

SHINANO RIVER, JAPAN'S LONGEST

TAMED WITH A COMBINATION OF OLD AND NEW LANDMARKS.



**Shinano River Work Office, Hokuriku Regional Construction Bureau,
Ministry of Construction**

Shinano River

The Shinano River originates deep in the central mountains of Japan at Kobushi-ga-dake (2,438 m) and flows along its length of 367 km, the Japan's longest (Fig. 1). Its catchment area is 11,900 square kilometers and annual total outflow amounts to 15.6 billion cubic meters. The Shinano River is said to be one of the three great rivers in Japan in every respect (Table 1).

Table 1: Ranking of Japan's Rivers

Length
(km)

Shinano R.	367
Tone R.	322
Ishikari R.	268
Teshio R.	256
Abukuma R.	239

Catchment Area
(km²)

Tone R.	16,840
Ishikari R.	14,330
Shinano R.	11,900
Kitakami R.	10,150
Kiso R.	9,100

Annual Flow volume
(10⁹m³)

Shinano R.	156
Abukuma R.	130
Mogami R.	113
Kitakami R.	102
Tone R.	80

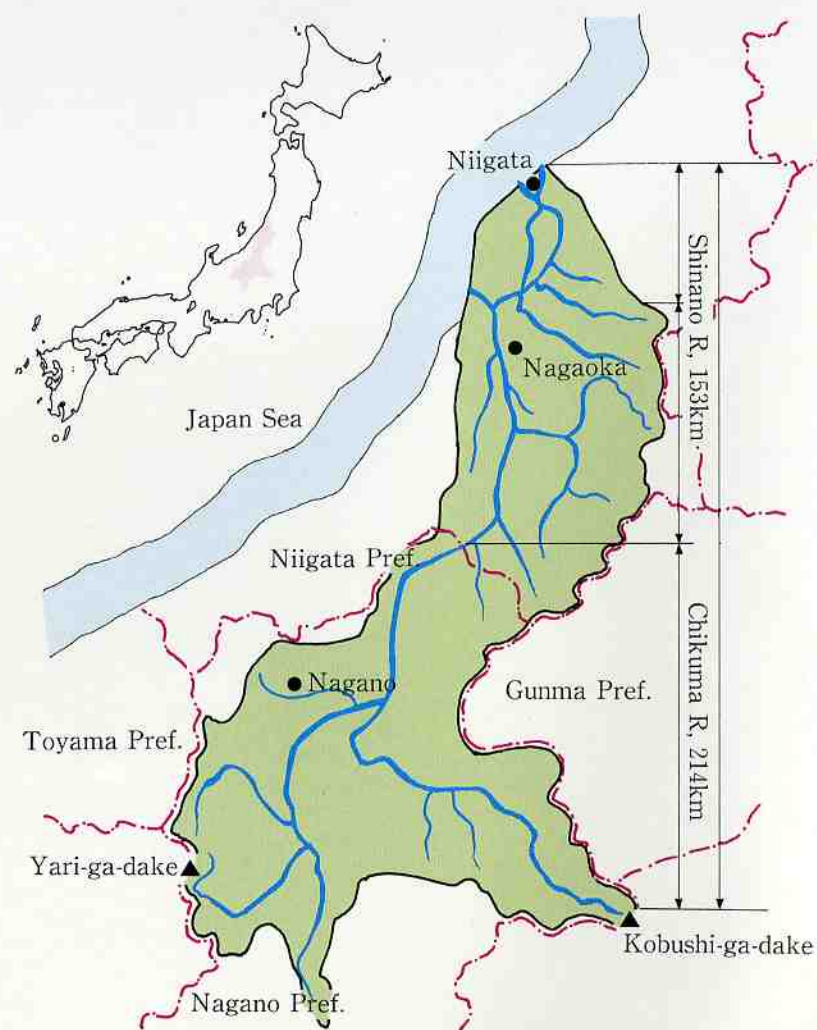


Fig.1 Shinano River and Its Catchment Area

The Shinano River flows through two prefectures: Nagano Prefecture for the upper reach and Niigata Prefecture for the lower reach.

And the upper reach is normally called the Chikuma River whereas the lower reach has always been called the Shinano River. The longitudinal profile of the river bed also is suggestive of two rivers connected (Fig. 2).

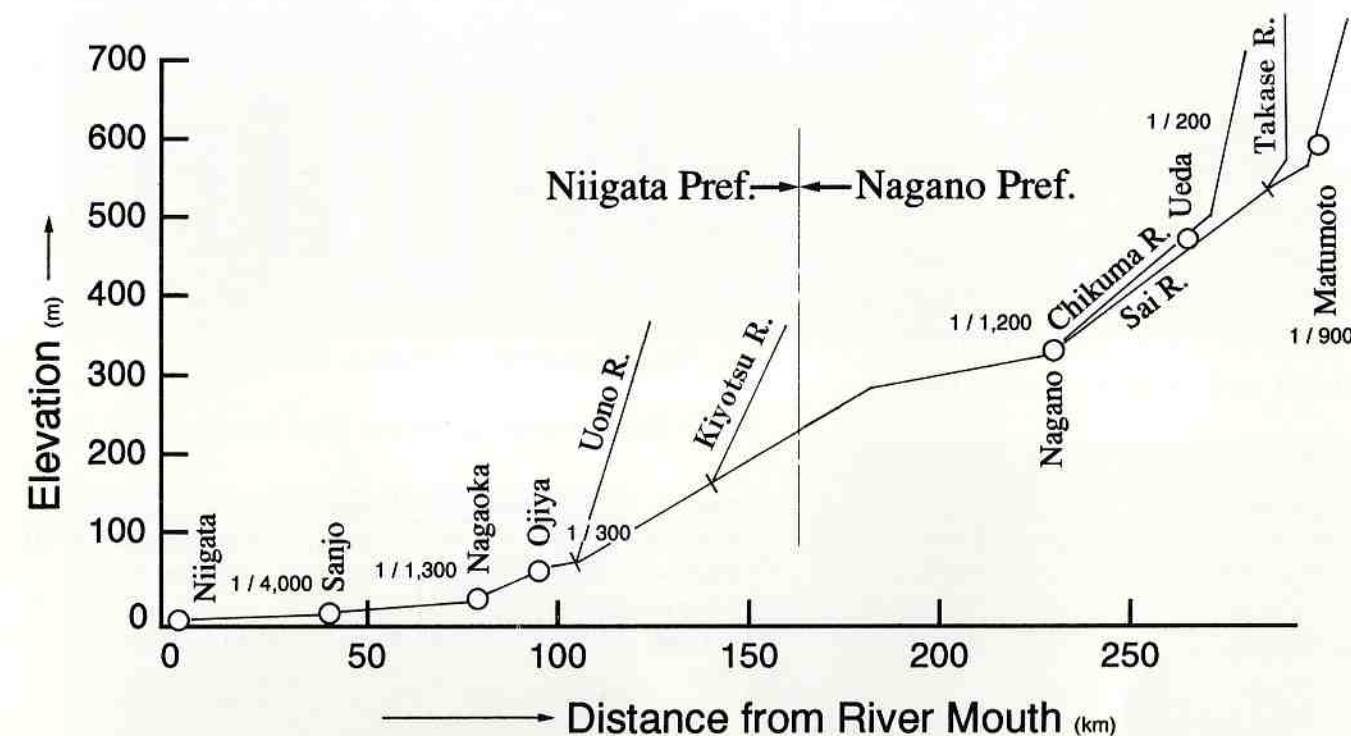


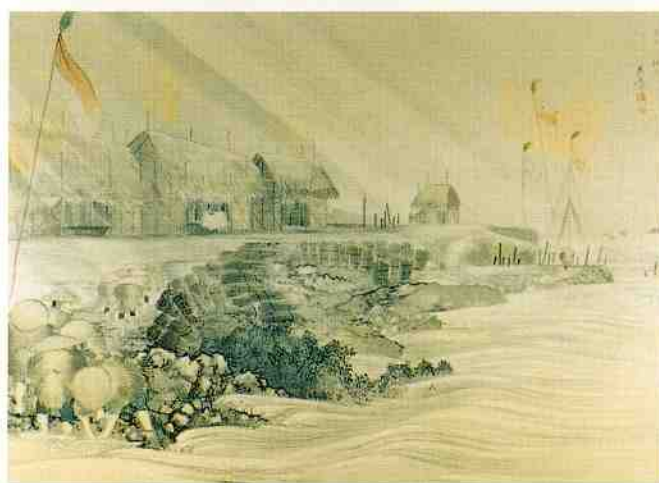
Fig.2 Longitudinal Profile of the Shinano River.

The upper reach, the Chikuma River, has a major tributary called the Sai River which originates from one of the central mountains called Yari-ga-dake (3,180 m) and the lower reach, the Shinano River, has a major tributary called the Uono River which collects the water along the boundary high-mountains between Kanto district and Niigata Prefecture. Thus the Shinano River takes care of the vast area of the central Japan. Flood water of the Shinano River is brought by mostly three causes: frontal rain of early summer (Japan's rainy season), typhoon which hits Japan summer to autumn and snowmelt water in spring. Perhaps the large amount of snowmelt flow is the unique feature of the Shinano River as illustrated in Fig. 3.



Damage causing floods have been rampant and enormous amount of river engineering works has been expended. Notably the lower reach, as it reaches the vast flat plain of the Niigata Prefecture, used to torment the inhabitants with recurrent flooding with breaking of embankment and inundation of the plain, until the Oukouzu Diversion work was completed.

Today the flow and river environment supports the life and products of the vast area of both Niigata and Nagano Prefectures.



Artist's recollection of flood damage and the epitaph in memory of embankment failure in 1886

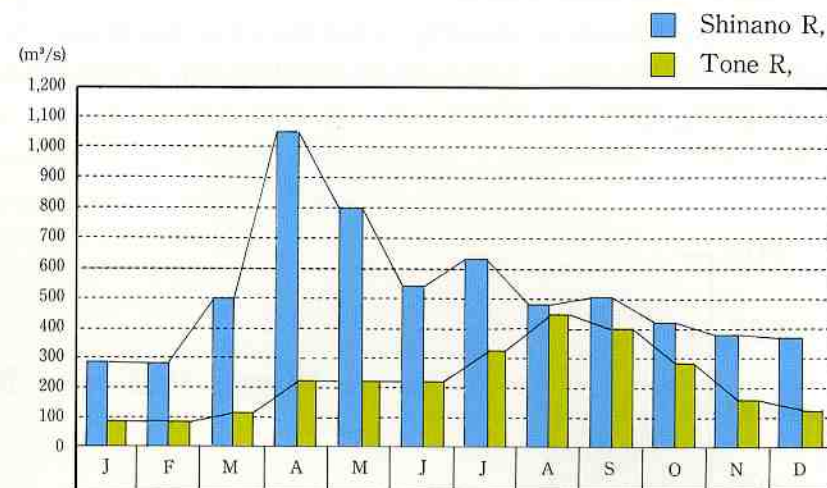


Fig.3 Comparison of Monthly Discharge

Table 2: How the water of Shinano River is used.

Usage	Flow rate (m³/s)	Remarks
Hydropower	1,490	Annual power output 4.35 million MWH
Irrigation	330	Irrigated field of 85,000ha
Industrial usage	26	
City water	9	Population serviced 1,400,000
Other	14	For Snowmelting etc.

The river supplies water to hydropower, irrigation, industrial usage and city water plant (Table 2). The river environment, rich in wild life and plants, is loved by inhabitants.

The lower reach of the Shinano River now possesses quite unique feature: the latest and the 61-year old civil engineering landmarks, Myoken Weir and Oukouzu Diversion Work respectively, both of which regulate the flow of the Shinano River. They work together with the contrast that the Myoken Wier shines with its modernness and high-technology whereas the Oukouzu Diversion Work emanates its age and contribution that is comparable with any great canals in the world of the day.



Beautiful scenery



Habitat for flora and fauna



Providing comfort to people



Rich Environment of the Shinano River

Myoken Weir



Myoken weir

Myoken Weir(Fig. 4) is located just upstream of Nagaoka City, where the Shinano River pours into the flood plain of Nagaoka-Niigata Area. The river bank is defined by cliffy river terraces upstream of this location whereas it runs the course defined by the embankments downstream. The slope of the river bed changes from 1 to 600 at this location to 1 to 1600 around Nagaoka. Therefore it has long been felt that a river controlling structure is necessary at this location. Construction of the Myoken Weir was started in 1985 and was completed in 1989 without trouble. Its function is three fold: one is to control the river bed from excessive erosion which is likely to take place as the river bed changes its slope around this area with additional benefit to ensure functioning of water intakes around this area, the second is to stabilize the flow upstream of the weir which shows a diurnal fluctuation due to the operation of the Shinano River (Ojiya) Hydropower Plant just upstream of the weir (Fig. 5), and the last is to support the planned bridge carrying the national highway.

The Shinano River Hydropower Station was built by East Japan Railway Corporation to supply electricity to run trains in the metropolitan Tokyo area. The water for this station is withdrawn at the Miyataka Weir which is located 45 km upstream of the Myoken weir at the maximum rate of 317 cubic meter per second and runs the turbines at the Hydropower Station which is located 6km upstream of the Myoken weir. The generated electricity with the maximum power of 449,000 kw is used to run commuter trains in the metropolitan Tokyo, then creating diurnal fluctuation of water level downstream of the power station. This fluctuation is smoothed by the operation of the Myoken weir (Fig. 5).

Weir length is 524 m and 8 motor-controlled gates are installed with one of them acting for flushing sediment. Upstream of the weir holds the maximum control volume of 1,100,000 cubic meters. Five fish ladder channels are installed at both sides of the weir with two for salmon and three for sweet fish.



Fig.4 Location of Oukouzu Diversion work and Myoken weir "Colored area indicates the inundation area had it not been for the Oukouzu Diversion Work.



Shinano-gawa (Ojiya) Power Station

The control facility of the Myoken weir is housed in the Myoken Central Control Building and equipped with a latest computer, remote control devices and various monitoring devices.

The operation of the weir is programmed into a computer and is run automatically with monitoring devices. The various states of the operation can be exhibited on a large color screen.

The Myoken Central Control Building also houses the exhibition room (Visitors' Center) with various kinds of pictures and objects related to the Shinano River as well as the Myoken weir.

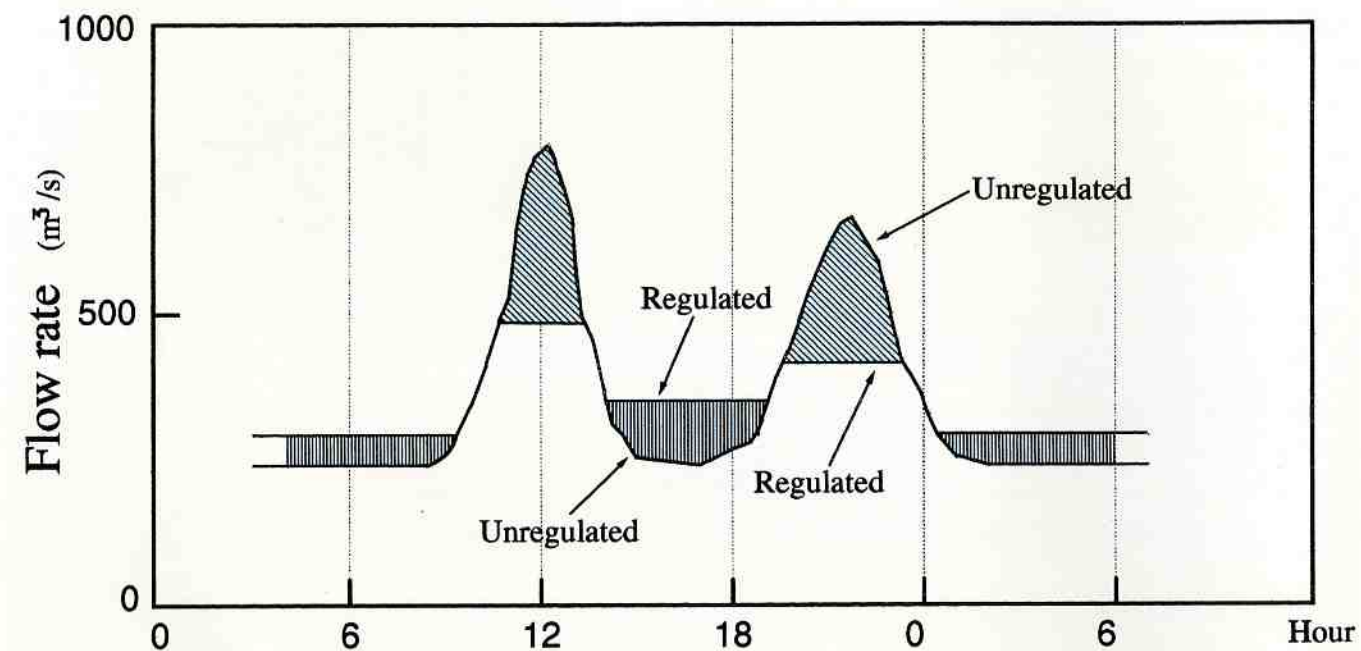


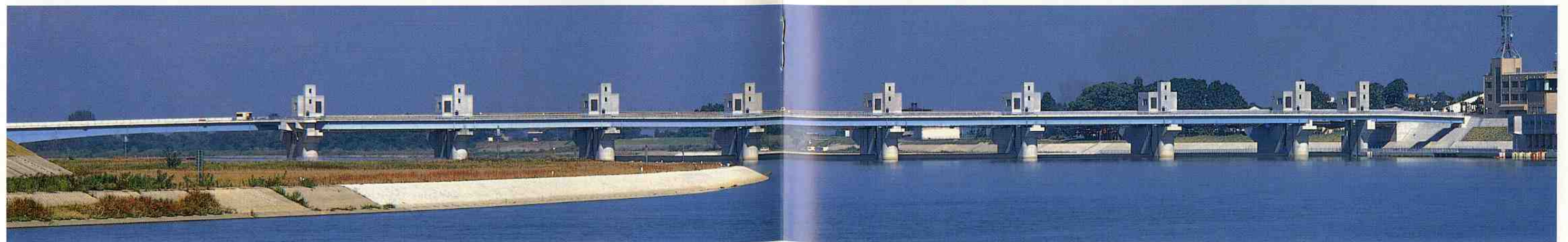
Fig.5 Regulation of flow downstream of Myoken weir



Control Room



Exhibition Room



Myoken weir

Oukouzu Diversion Work

WHAT IS THE OUKOUZU DIVERSION WORK ?



Oukouzu Diversion Work

The Oukouzu Diversion Work consists of the diversion channel approximately 10 km long which diverts the flood flow of the Shinano River into the Japan Sea, the main weir which controls the flow delivered into the mainstream and the diversion weir which controls the flow into the diversion channel. The function of these weirs is coordinated in such a way that flow into the mainstream is maintained at 270 cubic meters per second which is sufficient and necessary for water demand downstream of the weir. All the flood water in excess of this base flow is diverted to the diversion channel in order to protect the vast, rich Niigata Plain.

Diversion Channel: Diversion Channel is a channel excavated through low-lying hills. It has width of 720 m at the diversion point and narrows downstream to only 180 m at the channel mouth. Its bed slope steepens successively downstream from the diversion point (Fig. 6). Such a configuration was chosen

because of topography and economy of the construction, notwithstanding susceptibility to excessive erosion. Danger of erosion is tentatively checked with construction of the second ground sill close to the channel mouth to the sea.

Main Weir Consisting of 27 gates, the main weir controls the flow into the mainstream. It delivers the necessary flow into the mainstream and nothing more. Next to the main weir is installed a lock for navigation.

Diversion Weir Replacing the original weir, the diversion weir ensures the necessary distribution of flow into mainstream.

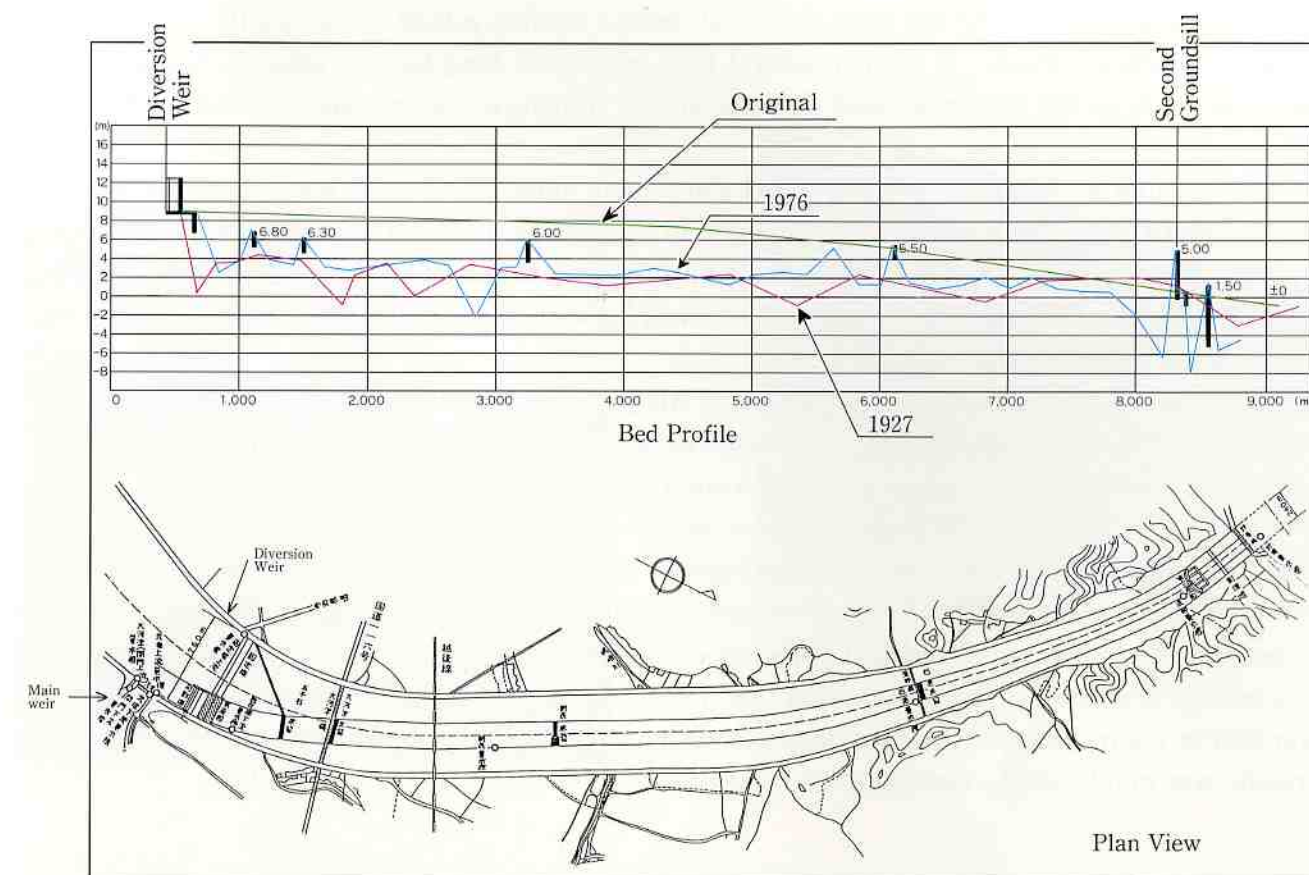


Fig. 6 Oukouzu Diversion Channel



Second Ground Sill

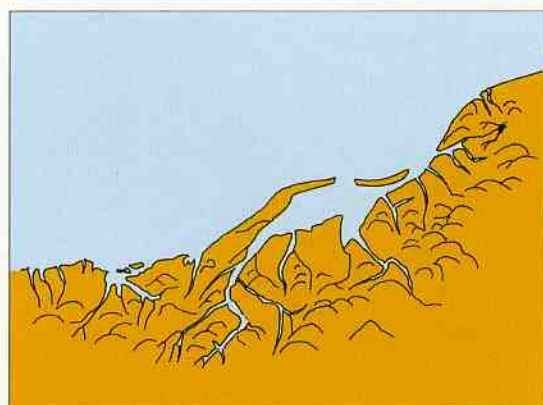


WHY OUKOUZU DIVERSION WORK WAS BUILT ?

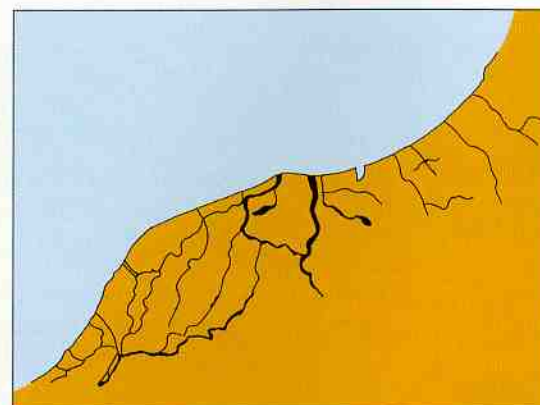
The present Niigata Plain used to be a giant estuary-like lake a long time ago and was slowly filled with sedimentary deposit carried down by the Shinano River, to form a marshy, low-lying land. This muddy Niigata Plain was assaulted innumerable times by devastating floods of the Shinano River. Indeed the Shinano River used to be called the 'Wild River', because of recurrent, numerous floods inundating the rich field and washing away countless houses, not to mention causing the loss of human lives. The Shinano River, as it approaches the Niigata Plain, appears heading for the Japan Sea at the then village of Oukouzu, only 10 km from the coast, before turning inland to yet another course of 60 km through the Niigata Plain. It is then natural that one would long for a diversion channel at this location to be freed by the recurring flood damage and to transform the marshy land into rich, fertile land.

The history related to Oukouzu Diversion Work dates back hundreds of years ago. During the period between 1716 and 1735, in the era of Edo, a local gentry named Kazu-emon Homma petitioned first time for the construction of a diversion channel to the central Shogunate government. Successively, petitions were filed again and again for about 200 years to no avail because of enormous work and cost which was thought to be impossible at that time.

After the Japanese era turned to modern age of Meiji in 1868, petitions were filed repeatedly for construction of a diversion channel and at the same time arguments were raised against such construction. Construction of diversion channel became a controversial issue under frequent floods. To resolve this issue the central government dispatched two senior engineers, a Dutch and a British, who were supervising the river engineering works all over Japan. They reported that construction of a diversion channel would be too expensive and hamper the navigation downstream. However, big floods occurred quite frequently thereafter and the central government in 1907 finally approved the diversion channel and the construction was started in 1908. After the initial completion of the construction in 1927, the diversion weir to control the flow into the diversion channel subsided and subsequently overturned. The major repair was conducted to complete the construction as it stands today 4 years later.



Old Day (millenia ago)



Present Day

Niigata Plain Old and New



HOW OUKOUZU DIVERSION WORK WAS BUILT ?

The Diversion Channel was constructed from the then village of Oukouzu to Teradomari, a village facing the Japan Sea. In between are the low-lying hills and a large amount of excavation work was needed. The amount of sandy soil removed was about 28 million cubic meters. This monstrous amount of earth moving had to be done exploiting the most modern mechanized machines at that time. Amount of manpower necessary for construction was also tremendous, amounting to 16 million. This was indeed the most enormous construction work that had ever been attempted till then.



Dirt Carrying Cart

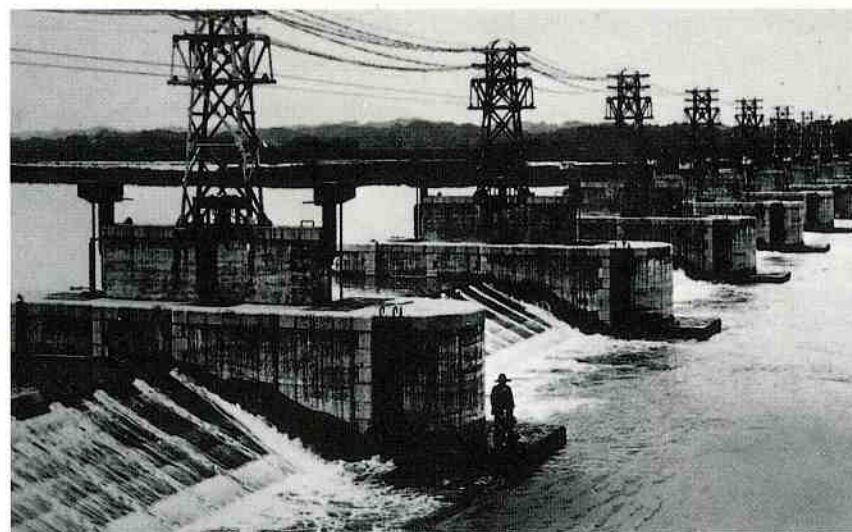


Mechanized Excavator



Excavation work (1908—1922)

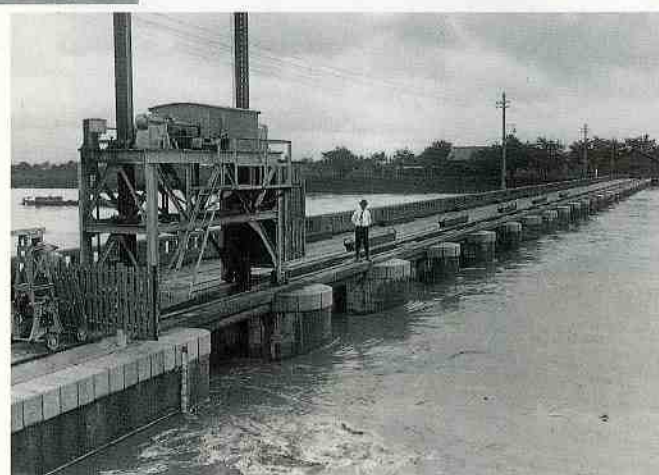
The construction went far from without trouble. During the period excavation was at full swing, three major landslides struck. Furthermore, after 5 years from the initial completion, the diversion weir controlling the flow to the diversion channel subsided and subsequently overturned due to excessive erosion losing its capacity to control the flow. The situation was serious as the water delivery to the Niigata Plain was all but shut off. The major repair work was immediately undertaken and, after 4 more years, a motor controlled gate and weir together with additional groundsill was installed in place of the original weir. The final completion was thus dated as 1931.



Original Diversion Weir as Completed in 1924



Diversion Weir



Original Mainstream Weir

Chronology of construction

- 1907 Construction authorized by the government
- 1908 Construction started
- 1922 Diversion work started its service.
- 1924 Initial completion inaugurated.
- 1927 Diversion weir subsided and major repair work started.
- 1931 Final completion.



Main Weir



WHAT THE OUKOUZU DIVERSION MEANS ?

Before the construction of the Oukouzu Diversion Channel, damage causing flood occurred every 3 to 4 years. After the completion flood damage has been greatly mitigated to stabilize the life in this area. Besides, the marshy wet Niigata plain, where people had to use boat or wade in waist deep to cultivate, has been turned to the rich, rice-producing country. The result can clearly be seen in sudden rise in rice crop per 10 a. of the Niigata Plain as depicted in Fig. 7.

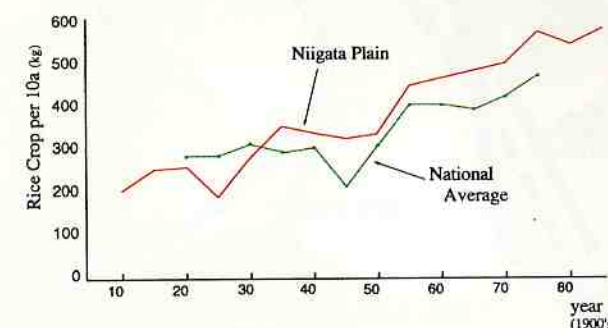


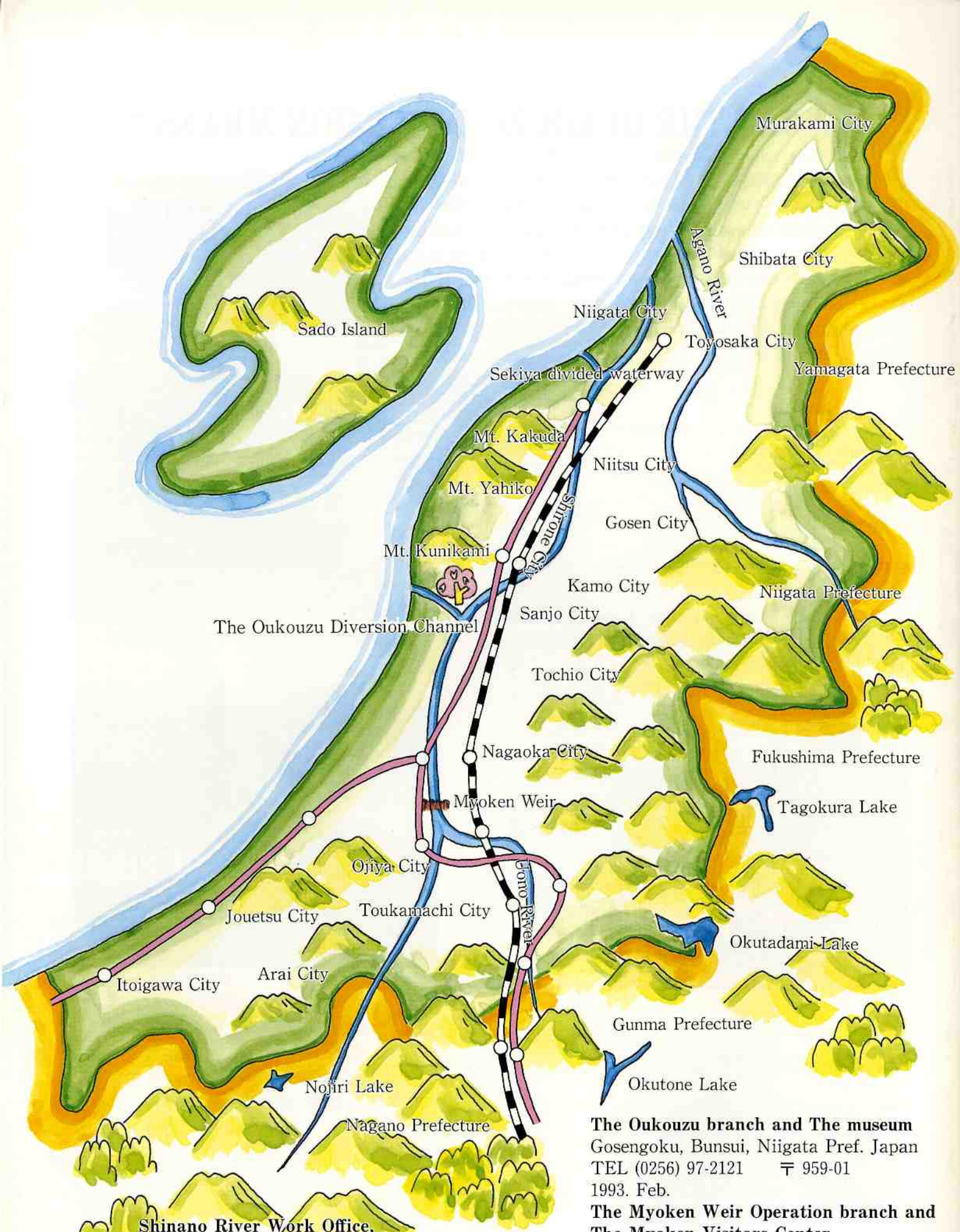
Fig. 7 Change in Rice Crop per 10a (A remarkable rise for Niigata Plain is due to Oukouzu Diversion Work.)



Farming in Marshy Field



Rich Rice Field



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