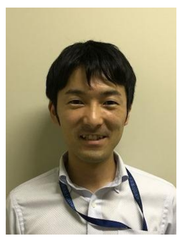

History of Water Resource Development in Tokyo Waterworks

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INTRODUCTION

Waterworks in Tokyo (hereinafter “Tokyo waterworks”) has been supporting the citizen's life and the urban activities in Tokyo as one of the essential utility since it first began to supply tap water via iron pipes and pressure in 1898.

As of FY 2016, Tokyo waterworks supplies water to 13.3 million Tokyo residents in an area of approximately 1,239 km2. Additionally, water rights of Tokyo waterworks totals approximately 6.3 million m3 per day, the facility capacity of its water purification plants is approximately 6.86 million m3 per day, and the total length of the distribution pipe network is approximately 27,000 km, making this one of the world’s largest-scale waterworks utilities. Securing water rights is the most important basic requirement for waterworks operation, and it is by no means an exaggeration to say that the history of waterworks is the history of securing water rights.

History of water resource development

Water resources development on the Tamagawa River

- At the time of its establishment, Tokyo waterworks took water from the Tamagawa River which flow through the west to east of Tokyo as its water resource.
- Water demand in Tokyo had also increased as Tokyo rapidly developed. Therefore, more and more water rights were required by the end of the 1900s.
- In order to respond to rapidly increasing water demand, Tokyo waterworks independently built waterworks dams on the Tamagawa River as a new water resource (completed Murayama Kami Reservoirs [completed 1924]), and the Ogouchi reservoir (completed 1957) .etc
- The Tamagawa River has been widely used for water supply and agricultural use since long ago. Therefore, there is already less potential of securing new water rights any more in the Tamagawa river.

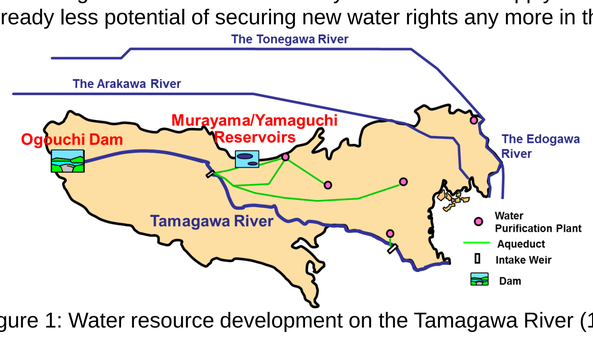

Figure 1: Water resource development on the Tamagawa River (1960s)

Figure 2: the Ogouchi Dam

Water resource development on the Tonegawa and Arakawa Rivers

- Tokyo waterworks tried to extend its water resources to the Tonegawa River which has much more water volume flowing through other prefectures. However, other prefectures objected to supplying Tokyo with their precious water resources.
- Meanwhile, during Japan’s high economic growth period that begun in 1955, water demand of industrial water and power generation was also increased in Tokyo and surrounding areas. Therefore, developing more and more water resources over wider area was needed.
- In 1957, the government mainly started to build Multipurpose Dam whose role include flood control, agricultural water or power generation. The prefectures invested in these constructions rather than constructing the dam by single own prefecture to acquire the water rights.
- In 1962, the Basic Plan for Water Resources Development was established, which shows the comprehensive development of the Tonegawa River System by the government. Tokyo waterworks started to invest in government-led construction project of multipurpose dams, water conveyance channel and other facilities to acquire water rights.
- In 1967, Yagisama dam, first multipurpose dam which Tokyo waterworks invested in was constructed. Also the Musashi Canal, an canal that transfers water from the Tonegawa River to the Arakawa River which flow through Tokyo, was constructed. Accordingly, Tokyo waterworks finally started to take water from the Tonegawa River.
- In 1973, the Act on Special Measures concerning Measures Related to Water Resources Areas was established to compensate the residents in the water resources areas who was made relocate to other places.
- In 1974, the government started to develop the Arakawa River System which has second biggest flow volume in Tokyo and surrounding areas as its water resources.

Yagisawa Dam

Musashi Canal, which transfers water from the Tone River to the Arakawa River

Tone estuary weir

Figure 3: Water resource facilities

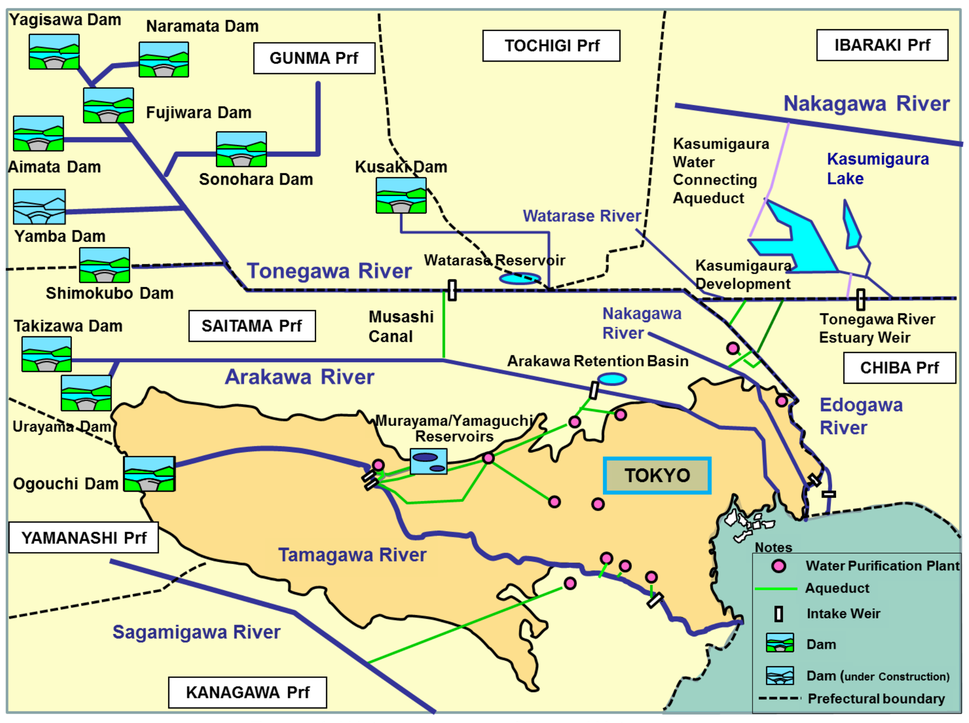

Figure 4: Water resources of Tokyo Waterworks

Water Shortage in the year of Tokyo Olympic (held in October 1964)

- Water shortage had been happening since 1957 because of the shortage of water resources which could not keep up with rapid urban growth.
- In August 1964, the year that Japan hosted the Olympics, Tokyo waterworks enacted a 50% restriction of water supply volume which is the most severe service restrictions in its history. Water was supplied for just four hours in the morning and five hours at night. Residents in Tokyo were given emergency water supplies provided by the JSDF, Tokyo Police Department, and the US armed forces.
- People were afraid that the Tokyo Olympic Games might have suspended due to the severe water shortage.
- Tokyo rapidly constructed the facilities to take water from the Arakawa river which Tokyo had not yet taken water from at that time and took water emergently from the Arakawa river.
  After that, Tokyo finally hosted the Olympic games successfully.

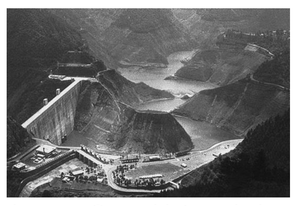

Figure 5: Ogouchi Dam during a water shortage period

Figure 6: Emergency water supply provided by the JSDF

Water resources area preservation measures

Background

- Construction of dams is likely to have a major impact on the local environment, such as causing the loss of the places to live of residents living around the water resource areas.
- Compensation for residents in water resource areas affected by the construction of dams was paid mainly for losses to agricultural lands or houses.
- This was not sufficient for reconstruction of water resource areas, and thus even greater compensation was required for water resource areas in order to smoothly proceed with water resource development with the understanding of local area residents.

Measures

- In order to further lessen the impact of dam construction, as well as to revitalize water resource areas, new community centers, nursery facilities, parks, and other facilities were constructed (Act on Special Measures concerning Measures Related to Water Resources Areas [1973]).
- In addition to that, intangible measures were also implemented, such as support for acquiring credentials needed to change occupations, etc. (Reservoir Area Development Fund [established 1976]).

- the prefectures investing in dam projects cover the costs for community revitalization, livelihood recovery, and various other projects.
- These kind of compensation contribute to making progress of dam construction

Figure 7: Development of Roadside Station Agatsumakyo

Figure 8: Development of a tenants’ office block in front of Naganohara-Kusatsuguchi Station

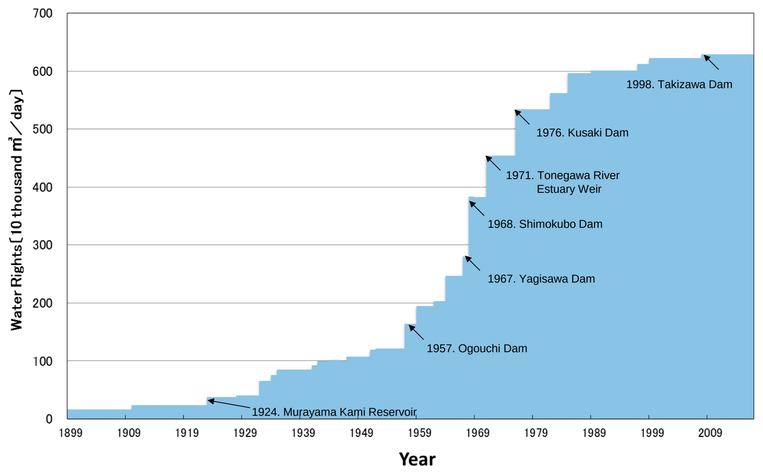

Figure 9: The amount of water rights over time

The amount of water rights of Tokyo waterworks

- Current amount of water rights is approx. 6.30 million m^3 per day
- About 80% of Tokyo’s water comes from the Tonegawa/Arakawa River system.
- About 20% of Tokyo’s water resources come from the Tamagawa River System.

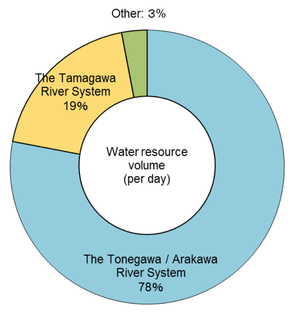

Figure 10: River system proportional breakdown

Towards securing stable water resources

Contextual information regarding water resources

- Japan has around twice the average annual precipitation volume as the global average, but its per-capita water resource volume is around 40% of the global average, falling to just around 10% in the Tokyo area.
- Due to geographical and other factors, water resource development is performed at the Tone River / Arakawa River System with the aim of handling water shortages that occur once every five years.
- This is unsafe planning for handling water shortages compared to places such as New York, which sets as its target the most severe water shortage recorded in its history.
- At the Tone River System in recent years, restrictions on water intake are implemented due to water shortages at a rate of once every three years.
- Based on the 2011 Great East Japan Earthquake, there are fears of disasters occurring in the future that may exceed those that occurred in the past.

In order to maintain stable water supply in case the severe drought, large-scale earthquakes, and other problems happens in the future, Tokyo Waterworks undertake “tangible” measures such as reinforcement of dam bodies at existing reservoirs, and “intangible” measures such as joint training with other municipalities, so that these bodies can respond rapidly in the event of a disaster.

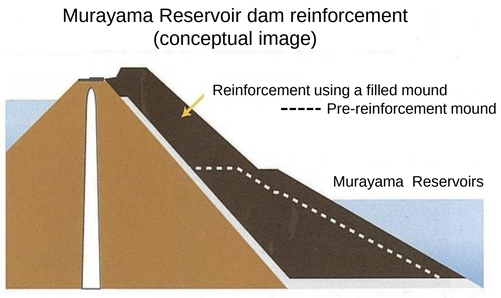

Figure 11: “Tangible” measures
-Reservoir dam reinforcement work-

Figure12: “Intangible” measures
-Collaborative disaster Training with other municipalities-