WORLD METEOROLOGICAL ORGANIZATION Global Water Partnership

THE ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

INTEGRATED FLOOD MANAGEMENT

CASE STUDY

JAPAN: *TOKAI HEAVY RAIN (SEPTEMBER 2000)*

January 2004

Edited by

TECHNICAL SUPPORT UNIT

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Ministry of Land, Infrastructure and Transport, Japan

1. Place

1.1 Location

Positions in the flood inundation area caused by the Tokai heavy rain:
Nagoya City, Aichi Prefecture is located at 35° – 35° 15' north latitude, 136° 45' - 137° east longitude. The studied area is Shonai and Shin river basin- hereinafter referred to as the Shonai river system. It locates about the center of Japan including Nagoya city area, 5th largest city in Japan with the population about 3millions. Therefore, two rivers flow through densely populated area and into the Pacific Ocean and are typical city-type rivers in Japan.

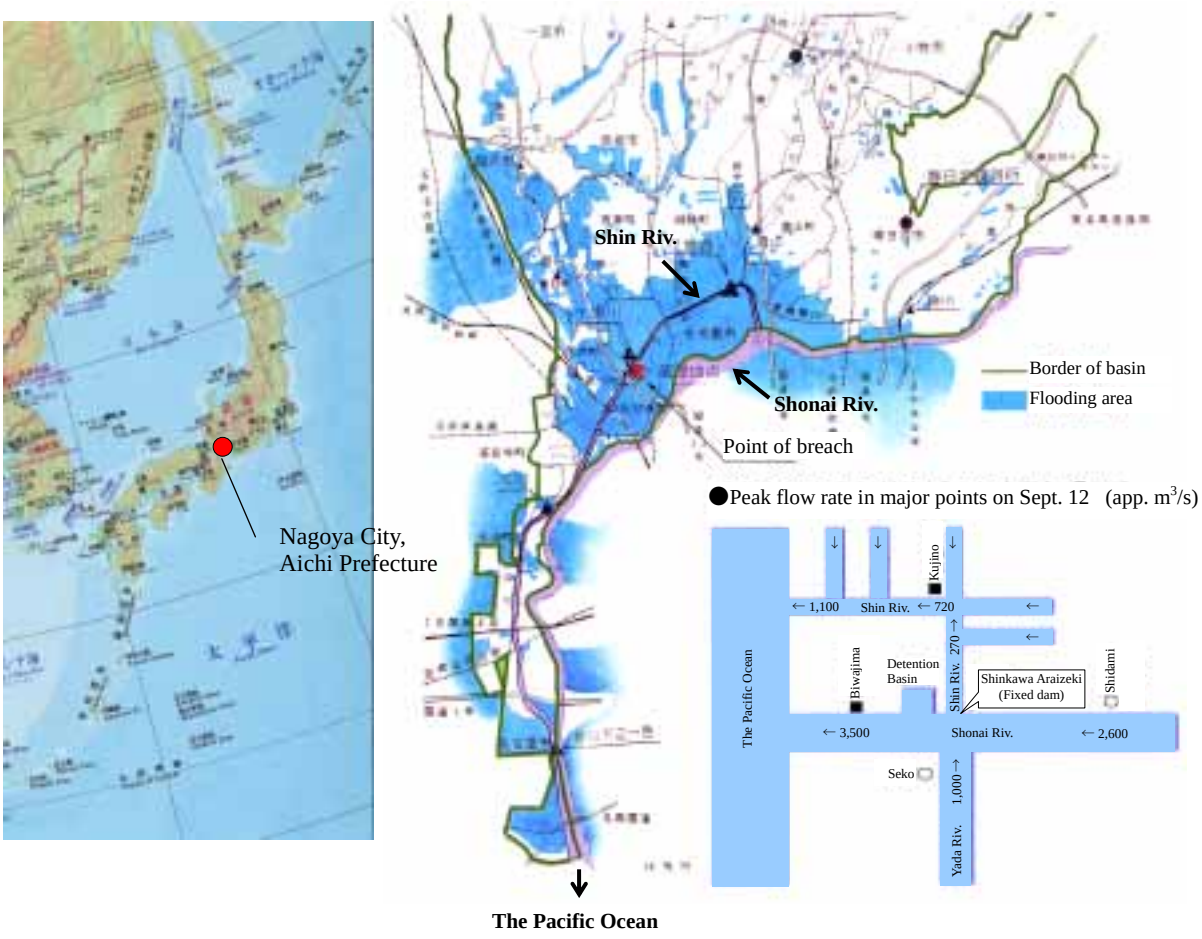
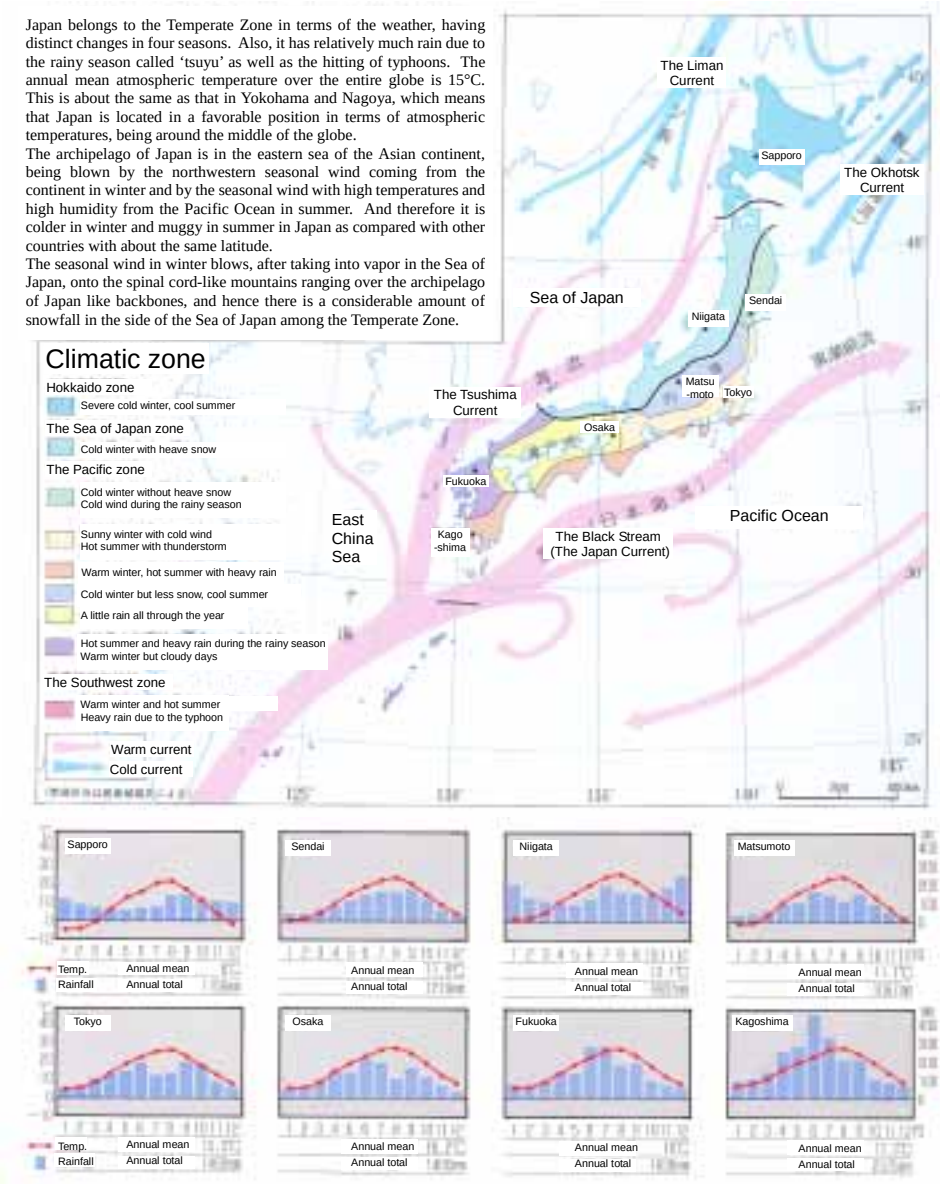


Fig. 1 Situation of the damage cause by the heavy rain in Sep. 2000

1.2 Characteristics of the basin

1.2.1 Natural characteristics

Japan has a temperate climate with its climatic regions being roughly divided into three. Nagoya where the Tokai heavy rain occurred belongs to a climatic region in which many thunderstorms occur in summer among the climatic region on the coast of the Pacific Ocean.



Source: Great Map House of the Archipelago of Japan

Fig. 2 Climate Regions of Japan

Atmospheric temperatures and precipitation differ greatly between summer and winter being affected by the seasonal wind.

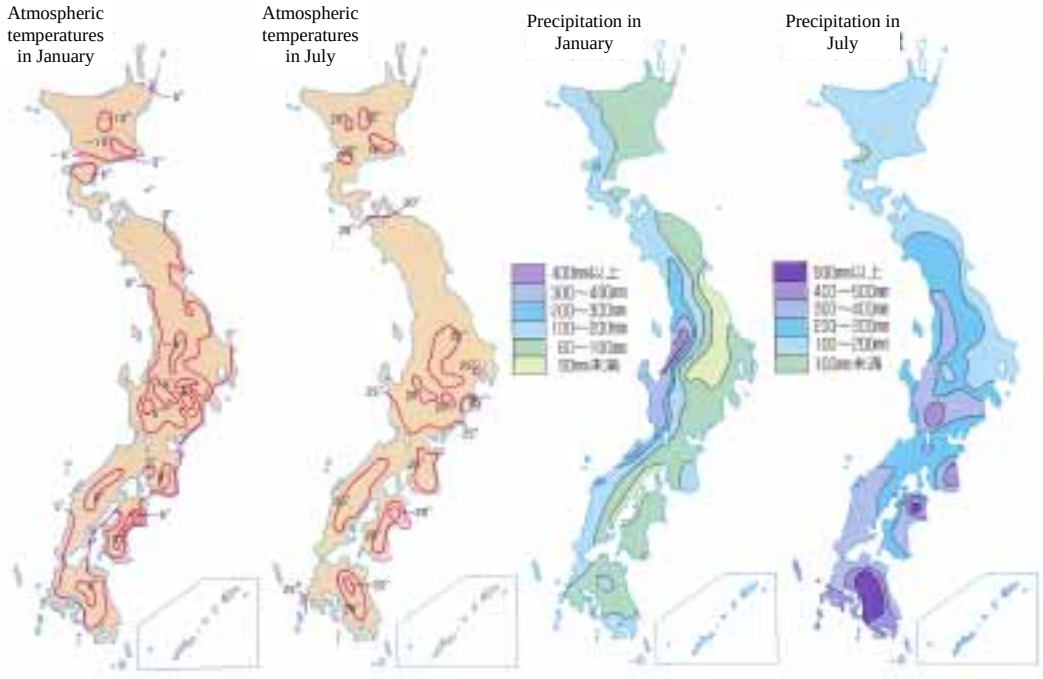
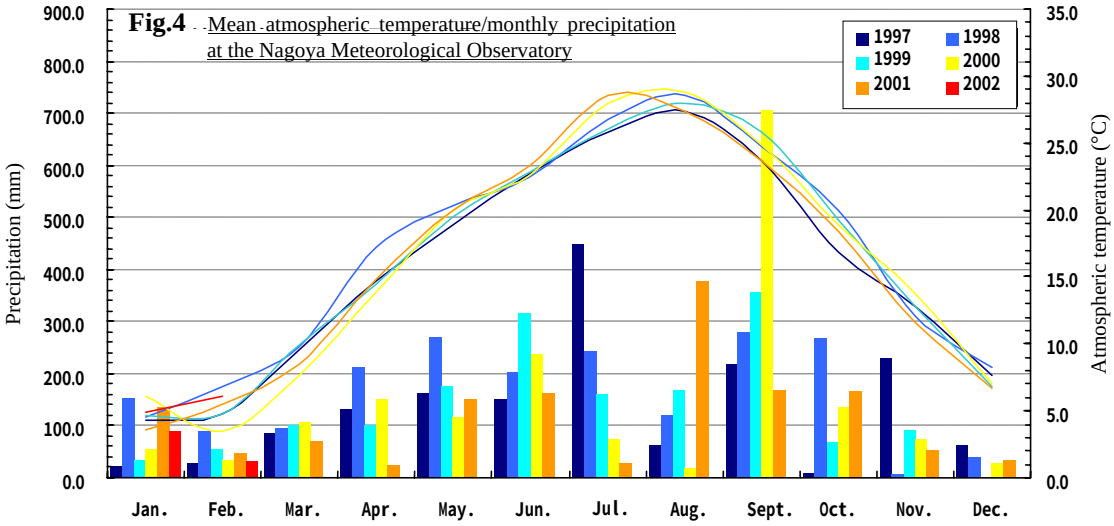


Fig. 3 Distribution of atmospheric temperatures and precipitation in winter and summer

The river system of the Shonai River which is the basin in question belongs to the climatic region on the coast of the Pacific Ocean, in which the weather is mostly fine in winter, and it is hot with many thunderstorms in winter.

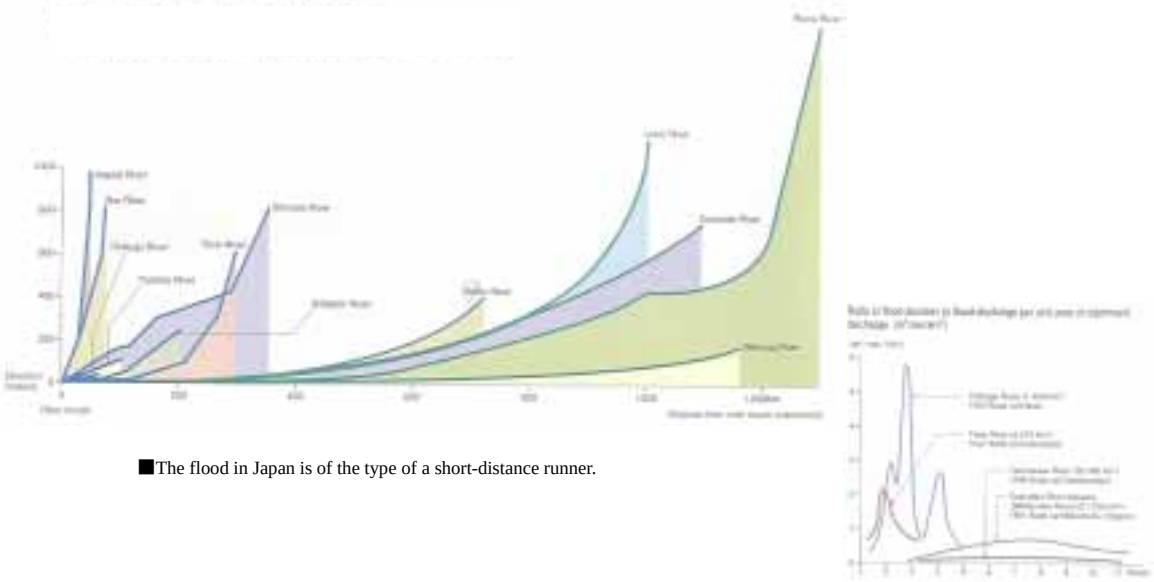
The figure below shows the precipitation data at the Nagoya Meteorological Observatory in recent years. The precipitation in September 2000 stands out, which was brought by the Tokai heavy rain.



Topographical conditions

[All over Japan]

Since the national land of Japan is made up of steep landforms, many rivers in Japan are torrential rivers, having steeper riverbed gradient than those in other countries. Hence, they are dangerous at the time of a flood because of the rapid time of arrival of the flood.

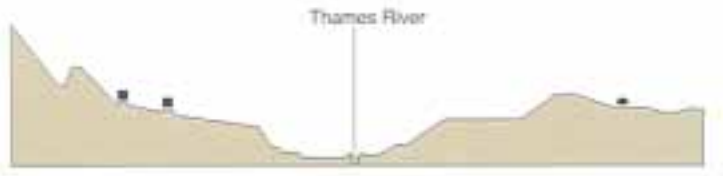


■The flood in Japan is of the type of a short-distance runner.

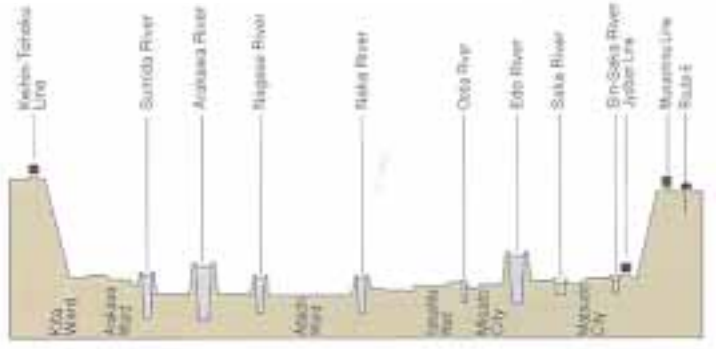
Fig. 5 Comparison of riverbed gradient

Since the riverbed gradient is steep and the amount of overflow is great, the embankment in Japan is built at a place above the protected lowland. And therefore the water level at the time of a flood becomes higher than the protected lowland, and once inundation occurs, serious damage is caused to the metropolitan area having high damage potentiality upon which assets concentrate.

●London and the Thames River

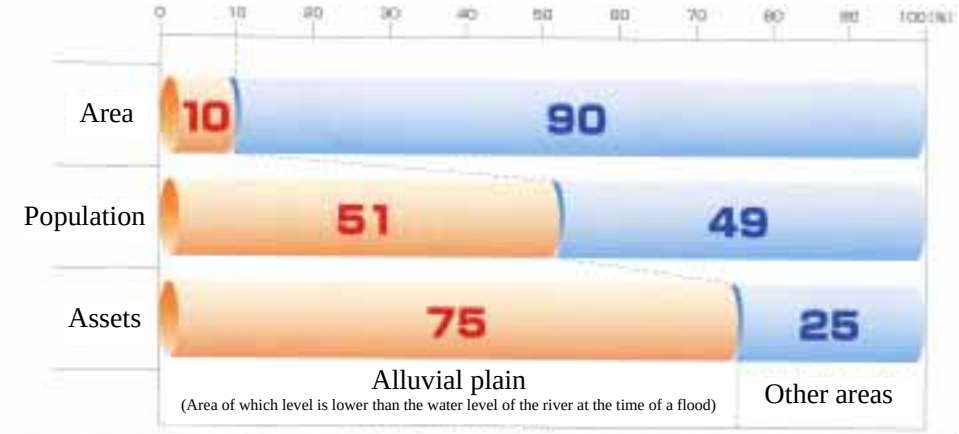


●Tokyo and the Edo River, the Ara River and the Sumida River



In the city area of London the Thames River flows at the lowest level, whereas in Tokyo the rivers flow at lands located above the city areas, which causes severer damage at the time of a flood.

Fig. 6 Features of City Rivers in Japan



Japan has a lot of mountain ranges and approx. 51% of the total population and approx. 75% of the total assets concentrates on the alluvial plains that occupy only 10% of the total national land. Therefore once the inundation of a river occurs, the damage caused thereby becomes more serious.

Fig. 7 Situation of the land use of the national land of Japan

[Basin in question]

The basin of the Shonai River is formed on the basis of the topography put between a chain of mountains in the northwest (Mt. Yudachi, Mt. Byobu, Mt. Mikuni and Mt. Sanage) and the hills located on its eastern side. In the lower reaches of the basin lies the Owari Plain.
As for the topographical condition of the Shonai River and the Shin River as well, their water levels at the time of a flood are higher than the level of the ground in the protected lowland.

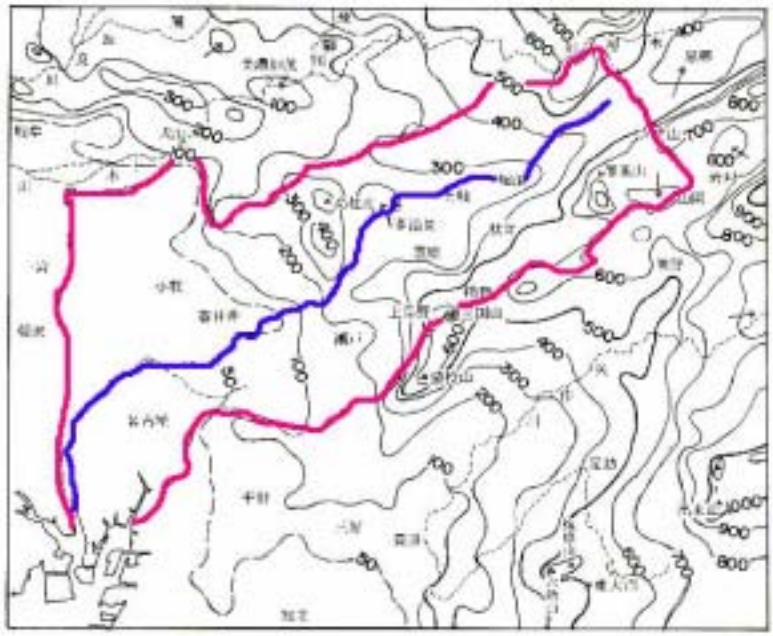


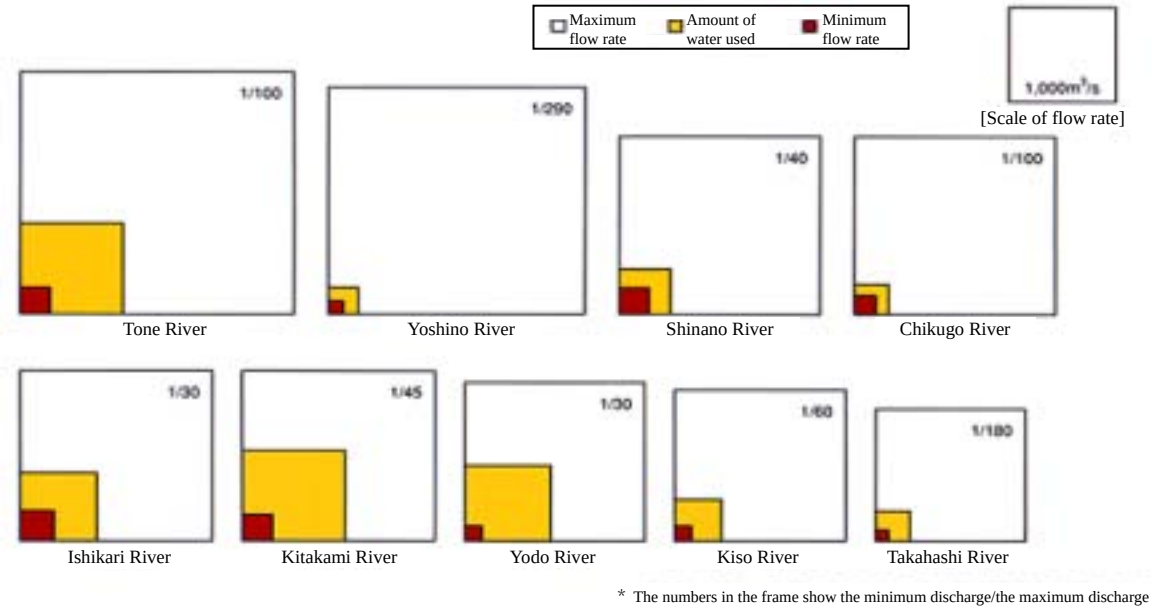
Fig. 8 Contour figure of the Shonai River Basin

1 Catchment area: Shonai River: 1,010 km^2, Shin River: 259km^2
2 Stream length (length of trunk line):
Shonai River: watercourse trunk line 96 km, Shin River: watercourse trunk line 24 km
3 Average riverbed gradient: Shonai River: 1/500 – 1/1,000, Shin River: channel plan

Hydrological conditions (inclusive of explanations of river systems)

[All over Japan]

Rivers in Japan have a feature that there is a big difference between the maximum flow rate and the minimum flow rate. Many rivers overseas have a small difference between the maximum flow rate and the minimum flow rate, while most of the rivers in Japan have a big difference between the maximum flow rate and the minimum flow rate due to its topographical conditions (See Fig.5). Since the flow rate of water use (water for people's lives and water for agricultural use) is greater than the minimum flow rate, water storage facilities such as dams are required in many cases.



* The numbers in the frame show the minimum discharge/the maximum discharge

Fig. 9 Comparison of flow rates in Japanese rivers

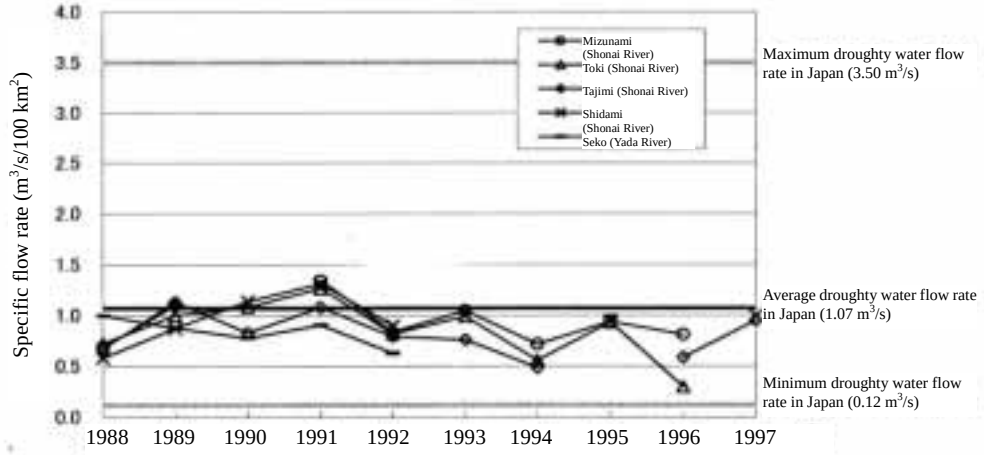
[Basin in question]

The flow regime in recent ten years (1988 – 1997) at each of the points of observation of flow rate in the Shonai River is given in Table.1, with the annual droughty water flow rate over the ten years at Biwajima being 6.76 m^3/s (unit discharge rate: 0.96 $m^3/s/100\ km^2$). Also, the unit discharge rate (flow rate converted to that per 100 km^2 of catchment area) gives a value equivalent to, or slightly smaller than the average value over the whole Japan.

Table. 1 The flow regime in recent ten years in the Shonai River

Name of River	Name of Point	Catchment Area (km^2)	Flow Regime (m^3/s)				Data Period
			Maximum Flow	Normal Flow	Low Flow	Droughty Flow	
Shonai River	Biwajima	705.0	25.98	15.17	10.68	6.76	1988~1997
			3.68	2.15	1.51	0.96	
	Shidami	532.0	21.21	12.15	8.22	5.15	
			3.99	2.28	1.54	0.97	
	Tajimi	367.0	13.89	8.07	5.20	2.97	
			3.78	2.20	1.42	0.81	
	Toki	284.0	10.33	5.99	4.11	2.43	
			3.63	2.11	1.44	0.85	
	Mizunami	209.0	7.92	4.76	3.22	1.96	
			3.79	2.28	1.54	0.94	
Yada River	Seko	105.0	4.17	2.69	1.98	1.32	
			3.97	2.56	1.89	1.26	

* The lower line in each cell of the table shows the unit discharge rate ($m^3/s/100\ km^2$)
* The maximum flow means the 75-day water level and also the normal, low and droughty flow mean the 185-day, 275-day and 355-day water level respectively.



Note) The droughty water flow rate in Japan shows the maximum value, minimum value and mean value of droughty water flow rates (mean flow rates throughout the year of observation) at the reference points in Class A rivers (of the 109 river system).

Source for reference:

1. Report on the Study Work of the Normal Flow Rate of the Shonai River for Fiscal Year 2000, Building Environment Laboratory

Soil conditions

[All over Japan]

The figure below shows the geological map of the Japanese archipelago. The geology around Nagoya is composed of sedimentary rock.

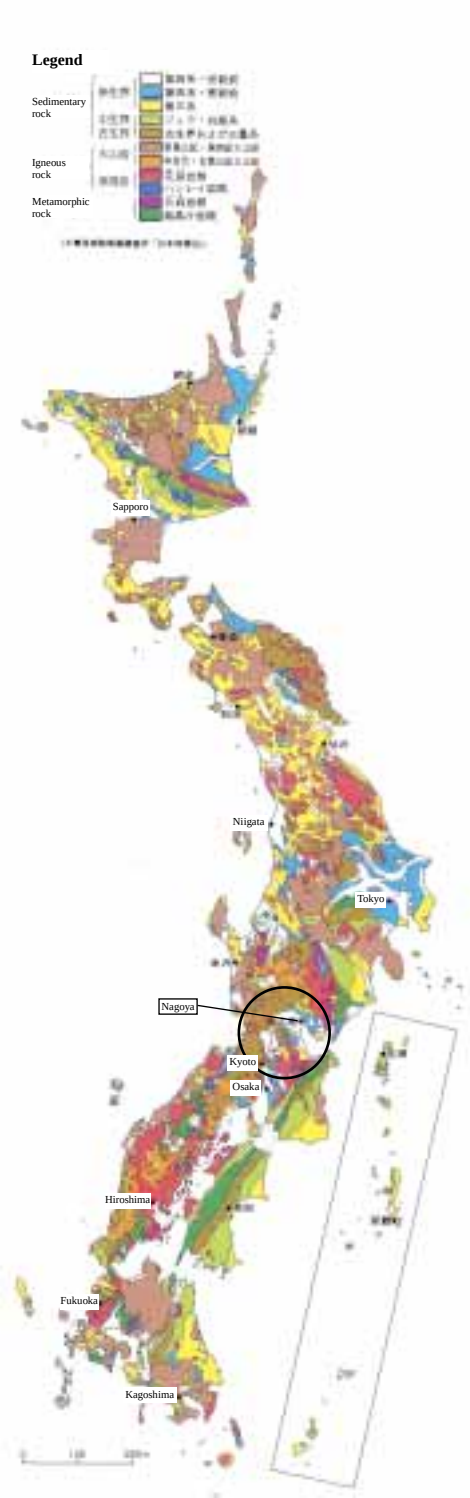


Fig. 10 Geology of the Japanese archipelago

1.2.2 Land and water use patterns

Both of the lower reaches of the Shonai River and the Shin River are the central part of Nagoya City, of which urbanization is under way. The mountainous areas are directly in contact with the plain.

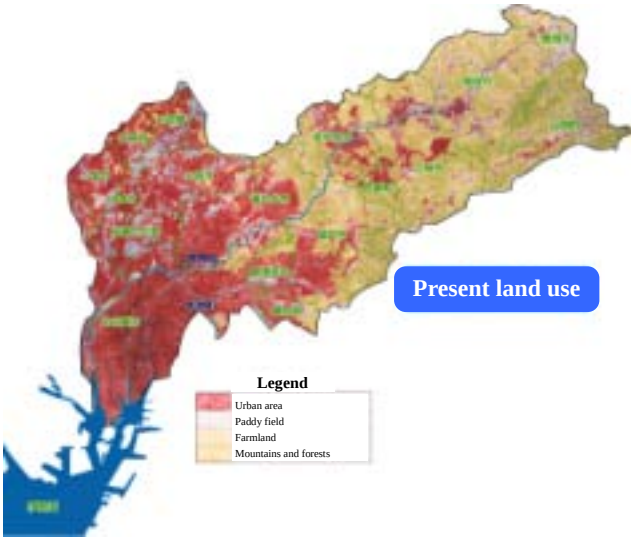


Fig. 11 Land use in the Shonai River Basin

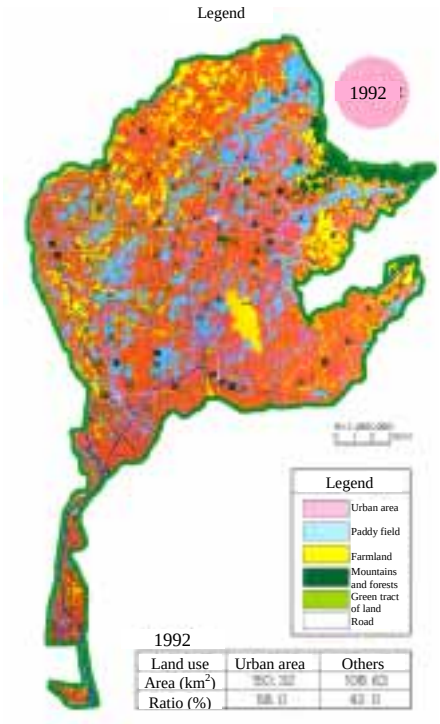


Fig. 12 Land use in the Shin River Basin

Transition of land use over the past 30 years

The middle and lower reaches of the basin centering around Nagoya City have undergone rapid urbanization, with a sharp decrease of the areas of mountains and forests as well as arable land. Although mountains and forests as well as farmland are decreasing in the upper reaches due to the residential land development, no such a rapid change has been experienced there as that in the city area in the lower reaches.

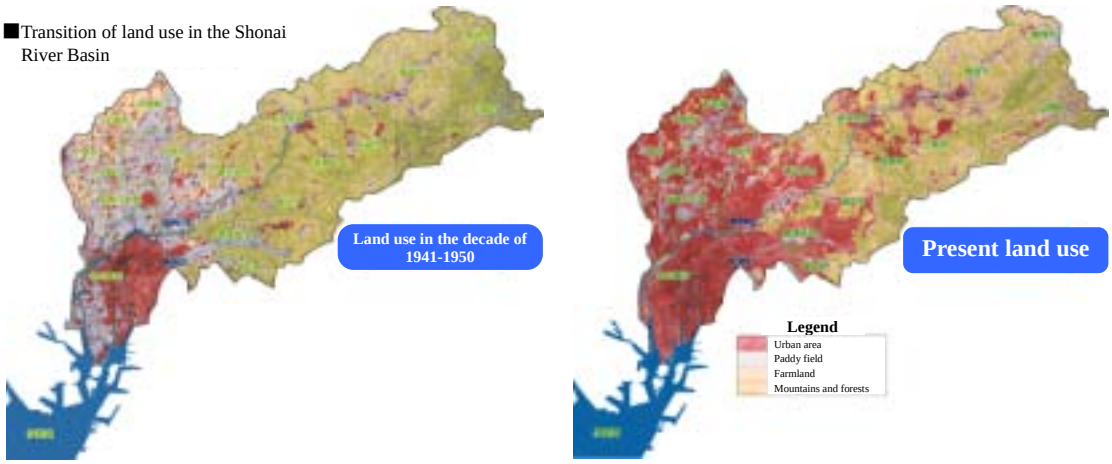


Fig. 13 Transition of land use in the Shonai River Basin

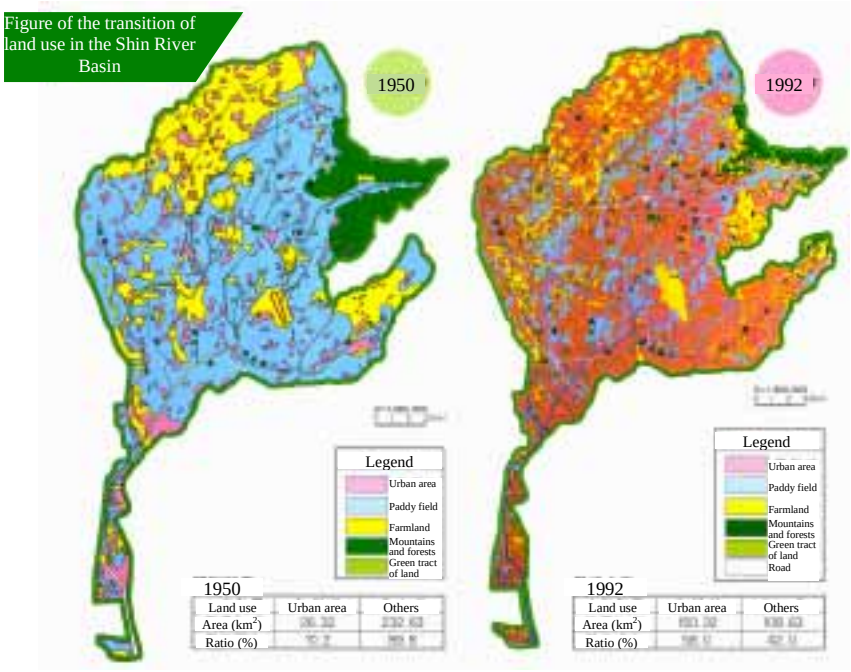


Fig. 14 Transition of land use in the Shin River Basin

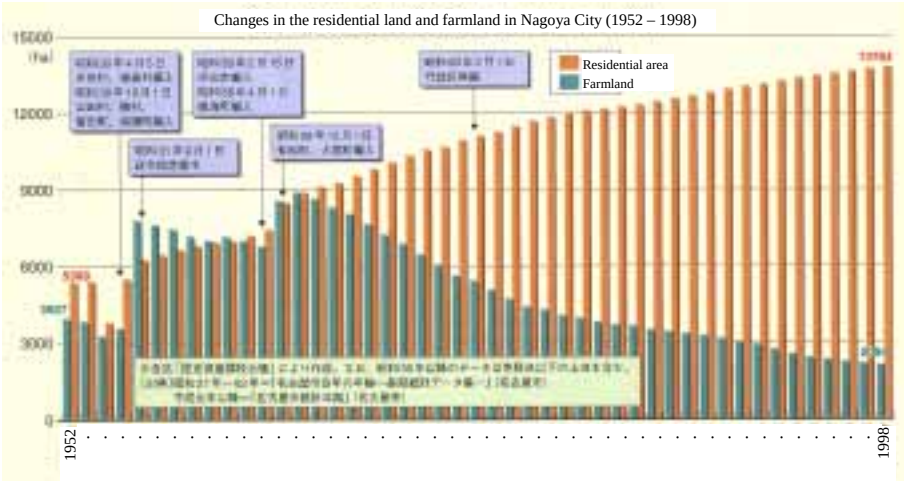


Fig. 15 Changes in the residential area and farmland in Nagoya City (1952 – 1998)
Source: Disaster Archipelago 2000

The rapid urbanization in the floodplain has been inevitable, because of continuous population growth and less percentage of available area (as much as 80% of Japanese territory are mountains) and most of productive/available lands are floodplains. People have no other choice but to highly utilize floodplains.

・Transition of land use over the past 30 years in the upper reaches of the flood inundation areas

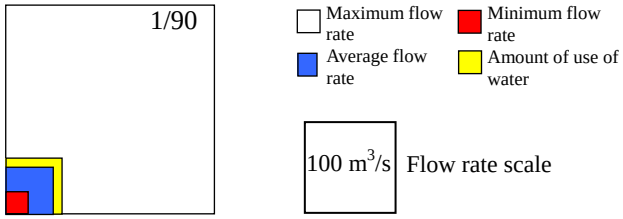
(See the preceding Section)

・Situation of use of watercourses (inclusive of channel arrangement measures such as the straightening of rivers, and others)

In the basin in question, no use of watercourses (such as the river-shipping and others) can be seen.

Situation of use of surface water

In the northern part of the basin (at the left-hand side of the bank of the Kiso River), there are many farm ponds, which are used as agricultural water.
The figure shows the hydrological situation of the Shonai River system. From this it can be seen that the amount of use of water around the Shonai River Basin is incapable of being met by the water supply from the Shonai River alone, which has been dependent on the Kiso River system since olden times.



The numerals show the rate of the minimum/maximum discharge.
The flow rate data have been organized from those over 30 years since 1972.
The amount of use of water has been extracted from the basic policy materials.

Fig. 16 Hydrological conditions of the Shonai River (at the point of Biwajima)

Table. 2 Permitted amount of water rights and number of customary water rights

River name	Irrigation water	Water for use for tap water	Water for industrial use	Water for use for power generation	Others	Total	Customary water rights
Shonai River (m^3/s)	7.103(7)	0.0008(1)	2.234(1)	4.17(1)	0.0007(1)	13.5085(14)	One case

* The figures in brackets under each column show the number of customary water rights

Use of flood water: above mean annual flow

As for the Shonai River, the Origawa Dam is presently under construction which aims at the flood adjustment of the Shonai River and the maintenance of normal functions of flowing water as well as power generation, and the flood water will be effectively put to use for power generation and for keeping normal flow rates.

Situation of use of inundation water: Utilization of flows that inundate the floodplain

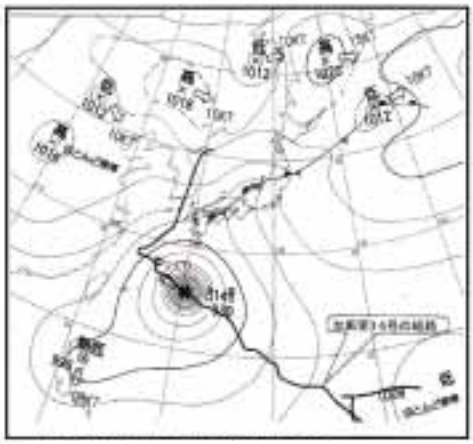
In Japan there is no example of use of flood water in the flood plain (mainly, farmland).

2. Outline of flood

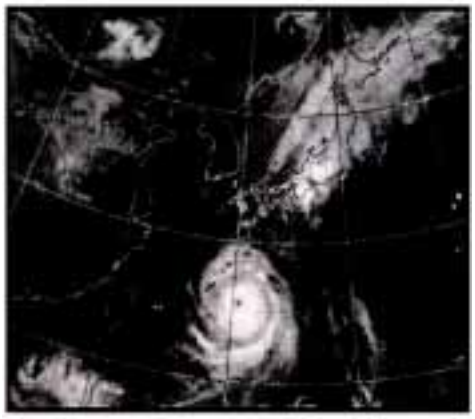
2.1 Type of the flood in question

Tokai heavy rain: An autumn rain front was the factor. Stimulated by Typhoon No. 14, the front was activated to bring heavy rain.

[Tokai heavy rain Sept. 11 – 12, 2000]
The autumn rain front that had been moving toward the south in the Sea of Japan strengthened its rainfall as a result of the influence of Typhoon No. 14 from the west, bringing a heavy rain from the Tokai region through to the Shikoku region. At the point of Nagoya of the Nagoya Meteorological Observatory, a total precipitation of 567 mm and a maximum hourly precipitation of 93 mm were recorded.
The heavy rain was caused by an autumnal rain front affected by Typhoon No. 14 which headed toward the west-southwest. This front was alongside the area stretching from the western part of Mie Prefecture toward the north-northeast up to the Chita Peninsula, and brought a great rainfall together with a local front which was formed by cold air from the west-southwest and warm air from the southeast.



▲Weather chart as of 21:00 o'clock on Sep. 11



▲Image from Himawari (lit. Sunflower; a geostationary meteorological satellite) as of 19:00 o'clock on Sep. 11

In Nagoya, the total rainfall in 2 days amounted to as much as 567 mm, which includes the maximum rainfall per hour of 93 mm.
At many monitored points in two rivers, water level exceeded designed water level and signs of possible collapse of banks were observed in many places (e.g. leakage of water from the bank, overtopping, partial collapse of the bank).

At last, Shinkawa river bank collapsed and that, together with inundation that was already widespread within sheltered area, made widespread and deep inundation over about 6,000 houses, many of these houses suffered over-floor flood which caused high amount of property losses. Flood-fighting communities/teams, established in local community basis, worked hard to prevent further damages.

About 10,000 personnel from the Self Defense Force and 470 from the Maritime Safety Agency also worked hard to rescue people from affected area. Also 20 cars with high capacity of drainage pumps – developed and owned by river authorities- smoothly arrived at severely affected area and worked hard to fulfill their purposes. The flooding and inundation lasted for 3 days.

2.2 Outline of the result of flood (type, period, maximum flow rate, cause, situation of damage: death toll, number of suffers, number of damaged houses, amount of damage, etc.)

It was reported as the damage caused by the Tokai heavy rain that the death toll was ten, recommendations for taking refuge were made for about 580,000 people, the number of damaged houses in which flooding reached above the floor level was 23,896, and the number of damaged houses in which flooding remained below the floor level was 39,544. (HP of Fire and Disaster Management Agency, Oct. 2000)

Table. 3 Major damage caused by heavy rains in Aichi Prefecture

Date of occurrence	Number of people dead or missing (persons)	Houses damaged totally, partially or with a small portion thereof having been broken (houses)	Flooding above/below the floorboard (houses)	Weather that caused the damage / remarks
1912/08/23-08/23	140	9000	Unknown	
1921/08/25-08/28	27			
1925/09/11	12	* 12	20000	Numerals marked with '*' show the totally damaged houses only.
1935/09/04	22	* 166	1400	
1938/07/19	13	* 13	2000	
1942/07/06-07/02	28	* 30	2700	
1952/07/16-07/11	8	* 5	52000	
1953/09/25	75	* 6783	90000	Typhoon 5313, with great damage being also caused by high tide.
1957/08/07	33	177	17588	"Tajimi heavy rain"
1959/09/14	8	23	80840	Of these, 14 houses flooded above the floorboard.
1959/09/26	3268	41063	116281	Isewan Typhoon. Great damage caused by high tide. 53560 houses flooded above the floorboard.
1961/06/23-06/29	6	183	74823	Heavy rain brought by a seasonal rain front in 1961.
1965/09/17	1	76	51350	Typhoon 6524, with 1728 houses having flooded above the floorboard.
1966/10/12	10	29	20758	"Higashi Mikawa local downpour".
1972/07/09-07/13	88	528	32152	Stationary front. Heavy rain in July 1972, with debris flows having occurred in Obara Village and others.
1974/07/24-07/25		38	57820	South coast depression.
1976/09/08-09/14	1	972	101190	Typhoon / stationary front. There was a levee crevasse in the Nagara River in An-pachi Town.
1980/09/11-09/12	7	239	60410	Typhoon / front.

Examples with 10 or more persons dead, or with 50000 or more houses having flooded, have been chosen. Those in 1970 and before that have been obtained by making partial corrections to the Aichi Prefecture Disaster Prevention Conference (1998). Those in 1971 and thereafter have been obtained by making partial corrections to the Japan Meteorological Agency (1999).

Situation of damage caused by natural disasters that occurred in 2000

(Investigated by the Disaster Prevention Division, Fire and Disaster Management Agency, Ministry of Public Management, Home Affairs, Posts and Telecommunications)

	Eruption of Mt. Usu (as of 20-2-2001)	Eruption of Miyake Island (as of 25-12-2000)	Tokai Heavy Rain (as of 2-10-2000)	Earthquake of western Tottori (as of 2-10-2000)
1. The dead or missing people	—	—	10	—
2. Injured people	—	1	88	182
3. Completely or half destroyed houses	270	16	104	3460
4. Partly destroyed houses	501	12	209	16964
5. Inundation above the floor level	—	—	27180	—
6. Inundation under the floor level	—	—	44111	—
7. Other damage				
Public building	13	7	55	937
Other building	18 (completely or half)	—	696	1972
Hospital	—	1	—	46
Road	59	38	107	670
Flooded Road	—	—	1523	—
Closed Road	—	—	16	—
Bridge	—	2	—	7
Dike, Levee (broken)	—	—	120	—
Erosion control measure	—	27	—	—
Landslide	—	20	88	367
Sediment run off	—	—	12	—
Harbor plant	—	4	—	—
Affected forest area	30.06 ha	—	—	—
Forestry plant	6	—	—	—
Suspension of the water supply	1	1593	—	7283
Electric power failure	—	1384	9668	12293
Gas	—	—	—	71
Telephone connection	—	1946	—	136

Source: Disaster Archipelago 2000

Hyetograph in Aichi Prefecture and others (total rainfall)

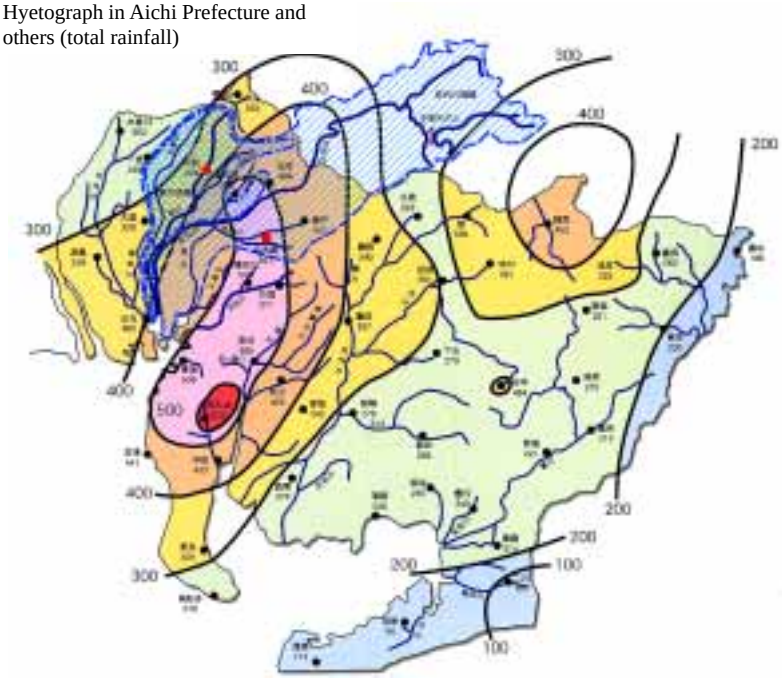


Fig. 17 Hyetograph in Aichi Prefecture and others (total rainfall of the Tokai heavy rain)

[Outline of major floods in the Shonai River]
Major floods that occurred in the Shonai River include floods on August 7, 1957, on September 26, 1959, on July 12, 1972, on July 4, 1975, on September 28, 1983, on September 25, 1988, on September 20, 1989, on September 19, 1991, on July 30, 1999, on September 12, 2000, and others. The outline of each of these is given below.

・Flood on August 7, 1957 (local downpour)

The stationary front extending over the sea in the east moved from the Kii Peninsula via around Nagoya to the offing of the Sanriku region, and during the period the front came closest to the Shonai River system. There was a rainfall of 100 mm through 500 mm in the Shonai River Basin, with the total rainfall in the midstream area of the main river, in particular, reaching 506 mm. In the city of Tajimi, various rivers flooded, with most of the central part of the city having been inundated. The flow rate at the point of Biwajima reached 2,300 m^3/s.

Showa Bridge, Tajimi City

In Tajimi City

・Flood on September 26, 1959 (typhoon)

Typhoon No. 15 (Isewan Typhoon) landed at the west of the Shiono promontory on 26th, went through the area to the west of Nagoya City, reached around Toyama, and then moved alongside the coast of the Sea of Japan. The maximum instantaneous wind velocity recorded was 47.5 m, hitting a record high since the establishment of the Nagoya Meteorological Observatory, and since it occurred almost the same time with the hide tide, the highest tide level in history was recorded in various places. And in addition, for two to three hours prior to the passing of the center of the typhoon, there was a heavy rain with an hourly precipitation of 40 – 70 mm in various places, with the river rising rapidly, and because of this as well as the high tide, embankments were breached in many places around the mouth of the river, causing a great disaster. In the Shonai River and the Shin River, there were 13 levee crevasses because of overflowing, and many people's lives were lost by inundation, causing enormous damage. In the whole prefecture of Aichi, the death toll reached 3,168, with 23,334 houses having been completely destroyed and 53,560 houses having been flooded above the floorboard.

Levee crevasse in Hojin Town, Nagoya City

・Flood on July 12, 1972 (seasonal rain front)

A front extending from Sakhalin through the coast of the Chinese Continent to the Korean Peninsula became stationary on 10th as a seasonal rain front that extended from the Kuril Islands through the coast of the Kanto region and across Shikoku and Kyusyu to the Chinese Continent. In the Shonai River Basin the total precipitation reached 200 – 350 mm from 9th through 13th. There was a heavy rain, in particular, in the upper reaches of the river. The flow rate in the point of Biwajima reached about 1,700 m^3/s.

Situation of flood in the Toki River

In Toki City

・Flood on September 28, 1983 (depression, autumnal rain front)

The rain brought by an autumnal rain front lying alongside the coast of the Honsyu Island from the 26th was strengthened by the approach of the large scale Typhoon No. 10, bringing intermittent heavy rains from the afternoon through the night of 28th. In the upper reaches, in particular, there was a heavy rain, with the total precipitation in the Ori River Basin reaching 300 – 350 mm, and that in other areas reaching 200 - 250 mm. Because of this, the water level requiring the action of the fire department personnel was surpassed in the entire river, and at the point of Biwajima the maximum flow rate since the start of direct supervision, of about 1,930 m^3/s was recorded, and the Isshiki Great Bridge on National Route 1 became dangerous with its girder being washed, and hence was closed temporarily.

・Flood on September 25, 1988 (depression, seasonal rain front)

An autumnal rain front that had been stationary was activated in association with the passing of a depression, and various places in the Tokai Region had a heavy rain from the night of 24th until after noon on 25th. The total precipitation since the start of the rain until 9 o'clock on 25th exceeded 100 mm in the whole basin, reaching 157 mm in Mt. Mikuni. Thereafter there was an extremely heavy rain in the upper and middle reaches from 13:00 to 14:00, the water level requiring the action of the fire department personnel or the warning water level was surpassed in various points, and at the point of Biwajima, in particular, a water level of 7.14 was recorded, which exceeded the maximum water level in recent years. In the lower reaches, there occurred a leakage of water in various places, and in Toki City inundation caused by the reverse flow of the main river occurred, and also inundation caused by landside water occurred in various places.

Fixed dam

Fixed dam

・Flood on September 20, 1989 (typhoon)

From the night of 19th to before dawn on 20th, Typhoon No. 22 passed the offing of the Kii Peninsula, heading east alongside the southern coast of the Honsyu Island. The Tokai region was hit by a heavy rain before dawn on 20th. In Toki City, in particular, which is located in the upper reaches, the maximum hourly precipitation reached 44 mm with the total precipitation of 144 mm, and the flooding of rivers of medium and small sizes occurred in various places of the tributary streams, with 463 houses being inundated above or below the floorboard. As a result of this, the “Emergency Project Related to the Restoration from River Disasters and Others” is implemented.
The average precipitation in the basin also reached around 120 mm, with the flow rate at the point of Biwajima having reached about 1,900 m^3/s.

Around the Mamba Bridge

・Flood on September 19, 1991 (typhoon)

The rain brought by an autumnal rain front lying alongside the southern coast of the Honsyu Island from 18th was strengthened gradually by the approach of Typhoon No. 18, and there were intermittent heavy rains that centered on the coastal areas from the morning of 19th. Heavy rains were brought to the middle and lower reaches, in particular, of the Shonai River Basin, recording the second largest daily precipitation in history in Nagoya as an example. In the Utsutsu River, a tributary steam, there was a levee crevasse, which brought great damage to Kasugai City. The average rainfall in the basin also reached about 170 mm, with the flow rate at the point of Biwajima reaching about 2,300 m^3/s.

Isshiki Great Bridge

Levee crevasse in the Utsutsu River

・Flood on July 30, 1999 (seasonal rain front)

A depression associated with a seasonal rain front passed the Sea of Japan from 29th to 30th, bringing a heavy rain in the Shonai River Basin as well from the afternoon of 29th to the morning of 30th. In the mountains in the upper reaches, in particular, there was a heavy rain of exceeding 40 mm per hour, with the total precipitation reaching 240 mm at maximum, and 160 mm as the average precipitation in the basin. As a result, there occurred inundation damage in about 100 houses in the upper reaches of Toki City and Mizunami City, and the flow rate at the point of Biwajima also reached about 1,900 m^3/s.

Around Biwajima

Inundation in Toki City

・Flood on September 12, 2000 (typhoon, autumnal rain front)

A front extending to the east and west of the Tokai region became stationary, and since a huge amount of damp air flowed from Typhoon No. 14 toward this front, there was a heavy rain centering on Aichi Prefecture (“Tokai heavy rain”). In the Shonai River Basin as well, the total precipitation exceeded 500 mm at maximum, centering on the middle and lower reaches, and it became the heaviest rain theretofore, with the average rainfall in the basin reaching 390 mm. Because of this, the water level exceeded a design high-water level in sections in the lower reaches, and a very dangerous state persisted with an occurrence of an overflow in the levee and others, with the flow rate at the point of Biwajima reaching about 3,600 m^3/s. In the Shin River, a tributary stream, because of a great flood from the basin and the flood that flowed from the Shonai River after overflowing a fixed dam, a dangerous state in which the design high-water level was exceeded persisted for a long time, and there occurred a levee crevasse at the left-hand side, which brought grave inundation damage centering on Nishi-biwajima.

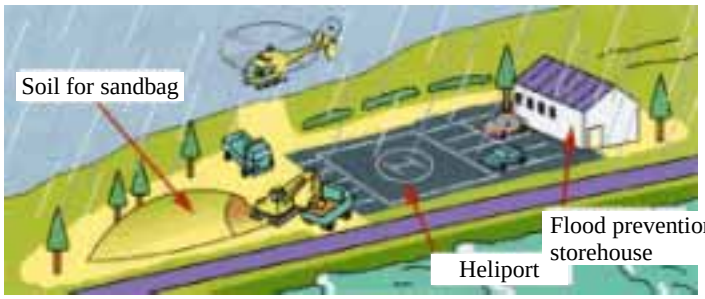
Around the bridge of JR Shinkansen (Bullet train) line

Isshiki Great Bridge

[A history of the flood control projects in the Shonai River]
As the flood control projects in the Shonai River system, a Buei levee had been built before the Oda family prospered, while they are said to have started as the full-scale projects when the excavation works of the Hori River and the construction of the Okakoi levees were carried out in 1610 in the Edo era in the same period as the building of Nagoya castle.
In the years of Tenmei, great flood control works were started after the damage caused by the floods that had continued during the years of Horeki, Meiwa and An-ei, and in 1784 the excavation of the Shin River and the construction of fixed dams started, to be completed three years later. ("Flood control in Tenmei") Also, in the 1800s relocation and repair works of the Nikko River were completed.
After the Meiji Restoration, the construction of levees and the repair of fixed dams in the Shonai River was carried out, and in the Taisho era and thereafter works have been carried out such as the raising of levees (1918), the relocation works of the Yada River (1930), the removal of the "Mid Island" in Biwajima (1958) and others.
The design high-water discharge of the Shonai River was determined in 1941 in the Shonai River repair works office of the Ministry of Internal Affairs to be 2,500 m^3/s at the point of Ajima and 2,700 m^3/s at the point of Biwajima. After that in association with its inclusion in the rivers under direct supervision in March 1969 to be designated as a Class A river system, a master plan of implementing works was determined in April 1969, in which the peak flow rate of the basic high water (in 50 year probability) at the reference point of Biwajima was made to be 3,150 m^3/s, with 300 m^3/s branched to the Shin River, and at the same time 150 m^3/s was adjusted in the Otai retarding basin, thereby setting the channel flow rate at 2,700 m^3/s which is the same as that in the plan theretofore. In April 1975, the master plan of implementing works was revised after the flood in July 1972, and the design high-water discharge at the point of Tajimi was determined to be 2,400 m^3/s (100 year probability) and that at the point of Biwajima to be 4,200 m^3/s (200 year probability). The flood adjustment at this time was made by the Origawa dam and the Otai retarding basin, which caused the branching amount toward the Shin River to become 0 m^3/s, realizing a full separation with the Shin River.
Based on this plan, construction works such as the construction of levees, the enlargement of levees, the excavation of riverbeds, groynes and bank protection works and others are under way, and in addition the construction of the Origawa dam aiming at the flood adjustment and the maintenance of the normal functions of flowing water as well as the Otai retarding basin aiming at the flood adjustment are under way.
Also, since grave damage was caused by the Tokai heavy rain in September 2000, the "Special Emergency Project as the Countermeasures against Terrible Disasters in the Shonai River and the Shin River" has been implemented since Fiscal Year 2000. The contents of the project are varied, including the building of levees (raising and embankment in the lower part), improvement in the bank protection, the excavation of river channels, the rebuilding and reinforcement of bridges, the rebuilding of fixed dams (raising), improvement in the Otai retarding basin, improvement in the system of disaster prevention information (e.g. Interactive Television (ITV), Optical fiber cable network, remote control of drainage pump), improvement in the flood fighting bases.

Construction of the Otai retarding basin

Construction of the Origawa dam



In the inundated area caused by dyke broken and overtopping, flood fighting bases will be improved to enforce its flood prevention capability.

Improvement of the flood fighting bases

2.3 Definitions of flood damage

There are no criteria, declarations or others that define flood damage.
As the one to represent the degree of danger at the time of a flood, the classification into the ranks of channel water levels (designated water level, warning water level and hazardous water level) is practiced, and if it is judged that the degree of danger is high, flood fighting alarms are announced. (Article 10 of the Flood Fighting Law)
However, in a case where a disaster occurs or there is the danger of an occurrence thereof, recommendations of evacuation may be issued for residents by the judgment of the mayors of municipalities. (Article 60 of the Disaster Measures Basic Law)

There exist criteria for projects according to the damage caused, in the restoration projects from flood disasters. The project having the highest project rank in the river projects of Japan is the Special Emergency Project as the Countermeasures against Terrible Disasters (River-Terrible-Special Project).
Ex. Criteria for adoption With 50 houses or more having been washed away or completely destroyed, with 2,000 houses or more having been inundated, and others.

[Article 10, Paragraph 4 of the Flood Fighting Law]
“The Minister of Construction must issue an alarm of flood fighting on the river, lake or seacoast designated by recognizing that there is the danger that serious damage may occur there in terms of national economy by a flood or high tide, and the Prefectural Governors must do so on the river, lake or seacoast other than the river, lake or seacoast designated by the Minister of Construction, that has been designated by recognizing that there is the danger that considerable damage may occur there by a flood or high tide.”

[Article 60 of the Disaster Measures Basic Law]
In cases where a disaster occurs or there is the danger of an occurrence of a disaster, if it is recognized that it is especially required in order to protect the lives or bodies of people from the disaster or otherwise to prevent the enlargement of the disaster, then the mayors of municipalities shall be able to make recommendations of evacuation against the residents and visitors staying in the areas which deemed to require such recommendations, and if it is deemed to require immediate attention, then they shall be able to direct evacuation against such people.

Aside
The order of evacuation is not expressly written in the laws. There is a description concerning the order of evacuation in Article 63 of the Disaster Measures Basic Law. The order is thought to fall into this category.

3. Flood control measures (flood management strategy)

3.1 Flood management strategy (legal system, plans, etc.): what kind of flood management is carried out from the viewpoint of Integrated Water Resource Management (IWRM) (Integrated Flood Management (IFM))

In Japan flood management is carried out based on the River Law. The River Law was enacted in 1896, establishing the law system on the river management mainly for flood control. After that in 1964, the River Law aiming at the river management throughout the river system in which the use of water was added to the flood control was enacted. Moreover in 1997, a system was established in which the river management was to be carried out by adding the environment to the flood control and the use of water, and besides revisions were made such as the introduction of a river improvement planning system that reflects the opinions of the people in the basin, and others. (See Fig.18 and Fig.19)

In carrying out the river improvement, the “Basic River Management Policy” and the “River Improvement Plan” are worked out.

The “Basic River Management Policy” is to determine the distribution of the flow rates of basic high-water and design high-water, and others as the basic policy of river improvement over the entire river system. The “River Improvement Plan” is to determine the whole concept of river improvement in both of the river works and the maintenance of rivers, for the sections of rivers for which the river improvement will be carried out systematically according to the Basic River Management Policy, by reflecting the opinions of local governmental organizations and local residents, and by showing the period of 20 – 30 years later clearly.

Thus in Japan the river management (= flood management) by means of the River Law has been practiced was started at an early stage, and awareness of floods is high. From the topographical characteristics, the purpose of the river management in Japan has been the flood control in the main since olden times. Studies have been made after World War II on the use of water (securing tap water and agricultural water by means of dams, etc.) and recently on the environment, and improvement aiming at the balanced flood control (river management) with reference to flood control, the use of water, and the environment.

3.2 Effectiveness of flood management policies

In Japan, the channel improvement (the building of levees and the construction of dams, retarding basins, and others) is carried out under the leadership of the national government and prefectural governments. At the time of a disaster, each local government takes the lead to carry out the flood fighting activities.

3.3 On flood preventive strategies

・Measures on structures (type)

Levees, dams, adjustment land, and others. Those resisting to the external physical forces of floods.

・Measures on non-structures (type)

Decrease in run-off: Storage in the basin (infiltration of rain water, storage in each house)
Related to disaster prevention:
Local disaster prevention plans (inclusive of information on disaster prevention, and others), local ordinances (regulations on construction, etc.) and the distribution of hazard maps

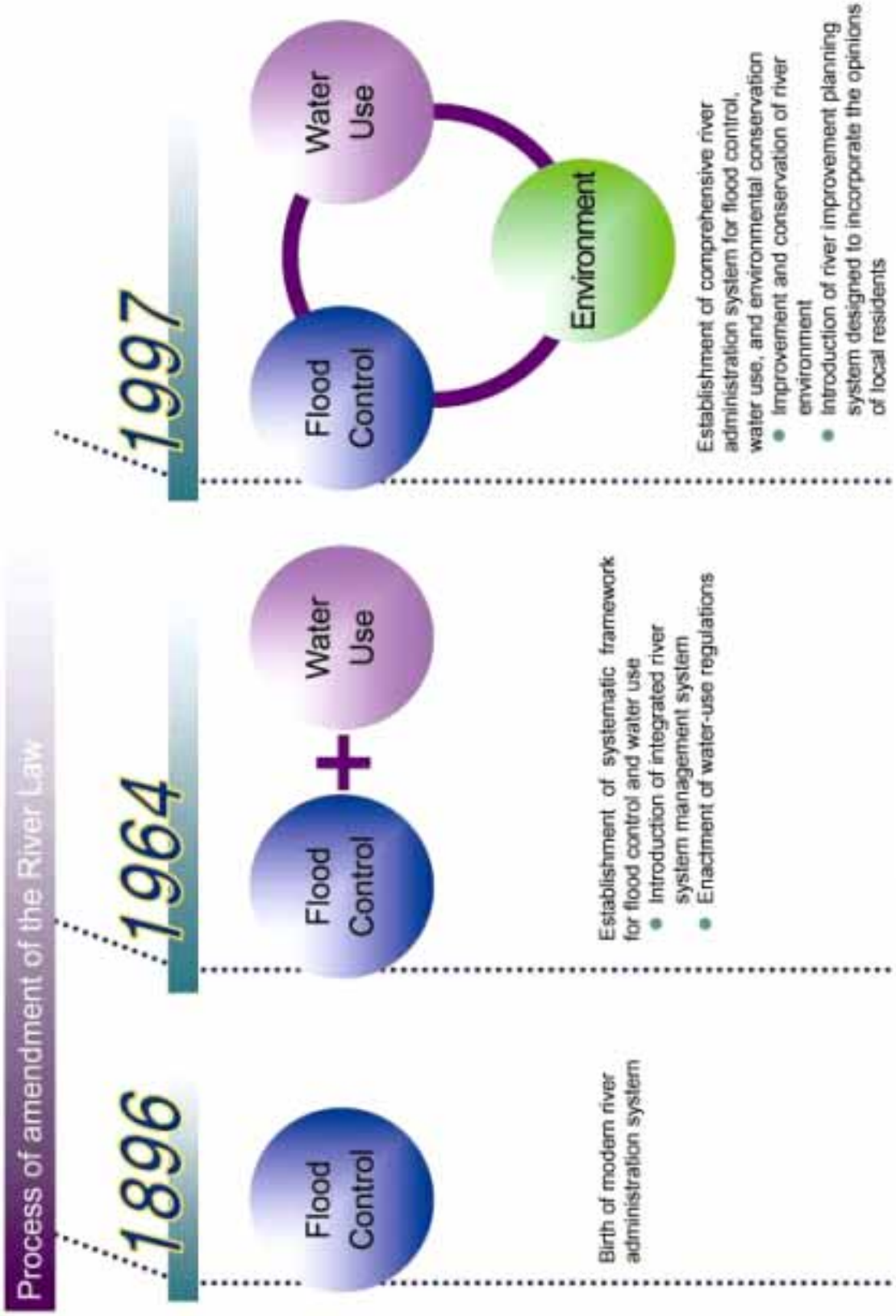


Fig. 18 Process of amendment of the River Law

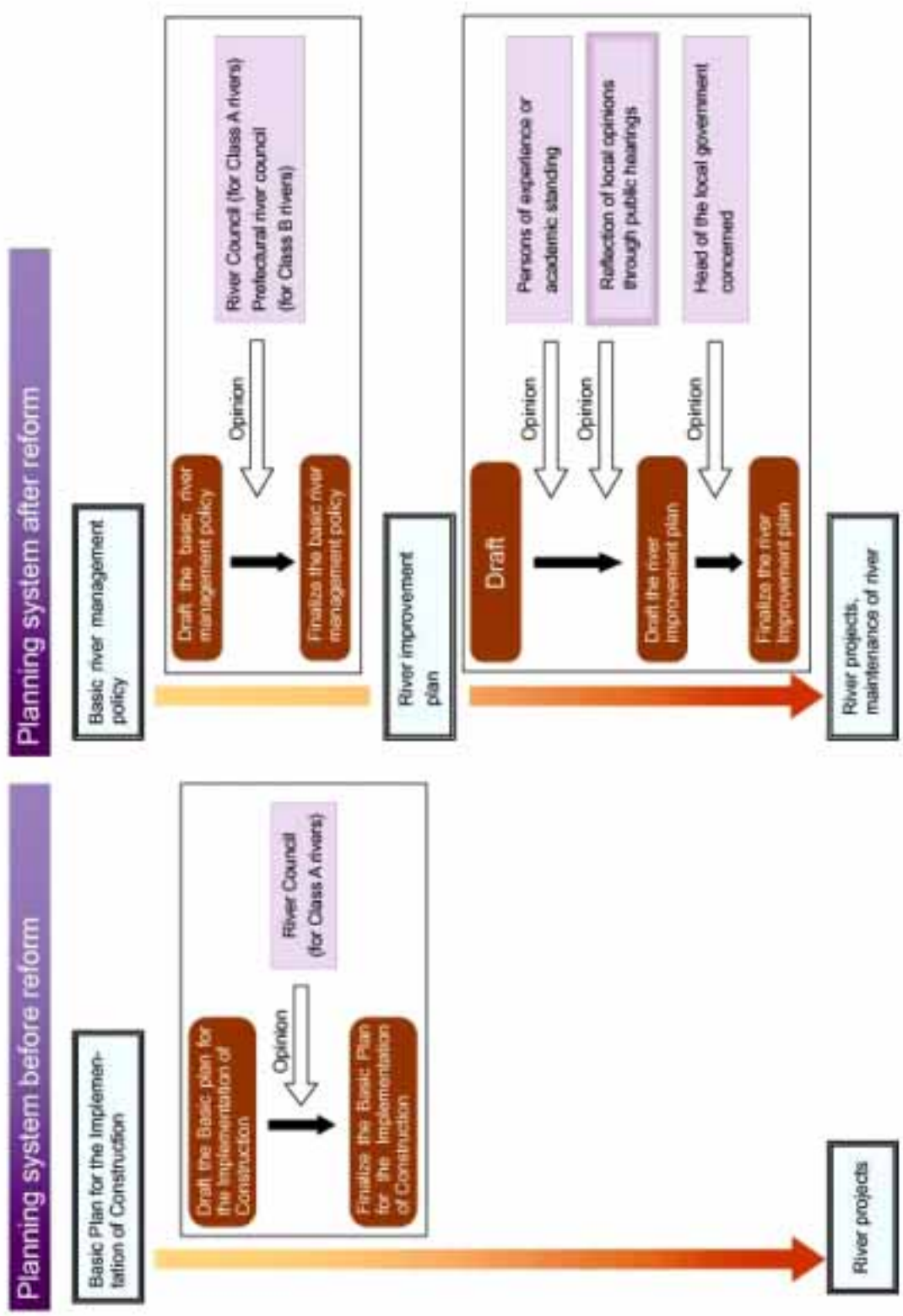
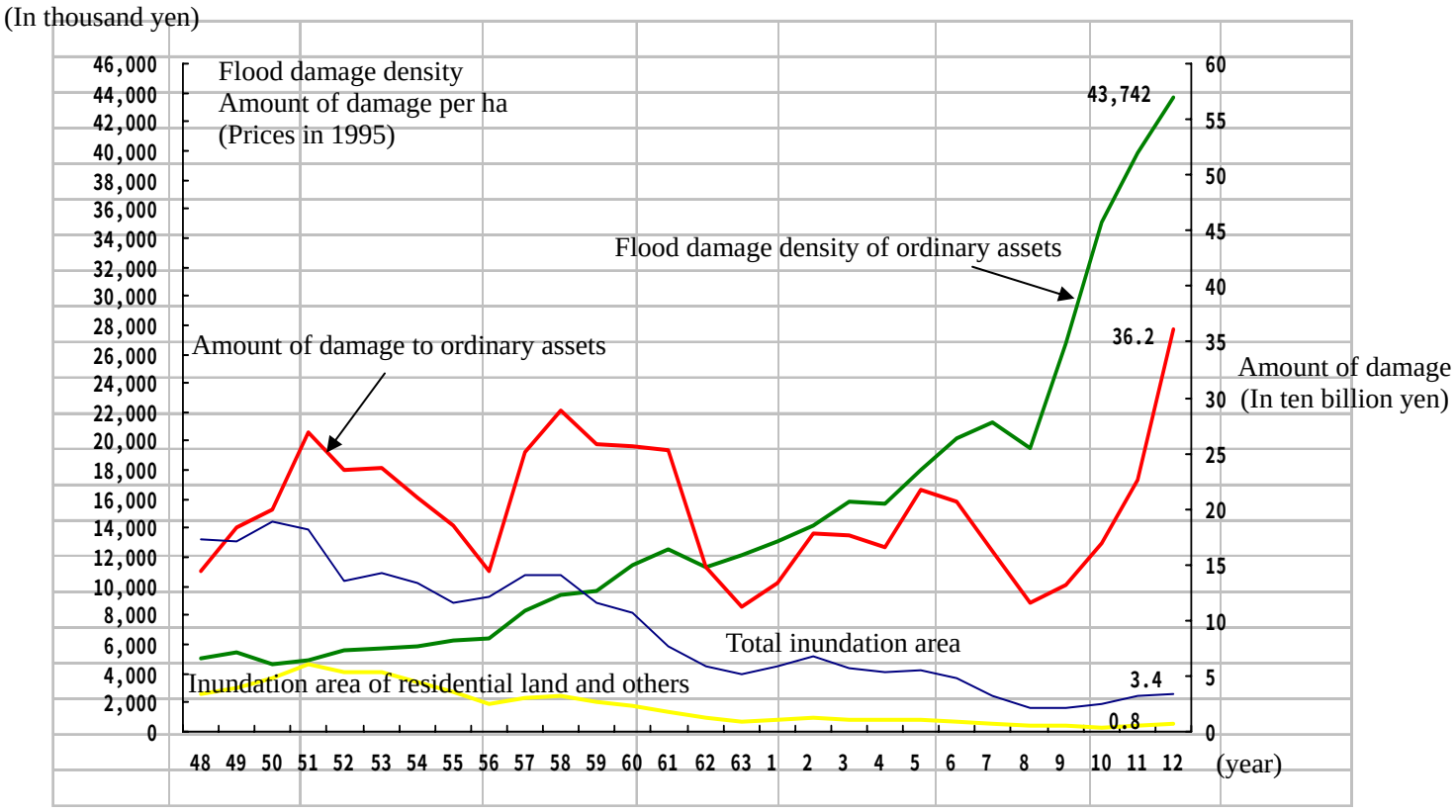


Fig. 19 Planning system

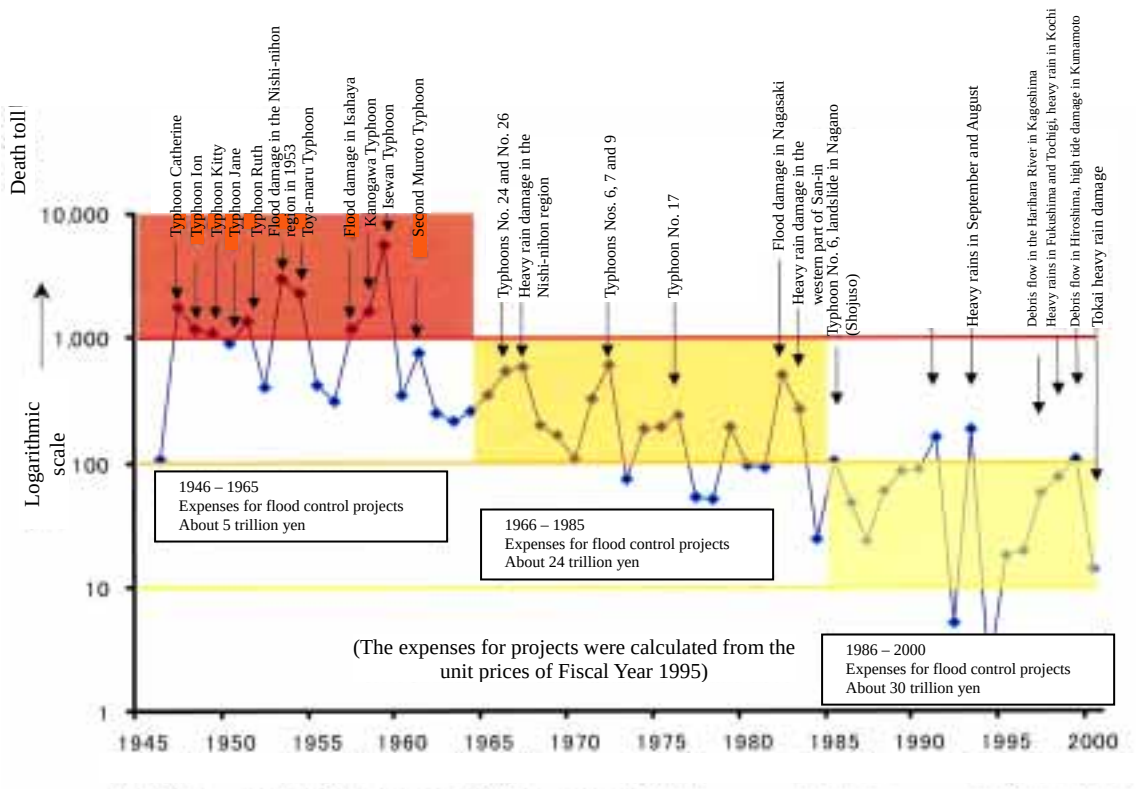
・Relative importance in measures on structures and measures on non-structures

Damage to humans and the area of inundation have been decreased in relation to the measures on structures and non-structures, whereas the damage to assets is in the trend of increase. This is caused by the fact that, as a result of implementing measures on structures, assets concentrate on flood plains, which increases the potentiality of damage.



Note) The amount of damage to ordinary assets and the flood damage density include the losses caused by the suspension of business. It is based on the "Flood Damage Statistics" of the Ministry of Land, Infrastructure and Transport.

Fig. 20 Transition of flood damage and the flood damage density of ordinary assets



The graph shows the total death toll due to the flood damage, sediment-related damage and volcanic damage.
The death toll was based on the Disaster Statistics (the River Bureau) (1946 – 1952) and the investigations of the National Police Agency (1953 –) and others.
The expenses for flood control are the actual amount (calculated from the indexes of the expenses for flood control projects in 1995, and are the total amount of flood control expenses including the projects by the national government subsidy (however, as for those of 1946 – 1959, the expenses for flood control by the sole expenses of local governments were calculated together due to the convenience of processing statistical data).
Prepared by the Office for Measures against Disasters, Disaster Prevention Division, River Bureau (September 2001)

Fig. 21 Transition of the victims of disasters

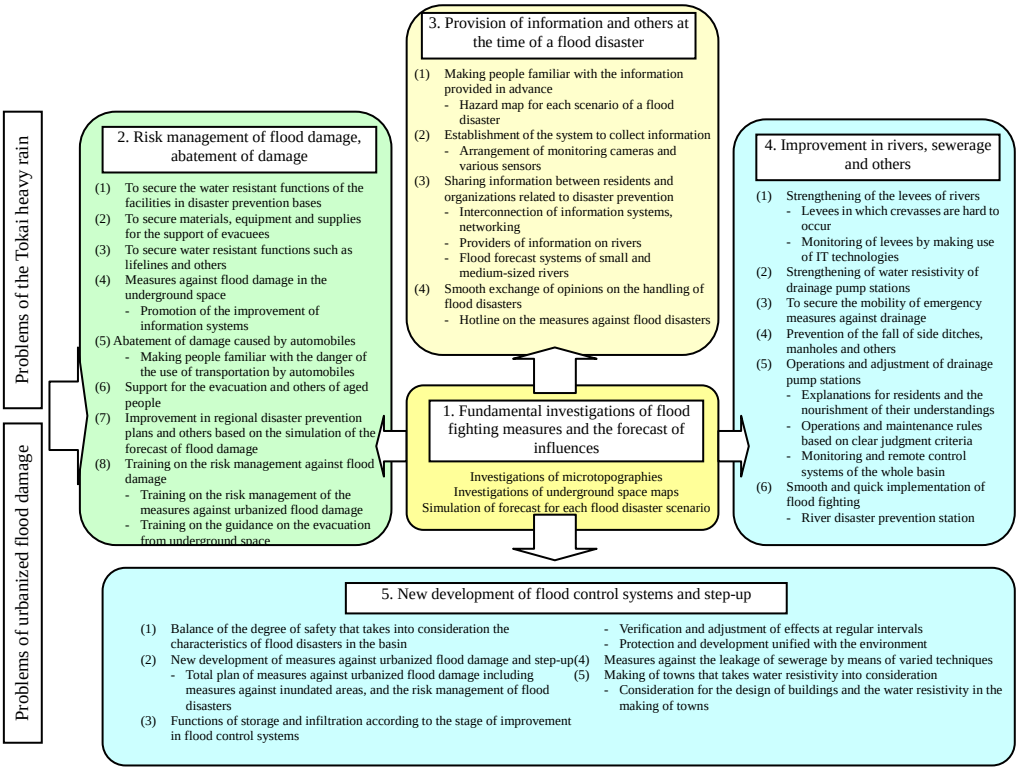
3.4 On the flood prevention strategies (measures) converted after great floods

[Emergency proposal concerning the measures against urbanized flood damage]

In order to cope with flood damage in city areas like the one caused by the Tokai heavy rain in which the damage potentiality is high, the “Committee on Emergency Studies of Urbanized Flood Damage” was organized in the River Bureau and the City Bureau of the Ministry of Land, Infrastructure and Transport.

This Committee made an emergency proposal concerning the measures against urbanized flood damage on November 9, 2000, and in order to promote the measures against urbanized flood damage that unifies rivers and sewerage from planning to management, the first “Committee on Studies of Measures against Urbanized Flood Damage” was held in July 2001.

Composition of the emergency proposal concerning the measures against urbanized flood damage



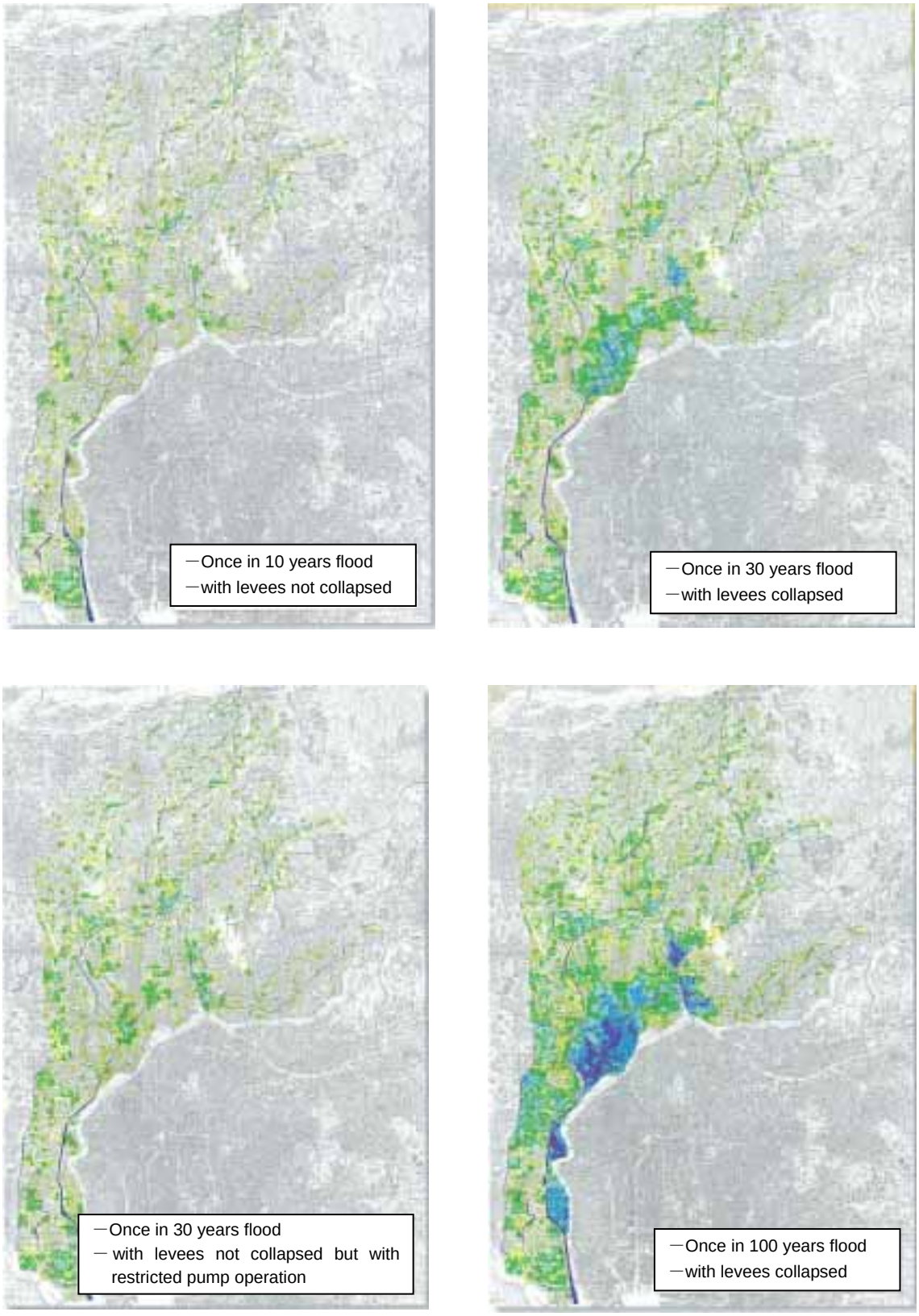
Source: HP of the Ministry of Land, Infrastructure and Transport
Emergency proposal concerning the measures against urbanized flood damage:
Committee on Emergency Studies of Urbanized Flood Damage on November 9, 2000

Fig. 22 Composition of the emergency proposal concerning the measures against urbanized flood damage

[Partial revision of the Flood Fighting Law]
Part of the Flood Fighting Law will be revised in June 2001. The objectives of the revision are given below.
“In order to seek the abatement of damage caused by flood disasters, measures shall be taken such as the new practice of flood forecast, in addition to that made by the Minister of Land, Infrastructure and Transport, to be made by prefectural governors, the publication of assumed areas of inundation by the Minister of Land, Infrastructure and Transport and prefectural governors, smooth and quick securing of evacuation in the assumed areas of inundation, and others.”
As a result of this, the making of hazard maps will be carried out by each municipality working as a unit, which will be used for evacuation activities at the time of a flood disaster.

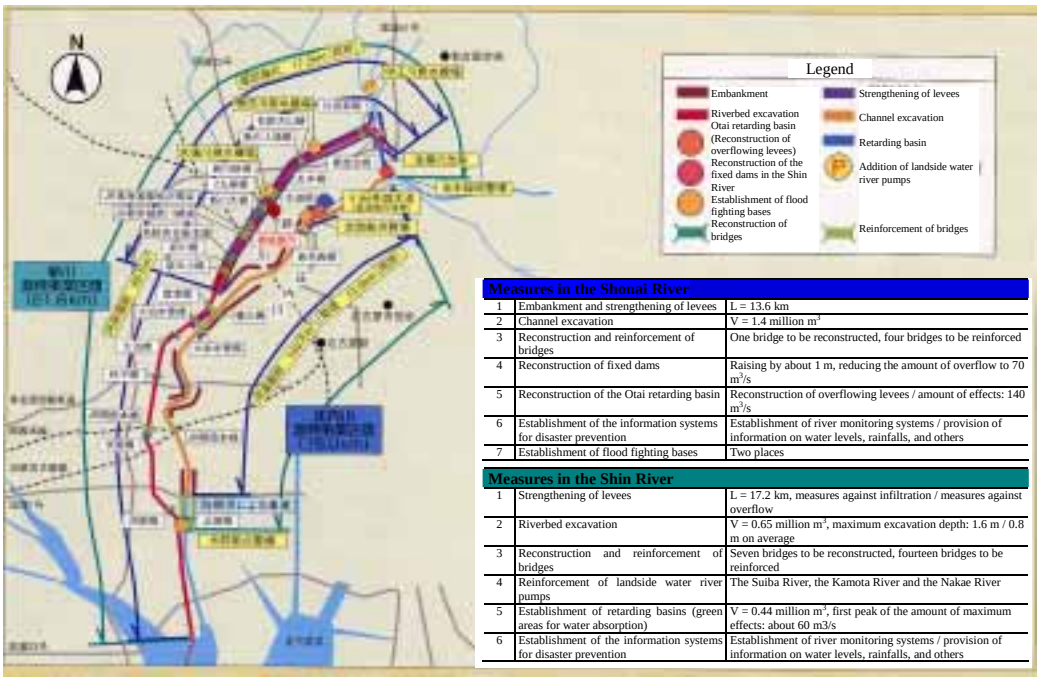
Examples of the use of hazard maps next page

Fig.23 Examples of Hazard Maps with various scenarios
－ Simulation at Shinkawa Riv. Basin



・New flood control measures (distinguishing measures on structures from measures on non-structures)

In preparation for the second coming of rainfalls having the scale of the Tokai heavy rain, the repair of rivers shall be implemented by means of the Special Emergency Project as the Countermeasures against Terrible Disasters in Rivers. Expenses for the project are 61 billion yen for the Shonai River and the Shin River. In addition to measures on structures, software measures such as the establishment of the disaster prevention information systems and others shall be implemented, to take comprehensive flood control measures. In the Shin River, there are places where landside water inundation occurred, for which the strengthening of drainage pumps shall be incorporated into the measures.



Measures in the Shonai River		
1	Embankment and strengthening of levees	L = 13.6 km
2	Channel excavation	V = 1.4 million m^3
3	Reconstruction and reinforcement of bridges	One bridge to be reconstructed, four bridges to be reinforced
4	Reconstruction of fixed dams	Raising by about 1 m, reducing the amount of overflow to 70 m^3/s
5	Reconstruction of the Otai retarding basin	Reconstruction of overflowing levees / amount of effects: 140 m^3/s
6	Establishment of the information systems for disaster prevention	Establishment of river monitoring systems / provision of information on water levels, rainfalls, and others
7	Establishment of flood fighting bases	Two places

Measures in the Shin River		
1	Strengthening of levees	L = 17.2 km, measures against infiltration / measures against overflow
2	Riverbed excavation	V = 0.65 million m^3, maximum excavation depth: 1.6 m / 0.8 m on average
3	Reconstruction and reinforcement of bridges	Seven bridges to be reconstructed, fourteen bridges to be reinforced
4	Reinforcement of landside water river pumps	The Suiba River, the Kamota River and the Nakae River
5	Establishment of retarding basins (green areas for water absorption)	V = 0.44 million m^3, first peak of the amount of maximum effects: about 60 m3/s
6	Establishment of the information systems for disaster prevention	Establishment of river monitoring systems / provision of information on water levels, rainfalls, and others

Fig. 24 Outline of the Special Emergency Project as the Countermeasures against Terrible Disasters in Rivers for the Shonai River and the Shin River

Special Emergency Project as the Countermeasures against Terrible Disasters in Rivers: Emergency river improvement project in areas where terrible damage occurred due to floods, high tides and others. To be implemented in five years on the whole. (Article 9, Article 10, Paragraph 2 of Article 60, and Article 62 of the River Law)

・Change in the relative importance of measures on structures and measures on non-structures

Until recently, Japanese flood management measures were mainly accomplished by structural measures (e.g. embankment, setting back of embankment, excavation of river bed, dams, diversion channel). However, especially for rivers in city areas, restrictions against smooth implementation of river works – such as skyrocketing land prices, need of displacement of a number of buildings and houses- had made structural measures more and more difficult to implement in a short period. On the other hand, concentration of properties into the city area was rapidly accelerated.

Therefore so-called “a policy on comprehensive flood control measures” was introduced in1979. This aimed at safely dealing with about 50 mm/hr rainfall level and be completed within about 10 years period. The main concept of this is to strengthen flood retarding function in the basin in many forms and incorporate these effects officially into flood management plans and strategies. An effort to seek for a combination of measures between water and land management was started, thus linkage between water and land-use authorities was required. (See Fig.26)

In rivers having a great difference between the flow rate at normal times and that at the time of a flood like the rivers in Japan, there is the danger that once flood damage occurs, the damage will become enormous. It is particularly conspicuous in city areas.
At present, repair of rivers is under way in rivers all over Japan, but the rate of the improvement in levees is still low, with the rate for the Shonai River being about 1/4. And therefore, when unexpected flooding occurs, if it is hard to cope with by measures on structures, there will be the need to supplement them with measures on non-structures. While both measures on structures and measures on non-structures are important, the importance of measures on non-structures has become greater against the urbanized flood damage in recent years.

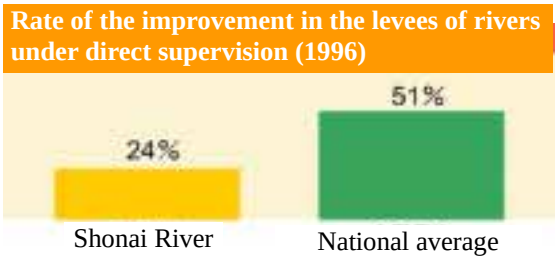


Fig. 25 Rate of the improvement in the levees of rivers under direct supervision (management by the national government)

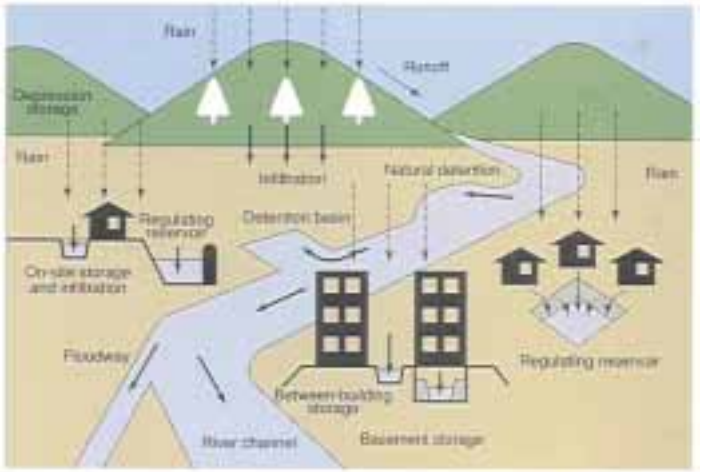


Fig. 26 Concept of comprehensive flood management

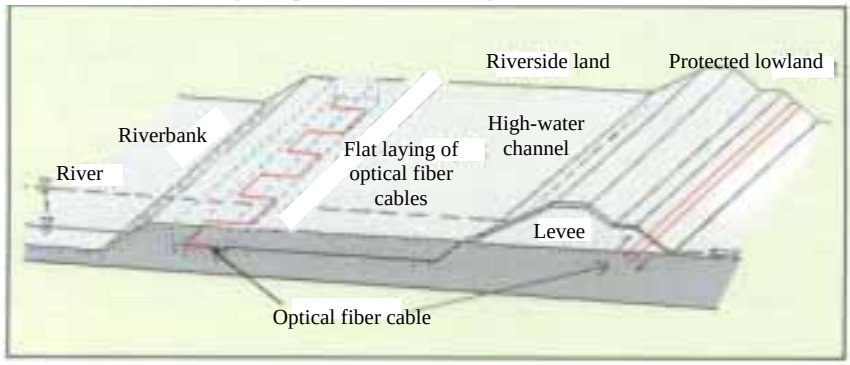
4. Flood and water management techniques
4.1 Method of collection and transmission of information/data

The national and prefectural river authorities are maintaining thousands of raingauge-stations and water level stations throughout Japan which are wirelessed, and used those data for daily management of rivers. However, how effectively and integratedly manage data obtained from these stations, and provide them to local people with adequate flood forecast or suggestions for evacuations, etc. had been in question.

For this purpose, in 1985 the Foundation of River Basin Integrated Communications (FRICS) was established under the auspices of Ministry of Construction, with financing from central government and the prefectures and also subscriptions from interested companies. The FRICS, which composed of a headquarters and eight regional centers, gathers data on rainfall from 23 precipitation rader bases as well as from above-mentioned traditional facilities. This information is processed in user friendly manner and passed on to users (each of them rents a display terminal) according to their needs, such as hydrographs, warning signals, water quality information, etc. The FRICS has now developed about 500 frames for use by its information service. Now FRICS's information service is also available to the publis through web site and also through cell phones (i-mode of NTT DoCoMo and others). (See Fig.29)

Recently there are examples in which the maintenance and management of levees by means of optical fiber cables are carried out, which are used for disaster prevention.

Method of monitoring the places of scouring and infiltration



Extracted from HP of OYO Corporation

Fig. 27 Maintenance and management of levees utilizing optical fiber cables

In Nagoya City where the Tokai heavy rain occurred, a fixed-point observation system was introduced, calling for the provision of information on water levels by residents.

[Fixed-point observation system]
Nagoya City strengthened the handling of urbanized flood damage by learning from a lesson in the Tokai heavy rain.
The fixed-point observation system is to grasp the situation of flood damage by having residents provide information on the situation of flood damage (such as the occurrence of inundation of … cm in front of the house). At present the HP of Nagoya City calls for cooperation on the fixed-point observation. Now there are about 700 points.

If there is the danger of flood damage, evacuation is announced for residents by recommendations on evacuation.

Fig.28 Examples of Picture Images provided by FRICS

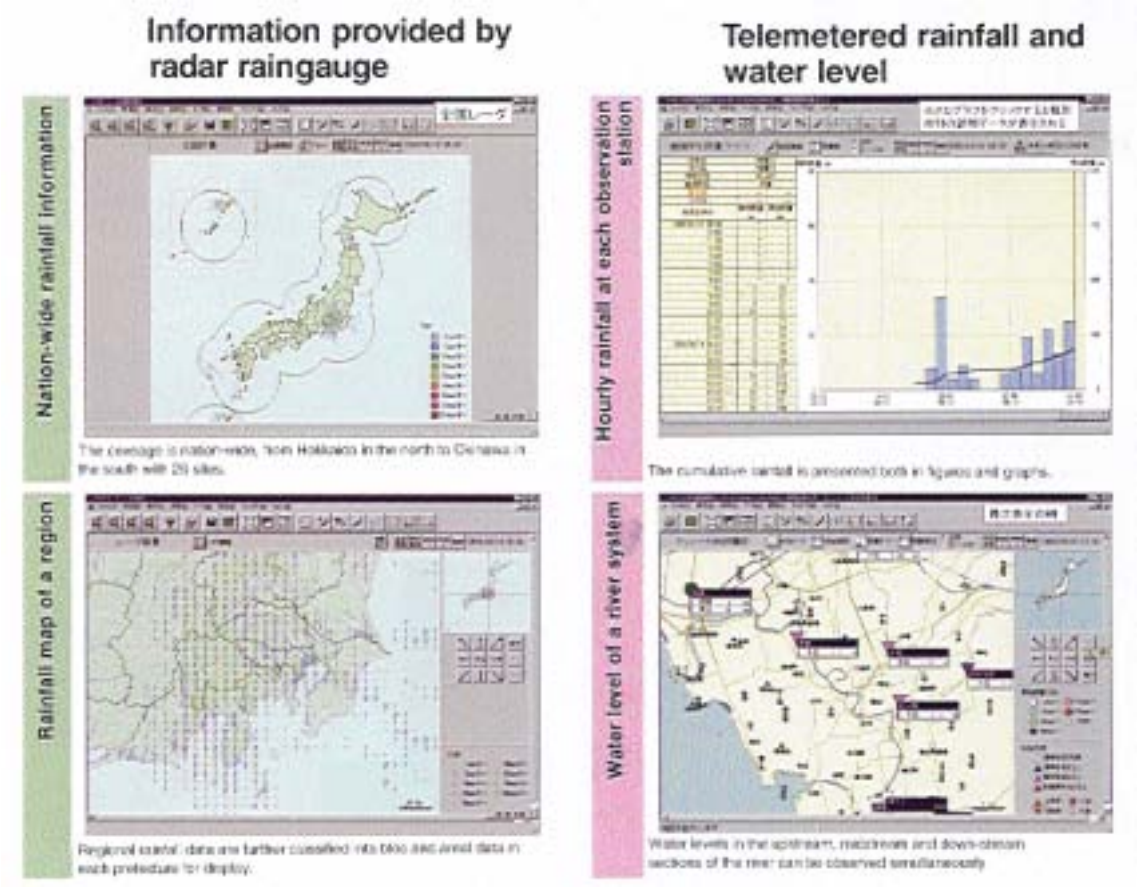


Fig.29 One to one service by mobile Internet

FRICS also provides rainfall information and water level information to many kinds of users by mobile Internet. All users can get the information anytime and anywhere.

In Nagoya City, it was decided after the Tokai heavy rain to announce preliminary information on recommendations on evacuation. The information on evacuation is to be announced hereafter in two stages of the preliminary information on recommendations on evacuation and the recommendations on evacuation.
The preliminary information on recommendations on evacuation is the information for residents to prepare for appropriate evacuation activities when there is the possibility of evacuation from numerical viewpoints (water level, rainfall, and others).

The means of transmission of information include public relations by means of PR cars, the Internet and others, local public relations through the district headquarters for disaster rescue, television, radio, and others.

4.2 Distribution of resources and method of use toward the Integrated Flood Management (IFM)

In Japan, rivers are classified into three categories of Class A, Class B and small rivers with respect to flood management (=river management, channel improvement, and others), and Class A rivers are managed by the Minister of Construction, Class B rivers by prefectural governors, and small rivers by the mayors of municipalities, each of them working as a river administrator. The distribution of human resources is set by the national government or each local government depending on the importance of the river in question. Regarding the budget, the distribution of the budget is made according to the ranks of the importance of flood control and the necessity of the use of water. A special budget will be allocated if serious damage has occurred (Special Project against Terrible Disasters in Rivers, etc.)

4.3 Method of putting flood water and flood plains into effective use

In Japan, there are few examples of putting flood water into effective use. However, the use of flood water by storing it (securing water resources by means of dams, weirs, farm ponds, etc.) for use for tap water and agricultural water is carried out.
As for flood plains, the topography of Japan is mostly made up of mountains, with few plains, and hence flood plains = land for living, which are necessarily put to effective use. Therefore there is a trend that population and assets concentrate on flood plains.

4.4 Effectiveness of legal regulations, incentives, license and permit (to keep the flood area off-limits, incentives to the flood control projects of levees and others, license and permit on development and construction, and others)

Legal regulations in the river administration are carried out based on the River Law. The use of rivers (flowing water, land, earth and sand) is clearly specified in Articles 23 – 25 of the River Law. The use requires the permission of the river administrator in many cases. While basically permission is given with regard to the use of a river, there is no legal protection for the flood damage of the possessor, and the person who wishes to possess it shall be responsible for such damage by him/herself.
The above is applicable only to the land within a river.

There is an example in which a local government who suffered inundation damage in the past enacted an ordinance to carry out the land management of residential land. (The Minato Ward of Nagoya City enacted an ordinance concerning the raising of buildings after the inundation damage caused by the high tide in 1991.)

5. Policy
5.1 Outline of water resource management, flood management, land management, development plan, measures to prevent and cope with disasters, and others

Water resource management: Water Resource Development Public Corporation Law
Flood management: River Law, Specified Multi-purpose Dam Law
Development plan, disaster prevention and handling: National Land Use Planning Law, Disaster Measures Basic Law

[Water Resource Development Public Corporation Law]
The purpose of the Water Resource Development Public Corporation is to contribute to the growth of national economy and the improvement in people's lives by means of implementing projects for the development or use of water resources based on the master plan for water resources development (hereafter called the "Master Plan for Water Resources Development") pursuant to the provisions of the Water Resource Development and Promotion Law (Law No. 217 of 1961), or taking other measures. (Article 1 Purpose)

Law No. 218 dated November 13, 1961

[River Law]
The purpose of this law is to carry out comprehensive management of rivers so that the occurrence of disasters in rivers as caused by floods, high tides and others can be prevented, and rivers can be put to proper use, and the normal functions of flowing water can be maintained, by means of which making contributions to the protection and development of national land, thereby maintaining the public safety and promoting the public welfare. (Article 1 Purpose)

Law No. 167 dated July 10, 1928

[Specified Multi-purpose Dam Law]
This law specifies the special cases of the River Law (Law No. 167 of 1964) concerning the construction and management of multi-purpose dams, and at the same time establishes the rights to use dams, thereby enabling the utility of multi-purpose dams to be demonstrated promptly and sufficiently. (Article 1 Purpose)

Law No. 35 dated March 31, 1957

[National Land Use Planning Law]
The purpose of this law is to specify the matters required for devising national land use plans, and to take measures concerning the regulations on the transaction of land as well as other measures for the adjustment of land use, thereby seeking comprehensive and systematic use of national land.

Law No. 92 dated June 25, 1974

[Disaster Measures Basic Law]
The purpose of this law is to establish required systems through the national government, local governmental organizations and other public organizations with respect to disaster prevention, in order to protect national land and the lives, bodies and property of the people from disasters, to clarify where the responsibilities lie, and at the same time to determine the basics of necessary measures against disasters, such as the preparation of disaster prevention plans, disaster prevention, emergency countermeasures against disasters, restoration from disasters, economical and financial measures on disaster prevention, and others, thereby seeking the improvement and promotion of comprehensive and systematic disaster prevention administration, thus being of help to the maintaining of social order and the securing of public welfare.

Law No. 223 dated November 15, 1961

5.2 Was any conversion of policies made after a great flood? If any conversion of policies was made, what were its cause and background?

As a policy against urbanized flood damage like the Tokai heavy rain, the “Committee on Emergency Studies of Urbanized Flood Damage” was organized in the River Bureau and the City Bureau of the Ministry of Land, Infrastructure and Transport, and it was proposed that flood control measures unifying rivers and sewerage should be taken.

[How effective flood control should be, including the measures taken in the basin]
Although this was not a policy after the Tokai heavy rain, the Minister of Construction (now the Minister of Land, Infrastructure and Transport) referred to the River Deliberation Council on Feb. 4, 2000 “how effective flood control should be, including the measures taken in the basin”. The major contents of this are related to the measures against floods (measures against basins) paying attention to the situation of rivers and the characteristics of the basin. In the background of this lies the fact that normal measures of river repair and others (embankment, channel expansion and others) cannot be made sufficiently as a result of the recent urbanization.
The Tokai heavy rain occurred in September of the same year, and an intermediate reply was published in December of the same year, with the contents incorporating the lessons learned from the Tokai heavy rain.

5.3 The policy conversion is to reflect the idea that floods should be managed based on the Integrated Water Resource Management (IWRM)?

The policy conversion (flood management measures unifying rivers and sewerage) can be said to be one of the comprehensive flood management measures. The comprehensive flood management measures are not to carry out the flood adjustment by river facilities such as channels and dams only, but are the measures to reduce within the basin the runoff that increased due to the development of the basin.

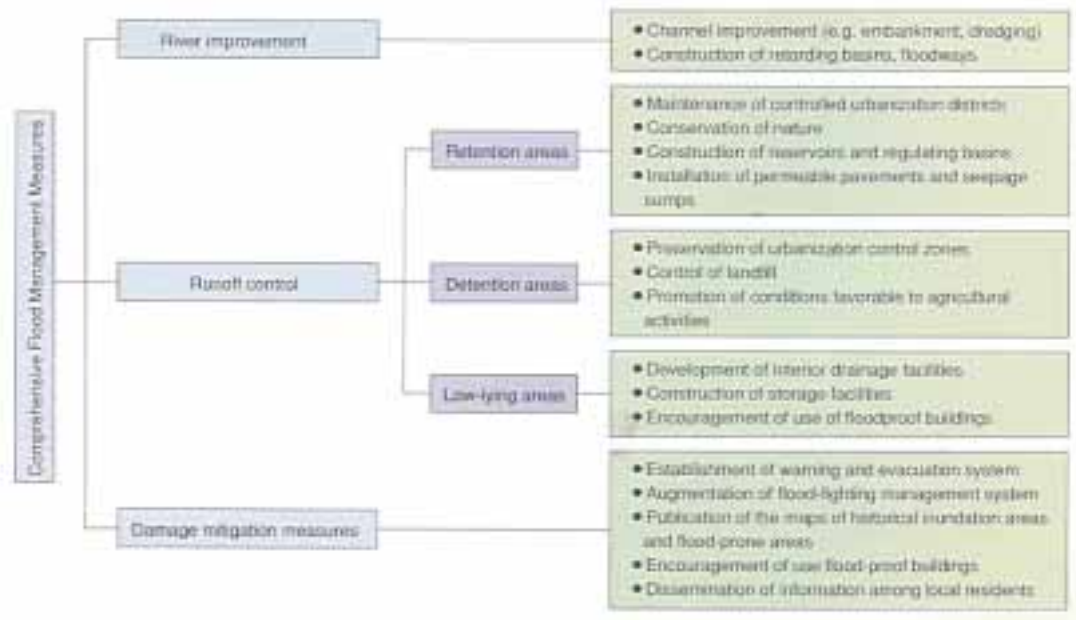


Fig. 30 Comprehensive flood management measures

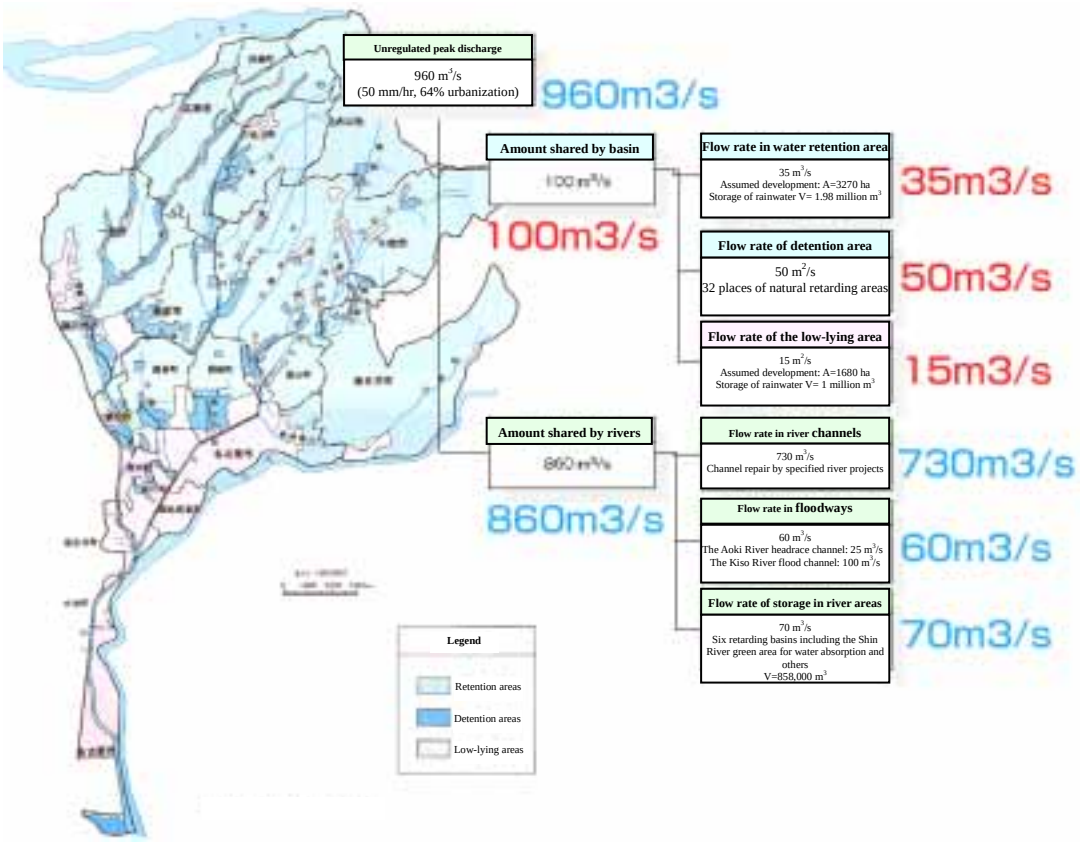


Fig. 31 Basin sharing plan in the Shin River Basin (extracted from the HP of the Shonai River Construction Works Office)

6. Organizations responsible for flood management

6.1 List of all the organizations related to flood management as well as the outline of the responsibilities and roles of each organization (at normal times and at the time of a great flood)

Rivers are classified into three categories of Class A, Class B and small rivers with respect to flood management (=river management, channel improvement, and others). Class A rivers are managed by the Minister of Construction, Class B rivers by prefectural governors, and small rivers by the mayors of municipalities, each of them working as a river administrator.

Rivers under consideration in the River Law are classified into Class A rivers, Class B rivers according to their importance. A system is provided for other rivers of a small scale, to which the provisions of the River Law are applied mutatis mutandis.

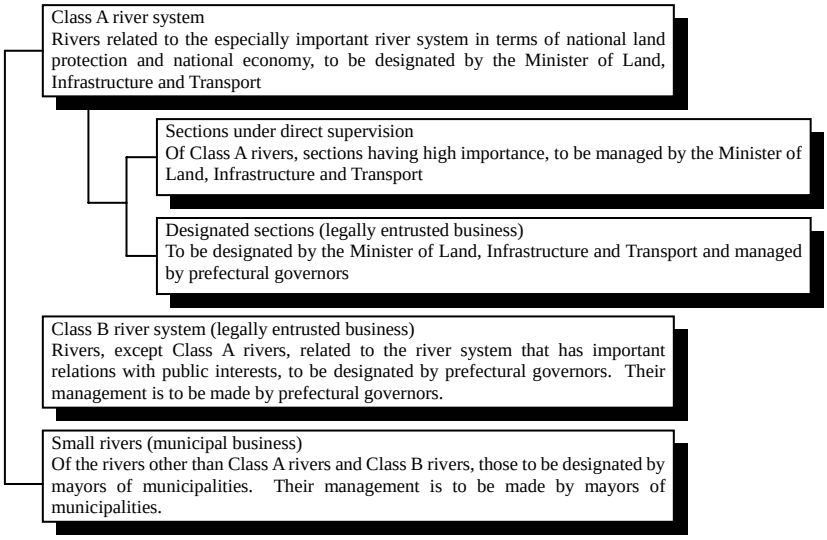
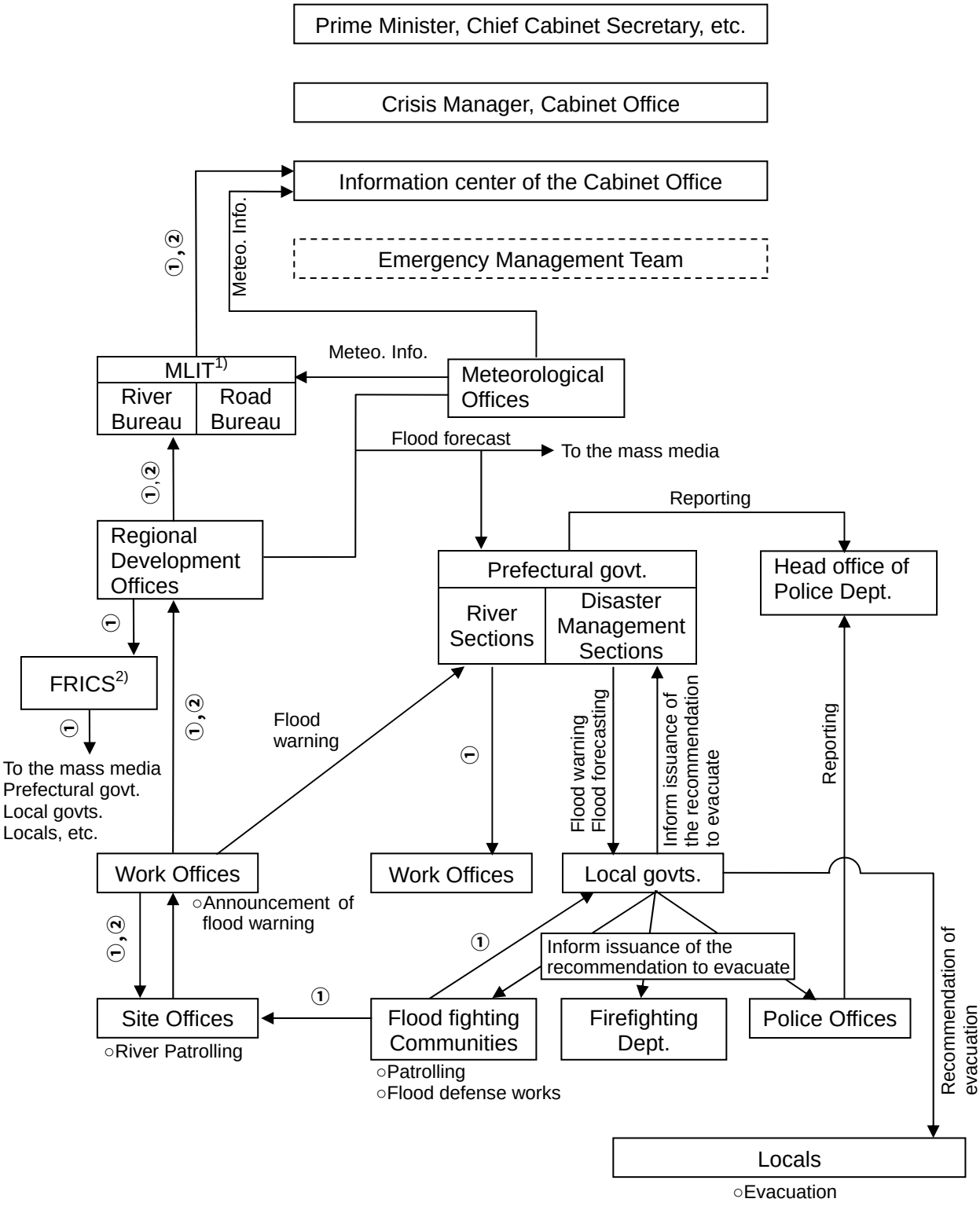


Fig. 32 Classification of river management

An example of the information flow between relevant organizations to cope with flood disaster, is shown in Fig.33

Fig. 33 Information flow to cope with flood disaster
－before the outbreak of disasters



1) Ministry of Land, Infrastructure and Transport
2) Foundation of River & Basin Integrated Communications
① Information of current situations
② Forecast on changes in water levels

Regarding the disaster prevention at the time of a flood, each local government takes the lead to carry out disaster prevention activities. The disaster prevention activities are carried out based on the flood fighting plan of each local government. Fire brigades are organized in almost all the local governments in Japan. Their establishment is stipulated by the ordinances of municipalities, and they engage in activities under the supervision of the head of a fire fighting brigade or the chief of a fire fighting station.

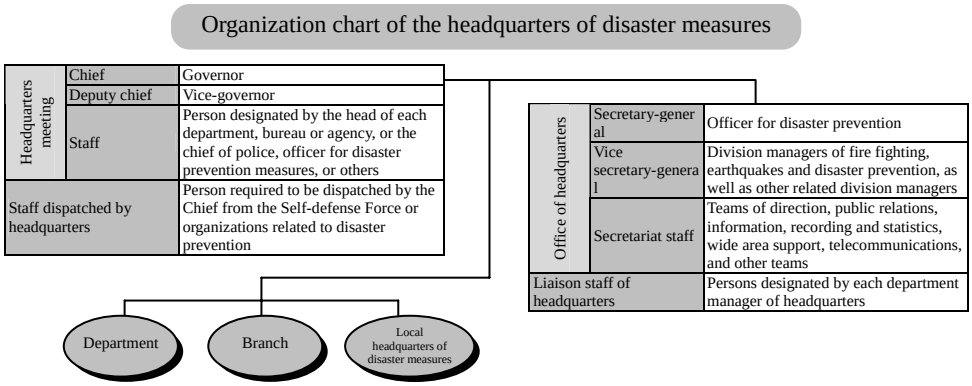


Fig. 34 Example of organization of the headquarters of disaster measures (Chiba Prefecture)

6.2 Range of cooperation among the organizations related to flood management (Cooperation among sections, cooperation among regions, international cooperation)

The cooperation among sections includes the cooperation among the sections of rivers, sewerage, agriculture and forestry. As for local governments, there is the cooperation among prefectures and municipalities. There also are systems of cooperation with private volunteers, and at the time of the Tokai heavy rain, the Aichi/Nagoya flood damage volunteer headquarters was set up within the Aichi prefectural office.
International cooperation is not applicable because there are no international rivers.

6.3 Is there any change in the level of cooperation at the time of a great flood?

The level of cooperation of administration at the time of a flood is uniform. The level of cooperation of private organizations and volunteers varies depending on the situation. In the Tokyo Metropolitan area, a cooperation system with volunteers associations has been organized.
Regarding the restoration business, the scale of the restoration business from disasters has been set according to the scale of a disaster.

The setup of disaster prevention meetings and the devising of regional disaster prevention plans are specified in the “Disaster Measures Basic Law”, and it is a total framework in this law to take such measures as to clearly define the responsibilities of the national government, prefectural governments and municipalities concerning disasters, to promote comprehensive disaster prevention administration (the setup of disaster prevention meetings having a hierarchical structure of national government – prefecture – municipality and disaster prevention headquarters), to promote systematic disaster prevention administration (preparation of disaster prevention plans), to render financial aid to terrible disasters, and others.

6.4 Is there any central government organization to adjust the activities of various organizations?

The Cabinet Office is in charge of the disaster prevention and measures against disasters. Here the Central Disaster Prevention Meeting is held to prepare the master plan of disaster prevention and earthquake disaster prevention plans and to promote their implementation, to prepare the plans concerning the emergency measures at the time of extraordinary disasters and to promote their implementation, to examine important matters related to disaster prevention (basic policy of disaster prevention, overall adjustment of measures concerning disaster prevention, notice of the emergency state on disasters, and others) in response to the request for advice of the Prime Minister and the minister in charge of disaster prevention and to carry out other activities.

[Major response of the national government at the time of the occurrence of the Tokai heavy rain (as of April 2000)] Excerpt from the HP of the Cabinet Office

- Observation of the stricken area by the Director-General of the National Land Agency and Minister of Construction (September 13)
- Observation of the stricken area by the General Parliamentary Vice-Minister of the National Land Agency (October 2)

Dispatch of the Self Defense Force (about 9,700 persons in total (withdrawn on September 26)), the Maritime Safety Agency (471 persons in total (withdrawn on September 14)) and others, for the purpose of engaging in activities of rescue for rescuing isolated people and others

- Implementation of emergency drainage measures such as the collection of (about 20) drainage pump vehicles from various parts of Japan and others (drainage was completed for the most part at 6:50 on September 14)
- Application of the Disaster Rescue Law and the Law for Support for the Reconstruction of the Living of the Victims of Disasters to nine cities and thirteen towns (September 11)
- Grace for redemption of the existing loans, and others (Finance Corporation for Small and Medium-sized Businesses, Finance Corporation for Agriculture, Fishery and Forestry, and others)
- Loan of support fund at the time of a disaster
  Loan for restoration from disasters, and the reduction of loan rate of low interest loan by the governmental small and medium-sized financial institutions, for small and medium-sized businesses
- Loan for houses for restoration from disasters by the House Loan Corporation
- The use of the reserve fund for public works and others amounting to about 21 billion yen for the works for restoration from disasters in rivers and others (Decision of the Cabinet Meeting on October 17)
- Designation of a terrible disaster (raising the ratio of subsidy for the restoration projects from disasters of farmland and others, as well as the special grant-in-aid measures concerning small and medium-sized businesses, Decision of the Cabinet Meeting on November 2)

6.5 How the people concerned are involved in flood management

In Japan, a legal system is put in order whereby the opinions of the people concerned (local residents, people concerned on agriculture, and people concerned on fishery) can be reflected on the river improvement plans (flood management). At the time of the revision of the River Law in Fiscal Year 1997, the “improvement and protection of the river environment” was added to the then existing management purposes of “flood control” and “use of water”, and also a system of planning of river improvement reflecting the opinions of local people was introduced. Making the consensus is pursued on the following several occasions:

1. Discussion and exchanging of views on the river planning at the ‘Basin Committee’, composed of literates, fishermen, local people, concerned persons, and representatives of relevant organization, etc.
2. Meeting with local people to exchange views
3. Local seminar
4. Collection of public views through questionnaires
5. Providing information and collecting ideas through internet and publications
6. Field survey with local people
7. Public announcement and inspection based on River Law

7. Lessons learned

After a great flood, what are the lessons learned from the viewpoint of the Integrated Flood Management (IFM)? (What kinds of measures against floods were evaluated (analyzed) as having succeeded or failed? And what were the reasons for the result of analysis?)

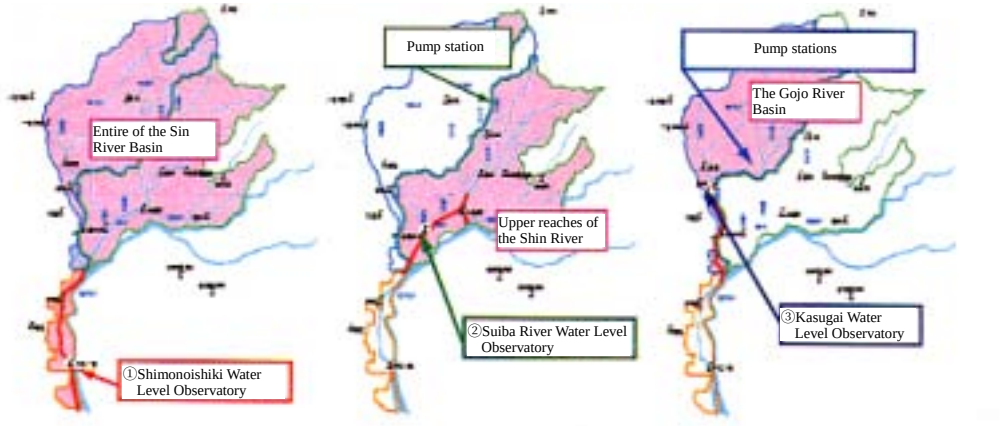
The Tokai heavy rain has brought the great damage that has rarely been seen in recent years as the “urbanized flood damage”, revealing the danger of urban areas where assets are concentrated against unexpected rainfalls. Not only in Nagoya City, but in metropolitan areas like Tokyo and Osaka, population and assets are concentrating year after year, and there is a trend in which damage potentiality increases, thus making it impossible to cope with unexpected floods by means of the conventional hardware measures. Hence, comprehensive flood control measures are required that attach greater importance to software measures.

[Measures on structures]
Since there were not crevasses in levees at the points exceeding HWL, the importance of hardware measures has been rerecognized.
In the Tokai heavy rain, the operation of drainage pumps was deemed to be the problem. When landside water is returned to a channel by means of a pump to avoid the inundation of landside water, it causes an increase in flow rate, and consequently there is an increasing danger of overflow, a crevasse in the levee and inundation. The figure below shows the operational rules of pumps in the Shin River Basin. The 19 municipalities in the basins of the Shin River and the Gojo River including Komaki City have agreed that “if the water level of the Shin River and the Gojo River rises and there is a danger of overflow and a crevasse in the levee, in order to avoid utter destruction resulting from the crevasse in the levee, as the ultimate means, the operation of drainage equipment alongside the rivers shall be compelled to be stopped”.

■The standard of water levels and basin area at which the operation of drainage pumps is to be stopped

① When the water level at the Shimonoishiki Water Level Observatory in the lower reaches of the Shin River reached T.P. * 2.90 m, the operation of drainage pump shall be stopped in the entire Shin River Basin.
② When the water level at the Suiba River Water Level Observatory in the upper reaches of the Shin River reached T.P. * 5.20 m, the operation of drainage pump shall be stopped in the upper reaches of the Shin River.
③ When the water level at the Kasugai Water Level Observatory of the Gojo River reached T.P.* 5.40 m, the operation of drainage pumps shall be stopped in the Gojo River Basin.

(* T.P. shows the average sea level in Tokyo Bay, which shows the water level of rivers measured with the same criteria as the sea level in the maps of the Geographical Survey Institute.)



Excerpt from the HP of Komaki City, Aichi Prefecture

Fig. 35 Operational rules of drainage pumps (put into practice since June 2001)

Measures on structures built before the Tokai heavy rain: Fixed dams. When the flow rate in the Shonai River increases, the flow rate in the Shonai River shall be flowed into the Shin River from the fixed dams. The crevasse in the levee at the time of the Tokai heavy rain was caused by the inflow from the Shonai River, and these are the emergency measures to rescue the Shonai River Basin having greater assets values.

[Measures on non-structures]
As the measures on non-structures, the improvement in information networks is incorporated into the Special Emergency Project as the Countermeasures against Terrible Disasters in Rivers. Also, such activities are carried out as the review of disaster prevention plans and others (Nagoya City), the handling of disaster prevention, the distribution of hazard maps, and others.
As the handling by private insurance companies, the enlargement of the coverage of fire insurance is made to cover compensation for flood damage as well.