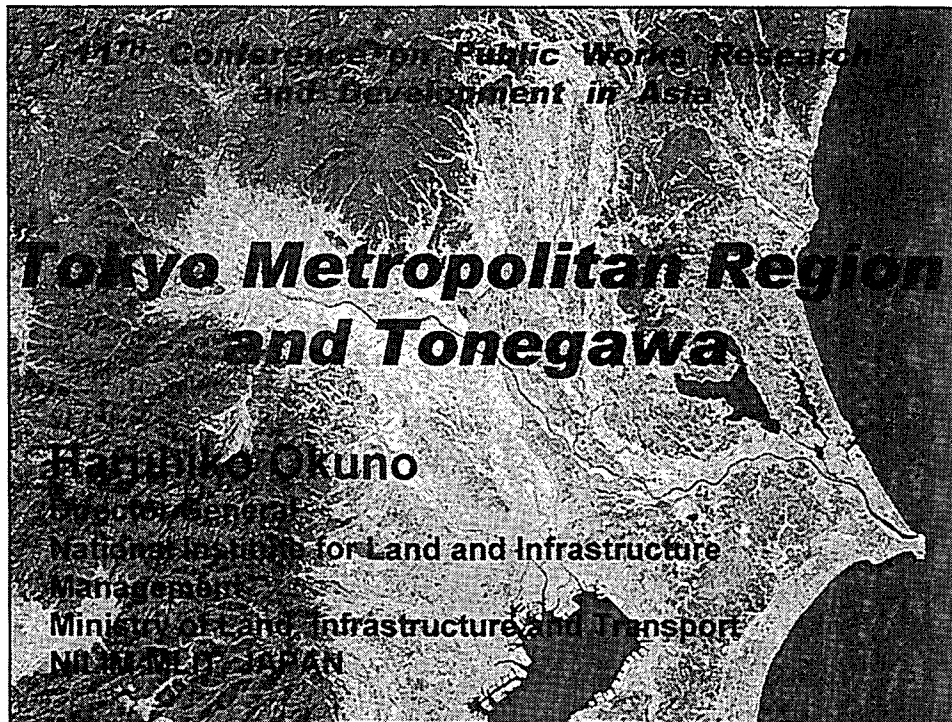


# D. COUNTRY REPORT

# **JAPAN**

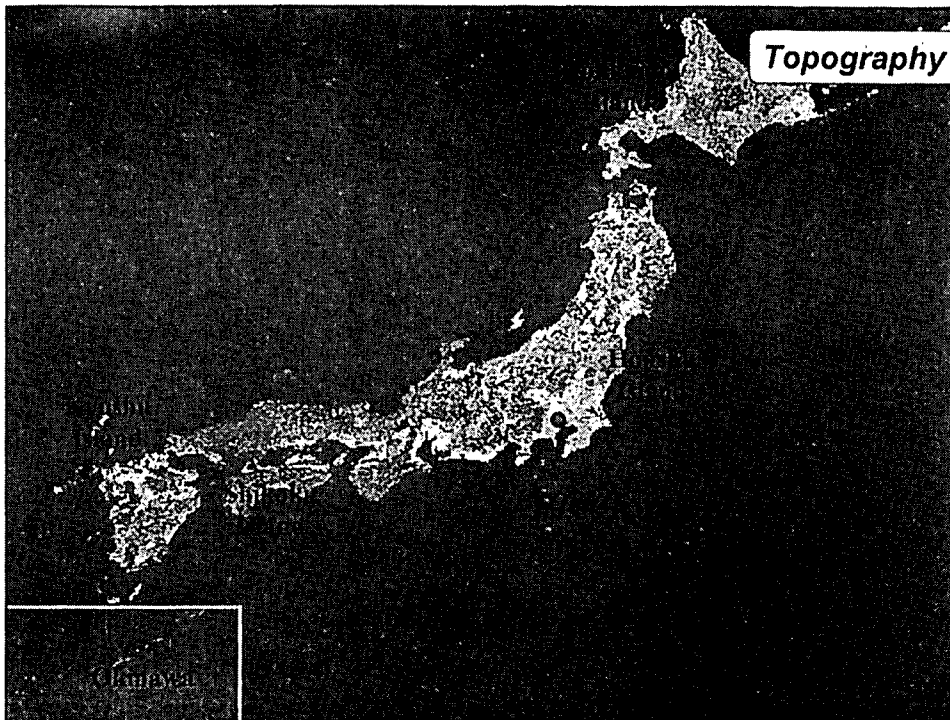
Mr. Haruhiko OKUNO  
Director General  
National Institute for Land and  
Infrastructure Management  
Ministry of Land, Infrastructure and  
Transport





## *Objectives*

- Review the history of Tonegawa riverworks projects (from Edo era circa 1600 - today)
- Review the issues arising from societal developments, and the role of river improvement projects, as exemplified by Tonegawa
- Explore future challenges and directions



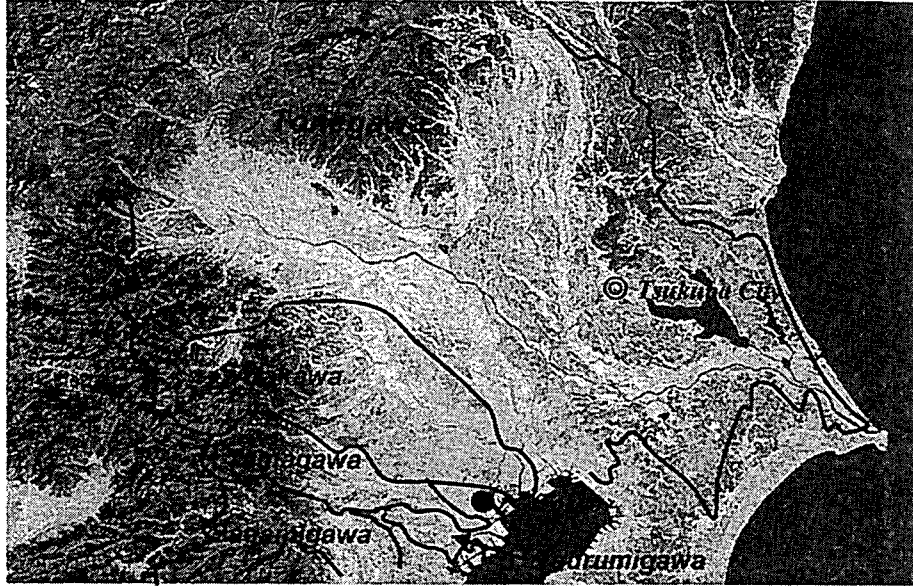
### ***General Characteristics of Japan***

- ***There are four major islands: Hokkaido, Honshu, Kyushu, Shikoku, and some 3,900 smaller islands.***
- ***Japan's total area: 377,815 square kilometers.***
- ***Mountains cover about 71% of Japan's land surface.***
- ***The islands of Japan lie in the temperate zone and at the NE end of the monsoon area.***
- ***Average annual rainfall across the country ranges from 1,000 to 2,500 millimeters.***

## *Tokyo Metropolitan Region*

*5 Primary River Basins*

Topography



### *General Characteristics of Tokyo Metropolitan Region*

#### ■ RIVER BASINS:

*Area of the 5 river basins is about 22,600 km<sup>2</sup>,  
with a total population of 28 million  
and total assets of about US\$ 3.2 Trillion.*

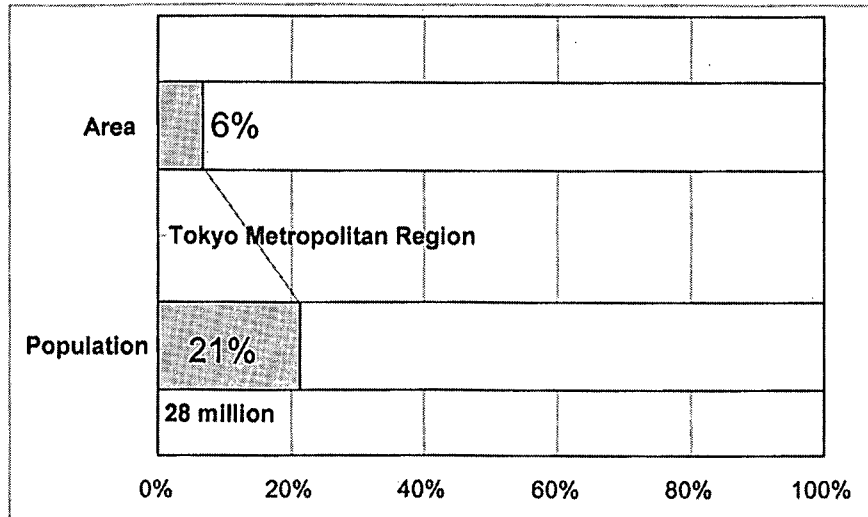
#### ■ CLIMATE

*Winter : low humidity with occasional snow  
Summer : high temperatures and humidity with  
an annual average rainfall of about 1500 mm.*

Social Frame

# Population

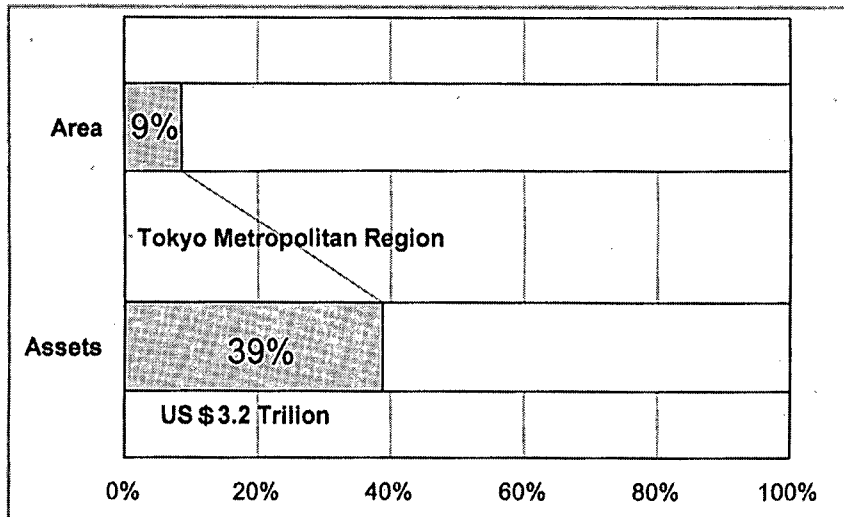
## Tokyo Metropolitan Region



Social Frame

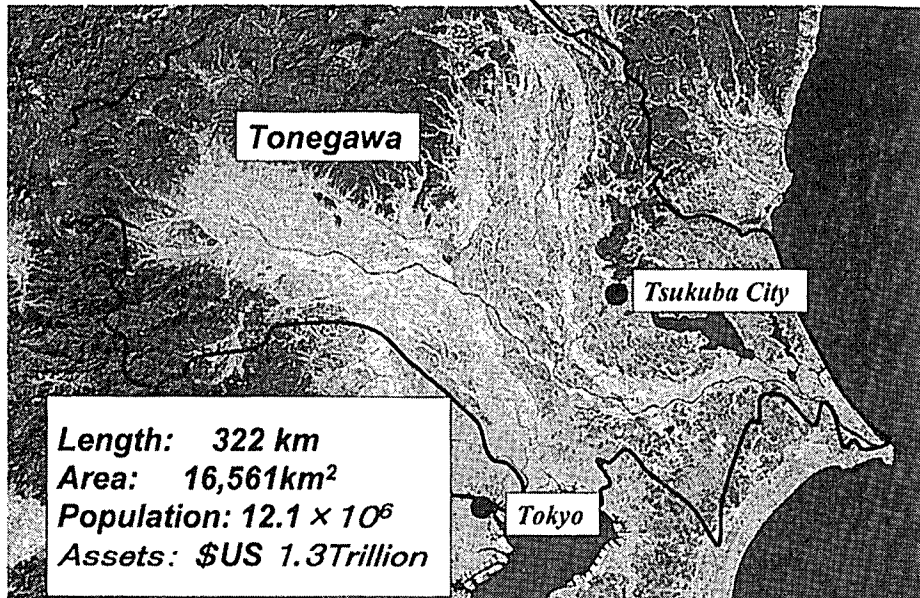
# Assets

## Tokyo Metropolitan Region



# Tonegawa

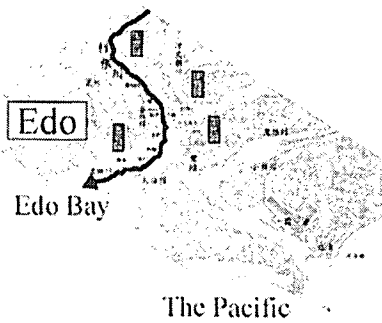
## Topography



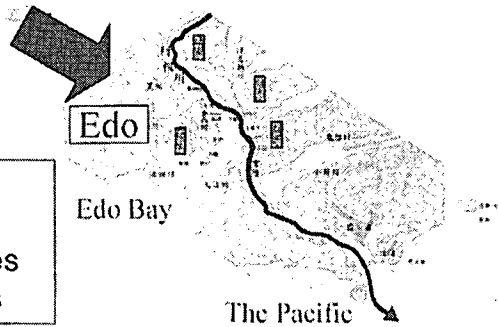
## History of Tonegawa Riverworks

### Edo era

### *Diversion Riverworks* (1594~1654)



Redirect Tonegawa  
out to the Pacific Ocean  
from Edo Bay

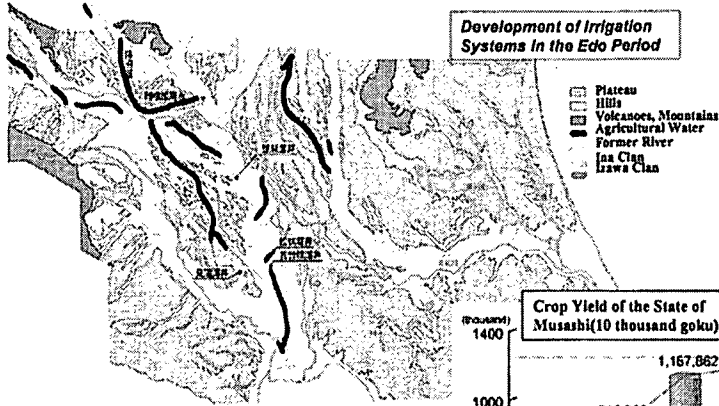


- Objectives**
1. Prevent floods in Edo
  2. Develop new rice paddies
  3. Allow navigation of ships

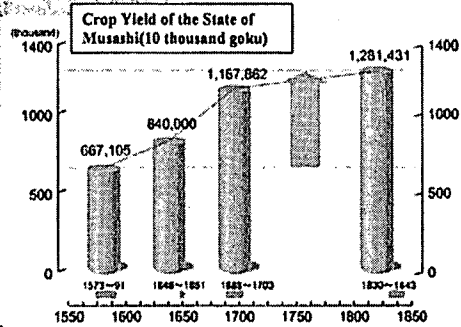


## Rice Paddy Development

Edo era

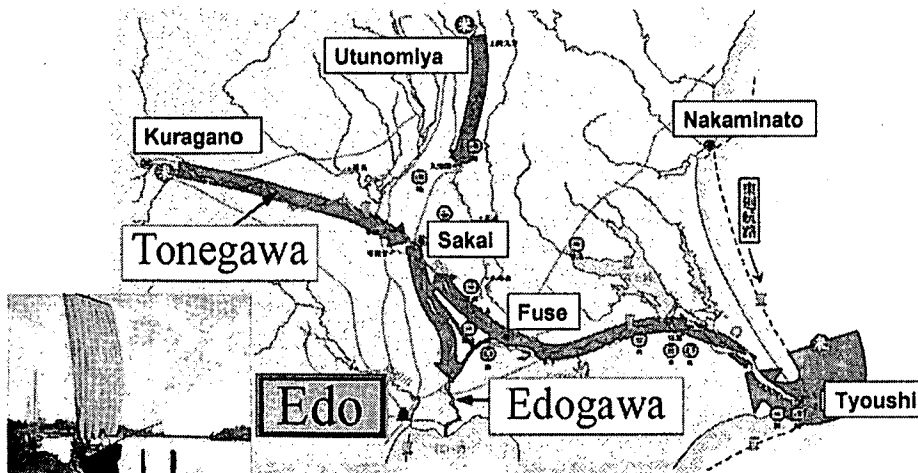


- The Tonegawa Diversion allowed the development of new rice paddies.
- Rice yields doubled, providing solid foundations for Edo's economy.



## Navigation

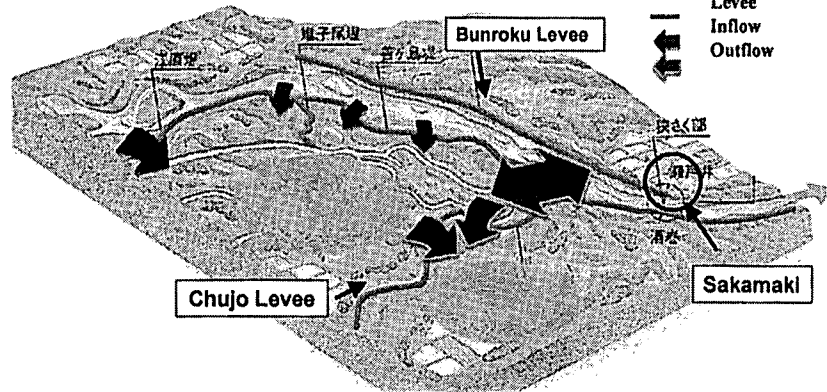
Edo era



- The Tonegawa Diversion also allowed the development of an intricate inland navigation network, to serve as arteries of the Edo economy.

### Regulating Flow in the Middle Reaches (Chujo Levee)

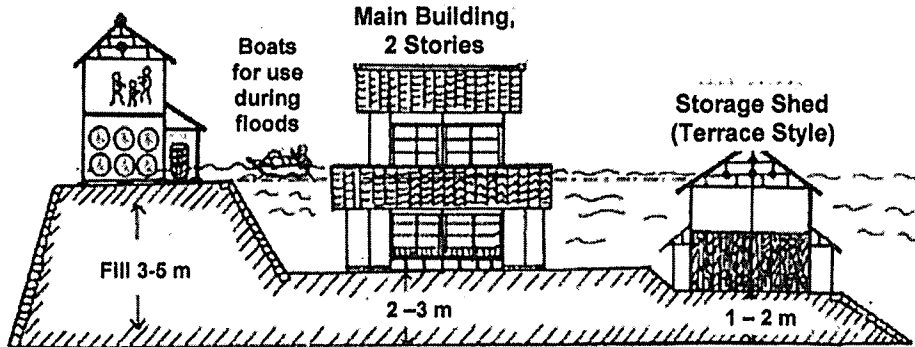
#### How the Chujo Levee Works



Area: 49 km<sup>2</sup>, Capacity: 120 × 10<sup>6</sup> m<sup>3</sup>

### Mizuka: A local initiative developed by flood prone areas

#### Mizuka

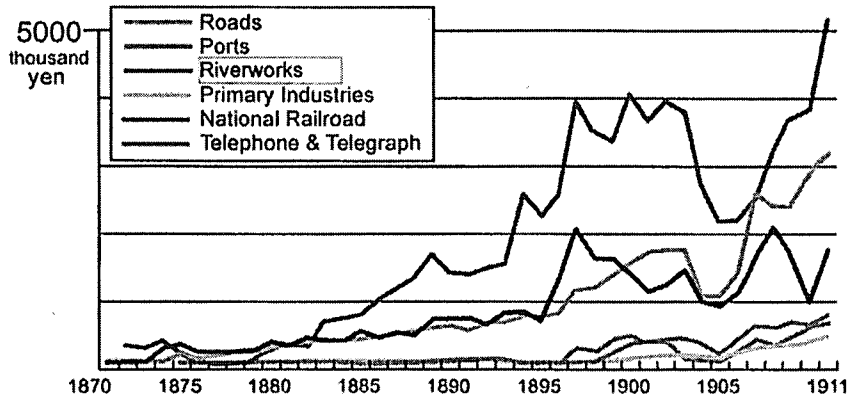


Mizuka: An Evacuation Refuge

Original drawing by Shigeru Miyata, October 1, 1960

## Public Investments (Nationwide) Meiji era

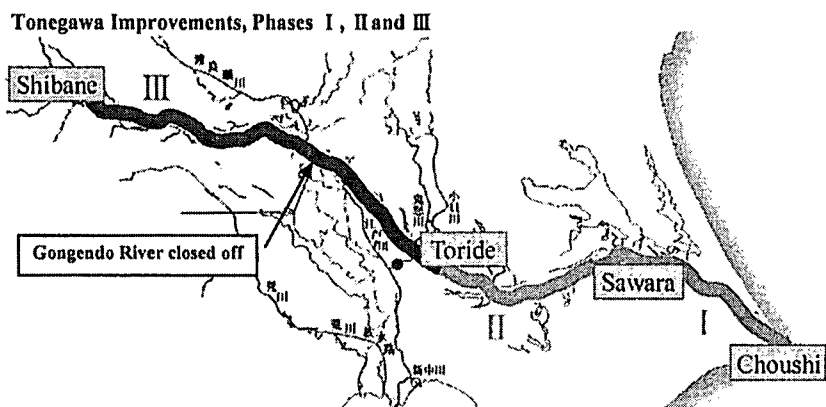
### ◇ Comparison of Public Investments in the Meiji Period



1896: River Law enacted

1900: Greater investment in riverworks

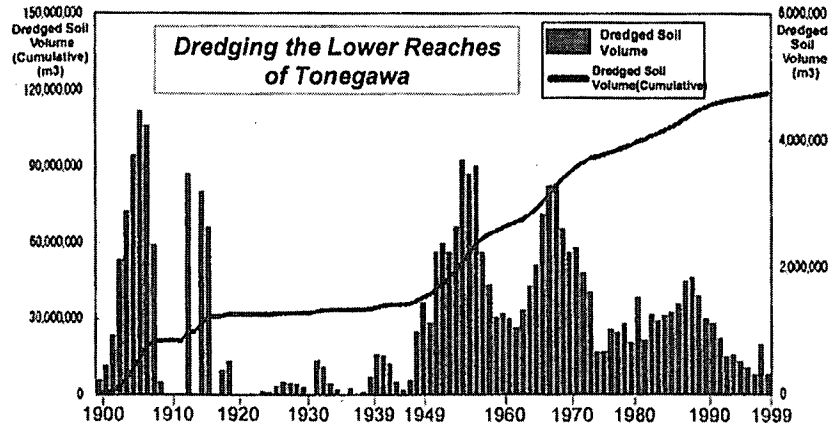
## The First Modern River Improvements (1900~1930)



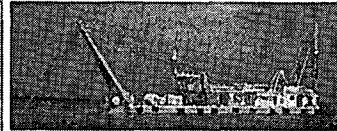
1900 Tonegawa Improvement Plan  
Dredging and levee works from  
the lower to the upper reaches

## *Dredging*

### *Enhancing Drainage Capacity in the Lower Reaches*



Dredged soil volume between 1900-1930 exceeded the Panama Canal excavation.



Dredger "Shimousa" currently in use.

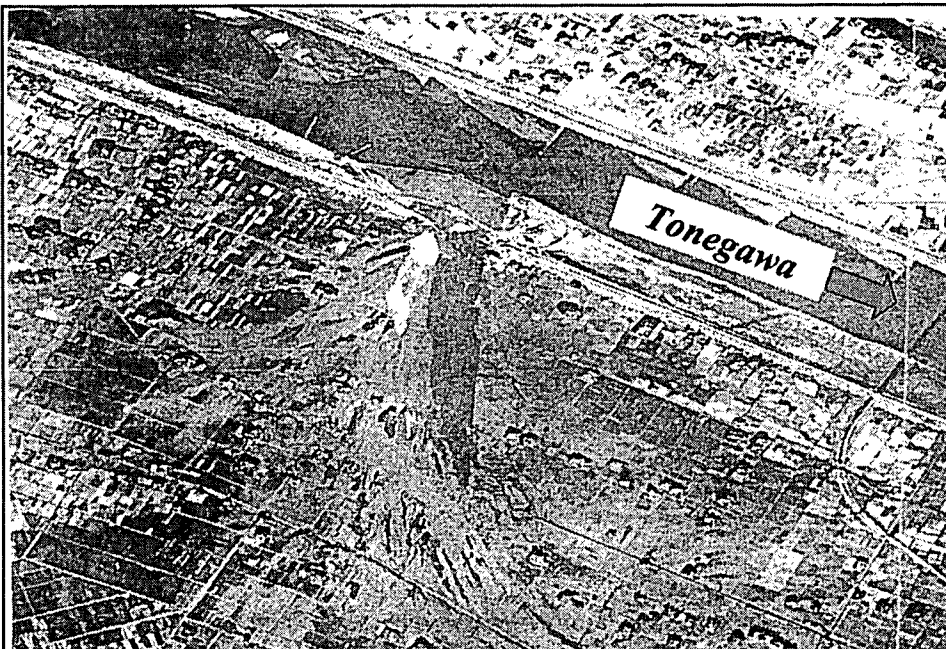
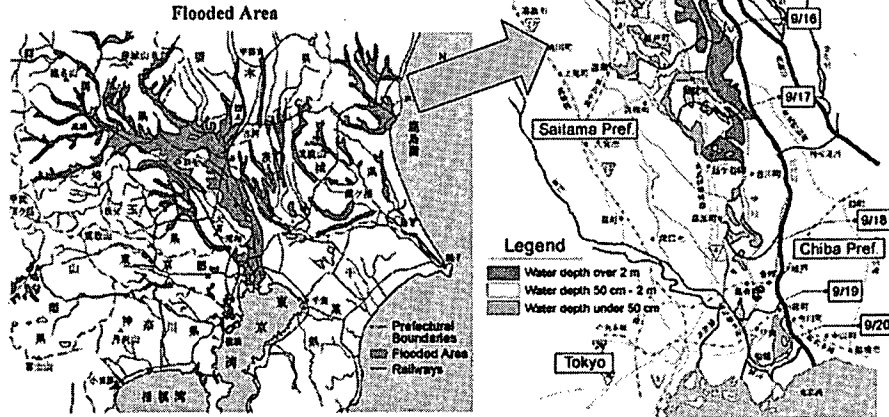
### *Construction of Retarding Basins in the Middle and Lower Reaches*



**Watarase Retarding Basin  
(Construction began in 1911)**

## Damage from Typhoon Kathleen (1947)

Point of Levee Collapse	Tonegawa 134.4 km (right bank)
Flooded Area	440 km <sup>2</sup>
Population within the Flooded Area	600,000
Damage	Approx. 7 billion yen (as of 1947) (general property + agricultural products)



**The Collapsed Tonegawa Levee** October 28, 1947

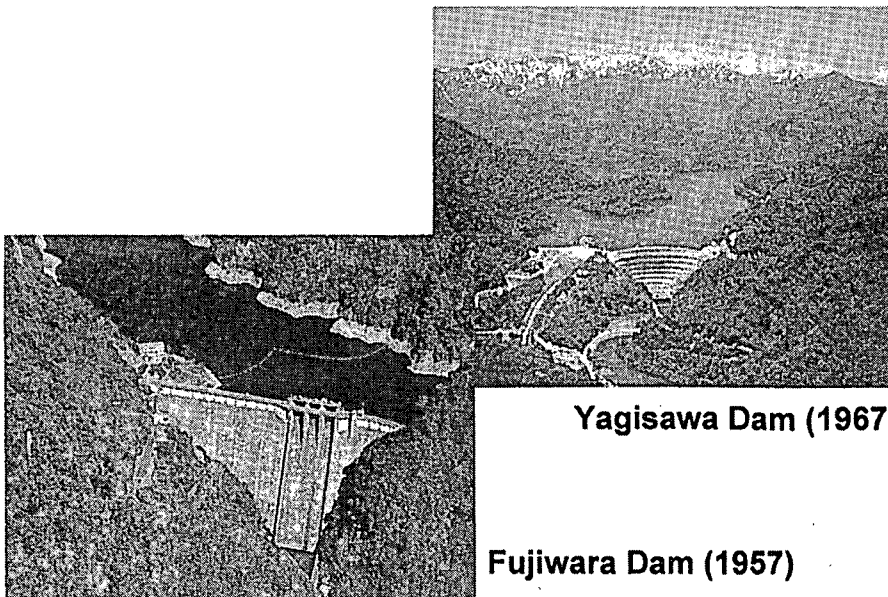
## ***Sabo Projects at the Headwaters***

### **Sabo Facilities for Erosion Controls**



**Ashio Sabo Dam  
(Watarase River)**

## ***Dam Construction in the Upper Reaches***

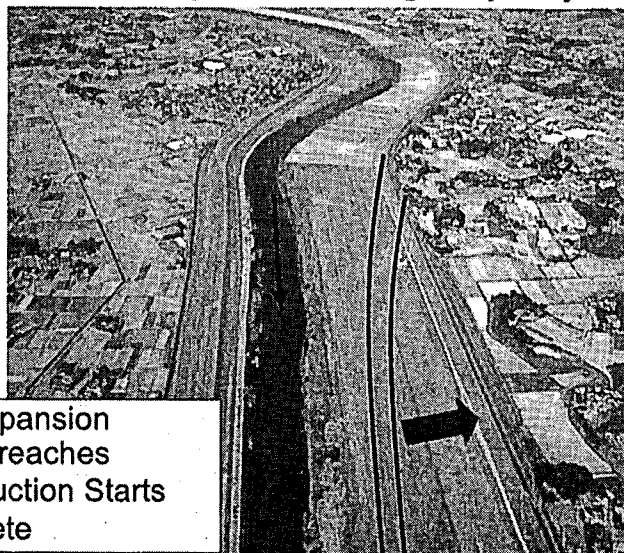


**Yagisawa Dam (1967)**

**Fujiwara Dam (1957)**

## River Width Expansion

### Enhancing River Drainage Capacity

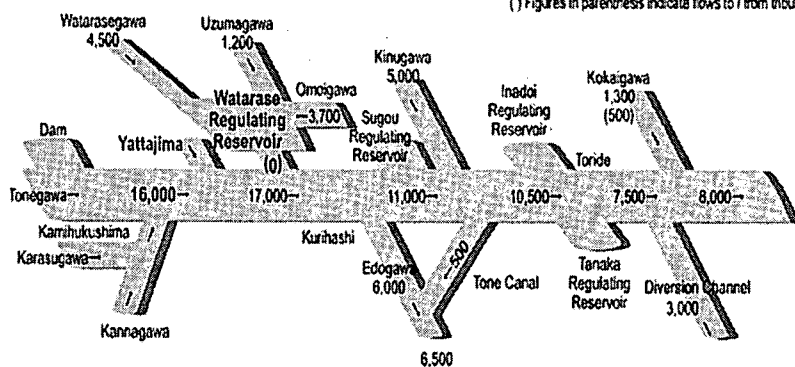


River width expansion  
in the middle reaches  
1949: Construction Starts  
1967: Complete

## Tonegawa Flow Distribution

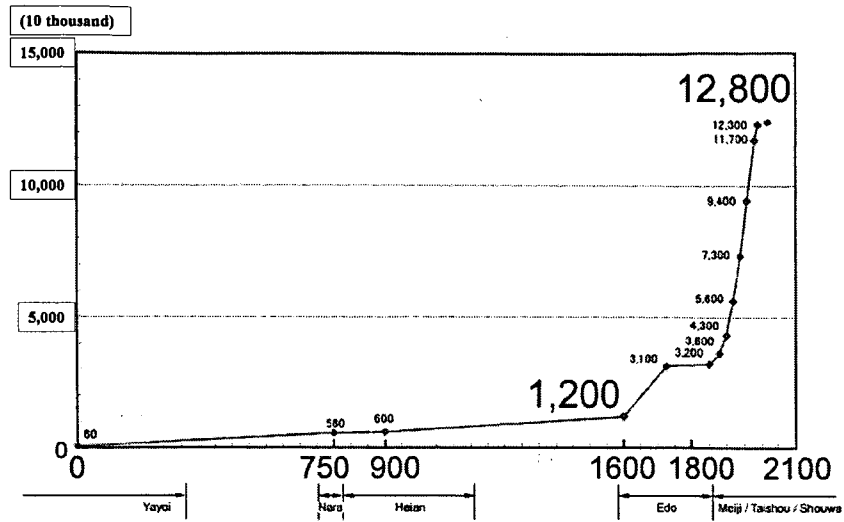
### Flow Distribution (m<sup>3</sup>/s)

( ) Figures in parenthesis indicate flows to / from tributaries

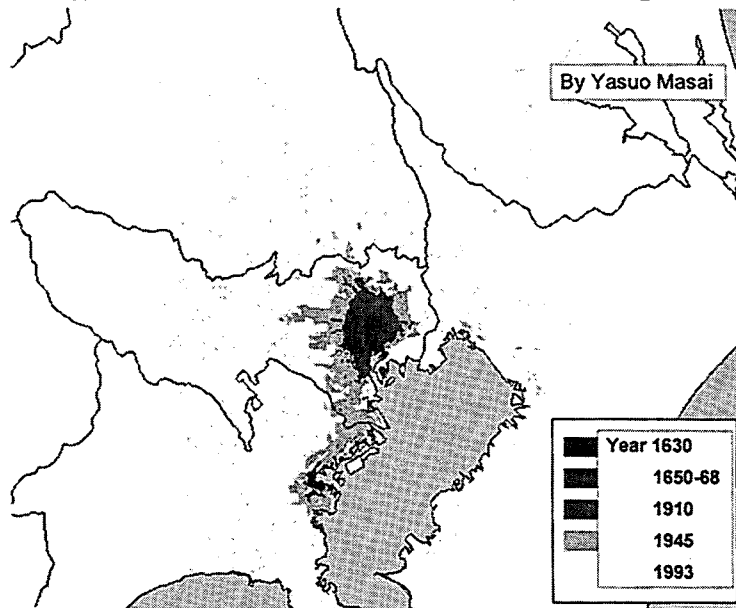


- return period:  $P=1/200$
- Yattajima: 22,000 – 6,000 → 16,000 (m<sup>3</sup>/s)

## Japan's Population

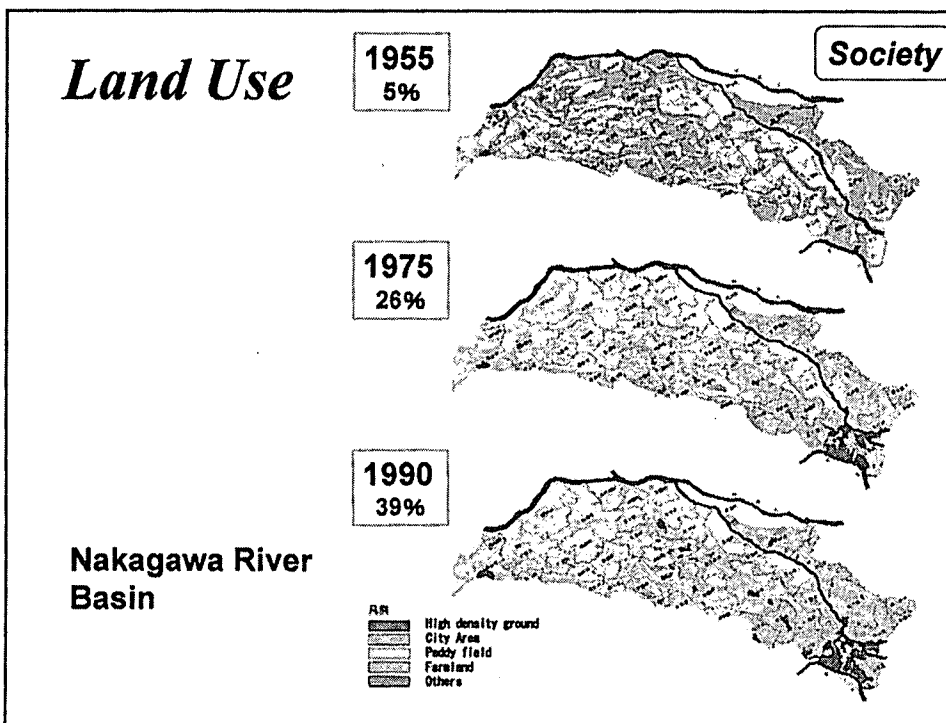
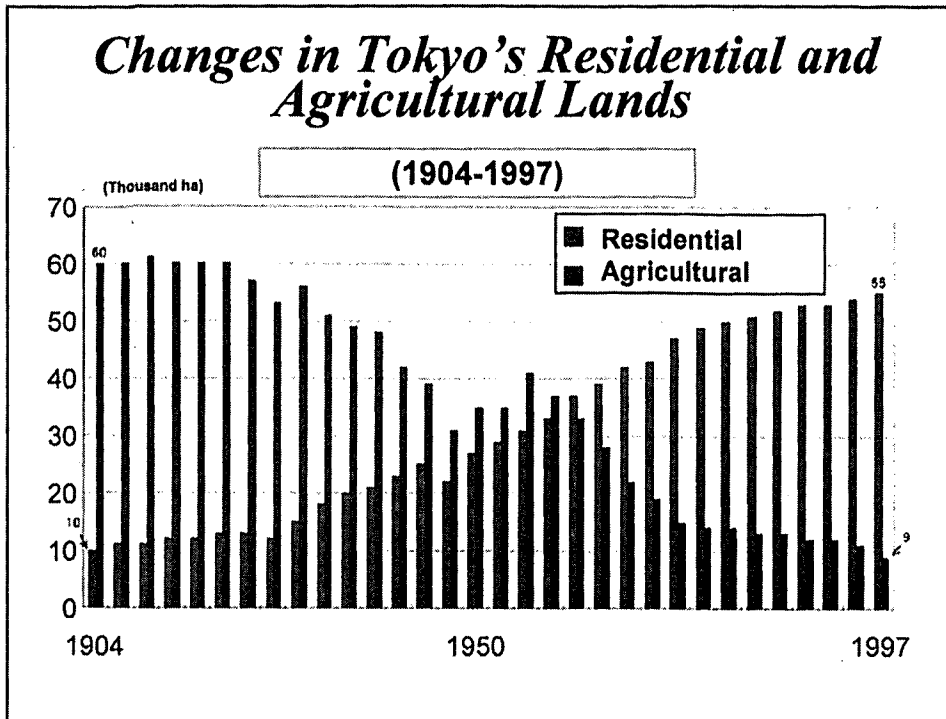


## Expansion of Edo-Tokyo Region

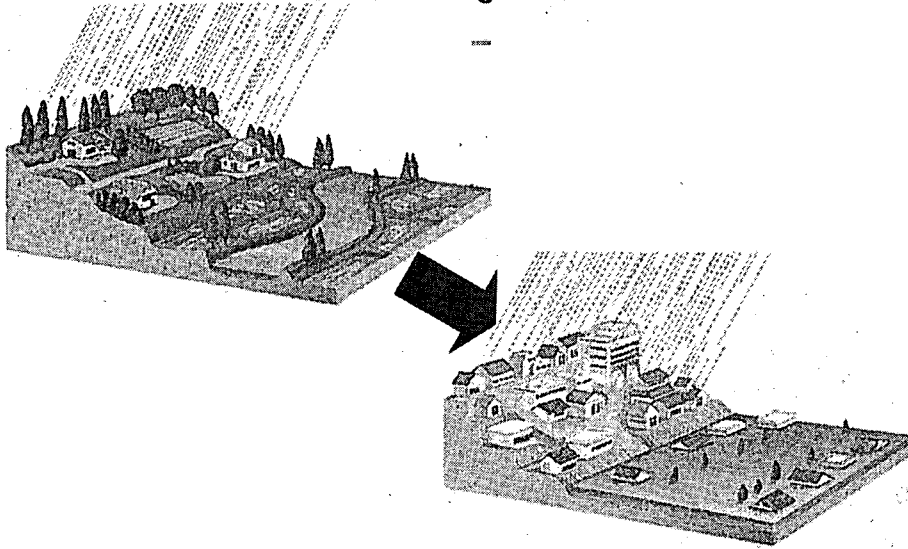




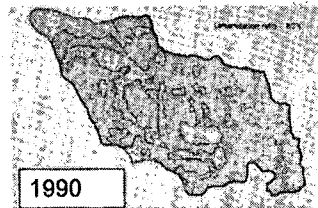
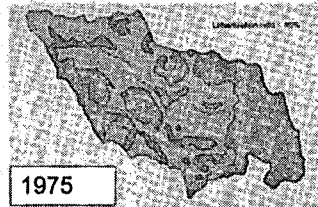
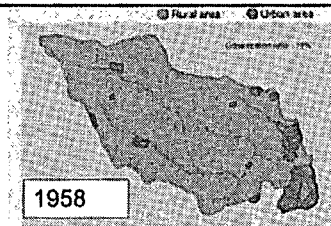
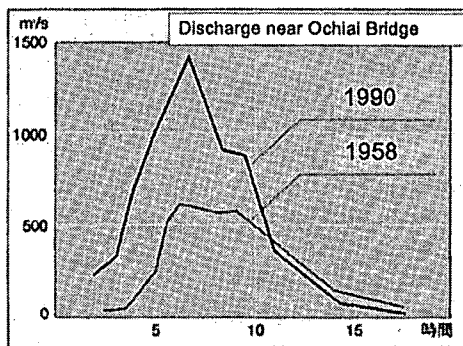
## Changes in Tokyo's Residential and Agricultural Lands



## Less Water Retention due to Urbanization



## Water and Cities



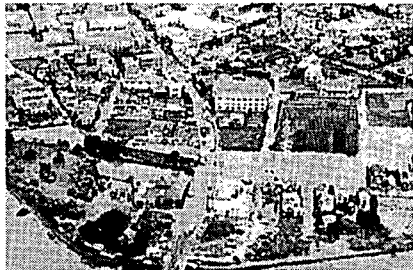
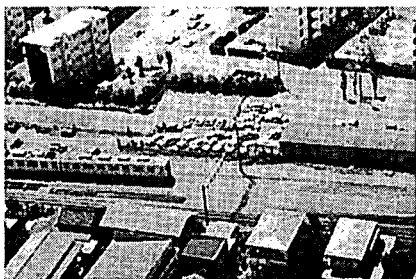
### Urbanization in Tsurumigawa

Concrete, asphalt, loss of forests and vegetation increase downstream runoff and aggregate flood damage

In about 30 years, urbanization rose from 10% to 80%, making only 10% of rural land.

## Flood (1)

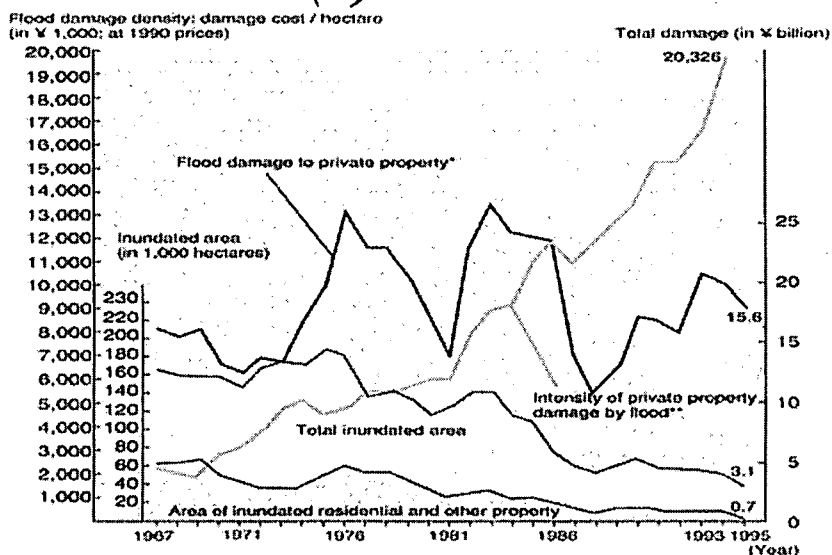
Current Problems



Nakagawa

## Flood (2)

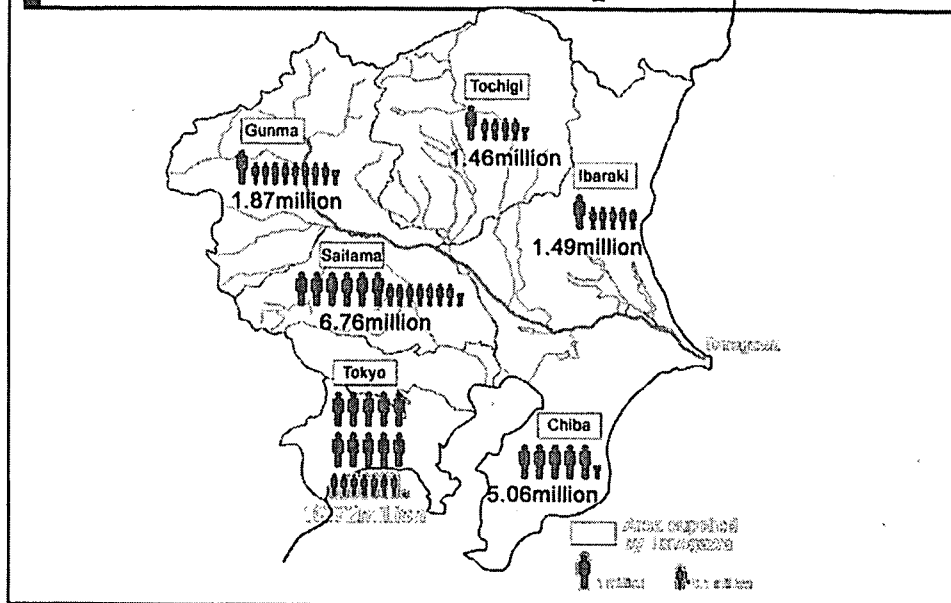
Current Problems



\* Private property damage by flood is the sum of direct damage plus loss due to interruption of business.  
 \*\* Density of private property damage by flood is calculated by dividing the private property damage by the area of inundated residential area.

## Tonegawa Supplies Water to 27 Million in the Metropolitan Area

Current Problems



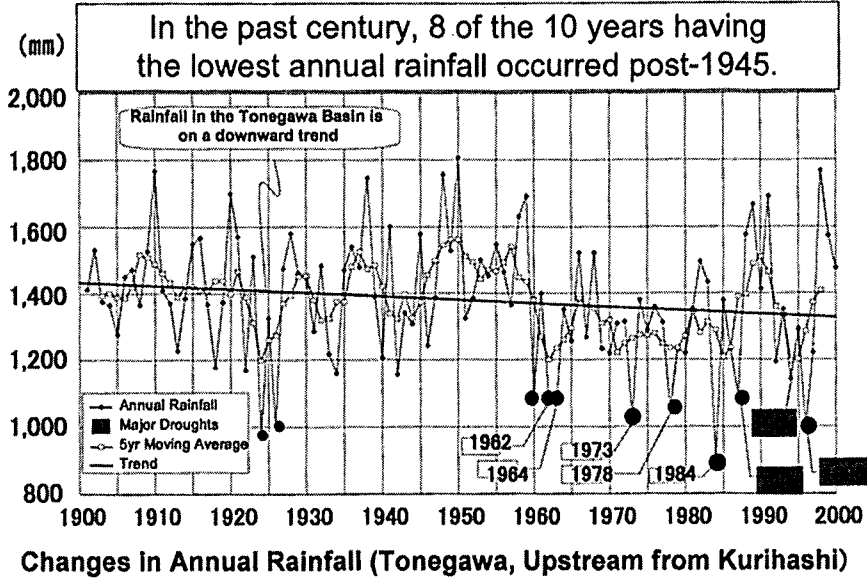
## Drought (1)

Current Problems

City	Present cycle of water shortage	Target level
Tokyo	3 years	10 years
San Francisco	11 years	Maximum Water shortage to date
New York	7 years	Maximum Water shortage to date
London	15 years	50 years

**Current Problems**

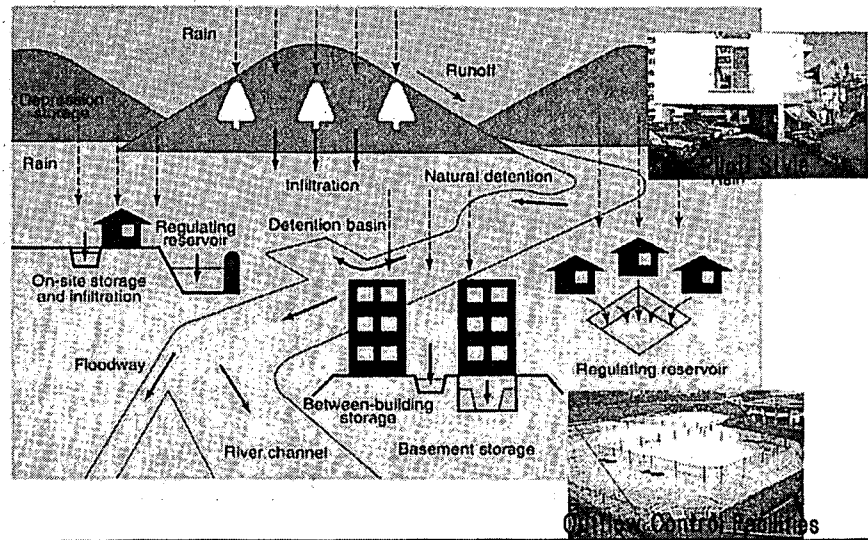
# Drought (2)



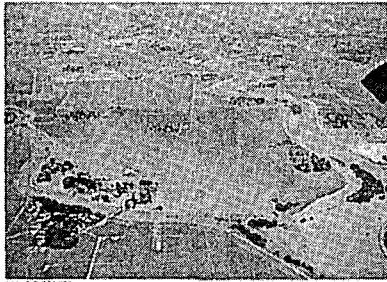
**Countermeasures**

# Comprehensive Flood Control Measures

■ Concept of comprehensive flood control

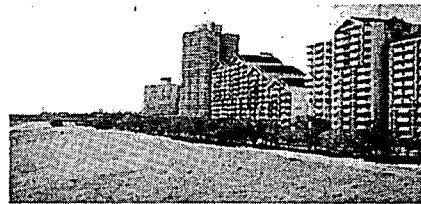


## Construction of Retarding Basins

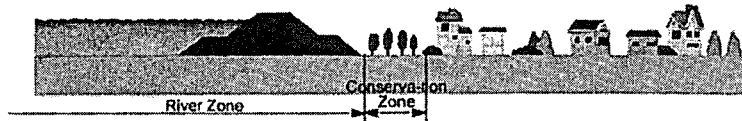


- Relocate communities to higher ground
- Construct retarding basins

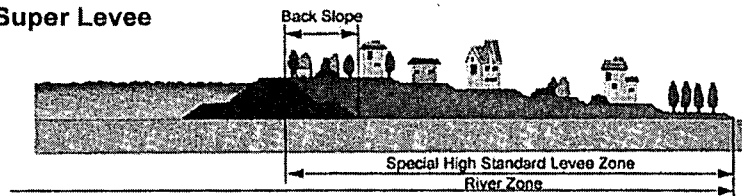
## Super Levees



### ● Traditional Levee



### ● Super Levee



Countermeasures

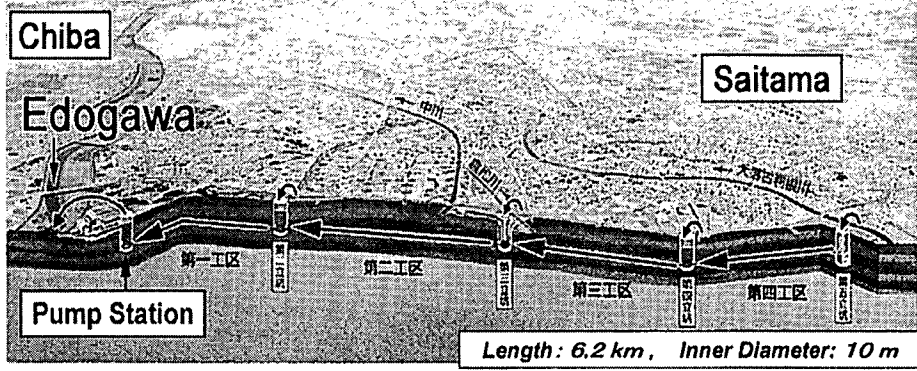
## Metropolitan Area Perimetric Diversion Channel

Objective:

- Prevent flood damage
- Provide good residential lots

Bird's-eye View

### Tokyo Bay



Length: 6.2 km, Inner Diameter: 10 m

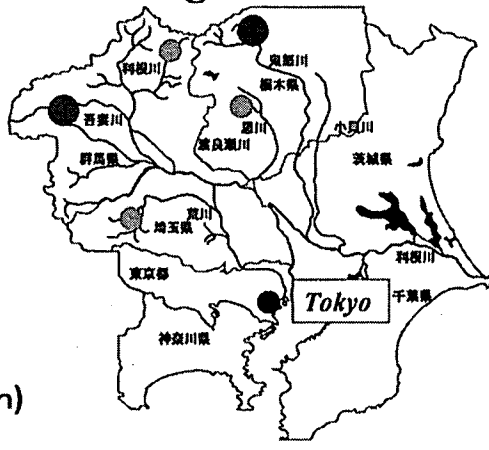
## Construction of Multi-purpose Dams

Countermeasures

### Yunishigawa Dam

### Yanba Dam

● MLIT  
● WARDEC  
(under construction)



## ***Contribution of Our Research Institute***

- **Advanced research to meet the demands of the time, and leadership in Japan's public works programs**
- **Theoretical support for hydraulic calculations, hydrological surveys, river channel planning, levee and dam designs**
- **Large-scale model experiments to better understand phenomena and determine design values**

## ***History and Achievements of Our Research Institute***

- 1925: Seismic Design Theory on Gravity Dams by Dr.Mononobe**
- 1926: Establishment of The First Hydraulics Laboratory in Japan  
( Akabane Branch )**
- 1952: Establishment of The Largest Testing Center in the Orient  
using river/dam hydraulics model  
( Shinozaki Experimental Lab.)**
- 1961: Developed the storage routing model ,  
the water-level gauge (Suiken Model 61);  
Establishment of the Laboratory using large-scale river/coast  
hydraulics model ( Kashima Hydraulic Lab.)**



### ***Conclusion (1)***

**At Tonegawa, levees, reservoirs and irrigation channels were developed to secure water and safety.**

**The flood plain was converted into residential lots and farmland to support livelihoods.**

**Population growth and urbanization led to increases in discharge volume and assets within the flood plain.**

**Potential damage during major floods has not decreased.**

**Comprehensive programs covering the entire basin, combining structural and nonstructural measures are necessary.**

### ***Conclusion (2)***

**Man has constantly modified nature to meet his needs , thereby coexisted with nature.**

**As this relationship continues in the future, it is important to implement measures that meet with the demand of the era.**

