Profile of Yodo River Dam Control Center

Aiming an even higher quality water management for the Yodo River basin

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Walking together with Water and Green...
We assure a life with safe and abundant WATER.

In order to supply urban water and to control flood in the Yodo River Basin, Seta River Weir, Amagase Dam and Yodo River Great Weir were constructed in the main river Yodo.

In addition, Takayama Dam, Shenrenj Dam, Murou Dam, Nunome Dam, Hinachi Dam, in the Kizu River, and HIYOSHI DAM in the Katsura River, have been constructed making a total of 9 facilities.

These facilities are integrally managed by the Yodo River Dam Control Center.

At present, in addition to these facilities, Kawakami Dam (Aoyama Town, Mie Pref.), in the upper stream of Kizu River, Daido River Dam (Otsu City, Shiga Pref.), in Daido River in the upper stream of Uji River and Niw Dam (Yodo Town, Shiga Pref.), in the Takatoki River in the Northern part of Lake Biwa, are under construction.

With the completion of these dams, it will be possible to provide a higher level of flood prevention and more plentiful water.
What kind of river is Yodo River?

The Yodo River basin is located in the Middle Area of the Kinki region and its origin is the Takatoki River in the North of Lake Biwa. After flowing from the Lake Biwa, Seta and Uji Rivers, it joins the Kizu and Katsura Rivers at the border of Kyoto and Osaka Prefectures, forming the Yodo River. With a drainage area of 8,240km² (including the 959km² of the Inagawa Basin), the Yodo River basin is a basin of big scale. Its main river, the Yodo River, flows through Osaka Plain and, on its way, bifurcates into Kizumi and Okawa (formerly called Yodo River) Rivers to flow into the Osaka Bay. The basin extends over 6 prefectures, Osaka, Kyoto, Hyogo, Shiga, Nara and Mie. A population of 10 million people live in this area, corresponding to the largest population of that among the Japanese representative basins.

Thus, the Yodo River basin is in the core of social, economic and cultural development in the Kinki area. The yearly average precipitation in Yodo River Basin is 1,600mm. The precipitation is very high in the rainy season from June to July and in the typhoon season in September, causing severe floods. On the other hand, due to the thawing of the snow accumulated during winter on the mountains in the Northern part of Lake Biwa, a steady flow is assured in early spring. In the Yodo River basin, due to the existence of narrow gorges, such as, Hozu Straights in Katsura River, Shishibori Valley in Uji River and the Iwakura Straights in Kizu River, occasional floods occur in the upper stream areas, while downstream, flood damages are reduced in the down stream. However, in the downstream in Osaka Plain, the ground level is lower than the river elevation. In particular, in central parts of Osaka, where the city has developed over areas having ground level lower than the Yodo River, severe damages are caused by floods in the Yodo River.

Flow Regime in Hirakata Point
The average from 1952 to 2001

<table>
<thead>
<tr>
<th>Month</th>
<th>Discharge (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>9.2</td>
</tr>
<tr>
<td>Feb</td>
<td>11.3</td>
</tr>
<tr>
<td>Mar</td>
<td>13.4</td>
</tr>
<tr>
<td>Apr</td>
<td>16.4</td>
</tr>
<tr>
<td>May</td>
<td>22.3</td>
</tr>
<tr>
<td>Jun</td>
<td>235.9</td>
</tr>
<tr>
<td>Jul</td>
<td>263.0</td>
</tr>
<tr>
<td>Aug</td>
<td>143.7</td>
</tr>
<tr>
<td>Sep</td>
<td>126.9</td>
</tr>
<tr>
<td>Oct</td>
<td>150.6</td>
</tr>
<tr>
<td>Nov</td>
<td>190.5</td>
</tr>
<tr>
<td>Dec</td>
<td>229.7</td>
</tr>
</tbody>
</table>

Table of Discharge Area

- Lake Biwa
- Uji River
- Kizu River
- Iga River
- Nabari River
- Others
- Katsura River
- Katsura River Mainstream
- Yodo River Mainstream

Graph showing the population of the largest basin drainage area.

Diagram showing the flow regime in Hirakata Point.

Diagram showing the precipitation in the Yodo River Basin.
Why are dams necessary?

Due to the mountainous geography of Japan, the country is prone to flood in the rainy and typhoon seasons when it rains torrentially in a short time. On the other hand, however, continuous sunny days cause shortage of water. In Japan, 51% of the population and 75% of the assets are concentrated in the flood prone area that corresponds to the 10% of the national territory. Dams not only prevent flood in case of heavy rain, but also play an important role in storing water, when there is shortage of rain. Dams and forests surrounding the water resources are important assets that protect our daily lives.

The bed slopes of Japanese rivers, compared to those of foreign rivers, are steep. Water from the rain flows at once from the mountains to the sea.

<table>
<thead>
<tr>
<th>Comparison between the bed slopes of the Japanese rivers to those of foreign rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese River</td>
</tr>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>The ratio between the maximum and minimum discharge is high in the Japanese rivers. As the required volume of water is far higher than the minimum discharge, it is necessary to store water.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outline of Water Resources Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>City of Tokyo</th>
<th>Population</th>
<th>12,870,000 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mileage</td>
<td>2,166 km</td>
<td>1,386 km</td>
</tr>
</tbody>
</table>

The discharge gradient in the Japanese rivers is high. Use the stored water when there is not sufficient water.

<table>
<thead>
<tr>
<th>Almost all the urban water in our country depends on dams.</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Water (Dams)</td>
</tr>
<tr>
<td>Ground water etc.</td>
</tr>
<tr>
<td>Recycled drainage water</td>
</tr>
</tbody>
</table>

In case of heavy rain, the dam gradually releases the stored water.

<table>
<thead>
<tr>
<th>Flood control by a dam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood water flows into the dam during heavy rain.</td>
</tr>
<tr>
<td>Discharge from Dam</td>
</tr>
<tr>
<td>The flood discharge is released from thedam upon the discharge level in the dam</td>
</tr>
</tbody>
</table>

In Japan, dams and river channels play their respective roles in flood prevention.

<table>
<thead>
<tr>
<th>River Name</th>
<th>Share of Dams and river channels in the main Japanese rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arakawa</td>
<td>47.8</td>
</tr>
<tr>
<td>Tone</td>
<td>57.3</td>
</tr>
<tr>
<td>Chikugo</td>
<td>62.0</td>
</tr>
<tr>
<td>Kirie</td>
<td>61.8</td>
</tr>
<tr>
<td>Ota</td>
<td>62.9</td>
</tr>
<tr>
<td>Yodo</td>
<td>75.6</td>
</tr>
<tr>
<td>Toyama</td>
<td>75.7</td>
</tr>
<tr>
<td>Yashio</td>
<td>78.2</td>
</tr>
<tr>
<td>Kiso</td>
<td>79.1</td>
</tr>
<tr>
<td>Shimanto</td>
<td>78.1</td>
</tr>
<tr>
<td>Nagara</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Dams have a capacity of storing water for supply and an extra capacity to retain temporarily the water of occasional heavy rain.

<table>
<thead>
<tr>
<th>Capacity of the dam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary</td>
</tr>
<tr>
<td>Extra capacity for flood control</td>
</tr>
<tr>
<td>Water storage for consumption</td>
</tr>
<tr>
<td>Extra capacity for flood control</td>
</tr>
<tr>
<td>Water storage for consumption</td>
</tr>
</tbody>
</table>

It is not possible to prevent flood without dams, helping safety on hills.
Control the flow of abundant water

In the Yodo River Dam Control Center, water management is performed by connecting the dams and weirs (9 facilities) of the Yodo River Basin. For this purpose, the condition of the Yodo River is monitored 24 hours a day through the various data from the Meteorology Agency, as well as total information provided by the River Information System and Radar Rainfall System, on the rain volume and on the water level of each river of the Yodo River area, together with information on each dam. The system that collects and processes the information on the Yodo River (Water Flow Management System) also plays the role of an Information Center, providing various data concerning the dams and their offices. In case of flood, inlet of the dam, as well as water level and volume of each river at the reference point are predicted. Then, information and instructions concerning flood control are sent to each dam administration office. On the other hand, in case of drought, long-term water volume of the dams and of the Lake Biwa are predicted and an efficient water supply is carried out.

Yodo River Water Management

Yodobee's Dictionary

Dan Properties
Figures, such as storage water level, inlet, discharge and storage volume of dams.
High Water Management & Low Water Management

**High Water Management**

The word "high-water" refers to flood and inundation. Simulation of the transition from ordinary conditions to rainfall is performed and flood control studies, such as investigation of the dam discharge is carried out in various ways. When there is an actual danger of flood, along with permanent monitoring, the collected data are sent to the concerned authorities, and flood warning or alarm is announced in joint with the Meteorology Department. Based on the information collected during flood, prediction calculations are performed and the control of flood is carried out.

**Low Water Management**

The word "low-water" refers to drought. Damages due to drought are reduced by supplying the water efficiently, after performing a drought simulation from the long-term rainfall prediction, that is based on data such as the river conditions and dam storage volume in the past.

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**Yodo River Flood Hazard Map**

- **Area inundated by 1905 Flood**
- **Area inundated by 1907 Flood**
- **Area inundated by 1920 Flood**

**Yodo River Flood Prediction**

- **Yodo River Flood Prediction Map**
- **Reference Points having Water Staff Gauge for Flood Prediction**

There are types of forecast in flood prediction; namely flood alarm, flood information and flood warning.

- **Flood Alarm**
  A flood alarm is issued when there is a possibility of the level of the corresponding water staff gauge to reach or exceed the dangerous level (a level, in which there is a danger of flooding in the area object to prediction to break, or flood damages to occur in an area without work).

- **Flood Warning**
  A flood warning is issued when there is a possibility of the level of the corresponding water staff gauge to reach the surveyed dangerous level (a level, in which there is a danger of damages of some kind, in need there with less, it is defined as high water channel level).

- **Flood Information**
  Flood information provides the current level of the river to the previous flood within and warning.

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**Recent Big Scale Inundations in the Yodo River**

<table>
<thead>
<tr>
<th>Date of occurrence</th>
<th>Meteorological Cause</th>
<th>Maximum Discharge(m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953. 9.25</td>
<td>Typhoon No.13</td>
<td>7,800</td>
</tr>
<tr>
<td>1956. 9.21</td>
<td>Typhoon No.15</td>
<td>6,410</td>
</tr>
<tr>
<td>1958. 8.27</td>
<td>Typhoon No.17</td>
<td>4,030</td>
</tr>
<tr>
<td>1959. 8.14</td>
<td>Front &amp; Typhoon No.7</td>
<td>6,800</td>
</tr>
<tr>
<td>1959. 9.27</td>
<td>Ise Bay Typhoon</td>
<td>7,200</td>
</tr>
<tr>
<td>1960. 8.30</td>
<td>Typhoon No.16</td>
<td>5,540</td>
</tr>
<tr>
<td>1961. 10.28</td>
<td>Cyclone &amp; Front</td>
<td>7,800</td>
</tr>
<tr>
<td>1965. 9.17</td>
<td>Typhoon No.24</td>
<td>6,870</td>
</tr>
<tr>
<td>1972. 9.17</td>
<td>Typhoon No.20</td>
<td>5,230</td>
</tr>
<tr>
<td>1982. 8. 2</td>
<td>Typhoon No.10</td>
<td>6,260</td>
</tr>
</tbody>
</table>

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**Recent Droughts in the Yodo River Basin**

When the rainfall is extremely low, there is shortage of water and a restriction on intake water must be adopted. In the Yodo River, during the record making 1984 and 1994 Droughts, the water intake was restricted for a long period of time. During the 1984 Drought, the water level of the Lakes Rice reached the recorded lowest level.

In 2000, the water supply from Lake Biwa was rationed for 100 days due to decrease in the water level.

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**Flood Control in Hyoshi Dam (The Typhoon No.10)**

From 16 to 17 October, 1966, a flood drowned over Koka area, and in the right after 14 October, the Typhoon No.10 340 km off of 490 km of the maximum discharge caused by the flood was controlled at the Hyoshi Dam, which stored about 14,000,000 m³ of the water. Downstream at Katashina point, a water level 5.6 m higher than the high water level was estimated for the case in which the dam did not exist.

In the case, the water level was close to the warning level of 4.9 m, and at areas where the height is low, flood counter measures would have been necessary. In the summer of the same year, the Katashina River, due to shortage of snow water, passes through the river, and the Katashina River was secured by the 15,000,000 m³ of water discharged from the Hyoshi Dam.

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**Why is a flood prediction alerted even when it is sunny?**

Flood alarm or warning for Uji River may be alerted even in fine weather. This is because the water stored in Lake Biwa is discharged to reduce the water level, after the risk of flood has been cleared.
Management of the Amagase Dam

The Amagase Dam is located in the Uji River. The Uji River, called the Seta River in the upstream, joins the Kizu and Katsura Rivers downstream to flow into the Osaka Bay as the Yodo River. In 1953, during typhoon No.13 the area along the Uji River banks was flooded, and which motivated the construction of the Amagase Dam in 1964.

Prevention of Flood
The inundation of the Uji River is prevented by reducing the design high water discharge of 1360m³/s to 840m³/s at the dam location, and flood in the downstream area is prevented by reducing the discharge to 160m³/s when the Yodo River main river reaches it's peak flow.

Generation of Electricity
The Amagase Power Station generates a maximum electric power of 92,000kW (electricity for a population of 100,000) and the Kisenyama Power Station, utilizing the Amagase Dam Lake as a regulation pond, generates a maximum of 466,000kW (electricity for a population of about 500,000) of pumping-up type power generation.

Providing Tap Water
The water supply area covers Uji City, Joyo City, Yawata City and Kumiya City. A maximum of 1.104m³/s of tap water is supplied to a population of 350,000. In Amagase Dam, various services such as discharge alarm and operation of gates are carried out during flood. Also, under normal conditions, several management services such as the proper management of the dam and dam lake, are carried out. Due to the large intake volume from the Lake Biwa located upstream to Amagase Dam, the dam is the busiest gates in Japan 50 to 80 days in a year.

Simulation of Flood in the Yodo River Upper Stream Area (Uji River)

Let's perform a simulation of flood to see its consequences in case the Amagase Dam did not exist, considering that a typhoon of the same scale as that of the No.10 of 1962 hit the area and the Uji River Dike breaks.

Outlines of the Amagase Dam Services

Management of the Dam in Ordinary Situation

Knowing the dam properties
Low water management
Monitor the discharge
Surveying of sedimentation
Patrol of the storage reservoir and the surroundings
Inspection of the monitoring equipment of the dike
Monitoring items such as uplift pressure of the whole dike
Inspection of the discharge facilities
Inspection of telemeter facilities
Patrol of warning board
Disposal of driftwood
Management of the office buildings
Inspection of electric facility
Maintenance
Water quality management
Permission / Approval service

Inflow prediction
Inspection of discharge facilities
Patrol of storage reservoir
Notification of outflow
Monitoring of inflow at upper stream monitoring point
Sound the alarm
Downstream patrol
Gate operation
Dealing with press and mass media

Dimension of the dam and reservoir

<table>
<thead>
<tr>
<th>River Name</th>
<th>Yodo River, Yodo River basin (Uji River)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>[Left Bank] Rokkoukku, Makishima-cho, Uji City [Right Bank] Makioyama, Makishima-cho, Uji City</td>
</tr>
<tr>
<td>Drainage area</td>
<td>Lake Biwa drainage area 3,848km² (Lake area 680km²) Amagase Dam drainage area 352km²</td>
</tr>
<tr>
<td>Total</td>
<td>(whole river basin area) 4,200km²</td>
</tr>
<tr>
<td>Type</td>
<td>Dome type Arch type</td>
</tr>
<tr>
<td>Crest length and dam height</td>
<td>Crest length 254m Dam height 73m</td>
</tr>
<tr>
<td>Volume</td>
<td>Dam main structure 121,500m³ Counter-dam apron 42,000m³ total 164,000m³</td>
</tr>
<tr>
<td>Geology</td>
<td>Sandstone, Slate</td>
</tr>
<tr>
<td>Conduit Gate</td>
<td>3 gates Outflow discharge 1,100m³/s (capacity) 840m³/s (design maximum discharge)</td>
</tr>
<tr>
<td>Crest gate</td>
<td>4 gates Outflow discharge 680m³/s (capacity)</td>
</tr>
<tr>
<td>Reservoir area</td>
<td>1.88km²</td>
</tr>
<tr>
<td>Normal water level</td>
<td>O.P. +78.5m</td>
</tr>
<tr>
<td>Normal top water level for flood season</td>
<td>O.P. +72.0m (16, ~15, Oct)</td>
</tr>
<tr>
<td>Minimum water depth</td>
<td>O.P. +56.0m</td>
</tr>
<tr>
<td>Available water depth</td>
<td>20.5m</td>
</tr>
<tr>
<td>Reservoir capacity</td>
<td>26,280,000m³ (about 70 times the volume of Koshien Stadium)</td>
</tr>
<tr>
<td>Electric storage capacity</td>
<td>20,000,000m³</td>
</tr>
</tbody>
</table>

Storage Distribution

Longitudinal profile

Plan for Flood Control

[Plan of garbage]
When it rains, a large amount of driftwood and garbage flows into the Amagase Dam. Although the driftwood and garbage are removed, it had totaled an yearly amount of 2,050m³, an equivalent of 10,000 barrels, in 1998. When the garbage is left in the reservoir, not only the aesthetic is spoiled, but also the dam operation and the water quality is badly affected.

To prevent the environment, the drifting bodies are collected from the Amagase dam.
Collect and provide information

To prevent damages of flood and drought, various telecommunication systems are installed so that information on the rivers and climate are collected and monitored.

We have the following telecommunication systems.

- **Radar System**
  - Rainfall data
  - Water level - Flow rate data
  - Dam properties data
  - Weather data

  Double circuits are installed for the case in which the main routes are interrupted by a disaster.

- **Mobile radio circuit**
  - Used as communication media during patrol and in disaster areas.

- **Discharge warning radio circuit**
  - Audible warning and siren are activated during the discharge.

- **Optical fiber telecommunication network**
  - Acquisition of graphic data such as that of CCTV is possible.

### Outline of Radar Rain Gauge

The Radar rain gauge launches an radio wave pulse while rotating its antenna.

The radio wave is reflected when it hits a raindrop or snow particle, and the amount of the reflected radio wave and its return time are measured. Through its direction and distance the rainfall is measured on an area.

### Radar Rain Gauge Data

- **(Indication of West Japan Rainfall)**

### Radar Monitoring Coverage

### Computer system

Information data on the basin (rainfall, water level, amount of intake, dam, weir properties, snowfall and water quality) is collected and the computer performs the data-processing and the computation for prediction.

The processed information is provided to the concerned disaster prevention related organizations to be widely applied.

### Short-term Rainfall Prediction System

In the Yodo River Dam Control Center, various systems are being developed aiming a perfect dam management.

As one of these systems, there is a system that predicts the rainfall for 1 to 4 hours ahead.

This system, using the Rainfall Radar data from the Ministry Land, Infrastructure and Transportation and the data monitored by the Meteorology Agency, calculates automatically the predicted rainfall for every hour, for 1 to 4 hours ahead.