Session 3: Safe Water Supply

Shinichiro Ohgaki (Chair)
Professor, Department of Urban Engineering, School of Engineering, The University of Tokyo

Kotaro Inoue (Organizer)
Principal Fellow, Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)

Masataka Watanabe
Professor, Faculty of Environment and Information Studies, Keio University

Taikan Oki
Professor, Department of Human and Social Systems, Institute of Industrial Science, the University of Tokyo

Shishan Qiao
Deputy Director General of Bureau of Comprehensive Development, and Director of Management Center of Water Resources, Ministry of Water Resources, P.R. China

Monthip S. Tabucanon
Director General, Department of Environmental Quality Motion, Ministry Of Natural Resources and Environment , Thailand

Wastewater Reuse and Innovation Ecosystem

Shinichiro Ohgaki
The water system in the Asian area is experiencing six major surges simultaneously: increasing urban populations, rapid economic growth and centralization, unprecedented technological development, social and cultural fragmentation, a surge of economic globalization and climate change. These surges pose many threats to water resources and the water environment, especially in megacities and surrounding agricultural areas.

The vulnerabilities of the water system can be divided into two categories. First there is natural vulnerability, including uncertainty of precipitation and uneven distribution of fresh water, as the natural ecosystem is highly sensitive to water quantity and quality. For example, after the Indian Ocean tsunami, certain inland fresh water resources turned saline for a significant time, deeply affecting drinking water and agriculture in the area.

The second is social vulnerability, such as the need for sanitation and the potential of water to contain pathogens. Urbanization is an example of a social vulnerability; over 627 million people will live in 60 megacities by 2015. In the 1995 Kobe earthquake, the disaster broke the main water duct, causing great damage. It is difficult for small water facilities to control for all pathogens and parasites, such as those that cause dialysis and cryptosporidium, which had major outbreaks in Japan and the United States in the mid-1990s. How to allocate budget, human resources and technology for water utilities is a major issue.

In the past, many measures were taken to address vulnerabilities, but we now face the additional issue of climate change. The key issue is how to adapt globally and locally. There are great diversities among water management conditions and policies depending on the climate and geography of each location, as well as the socioeconomic background of the people living there. Even in Japan, we can see effects of changing climate in the form of decreased snowfall and more frequent drought.

Water involves both a supply side and a demand side. In Mexico City, wastewater is used for irrigation and fertilization of soil. In Tianjin City, China, reclaimed wastewater treated by membrane is used for toilet flushing in residential areas. Hong Kong is using seawater for toilet flushing. Tokyo's three watersheds are discharged into Tokyo Bay, which has helped improve the water quality environment. In Japan, wastewater is not used for drinking, but for toilet flushing.

In terms of cost, a government study has shown that increased volume of wastewater decreases cost. In Tadotsu City, which was suffering drought, government organized it so that effluent from the wastewater treatment plant was transported, treated by filter and ozonization and carbon and then discharged for landscape use in the city, as well as for irrigation for rice paddies, while the rest went into the river.

There are a number of factors affecting innovation ecosystems. One is strong government leadership. Another is a budget that draws on a variety of sources at multiple levels of government. A third is increasing the incentives for young people from rural areas to stay in their home areas. A fourth is a consensus based on historical experiences of intense droughts, which has a bearing on the third point. A fifth is the shortage of water for paddy fields due to the geographical features. A sixth is development of new technologies.

Finally, I would like to propose six points of possible actions by GIES for adapting to climate change. First, there are natural and social points of vulnerability in the water supply. Second, these points are locally specific, and require specific, flexible measures on the part of water utilities. Third, it is necessary to accelerate policy formation for adaptation technologies while also taking measures against conventional vulnerabilities. Fourth, economic constraints for implementation should be analyzed quantitatively for public consensus. Fifth, cooperative global research on the impacts of climate change on water quality related to water supply and water environment is needed. Sixth, the informational needs of the water sector should be conveyed to climate change researchers.

Q&A/Comments

Question 1. Developing countries often do not have central waste treatment facilities for many residents, who also lack domestic treatment facilities. This affects the groundwater, which is the supply of water. Did you take this into account?

S. Ohgaki
Groundwater is indeed very important to sanitation.

World Water Resources in the 21st Century

Taikan Oki
Water issues can be divided into three categories: access to safe drinking water for survival, water for profit or water for production, and water for living comfortably, for washing and cleaning. Water is already facing significant problems, particularly in the developing countries. Climate change and urbanization will aggravate these issues, possibly increasing the risk of international conflict.

I will show you future projections of water demand and water supply by the IPCC. Statistics on the late 20th century can provide insight into the future. The world population doubled between 1961 and 2004, while crop yield per acre increased by 220%. Given that calorie intake per person has also increased, population has theoretically outgrown food production. However, the 0.8 billion starving people in the world lack food due to the social system that delivers the food rather than to address the actual shortage of food. In fact, as population increased, irrigation increased, so fertilizer input is helping to increase the crop yield, helping to feed the population.

Examples show that as wealth of a country increases, so does water use. However, there is a ceiling to this growth in water use. Japan, for example, produces a lot of industrial goods, but withdraws much less water, because water reuse in factories is as high as 80%, compared to 70% in China. Effectively this means that China requires 50% more water to produce the same quantity of goods as Japan. Major increases in water withdrawal are expected for many parts of Asia and the Americas going forward, so there is a real need for innovation for water efficiency.

In Europe or Africa, most of the water issues relate to drought and water shortage rather than flooding. However, with global warming, the dry regions will become dryer and the wet regions will become much wetter, heightening both drought and flood risk in the respective areas. Water resources will be more unevenly distributed. For some areas, both flood risk and drought risk will increase, with patterns of dryness followed by intense precipitation.

If the world follows the IPCC's A2 scenario, after the middle of the century, if there is significant population growth and minimal technology transfer, water stress will increase greatly. If population growth is minor and a great deal of technology is transferred, the level of water stress will hit a ceiling or even decline during the latter half of the century. The IPCC projections are not predictions; through human activity and initiatives we can change the future. Climate change is important, but land use change and food demand changes, together with lifestyle, technology and the economy also have an effect on water.

In coping with water hazards, it is important to note that although capabilities exist to some extent, climate change will increase the frequency of catastrophic events. Coping capacity must be increased, but unfortunately it is not possible to predict how much it will need to be changed.

Although the session was focused on water, water is one part of an important triangle of water, energy and food. Water is very much needed for food production, but if water is truly scarce, food can be imported to save water. Abundant water allows generation of hydropower, but at the same time a great deal of energy can enable people to produce fresh water economically. In biofuels, however—one of the major subjects of interest for meeting the energy shortage—water is required to grow the crops to make energy. Therefore, it is necessary to promote both mitigation and adaptation in terms of climate change.

Q&A/Comments

S. Ohgaki
Can you clarify your statement about the economy helping to sustain energy use?

T. Oki
Although some claim that climate change adaptation mitigation is not required, in fact adaptation measures reduce vulnerability to water hazards and create a healthier environment.

Question 2. Very poor and water-resource poor nations cannot afford to import foods. Also, it may be necessary to change the kinds of plants grown in response to climate change.

T. Oki
Yes, it is important not to forget that water issues are closely tied to poverty.

Modern Concept and Implementing Exploration of Water Resources Management

Shishan Qiao
Water is important both for human, plant and animal life and for the socioeconomic environment—it is the most important active control factor in the ecosystem. In China, food, petrol and water are the three major strategic resources, while long-term challenges include improving a water environment frequently faced by floods.

China consumes a low per-capita share of water, which is unevenly distributed over the course of the year and also geographically from the water-rich east to the dry west, and in the north, which has seen a marked decline in water resources. China needs to develop a water conserving society. For the temporal distribution, reservoirs are needed, while to address the spatial distribution, a water transfer project is required. For the quality deficit solution, more attention must be paid to water conservation.

However, water use has been rising in China as a result of economic development and due to increased support for agriculture and irrigation. China's efficiency is very low; there is a low rate of reuse of industrial water, compared to Japan

and the United States. This means that each year there is a significant shortage.

China is still failing to change the four major problems related to water: flood, water shortage, water pollution and soil erosion. These are four big problems. Moreover, China is prone to flood disasters related to climate change. Annual disaster loss is about 120 billion yuan, around 1% of the GDP. In addition to floods and typhoons, water shortage has become a major concentration of the socioeconomic development, both in cities and agriculture areas, the latter with serious drinking water shortage issues.

China's water resources have two contradictions: between water resources and the need of sustainable development of economy and the society, and between the extensive economic growth mode and the actual conditions of water resources and water environment. Socioeconomically, there are four basics: high standards for water quality, effective supply of water, reasonable distribution among industries and sufficient concern for ecology. In recent years there has been progress on water management and awareness. The legislative system pertaining to water is also being fine-tuned.

To respond to floods, it is necessary to change thinking so that rather than controlling floods, floods are given extra room—this means bringing the restorative capacity of nature into full play. To avoid pollution, a green economy must be developed. To establish a society that conserves water, water consumption must be reduced even as the value of operation per unit of water consumption increases, while ensuring that water resource development is not realized at the expense of the eco-environment.

Q&A/Comments

Question 1. What measures have been taken since 2000 on the Yellow River?

S. Qiao
The Yellow River poses many water-related challenges, as its flow changes over 26 times each year. Conventionally, we build dams and dikes to control flow, but this causes water levels to rise. Now we take a different approach to determine what the flow should be. Currently these issues are dealt with by a consortium of local governments who vote on how to distribute water each year. The Ministry plays a key role in brokering these agreements.

Question 2. Are there any discussions of prioritizing irrigation and agricultural production?

S. Qiao
Although agriculture is important, other industries are also growing. The response to this would be to improve irrigation efficiency, and to make new industries invest more initially for the efficient use of water.

Question 3. Is it true that water use charges in China have doubled since the year 2000?

S. Qiao
That is not entirely true; what happened is that land that was not previously irrigated became irrigated, expanding the area. Farm subsidies for water could waste funds, but also the farmer needs to think about how to save costs.

Question 4. Although Thailand and China are facing the same problems—water quality, water quantity, flood and erosion—China is focused on water saving policies. Thailand is exploring new ways to get water from the Mekong River, which requires international agreement among the four countries. Information and data sharing on the Mekong is an excellent mode of cooperation.

S. Qiao
Collaboration is crucial for such issues. The Yellow River is also facing shortages. At times there are droughts, and at times events like the heavy snowfalls of the past year provide sufficient flow. There is a need to discuss, organize and balance water use.

Assessing the Water Resources Situation in China

Masataka Watanabe
My talk focuses on Asia and more specifically China, asking the question how can we integrate the unknown data and how we can scientifically understand and assess the situation in Asia, particularly involving the resources or ecosystem service condition? I raise three points: food production, industry and ecosystem conservation, which included water resources, silt secretion, the water purification capacity and soil fertility capacity. The major task of the UN Millennium Ecosystem Assessment is to determine how to evaluate those capacities or ecosystem services commutatively, but this process is still ongoing.

My project in China was to estimate the production and pollution load in a more commutative way. The natural system must be considered in terms of the socio-economic system as a whole. A variety of monitors have been established in China, including fire stations, water cycle and key monitors, GIS databases and food models.

Agriculture in southern China is primarily rice cultivation, but there is a wider variety of crops grown in northern China. Therefore, understanding how croplands are utilized is of great importance. We therefore collect a variety of data to give us an accurate picture of the situation. In northern China, water demand results from production, not only in agriculture, but across all industries. We analyzed water use in northern China and connections to the middle section of the Yangtze, determining who is the final water user based on production in monetary terms.

Based on natural systems monitoring, we are trying to introduce a mixture of technologies suited to the various water situations. In doing so, we have to consider four ecosystems: water resources, purification capacity, carbon safety stations capacity, and soil fertility capacity.

Unfortunately, however, whether or not these proposals are realistic must be evaluated in economic terms. We are considering introducing a certain level of water pricing, and investigating how that propagates through the model. Water-saving in energy producing crops is being considered. However, because the price of energy right now is severely affecting China, the water-saving energy production crops might be unrealistic. All driving forces, states, responses, pressures and effects need to be considered in the situation.

Q&A/Comments

Question 1. Has your research indicated what degree of water saving can be expected?

M. Watanabe
Much of the existing research focuses on the agriculture sectors; probably pricing would be higher in the industrial sector. This research focuses on East Asia, looking at sixty industrial sectors.