

Fuji-kawa

Map of River

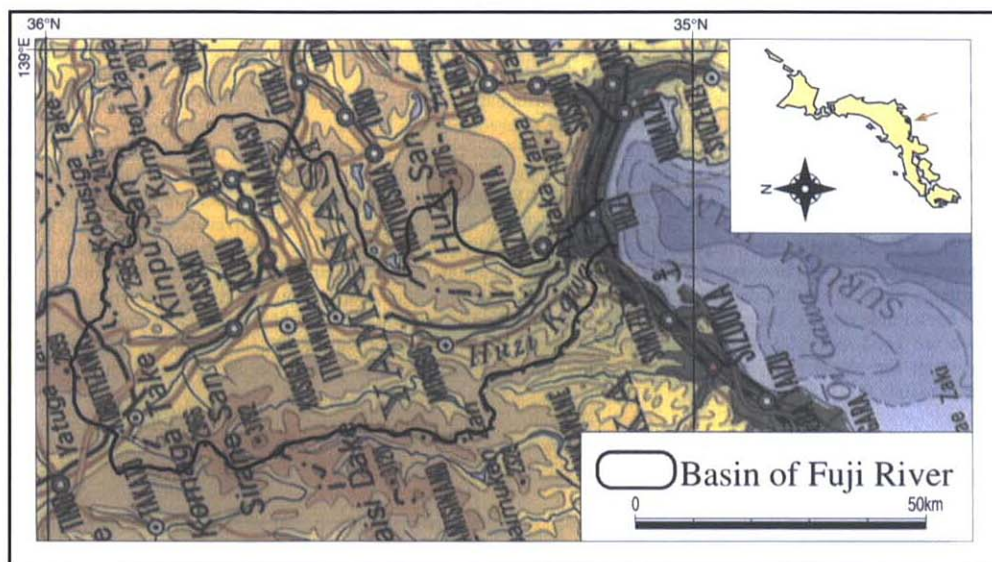


Table of Basic Data

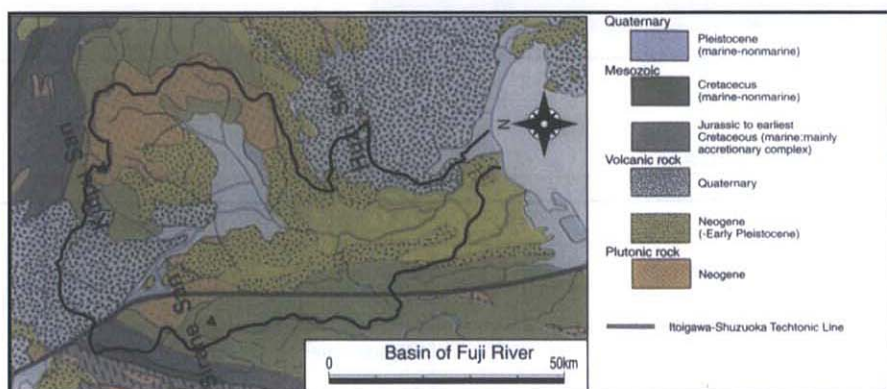
| | | |
|--|-----------------------------------|-----------------------|
| Name: Fuji River | | Serial No.: Japan-5 |
| Location: Central Honshu, Japan | N 35° 46' ~ 35° 07' | E 138° 12' ~ 138° 39' |
| Area: 3,570 km ² | Length of main stream: 128 km | |
| Origin: Mt. Nokogiri-dake (2,685 m) | Highest point: Mt. Fuji (3,776 m) | |
| Outlet: Suruga Bay, Pacific Ocean | Lowest point: River mouth (0 m) | |
| Main geological features: Neogene; Lava, Granite, Andesite | | |
| Main tributaries: Fuefuki River (1,028 km ³), Haya River (510 km ³) | | |
| Main lakes: None | | |
| Main reservoirs: Hirose Reservoir (14.3x10 ⁶ m ³ , 1975), Arakawa Reservoir (10.8x10 ⁶ m ³ , 1986) | | |
| Mean annual precipitation: 1,055 mm (1961~1990) at Kofu | | |
| Mean annual runoff: 59.9 m ³ /s at Shimizubata (2,180 km ³) (1952~1993) | | |
| Population: 883,000 (1985) | Main cities: Kofu, Nirasaki, Fuji | |
| Land use: Forest (87.4%), Rice paddy (3.1%), Other agriculture (2.9%), Urban area (6.6%) (1985) | | |

1. General Description

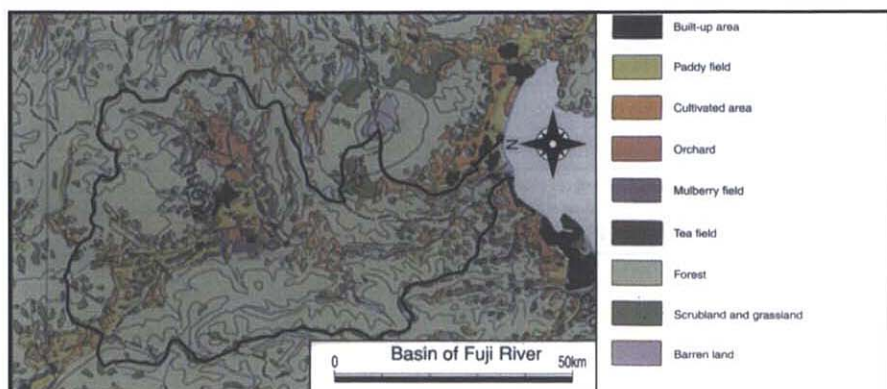
The Fuji River, located in the central Honshu island, is one of the steepest rivers in Japan. It is 128 km long and drains an area of 3,570 km². Originating from Mt. Nokogiri-dake (2,685 m), it runs from the mountainous region to the Kofu basin, and again through the mountainous region before flowing out into the Pacific Ocean. Traditionally, the river reach upstream of the confluence with Fuefuki River is called Kamanashi River. The ministry of construction however decided to identify this branch as well, as part of Fuji River. The catchment receives an average annual precipitation of approximately 2,100 mm. The mean annual discharges at the hydrological observation stations Shimizubata and Kitamatsuno during the period 1953 to 1994 have respectively been 59.9 m³/s and 69.2 m³/s. There are 4 small size reservoirs which have a total storage capacity of less than 18.9 x 10⁶ m³ along its tributaries. The upper reaches of the main channel lie in the mountain range called the Japanese South-Alps which are over 3,000 m high and where the Itoigawa-Shizuoka Tectonic Line runs. The middle and lower stream produce a large amount of sedimentation because of the presence of fragile rocks in this tectonic area. Flat land areas are found only along the middle reach of the main channel and near the river mouth, and they (refer to 5.2) are considered as very important economic and political locations. There have been many historical flood disaster prevention works along the Fuji River. Some of them, such as "Shingen Bank", "Manriki Woods", and "Karigane Bank" are still being used. Since the modern embankment period, continuous river improvement projects have been implemented. These include the Japanese first sand arrestation dam and the three streams junction control which are good examples of river engineering. New projects to improve the river environment preserving its ecosystem for plants, fish, and birds are being strongly pursued. The population in the basin in 1985 was approximately 900,000.

2. Geographical Information

2.1 Geological Map



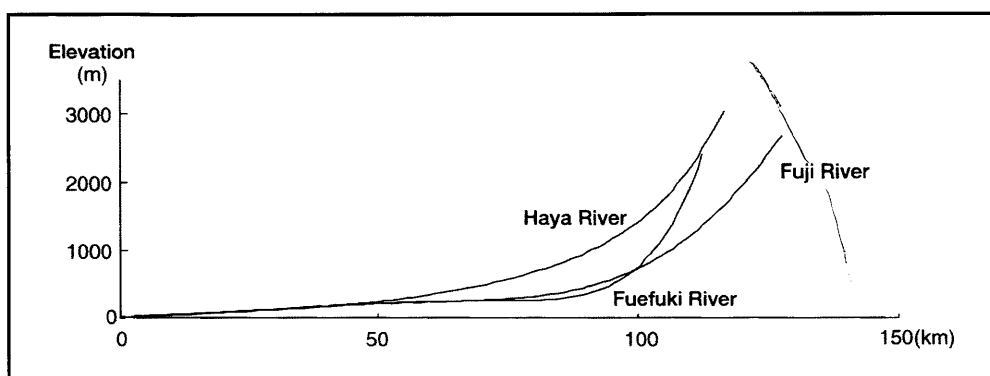
2.2 Land Use Map



2.3 Characteristics of River and Main Tributaries

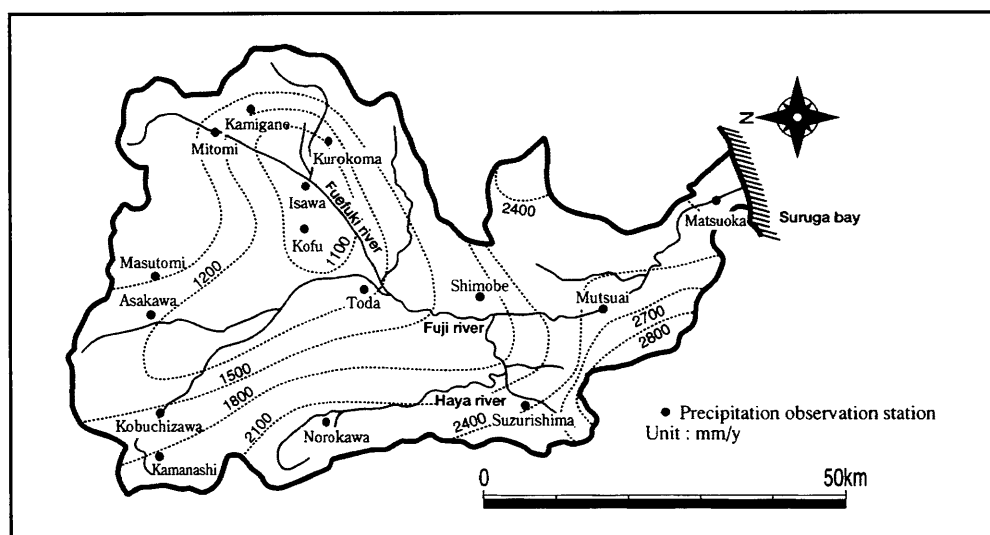
| No. | Name of river | Length [km] Catchment area [km ²] | Highest peak [m] Lowest point [m] | Cities Population (1985) | Land use [%] (1985) |
|-----|------------------------|--|--|-----------------------------|---------------------------------|
| 1 | Fuji (Main river) | 128 2,018 | Mt. Nokogiri-dake 2,685 River mouth 0 | Nirasaki, Fuji 456,000 | Forest 87.4% Rice paddy 3.1% |
| 2 | Fuefuki (Tributary) | 54 1,040 | Kobushi-dake 2,475 Confluence 237 | Isawa, Kofu 423,000 | Other agriculture 6.6% |
| 3 | Haya (Tributary) | 71 514 | Kita-dake 3,192 Confluence 199 | ----- 3,700 | Urban area 2.9% |

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyetal Map and Observation Stations



3.2 List of Meteorological Observation Stations

| No.* | Station | Elevation [m] | Location | Observation period | Mean annual precipitation[mm] | Observation items ¹⁾ |
|---------|-------------|---------------|---------------------------------|--------------------|-------------------------------|---------------------------------|
| 31206 * | Kobuchizawa | 852 | N 35° 51' 17" E 138° 19' 12" | 1926 ~ present | 1,229 1957~1993 | P |
| 31211 * | Asakawa | 1,000 | N 35° 52' 10" E 138° 27' 24" | 1955 ~ present | 1,224 1955~1993 | P |
| 31210 * | Masutomi | 1,065 | N 35° 52' 18" E 138° 30' 19" | unknown ~ present | 1,153 1947~1993 | P |
| 31201 * | Mutsuai | 140 | N 35° 17' 04" E 138° 27' 27" | 1926 ~ present | 2,329 1926~1993 | P |
| 31216 * | Norokawa | 1,130 | N 35° 38' 33" E 138° 17' 57" | 1955 ~ present | 2,192 1955~1993 | P |
| 31218 * | Suzurishima | 447 | N 35° 24' 20" E 138° 20' 06" | 1942 ~ present | 2,182 1926~1993 | P |
| 31212 * | Mitomi | 830 | N 35° 46' 20" E 138° 44' 20" | 1926 ~ present | 1,246 1935~1993 | P |
| 47638** | Kofu | 273 | N 35° 39' 54" E 138° 33' 24" | 1894 ~ present | 1,055 1961~1990 | DS, P, SR |

*: Serial number used by River Bureau, Ministry of Construction

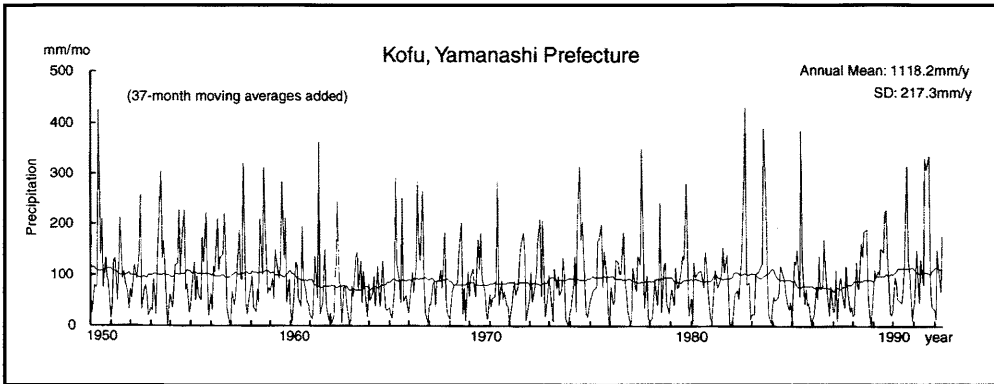
** : Serial number used by Meteorological Observatory, Japan Meteorological Agency

1) DS: Duration of sunshine; P: Precipitation; SR: Solar radiation

3.3 Monthly Climate Data (Observation station: Kofu)

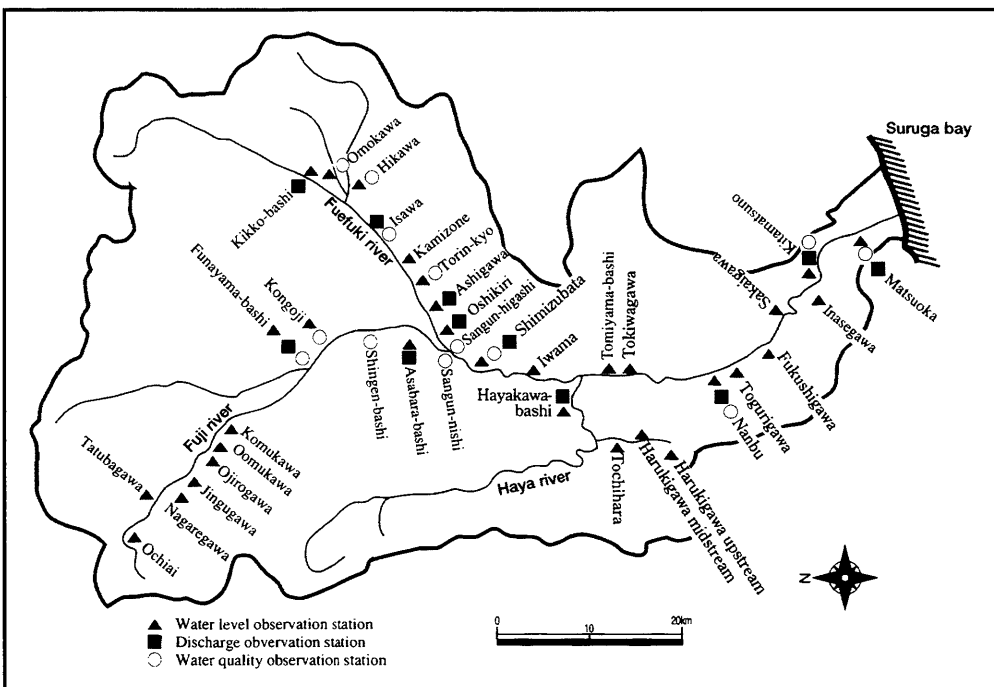
| Observation item | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Period for the mean |
|--|------|------|------|------|------|-------|-------|-------|-------|------|------|------|--------|---------------------|
| Temperature[°C] | 2.0 | 3.4 | 7.0 | 13.3 | 17.8 | 21.3 | 24.8 | 25.9 | 21.9 | 15.9 | 9.8 | 4.1 | 13.9 | 1961~1990 |
| Precipitation [mm] | 32.5 | 46.8 | 75.0 | 84.5 | 86.4 | 149.9 | 118.2 | 137.3 | 150.3 | 98.1 | 49.5 | 26.5 | 1,055 | 1961~1990 |
| Solar radiation [MJ/m ² /d] | 9.7 | 11.7 | 14.4 | 16.9 | 18.7 | 16.5 | 16.5 | 16.5 | 12.3 | 10.7 | 8.7 | 8.3 | 13.5 | 1961~1990 |
| Duration of sunshine [hr] | 198 | 177 | 202 | 185 | 200 | 141 | 153 | 185 | 131 | 149 | 167 | 189 | 2,075 | 1961~1990 |

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



4.2 List of Hydrological Observation Stations

| No.* | Station | Location | Elevation [m] | Catchment area (A) [km ²] | Observation period | Observation items ¹⁾ (Frequency) |
|-------|----------------|--|---------------|---------------------------------------|--------------------|---|
| 31209 | Funayama-bashi | 83.7 km from the river mouth | 341.5 | 482 | 1961~present | H1,Q(10d) |
| 31201 | Shimizubata | 60.9 km from the river mouth | 249.8 | 2,180 | 1953~present | H1,Q(10d) |
| 31206 | Kitamatsuno | 10.7 km from the river mouth | 42.9 | 3,540 | 1936~present | H1,Q(10d) |
| 31217 | Tourinkyo | 4.8 km from the confluence of the Fuji River | 244.0 | 916 | 1953~present | H1,Q(10d) |

1) H1: Water level in recording chart; Q: Discharge, 10d: every 10 days on average

| No.* | \bar{Q} ²⁾ [m ³ /s] | Q max ³⁾ [m ³ /s] | \bar{Q} max ⁴⁾ [m ³ /s] | \bar{Q} min ⁵⁾ [m ³ /s] | \bar{Q} / A [m ³ /s/100 km ²] | Q max / A [m ³ /s/100 km ²] | Period of statistics |
|-------|---|---|---|---|--|--|----------------------|
| 31209 | 14.7 | 3,110 | 360 | 1.9 | 3.1 | 646 | 1972~1994 |
| 31201 | 59.9 | 5,710 | 1,550 | 17.5 | 2.7 | 262 | 1935~1994 |
| 31206 | 69.2 | 2,400 | 4,540 | 4.0 | 2.0 | 350 | 1967~1994 |
| 31217 | 24.1 | 2,630 | 670 | 9.4 | 2.6 | 287 | 1966~1994 |

*: Serial number used by River Bureau Ministry of Construction

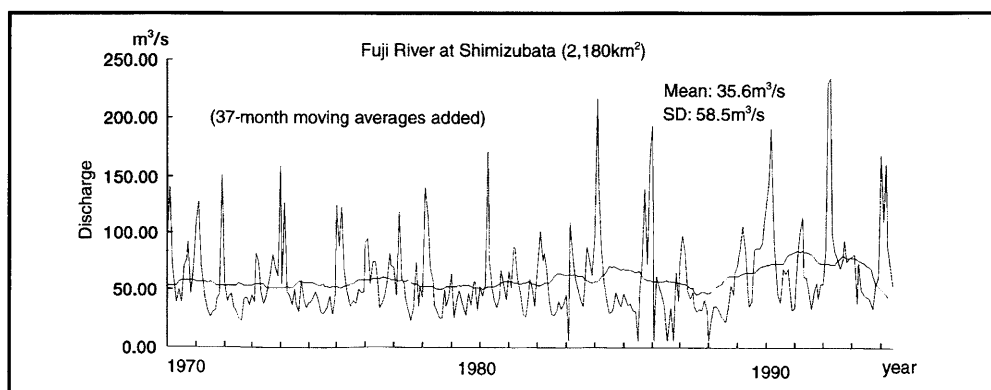
2) \bar{Q} : Mean annual discharge

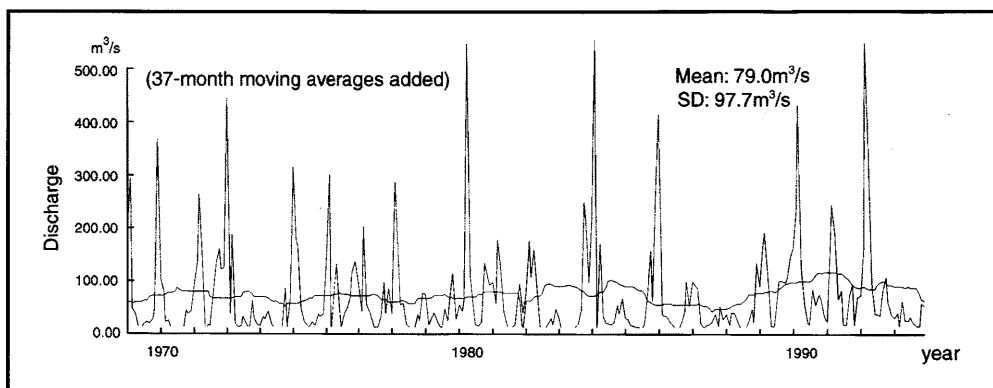
3) Q max : Maximum discharge

4) \bar{Q} max : Mean annual maximum discharge

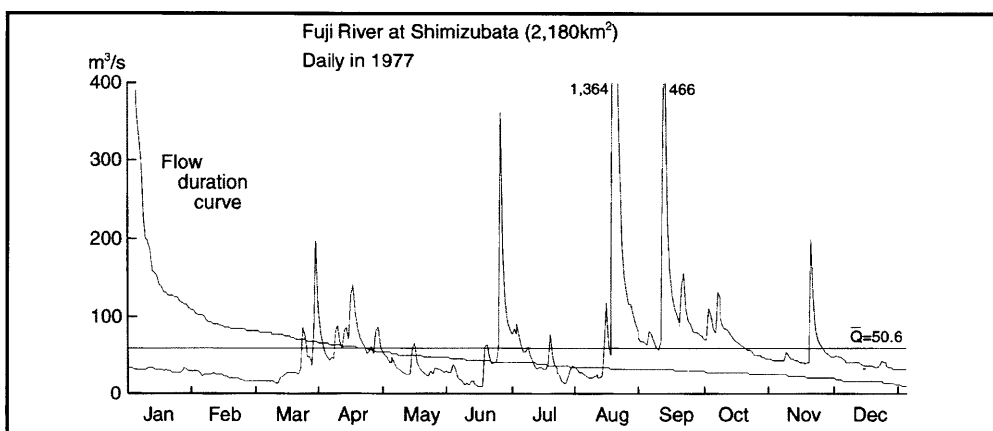
5) \bar{Q} min : Mean annual minimum discharge

4.3 Long-term Variation of Monthly Discharge





4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features

The main stream and tributaries of Fuji River have rapidly increasing flood discharge hydrographs and high peak flows due to the steep geographical feature in the basin. For example, the time for a flood wave to travel from the upper stream edge to Shimizubata observation station in the middle part of the river, a distance of over 50 km, is approximately 2 hours. The basin area is ranked as the fifteenth among the directly controlled rivers in Japan, but ranked as third with respect to the projected discharge which is characterised by the steepness of the river. Since the modern era, there have been record floods in 1907, 1959, and 1982. During the flood in 1982 which has been caused by typhoon no. 18, an estimated maximum discharge of 14,000 m³/s has passed through the Kitamatsuno discharge observation station in the lower part of the river. Much of the rain that falls over Mt. Fuji in the Fuji River basin infiltrates into the sub-surface and partly springs out into the tributary, the Shiba River. A relatively large amount of the ground water recharge takes place around the southern area of Mt. Fuji.

The Fuji River which originates from the Itoigawa-Shizuoka Tectonic Line region produces not only a high discharge but a high volume of sedimentation as well. The result is a rapid change of the river bed, an active formation of alluvial fan area, and the formation of a large portion of elevated river beds in Kofu basin. These features are directly related to difficulties and problems concerning water control maintenance. The Ministry of Construction has been directly executing several protection projects along the upstream of the Haya and Kamanashi Rivers to control sedimentation in the long term. These measures have prevented any casualties during the severe flood in 1982 compared to the loss of 54 lives during a similar but less severe flood that occurred in 1959. The long committed sand arrestation works have been proved to be effective. Recent projects undertaken carefully consider the importance of ecological preservation and natural environment protection.

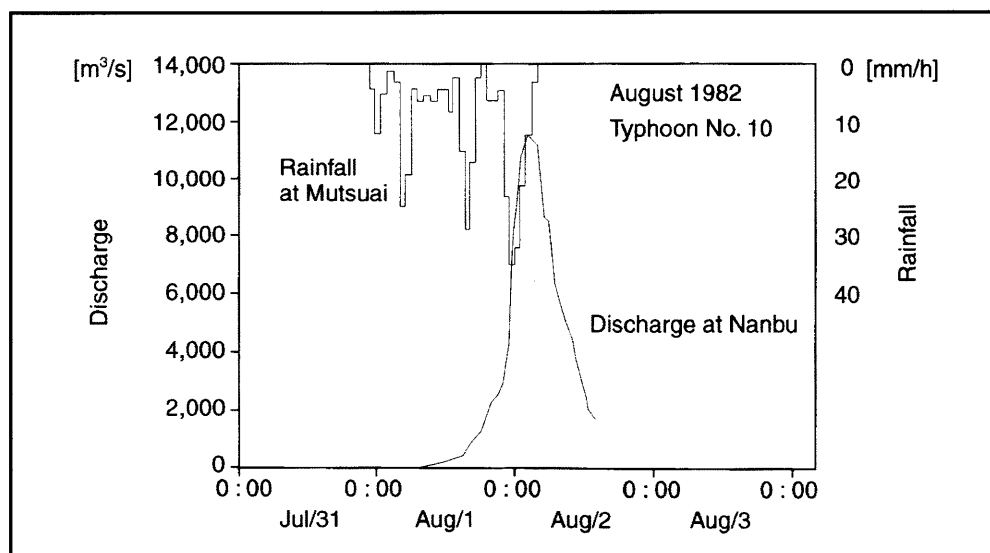
4.6 Annual Maximum and Minimum Discharges

At Shimizubata [2,180 km²]

| Year | Maximum ¹⁾ | | Minimum ²⁾ | | Year | Maximum ¹⁾ | | Minimum ²⁾ | |
|------|-----------------------|---------------------|-----------------------|---------------------|------|-----------------------|---------------------|-----------------------|---------------------|
| | Date | [m ³ /s] | Date | [m ³ /s] | | Date | [m ³ /s] | Date | [m ³ /s] |
| 1952 | | 821 | | 11.5 | 1973 | 6.27 | 131 | 6.21 | 24.8 |
| 1953 | | 1,608 | | 16.6 | 1974 | 9.01 | 1,901 | 8.21 | 17.8 |
| 1954 | 9.19 | 2,230 | | 22.8 | 1975 | 8.23 | 1,731 | 8.5 | 21.7 |
| 1955 | 10.11 | 591 | | 12.4 | 1976 | 9.17 | 1,769 | 8.26 | 21.6 |
| 1956 | 9.26 | 1,981 | | 21.7 | 1977 | 8.18 | 1,824 | 6.16 | 8.0 |
| 1957 | | 1,183 | | 23.3 | 1978 | 10.09 | 203 | 8.5 | 13.5 |
| 1958 | 9.18 | 1,190 | | 10.6 | 1979 | 10.19 | 1,988 | 6.26 | 10.2 |
| 1959 | 8.14 | 5,712 | | 9.5 | 1980 | 9.01 | 463 | 6.25 | 20.8 |
| 1960 | 8.11 | 1,009 | | 14.9 | 1981 | 8.30 | 1,892 | 6.21 | 16.0 |
| 1961 | 6.27 | 3,171 | | 12.4 | 1982 | | | | |
| 1962 | | 622 | | 24.4 | 1983 | 8.16 | 3,358 | 5.15 | 23.8 |
| 1963 | | 468 | | 20.9 | 1984 | 6.27 | 275 | 6.6 | 16.6 |
| 1964 | | 590 | | 14.9 | 1985 | | | | |
| 1965 | 9.10 | 2,840 | | 18.8 | 1986 | | | | |
| 1966 | 9.25 | 3,199 | | 14.5 | 1987 | 9.25 | 370 | 2.13 | 2.6 |
| 1967 | 7.10 | 502 | 6.23 | 9.1 | 1988 | 9.25 | 1,309 | 6.21 | 18.2 |
| 1968 | 8.30 | 656 | 6.22 | 15.4 | 1989 | 8.27 | 1,429 | 1.5 | 26.7 |
| 1969 | 8.5 | 1,609 | 12.31 | 25.0 | 1990 | 8.10 | 1,816 | 8.7 | 11.4 |
| 1970 | 6.16 | 1,754 | 1.19 | 21.1 | 1991 | 9.19 | 3,223 | 11.4 | 27.5 |
| 1971 | 8.31 | 402 | 6.27 | 17.0 | 1992 | 10.9 | 503 | 9.11 | 21.7 |
| 1972 | 9.17 | 2,460 | 12.3 | 25.7 | | | | | |

1), 2) Instantaneous recording chart

4.7 Hyetographs and Hydrographs of Major Floods



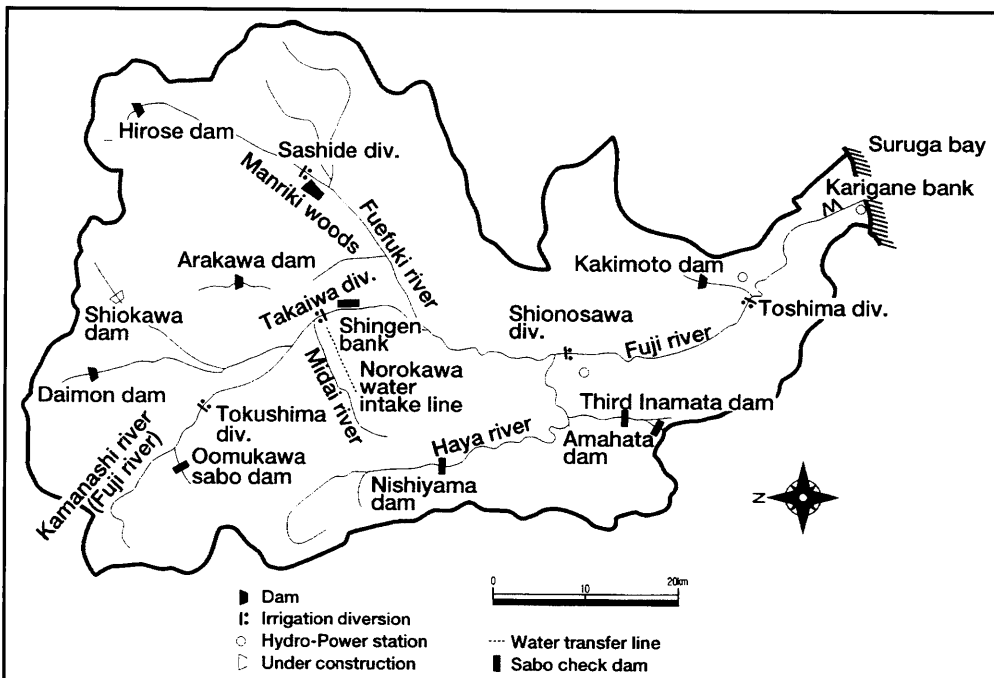
5. Water Resources

5.1 General Description

The Fuji River including its tributaries have very steep river bed slopes. The heavy precipitation which falls over the mountainous areas, especially the main stream Kamanashi River and its tributary Haya River, bring about rapid and very high discharges. On the other hand, during the drought season the channel flow decreases drastically. It is not uncommon to see no channel flow in alluvial fan areas. The flow discharge has a very wide range and therefore it is one of the most difficult rivers to control and to utilize its resources. Many efforts have been made to construct watergates and irrigation canals for agricultural use and to modify the river flows.

Before, during, and after the war, many hydropower stations were built mainly along its tributary, Haya River. Most of such power stations are run-of-river type and frequent use of water resources causes a shortage of river flow during a drought season. Another environmental concern is required to solve this problem. The area of the Fuji River still preserves a relatively good natural environment. However, it is about to face a permanent water shortage due to the population increase, various changes in human life styles, and expansion of high-tech industrial organizations because of its close proximity to the Tokyo Metropolitan area. Moreover, it is necessary to provide a constant supply of water for municipal consumption in the Kofu basin and agricultural use in the hilly area where various fruit industries have developed. During the past 25 years, four multi-purpose dams of relatively small size - Hirose, Arakawa, Daimon, and Shiokawa - have been constructed. The Shiokawa dam is still under construction and is expected to be completed in September, 1998.

5.2 Map of Water Resources Systems



5.3 List of Major Water Resources Facilities

Major Reservoirs

| Name of river | Name of dam (reservoir) | Catchment area [km ²] | Gross capacity [10 ⁶ m ³] | Effective capacity [10 ⁶ m ³] | Purpose ¹⁾ | Year of completion |
|---------------|-------------------------|-----------------------------------|--|--|-----------------------|--------------------|
| Fuefuki | Hirose | 76.64 | 14.30 | 11.35 | A, F, P, W | 1975 |
| Ara | Arakawa | 72.4 | 10.80 | 8.60 | F, N, W | 1986 |
| Daimon | Daimon | 51.7 | 3.60 | 2.35 | F, N, P, W | 1986 |
| Shio | Shiokawa | 85.3 | 11.50 | 18.90 | A, F, N, P, W | (1998)* |
| Haya | Nishiyama | 172.0 | 2.40 | 1.03 | P | 1957 |
| Sano | Kakimoto | 33.6 | 7.62 | 7.14 | P | 1952 |

- 1) A: Agricultural use; F: Flood control; I: Industrial use; N: Maintenance of normal flows; P: Hydropower;
W: Municipal water supply
*: Under construction

Major Water Transfer

| Name of transfer line | Name of rivers and places connected | | Length [km] | Maximum capacity [m ³ /s] | Purpose ¹⁾ | Year of completion |
|-----------------------|-------------------------------------|---------------------------------------|-------------|--------------------------------------|-----------------------|--------------------|
| | From | To | | | | |
| Norokawa Diversion | Head of the Midaigawa Alluvial Fan | Bottom of the Midai-gawa Alluvial Fan | 7.0 | 0.24 | W | 1959 |

- 1) W: Municipal water supply

5.4 Major Floods and Droughts

Major Floods

| Date | Peak ¹⁾ Discharge [m ³ /s] | Rainfall [mm] Duration | Meteorological cause | Dead and missing | Major damages (Districts affected) |
|---------------|--|------------------------------|-------------------------------|---------------------|---|
| 1907. 8.26 | N.A. | 315 5 days | Typhoon | 233 | Houses completely destroyed or washed away: 11,943 |
| 1935. 9.26 | N.A. | 419 6 days | Typhoon | 39 | Houses completely destroyed or washed away: 223 |
| 1947. 9.15 | 2,977 | 500 3 days | Typhoon Catherine | 0 | Houses completely destroyed or washed away: 83 |
| 1948. 9.16 | N.A. | 255 2 days | Typhoon Ion | 3 | Houses completely or partly destroyed or washed away: 90 Houses inundated: 4,360 |
| 1959. 8.14 | 5,240 | 364 3 days | Typhoon No.7 | 50 | Houses completely or partly destroyed or washed away: 596 Houses inundated: 1,810 |
| 1959. 9.26 | 2,369 | 189 3 days | Typhoon No.15 | 4 | Houses completely or partly destroyed or washed away: 837 Houses inundated: 931 |
| 1966. 9.25 | 2,850 * | 341 5 days | Frontal rain Typhoon No.26 | 174 | Injuries: 97 Houses completely destroyed: 160 Houses washed away: 38 Houses inundated: 341 |
| 1982. 8.2 | 5,600 * | 689 3 days | Typhoon No.10 | 0 | Houses completely destroyed: 30 Houses partly destroyed: 35 Houses inundated: 1,670 |

* Approximate value

1) At Shimizubata (2,180 km²)

5.5 River Water Quality

At Fujikawa-bashi ¹⁾ in 1995

| Date | 1/ 8 | 2/ 13 | 3/ 13 | 4/ 30 | 5/ 28 | 6/ 28 | 7/ 23 | 8/ 20 | 9/ 17 | 10/ 22 | 11/ 19 | 12/ 10 |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| pH | 7.8 | 7.4 | 7.6 | 7.7 | 7.4 | 7.6 | 7.8 | 7.6 | 7.5 | 7.2 | 7.6 | 7.7 |
| BOD [mg/l] | 1.2 | 1.6 | 1.4 | 0.9 | 0.8 | 1.1 | 0.5 | 1.2 | 0.2 | 0.7 | 1.4 | 1.4 |
| COD _{Mn} [mg/l] | 1.4 | 2.2 | 2.8 | 2.6 | 2.6 | 3.0 | 2.7 | 2.6 | 3.4 | 1.9 | 2.0 | 2.5 |
| SS [mg/l] | 2 | 2 | 32 | 22 | 9 | 42 | 11 | 14 | 152 | 52 | 5 | 10 |
| Coliform group ²⁾ [MPN/100 ml] | 3.3x10 ² | 2.6x10 ² | 2.7x10 ³ | 1.7x10 ⁴ | 7.0x10 ² | 3.3x10 ³ | 3.3x10 ³ | 7.9x10 ⁴ | 2.4x10 ⁴ | 7.9x10 ³ | 1.7x10 ³ | 7.9x10 ³ |
| Discharge ³⁾ [m ³ /s] | 17.9 | 12.5 | 62.0 | 54.7 | 8.1 | 84.5 | 44.6 | 94.7 | 300.0 | 171.0 | 66.7 | 33.2 |

1) Located near Fuji City 3 km upstream from the river mouth.

2) Measurement method: BGLB (brilliant green lactose bile) culture MPN (most probable number) method.

3) Discharge on the water quality observation date at Kitamatsuno.

6. Socio-cultural Characteristics

The Kofu basin, located in the middle and upper part of the Fuji River, has limited flat land space for crop growth such as rice. About 450 years ago, the very famous lord general, Takeda Shingen, completed comprehensive and effective flood prevention works to protect the precious crop fields against overtopping of the main channel of the Fuji River around the western part of the basin. These construction projects included the relocation of the flow route of the tributary, the Midai River. Furthermore, he completed the flood prevention works along another tributary, Fuefuki River, in the eastern part of the basin facilitating tree-planting and stone covering along the river banks. These works are called "Shingen-zutumi" and "Manriki-bayashi" respectively and are still maintaining their effect over time as some of the most famous Japanese historical flood prevention projects. There is another important flood control works named "Karigane-tei" near the river mouth. This construction was carried out by the Furugori clan about 350 years ago. This work, continued through three generations to complete, still protects the area of Fuji city from a rapid stream of the Fuji River.

The annual precipitation in the Kofu basin is as low as 1,100 mm. The climatic condition and water holding capacity of the surface soil in the hilly area is suitable for fruits growth such as grapes, peaches, plums, and cherries. As a matter of fact, the Kofu basin ranks No. 1 in terms of production of grapes, peaches, and plums. For quite some time, jewellery industries have also become famous in the Kofu area. Companies specialised in high-tech production such as semi-conductor and precision engineering, are also on the increase. In the area along the lower part of the river, a major pulp industrial complex has developed utilising the abundant quantity of ground water resources available around Mt. Fuji. There is a famous temple in the mountainous area along the middle part of the river, called "Kuonji", which is the head temple of the Nichiren sect. Many worshipers visit this temple throughout the seasons.

7. References, Databooks and Bibliography (In Japanese)

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