Impacts of Climate Change on Water Quality and Measures against Future Issues

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2009

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Influence of Climate Change on Water Quality

1. Increase in frequency of turbid water inflow due to increase in heavy rain
2. Stagnation of circulation in reservoir due to global warming
3. Increased risk of toxic chemicals in raw water due to increase in vermin
4. Increase in production of trihalomethane due to water temperature rise
5. Increased risk in pathogenic microorganisms in tap water due to water temperature rise
Heaviest Rain by Typhoon No.9 in September 2007

Course of Typhoon No.9 in September 2007

Weather map at 9 a.m. on September 6th

Reference from Japan Meteorological Agency
Water Resources for Water Supply in Tokyo

- Tone River
- Ara River
- Musashi Channel
- Tama River
- Sagami River
- Edo River
- Ogochi Reservoir
Ogochi Reservoir and Ozaku Purification Plant
Rainfall Status of Typhoon No.9 in September 2007

Total amount of rainfall: 699 mm
in Ogochi Reservoir Maintenance Office observation
Contour Map of Turbidity in Ogochi Reservoir on September 18, 2007

Example of turbidity data in front of the Dam

Altitude (m)

300 deg.
200
100
50
10
3.5
50
60

Tokonoha
Tozura
Miyama-bashi
Mugiyama
Kouchi
Yuba
Atami
In front of the Dam

Effluent
Change in Turbidity of Raw Water in Ozaku Purification Plant after Typhoon No.9

Highest value: 1900 deg.

Lower supply capacity in Ozaku if turbidity is 200 degrees or more.

Annual average of turbidity of Ozaku raw water
Stagnation of Circulation in Reservoir due to Global Warming

Normal water circulation
From spring to autumn

If global warming advances
From spring to autumn

Winter

Global warming
Stagnation of Circulation in Reservoir due to Global Warming

- Nutrition salts eluting from sediments at the reservoir bottom may cause phenomena such as water-bloom even in winter.
Increased Risk of Toxic Chemicals in Raw Water due to Increase in Vermin

- Atmospheric temperature rise may have an impact on terrestrial ecosystem.
- The amount of agricultural chemicals is expected to rise due to an increase in the number of vermin.
Increase in Production of Trihalomethane due to Water Temperature Rise

- The reaction rate of production of trihalomethane increases with water temperature.

- More consumption of residual chlorine due to water temperature rise requires more supply of chlorine in the water purification plant.

\[
\text{Organic material} + \text{Chlorine} \rightarrow \text{Trihalomethane}
\]
Increased Risk of Pathogenic Microorganisms in Tap Water due to Water Temperature Rise

- Elevated water tanks affected by urban warming will increase the risk of pathogenic microorganisms in the tap water.
Measures in Waterworks against Climate Change

- **Mitigation measures in waterworks**
  1. Promotion of renewable energy
  2. Promotion of measures for water leakage prevention

- **Adaptation measures in waterworks**
  1. Measures to mitigate water-bloom in reservoir
  2. Introduction of advanced purification
  3. Proliferation/promotion of direct connection water supply
Promotion of Renewable Energy in Waterworks

- **Solar power generation (Asaka Purification Plant)**

<table>
<thead>
<tr>
<th>Power generation scale (kW)</th>
<th>At the end of FY2006 (Record)</th>
<th>At the end of FY2016 (Target)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6,803kW</td>
<td>10,000kW</td>
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</table>

Target of power generation scale of renewable energy in Tokyo Waterworks.
Promotion of Measures for Water Leakage Prevention

- Leakage rate (%)
- Systematic detection
- Emergency repair

20% in 1955

3.3% in 2007
Effect of Water Leakage Prevention

- Leakage rate: 20% in 1955 → 3.3% in 2007

- Saving of approx. 340 million m³/year of water (equivalent to water distribution in a city with 2.5 million residents)

- Saving of approx. 70 billion yen/year of cost

- Approx. 68 thousand tons/year reduction of CO₂ emissions
Measures to mitigate water-bloom in reservoir against global warming

- Fences stop the flow of algae toward the direction of the dam in Ogochi Reservoir.
Measures to mitigate water-bloom in reservoir against global warming

- Algae between the fences is transferred to the reservoir bottom with the pump system.

35m from full water level
Effect of measures to mitigate water-bloom in Ogochi Reservoir

Day of water-bloom appearance (days)

- Blue-green algae
- Others

Installation of equipment

- Fences
- Pumps
Introduction of Advanced Water Purification Treatment to Reduce Odors and Chlorine Supply

- Coagulation and sedimentation
- Ozone treatment
- Biological activated carbon absorbing basin
- Rapid sand filtering
- Purified water
Proliferation/promotion of Direct Connection Water Supply

Water supply system with receiving tank

Pressure water service system

Water pressure in distribution pipe released at receiving tank

Effective use of the water pressure in distribution pipe

Elevated tank

Pump

Receiving tank

Booster pump unit
Waterworks in the Future: Preparing for Risks Caused by Climate Change

Waterworks: Operations based on past climate conditions (patterns of rainfall and snowfall)

Unprecedented changes in the environment due to climate change

Temperature rise after 100 years

Analysis/research of risks associated with climate change and provision of appropriate information

Studies of approaches that are not bound to conventional ideas or frameworks