Introduction

This brief outlines the major management issues for Lake Biwa, the largest freshwater lake in Japan. The lake enjoys a long history with its watershed communities for more than thousands of years, fostering a unique lake culture in the surrounding area. The birth of the lake can be traced back to some four million years ago. As one of few ancient lakes in the world, it embraces rich ecosystems in the lake, with fifty seven endemic species being recorded. At the same time, it is the principal water resources in Japan, supplying drinking water for 14 million people in its watershed and downstream areas. In spite of this fact, its catchment area is highly industrialized and urbanized, where 1.3 million people live and the population is still increasing at one of the highest growth rate in Japan. It also attracts people with its scenic beauties; every year some 30 million tourists visit the lake.

The greatest characteristic of the lake in terms of lake management is its geographical condition in which its watershed including the lake itself is almost identical to the jurisdictional area of Shiga Prefecture. The history of the lake management is thus the one of environmental administration by the prefectural government, which has taken an integrated and holistic approach toward the management and conservation of Lake Biwa.

The history of the lake management was also a long one of conflicts over water utilization and flood control between Shiga and the central government or the downstream mega-cities including Kyoto, Osaka and Kobe. Launched, as a resolution to the conflicts as well as a tool for local economic and water resources development, was the Lake Biwa Comprehensive Development Project (LBCDP), the largest water resources development project in Japan. LBCDP made possible to pour in the large amount of funds that are from the central and downstream local governments and needed to implement not only water resources development but also conservation works for the lake and its watershed. With LBCDP, deterioration in the lake water quality has been prevented to some extent. However, a negative legacy from the project has come to be prominent in these years although it was neglected then.

Meanwhile, the environmental administration, particularly on water environment, of Shiga Prefecture, for which the conservation of Lake Biwa is the top-priority, has always led the one of the central government. Environmental consciousness of Shiga people for the lake gave birth to the Soap Movement, the most successful citizens’ movement in Japan, and enabled the prefectural government to enact the Eutrophication Control Ordinance, the very first act for eutrophication control in Japan.
Lessons learned from the history of lake management and pollution issues and countermeasures for Lake Biwa have to be highly informative and helpful for those many lakes facing the same types of issues.

Figure 1  Lake Biwa and the Yodo River Region

Background

2.1 Bio-physical Features

Lake Biwa is the largest lake in Japan and has a surface area of 670 km². Located in the uppermost reaches of the Yodo River Basin in central Honshu Island, it occupies one sixth of the jurisdictional area of Shiga Prefecture that lies upstream of Osaka and Kyoto Prefectures. The lake consists of the minor basin in south (South Basin) and the major basin in north (North Basin), the latter being 11 times greater in surface area than the former. The South Basin has an average depth of only 4 meters, and the North Basin has an average depth of 43 meters. The lake has a volume of 27.5 km³, a shoreline length of 235 km, and a turnover rate of 15 years. The watershed (3,848 km²) including the lake itself is almost identical to the jurisdictional area of Shiga Prefecture. It covers 90% of the prefectural land and consist of forest-covered hills and mountains (50.6%), rice paddy fields and other farmlands (14.7%), urban and industrial areas (18%), and the lake itself (16.7%). During the past decades, the urban and industrial area has been expanding, especially in the southeastern part
of the watershed. The population in the catchment area has been increasing in a second highest growth rate in Japan and is about 1.3 million today. While more than 400 tributaries flow into the lake, there is only one natural watercourse, the Seta River, flowing out of Lake Biwa. The Seta River is joined by the Kizu and the Katsura Rivers to become the Yodo River, which pours into Osaka Bay and eventually to the Pacific Ocean.

Annual precipitation and average temperature in the catchment area are about 1700 mm and 14 degrees C, respectively. The lake is classified as a semi-tropical lake as it is never frozen. Thermocline formation is observed from May to November in the North Basin, but not in the South Basin. It is a typical monomictic lake.

The lake was formed some four million years ago and is therefore one of the oldest lakes in the world geologically, though it was originally located some distance south and moved gradually to its present place about 430,000 years ago. The long history of isolation from the other water bodies is suggested by the lake's biota, which is fairly rich for an island lake. More than 1,000 animal and plant species including 57 endemic species have been recorded so far for the lake. Among the endemic species, 12 are fishes and 38 are benthos including many mollusk species.

Lake Biwa renders itself as an invaluable source of freshwater resources, i.e., in terms of fishery and water supplies, which also providing for tourist interests with its scenic and recreational attractions. The national park area encompassing Lake Biwa is also one of the most visited recreational sites in Japan. The navigational use of the lake, limited today mostly to pleasure boat tours, was quite important until the 1950s both for passenger and commercial transportation. In addition, for the native Shiga residents, Lake Biwa has been the source of spiritual and even religious inspirations. Shiga is called "Lake Country." The social and cultural settings of the watershed communities have naturally been affected greatly by the history of their interaction with the lake and evolved over thousands of years. Lake Biwa’s water, together with water from the Kizu and Katsura Rivers, is used for municipal, industrial and agricultural purposes in Kyoto, Osaka and other downstream areas of the lake. The average amounts of water used today for municipal, industrial and agricultural purposes are, respectively, 6.6 million, 1.2 million, and 23.6 million m³/day. The water for municipal use is distributed to 8 cities, 28 townships and 1 village in four prefectures in Shiga, Kyoto, Osaka and Hyogo Prefectures, with its combined service population being about 14 million.

The industrial water demand, which is less than 20% of municipal demand, has been declining due to decrease in the number of water-intense industries in the region and due to improvement of water-use efficiency over the past decades. The agricultural water use takes place mostly in Shiga and Osaka Prefectures, about two thirds being in the former and one third being the latter.

2.2 Political and Socio-economic Features on Development and Conservation
Shiga Prefecture, within which 98% of the entire Lake Biwa and its catchment area lies, was economically underdeveloped up until middle of the 1970s. The strong desire of the watershed communities for economic and regional development of the lake watershed was partially fulfilled by the Kinki Region Improvement Law (KRIL) of 1963 in which the lake watershed was designated as a development zone within the framework of the national development plan for the Kinki Region. Once designated as a development zone, the regional authority would be required to lay out specific plans for appropriate population size, labor force requirements, categories of industrial to be promoted, land use and the required infrastructure systems, and to mobilize financial resources as appropriate.

The enactment of a special Law for Lake Biwa Comprehensive Development (LLBCD) of 1972 was implemented within the framework of KRIL, within which a comprehensive set of projects for water resource development, flood control and regional infrastructure development was called the Lake Biwa Comprehensive Development Project (LBCDP: 1972-1997).

The kind and the scale of development taking place in and around the lake watershed invariably affects the amount of water to be withdrawn out of a lake. Water resource development policy is, therefore, generally closely intertwined with regional economic development policy. In the case of Lake Biwa, the demand for water in the downstream region of Lake Biwa, called the Keihanshin (Kyoto, Osaka and Kobe) area, was projected in the mid 1960s to be dramatically increasing in the following decades.

However, LBCDP did not have an easy delivery. There was a devastating conflict between the central government, who wanted to implement a large-scale development project, and the prefectural government, who wanted to minimize nature destruction by the project. After several years of scientific debate and tough and political negotiation, Shiga was successful, to some extent, in turning down the original large-scale development plan proposed by the central government. Shiga Prefecture, the central government and the downstream governments finally came to agree on the enactment of LLBCD mentioned above to realize a major national project, LBCDP.

For the Keihanshin Region, the development of water resources out of Lake Biwa constituted part of a comprehensive water resource development for the whole of Yodo River whose water resource management is dictated by the River Law of 1964 (revised in 1997), and the Water Resource Development Law of 1961.

The development and conservation needs arising within a watershed community evolve over periods. Generally, the needs shift from those towards development, followed by those towards control of environmental degradation, and eventually by those towards conservation and restoration of natural resource values. In the end, the pursuit of a comprehensive, coherent and consistent legal framework for lake management may become a major concern for the community. The legislative scheme devised in each phase of lake management reflects the administrative response towards fulfillment of such needs in each community. As the phase evolves, however, the resource management conflicts become severer, and the development of
legal schemes of compromise in resource use and conservation become more and more problematic. After the completion of LBCDP, the pursuit for an appropriate legislative framework for comprehensive conservation, or the enactment of a special Law for Lake Biwa Comprehensive Conservation (LBCCP), became a major interest for Shiga Prefecture. Such a legislative framework, however, was not realized because, for the national and downstream local governments, the investment requirements for the conservation components such as construction of a comprehensive sewerage system around the lake had already been included and implemented as part of LBCDP.

Biophysical Environment

3.1 Past and Current Conditions

The water quality of Lake Biwa deteriorated significantly during the high economic growth era of the 1960s, mainly due to rapid growth of population, inadequate treatment of wastewaters, and abuse of agri-chemicals in the catchment area. A wide variety of countermeasures, including the strengthen of industrial effluent standards, the prohibition of use of phosphate-containing synthetic detergents, and the construction of sewerage systems have been conducted since then to prevent further deterioration in the lake water quality. With those efforts, we have been successful in avoiding its further degradation; however, no indication has yet to be seen for improvement in the water quality. See more details in Section 3.2.

Figure 2  Transparency in Lake Biwa

In the meantime, significant changes have been induced by human activities to the littoral and catchment area during the past decades. There used to be 29 km² of lagoons, which scattered around the lake. Those lagoons provided breeding and spawning sites for native fish, and acted as buffer zones to reduce land-based nutrient loadings to the lake. However, most of them were reclaimed to form new paddy fields before and after World

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1 The data are adapted from Shiga Prefectural Government Environmental White Papers.
War II (WWII), remaining only 4 km² today. Natural lakeshores have been disappearing gradually due to the development of the lakeshores. The area of reed belts has also decreased, being less than one half of the 1950s. Most of rivers flowing into the lake were straightened and concreted for flood control purposes. Meanwhile, urbanization due to rapid population growth has continued in the catchment area, resulting in a decrease in green areas. Through farmland improvement projects, the irrigation system for agriculture has totally changed. Irrigation ditches were completely separated from drainage ones and vertical interval was installed between paddy fields and drainage ditches to improve drain capacity. As a result, cascade use of water in old days can no longer be seen and fish cannot run up to paddy fields for breeding. Today 44% of the entire farmlands in Shiga were irrigated with water pumped up from the lake, and drain water from the farmlands runs off through drainage ditches directly into the lake.

The area of forests in the catchment area has been decreasing due to rapid urbanization in Shiga since the 1960s. More importantly a large area of pinewoods, which had been intensively used as secondary forests providing fuel woods and green manures for people, have been sifting to deciduous forests gradually as the forests are no longer used so much after WWII.

Fish catches in Lake Biwa have been declining dramatically, today being almost one third of the late 1960s. Most of native fish breed in the littoral area or lagoons around the lake. However, due to road construction along the lakeshores, reclamation of lagoons, and changes in irrigation system for paddy fields in the catchment area, a lot of endemic cyprinid fishes lost those breeding and nursery sites. Another hazard for the fishes is intentional lowering of the lake water level in June, when it happens to be their spawning season. Their eggs would thus dry up even if they succeeded to spawn. Furthermore, if their eggs could hatch out, their juveniles would be killed by invasive species, e.g., black bass and blue gill, or toxic herbicides or insecticides being spread and flowing out of paddy fields in the catchment area.

Another major concern today is the adverse effects of global warming on the lake. According to the predictions of climate change models, amount of snow is projected to decrease significantly in Japan for the next decades. Presumably because of global warming, amount of snow has been declining also in Shiga during the past decades. Snow becomes cold and heavy melt water, which contains high concentration of dissolved oxygen and reaches the lake bottom to supply the necessary dose of oxygen there. However, due to recent shortage of snow, oxygen supply by melt water is not enough, resulting in the development of anoxic zone in the deep layer of the North Basin in summer. Lack of dissolved oxygen may escalate further deterioration of the lake water quality.

### 3.2 History of Lake Degradation

The history of environmental issues, particularly of water quality degradation, in Lake Biwa can be categorized into four phases.
The first phase was characterized as piscatorial damage caused by agri-chemicals. After WW II, a large area of lagoons around the lake was converted to new farmlands for the sake of eliminating poverty and food shortage. At the same time, significant amount of agri-chemicals were applied to increase crop yields and alleviate farm works, as a result causing serious soil and water pollutions in Shiga. The most serious issue was massive death of fish by PCP, a commonly used herbicide then. The loss of fishery in 1962 was estimated to be 400 million yens. To cope with this issue, the prefectural government set a guideline for the use of agri-chemicals for the first time in Japan, and directed farmers to use them appropriately and not to use some of them within 6 km-areas around the lake. A few years later, the Agricultural Chemicals Regulation Law was revised and the use of persistent and hazardous agri-chemicals including PCP, BHC, and DDT were completely prohibited in Japan.

The second phase was in the era of environmental pollution in the 1970s. During the high economic growth era in the 1960s, many pollution issues, such as Minamata disease, Ache-ache (Itai-tai) disease, Niigata Minamata disease, and Yokkaichi asthma, were rampaging nationwide while standard of living in Japan went up dramatically. Shiga was not exceptional; heavy metal pollution by antimony and fishery pollution by PCB also took place in 1968 and 1972, respectively. To address these issues, the prefectural government enacted the Pollution Control Ordinance in 1969, laying down stricter effluent standards for industrial wastewater. The Water Pollution Control Law also went into effect in 1971.

Although environmental issues in Phase 1 and 2 were serious, they were very local and the damages were confined to fishery mainly. However, the characteristics of issue changed entirely in Phase 3, which began from the outbreak of “freshwater red tide” in 1977. The phenomenal economic growth in Japan in the 1960s, which caused severe environmental stress across the country, also began to affect the water quality of this lake as a whole behind the scenes. As early as 1959, the outbreak of Closterium aciculare caused clogging of sand filters in a water purification plant in Kyoto for the first time. Eutrophication became more severe, i.e., in the North Basin from oligotrophic to mesotrophic and in the South Basin from mesotrophic to eutrophic. The lake’s biota began to exhibit correspondingly drastic changes. The bluegreen blooms of Oscillatoria resulted in taste and odor problems with drinking water for the first time in 1969. There have also been frequent occurrence of “freshwater red tide” resulting from the bloom of flagellate alga, Uroglena Americana, the first outbreak of which took place at west side of the North Basin in May 27, 1977.

People in Shiga were very much shocked by this incidence, which made people reconfirm the escalation of eutrophication. From then on, environmental awareness of people in Shiga was raised considerably, the Soap Movement (See more details in Section 4.4), which was initiated by women's consumer groups in the 1970s, was backed by strong public support and spread out all over the prefecture. This citizens' movement pushed the prefectural government to enact the Eutrophication Control Ordinance in 1979. This ordinance set stricter effluent standards on phosphorus and, for the first time in Japan prohibited the use of phosphate-containing synthetic detergents.
This ordinance helped improve the quality of lake water in the early 1980s. Nonetheless, the rate of improvement faded away quickly in the latter part of the 1980s and the lake water again began to show signs of deterioration since then. Today much focus is placed on how to control non-point sources for nutrients in the catchment area. The outbreak of bluegreen algae *Anabaena* occurred for the first time in 1984 in the South Basin in 1994, the most severe drought year on record, in the North Basin. All of these phenomena have recurred almost every summer since their initial appearances.

Environmental issues of Lake Biwa are now in Phase 4, in which emerging after the eutrophication issue is degradation in the lake and its lakeshore ecosystems. Traditionally environmental policy in Japan has placed focus on the achievement and compliance of environmental standards, lacking of consideration on ecosystems and landscapes, to which no standards has been laid down yet. Consequently degradation in the lake and its littoral ecosystems, including disappearance of natural lakeshores, become serious issues in Lake Biwa today. Reflecting on this shortcoming, the prefectural government developed in 2000 the Lake Biwa Comprehensive Conservation Plan, called “Mother Lake 21 Plan”, for literally the comprehensive conservation of the lake and its watershed. The plan sets up three major goals for 2050: the water quality to be restored to the level of the late 1950s; people to live together with forests and make full use of the natural water cycle; and a variety of unique living creatures in a rich natural ecosystem. Within the framework of this plan, the establishment of citizens’ watershed organization in each major river flowing into the lake has been also promoted for these years.

Meanwhile, the disturbance of lake ecosystem, such as a decrease in native and endemic fish, by invasive fish becomes apparent. In addition, with the improvement of accessibility to the lakeshores, more tourists come to visit and make use of there for recreational purposes. As a result, littering of garbage, fish lines, and lures become serious issues. Another issues are noise problem of personal watercrafts, water pollution by emission gas of pleasure boats, and recreational vehicles onto the beeches. To protect living environment along the

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2 The data are adapted from Shiga Prefectural Government Environmental White Papers.
lakeshores and ecosystems in the lake and its littoral area, the prefectural government enacted in 2002 the ordinance for Appropriate Leisure Use of Lake Biwa. The ordinance designates regulatoryzonings for pleasureboats, prohibits the drive of personal watercrafts with 2-cycle engine, and forbids the release of invasivefish that are once caught.

3.3 Lake and Drainage Basin Resource Conflicts

As implied in Section 2.2, the history of Lake Biwa and Yodo River water management was one of a conflict of interests and the resolution in terms of flood control and water utilization between Keihanshin Area downstream, particularly the Greater Osaka Region, and Shiga Prefecture upstream. Early in the history of Lake Biwa management, the communities in the immediate surroundings of Lake Biwa experienced severe flooding of their agricultural fields. The practical solution at that time was to increase the discharging capacity of the Seta River by dredging, which might, however, increase risk of flooding in downstream Osaka area instead. The national government finally agreed, after a severe flooding\(^3\) of 1896, to a major dredging of the Seta River at the outlet of the lake in combination with the construction of Seta Weir, the only artificial water-flow control facility of the lake outflow. The weir, constructed in 1905 and renovated in 1961, controls the lake water level and discharge rate to Yodo River.

As for water resources development, the first significant human intervention took the form of construction of a canal linking to the lake with Kyoto City, which was initiated in 1874 and was completed in 1885. The city, whose development had been hampered by lack of water at the time, was able to regain its economic strength. Nearly a century later, another major human intervention for water resources development was introduced in the form of LBCDP mentioned previously, when the phenomenal economic growth in Japan after WWII prompted a sharp increase in water demand in the late 1960s in the downstream Yodo River and the Osaka Bay area. The industrial use of groundwater in the region was becoming severely constrained due to competition between industrial establishments and due to land subsidence caused by the overuse of the water. Domestic water supply needs also began to increase in the Yodo River area after suburban cities joined Osaka in requiring access to the Yodo River water, leading to the inception of large-scale water resource development, LBCDP.

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\(^3\) The flooding allowed the lake water to rise by a maximum of 3.76 m, and kept some of the watershed communities in water up to 220 days.
The Lake Biwa Comprehensive Development Project (LBCDP) was a major national project with its primary object being provision of additional supply of Lake Biwa water to the downstream region. The specific goals of the Project were: (1) to construct levees around the lake with various flow control structures to enable the release of an additional 40 m³/sec of lake water through the Yodo River; (2) to improve the flood control capability of rivers by channelization and by installation of flow control gates along the Lake Biwa coastline as well as along the Yodo River itself; and (3) to improve the water irrigation pipelines and around-the-lake sewerage systems. The financial arrangement of these massive development projects came from the national government, the downstream prefectural and municipal governments as well as from Shiga Prefecture. LBCDP cost 1.9 trillions yen in total, and became the largest project whatsoever implemented for water resources development in Japan. The project laid sound foundations for flood control and water utilization, and industrial and urban infrastructures, boosting the economy of Shiga. Today the average income of people in Shiga is the third highest in Japan, following Tokyo and Aichi Prefectures. There are many factories of high-tech industries around the lake, in which, e.g., 60% of desalinization membrane in the world are produced.

It should be also noted that the largest portion of the project expense, 26.6%, went into the development of sewerage systems in the catchment area, which was very effective to reduce nutrient loading from domestic to the lake.
However, LBCDP also triggered massive destruction of the lakeshores and littoral ecosystems as a result, and possibly degradation in the lake water quality, becoming a major dispute over the development or conservation of Lake Biwa. In 1976, demanding the right to enjoy clear water, a kind of environmental rights, more than 1000 citizens, who were mostly residents of Osaka, brought suit against the central and Shiga Prefectural governments to stop the project. Although the plaintiff lost the case after 13 years of civil lawsuit, argumentation in this case came to fruition as Shiga Prefectural Government enacted the Reed Belt Conservation Ordinance, the first act in Japan therein advocating the importance of ecosystem, in 1992, and the Basic Environment Ordinance in 1996. Being in line with the trend of the times, people's concern has been sifting from comprehensive development to comprehensive conservation of Lake Biwa.

4. Management Environment

4.1 Lake Management Programs and Processes

Flood control and water level control

The water level of Lake Biwa, being controlled by Seta Weir, may rise up to 1.4 meters above the Biwa-ko Surface Level (BSL) to prevent the downstream from flooding in the case of torrential rains whereas it may decline down to 1.5 meters below BSL to meet the water demand of the downstream in the case of drought. To cope with such water fluctuation, embankments surrounding the lake were constructed to protect the lakeshore areas and drainage facilities were installed to prevent those areas from inundation within the framework of LBCDP, in which a lot of mudslide and flood control dams were also constructed upstream of the watershed and a lot of rivers' courses downstream were changed and improved for flood control.

The flood control measures made within LBCDP have been successful to some extent, with which flood damages in the lake watershed and downstream areas have declined significantly. However, adverse effects of water level control on the lake and its littoral ecosystems become prominent though they were not so apparent at the beginning of LBCDP. Inviting a wide range of stakeholders, a process to review the rule of water level control at Seta Weir just started a few years ago.

Agriculture

Pumping facilities to lift up lake water were also equipped widely over the prefecture within LBCDP, prior to which people in Shiga relied exclusively on rivers and ground waters for irrigation. Out of 600 km² of farmland in Shiga, 90% is faddy field. For long years, people in most part of Shiga had suffered from water shortage for rice cultivation, and thus constructed a lot of sluice gates and reservoirs, developing very water conservative irrigation system, in which discharge from paddy fields upstream is made use of by ones downstream in a cascade manner. Such irrigation watercourses connected together paddy fields, creeks, and lagoons to make up specious water corridors for aquatic lives. The corridors acted as regulating pondages and create unique and irreplaceable semi-artificial ecosystems around the lake.
However, farmers in Shiga today can make use of as much of water as they want and when necessary with the pumping facilities. There is no incentive for them to save water. In addition, owing to the complete separation of irrigation and drainage ditches with farmland improvement projects, all the drain from paddy fields runs through drainage ditches directly into the lake, and aquatic creatures can no longer transfer within the water corridors. The unique aquatic ecosystems are at edge of disappearance.

**Forestry**

Although the total area of forests in Shiga has been decreasing constantly since the high economic growth era of the 1960s, forest-covered hills and mountains still occupy a half of the prefectural area, acting as storage of water and natural mudslide dam. Most of the forests in Shiga are secondary forests, which had been used in a sustainable manner by people to gather fuel woods and green manures for paddy fields until WWII. However, such functions of the forests became no necessary with the advent of oil fuel and chemical fertilizers after WWII. Furthermore, most of the forests are not in good maintenance today as forestry in Japan as a whole has been declining and the number of its workers has thus been decreasing. As a result, a large area of pinewoods, the typical secondary forest in Shiga, has been changing gradually to deciduous forests, the natural vegetation around the lake, and ecological services provided by the forests in the catchment area has been enhancing ironically. On the other hand, the future of forestry in Shiga is sill being sought.

**Fishery**

Fishery is not a major industry in Shiga and thus there is no serious water pollution associated with aquacultures in the lake. However, fishery in Lake Biwa has fostered a unique food culture in Shiga, including small Ayu fish boiled in sweetened soy sauce and "Funa-Zushi", a ferment food made of indigenous fish named "Nigorobuna" (cyprinid). In addition, among other diverse piscatologies, "Eri", a unique and traditional fixed netting in the lake, shapes a scenic beauty off the shores. The lake fishery plays a central role in the Japanese freshwater fishery. Shiga is shipping to the other prefectures a large amount of juvenile of Ayu fish, the most popular freshwater fish in Japan, although the shipment today is not as much as it used to be. Cultivation of freshwater pearls was also once-booming in the lake.

LBCDP cast a shadow also over the fishery. Within the project, fishermen in Shiga were paid a high amount of compensation, separately from one for individual lakeshore development, for the lowering of the lake water level associated with the project. With the compensation, expensive and high-tech fishing boats and gears became available for fishermen, aggravating over fishing of the lake to some extent.

These days' fishermen in Shiga are trying to sift from fishery of catching to one of cultivating. Stocking the lake with artificially hatched and raised native fish has been attempted. However, lost of

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4 *Carassius auratus grandoculis*

5 *Plecoglossus altivelis altivelis Temminck et Schlegel*
breeding and spawning sites of native fish together with adverse effects of invasive fish, fish catches in Shiga has been declining significantly. Fishery of the lake thus faces serious problems today.

**Nature conservation**

Lake Biwa and its surrounding areas were designated in 1950 as the first quasi-national park in Japan. Together with four other nature reserves, preserve areas occupy 37% of the catchment area. Every year 30 million tourists come to Shiga to enjoy its nature and picturesque beauties. The lake is also an important relay point for migratory birds including ducks, and thus became a designated wetland of the Ramsar Convention in 1993. On the other hand, agricultural damage by wild life including boars, deer’s, and monkeys and piscatorial one by cormorant become a serious issue today. In addition, abuse of the lake and lakeshores by too many tourists is causing another serious issues as described in Section 3.2.

### 4.2 Reduction of Lake Stresses

The regulatory program on industrial discharge control began to take effect first in Japan in the early 1970s. Preceding this movement of the central government, Shiga Prefectural Government enacted the Pollution Control Ordinance in 1969 to regulate industrial wastewaters.

In 1970, environmental standards for water quality was established based upon the Basic Law for Environmental Pollution Control of 1967. The standards consist of ones for the protection of human health and for the conservation of living conditions; the formers was applied to every water bodies, and the latter's were further classified into six types with taking into account the kind of water body, either rivers, lakes or seas, and its current usage and water quality. Lake Biwa is classified into Type AA, the clearest water, because it is the most important freshwater body in Japan.

As the Water Pollution Control Law went into effect in 1971, the prefectural government set another stricter standards topping up the national standards for industrial wastewaters as well as revised the Pollution Control Ordinance. The revised ordinance adopted a license system for installation and change of specific facilities using hazardous materials; strengthen effluent standards on hazardous substances as severe as environmental standards; and set an additional standard for antimony as its pollution took place only in Shiga.

In short, the central and the prefectural government's policy of the 1970s for water pollution control was to achieve and comply the environmental standards by controlling industrial wastewaters depending on the type of receiving water body. With all the above efforts, the water quality of Lake Biwa has complied with the environmental standards for human health up till today.

In the wake of freshwater red tide in 1977, Eutrophication Control Ordinance was enacted in 1979. The ordinance prohibits the use, sale, and gift of synthetic detergents containing phosphate; sets the very first nitrogen and phosphorus standards for industrial effluent in the world; and formulates guidelines for
appropriate use of artificial fertilizers and management of irrigation water in agriculture and for appropriate treatment of livestock wastes and gray waters from domestic, those guidelines which were to control non-point sources of nitrogen and phosphorus. The ordinance should be highly appreciated since it recognized that nutrient loading of nitrogen and phosphorus be reduced to prevent lake eutrophication and comprehensive and well planned countermeasures be indispensable to addressing the problem. Such countermeasures are necessary as nitrogen and phosphorus may run off from a wide range of sources and victimizers of pollution cannot readily be differentiated from its victims in this issue, being utterly different from other pollutions.

The Eutrophication Control Ordinance of Shiga Prefecture then had a tremendous influence on the water quality control of lakes and environmental movements in Japan. Six years later, the Water Pollution Control Law was revised, in which effluent standards of nitrogen and phosphorus for lakes were set down for the first time. In addition, with a view to taking comprehensive and systematic actions to improve water quality of lakes, a Special Law for Lake Water Quality Conservation was enacted in 1984, in which each local government in charge of designated lake has to formulate a water quality conservation plan every five years.

With the enforcement of this ordinance, the phosphorus concentration of the South Basin has apparently decreased. However, as the entire lake, environmental standards for phosphorus (0.01 mg/L) as well as nitrogen (0.2 mg/L) have not been achieved yet. See Figure 5 and 6.

![Figure 5](total-phosphorus-in-lake-biwa.png)  **Figure 5** Total phosphorus in Lake Biwa

![Figure 6](total-nitrogen-in-lake-biwa.png)  **Figure 6** Total Nitrogen in Lake Biwa

To protect the water quality of Lake Biwa, as water resources of 14 million people in the Keihanshin area, Shiga has had the strictest effluent standards for industrial wastewaters in Japan. Factories and establishments in Shiga have installed highly advanced facilities for wastewater treatment to comply with the standards. In addition, the construction of treatment plants for human wastes and treatment facilities for communities’ wastewater have been facilitated in Shiga since the late 1970s as well as the construction of sewerage system,

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6 The data are adapted from Shiga Prefectural Government Environmental White Papers.

7 The data are adapted from Shiga Prefectural Government Environmental White Papers.
which population coverage was far below the national average in the 1970s, within the framework of LBCDP. All those treatment facilities are capable of removing nitrogen and phosphorus. The population coverage of sewerage treatment in Shiga is today greater than 70% whereas 60% is the national average.

With the above infrastructures, pollution loading from point sources to the lake has been reduced considerably. However, improvement in the lake water quality has not been apparent because of long retention time of Lake Biwa, 5.5 years, and of persistent loading from non-point sources in the catchment area. Unfortunately, what has been done in addition to those dictated in the Eutrophication Control Ordinance to control pollution loading from non-point sources is very little in Shiga although its importance is highly recognized⁸. Reduction and reuse of irrigation return flow from paddy fields are only countermeasures that have been attempted, which have not, however, produced any effective results.

In the mean time, the prefectural government enacted the Basic Environment Ordinance in 1996 in the view of promoting and implementing its environmental policies toward sound and high quality environment. One of its fundamental policies is to achieve harmonious coexistence of nature and humans while the others are to develop a recycling-oriented society, achieve sound environment with citizens’ participation, and contribute to global environmental issues. This ordinance was lead by the Reed Belt Conservation Ordinance, which is to protect and cultivate reed belts in and around the lake. Reed belts are original scenery of Lake Country, Shiga, habitat of a wide range of fish and birds, natural barrier for shore protection, and water purification facility. The lake was also designated as a Ramsar Convention site in 1993. Restoration of littoral ecosystems and wetlands are one of the major challenges today in Shiga.

In this line, another major issue today for Lake Biwa is adverse effects of invasive species. As for overgrowth of Canadian pondweed⁸, an invasive weed to the lake, the prefectural government has studied the ecological functions of weeds including such invasive species and the effective way to reap, as well as harvested the weed frequently. On the other hand, as damage by invasive fish on native and endemic fish became apparent in the 1990s, the ordinance for Appropriate Leisure Use of Lake Biwa to prohibit the release of invasive fish once caught was enacted in 2002. A subsidy system for buying invasive fish at about 2-3 US$/kg from fishermen has been also implemented to exterminate them. However, any countermeasures have had no effect so far on invasive fish; precautionary measure may be the only way to prevent the invasion of exotic species.

4.3 Enabling Environment

Legislative framework for the management of Lake Biwa

In the River Law, the governor of Shiga Prefecture is appointed as the administrator of Lake Biwa. This is an exceptional case in Japan and only admitted for Lake Biwa. This happened because then-governor of Shiga Prefecture refused to transfer the administrative right of the lake to the central government when the law was enacted.

⁸ Elodea Nuttallii St. John and Egeria densa Casp
revised in 1964. At that time, the administrative right of the other major rivers and lakes including Lake Kasumigaura, the second largest lake in Japan, were all transferred to the central government. From then on, the prefectural government has taken heavy responsibility as well as significant power and authority for Lake Biwa. Those innovative and wide-ranging ordinances described in Section 4.2 are results of the prefectural government's effort to fulfill its responsibility. The prefectural government is today carrying out the management and conservation of the lake and its watershed with the legal system shown in Table 1.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Name of laws and ordinances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term objectives and guidelines for environment policy</td>
<td>• Basic Environment Law&lt;br&gt;• Basic Environment Ordinance&lt;br&gt;• Mother Lake 21 Plan</td>
</tr>
<tr>
<td>Regulation on water withdrawal and diversion</td>
<td>• River Law</td>
</tr>
<tr>
<td>Pollution control</td>
<td>• Water Pollution Control Law: environmental standards for human health, living conditions, and eutrophication control&lt;br&gt;• Special Law for Lake Water Quality Conservation: Conservation plan for water quality including COD, Total Nitrogen, and Total Phosphorus&lt;br&gt;• Ordinance for more stringent prefectural effluent standards based upon Water Pollution Control Law: effluent standards for human health, living conditions, and eutrophication control&lt;br&gt;• Pollution Control Ordinance: addition of control subjects and parameters&lt;br&gt;• Eutrophication Control Ordinance: regulation on detergents, industrial effluents, fertilizers, and etc.&lt;br&gt;• Domestic Wastewater Control Ordinancevi</td>
</tr>
<tr>
<td>Regulation on development</td>
<td>• National Land Utilization Planning Law: national land use plan and general plan of land use&lt;br&gt;• City Planning Law: urbanization-designated and -restricted areas&lt;br&gt;• Law Concerning the Improvement of the Agricultural Promotion Area: agricultural developing area&lt;br&gt;• Forest Law: regional forest plan&lt;br&gt;• Natural Parks Law&lt;br&gt;• Natural Environment Conservation Ordinance&lt;br&gt;• Prefectural Natural Parks Ordinance&lt;br&gt;• Environmental Impact Assessment Ordinance</td>
</tr>
<tr>
<td>Conservation of Ecosystems</td>
<td>• Nature Protection Law, Wildlife Protection and Hunting Law&lt;br&gt;• Natural Environment Conservation Ordinance&lt;br&gt;• Reed Belt Conservation Ordinance: conservation, preservation, and ordinary areas&lt;br&gt;• Designated as a Ramsar Convention wetland&lt;br&gt;• Appropriate Leisure Use Ordinance: regulatory zoning of pleasure boats, prohibition of the re-release of invasive fish, and etc.</td>
</tr>
<tr>
<td>Conservation of Landscape</td>
<td>• Landscape Conservation Ordinance: lake, roadside, and river landscape areas</td>
</tr>
</tbody>
</table>

*Laws and ordinances in bold letters are referred to in this document.

A major challenge for Shiga today is to develop a new legal system not only to protect but also to restore and revitalize the lake and its coastal ecosystems that were damaged by LBCDP and other development works.
Changes in administration system

Shiga Prefectural Government has been directly in charge of the management and conservation of Lake Biwa and its catchment area. To manage the lake and its watershed appropriately and to respond to the demands of the times, the prefectural government has continuously evolved its administration system and structure. It was a history going for the integration of relevant administration organs for that purpose. Table 2 summarizes changes in administration system of the prefectural government.

### Table 2  Changes in environmental administration system of Shiga Prefectural Government

<table>
<thead>
<tr>
<th>Year</th>
<th>Department and division in charge of Lake Biwa and its catchment area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Department of Welfare (Antipollution Measure Office)</td>
</tr>
<tr>
<td>1972</td>
<td>Department of Planning, Life Environment Bureau (Antipollution Division, Drinking Water and Waste Management Division, Nature Conservation Division, Prefectural Life Division)</td>
</tr>
<tr>
<td>1974</td>
<td>Department of Life Environment (Antipollution Division, Environmental Policy and Waste Management Division, Nature Conservation Division, Prefectural Life Division)</td>
</tr>
<tr>
<td>1979</td>
<td>Department of Life Environment (Environment Office, Waste Management Division, Nature Conservation Division, Prefectural Life Division)</td>
</tr>
<tr>
<td>1996</td>
<td>Department of Lake Biwa and the Environment (Water Policy Administration Division, Environmental Policy Division, Waste Management Division, Ecological Lifestyle Promotion Division, Nature Conservation Division, Forest Conservation Division, Forestry Administration Division, Sewerage Construction Division, Sewerage Planning Division)</td>
</tr>
</tbody>
</table>

As shown in Table 2, pollution control administration of the prefectural government began in 1970 with one division. It was strengthened in 1972, and became an independent administration unit in 1974. In 1979 the system was reorganized to address the eutrophication problem with the enactment of [the Eutrophication Control Ordinance](#). Incorporating into divisions for forestry and sewerage administration, the latest reform was made in 1996 to lay out a new framework for the promotion of watershed management.

Monitoring and research capacity

Lake Biwa is the most well studied lake and rich in data in Japan. Water temperature and transparency have been monitored by [the Fishery Experiment Station](#) since 1922. The current monitoring system consisting of 48 stations in the lake was established in 1966; thereby the focus of monitoring in Shiga was shifted from industrial pollution to lake water quality as a whole. The monitoring of the lake is mainly carried out today by [the Institute of Public Health & Environment Science](#), a prefectural research laboratory established in 1972, together with [the Lake Biwa Works Office](#) of Ministry of Land, Infrastructure and Transport. Such longtime monitoring revealed, for example, that dissolved oxygen at the bottom of North Basin was depleting.

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The prefectural government has also continued efforts to enhance its research capability in order to address the management and conservation of Lake Biwa and its watershed. The efforts include the establishment of the Lake Biwa Research Institute in 1982, and the University of Shiga Prefecture and the Lake Biwa Museum both in 1995. Together with other research institutes located around the lake, e.g., ones of Shiga University and Kyoto University, those research organs make a cooperative framework for comprehensive studies on Lake Biwa and its surrounding area.

**Environmental Education**

Every year primary school children in the 5th grade take a 2-day work-study program called the "floating school" on Uminoko, a ship built by the prefectural government exclusively for environmental education. The program started in 1983, since then more than 300 thousands children have embarked the ship. In 1995, the "Lake Biwa Museum" was open. It welcomes, as the best learning spot for people about Lake Biwa, more than 600 thousands visitors every year.

**History of citizens' movement**

The history of citizens' movement for Lake Biwa cannot be described without referring to the Soap Movement. The movement originated in the beginning of 1970s with a Soap use campaign by homemakers who were concerned about babies' diaper rash and housewives' eczema caused by synthetic detergents. In 1977, it changed, however, its direction with outbreak of red tide in the lake, shifting to a boycott campaign of phosphate-containing synthetic detergents for the conservation of lake water quality as people came to know through mass media that synthetic detergents might cause eutrophication (red tide). With the participation of a wide range of organizations, the movement, which started by women's consumer groups, spread out all over the prefecture rapidly, and established the "Citizen Forum for Conservation of the Aquatic Environment around Lake Biwa (Biwa-ko Forum)" in 1978.

Meantime, Shiga Prefectural Government, who had also intended to regulate the use of phosphate-containing synthetic detergents to control eutrophication of Lake Biwa, supported the Soap Movement in full scale, starting deliberation about making an ordinance for that purpose. Detergent manufacturers responded strongly against this movement of the prefectural government, and deployed extensively an anti-campaign against the regulation of synthetic detergents. Ironically, this anti-campaign made more people in Shiga know the issue of phosphate-containing synthetic detergents.

Backed by strong public support, the prefectural government enacted the Eutrophication Control Ordinance in 1979. It was a trial for the first time in Japan to regulate not the activities of companies but ones of farmers and ordinary people. The Soap Movement born in the watershed of Lake Biwa expanded to become a nationwide movement to purge synthetic detergents. Within three years, most of prefectural governments in Japan had initiated some actions for the detergent issue. The Eutrophication Control Ordinance of Shiga...
Prefecture then had a tremendous influence on the water quality control of lakes and environmental movements in Japan, as mentioned in Section 4.2.

The detergent manufacturers, who had strongly opposed the enactment of the ordinance, changed their production processes to start making synthetic detergents containing no phosphate shortly after the enactment. Today no detergents containing phosphate are produced or sold in Japan.

The Soap Movement is highly appreciated because it was led by women; raised the issue that we were responsible for the degradation of lake water quality; made the local government enact the ordinance; and finally changed national policy on water quality management. It is known and described as the first and most successful case of citizens' environmental movement in Japan. With the movement, women's participation in society was also promoted considerably in Shiga, where people were very conservative then. It produced a lot of women activists, who have led environmental movements in Shiga from then on. Another outcome of the movement was in 1990 the establishment of “Environmental Cooperatives”, which specializes in promotion of the use of environmentally sound commercial products.

However, the movement lost its goal and impetus shortly after the advent of synthetic detergents containing no phosphate. The percentage of people who do not use synthetic detergents but soaps is less than 30% in Shiga today, even though it marked the highest, 70%, in 1980. With complexity of environmental issues and diversified values of people today, Biwa-ko Forum has been searching for an alternative goal to the Soap Movement, but not yet successful. By the same token, Citizens' movement in Shiga has not been very active since the late 1980s with exception of a few unique activities such as “Fire-fly Monitoring” by thousands of citizens.

In Japan as a whole, NGOs and NPOs' activities were finally acknowledged by the general public through very active involvement of volunteers in Kobe earthquake of 1995 and "Nakhodka", a Russian tanker, Oil Spill of 1997. To that end, Shiga Prefectural Government established in 1997 the "Ohmi (Shiga) Network Center" for NGOs and NPOs in the view of promoting and supporting voluntary and social activities of citizens.

At the same time it became apparent that more integrated and concerted efforts by local people in individual watershed of rivers flowing into the lake and whereby organization of people would be indispensable to watershed management for Lake Biwa. One of the very first trials for that purpose was to establish the “Akanoi Environmental Citizen Initiatives” in 1996, which is a watershed community initiative to clean up the Bay of Akanoi. In Shiga, there are many other watershed organizations today, most of which are, however, founded by different departments of Shiga Prefectural Government or local municipalities. Although those organizations head for the same goal toward the conservation of Lake Biwa's water environment, there is no coordination or concerted activities at all among different types of organization mainly due to sectionalism among different administrative organizations. Typically morale and economic foundations of those organizations are not solid enough. Governmental organizations tend to demand outcomes in a short period and thus support financially those organizations only for a few years. A sound partnership between local governments and watershed organizations, and fostering of those organizations with people's initiatives are major challenges ahead for us.
Private initiatives

A unique case of private initiatives in Shiga is the formation of the "Shiga Environment Conservation Association" in 1981, which consisted of more than four hundreds relevant local companies. The association originated from an information exchange group of personnel in charge of wastewater treatment in industries. Such association was needed for Shiga's industries to meet social demands for water pollution control, as they had to develop new technologies, ahead of the other prefectures in Japan, for the removal of nitrogen and phosphorus from the effluents.

When the Eutrophication Control Ordinance that set down effluent standards of nitrogen and phosphorus for industrial wastewater was enacted, there was no major objection from the local industry. Shiga's industry had to live with the ordinance to get along with the neighboring communities. For the same reason, a factory has to make a gentleman's agreement with its neighboring community in Japan, in which stricter effluent or emission targets are to be laid down in most of the case.

Global Cooperation

Shiga Prefectural Government, for which the management of Lake Biwa is the high-priority issue, has been committed itself to international cooperation and information exchange on lake issues for years. In this line, it hosted the first World Lake Conference in Otsu in 1984 and founded the International Lake Environment Committee (ILEC) in 1986. The World Lake Vision, which was presented at the World Water Forum III in 2003, is another achievement made possible by strong initiatives of Shiga Prefectural Government.

5. Lessons Learned and Recommended Initiatives

5.1 Political interest and commitment

Political interests and commitments over Lake Biwa, including opposing ones between Shiga and the central government or the downstream prefectures, have changed with the times. As far as Shiga is concerned, its focus was first placed on flood control and measures for water shortage in the early days, and sifted then to local development and economic growth in the 1950/60s, and the control of pollutions and eutrophication in the 1970/80s. Today's major concern of Shiga is to achieve the conservation of the lake and littoral ecosystems. This resulted from reflecting changes in value of people in Shiga, in which people came to see the higher resource value of the lake as their living standard rose, and political efforts to fulfill their needs. On the other hand, political interest of Shiga has been always in confrontation with one of the central government or the downstream areas. As described in Section 2.2, LBCDP and the negotiation process for its inauguration led up to a dispute resolution.

The strictest effluent standards in Japan and the enactment of the Eutrophication Control Ordinance were realized by strong political commitment and initiatives of the governors at that time. However, they would not be possible by political interest and commitment alone. As implied in the Soap Movement, which gave birth to the ordinance, they became possible by strong support of the public.
• The higher the perceived resource value of the lake, the stronger the interest and commitment becomes. The political interest and commitment will come in different forms at different times of the history of lake management, and they are often the end result rather than the achievable objective. When opposing political interests and commitments clashes, the process of dispute resolution has to be instituted. Dispute resolution may be enhanced sometimes by such mediating factors as scientific knowledge, third-party initiatives and concerns, and innovative institutional arrangements.

• It is difficult, in general, to achieve sustainable management of lake resources without political commitment and interest. However, political commitment and interest alone won’t achieve sustainable management of lake resources, as sustainability depends greatly on the synergy created by the basin communities, individual citizens, local industries and the local government, facilitated by political interest and commitment.

5.2 Sustainable institutions

Shiga Prefectural Government, instead of the central government, has taken full responsibility for the management of Lake Biwa and developed necessary infrastructures to fulfill its responsibility for years. The prefectural government has also continuously improved its administration system to respond to the demands of the times. It was a history of administrative system integration toward further comprehensive conservation of the lake and its catchment area. However, harmful effects of sectionalism among ministries and divisions still remain. Further integration of the administration system in the true sense for that purpose is of necessity.

• Regardless of development or conservation, comprehensive management of large lakes that support municipal, industrial and agricultural activities of significant magnitude like that of Lake Biwa, will require very strong local government capacity to implement the needed infrastructure development projects that may typically span decades.

• Many of the infrastructure projects for lake resource development and conservation will require decades of continuous construction works and sustainable management. Special institutional design with integrated rather than sectoral arrangements may be quite useful for efficient implementation of these projects.

• Suitable institutional arrangements that satisfy local government needs to provide basic environmental services to the communities such as sewerage, industrial waste management, etc., may not necessary be sufficient to bring about the needed improvements in environmental and ecological condition of the lake since lake management will invariably require integrated management of water, air and land resources, encompassing such activities as control of non-point sources of pollution, restoration of ecological functions of land and riparian environments, etc. Efficient mobilization of limited financial and manpower resources to deal with a range of interrelated environmental issues will require holistic and flexible institutional arrangements.

5.3 Financing mechanism

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A major reason why Shiga, once-poor prefecture, could somehow manage its economic development and the conservation of Lake Biwa was LBCDP.

- The financial base of lake-region governments alone may not be sufficient to undertake the necessary development and conservation projects. As implied in the Special Law for Lake Biwa Comprehensive Development and cost-sharing with the downstream local governments under LBCDP, the special legislation to facilitate mobilization of financial resources from the central government, including preferential subsidies, as well as from the downstream local governments that benefit from development of lake resources, could be of critical importance.

5.4 Legislative frameworks

Since Shiga Prefectural Government is a local government, who knows best about Lake Biwa, it became possible to implement appropriate and fine management of the lake to meet specific requirements for the lake and needs of local communities. Such fine lake management and conservation have been realized with its thorough legislative framework for that purpose.

- Lake management encompasses a wide range of environmental issues, each of which has to be properly addressed with specific legal provisions that will meet particular requirements specific to individual lakes. The legal provisions to promote regional development, with specific aim to develop resource values of a lake, may or may not have adequate provisions for environmental and ecological needs of the lake and its watershed. It will be most useful to introduce and implement formal and informal legal provisions, including local government ordinances, which can meet specific needs of the local communities that will have to deal with such environmental requirements.

5.5 Stakeholder participation

The citizen initiatives in lake management take many different forms. The housewives’ initiatives in the promotion of the “Soap Movement”, is a most well known one in the case of Lake Biwa. Other well-known Lake Biwa examples include an NGO activity specializing in local water-culture studies with “Fire-fly Monitoring” by thousands of citizens, the nation’s first “Environmental Cooperatives” that specializes in promotion of the use of environmentally sound commercial products, and a watershed community initiative to clean up the Bay of Akanoi, called the “Akanoi Environmental Citizen Initiatives”. These and other citizen initiatives constitute an essential part of environmental governance that has to deal with extremely complex issues of lake management.

A lot of lessons can be learned from LBCDP. The following are lessons also can be learned from LBCDP in terms of stakeholder participation:

- For a lake that is as complex as Lake Biwa, resolution of conflicting resource-use interests among sectors, of severely strained relationships among the upstream, downstream and riparian local governments, and
of development impetus of industries vs. environmental conservation initiatives of citizens and local NGOs, etc., the stakeholder participation has been and will continue to be essential part of lake management. While there exist no set formula to bring about successful stakeholder participation, not to mention amicable resolution of conflicts themselves, the stakeholders must accept to live with conflicts that may be significantly ameliorated with mutual facilitation over the course of continuous dialogues.

- The central government can often play a crucial role in resolving conflicting interests among the riparian local governments, both in terms of being part of the river-lake basin institutional system and through political facilitation, often accompanied with legal, financial and institutional provisions. In the case of Lake Biwa-Yodo River management, the central government played dual roles, i.e., both as an important part of the river-lake basin system and as a facilitator with legal, financial and institutional provisions.

5.5 The linkages between the lake management program and the national and regional water resources management efforts

LBCDP was devised to meet the projected water resources needs of the Keihanshin Industrial Belt to cater for the thriving Japanese economy in the early 1970s. While water resource remains to be as important a factor to as 30 years ago, the subsequent environmental and ecological concern in lake management have evolved and grown also to become as important a national agenda as water resource development.

On one hand, the fact that Lake Biwa management has had strong linkage with the broader national and regional water resources management efforts greatly facilitated Lake Biwa achieve what the local government alone would never have been able to achieve, i.e., implementation of LBCDP. On the other hand, the strong linkage with regional and national water resources management efforts did significantly affect the environmental and ecological integrity of the lake watershed and its coastal zones. It is important for local government to be aware, therefore, that it receives due support from regional and national governments for the conservation of lake environments as well.

On the contrary, the lake management program of local government may have influence on the national policy with respect to water quality management within the entire water resources management. The Eutrophication Control Ordinance prompted the revision of the Water Pollution Control Law and enactment of Special Law for Lake Water Quality Conservation.

5.6 Scientific information and research

Underestimating adverse effects of the water level control on the littoral ecosystems was the largest failure of LBCDP. Although a lot of researchers were mobilized in the preparatory study of the project, even those researchers could not predict accurately the current issues facing Lake Biwa. This implies the limitations of science; science does not always help us make right judgment. However, it is also science that can reveal and repair the failures. The lake management cannot be feasible without scientific knowledge. As the long-term monitoring of Lake Biwa detected oxygen depletion at the bottom of North Basin, local research capability that makes possible a long-term field study is indispensable to lake research. To this end, the
The prefectural government has established a series of research institutes, and utilized outcomes of studies made by those organizations.

Furthermore, scientific knowledge is meaningless unless it is widely disseminated and become common knowledge among people. In the Soap Movement, enactment of the ordinance was made possible as people came to know the effect of phosphorus in synthetic detergents on eutrophication. In this line, the prefectural government has continued its efforts to ferment among people a common understanding of the lake issues with environmental education, including the floating school and Lake Biwa Museum.

- Sustainable lake management is synonymous to sustainable use of lake resources. Sustainable use of lake resources won’t be achievable unless the respective users agree to some basic principles in resource availability in the past, now and in future, with due protection and conservation measures collectively introduced. While the scientific knowledge today is still far too limited to determine how a particular lake fares with regard to the sustainability of resource values over the course of time, making judgment on resource sustainability without scientific knowledge in relation to possible natural and anthropogenic variances would be futile. A scientifically well-informed decision is important, not because that the decision will be correct, but because the decision can be assessed scientifically to be corrected with new scientific findings. While there is no good measure of the appropriate level of investment on science for lake management, the level of funds wasted for lack of scientific approach in management far outweigh the required investment.

6 References


Shiga Prefectural Government (1997) Lake Biwa -- Conservation of Aquatic Environments


Transportation capability of Shiga has been also improved significantly by the construction of motorway-topped levees around the lake, which was not however the primary objective of the construction.

In Japan, financial arrangement for the construction of sewerage system in general come 50% from the central government and 50% from local government. However, within the framework of LBCDP, additional financial arrangement (15%) eventually came from the central and downstream local government, and thus Shiga bore only 35% for the construction cost. The running cost of wastewater treatment facilities is born by each municipality and users. Although users in Shiga pay some 2 US$/m$^3$ of wastewater, municipalities have to fill a large amount of deficit.

The national government has protected rice cultivation farmers in full scale with its agricultural policy for many reasons. The financial revenues to rice are very high because of price supports. In addition, since most farmers cultivate part-time, they prefer rice, which is the least labor intensive farming today in Japan.

Any industrial wastewater must comply with effluent standards laid down in the Water Pollution Control Law and ordinances. There is no other regulation for industrial wastewaters since such laws and standards were made after long negotiation process among relevant ministries concerned.

Shiga Prefecture prioritized the control of point sources for eutrophication control simply because its cost performance was believed to be better than non-point sources. It should be also noted that erosion of farmland is not serious in Shiga because most of the farmland are terraced and bounded paddy fields.

The ordinance demands all houses be connected with sewerage system within three years after the completion of the construction in the area. However, there is no penalty for violation.

There is no specific financial mechanism in Japan for water management, except for the charge of wastewater as well as tariff for tap water. Most of public works including the construction of sewerage system are lacking financial mechanism to recover the expenses. This is mainly due to the political fact that public works have been implemented for job creation and local economic development. For the same reason, there was no evaluation mechanism for public works when LBCDP was in progress. However the idea to analyze cost-benefit and cost-effectiveness of public works at planning stage and evaluate administrative performance is getting more and more common today although such mechanisms are still in the middle way to develop.

Most of laws and ordinances today demand public comments prior through public hearing etc. to the finalization of plans. Some of ordinances including the Appropriate Leisure Use Ordinance and Mother Lake 21 Plan dictate the establishment of local people's organizations to fulfill the objectives.

The Central Government happened to play the crucial role in mediating between Shiga and the downstream local governments in the preparatory process of LBCDP, mostly because then central government had power, including financial power through budget and allocation rules sharing revenues between central and local governments, to resolve the conflict and was in a position of a third party. However situation today is much more complicated; wider range of stakeholders are invited into decision-making process. Dispute resolution is getting more and more problematic.