Sewerage Policies and Finances in Lake Basin Management, a Case of Lake Biwa, Japan

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1. Background

Resource development, use and conservation of lakes have been major undertakings across continents, particularly with regard to satisfying human needs within, and sometimes beyond, the lake basin. Because of their unique characteristics[i], however, lakes are extremely vulnerable to external stresses. The aquatic environments such as lakes can be easily impacted by the human-induced stresses, e.g., pollution loads from household and industrial sources, runoffs from land-based sources, as well as airborne pollutants. The sewerage systems (synonymous to wastewater systems[ii] in this paper) can play a very important role in reducing such pollution loads from households and other point sources of pollution. For the sewerage systems to be used for lake basin management, however, they have to be economically viable and technologically possible. The economic viability, in simple terms, has do with payment for the construction, operation and maintenance of the system not only for the amenity and environmental health benefits, but also for the keeping the lake water quality above a certain threshold value. The users may be willing to pay for the household amenity but they may not be able to afford the cost for improving the lake water quality. In particular, when the sewerage system is to be equipped with capability to reduce the nutrient concentration in the effluent water discharged to the lake, such cost has to be somehow paid for not only by the system users but also by the society at large.[iii] Regardless, the development of sewerage systems for lake basin management invariably requires mobilization of financial resources, technology application capacity, as well as due institutional basis for implementing the long-term program for construction, operation, maintenance, as well as management of the systems.

With the above in mind, this paper intends to give an overview of how the sewerage systems have evolved for fulfilling the above two purposes in Japan, particularly in the Lake Biwa basin in Shiga Prefecture. The information provided is hoped to facilitate the understanding of institutional and financial challenges to overcome in resorting to sewerage systems for lake basin management in the world, particularly in developing countries.

2. Lake Water Quality Problem and Improvement: A Legal Framework

Enactment of the eutrophication control ordinance in Shiga Prefecture in Japan was triggered by the sudden appearance of red tide in Lake Biwa in the late 1970's. The ordinance has led to the banning of the use of phosphorus-containing detergents within the prefectural jurisdiction. The spirit of this ordinance quickly spread across Japan, and indirectly led to, first in 1982, the inclusion of phosphorus and nitrogen as part of the national environmental quality standards for lakes and estuaries as required, second in 1984, the enactment the Law Concerning Special Measures for Conservation of Lake Water Quality (commonly referred to as "the Lake Law").

The Law specifically target those lakes where their water quality has been in urgent need of improvement, to be identified as the "designated lakes" by the Prime Minister. It aims at: (1) introducing special regulations to control pollutant discharges into the watershed of designated lakes over and above existing regulations of the Water Pollution Control Law, and at (2) carrying out comprehensive lake water quality improvement measures, in the form of "lake water quality conservation plan" for each of the designated lakes. [iv] The comprehensive measures should include projects for improving the effluent water quality of sewerage systems for the purpose of eutrophication control. It also stipulated the need for close cooperation among the national government, local governments, private enterprises, and local residents, playing an instrumental role in the shaping of lake basin management policy across Japan, including that for Lake Biwa. Currently, 11 lakes have been designated. The prefectural governments in charge of the designated lakes revise the water quality conservation plan every five years, with an assortment of legal, institutional and technological instruments.[v]

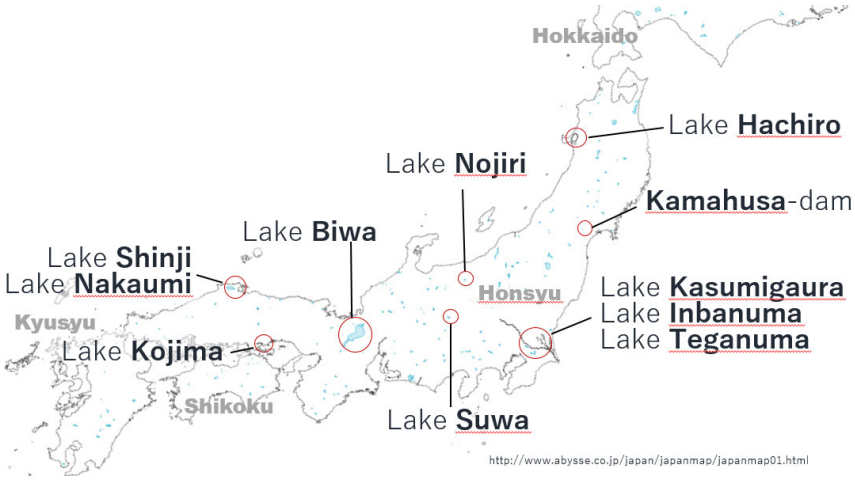

Figure 1 Designated Lakes for Lake Water Quality Conservation Plan in Japan

Though other policy instruments such as stringent enforcement of effluent discharge from industries also contributed greatly to lake water quality improvement, it is believed that the role played by the sewerage systems have been instrumental for suppressing the phytoplankton growth in the lake. Figure 2 shows the downward trends in TP (total phosphorus) concentration from around 1980 to around 2010, both in the South and North Basin. The TN (total nitrogen) concentration also showed a certain downward trend in the South Basin up till 2010. Although the COD concentration continued to increase during the period, the decreased in phytoplankton concentration over the time period led to the improvement in transparency.

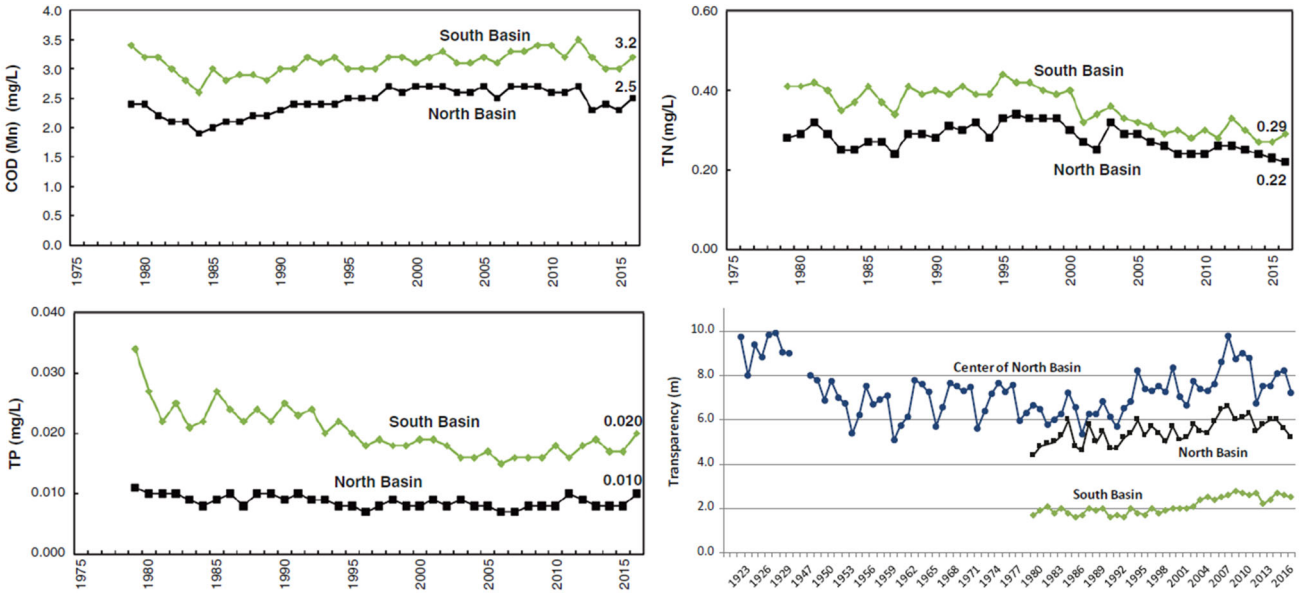

Figure 2 The Lake Biwa Water Quality Changes (Lake Biwa, 2020, pp.536-537)

3. Alternative Sewerage Systems in Japan

While the role played by sewerage systems has been instrumental in improving the Lake Biwa water quality, and in improving the household sanitation and amenity by the induced transformation from the privy type facility to the flushing type one, the Lake Biwa case may not necessarily be presentable as a typical and replicable example for those facing the similar challenges today particularly in developing countries. As a matter of fact, the Lake Biwa experience needs to be explained in the historical context, i.e., the evolution over several decades of sewerage policies and institutions in Japan as well as in the Lake Biwa region

3-1 The Dawn of Sewerage Systems in Japan

Let us first review the evolution of sewerage systems in Japan as a whole.

The first public sewer pipeline system in Japan, the Kanda Sewer in Tokyo, was laid in 1884-85 after the cholera epidemic in the 1880s. Subsequently, the first Sewer Law was enacted in 1900 for the purpose of upgrading the sewer system to deal with deterioration of urban sanitation. The Law played an instrumental role in preventing the spread of waterborne diseases and for improving the environmental hygiene in the low-land areas. However, the priority public investment was development of public water supply systems rather than sewerage at the time when Japan was still struggling to industrialize more for the purpose of militarization than for social prosperity. Nonetheless, the Public Cleansing Law administered by the Ministry of Health (hereafter referred to as MH) enacted in 1900 was revised in 1930 for municipal governments to take responsibility in collection, transportation and treatment of human wastes.[vi] The Ministry also took charge in improving the design of onsite holding tank (septic tank) system for the treatment of human excreta and household wastewaters. However, it was not popularized because of relatively high cost for installation and the inadequate provisions for the public hygiene improvement.

3-2 The Post WW-II Developments in Managing Human Excreta

The devastations of infrastructure systems caused by WW-II were not easily restorable after the war. For some time, the rampant discharge of wastewaters was quite common across the country, causing serious environmental degradation and frequent occurrence of waterborne diseases, as well as other public health hazards. Although the institutional disarrays still prevailed, management of human excreta was among the top priority issue for the nation, leading to the enactment of new legislations, mobilization of financing resources and development of new technical guidelines.

The development of sewerage systems was promoted in major metropolitan areas such as Tokyo, Osaka and Nagoya, but the collection of nightsoil for application to farmlands persisted in the suburban agricultural lands as well as in the rural areas. The on-site septic tank system that allows human excreta to be separately treated (called "Jokaso [meaning the cleansing tank]" or "Tandoku Jokaso [meaning a single chamber cleansing tank]") was developed around 1950 by the Kanagawa Prefectural Institute of Public Health. In 1953, MH legislated a national subsidy program to promote the system. Because of the subsidy and the gradual inclination toward flushing toilets, the system became popularly installed in areas where there was no public sewerage system. Thanks to the enactment of the Building Standards Act in 1950 that necessitated either connection to the public sewerage system or installation of an onsite sewage treatment and disposal system, the "Jokaso" system finally gathered momentum for popularization in areas where there is a plan for the public sewerage system to be developed. As in 1962, the treatment ratio of the total amount of human waste in areas designated by the Cleaning Law (enforced in 1954) implemented under the administration of MH was 6.0% for "the Jokaso system", while the corresponding figure for public sewers under the Ministry of Construction (hereafter referred to as MC) was 5.5%.

As Japan entered the era of high economic growth in late 1950s – early 1960s, the "Living Environment Facility Development Emergency Measures Law" submitted by the Cabinet Ministry was enacted in 1963, with the resultant provision of the "Five-year Plan for Development of Living Environment Facility" as emergency measures. This Plan consists of four separate five-year plans for "Sewerage System Development" (administered by MC), "Construction of Wastewater Treatment Plants", "Nightsoil Treatment Plants" and "Solid Waste Management" (all administered by MH).[vii] The Law enabled the national government to provide subsidies to the local governments to manage human excreta generated by the population of some 80 million out of the total population in Japan then of 100 million. The plan took into account the population to be served by the nightsoil system as 50 million.[viii]

The wastewater management issues faced by large business establishments were incorporated into the industrial wastewater treatment scheme administered by the Ministry of International Trade and Industry. Nonetheless, the use of septic tanks was still considerable among the small-scale business establishments located outside the public sewerage service area and in the areas where the public sewerage was unable to provide the needed service. On the other hand, MC being one in charge of implementing the Water Pollution Control Law[ix] and the Revised Sewerage Act (1968) gradually gained control in pollution control of the public water bodies for which the municipal sewerage systems was considered to play a key role.

3-3 National Program Framework for Sewerage Development

Under the jurisdiction of MC, the first five-year sewerage improvement plan was formulated for the period between 1963 and 1968, after which the five-year improvement plan was successively repeated till the terminal year of the 8th plan or 2002. The Ministry categorizes the sewerage system broadly into two groups, one being the "Public Sewerage System (PSS)" and another being the "Regional Sewerage System (RSS)".

PSS is defined as "a sewerage system managed by a local public body mainly for the purpose of eliminating or treating sewage in urban areas, with its terminal point being its treatment plant, or being the connecting point to a network of an RSS to which this PSS constitutes a subnetwork. As a general rule, PSSs are installed and managed by municipalities.

A Regional Sewerage System (RSS) is a sewerage system encompassing the service areas of two or more municipalities with a treatment plant to serve for all of the constituent municipalities. As a general rule, the installation and management of basin sewerage are carried out by the prefecture in charge, but the municipalities can also undertake such tasks in consultation with the prefecture.

In 1965, the first regional sewerage system was constructed in Neyagawa, Osaka, and in 1967, the Sewerage Improvement Emergency Measures Law was enacted to accelerate the development of sewerage systems in the whole of Japan.

In the meantime, the budgetary scale of Sewerage Improvement Five-Year Plan increased from 300 billion yen in the first plan (1963-1967), 600 billion yen in the second plan (1967-1977), and 2.6 trillion yen in the third plan (1971-1975). This third five-year plan period coincided with the inauguration year, 1972, of the Lake Biwa Comprehensive Development Project to be discussed under 3.6. The budget was further increased to 6.9 trillion yen in the 4th sewerage development five-year plan (1976-1980), 8.5 trillion yen in the large 5th plan (1981-1985), and 11.7 trillion yen in the 6th plan (1986-1990), reaching the population coverage to 44%. In addition, as mentioned earlier, the revision of the Basic Law on Pollution Control in 1982 added the standard values for total nitrogen and total phosphorus for lakes and other enclosed bodies of water, with the need for installation of tertiary treatment capability. However, there was still demand for septic tanks in areas outside the area of the sewerage development plan, and MH decided to issue a national subsidy program for the installation of "Jokaso" with capacity to take in not only the human excreta but also the household grey waters in 1987. Such a "Jokaso" type was named the "Gappei (meaning 'combined') Jokasho" as contrasted to the "Excreta-only Jokaso" or "Tandoku (meaning 'single purpose') Jokasho" in Japanese.

It is important to note that the LBCDP budgetary component during the 25 year period 1997 was 237 billion yen out of the total of 2 trillion yen, meaning that the large-scale financial mobilization for the Lake Biwa Regional Sewerage System was made possible under the exceptionally favorable public investment for the development of sewerage across Japan.

Table 1 Sewerage maintenance five-year plans

Term of the 5-year Plan	1st 1963-67	2nd 1967-71	3rd 1971-75	4th 1976-80	5th 1981-85	6th 1986-90	7th 1991-95	8th 1996-2000
Investment (billion yen)	300	600	2,600	6,900	8,500	117,000	16,700	23,700
Target % Population Served	27	33	38	40	44	44	54	66
Actual % Population Served	20	23	26	30	36	44	54	62

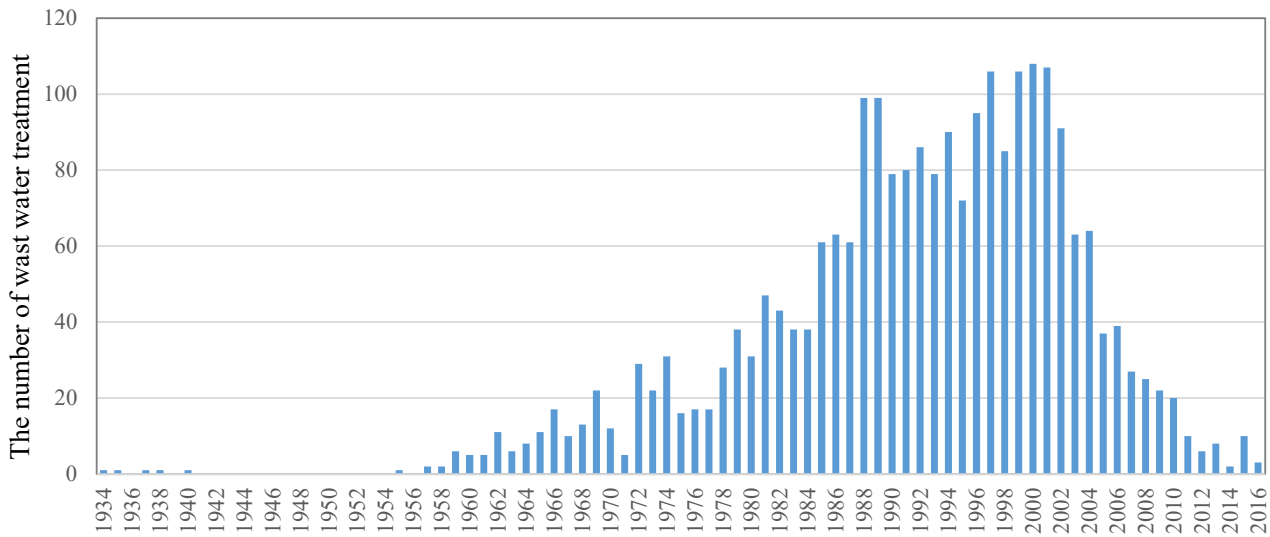

Figure 3 Trend of Public Sewerage System Construction

3-4 Rural Community Sewerage System

In the early 1970s, when MC successfully launched an all-out effort to obtain funds for sewerage development, the Ministry of Agriculture, Forestry and Fisheries (hereafter referred to as MAFF) also launched a drive to develop their own rural community sewerage project called the Agricultural Comprehensive Maintenance Model Project, with 1.5 billion yen for subsidization. The conceptual basis of the Agricultural Community Sewerage System (ACSS) is similar to that of PSS, except that ACSS is administered by MAFF. The overall program aims at conservation of ambient water quality mainly to improve the living environment of rural populations while contributing to the conservation of public water courses in the rural areas. In general,

their technical specifications include the installation of pipelines for collecting sewage from toilets, kitchens, baths, etc. of each household, and the construction and maintenance of a treatment facility (treatment plant) that cleans this sewage and discharges it into the river. While PSSs cover the city planning areas (urban areas), the ACSSs cover the rural areas.

Technically, an ACSS unit works in much the same way as a PSS unit, i.e., to collect and treat wastewaters generated in the rural settlements. Although the required treatment efficiency is set lower than that of PSS, the time required for construction is much shorter as the population served by each would be small, making it more economical than having a nearby PSS (if there is one) to extend its sewer line to include this agricultural community as part of its service area. In the meantime, there were problematic issues involving ACSS. For example, there were cases where the downstream communities confronted the upstream communities for the treatment effluents discharge by the former into the stream flowing down through the latter. Regardless, nationally as of 2018, about 5,000 facilities are in service in about 900 municipalities, accounting for 2.7% of the overall sewage treatment population coverage of 91.4%.

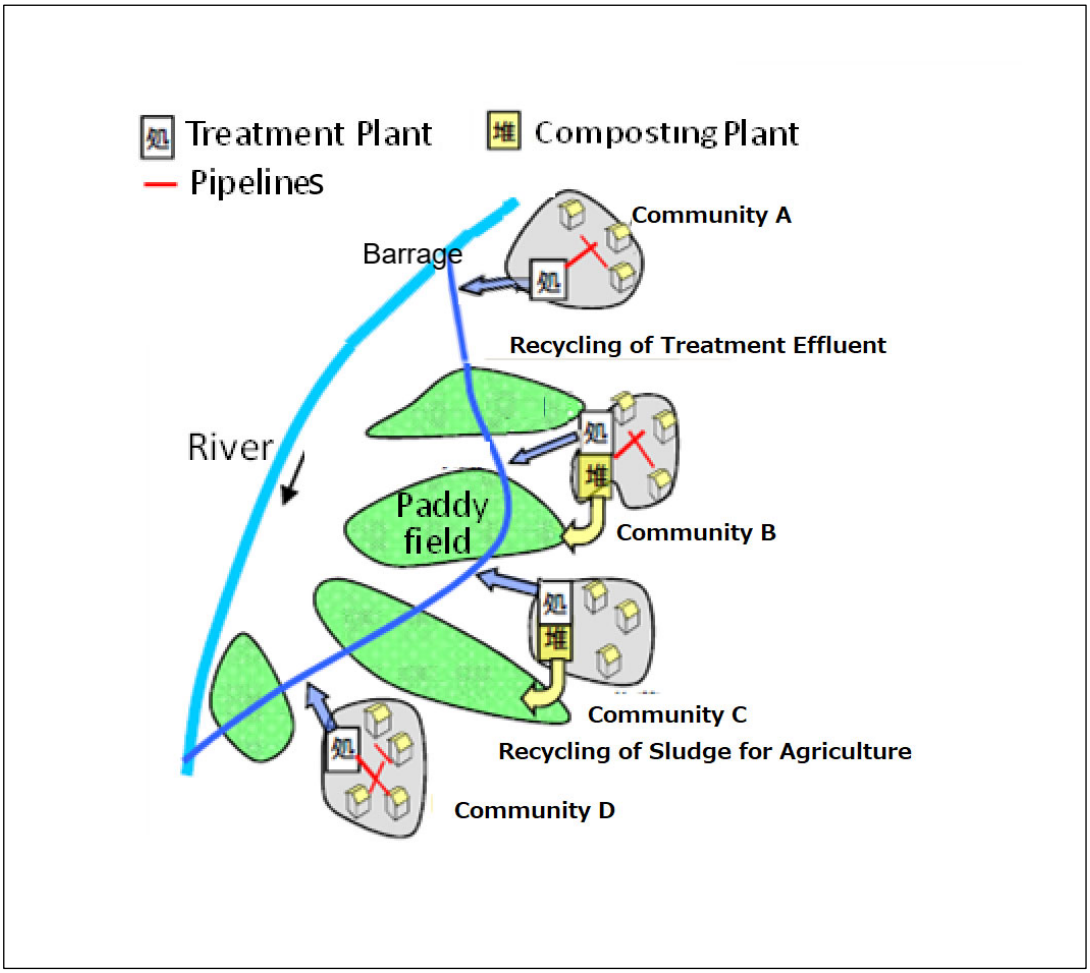

Figure 4. A Schematic of Agricultural Community Sewerage System

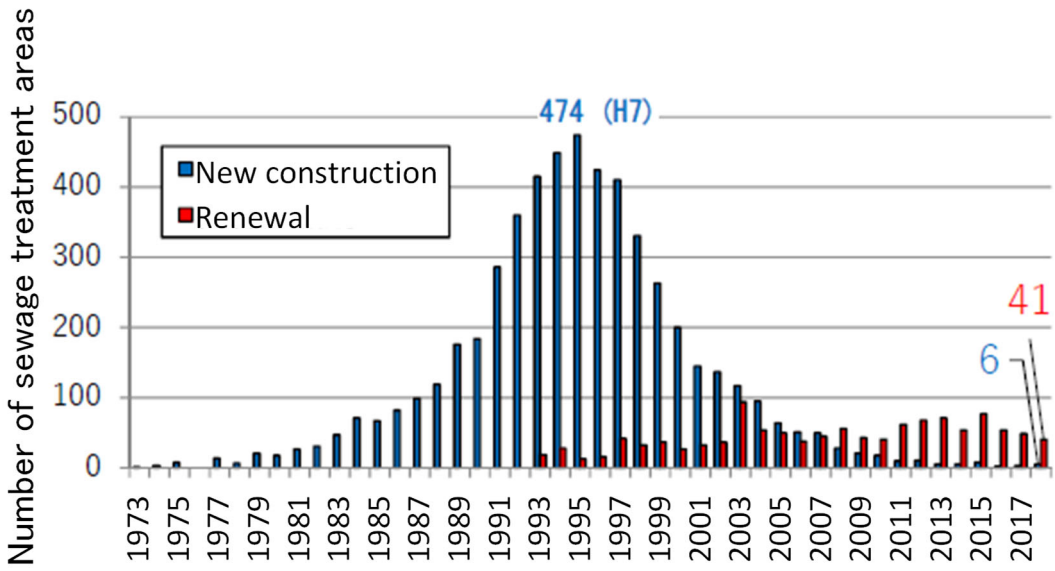

Figure 5 Promotion of Agricultural Community Sewerage System

On the other hand, the MC further increased the investment amount from 1976 to 6.9 trillion yen in the 4th sewerage development five-year plan, 8.5 trillion yen in the large 5th plan from 1981, and 11.7 trillion yen in the 6th plan. The sewerage penetration rate improved to 44%. In addition, the revision of the Basic Law on Pollution Control in 1982 added the standard values for total nitrogen and total phosphorus, which required advanced treatment of sewage. However, the demand for septic tanks persisted in areas outside the planned sewerage service area, and MH acquired a subsidy program for installation and maintenance of the more technologically advanced septic tank system, called the "Jokaso System" in 1987.

3-5 Consolidation of Policies among the Three Ministries[x]

The basic public investment plan issued by the Economic Planning Agency in 1990 stated that the percentage of population served by sewerage be set at 90% by the beginning of the 21st century. MC, MAFF, and MHLW[xi] had already been providing subsidies respectively for development of urban sewerage systems, rural sewerage systems and the "Jokaso" systems. In the first half of 1990, the "Jokaso" program having been implemented up till then by MHLW was transferred to the Ministry of Environment (hereafter referred to as ME). Subsequently, the Ministry of Land, Infrastructure, Transport and Tourism (MLITT in short; former MC till 2001), MAFF and ME jointly formulated an overall basic policy in 1995 for efficient improvement of sewage treatment, resulting in preparation of a manual for undertaking the same at the local government level. The work at the local government level was completed by 2007, and as a result, the decision was made to promote installation of "Gappei Jokaso" but to prohibit installation of "Tandoku Jokaso" in areas where there will be no PSS or ACSS expected to provide their services. The proportion of service coverage by these different systems is as shown in Figure 6.

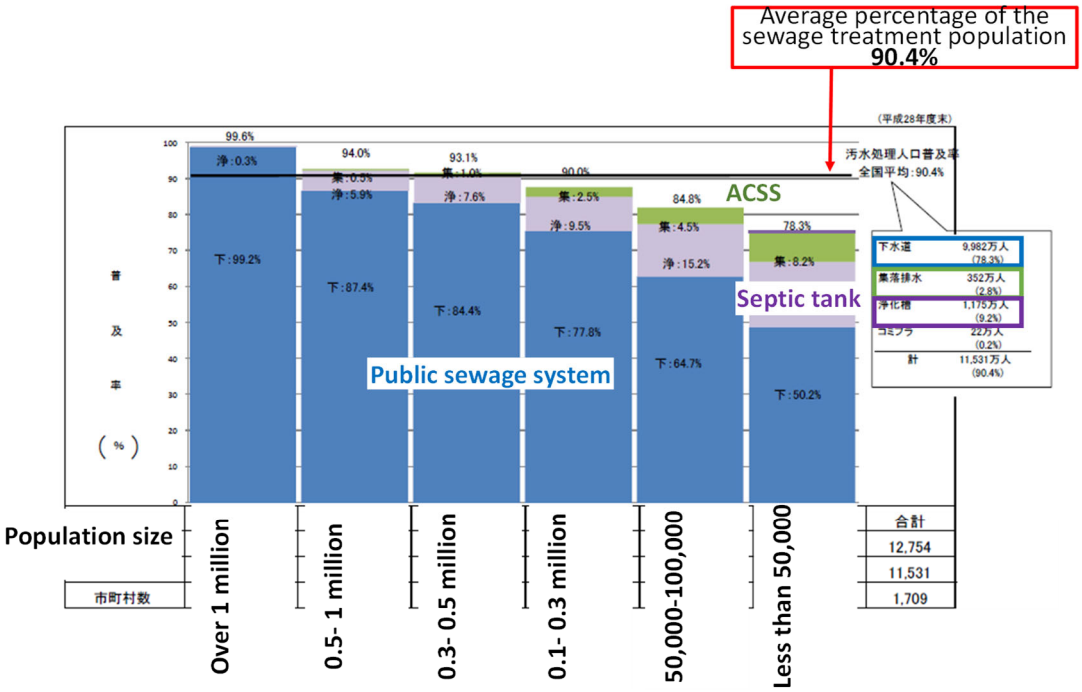

Figure 6 Percentage of Each Type of Sewerage System

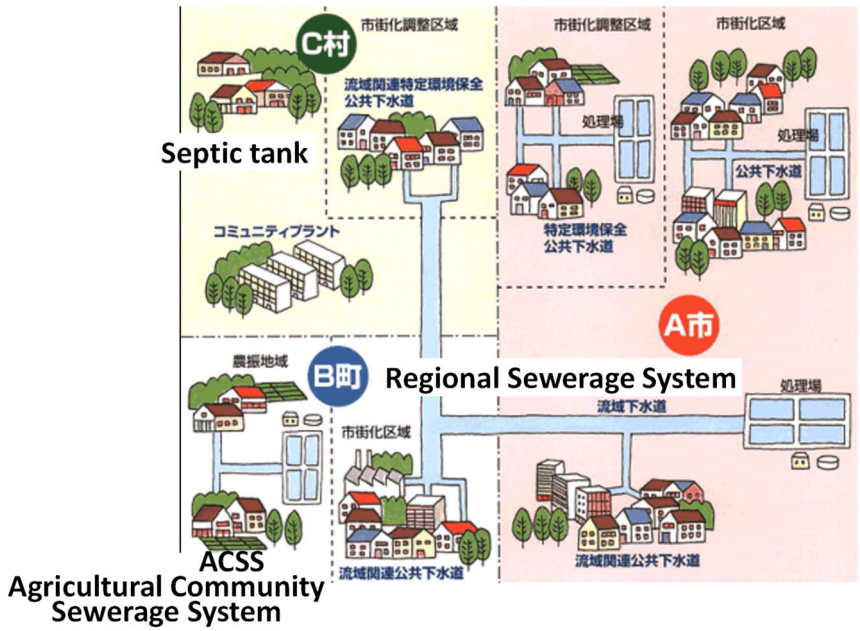

Figure 7 Type of Waste Water Treatment Systems

3-6 Sewerage Systems in the Lake Biwa Basin

As a background related to the conservation of the Lake Biwa basin, the Otsu City Industrial Sewerage was first put into service in the prefecture in 1969. From 1972, Lake Biwa Comprehensive Development was started based on the Lake Biwa Comprehensive Development Special Measures Law. In the same year, the prefectural

ordinance[xii] set the discharge standard on the human waste septic tank. The Lake Biwa Comprehensive Development Project extended by ten years in 1982, then by five years again in 1992, and ended in 1997. At the time of the first extension (until 1982), there was a demand for ACSS in areas outside of plan or with delayed progress, so ACSS had to be added to the Lake Biwa Comprehensive Development Project. The Projects had confusion for about ten years, including surrounding the construction of the basin sewerage system. The project continued until 1997. In 1984, the Lake Law was enacted, for reduction of water pollution in a designated lake basin.

In the case of Shiga Prefecture, the municipal wastewater (wastewater from commercial establishments, public buildings, small industries and general households) has been another major source of lake pollution. More than one-third of the TP and more than a quarter of TN and COD loads are attributed to this source of input. Three major categories of sewerage systems, aside from the public sewerage in the City of Otsu that has been operating since the mid-1960s, have been instituted in the Lake Biwa basin (Figs. 6 and 7). They are: the regional public sewerage program, which is catered for by four regional service districts, each with a large centralized treatment plant (57% population coverage as in 1998), the rural sewerage program consisting of some 200 individual community service systems (12.3%), and the on-site treatment technologies servicing individual households not yet served by either of the above two programs (30.8%) (Lake Biwa: Have Sustainable Development Been Met?). There are 39 sewerage enterprises in 19 municipalities. The earliest sharing started was the Otsu City Public Sewerage in 1969, eight businesses started in 1982, and the development progressed from 1986 to 2000. Of the 39 entities, 1 is basin sewerage, 18 is public sewerage, and 20 is public sewerage for specific environmental conservation.

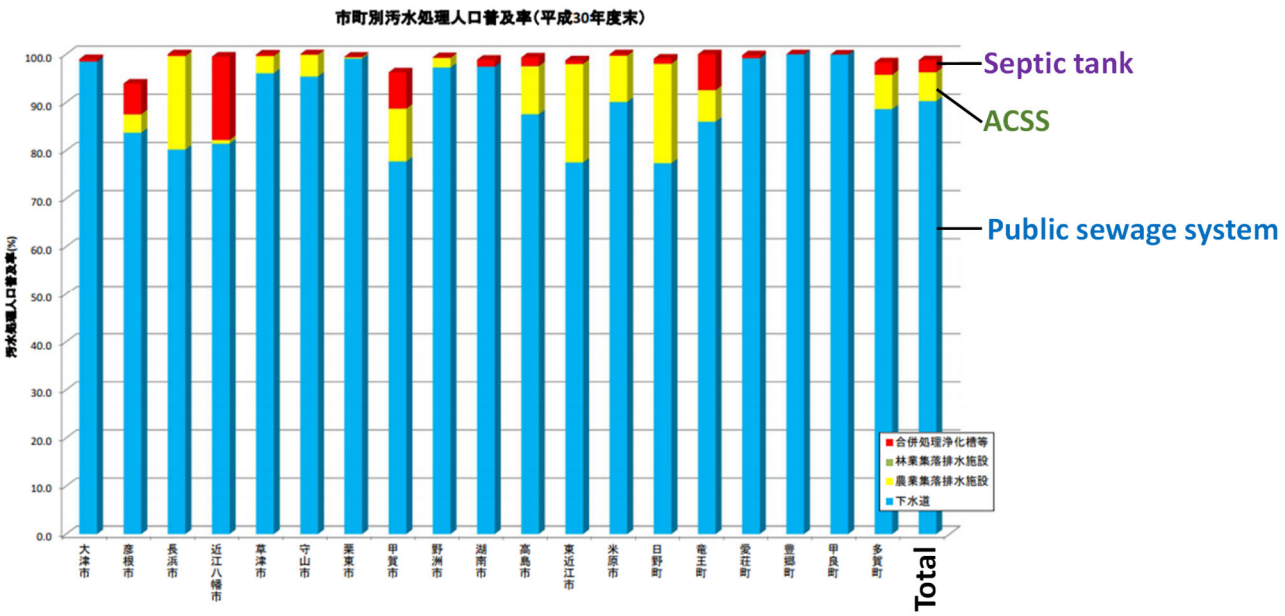

Figure 8 Different type of System in Each City/Town in Shiga Pref.

4. Finance System for Sewage Treatment

4-1 Outline of Sewage System Finance

The Sewerage Law was enacted in 1958, and the weight of sewerage construction in public works projects increased from the 1960s. In particular, sewerage was positioned as one of the main measures of the four totals, which was "water resource development / conservation, comprehensive management of water system".

Basic conceptual framework on sewerage system cost sharing by the individual citizens and by the government was as follows:

- 1961: The proposed basic concept was that the cost for sewage management to be borne by the individual citizens, and the cost for rainwater management was to be borne by the government, i.e., individual citizens' proportion (sewage treatment and disposal) 5 vs. governments' proportion (i.e., low-land and storm water drainage) 5
- 1966: The proposed basic concept was that the weight for the government burden for the sewage management to be increased, i.e., individual citizens' proportion 3 (responsible for payment for the sewage treatment and disposal services) vs. governments' proportion 7 (i.e., responsible for payment for the low-land and storm water drainage)
- 1973: The national government bear the responsibility for fulfilling "the national minimum", i.e., to provide the entire population, i.e., all individuals should be provided with adequate sewerage facilities by the government but they need pay for the sewerage service received, i.e., operations and maintenance costs. Those residing in the rural areas and in the areas to be environmentally protected need to be preferentially treated, i.e., to bear less than the urban dwellers.
- 1979: The national government, local governments and the individual citizens should all to bear the appropriate levels of financial burden. Those residing in small and medium size urban areas, in agricultural and fishery communities be appropriately supported financially.
- 1985: The same as in 1979, i.e., the sewage treatment cost to be borne by individual citizens, the stormwater treatment cost to be borne by the governments. In cases where the costs are excessively high, due considerations may be given for subsidization.

4-2 Financial Sources for Sewerage Systems in Japan

First, the sewerage business is managed independently by the local government as a public enterprise account (sewerage business account) instead of a general account. Sewerage costs are divided into "capital costs" such as construction costs and "maintenance costs". Most of the capital costs are covered by national treasury subsidies and local bonds, and the beneficiaries bear only the cost of developing end culverts. Local bonds are redeemed at a fixed amount every year from the viewpoint of intergenerational equity. The maintenance cost is based on the principle of public rainwater and private sewage, and the financial measures differ depending on the type of sewerage. Since 2006, in the case of the public sewerage (confluence type), 60% of treated water is rainwater and 40% is sewage. Seventy percent (70%) of the cost for rainwater is covered by local allocation tax, and the remaining 18% is covered by the general financial resources of the local government. Although 40% is covered by the user fee, in reality, the user fee alone cannot cover it, and many local

governments transfer it from the general account. In the case of “separate sewer” system (the sewers for discharges from households and other establishments and the sewers for stormwaters are separate systems” , the public expense burden rate changes depending on the population density in the treatment area, but in general, the ratio that should be covered by the user fee is higher than that in the “combined sewer” system (the same sewer system is used for collection and treatment of households and other point-source wastewater as well as for collection of stormwaters directly to public water courses; the system poses a problem of pollution by point-source wastewaters being directly discharged to water courses at time of storm weather). Except for public sewerage such as ACSS, 70% of rainwater and 30% of sewage, 70% of rainwater (49% of the total) is covered by local allocation tax measures, the remaining 21% is covered by local governments, and 30% is covered by royalties. The financial burden for sewage treatment by law is mentioned in the articles of the Water Pollution Law and the Sewerage Law, but other laws do not clearly describe the financial resources measures for lake conservation.

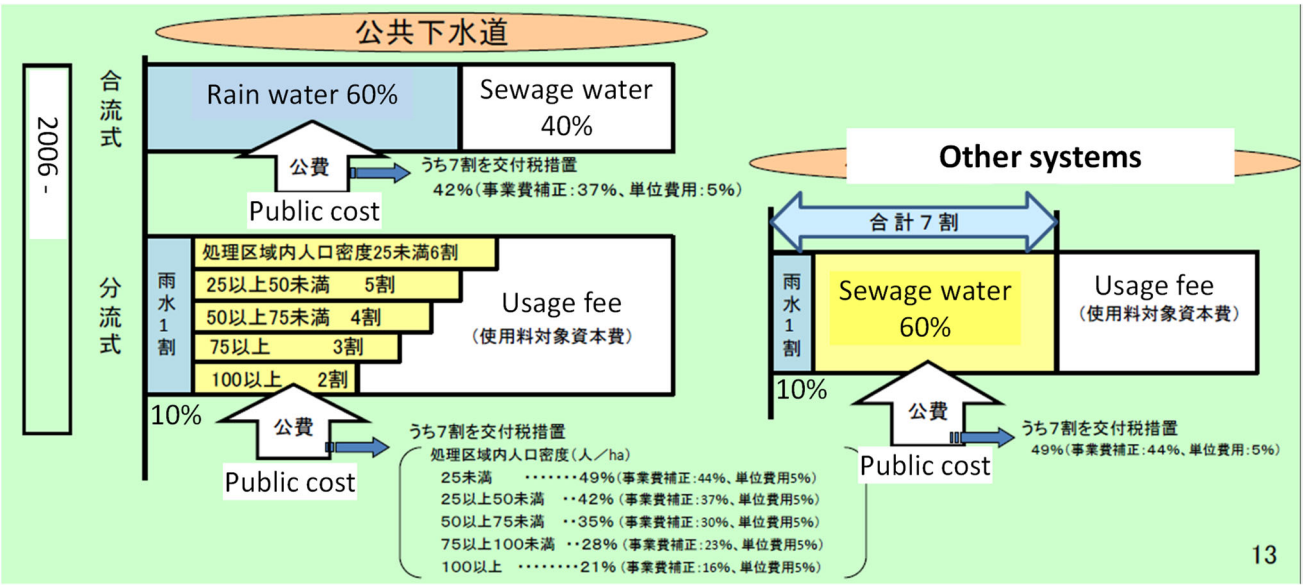

Figure 9 Sharing of the Cost Burdens by National Government, Local Government, and Users

As a guideline for the beneficiary burden for each business category, if the monthly household user fee is 20 m3, the average user is cheaper as the population density in the treatment area increases in public sewerage, and local governments with 100 or more people per ha. In contrast to about 1,800 yen for municipalities with less than 25 people, this amount is about 3,000 yen, which is almost the same as the average user fee for treatment facilities other than public sewerage.

4-3 Assessment of the Transgenerational Sharing of Sewerage Service Costs

In this section, the determination of incurred costs for construction, operation and maintenance of sewerage systems in the Shiga municipalities have been attempted for two types of PSSs, i.e., the first type being the municipal sewerage systems in the areas designated as the urban area, and the second type being the environmental conservation sewerage systems in the areas designated as the "pseudo urban" area. Of a total of 19 municipalities (13 cities and 6 townships), 14 are served by both types of sewerage. The user fee varies greatly from 113 yen to 239 yen per ha. In addition, based on the assumption of 20 cubic meters per household per month, the calculated user fees are generally higher than the national average (indicated as those cells highlighted in yellow for the public sewerage, and those cells highlighted in yellow-green for the specific environmental protection sewerage). As for the coverage rate by the user fee out of the overall incurred costs for managing the sewerage system by each of the municipalities, the rate is less than 50% for a majority of the municipalities (the brown highlighted rows under the column "Coverage rate of user fee".

Table 1 The municipal sewerage system user fees in Shiga Prefecture

		Area (ha)	Population (people)	Population density (people/ha)	Usage fee (20㎥/mounth)(yen)	Coverage rate of usage fee
A city	PS	5,313	331,076	62	3,691	73.8%
A city	PSD	214	5,217	24	3,761	29.5%
B city	PS	1,881	83,587	44	3,264	36.0%
B city	PSD	266	7,117	27	3,264	22.4%
C city	PS	1,927	62,901	33	3,374	57.2%
C city	PSD	1,536	32,070	21	3,374	44.5%
D city	PS	1,248	56,389	45	3,196	46.8%
D city	PSD	240	6,414	27	3,052	19.4%
E city	PS	1,797	107,551	60	2,649	64.5%
E city	PSD	631	17,352	27	2,649	38.1%
F city	PS	1,333	72,315	54	2,765	65.8%
F city	PSD	211	5,164	24	2,266	26.3%
G city	PS	1,628	66,819	41	2,412	60.7%
H city	PS	1,929	38,367	20	2,853	42.7%
H city	PSD	820	32,612	40	2,853	42.7%
I city	PS	900	37,337	41	3,572	84.3%
I city	PSD	314	10,203	32	3,579	84.3%
J city	PS	1,680	52,466	31	3,035	52.6%
J city	PSD	80	787	10	3,035	52.6%
K city	PS	969	23,354	24	3,695	37.5%
K city	PSD	1,081	18,403	17	3,695	34.6%
L city	PS	1,655	58,630	35	3,307	65.8%
L city	PSD	886	27,642	31	3,306	42.1%
M city	PS	1,006	18,783	19	3,132	33.4%
M city	PSD	758	16,982	22	3,131	33.5%
N town	PS	399	8,258	21	2,366	34.9%
N town	PSD	295	8,506	29	4,785	46.5%
O town	PSD	388	10,396	27	2,921	37.6%
P town	PSD	906	21,007	23	3,010	43.0%
Q town	PSD	369	7,407	20	3,089	43.6%
R town	PSD	403	7,367	18	2,913	25.4%
S town	PS	210	4,791	23	3,678	60.3%
S town	PSD	120	1,893	16	3,678	52.0%

PS: Public sewage system

PSD: Public sewage system for designated area

50-75people /ha	PS・Above average	Less than 50%
25-75people/ha	PSD・Above average	
Less than 25 people/ha		

The computational process for Table 1 can be described in detail using the case of Kusatsu City, shown below. For the fiscal year 2017, the amount of receivable water was about 15,000 million m3, and the total user fee amount collected was about 1.9 billion yen as shown in the income balance, but the amount fell short by about 480 million yen that had to be covered by the general account budget. As for expenditure, about 830 million yen was paid as the proportionate cost burden to share for Shiga prefecture. On the other hand, concerning capital income, corporate bond redemption (debt repayment) accounts for more than half of the expenditure, about 1.9 billion yen, and for that purpose, about 770 million yen of new corporate bonds had to be issued. Besides, about 780 million yen had to be borrowed from the city's general account. Still, the shortage of 1.2 billion yen had to be paid out of the profit balance.

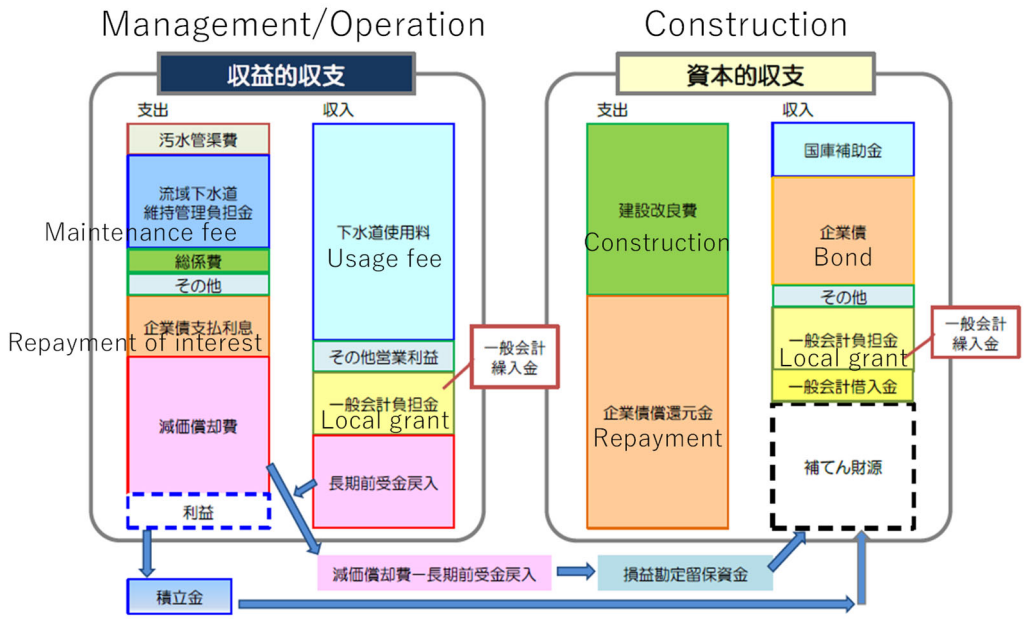

Figure 11 The Balance of Payments for Sewage System in Kusatsu City

On the other hand, in the case of ASCC, out of the expenditure of about 2.5 billion yen, 580 million yen was covered by the royalties and about 1.1 billion yen was covered by the city's general account. Unlike the sewerage system, there is no national subsidy for the capital expenditure. Therefore, about 300 million yen was borne by the city's general account, but the redemption amount of corporate bonds is 900 million yen, making about 600 million yen short. In conclusion, in either the PSS case or the ACSS case, paying off the capital cost as well as the operations and maintenance cost out of the user fee revenue would not be possible. The city has to depend on its general account disbursement and on the national subsidies.

5. Review of Other Means of Financing in Lake Basin Management

5-1 Fulfilling the Budgetary Requirements for Legislated Management Plans

There is no stipulation about the budgetary provisions in “the Lake Law” about the implementation of activities identified in the lake water quality conservation plan being developed, except for the statement, "the national government and local governments should endeavor to take the necessary financial measures". All of the required stress reduction activities in the “Lake Water Quality Improvement Plan” to be revised every five years. However, the governmental sectors responsible for reducing or ameliorate the level of stress causing activities or for undertaking the mitigation activities may be able to arrange for financing for such activities within their sectoral decision-making process by, for example, making a case for additional level of funding for fulfilling their respective sectoral responsibilities.

As an aside, there is another law administered by MLITT entitled the “Law for the Promotion of Nature Restoration” which came into force in 2003 with the aim of regaining previously damaged ecosystems and other natural environments. To date, a council was established at Lake Kasumigaura, Lake Nakaumi, Lake Izunuma / Uchinuma, and Lake Mikatagoko to undertake activities contributing to fulfilling the purpose of the Law. However, there is no stipulation in this Law also about subsidization for such activities, similarly to the case with the “Lake Law”. As in the “Lake Law” case, the mobilization of financial resources is realized based on the prevailing budgetary considerations by the sector agencies in charge.

5-2 National Government Grants for Conservation of Lake Ecosystem

Although not exclusively targeted to lake basin management, there are reported cases where the activities are undertaken using the grants from ME and MLITT for the purpose of ecosystem conservation and restoration. For example, the grantee bodies undertook activities at the Lake Mikatagoko project sites in Fukui Prefecture in 2008 using the promotion project grant from MOE. Similarly, the grantee bodies undertook a project in 2010 administered by MLITT for what is called the “social capital development comprehensive grant / integrated river environment improvement” at project sites in Lake Inba-numa in Chiba Prefecture.

5-3 Use of the Special-Purpose Taxation at the Prefectural Level

There are cases where the prefecture has established its own ordinance, collects taxes for the purpose of conserving lake basins, and uses them as financial resources for conservation policies for forests and lakes. For example, in Ibaraki Prefecture, the Ibaraki Prefecture Forest and Lake Environmental Tax Ordinance was enforced in 2008, and the tax is collected from individuals and corporations and used in environmental conservation policies such as forest, lake and river conservation. In 2009, Shiga Prefecture enforced the Lake Biwa Forestry Prefectural Tax Ordinance, which collects 800 yen for individuals and about 11% of corporate prefectural tax for corporations annually. This is utilized in the forest development policy, which is the source of Lake Biwa.

5-4 Budget for Research and Demonstration Experiments

In some cases, research and experiments that contribute to lake conservation are conducted with the support of the Ministry of the Environment. For example, Kahokugata in Ishikawa Prefecture was selected for the

Environmental Technology Demonstration Project from 2006 to 2008, and Nakaumi in Shimane and Tottori Prefectures was selected for the Comprehensive Environmental Research Promotion Fund from 2008 to 2010.

5-5 Budget for Civic Activities and Council Management

The prefectural governments may provide funds for citizen groups and researchers to carry out the civic-oriented activities managed by duly established councils. For example, Shizuoka Prefecture and Hamamatsu City contribute 7 million yen a year to promote civic activities for the conservation of Lake Sanaru. Similar arrangements were made by Kagoshima Prefecture, Ibusuki City, and Minamikyushu City to establish a council for the conservation of Lake Ikeda. In Yugabuchi in Aichi Prefecture, four cities in the basin established a fund to establish the Yugabuchi Water Quality Purification Promotion Council. In Kahokugata in Ishikawa Prefecture, 2 cities and 2 towns in the basin each contributed 500,000 yen (2 million yen in total) for the Kahokugata Environmental Measures Period Alliance to undertake activities to assist the Nature Restoration Council.

6. Summary and Conclusion[xiii]

This paper was prepared with the intention to give an overview of the sewerage policies and finances in lake basin management in Japan, with particular reference to the Lake Biwa Basin region, or Shiga Prefecture. Historically, there were occasional incidents of epidemics in late 19th through mid-20th century when improvement of human excreta management and water pollution control were only slowly making progress. The WW2 devastations and the subsequent population increase and rapid industrialization in the 1950s and 1960s was hardly matched by the amount of environmental infrastructure investment, resulting in rampant water pollution and public health outcries. It was in late 1960s and early 1970s when the legal frameworks were aligned to accelerate the environmental and sanitation infrastructure investment, with mobilization of the necessary financial resources by the responsible national and local government offices. The process, however, was a nebulous one. A public sewerage system was introduced for the first time in Shiga Prefecture in 1969, with only a few percentages of population served by the system even in the 1970s, with on-site septic tank system still serving most households. In fact, the urban and suburban areas in Shiga Prefecture were only gradually served by the public sewerage system, while the onsite systems and rural community sewerage systems coexisted in disarray for some time. It was in mid-1990s when the fragmented sectoral policies and programs on sewerage management began to be unified. Though the stagnant economy in Japan over the last few decades has deterred the environmental infrastructure investments, the progress in the construction of public sewerage systems was continued to date, having the population coverage today having reached slightly more than 90 percent.

The transgenerational sharing of sewerage service costs were computationally assessed for the case of Lake Biwa sewerage systems, i.e., the incurred costs for construction, operation and maintenance of sewerage systems in the Shiga Prefecture. The municipalities are served by two types of PSSs, i.e., the first type being the municipal sewerage systems in the areas designated as the urban area, and the second type being the environmental conservation sewerage systems in the areas designated as the “pseudo urban” area. Of a total of 19 municipalities (13 cities and 6 townships), 14 are served by both types of sewerage. The user fee varies

greatly from 113 yen to 239 yen per ha. In addition, based on the assumption of 20 cubic meters per household per month, the calculated user fees are generally higher than the national average. As for the coverage rate by the user fee out of the overall incurred costs for managing the sewerage system by each of the municipalities, the rate is less than 50% for a majority of the municipalities. The cost of introducing the treatment facility is borrowed from the government for intergenerational equity and is returned little by little every year, but it is expected that the income will decrease due to the decrease in the population of the treatment area in the future. Besides, the government has borrowed more money to repay the debt, and the future of repayment is uncertain. At the time of construction, the hurdles for introduction were lowered by subsidies from the government, but it is necessary to carefully consider the financial system for sewage treatment, taking into account the subsequent maintenance, the amount of water yielded, and the estimated amount of income.

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[i] Three features to be highlighted are 1. Integrating Nature (Everything comes together), 2. Long Retention Time (Problems remain long, and finding solutions also takes long time) and 3. Complex Response Dynamics (Everything affects everything else in water). (Need to refer to "RCSE and ILEC. 2014, "Development of ILBM Platform Process: Evolving Guidelines for Participatory Improvement. 2nd Edition [https://www.ilec.or.jp/wp-content/uploads/pub/DevOfILBMPP_en_2nd.pdf])

[ii] The Japanese terminology applied to "sewerage systems" literally expressed as "the lower water system" as contrasted to the terminology applied to "drinking water systems" literally expressed as "the upper water". While the terminology of "the lower water" does connotes a sense of "wastewater", it has historically contributed to the urban-suburban metabolism of nutrients through the traditional practice of nightsoil transported out of the urban area to the suburban agricultural fields for application as fertilizers, implying that "the lower water" does not necessarily imply that they are "wastes". In the above sense, the term "sewerage", rather than "wastewater" suits well in discussing the subject in the historical context in Japan.

[iii] Containing over 90% of the world's liquid surface freshwater, natural and artificial lakes provide many uses for sustainable human livelihoods and economic development, while serving as essential habitats for a great variety of flora and fauna. Resource development, use and conservation of lakes have been major undertakings across continents, particularly with regard to satisfying human needs within, and sometimes beyond, the lake basin. Lakes are vulnerable, however, and their overall condition is deteriorating. Lake basins are easily impacted by complex land and water relationships; they receive water, sediments, contaminants, nutrients and biota from rivers, surface runoff, groundwater, and the atmosphere. Because of their unique characteristics, lake systems are much more vulnerable to stresses, and more difficult to manage, compared to river systems (ILEC, 2007)

[iv] The details of the planning process is described in Okada and Perterson (2000). The descriptions on the revised Law, which now include nonpoint source control by designating the Lake Environment Protection Area, is given in Kai-Qin, et. al. (2009).

[v] The above Law was revised in 2005 to include the corrective measures for non-point sources of pollution from agricultural activities and other land-based sources. And in the case of Lake Biwa, the legal framework has been expanded further, i.e., the Act for the Conservation and Restoration of Lake Biwa in 2015.

[vii] Please note that, for some time, the inter-ministerial rivalries prevailed in that the construction and management of sewer pipeline networks was placed under the jurisdiction of the Ministry of Construction based on the Sewerage Law, and the construction and management of treatment plants was placed under the jurisdiction of the Ministry of Health based on the Cleaning Law.

[viii] http://www.env.go.jp/recycle/waste/0-1josyou.pdf

[ix] https://www.mlit.go.jp/crd/sewerage/rekishi/02.html

[xii] (the ordinance that establishes the emission standard based on the provisions of Article 3, Paragraph 3 of the Water Pollution Control Law)

[xiii] **<Supplementary Information>**

However, the issues were that a huge investment was required and that the period until the water quality improvement effect was realized was long. It should be noted that the situation was not full-scale efforts to reduce the surface source load that affects agricultural production activities. When the facility maintenance project began to take off in the 1980s, the treatment facility reduced the appropriate pollution load, and the water quality gradually improved.

Regarding lake water quality, environmental standards have been set for each lake under the Act on Advancement of Project for Quality Management of Raw Water. At that time, it was necessary to ensure consistency between related laws.

1958 Act on water quality conservation in public water bodies
Law for regulation of industrial wastewater
1958 Sewerage Act
1967 Basic Pollution Act
1970 Water Pollution Prevention Act
1983 Purification Tank Act
1984 Act on Advancement of Project for Quality Management of Raw Water
2015 Act on the conservation and restoration of Lake Biwa

X-1 Shiga Prefecture Ordinance for Lake Biwa Conservation.

Shiga Prefecture has formulated ordinances related to Lake Biwa conservation.

1980 Prefectural Ordinance Concerning the Prevention of Eutrophication of Lake Biwa
1992 Ordinance on the Reed Beds around Lake Biwa
1992 Anti littering Ordinance
1996 Basic Environmental Ordinance," "Ordinance to Promote Domestic Wastewater Measures
2003 Ordinance relating to the Appropriate Leisure Usage of Lake Biwa,
2003 Ordinance for Environmentally Friendly Agriculture Promotion
2004 Lake Biwa Afforestation Ordinance
2005 Ordinance for Prefectural Tax for Lake Biwa Afforestation

- On the premise of building a system based on the national sewerage development promotion policy, sewerage development was promoted to be consistent with the prefecture-led efforts.
- Regarding the reduction of agricultural pollution load, we tried to make it consistent with the legal system regarding the use of fertilizers and pesticides in the national agricultural policy.
- Some have built a unique legal system that reflects the prefecture's unique guidelines. Only the Water Pollution Law and the Sewerage Law refer to financial security in laws and ordinances.
- There is no clear description of other laws regarding financial resources for lake conservation.

X-2 Various types of water quality standards

1) Water quality standard for drinking water (specified by the Water Supply Act)
2) Water source water quality standards (It is stipulated by the Act on Advancement of Project for Quality Management of Raw Water. Standards are set for each purpose of use, such as the water quality at the water intake of the water purification facility, and if the raw water quality exceeds the capacity of the water purification facility, water intake is stopped and water is supplied from another system.
3) Water quality standards for discharge to public water areas (there are penalties stipulated by the Water Pollution Prevention Act. The law involves penalties.)
4) Environmental standards specified by the Basic Environment Act. The purpose of the law is human health and environmental protection and there are no penalties.