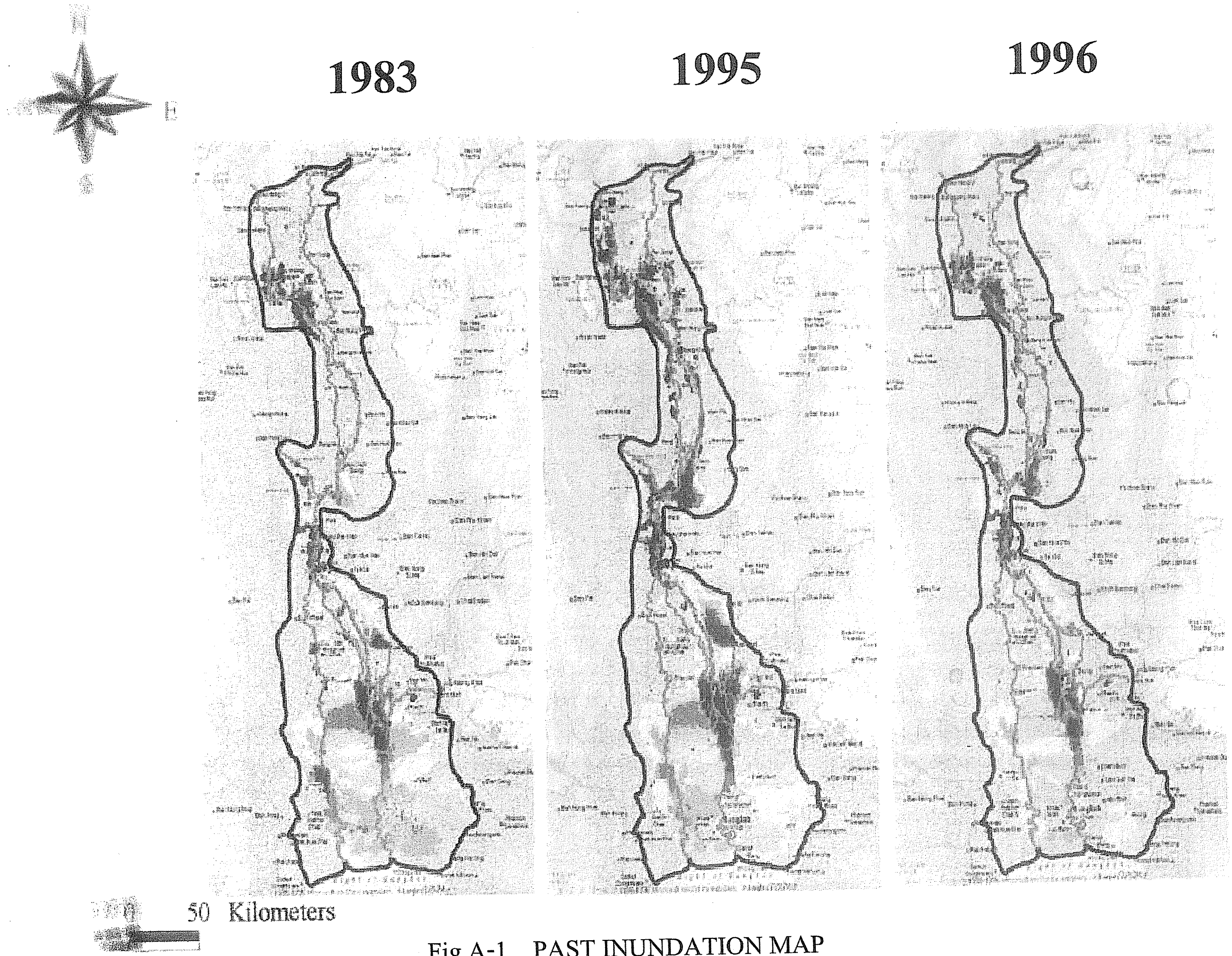
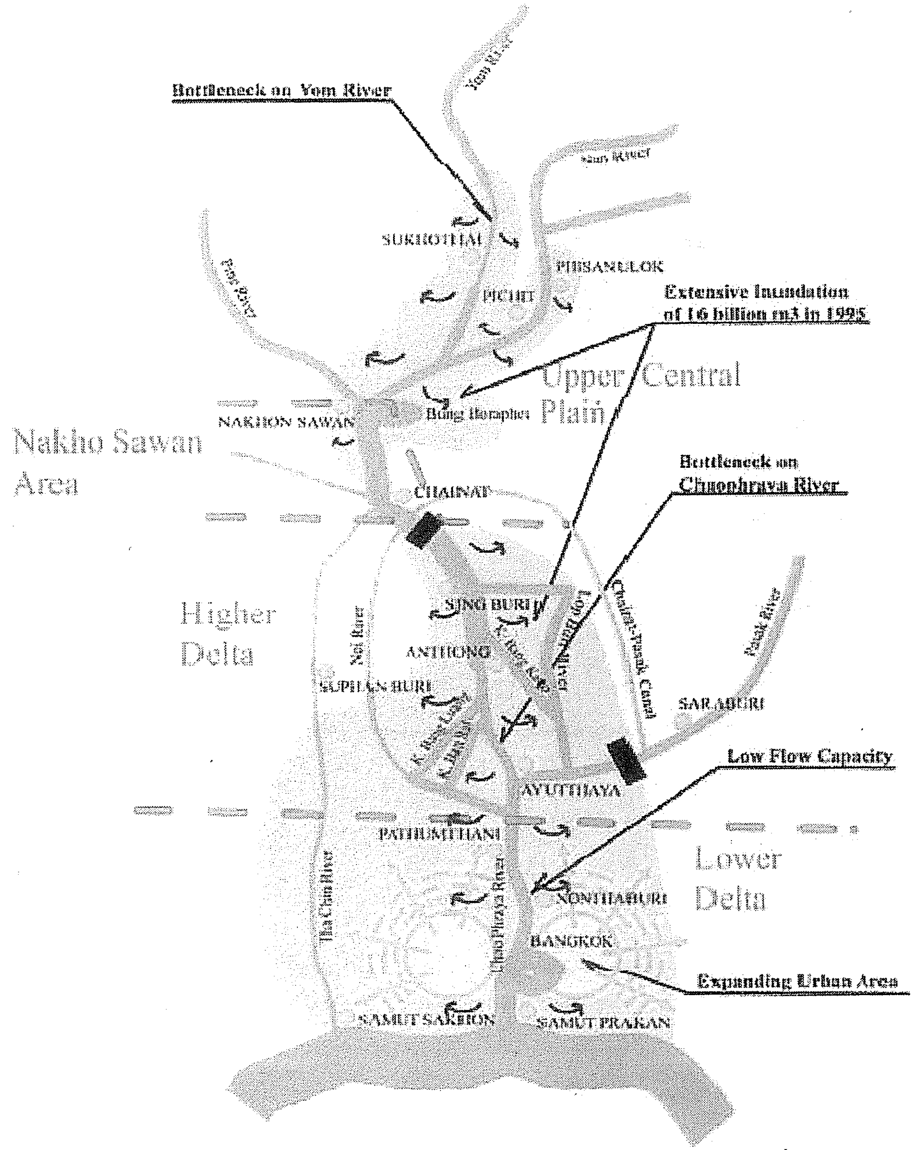


Fig A-1 PAST INUNDATION MAP



River and Flooding Condition

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

* : On-going Project

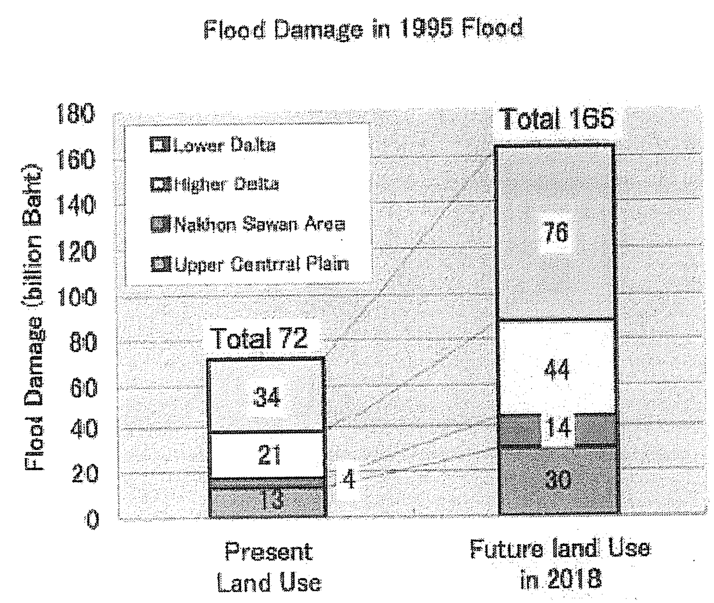


Fig A-2 PRESENT FLOODING SITUATION

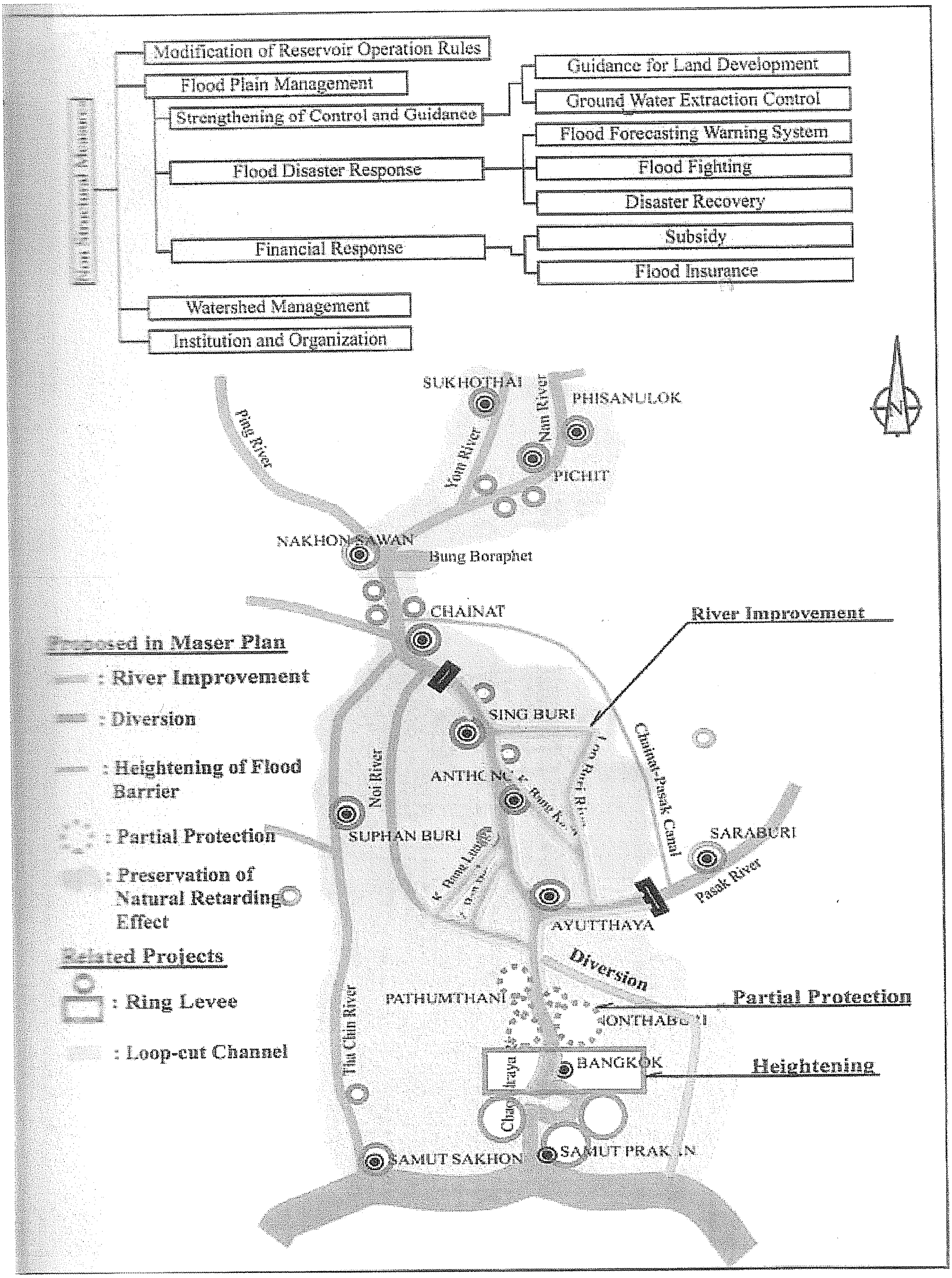


Fig A-3 MAJOR PROPOSED MEASURES

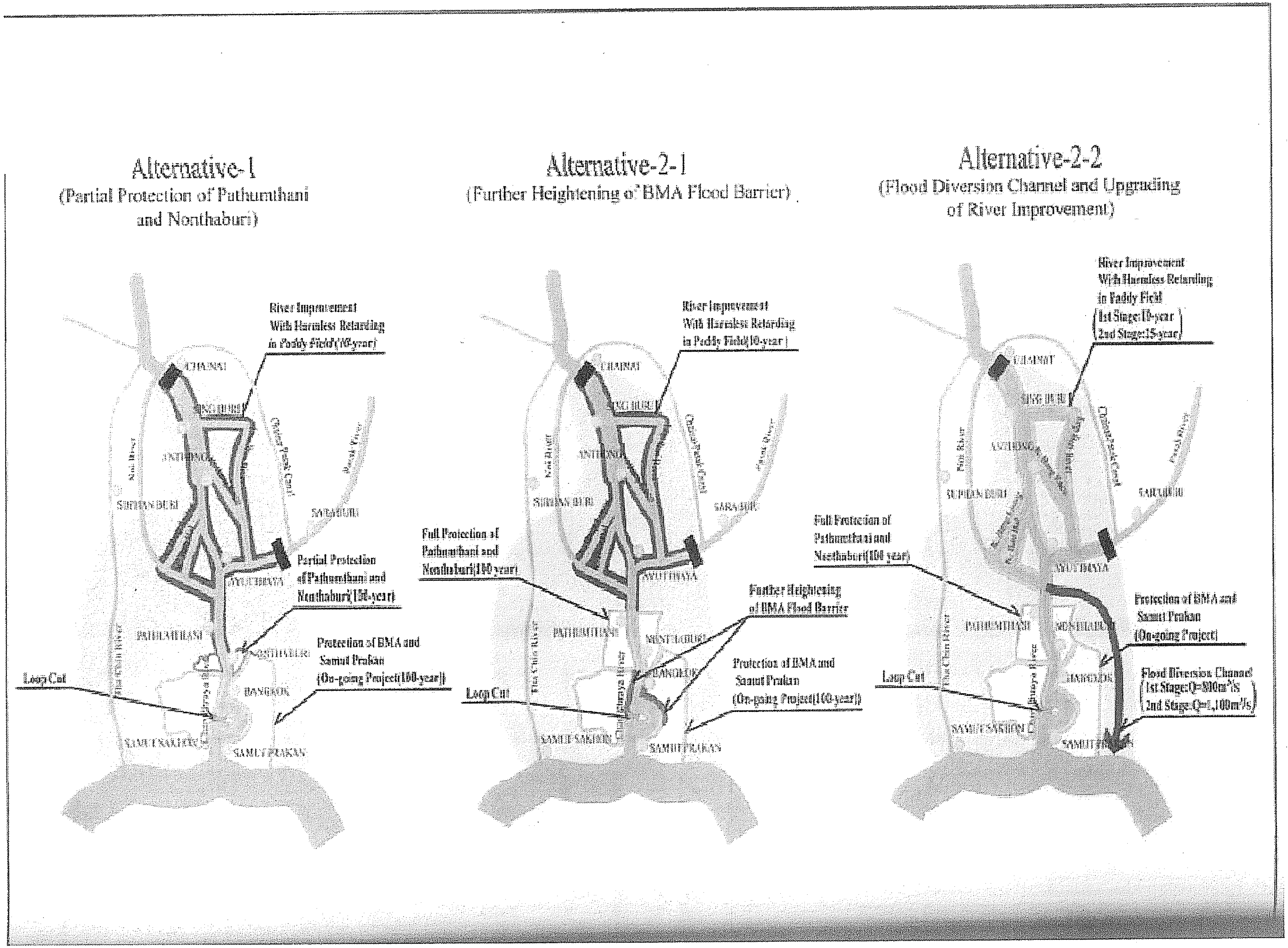


Fig A-4 ALTERNATIVES

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
(MARD)

COUNTRY REPORT OF VIETNAM

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

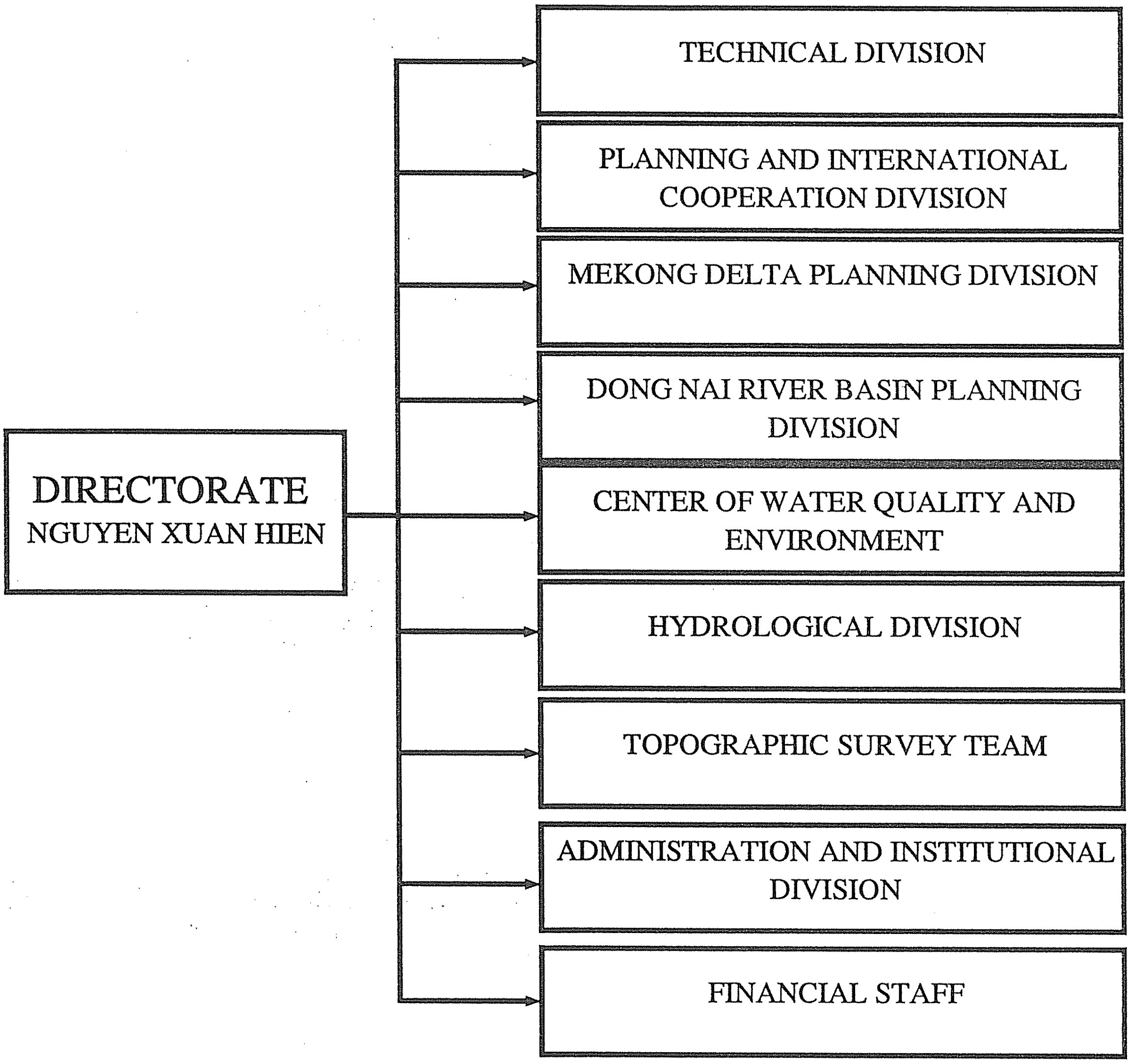
JICA EXECUTIVES' SEMINAR
ON PUBLIC WORKS AND MANAGEMENT
JFY 2005

Prepared by: NGUYEN XUAN HIEN

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

HO CHI MINH CITY, AUGUST, 2005

SUB-INSTITUTE FOR WATER RESOURCES PLANNING (SIWRP)



SIWRP belongs to the Ministry of Agriculture and Rural Development

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

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

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

- **Personal Data**

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

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

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

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CONTENT

I. INTRODUCTION

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

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

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

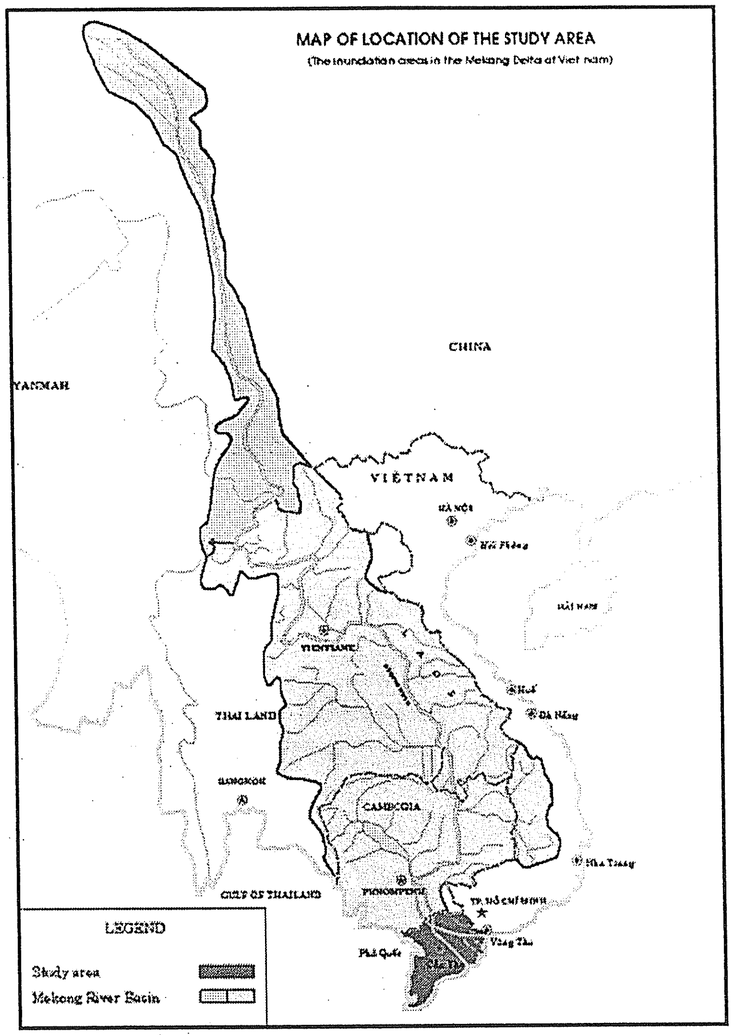
Nevertheless, floods also have positive effects, floods carry sediments to enrich the rice fields, increase aquaculture production, leach toxic ions from acidic soils and generally cleanse the land.

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

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

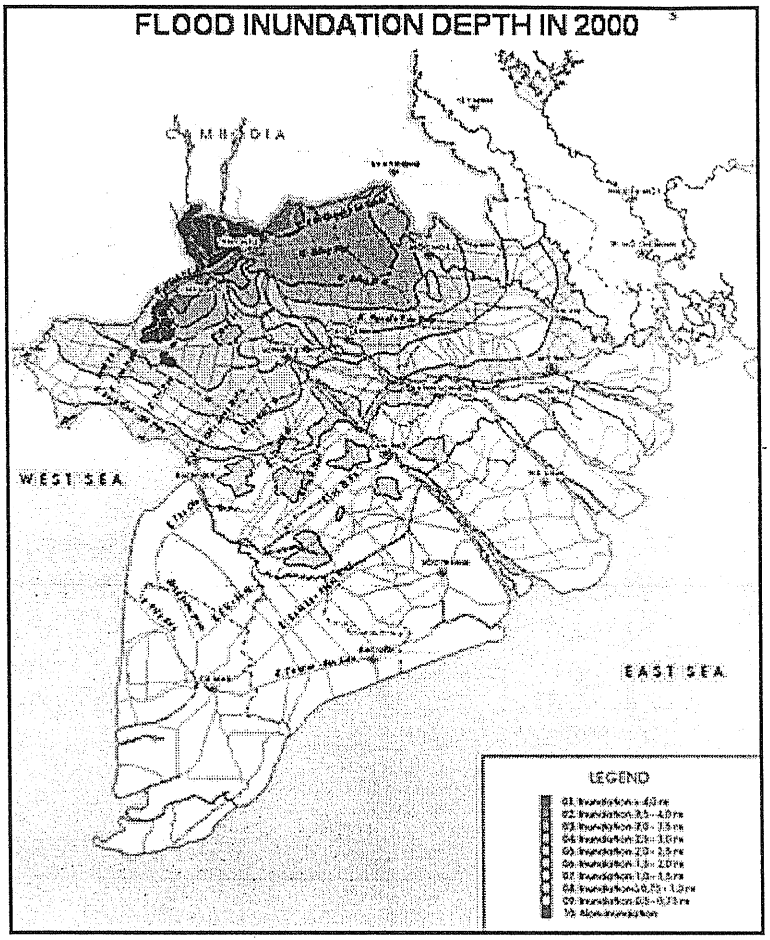
2.1. Characterization of the flood in the Mekong Delta

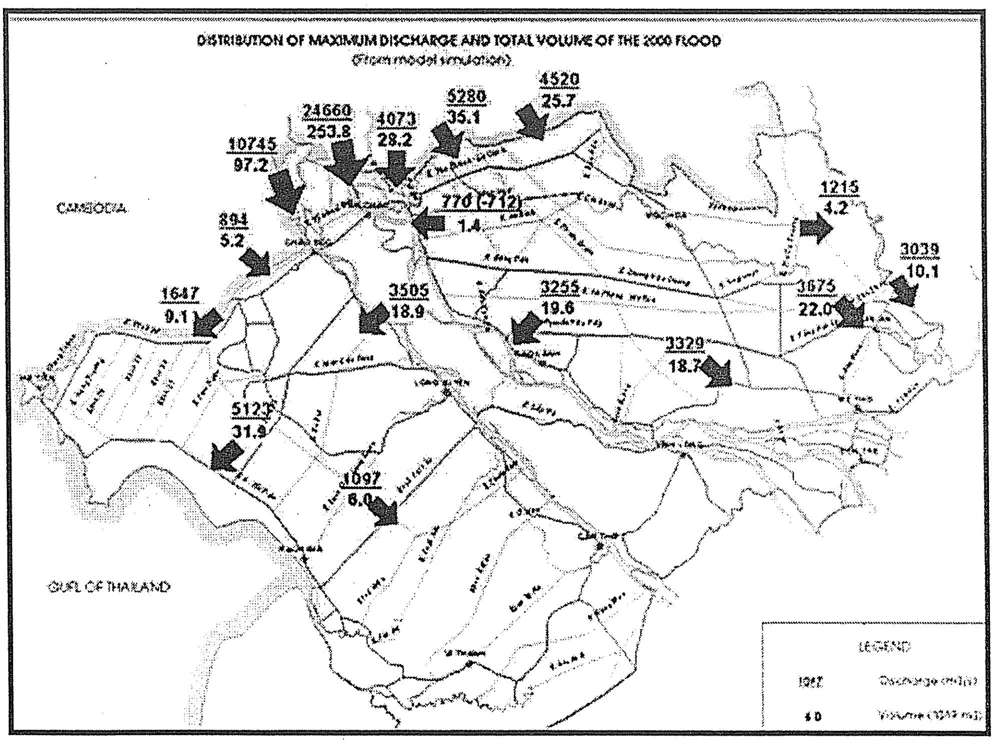
In the flood season the river system does not have sufficient capacity to discharge the total amount of water. Consequently, this results in storage and overland flow in flood plains in Cambodia and Vietnam. The flooding starts downstream of Kompong Cham in Cambodia, from Kompong Cham, flood is regulated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



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

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


FLOOD INUNDATION DEPTH IN 2000
CAMBODIA
WEST SEA
EAST SEA
LEGEND


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

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

2.2 Flood impacts on socio-economy and environment

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

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

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

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

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

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

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

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

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

2.3 Objectives

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

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

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

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

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

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

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

2.4 Structural Measures

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

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

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

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

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

2.5 Non-Structural Measures

2.5.1 Preparedness Measures

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

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

2.5.2 Response Measures

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

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

2.5.3 Recovery Measures

There appear to be three tiers of recovery operations.

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

III. CONCLUSION AND RECOMMENDATION

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

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

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

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

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

Outline of ICHARM

Dr. Tadahiko SAKAMOTO

Chief Executive

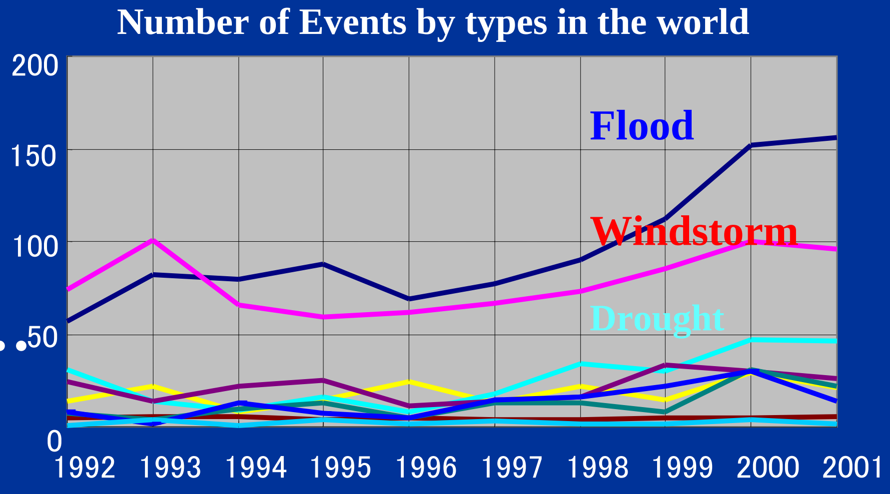
Public Works Research Institute (PWRI)

Tsukuba, Japan

Background

-Water hazards as a major challenge-

The number of water-related disasters is still increasing



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

The water-related disasters will be …

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

Reduction of water hazards is vital to alleviating poverty

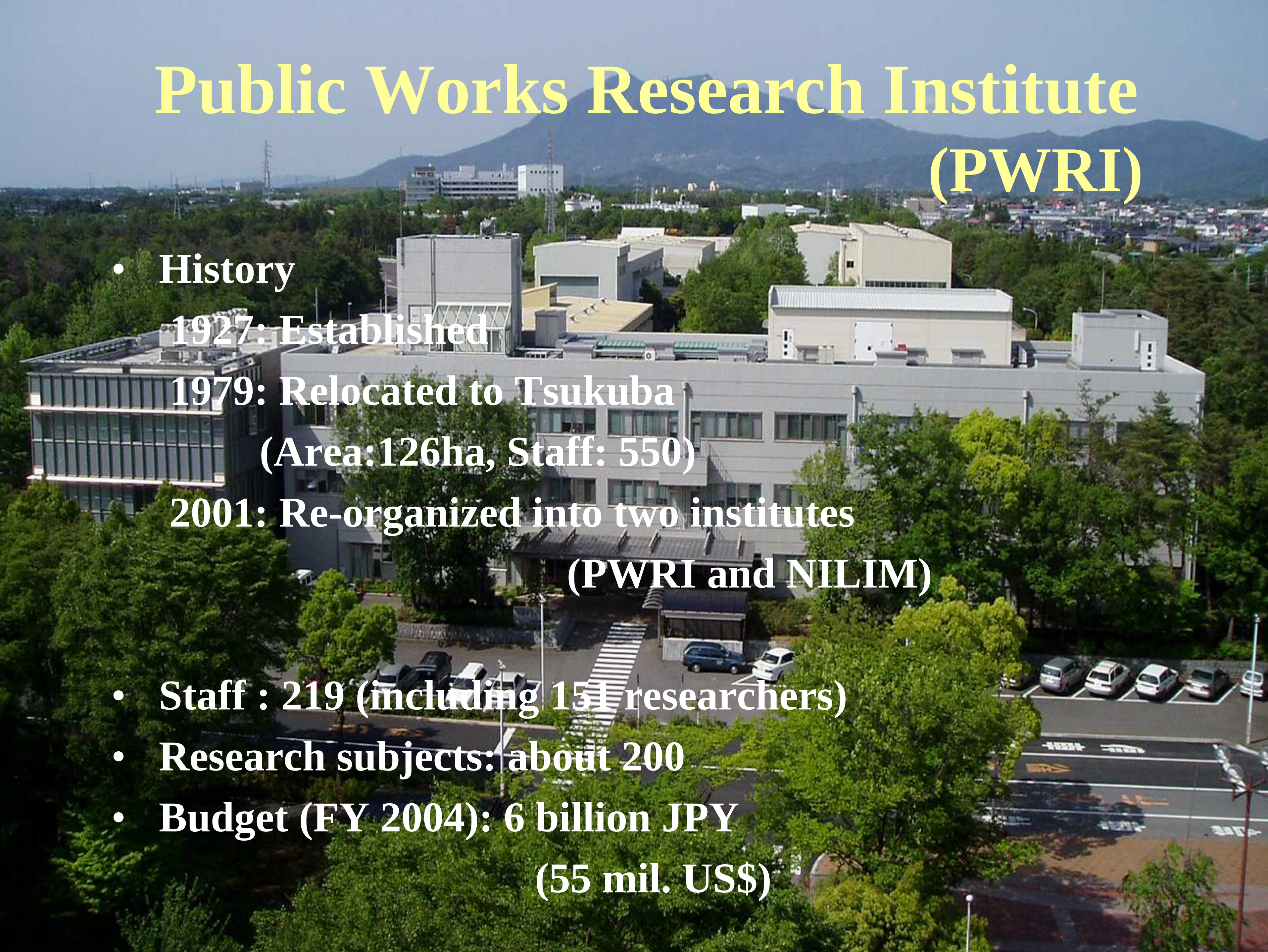
Background

-The Need to deal with water-related disasters-

2002 World Summit on Sustainable Development (Johannesburg)

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

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



Public Works Research Institute (PWRI)

- History
  - 1927: Established
  - 1979: Relocated to Tsukuba (Area:126ha, Staff: 550)
  - 2001: Re-organized into two institutes (PWRI and NILIM)

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

Objective of ICHARM

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

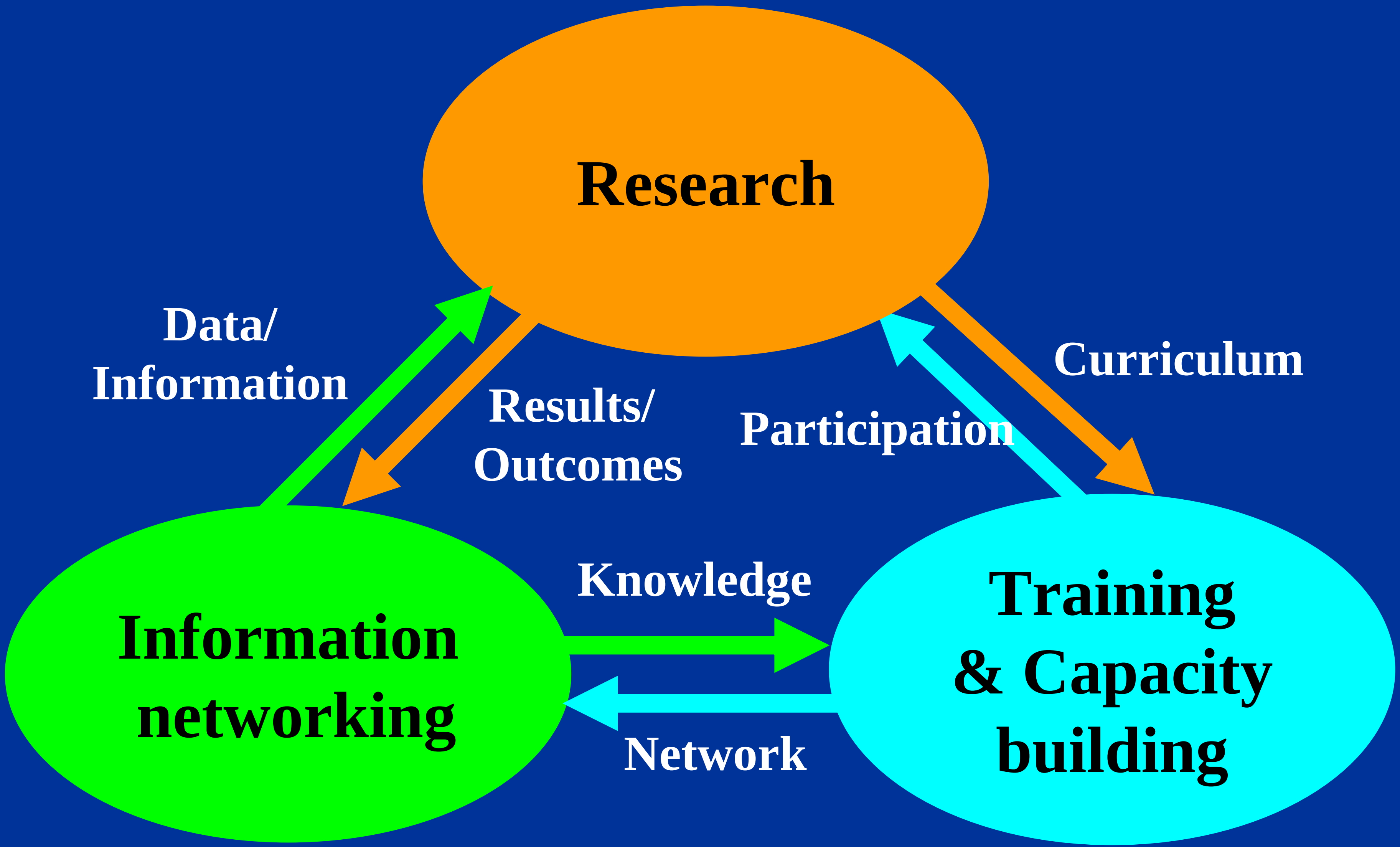
⇒ **Contribution to prevent or mitigate water-related disasters throughout the world**

Framework of ICHARM

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

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

Pillar Activities of ICHARM



Activities

- Research -

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

Activities

- Training and Capacity building -

Conducts JICA training courses, including

- River and dam engineering
- Flood Hazard Mapping

A new course on comprehensive tsunami disaster prevention is in preparation

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

New training course on Flood Hazard Mapping

Objective

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

Framework

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

Activities

- Information Networking -

Information networking will be synergized with research and training activities

in order to enhance integration and coordination:

Through the information network…

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

Preparatory Activities

October 2003

32nd UNESCO General Conference

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

October 2003

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

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

Preparatory Activities (cont'd)

January 2004

International technical workshop at PWRI

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

→ Summary Report on directions of the Centre

International Symposium in Tokyo

April 2004

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

July 2004

A preparatory meeting of IFI/P hosted by PWRI

Preparatory Activities (cont'd)

September 2004

UNESCO IHP Intergovernmental Council

→ Resolution to support the proposal

January 2005

World Conference on Disaster Reduction

(Hyogo Japan, organized by ISDR)

→ Recognition of the role of ICHARM

→ Official launch of IFI


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

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

International Flood Initiative (IFI)

Mission

Promote an integrated approach to flood management

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

Implementation

UNESCO, WMO, UNU, UN-ISDR, IAHS ･･･

Secretariat : ICHARM

Preparatory Activities (cont'd)

April 2005

UNESCO Executive Board

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

Preparatory Activities (cont'd)

October 2005

33rd UNESCO General Conference

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

Office Space of ICHARM

Research Staff 20
(in initial stage)

Office space
2,000m^2

Thank you for your attention

For more information :

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