2

Flood and Erosion Control

Public demand is growing for systematic development of infrastructure. Measures to control floods, sediment disasters, volcanic eruptions, and coastal erosion are among the most important components of infraestrurure because they provide a foundation on withc to build safe and comfortable living environments.

Flood damage prevention

What is being done, and what can be done.

Various facilities and systems have been established to provide protection from flood damage.

River information systems ensure successful river management.

Radar raingauges and telemeter systems are used to measure water level, rainfall, etc. Information thus obtained is processed and provided to concerned governmental agencies and local residents so that timely and appropriate river management and flood defense measures can be taken.

• Widening of channels and embankments

Rise in water level is reduced by increasing the width. Levees are also used to prevent overtopping.

• Detention basins

Water is diverted from a swollen river, and the water is returned to the river after the threat of flooding has disappeared.

• Floodways

Canals are used to divert water from the middle or lower reaches of the river and directly channel the water to other rivers or the sea. This technique helps to reduce river flow.

Japan lags behind other countries in river improvement.

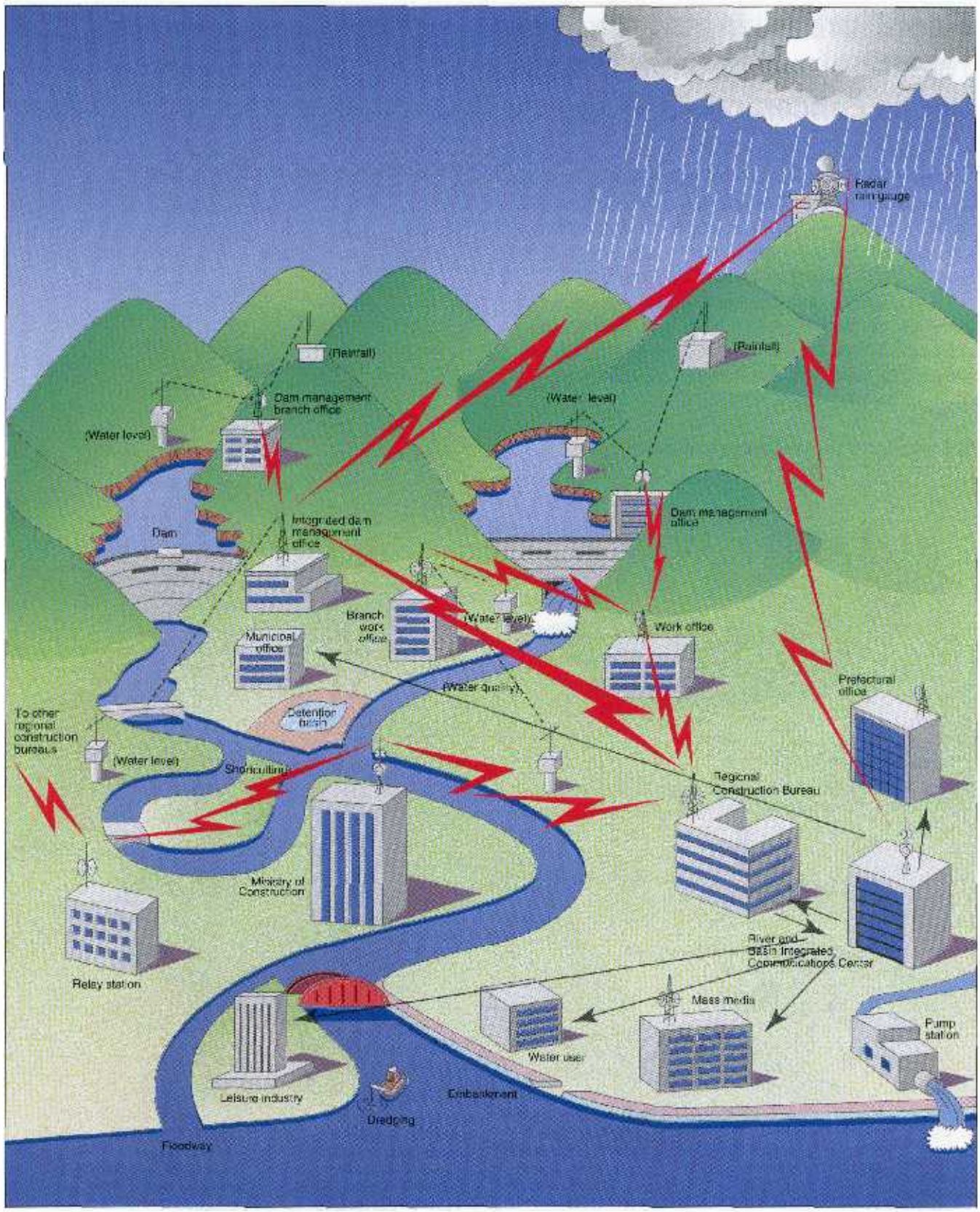
Flood control plans for major rivers are usually based on the greatest amount of rainfall that might be expected to occur, once in about 100 to 200 years. Since, however, the task of attaining this goal takes a very long time, current practice is to set a less ambitious goal for a shorter period and upgrade the degree of flood safety in stages. Japan is still far behind European countries and the United States in the field of channel improvement.

Channel improvement (Japan)

	Eighth Five-Year Flood Control Program	
	Goals (short term)	Expected improvement (end of 1991 to end of 1996)
Flood protection ratio in urban area	To prevent flood damage resulting from heavy rains equivalent to 50 mm per hour	45%→53%
Major rivers	To prevent flood damage resulting from heavy rains occuring every 30-40 years	62%→69%
Smaller rivers	To prevent flood damage resulting from heavy rains occuring every 5-10 years	35%→43%
Sediment disaster prevention measures	To prevent sediment disaster resulting from heavy rains occuring every 5-10 years	20%→27%

Channel improvement conditions (Europe, US)

Country	Target flood probability	Degree of improvement of main channel embankment
US	Once in 500 years (Mississippi River)	70% (1979)
UK	Once in 1 000 years (Thames River)	Substantially completed (1983)
Netherlands	Once in 10,000 years (Storm surge plan)	Substantially completed (1985)
France	Once in 100 years (Seine River)	Substantially completed (1988)


Radar rain gauge
(Rainfall)
(Rainfall)
Dam management branch office
(Water level)
(Water level)
Dam
Integrated dam management office
Dam management office
Branch work office
(Water level)
Work office
Municipal office
(Water quality)
Prefectural office
To other regional construction bureaus
Detention basin
(Water level)
Shoreline
Regional Construction Bureau
Ministry of Construction
River and Basin Integrated Communications Center
Relay station
Mass media
Pump station
Water user
Leisure industry
Embankment
Dredging
Floodway

Urbanization and flood damage

Rapid urbanization and suburbanization is impairing the retention and detention capabilities of nature. Consequently, floods concentrate in a shorter time and in a greater quantity.

Rapid urbanization has been in progress in many parts of the country, particularly in the Tokyo metropolitan area. In Kanagawa prefecture, for example, rural land including forest and farmlands accounted for 90% of the land in the Tsūrumi River basin in 1958. By 1990, however, rural land had decreased to 20%.

Asphalt and concrete prevent natural permeation of stormwater into the ground. As a result, stormwater fills rivers and depressions more quickly in urban areas than in rural ones, increasing the risk of urban flood damage.

■ **Aggravation of flood damage by urbanization**

• **Before development**

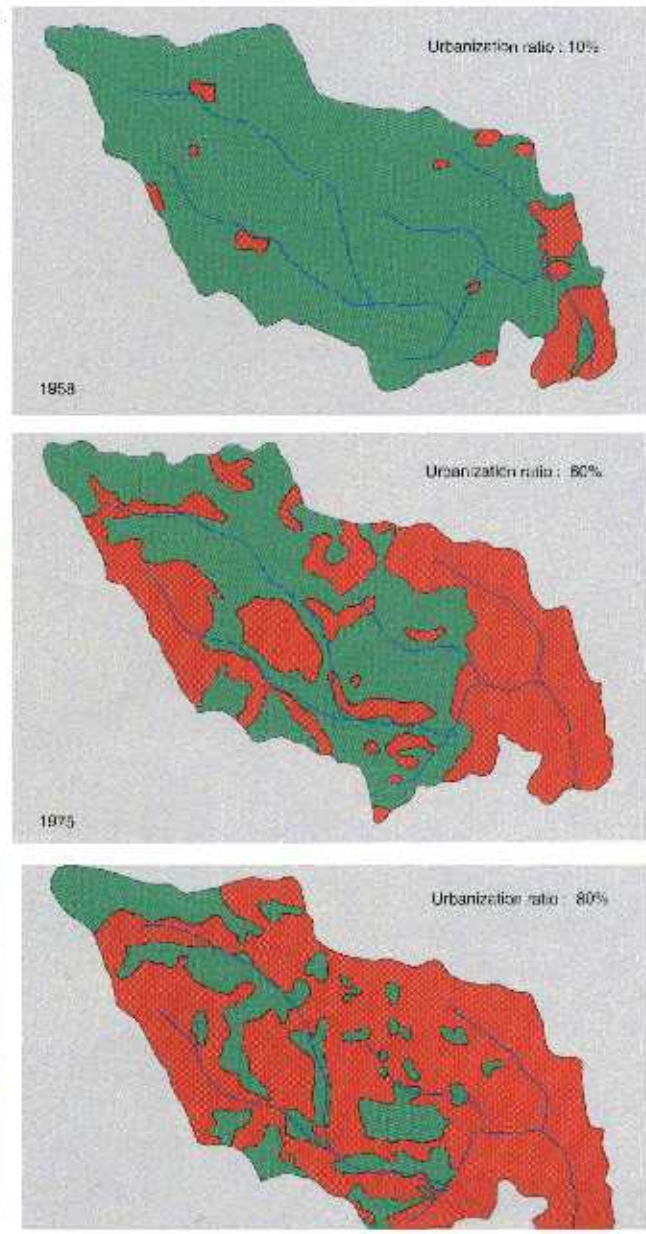
Most of the stormwater infiltrates into the ground or is retained on the ground surface. As a result, runoff downstream is reduced

• **After development**

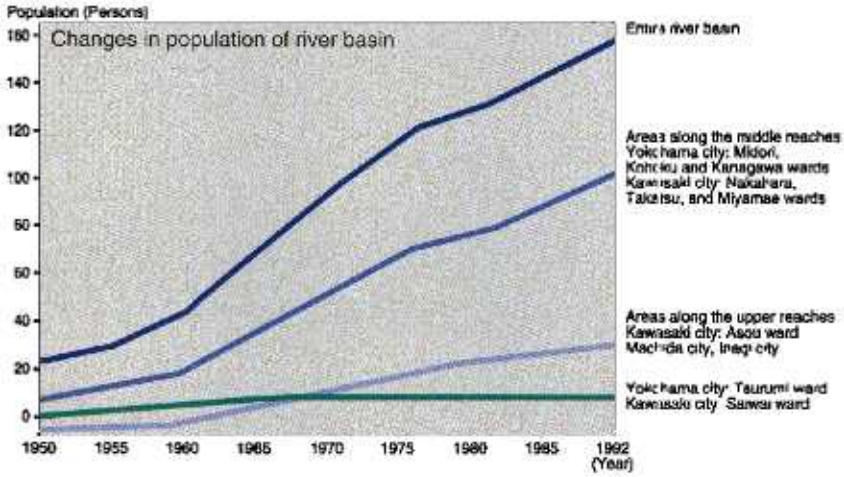
Concrete, asphalt, the loss of forest, vegetation increase runoff downstream and aggravate flood damage in low-lying areas

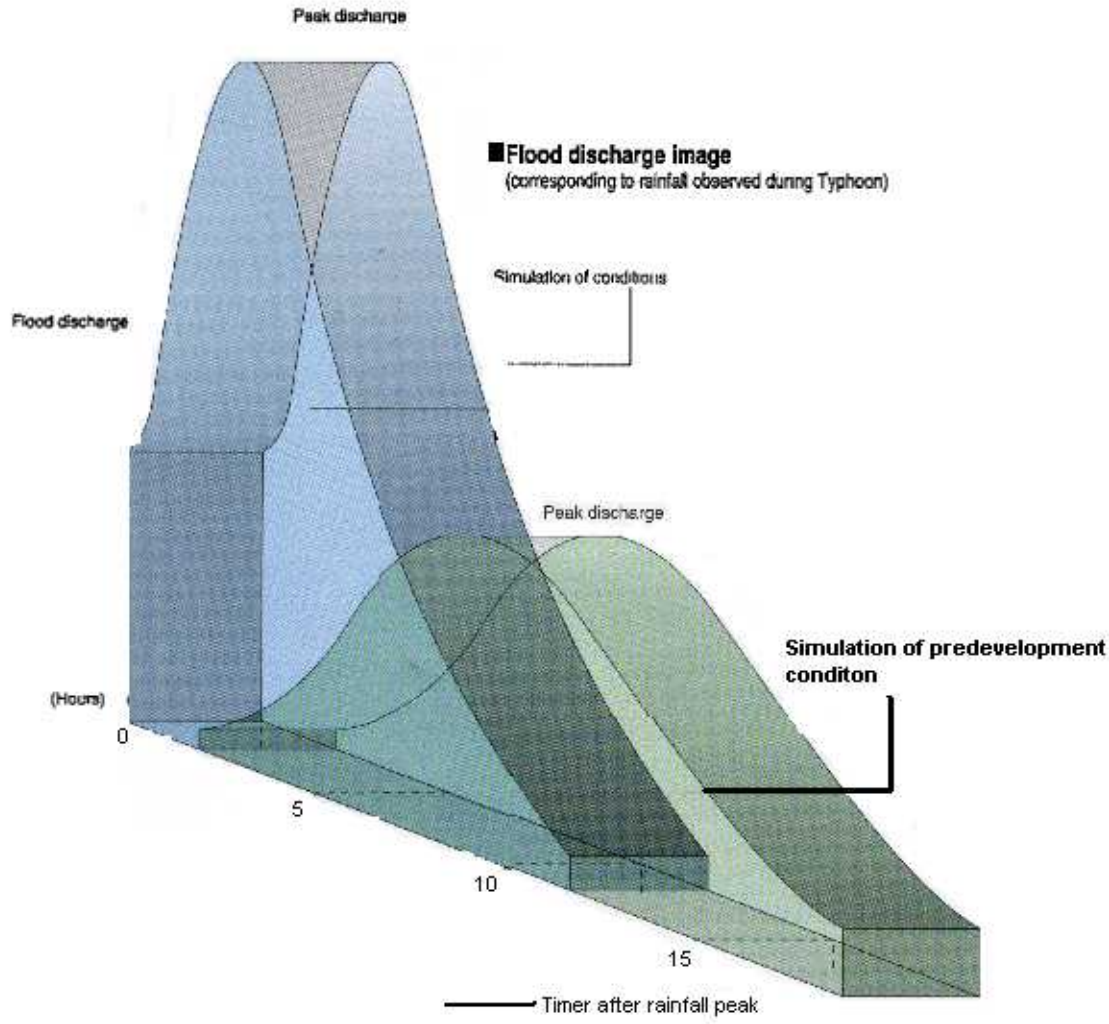
■ **Urbanization in the Tsurumi River basin**

● Rural area ● Urban area



In about 30 years, urbanization rose from 10% to 80%, leaving only 20% of rural land


Population (Persons)
Changes in population of river basin
160
140
120
100
80
60
40
20
0
1950
1955
1960
1965
1970
1975
1980
1985
1992
(Year)
Entire river basin
Areas along the middle reaches
Yokohama city: Midori,
Kohoku and Kanagawa wards
Kawasaki city: Nakahara,
Takatsu, and Miyamae wards
Areas along the upper reaches
Kawasaki city: Asou ward
Machida city, Inagi city
Yokohama city: Tsurumi ward
Kawasaki city: Saiwai ward


Peak discharge
Flood discharge image
(corresponding to rainfall observed during Typhoon)
Simulation of conditions
Flood discharge
Peak discharge
Simulation of predevelopment
conditon
(Hours)
0
5
10
15
Timer after rainfall peak

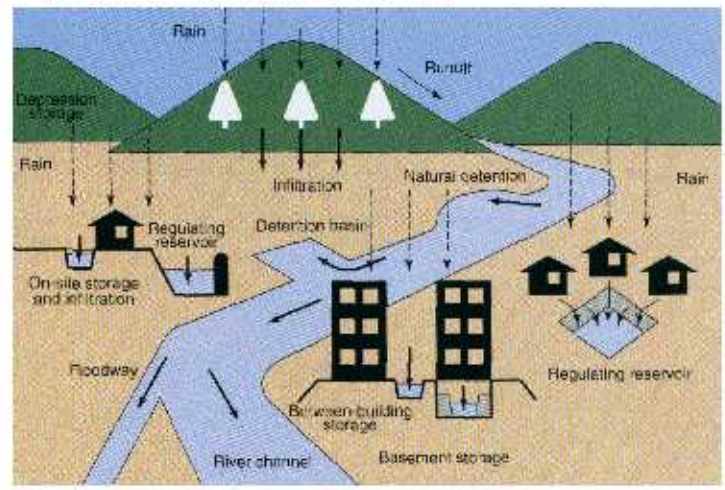
Integrated flood control measures

Japan is in need of Integrated flood control to cope with rapid urbanization.

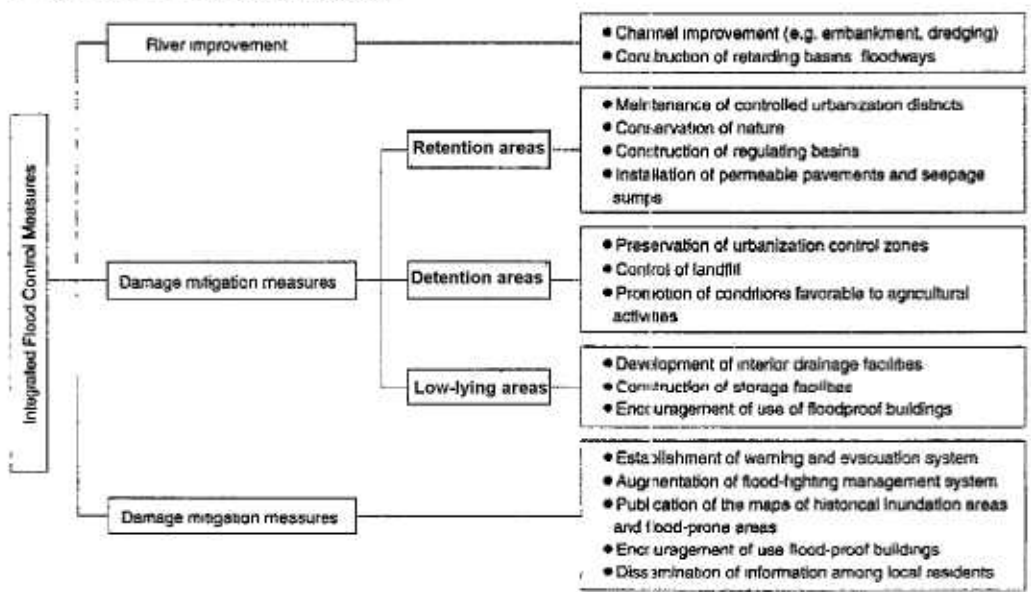
One consequence of rapid urbanization is the growing concentration of population and property in low-lying lands which have historically been subject to flooding. This trend is aggravating flood damage.

Conventional river improvement that relies on levees and detention basins is not enough. There is an urgent need for a comprehensive approach that combines (1) river basin measures, such as the construction of facilities designed to preserve and enhance the retention and detention capabilities of river basins and the development of land uses and buildings that are highly resistant to floods, and (2) damage mitigation measures, such as the establishment of warning and evacuation systems.

■ **Concept of comprehensive flood control**



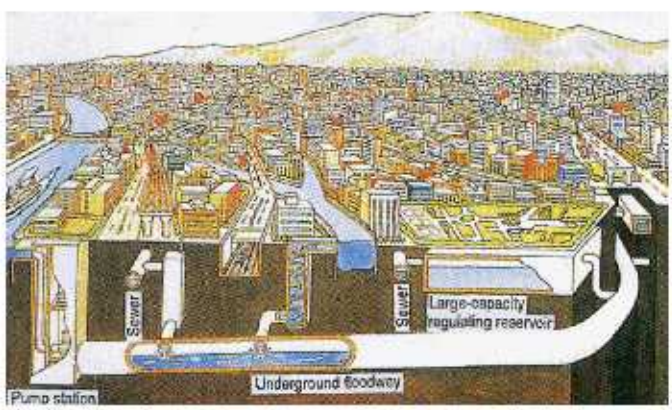
■ **Integrated of flood control measures**



■ **Infiltration facilities to mitigate urban floods**

Impervious asphalt and concrete over the ground surface reduce permeability and retention capability. By installation of infiltration facilities such as rainwater percolation intakes, stormwater can be allowed to filter into the ground. These facilities help to increase the retention capacity and thereby lessen the loads imposed on rivers by reducing (1) total runoff to rivers and (2) peak discharge.

■ **Construction of underground floodways and underground regulating reservoirs is an effective means of solving the problem of urban flooding.**



In major cities, it is becoming more difficult to construct new surface floodways Underground floodways and underground regulating reservoirs are underground "rivers" and "ponds" designed to protect the overlying cities from floods.

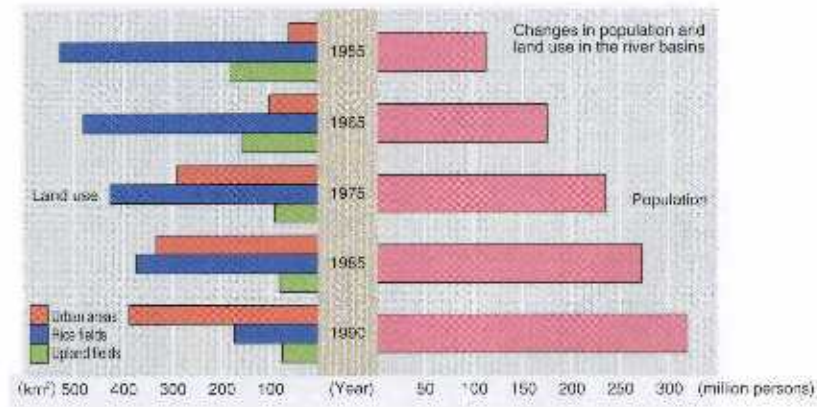
Housing development and flood control

Waves of residential land development are sweeping over alluvial lowlands in the Tokyo metropolitan area.

■ **In the basins of the Naka and Ayase rivers in eastern Saitama prefecture, the last 30 years have seen very rapid development of residential land.**

In response to the growing demand for housing in the Tokyo metropolitan area, residential land is expanding from the more or less elevated western region to the flood-prone eastern region. For instance, the percentage of urbanized areas in the Naka and Ayase river basins in eastern Saitama prefecture more than tripled from 11% in 1965 to 39% in 1991.

The risk of flood damage has increased with urbanization of low-lying areas. There is an urgent need, therefore, for integrating effective flood control with residential land development.

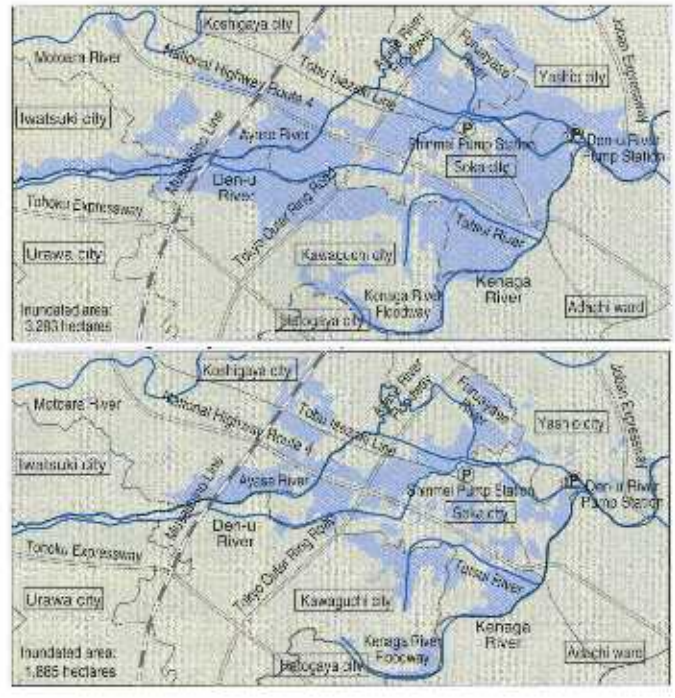


■ **Flood control measures, including the construction of the Ayase River Floodway, have reduced flood damage to about one-third.**

In the Naka and Ayase river basins, Typhoon No. 18 (1991) flooded about 20,000 houses. Thanks to partial completion of the Ayase River Floodway, however, flood damage caused by Typhoon No. 11 (August 1992), which was accompanied by a similar amount of rainfall, was held to a minimum of about 6,800 houses, roughly one-third of that of the 1991 flood.

■ **Comparison of flood damage to houses in the Naka and Ayase river basins: 1991 vs. 1993**

Area flooded during the September 1991 flood (Typhoon No. 18)

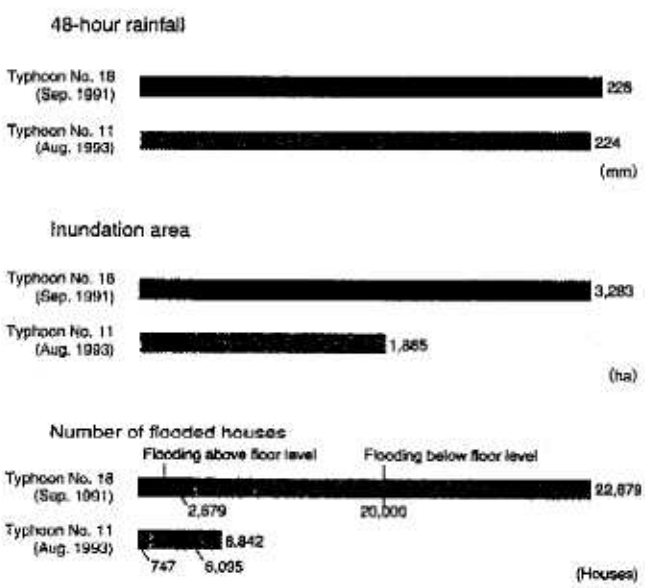


Urbanization is closely coordinated with flood detention and regulation. The goal is not only to reduce flood damage but also to build a comfortable community, making effective use of waterfront space. Increased property value is an added benefit.

Integrating flood detention and regulation with housing development in urban development programs can dramatically enhance the degree of protection from floods. This promotes creation of a living environment and community that makes effective use of waterfront space. This can result in creating an attractive environment and providing higher value-added housing.

Enjoying the riverside.

Chiba New Town (Chiba pref.)

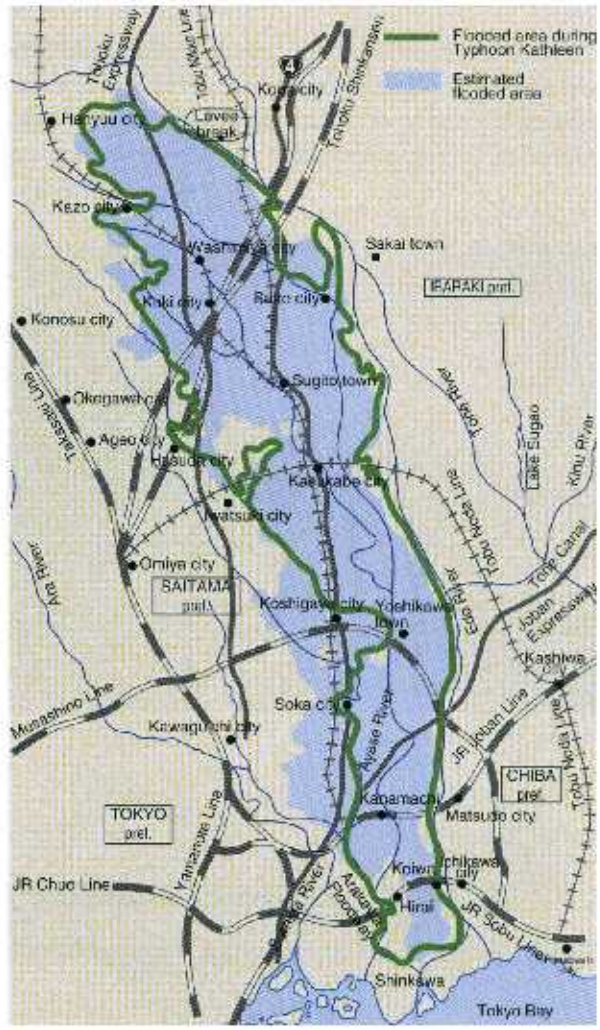


Super levees for flood preparedness and community development

If another Typhoon Kathleen hits Japan today, direct damage alone would amount to ¥15 trillion, about 150 times as much as the damage caused by the 1947 typhoon.

The function of a dam is to regulate the downstream flood discharge by storing storm flood only when flood discharge is high. Thus, dams reduce the peak discharge downstream and prevent a sharp increase in streamflow.

	Area flooded (1947) (Typhoon Kathleen)	Area likely to be flooded today	Remarks
Flooding area	estimated 440 km²	estimated 555 km²	Aggravation due to subsidence
Economic loss	estimated ¥100 billion	estimated ¥15 trillion	(at 1992 prices)
Number of affected persons	estimated 600,000 (1947)	estimated 210,000 (1992)	
Number of houses damaged	estimated 150,000	estimated 660,000	



■ **Flooding of the Tone River would inundate the alluvial lowlands.**