

Chapter 10 LAW CONCERNING SPECIAL MEASURES FOR THE
 PRESERVATION OF LAKE WATER
 QUALITY AND THE EFFECTS
 OF THE LAW

1. The Present Condition of Lakes of Japan

1.1 Types and Number of Lakes in Japan

The number of lakes in Japan, including those being made artificially with diameter more than 100 m, is approximately 11,600 ¹⁾. According to a national wide survey which was carried out by Environment Agency in 1984, total number of lakes having water area more than 0.1 km² and watershed area more than 1km² is 1,120. Approximately 80% of those are artificial lake, e.g., dams for water supply and ponds for irrigation use. When comparing by water volume, however, about 90 % of lake's volume is occupied by natural lakes (Table 10-1) ¹⁾.

When we take account of small-scale lakes and ponds, the number of dams with bank which

Table 10-1 Number of lakes and dams in Japan*		
Lake type	Number**	Total volume 10 ⁶ m ³
Natural lakes	197 (17.6%)	117,435 (89.4%)
Dams	763 (68.1%)	13,521 (10.3%)
Ponds	160 (14.3%)	346 (0.3%)
Sum	1,120	131,302

* source: Research results by Japan Environmental Agency (1984)
 **lakes with area more than 0.1km² and with watershed area more than 1 km² except salt lake

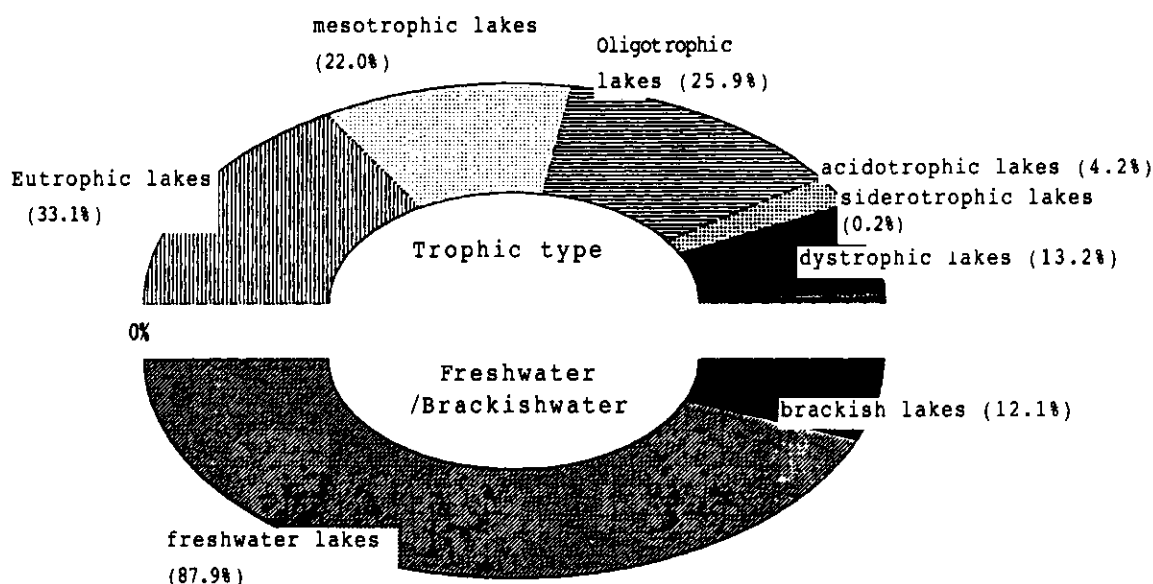


Fig.10-1 Types of lakes in Japan

height more than 15 m constructed by 1983 are 2462, and irrigation ponds with served area more than 1.0 ha are 97,564 in 1981.

Japan Environment Agency is conducting the surveys on lakes with water area more than 1 ha (app. 480 lakes) for investigating water quality, lake shore condition, species of fishes, etc. every five year from 1979²⁾³⁾. According to the survey, as shown in Fig. 10-1, when lakes are classified by nutritional state, number of eutrophic lake is largest (33%), secondary oligotrophic lake (26%), thirdly mesotrophic lakes (22%). On the other hand, when lakes are classified by fresh water lake and brackish-water lake, the number of former is larger than latter: app. 88% is freshwater lake.

1.2 Water Quality of Lakes

Water quality of lakes in Japan is deteriorated remarkably in recent years, due to the increase in pollution load associated with the land developments and economic activities around lakes. Achievement rate of environmental standards of lake water quality measured by chemical oxygen demand (COD) is lower (around 40%) than that of rivers or sea area (Fig. 10-2). Furthermore, problems on water use by eutrophication are becoming serious in a part of lakes, e.g., problems on filtration at water treatment plants, odor of drinking water, occurrence of freshwater red tide and bloom of blue-green algae. The condition of water quality and problems for water use at main lakes in Japan are shown in Table 10-2¹⁾.

2. Law Concerning Special Measures for the Preservation of Lake Water Quality (the Lake Law)

2.1 Circumstances of the Establishment of the Law

The improvement of water quality of lakes in Japan is not clear, although we have carried out such measures as establishment of national effluent standard, upgrading of the effluent standard and construction of sewerage system. The reason of the stagnation of improvement of lake water quality is considered as follows:

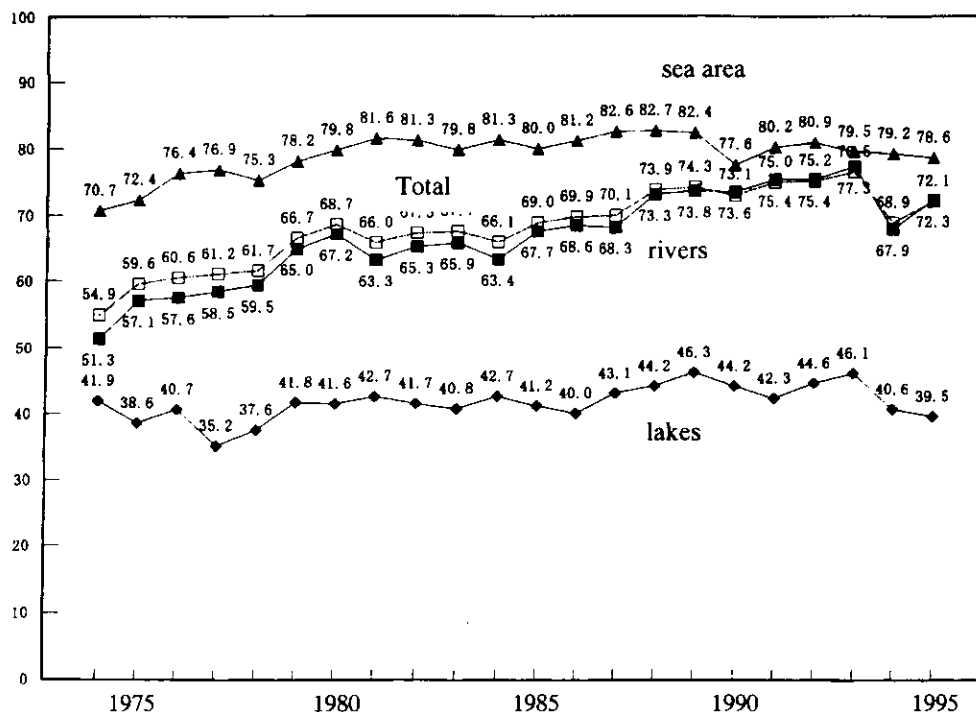


Fig.10-2 Changes in attainment rate of environmental standard of BOD、COD.

lakes	prefecture	COD Environmental standard	COD			water use	problems of water use (1972-)
			1982 75% value	1994 75% value	attainment		
		mg/l	mg/l	mg/l			
Lake Biwa	Shiga	Northern lake 1.0	2.6	2.9	×	drinking, irrigation, industrial use, aquaculture, fishing,	odor of tap water clogging of sand filter
		Southern lake 1.0	3.9	3.8	×	boating, leisure	death of fish unsuitable for water bathing
Lake Kasumigaura	Ibaraki	3.0	11	western lake 10	×	drinking, irrigation, industrial use,	odor of tap water death of carp in aquaculture
				Northern lake 8.8		aquaculture, fishing, boating	unsuitable for water bathing
Lake Suwa	Nagano	3.0	8.3	7.3	×	irrigation, aquaculture, fishing, boating	death of carp in aquaculture decrease in value of sightseeing
Lake Shinji	Shimane	3.0	6	5.6	×	aquaculture, fishing, leisure	decrease in value of sightseeing
Lake Nakaumi	Shimane	3.0	5.6	6.6	×	aquaculture, fishing,	decrease in value of sightseeing
	Tottori					leisure	
Lake Inbanuma	Chiba	3.0	15	12	×	drinking, irrigation, industrial use,	odor of tap water decrease in value of sightseeing
						aquaculture, fishing, irrigation, aquaculture,	decrease in population for fishing damage on rise, decrease in population for fishing,
Lake Teganuma	Chiba	5.0	25	24	×	fishing, boating	decrease in value of sightseeing, damage on fishes and shells
Lake Kojima	Okayama	5.0	9.8	11	×	irrigation, aquaculture, fishing	damage on rise,
Kamafusa Dam	Miyagi	1.0	2.7	1.9	×	drinking, irrigation,	odor of tap water
						industrial use, aquaculture, fishing,	clogging of sand filter

1) Lakes are easy to accumulate pollutants because lakes are enclosed water body and water stays there. Therefore, it is necessary to reduce inflowing pollution load more thoroughly for improvement of lake water quality than that of river water quality.

2) Water pollution of lakes is caused by various nutrients sources such as industrial wastewater, domestic wastewater, agricultural wastewater, livestock wastewater, nutrients load by aquatic culture, etc. Therefore, conventional measures, e.g., establishment of effluent standard for industrial and domestic wastewater and construction of sewerage system, are not sufficient. It is necessary to carry out overall measures.

3) Condition of water quality and causes of water pollution are various among lakes. Therefore, conventional common measures are not sufficient. Unique measures based on a condition of each lake should be considered for water quality improvement, and measures should be carried out intentionally.

In order to progress those integrated measures, it is important to cooperate among related ministries and divisions of national government, local government, industries and citizens.

Making a draft of the Lake Law was proceeded considering those background of water pollution of lakes.

In the process of making the draft of the Lake Law, firstly, the Director General of Environment Agency request the Central Environment Protection Committee to make a report for establishment of measures for lake water conservation in 1980. Then the report was submitted from the committee in 1981. The Environment Agency made a draft of the Law based upon this report in 1983. The draft was submitted to the Diet in 1983, approved by the Diet in 1984, and enforced in 1985.

2.2 Contents of the Lake Law

(1) Purpose

The purpose of the law is to establish the basic policy for the preservation of lake water quality and formulate a plan regarding the measures to be taken for the preservation of water quality of such lakes where it is eminent to establish an environmental standard regarding the pollution of water quality and take special measures such as enacting necessary regulations relative to the facilities discharging polluted water, waste liquids and other substances causing the water pollution whereby contributing to ensure a healthy and cultural life of the people.

The report in 1981 submitted by the Central Environment Protection Committee proposed a law system that protect natural environment around lakes in addition to improvement of lake water quality. However, it was considered that protection of natural environment around lakes was possible by application of the existing laws such as "Natural Environment Protection Law", "Forest Law", "Urban Planning Law". Consequently, The Lake Law was written aiming at lake water quality protection.

(2) Structure of the Law

The Law focuses on lakes where improvement of water quality is urgent. Prime Minister designates those lakes as "designated lakes", and central and local government have obligation to improve those lake water quality using various kinds of measures. The aims of the law are summarized as follows:

- 1) Introduction of special regulations to pollutant discharges in the watershed area of the designated lakes in addition to the regulations by the Water Pollution Control Law.
- 2) Carrying out various measures for lake water improvement comprehensively with corporation between central government and local government according to the plan based on the Lake Law. The system of the Lake Law is shown in **Fig. 10-3**.

Designated lakes are designated by Prime Minister on the basis of the proposal of Prefectural governor. Needed lake conditions for the designation are as follows:

- 1) Water quality environmental standards are not satisfied in the lake, or it is predicted in the near future that water quality environmental standards become unsatisfied in the lake.
- 2) Comprehensive measures for water quality preservation are needed in consideration to the changes in water quality.

There are ten designated lakes in 1997 (Kamafusa dam, Lake Kasumigaura, Lake Inbanuma, Lake Teganuma, Lake Suwa, Lake Nojiri, Lake Biwa, Lake Nakaumi, Lake Shinji, and Lake Kojima).

(3) Establishment of Basic Policy for the Preservation of Lakes Water Quality by the National Government

Legal System Concerning Special Measures for Conservation of Lake Water Quality

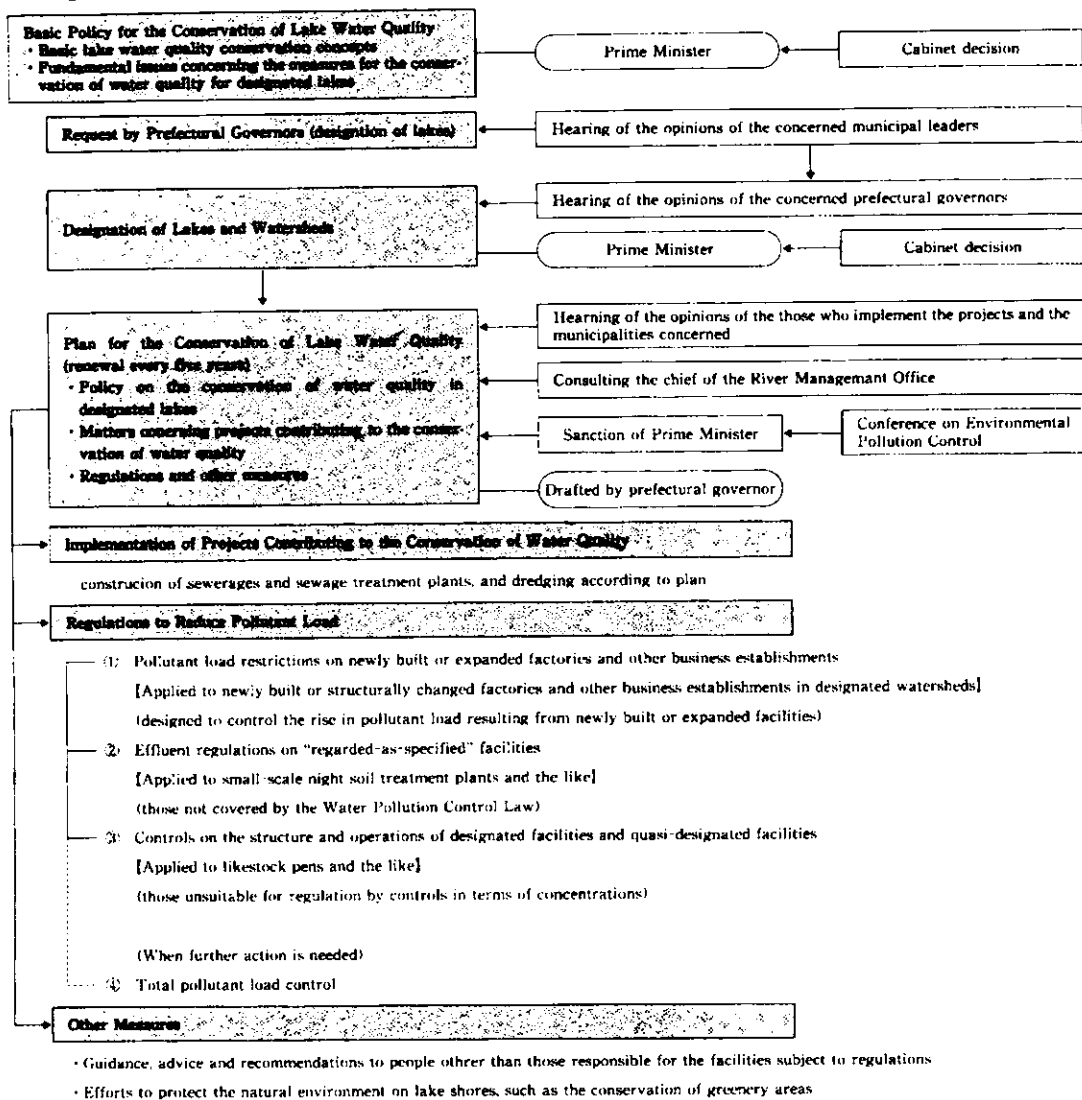


Fig. 10-3 Legal System concerning the Lake Law

Intimate cooperation among the national government, local governments, enterprises, and residents is indispensable to execute various measures to improve water quality of lakes. Therefore, the national government was assumed to have to provide for "Basic Policy for the Preservation of Lakes Water Quality" considering the conditions of lakes in the Japan besides the designated lakes. Moreover, the basic policy had to be a basic idea to carry out water quality improvement measures corresponding to the characteristic of lakes and the causes of water pollution with due consideration to the public functions of lakes such as a flood control function, resources of tap water, irrigation water and industrial water, and fishery.

"Basic Policy for the Preservation of Lakes Water Quality" was established as a Prime Minister's Office notification based on the Lake Law in 1984. A basic direction of the measures for lakes water quality improvement is mentioned in the basic policy as follows:

(1) It is easy to deteriorate lake water quality, however, it is very difficult to improve lake water quality once it is deteriorated. Therefore, we should keep water quality of a lake where its water quality is maintained good condition for water use in the region. On the other hand, we should enhance and reinforce water quality improvement measures for lakes where

preferable water quality for the water use is not secured.

(2) Most serious problem of lake water quality in Japan is eutrophication caused by the increase in algal production with increase in inflow of nutrients and the increase in inflow of organic matter into the lake from its watershed area. Growth of algae, concentration of organic matter and that of nutrients are affecting each other. Therefore, objectives for improvement of lake water quality should be expressed by appropriate parameters such as COD, nitrogen and phosphorus considering each characteristic of lakes.

(3) Improvement of lake water quality is not always realized by reduction of a pollution load from a specific source because water pollution of lakes is originated from various causes. Therefore, we should promote integrated measures in cooperation with related organizations and people.

(4) In addition, we should consider and utilize the potential ability of flora, fauna, soil and other things which composes the ecosystem for water purification when we make plan for water purification in agricultural land, forest and lakeside area.

(4) Establishment of a Plan for Preserving the Lake Water Quality by Local Government

When designated lakes and designated areas are established in accordance with the Lake Law, the governor of prefectures, as stipulated in "the Basic Policy for Preservation of Lake Water Quality", shall prepare a plan (hereinafter referred to as "Plan for the Preservation of Lake Water Quality"), every 5 years, regarding the measures to be taken for preserving the water quality of designated lakes. The Plan for the Preservation of Lake Water Quality shall stipulate the following particulars:

- (1) Policy regarding the preservation of lake water quality.
- (2) Plan of works relating to the construction of sewers and septic tanks, dredging and other works contributing to the preservation of lake water quality.
- (3) Legal measures such as regulations for the preservation of lake water quality.
- (4) In addition to the preceding 3 particulars, other measures for the preservation of lake water quality.

When preparing the Plan for the Preservation of Lake Water Quality, the governor of prefecture should obtain opinions of the person implementing the enterprise as stipulated in the Plan for the Preservation of Lake Water Quality, that of the mayors of the cities, towns and villages concerned, and that of the person in charge of managing rivers, then the governor shall obtain the approval of the Prime Minister.

Outline of the process of making the plan are shown as follows:

- (1) The water quality of a designated lake and the amount of pollution load discharged into the lake from the watershed area are determined. Then, the changes in the amount of the pollution load in the future are estimated considering trends of the population, industries and other human activities, and the effects of the changes in pollution load on the water quality of the lake is predicted.
- (2) All measures that may improve the water quality of the lake are listed up, and effects of those measures on lake water quality are evaluated.
- (3) Target of the plan and measures for achieving the target are summarized based on the result of the above-mentioned investigation. In the process of drawing the plan, they should give consideration to the public functions of lakes such as flood control ability, resources of water, resources of fishery and other public functions. They should also take account of regional development plans in the area around the lakes and adjust the plan for lake water preservation with these other plans.

Guideline of measures for water quality preservation of designated lakes were mentioned in

the Basic Policy for the Preservation of Lakes Water Quality as follows:

(1) Construction of sewerage and night soil treatment facilities

The construction of public sewerage system should be promoted because sewerage system is effective to reduce pollution load from households and industries. Moreover, construction of treatment facilities of night soil and gray water should be promoted by considering the condition of each area.

(2) Reduction of pollution load from industries

Control of pollutants discharges from industries by installation of effluent standard and/or regulation of total quantity of pollution load. Effluent standard is applied to industrial or business facilities based on Water Pollution Control Law, but the Lake Law can apply the effluent standard to facilities which are not applied by Water Pollution Control Law.

(3) Reduction of pollution load from households

A proper installation and maintenance of septic tanks (Joukasou) are promoted considering the progress of construction of public sewerage and small scale sewerage. Moreover, treatment of gray water should be promoted by proper facilities, e.g., Joukasou. Prevention of suspended solids discharges by kitchen works also should be promoted in order to reduce pollution load from households.

(4) Reduction of pollution load from livestock

Pollution load from livestock should be reduced by application of effluent standard, maintenance of livestock sheds, and construction of treatment facilities for livestock excretions.

(5) Reduction of pollution load from fishes cultivation facilities

Structure and maintenance method of fishes cultivation facilities should be improved for reduction of pollution load.

(6) Reduction of pollution load from nonpoint sources

Nonpoint pollution load from farmland should be decreased giving consideration to livelihood of farmers and actual activities in farmland in addition to the measurement of pollution load from farmland.

Nonpoint sources by runoff from urban areas should be also decreased by appropriate measures based on the measurement of the pollution load by runoff and its effects on lake water quality.

(7) Dredging of bottom sediment and other measures for improvement of lake water quality

Dredging of bottom sediment, aeration, introduction of clear water and removal of aquatic weed should be applied to the area where organic substances are accumulated on bottom sediment of a lake or rivers inflowing to the lake.

(8) Protection of forests in watershed area of a lake and natural environment along the lakeshore.

Besides the above mentioned measures for reducing pollution load into a lake, protection of forests in the lake watershed area and natural environment along the lakeshore should be promoted according to the existing laws, i.e., Natural Environment Protection Law, Natural Park Law, Forest Law, Urban Planning Law, Urban Green Area Conservation Law and River Law.

(5) Restriction for Pollution Load Reduction

In designated areas, the governor of prefecture shall establish a regulation standard with the parameter of COD, total nitrogen and total phosphorus aiming at wider application of effluent standard to industries and households than that by the Water Pollution Control Law. The Lake Law regulates the effluent from the following facilities as quasi specified facilities.

1. The following facilities installed in hospitals having more than 120 but less than 299 beds.
 - a) Kitchen facility
 - b) Washing facility
 - c) Bathing facility
2. Septic tanks with daily flow rate more than 50m³ with a capacity for more than 201 and less than 500 persons.

On the other hand, the next facilities considered that the increase leads to reduction of the pollution load to specified lakes are removed from the restriction object.

- (a) public sewerage treatment plant
- (b) public night soil treatment plant
- (c) small scale treatment plant constructed in agricultural area

The restriction by regulation standard according to the Lake Law is not, however, seemed to be sufficient because restriction to the quasi specified facilities is applied only to newly constructed facilities or enlarged facilities. The restriction is not applied to existing facilities. The restriction by the Lake Law is considered to be supplementation of the restriction by the Water Quality Control Law. The lake Law is devised to be, rather than the law which gives priority to the pollution load reduction by effluent standard or pollution load allowance, the law which gives priority to the load reduction by integrated measures according to the Lake Water Quality Conservation Plan.

(6) Improvement Advice and Improvement Order

When a person having a specified facility in a designated area is seemed to be in violation of the standards set forth, the governor of prefecture may advise such person to improve the structure or the method of usage within a specified period. And when the person receiving the advice mentioned in the preceding paragraph continues to use the designated facility concerned failing to follow the advice, the governor of prefecture may order the person to improve the structure or the method of usage within a specified period. The governors of prefectures, however, should pay attention to management condition of enterprises in applying the actions to small scale enterprises.

(7) Designated Facilities

In designated areas, facilities which are not appropriate for regulation by the effluent standards are named "designated facilities", i.e., such facilities as follows:

1. The following facilities to be used for livestock farming and service industry:
 - a) Pig shed (relative only to work areas with pig sheds occupying a total area of more than 40 square meters but less than 50 square meters).
 - b) Cow shed (relative only to work areas with cow sheds occupying a total area of more than 160 square meters but less than 200 square meters).
 - c) Horse shed (relative only to work areas with horse sheds occupying a total area of more than 400 square meters but less than 500 square meters).
2. Facilities to breed carps (applicable only to net crawls occupying an area of more than

500 square meters).

Persons intending to install such facilities should submit a notice stating the following particulars to the governor of prefecture.

- (1) Name of individual or name, address and the name of representative in case of a company.
- (2) Location of the specified facility
- (3) Classification of the specified facility
- (4) Structure of the specified facility
- (5) Method of usage of the specified facility
- (6) Other matters specified by the Order of the Prime Minister's Office

This written report system may give the chance to the business persons to consider the necessity of the control of facilities in order to decrease pollution load, and may give the chance to administrator to state some advices to the business person for decreasing pollution load from those facilities.

(8) Guidance to Persons who Don't Have Specified or Designated Facilities

The governors of prefectures may offer guidance, advice and suggestions necessary to accomplish the Plan for the Preservation of Lake Water Quality to persons, other than persons having a specified facility, who are discharging into Public Water Area polluted water, waste liquids and other substances causing the pollution of water.

(9) Penal Provisions

Persons in violation of the order of prefectural governor shall be sentenced to a prison term of not more than 1 year or be fined not more than 500 thousand yen.

(10) Other Important Aspects for Improvement of Lake Water Quality

In addition to those things mentioned above, it was assumed that the following aspect was important for promoting the improvement of lake water quality.

- (a) Water quality improvement works for lakes other than designated lakes.
- (b) Improvement of water quality monitoring system.
- (c) Promotion of investigation research and development of technology for water quality conservation.
- (d) Investigation of lake ecosystem

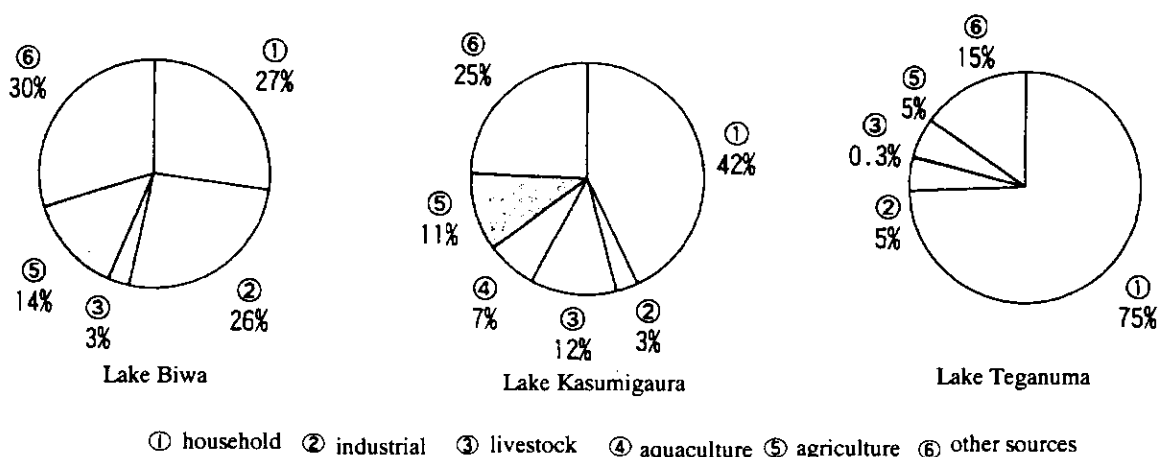


Fig.10-4 COD load into lakes (1993年) ⁵⁾

- (e) Investigation of generation mechanism of fresh water red tides
- (f) Measurement of pollution load from forest area, farmland and urban area.
- (g) Evaluation of water purification ability in forest, wetland and lake itself.
- (h) Development of treatment technology for various kind of wastewater.
- (i) Development of measures for improving lake water quality.
- (j) Development of technology for water quality monitoring.
- (k) Spread of the information concerning lake water quality and its improvement measures.

Voluntary activities by farmers and citizens are important for decreasing pollution load from farmland and non-sewered residential area. In that means, spread of the information concerning lake water quality and its improvement measures to farmers and citizens should be promoted.

3. Effect of Enactment of the Lake Law on the Water Quality of Designated Lakes

More than ten years have already passed from the plans were enacted (1985) in five lakes, e.g., Lake Kasumigaura, Lake Inbanuma, Lake Teganuma, Lake Biwa and Lake Kojima. The plans for the five lakes are now in third stage. Have the water quality of lakes been improved by executing the plans in ten years? Let's see the effect of the plan on the water quality in the case studies of Lake Biwa and Teganuma Lake. The former lake is polluted by both point sources (households and industries) and nonpoint sources (farmland and forest). On the other hand, the latter lake is mainly polluted by point sources, i.e., households wastewater as shown in Fig.10-4.

3.1 Lake Biwa

Figure 10-5 shows the changes in water quality of northern and southern lake of Lake Biwa with the target value of the Plan of Water Quality Conservation in Lake Biwa.

Water quality in Lake Biwa have not been improved clearly, as a results, the target value have not been achieved. Changes in pollution load into the lake does not correspond to the changes in water quality as shown in **Fig.10-6**. The water quality in Lake Biwa have not been improved although the amount of pollution load into the lake have decreased.

The following explanation is considered for reasons of the contradiction.

- (1) There is a possibility that pollution load from farmland is underestimated. If pollution load from nonpoint sources such as farmland is large compared to point sources, lake water quality will not improved easily by the decrease in pollution load from point sources.
- (2) An increase in the amount of pollution load of nitrogen and phosphorus according to spread of septic tank (Joukasou). The amount of the nitrogen and phosphorus load increases when pit latrine is changed to flush toilet by the construction of Joukasou.
- (3) There must be a possibility that the amount of pollution load from households increases by the change in the lifestyle.
- (4) The hydraulic retention time in Lake Biwa is long (estimated to be about five years), therefore changes in water quality in Lake Biwa is slow comparing to the changes in pollution load from watershed area.
- (5) The pollution load from bottom sediment, i.e., nutrients release, may not decrease corresponding to the decrease in pollution load from watershed area. However, the contribution of the nutrient release from bottom sediment in Lake Biwa may be small because bottom of the lake is maintained aerobic.

On the other hand, **Fig.10-7** is calculated changes in pollution load into Lake Biwa if measures for improving the lake water quality had not been done. It is clear that pollution load would increase if we did not carry out the measures according to the Lake Law and other prefectural ordinance. Especially, the amount of the load from households would increase if there were no measures. It is assumed that increased pollution load is decreased mainly by the construction of sewerage system.

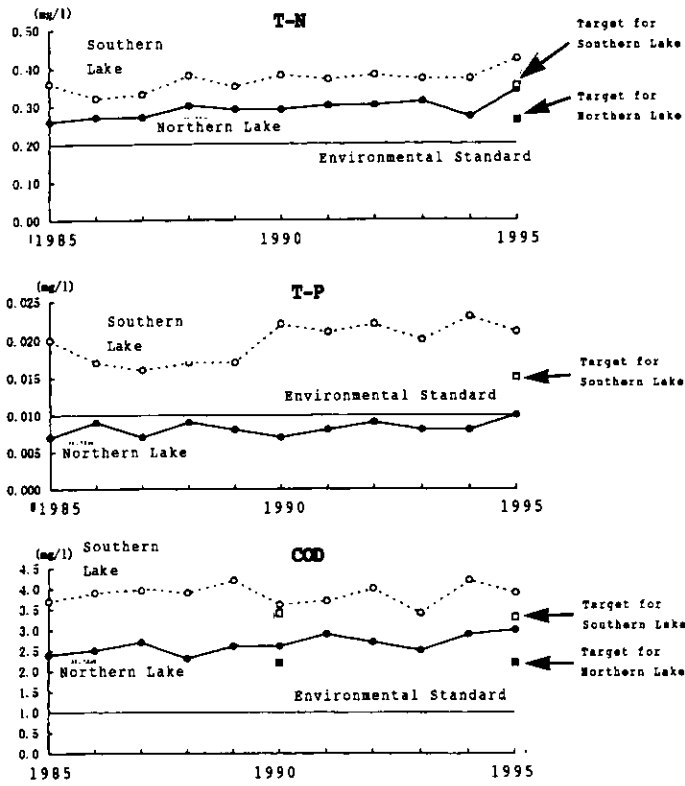


Fig.10-5 Changes in water quality in Lake Biwa.

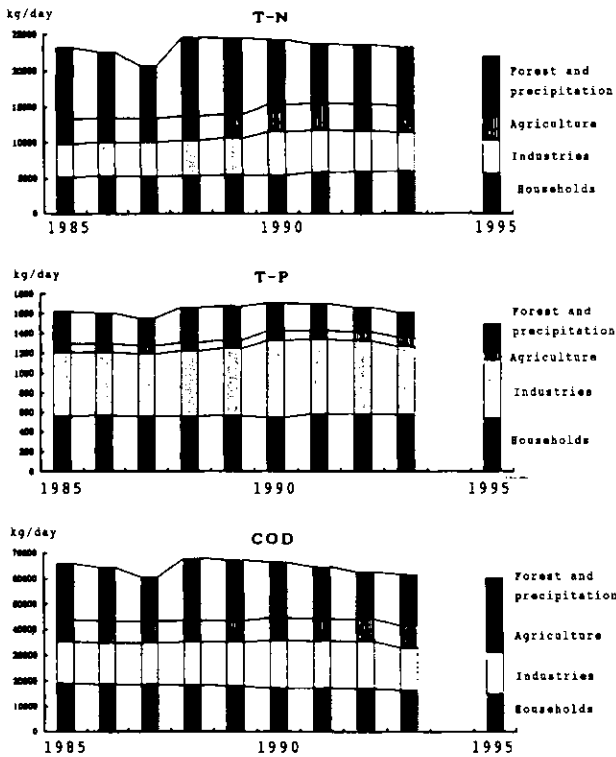


Fig.10-6 Changes in pollution load into Lake Biwa. 4)

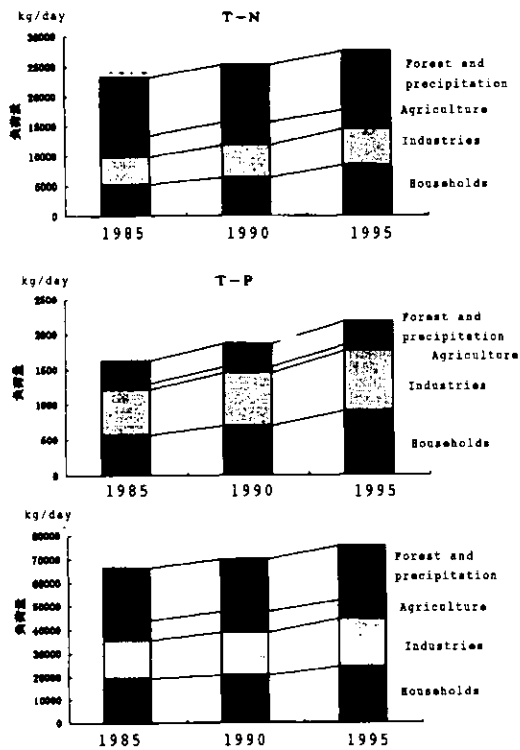


Fig.10-7 Changes in pollution load into Lake Biwa if any measures were not carried out. 4)

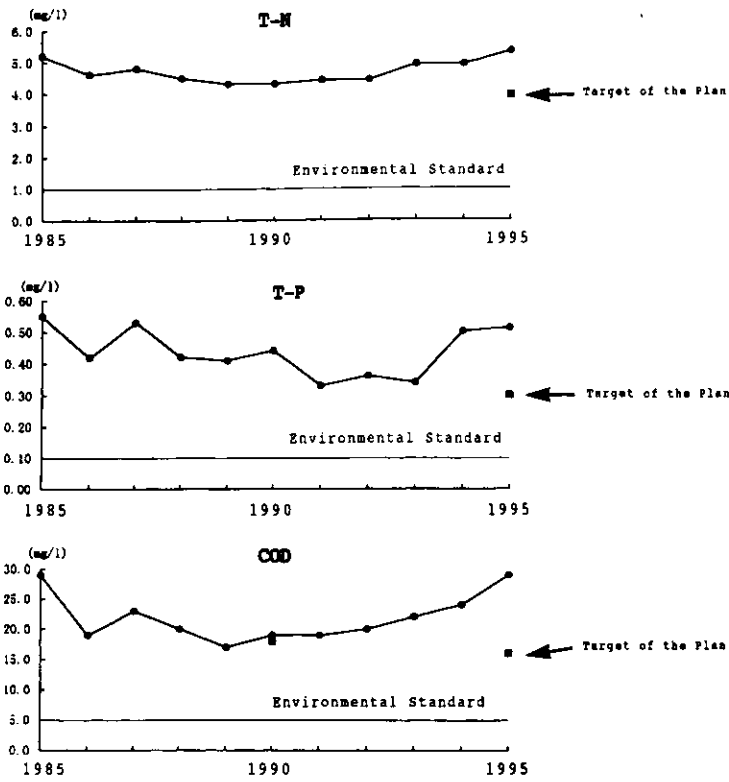


Fig.10-8 Changes in water quality in Lake Teganuma.

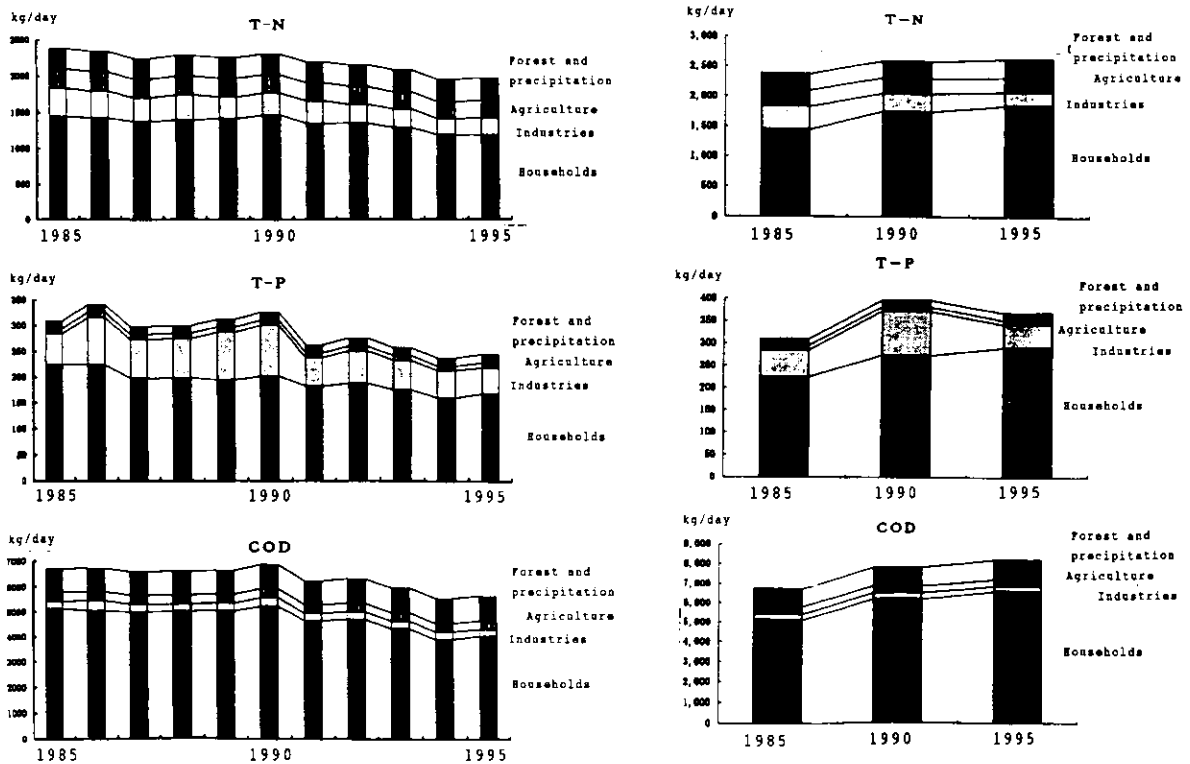


Fig.10-9 Changes in pollution load into Lake Teganuma.⁴⁾

Fig.10-10 Changes in pollution load into Lake Teganuma if any measures were not carried out.⁴⁾

3.2 Lake Teganuma

Changes in water quality in Lake Teganuma is shown in **Fig.10-8**. Changes in pollution load into the lake is shown in **Fig.10-9**. **Figure 10-10** shows the estimated changes in pollution load when measures for improving the lake water quality based on the plan have not been done. The lake water quality have not been improved though the pollution load might have decreased. Because the hydraulic retention time of the lake is much shorter than that of Biwako, the water quality of the lake has strongly be influenced by the water quality of inflowing rivers. The changes in the water quality in the rivers have not been improved ⁴⁾.

The case study in Lake Teganuma shows that measures aiming at the reduction of the amount of pollution load are not already effective to improvement of lake water quality.

4. Summary

The improvement of the lakes water quality is not advanced although various kinds of measures for improving the water quality have been carried out, eg., legal restriction of effluent quality and construction of sewerage system. It is clearly shown in Japan's experience that once deterioration of lake water quality have proceeded, restoration of the water quality is extremely difficult.

The followings are subjects we should carry out for the improvement of lake water quality.

- (1) Reduction of pollution load from nonpoint sources.
- (2) Nitrogen and phosphorus removal in septic tanks (Joukasou).
- (3) Nitrogen and phosphorus load reduction in small-scale factories and business facilities, e.g., small food processing factories, restaurants, hotels, leisure facilities and fish breeding facilities.

References

- (1) Japan Environment Agency and Research Society of Water Quality Laws (1986) Conservation of Lake Water Quality (in Japanese).
- (2) Japan Environment Agency (1988) Environment of Lakes in Japan (in Japanese).
- (3) Japan Environment Agency (1995) Environment of Lakes in Japan II (in Japanese).
- (4) Japanese Society of Water Environment and Japan Environment Agency (1997) The Report on Improvement Measures for Lake Environment.
- (5) Japan Environment Agency (1996) Administration for Conservation of Water Environment in Japan.