Industry and Water Management in Shiga Prefecture

Akihisa Mori,
Faculty of Economics, Hikone, Shiga University. Japan. 522-8522
amori@biwako.shiga-u.ac.jp.

Introduction

In Japan, local governments initiated environmental policy during 1960s and 1970s. This is because the central government lagged behind the enactment of the environmental laws. Therefore, most of the environment legislation allows local governments to expand the applicable range and to introduce standards for regulation. It also allows them to legislate regulations applied only in their jurisdiction in case their local environment is seriously damaged. They also concluded a pollution prevention agreement with industry, which causes serious pollution. (A pollution prevention agreement is one of the policy instruments which are not legally binding: factories would not be punished in principle when they break the agreement. But they must obtain permission from the local government when they establish or restructure plants and equipment. Therefore, they should observe the agreement to proceed with the business).

However, regulatory measures do not necessarily ensure the reduction on the total volume of resource use and pollutant load because firms can locate new plants and continue to discharge pollutants as long as they attain a standard. The effectiveness of local environmental policy is limited to the one which local governments with enough financial capacity introduce (Levitt, 1996). This is because a stricter environmental policy raises the firm's environmental costs, which may work against the region’s development goals.

This is true of Shiga Prefecture, where the production increases rapidly, along with the dramatic change in the industrial structure. The gross Prefecture production increased about 30 times in nominal term, from 0.2 to 5.9 trillion yen, and 7 times in real term during these 30 years. This change was brought about by the shift in the production from agricultural to the industrial sector. Figure 1 shows the share of the primary sector has declined 20% while industrial sector increased 20% in the production during these 30 years. This change was promoted by the construction of the highway and bullet train that pass through Shiga Prefecture. Rich and clean water resources also encouraged firms to locate their factories in Shiga. Moreover, factories could employ farmers who can earn enough from weekend agriculture. As more farmers have worked for factories, per capita income has increased, and ranks third followed by Tokyo and Osaka.

A major shift was also seen within the industrial sector. Figure 2 shows that the share of traditional industry, such as textile, ceramic and general machinery industry was high in 1960's, while that of electric machinery, chemical, transport equipment and food processing has become greater since 1970s.

The more industrialization has proceeded, the worse the environment has become. To prevent deterioration of the environment, Shiga Prefecture enacted the 'Eutrophication Prevention Ordinance', established stricter standards and applied it to a wider range of factories than the central government. This ordinance has forced factories to take additional measures. According to the questionnaire conducted by Shiga University Joint Research Center, 18% of factories feel they have been greatly affected from that ordinance and 42% a little (Shiga University Joint Research Center, 2000). However, neither a license for the plant installment nor a land use regulation has been introduced even though they are indispensable to regulate total volume of pollutants load. This is because these strict regulations are thought to violate the freedom of the economic activities and the property right (Tsuchiya, 1999).

Instead of stricter regulations, a voluntary approach has been gradually introduced in recent years in Japan. Export industry a begun to build an environment management system and some small factories have adopted it. Environmental Agency ha presented guidelines for environmental accounting so that it can promote industries to conduct clearer production in a cost-effective approach.

The structure of this paper is as follows. The theoretical framework is presented on the form's incentives for the environmental management in section 2. The factor behind the increase in the expected marginal penalty is briefly shown in section 3. In section 4 case studies are used to analyze how firms have dealt with increasing expected marginal penalty in Shiga Prefecture. Finally, the effect of the firms' enhanced environmental management on the water environment is examined.

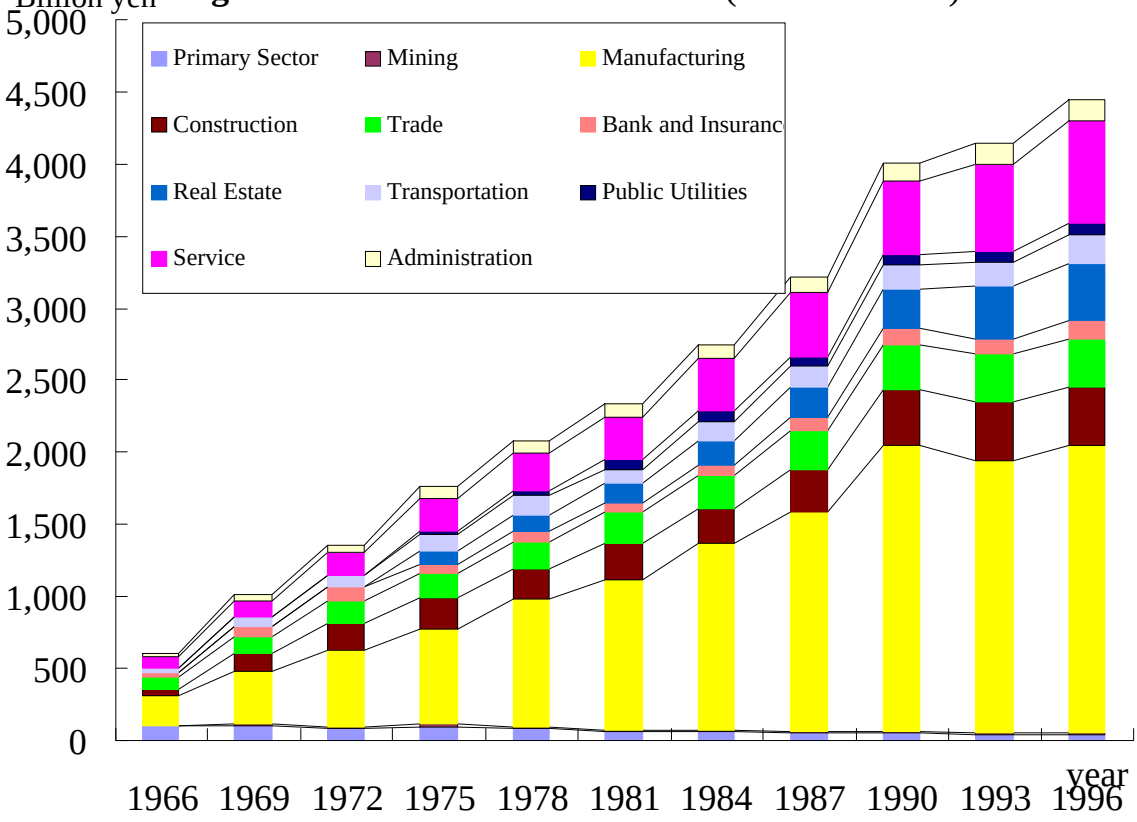


Figure 1 Gross Prefectural Products (Constant Price)

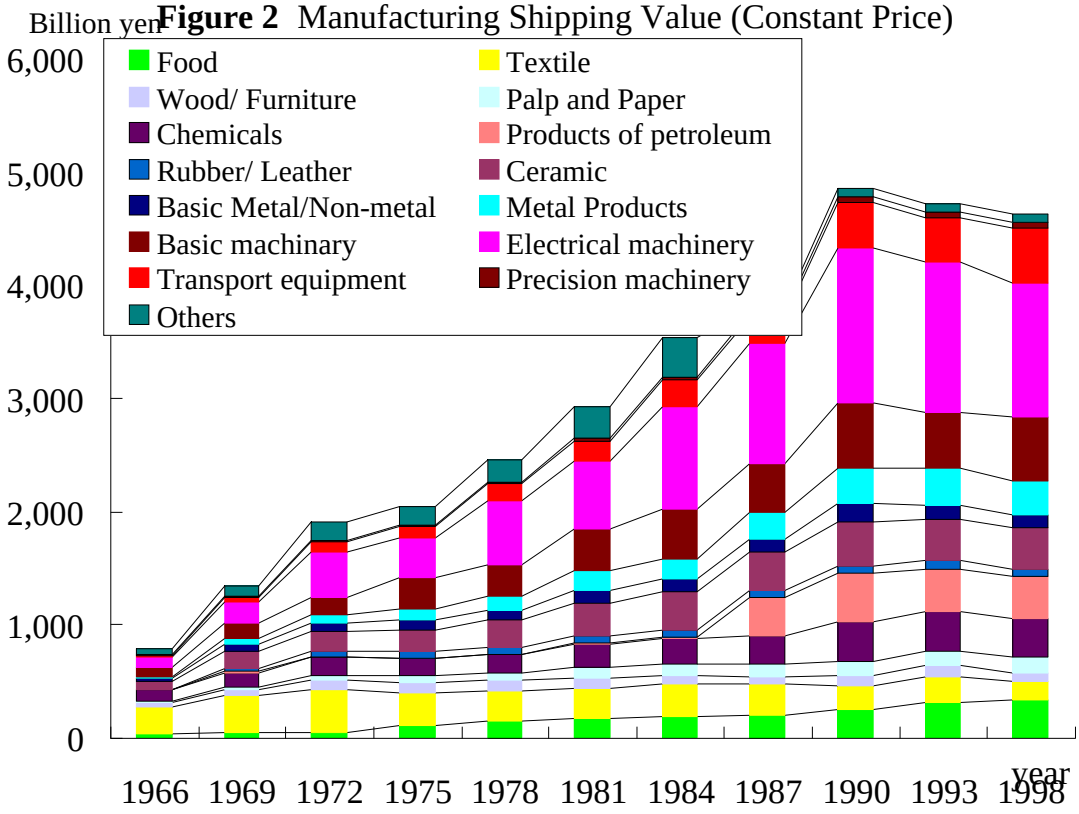


Figure 2 Manufacturing Shipping Value (Constant Price)

Why Firms Conduct Environmental Management: A Theoretical Framework

In the case where no authority manages the environment, firms select a plant's location and discharge pollutants without considering any impact and/or cost to the environment. One may imagine the area will be pollution-intensive.

However, at times industry voluntarily reduces pollution discharge even when government does not introduce any environment policy. Local people nearby may start anti-pollution movement and make complaints directly to the plants. They may submit petitions to the governments or file a suit for damage and suspension of operation. Banks and other financial institutions may also offer finance to the polluter on less favorable terms, considering that polluters will have to pay a huge cost in the future. In other words, factories will face more severe penalties as pollution intensity increases and bring more environmental risks and damage to the stakeholders.

This relation becomes much clearer when the regulation has been introduced. Even where weak regulations are employed, they are bound to be observed if the plant's pollution intensity exceeds the legal limit.

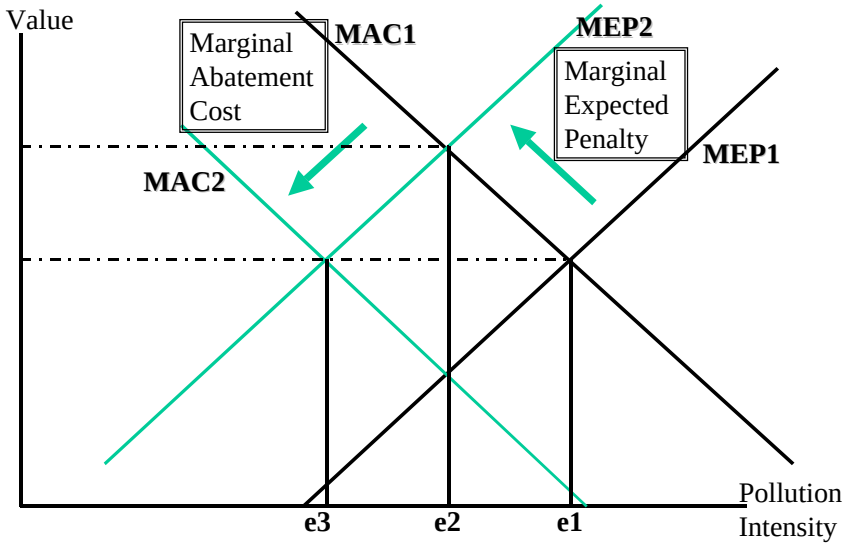
We can draw this relation as marginal expected pollution penalties (MEP) schedule in Figure 3. This upward-sloping line shifts with the changes in the income, education level, sensitiveness toward the environment risk of the local people and quality of information available to the stakeholders (Hettige *et al.*, 1996; Pargal and Wheller, 1996).

However, neither penalty from the stakeholders nor weak regulations ensure sound environmental practice. It is the standard setting based on the scientific findings and strong enforcement backed by support from the people, that ensures it. The MEP schedule will shift upward as the regulator obtains more scientific findings and public support for strong enforcement.

Confronted with MEP, a cost-minimizing manager needs information about abatement costs before deciding how much to pollute. Pollution abatement can be cheap at low levels of abatement but expensive at high levels. This relation is shown as marginal abatement cost (MAC) schedule in Figure 3.

The level and schedule of MAC can differ by sectors and plant size. Organic water pollution intensity is higher in processing industries such as food, pulp and paper, chemical and textile manufacturers while toxic chemical use is greater in assembly industries as well as chemical sector (Hettige *et al.*, 1998). Larger plants can install pollution control technology and change the production process easier, due to financial and technological capacity. Large firms are also favorable because they have much more opportunity to invest on new plants; sometimes new investment may be the only chance to install more efficient and less pollution intensive plants (O'Conner, 1994).

Figure 3 A Manager's Environmental Problem



The manager 's cost minimizing choice is the pollution intensity level where MAC and MEP are equal. At this level, neither increasing nor decreasing pollution will lower a plant's overall costs. But the manager's role is not limited to this choice in the long run: he should also consider how to prevent the MAC from increasing while reducing the pollution intensity. Plants should shut down or move to another place when MAC continues to rise with MEP.

Here cleaner production becomes indispensable. Firms may reduce pollution intensity while enhancing production efficiency, because it promotes them to improve production process and to introduce environmental management system. (ISO 14000 was developed as a management system so that industry can yield cleaner production at lower costs. A major motive in obtaining certification has been an improved image and better relations with the government (Matouq, 1999). MAC will decrease if the cleaner production technology and methods are provided cheaper.

Government can help firms to introduce cleaner production methods. Actually, many local governments have done so it, as an environmental and regional development policy.

How Has the MAC Schedule Changed in Shiga Prefecture?

Shiga Prefecture government did not take any initiative in pollution control in 1960s. However, it initiated the environmental policy and enforced more severe regulations than other Prefecture in 1970s. Factors behind this were the residents' high environmental awareness, which was raised by the worsening of the quality of water in Lake Biwa: it is the source of reticulated water for people living in downstream areas as well as Shiga Prefecture.

Table 1 Laws and Regulations on Industrial Water Pollution in Shiga Prefecture

year	Laws and regulations
1969	Enactment of the "Shiga Prefecture Pollution Prevention Ordinance"
1971	Enactment of the "Water Pollution Control Law" by the central government
1972	Revision of the "Shiga Prefecture Pollution Prevention Ordinance"
	Introduction of the permission system for the installment of the plants that are likely to cause pollution Established effluent standards concerning boron and antimony
	Expansion of the types of business under the regulation to include the business which discharge effluents over 30 cubic meters Application of the total COD load control to the plants which discharged large volume of effluent
1980	Enactment of the "Eutrophication Prevention Ordinance"
	Established effluent standards concerning nitrogen and phosphorus
	Prohibition of the use and sale of the synthetic detergent which contains phosphorus
1985	Enactment of the "Law Concerning Special Measures for Conservation of Lake Water Quality"
	Expansion of the types of business under the regulation to include large night soil treatment plants and medium-size hospitals
1986	Settlement on the first "Conservation Plan of Lake Water Quality"
1987	Settlement on the "Environment Management Plan for Shiga Prefecture"
1989	Establish the effluent standard for trichroloethylene and tetrachroloethylene
1996	Expansion of the types of business under the regulation to include the business which discharge effluents over 10 cubic meters, such as: night soil treatment plants for residential housings, hotel business, food processing industry such as tofu and beverage, and restaurants Enactment of the "Shiga Prefecture Basic Environmental Ordinance"
1997	Settlement on the "Comprehensive Environment Management Plan for Shiga Prefecture"
1998	Hold the first "Shiga Environmental Business Exhibition"
1999	Establishment of the "Green Purchase Network in Shiga Prefecture"

Table 1 illustrates the brief history of environmental policy in Shiga Prefecture. In 1972 Shiga Prefecture government revised the ordinance to establish more severe effluent standards and to apply these to more plants than the central government. To reduce the total load, the total COD load regulation was also applied to the plants which discharged much effluent. The plants under regulation were expanded again in 1974 to regulate Japanese inn, bathing and washing businesses.

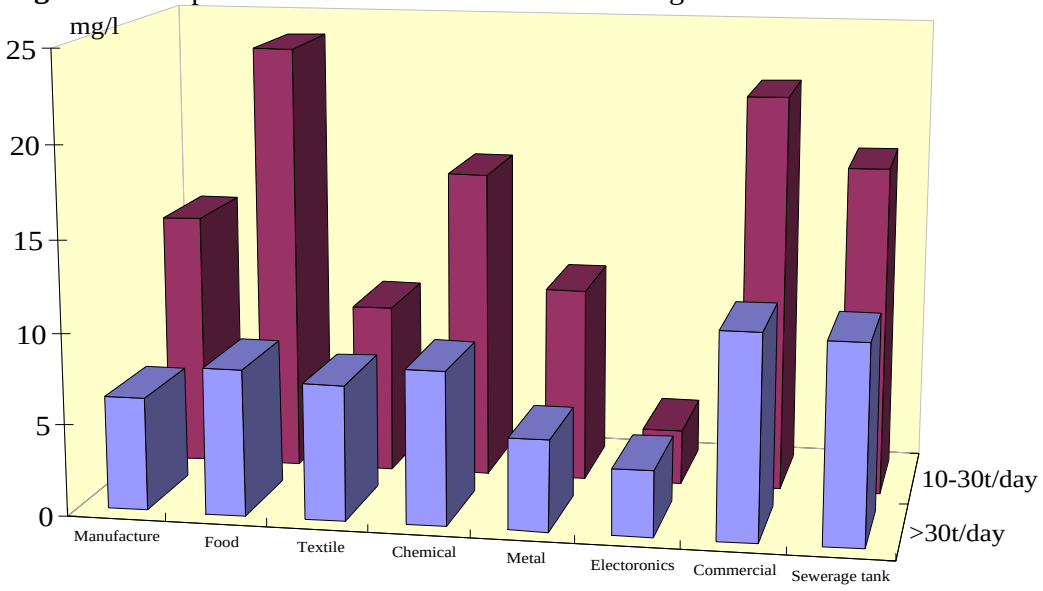
However, it soon became apparent that eutrophication has occurred in Lake Biwa. Red tides occurred in almost every year in 1970s. *Microcystis aeruginosa* was firstly detected in 1986 and has been done almost every year since then. With the help of local pressure, Shiga Prefecture government enacted the 'Eutrophication Prevention Ordinance" in 1978. This ordinance established effluent standards for nitrogen and phosphorus which were the major pollutants for eutrophication the central government did not regulate. It also prohibited the use and sale of the synthetic detergent which contains phosphorus.

It was five years later that the central government legislated the law to regulate nitrogen and phosphorus in the specified lakes and swamps. This law (the Special Law on Lake and Swamp Water Preservation) also allowed local governments to regulate total COD load and to expand the plants under regulation to pig, cattle and horse tassel facilities. However, it has not brought any additional pollutants reduction in Shiga Prefecture, for most of the regulations had been applied. It costs much administrative burden to enforce total COD load regulation while plants usually discharge effluent at the level lower than regulation (Kitamura, 1999). In addition, land use regulations, which were examined in the legislation process, was not enacted. Therefore, Shiga Prefecture government could not employed any policy instrument to reduce total load on COD, nitrogen and phosphorus.

Shiga Prefecture government settled on the 'Environment Management Plan for Shiga Prefecture' in 1987, which uses land use planning and the environment impact assessment as instruments for pollution prevention. However, no concrete measures were introduced at all to ensure the policy instrument considered in the plan. It made it clear that regulatory methods did not improve water quality any more as long as they focused only on large plants.

In 1996, Shiga Prefecture government expanded plants under the regulation again to include small size business: one which discharges effluent more than 10 cubic meters per day. Those which were put under regulation were night soil treatment plants for residential housings, hotel business, food processing industry such as tofu and beverage, and restaurants (Shiga Prefecture government, 1997; 1998). It excluded application to them because they discharge only 1.8% of total effluent and regulation may cause serious adverse effect to the local economy. But it gave up exclusion when it found the concentration of total nitrogen is more than 2 times larger in their effluents than in large plants (**Figure 4**). It found even small plants became a big source which could not be ignored, when they located together along a river basin.

Figure 4 Comparison of COD Emission Between Large and Small Pollutants



Concerning ground water, the central government established standards for underground water and soil in 1991 and has enhanced them gradually. Shiga Prefecture government did not take a separate initiative in the policy formation and the same standards are applied.

The Influence to the Marginal Abatement Cost: A Case Study

Framework

Ian *et al.*(1995) point out major five motives behind the adoption of environmental management systems and cleaner technologies. The initial and most important force is the compliance with environmental regulations, including anticipation of forthcoming regulations. The second is the perceived financial benefits. Firms can make large cost-saving through reduction of energy use and of waste, and through enhancement of production efficiency. The third one is the general commitment to environmental responsibility and care from within their own company. The other two motives are pressure from outsider: from industrial clients as well as local communities and financial stakeholders.

Ian *et al.*(1995) researched the relationship between a firm's motive and her environmental management measures. When compliance is the only motive, a firm tends to take passive approach, and to choose end-of-pipe solution. This is because end-of-pipe facilities may be favored on grounds of cost, ready availability and ease of implementation. In these cases cleaner production may be delayed until new plant is commissioned and/or new products designed. When a firm moves to 'compliance-plus' stage, end-of-pipe solution is not enough. A firm will pay greater attention to modification of existing process and products and to organizational change affecting level of activities beyond production plants. Finally, when pressures from outside stakeholders become a major motives, it will develop environmental management system further beyond the firm, taking in the entire value chain for the products and process materials used, and forming linkages with suppliers and product consumers.

Applying this three-stage framework, this paper examines how far the companies have moved towards cleaner production in Shiga Prefecture. Then it analyses how the difference in the stage influences the volume of water consumption and of discharging pollutants, and the environmental cost.

Findings from the Case Studies

Table 2 summarizes the stage of environmental management, change in the water consumption and volume of wastewater of five plants. We take these five plants as cases, for they are different by the type of industry, the scale, and the number and location of other plants.

We can find three features from Table 2. The first point is that the leading companies in the industry are classified in the 'excellent stage,' and they initiate environmental management system further beyond the firm. Three leading companies in Table 2 obtained ISO 14001 certification earlier and have collaborated with suppliers on changes to input materials and product specifications. However, a precision equipment company, which has plants only Shiga and Kyoto Prefecture, has been reactive to the increasing MEP; that is, has mostly focused on the end-of-pipe solution to comply with the tightening regulations.

The second finding is that the stage can be different by the type of industry even among the leading companies. The textile and dyeing industry has a process that removes sizing agents, color material and lipid in fabric before dyeing, and rinses fabric after it. This results in the discharge of huge volume of colored effluent which includes a sizing agent, lipid and a surface active agent. The plant in the case study installed end-of-pipe solution, even though this solution required a huge amount of investment and operational cost. The reason behind this choice is that the company found it very difficult to change the production process or materials without keeping the quality of the products. It is not until now that the company has launched the development of technology which reduce environmental impacts.

On the contrary, the food processing and beverage company has developed environmental management system beyond its boundary. On the one hand, the plant installed end-of-pipe facilities to comply with the tightening regulations in 1970s. On the other hand, the company has invested in the research and development to reduce industrial waste and sell it as goods with higher value added. This company takes this approach because it has suffered from the huge quantity of industrial waste which is necessarily generated in the production process.

Table 2 Findings from the Case Study

	Beverage Food Processing	Electronics and Electrorical	Textile Dyeing	Precision Equipment	Electoroplate
	Major	Major	Major		Small
Compliance Widespread use of end-of-pipe Regulation as key motivating factor					
Compliance plus Focus on process change and waste minimization Internal eco-audit Awareness of cost saving and benefit					
Excellence Eco-management system beyond the firm Take in the entire value chain for products					
Reduction in Water Consumption					
Reduction in Waste Water					

The electronics manufacturing company resides in the middle. When water quality regulations are tightened in 1970s, the plant took a defensive approach; it employed closed system for one part of its waste water to collect the chromium and installed end-of-pipe facilities to remove COD, nitrogen, fluorine and other heavy metals from the rest. When ground water regulations were introduced, it rearranged the chemical and waste liquid storage tanks and pipeline to install them on the ground. However, when the use of CFCs and solvents were prohibited the company changed raw materials and rinsing processes. In addition, the company introduced internal environmental audit, in which environmental performance is checked as serious as external one, to reduce its total environmental impact from production as well as transportation.

The effect on the water consumption and pollutants load in waste water is also patchy. The textile and dyeing plant has not reduced water consumption or the pollutant load in the effluent, though the production has not increased much. The food processing and beverage plant has not reduced water consumption nor effluent discharge per production, and pollutant load significantly yet. The electronics manufacturing plant increased the water consumption because of the investment on the new production line that requires huge volume of water, and the transfer to aqueous cleaning processes. This increase, in turn, has brought water conservation into sharper focus and set goals to reduce water consumption 2% each year.

The third finding is that the motive is compliance of regulations for most of the small size plants and they tend to depend on the end-of-pipe solution. Some of them have room for reducing pollutant discharge if they manage the production process and effluent properly. However, most of them have not conducted environmental management since the regulations are applied to them. To comply with regulation promptly, they have no choice but to install end-of-pipe technology that are readily available. Moreover, they are hard to initiate to reduce the pollutants in the supply or the value chain for the products because of their limited influence to suppliers.

Supply of Water Management Technology

Concerning supply side, it is end-of-pipe technology and environment monitoring equipment that have taken the greater share so far. It is estimated that the market size of end-of-pipe technology and related service will

expand to 34 trillion yen in 2010 from 21 trillion in 1996 in Japan (The Association for Machine Industry and Industrial Machinery Industry, 1998). The market size for water management technology is estimated to increase 4 trillion yen during these 15 years. However, 90% of them are related to water supply, sewerage, regional water reuse projects that are initiated by public sector, and even the rest is end-of-pipe technology that may be exported to developing countries. According to another estimation, the marker size is projected to expand from 1.5 to 4.5 trillion yen in 2001 for a consultant service, environment impact assessment, information diffusion, and an environmental business in financial and trade sector (Eco Business Network, 2000).

However, increasingly companies are providing technologies and consulting services for cleaner production, as more plants require them.

One of them is a small-size metal machinery company in north Shiga. It paid attention to the prohibition of the organic solvent use and developed the technology which conducts metal parts and press products cleansing only with the alkaline water. This technology is not just a substitute for the organic solvent, but enables many plants to reuse its effluent without treatment facilities. In other words, the company has developed the technology which may attain the prevention of the pollution caused by an organic solvent, reduction in the water consumption and the environment cost to a plant at the same time.

Another example is a NGO-based company. This 'company' focuses on the polluted waste water discharged from small scale business and household and has developed and diffused low-cost water management technologies. As in Tadatomo's paper, most of them discharge it without any treatment in rural areas, as the Shiga Prefecture government has constructed sewerage system gradually in urban area. It has developed the combined septic tanks that can treat of both night soil and other domestic waste water. Some residents and officials in governments realized the advantages of these combined septic tanks during the demonstration projects. It is easier to maintain, has much less BOD discharge in outflow water, and is more cost-effective than the ones major firms produced at that time. This results in the other firms' development and diffusion of cost-effective combined septic tanks.

The 'company' also developed a biodiesel fuel plant which changed waste cooking oil into fuel for diesel automobiles. The feature of this plant is that it can reduce both water pollution from household and fossil fuel use. (Originally the company collected waste cooking oil and developed a plant which changed it into soap in order to reduce water pollution from households. However, more consumers now buy synthetic detergents instead of soap made from waste cooking oil. The company had to find out the alternatives to prevent waste cooking oil into the rivers, which resulted in the development of the biodiesel plant).

This plant has a potential to integrate environmental goals into regional development: on the one hand the company promotes farmers to grow rape flowers for cooking oil in abandoned rice fields. On the other hand, it contracts out the production and sales of the plant to the small and medium size firms in the region.

These initiatives have made Shiga Prefecture government change its regional development policy. It has focused on the introduction of manufacturing plants since early 1990s. Now it supports firms in the Prefecture in developing environmental technologies and to form linkages with its suppliers and consumers as a development policy.

Effect on the Water Consumption and Pollutant Load

Because of a lack of latest statistics, it may be too early to evaluate these firms' recent environmental management in response to the tightening regulation. This may be especially true of the change in discharged pollutant load. However, it is worth noting that how much end-of-pipe solution has reduced water consumption and pollutant load since 1995.

Water consumption has increased more than 2.5 times during these 30 years in the industrial sector (Figure 5). The is because many firms have built new plants and expanded existing ones even though they reduced water consumption per production, and they need water for boiler and cooling facilities. This figure shows that water consumption decreased three times (1972-75, 1984-87, and 1990-93), but it should be noted that they suffered from depression during these periods, as seen in the decrease in land area for industries.

The increase in water consumption, however, does not signify that water supply from rivers and Lake Biwa has increased at the same amount. Some firms have invested to recycle their effluent to comply with the

Shiga Prefecture Pollution Prevention Ordinance and the Eutrophication Prevention Ordinance. Recycled water consumption exceeds 80% in the ceramic, electric and electronic machinery, and the transport equipment sector (Figure 6).

Figure 5 Water Use Volume and Area for Industries

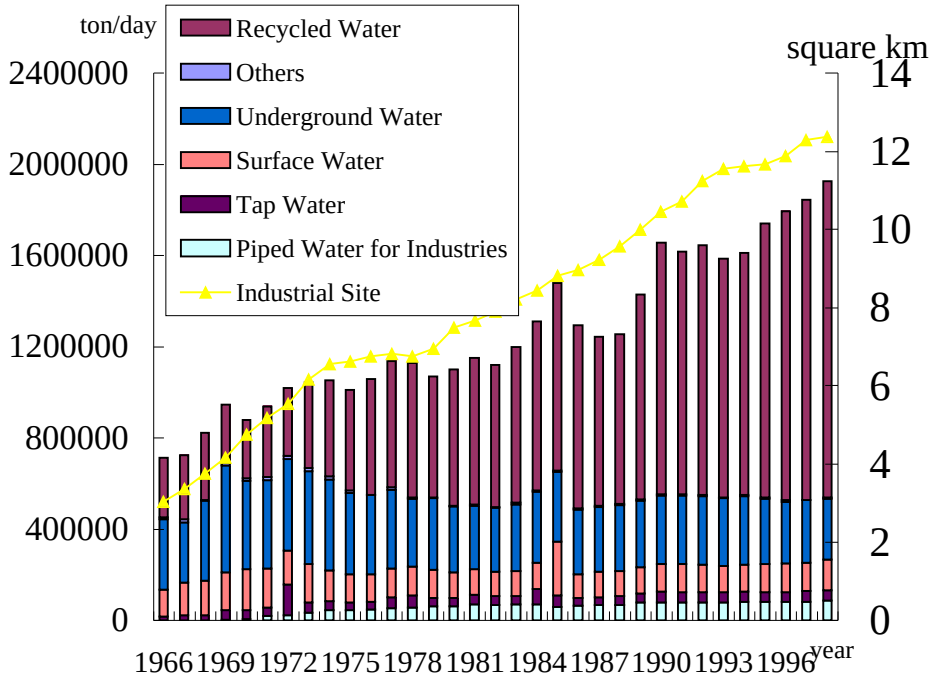
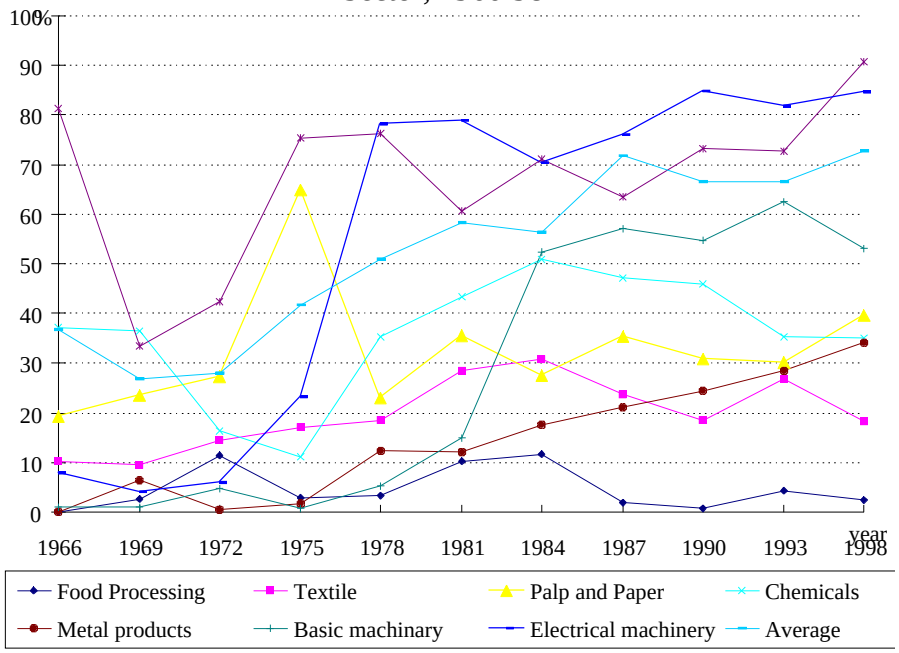


Figure 6 Rate of Effluent Recycle by Industrial Sector, 1966-98

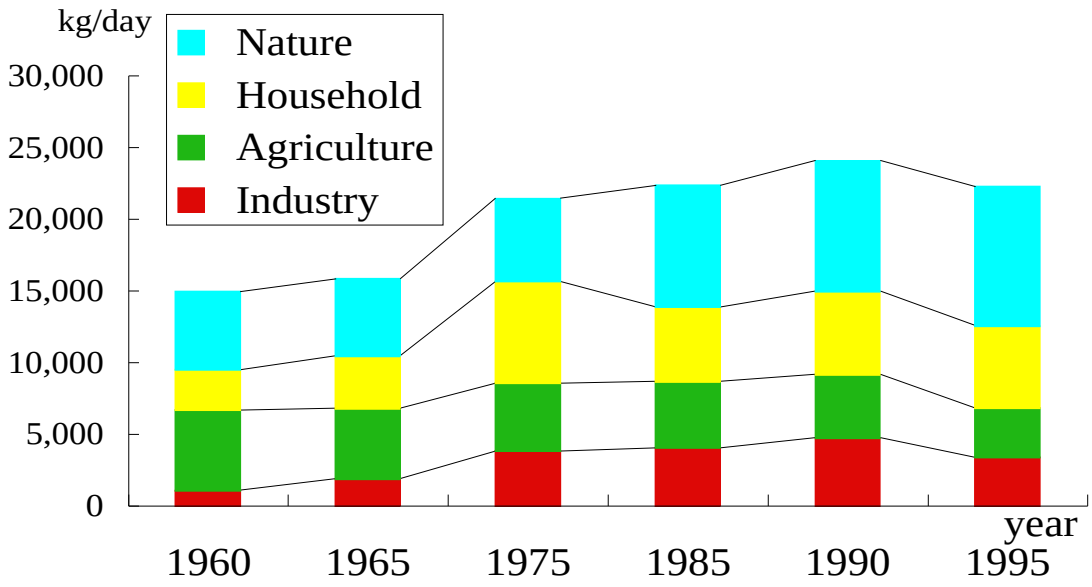


But even these sectors have not reduced water consumption significantly. Some plants employed closed system for all the effluent at one time, but adjusted the system only for the effluent that included toxic materials and discharged the rest to the river after treatment. Other plants increased water consumption after

they have given up using CFCs and solvents in the rinsing process. Other plants consumed little recycled water because they demand higher quality of water in the production and/or cleansing processes.

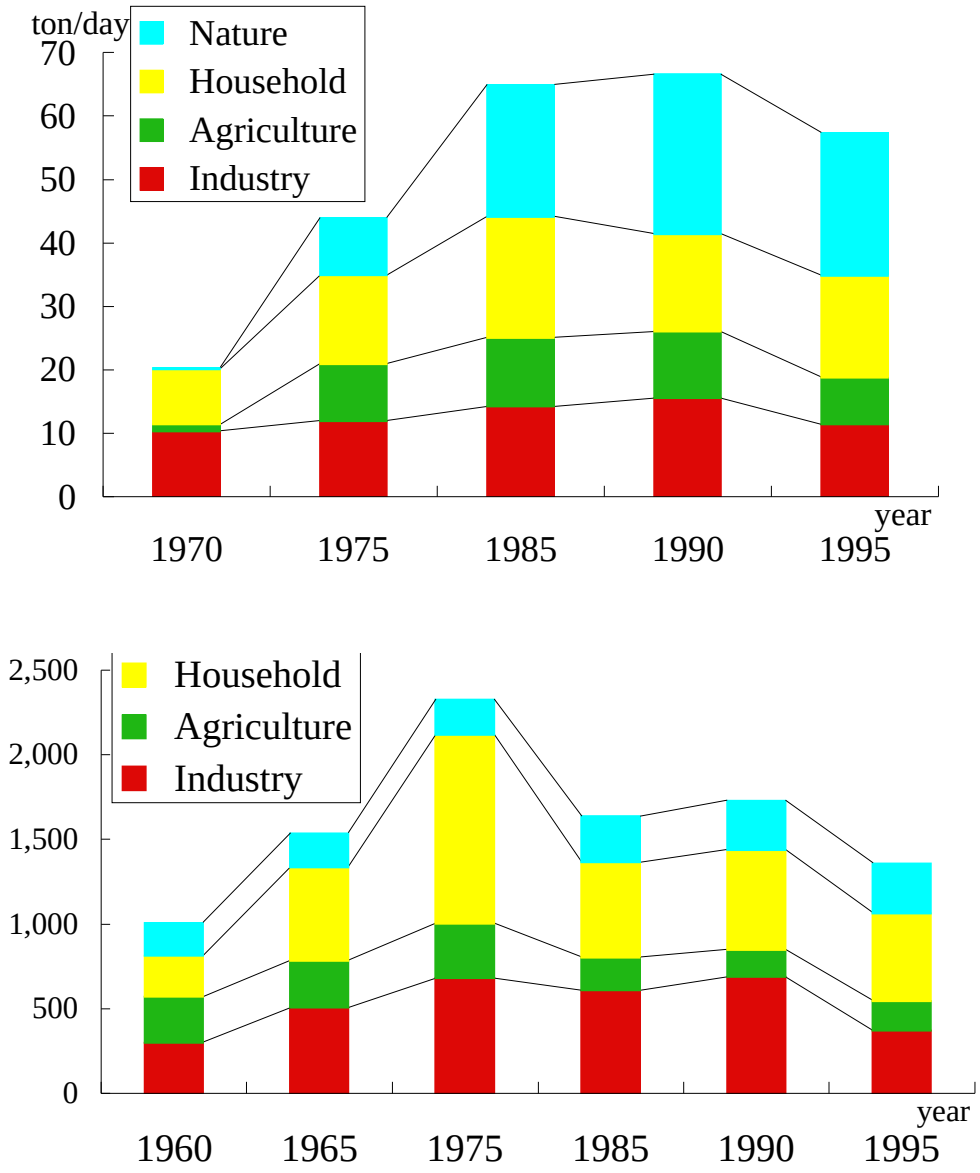
Pollutant load discharge in industrial waste water has not decreased significantly either. Nitrogen and phosphorus discharge turned into the decrease in 1975 (Figure 7and 8). This decrease may be partly a result of the tightened regulations. However, business cycle is considered to have had greater influence since then, considering they increased again in 1990 and reduced slightly in 1995. Many golf courses have been developed and consumption of fertilizer, herbicide and pesticide increased accordingly. COD discharge has increased consistently until 1985, and it was 1990s that the discharge turned into decrease (Figure 9).

Figure 7 Total Nitrogen Load in Lake Biwa by Source



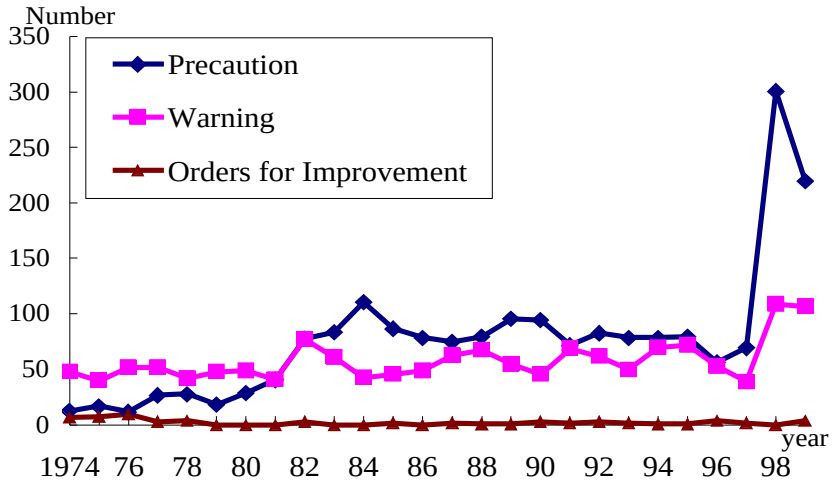
This trend may be inferred from the plants that have breached regulations. Figure 10 shows that there is little change in the breached plants. Exception is 1997 and 1998, when the target of regulations were expanded to small plants. However, considering the dramatic decrease in 1999 pollutant load discharge decreased to some extent.

Figure 9 Total COD Load in Lake Biwa by Source



Why have water consumption and pollutant load discharge not decreased significantly while each firm made efforts towards environmental management? From the analysis of this paper it may be because there is a limit in their reduction relying only on the end-of-pipe solution and the reduction has been offset by plant investment and production increase. This resulted necessarily from the unwillingness of Shiga Prefecture government in regulating land use, thus in controlling total pollutant load discharge, while there is much area for new plants and business.

Figure 10 Administrative Guidance Cases, 1974-98



Conclusions

This paper points out the factor behind the rising marginal expected penalty schedule in Shiga Prefecture, and analyzes how the plants have built and enhanced environmental management, with special focus on the change in the management system from end-of-pipe solution. Then, it examines the change in water consumption and in pollutant load from industrial source during the period when plants depended mostly on the end-of-pipe solution. The findings are summarized as follows:

- Most of the plants selected end-of-pipe solution to comply with regulations when Shiga Prefecture government enacted several ordinances for environmental protection in 1970s and 1980s. This solution turned out to have a clear limit in the reduction of water consumption and of pollutant load from effluent in the industrial sector. Nonetheless, it did not enact any regulation for total discharged pollutant control, such as land use regulations. As a result, reduction in the pollutant load discharged from each plant has been completely offset by the increase in the number of plants and in the production.

- Recently some leading companies has been developing environmental management system further beyond the firm, taking in the entire value chain for the products and process materials used. However, the paper points out only few companies reached this stage in our case studies. This is reflected by the differences in the production process and materials input as well as the availability of resources. This paper also shows even these leading companies have not yet reduced total water consumption nor reduced discharged pollutant load in the effluent, even if they have done at some production processes.

- On the supply side, development has been undertaken gradually for low-cost technologies which supports a plant's water management in a cheaper way. Then, connection was born and enhanced between the small and medium size firms toward the development and diffusion of the technologies. Shiga Prefecture government is also supporting it as one of the regional development policies. It can be concluded that the conditions have been created that strict local environmental policy does not contradict with regional development.

The reaming challenge is to analyze the influences of recent development of environmental management system on a plant's marginal abatement cost as well as on total water consumption and discharged pollutants. This will be done next after the latest statistics are available.

References

Christle, Ian, Heather Rolfe and Robin Legard, (1995). *Cleaner Production in Industry: Integrating Business Goals and Environmental Management*. London: Policy Studies Institute.

Eco Business Network, (2000). *Global Environment Business 2000/01*. Sangakusha. (in Japanese)

Hettige, Hemamala, Mainul Huq and Itoli Pargal, (1996). 'Determinants of Pollution Abatement in Developing Countries: Evidence from South and Southeast Asia,' *World Development*, **24**,1891-1904.

Hettige, Hemamala, Mani M. and David Wheeler, (1998). 'Industrial Pollution in Economic Development: Kuznets Revisited,' *World Bank Development Research Group Working Paper* No. 1876.

Kitamura, Yoshinobu, (1999). "The Special Law on the Lake and Swamp Water Preservation," Abe, Yasutaka and Nakamura Masahisa (eds.), *Environment and the Law of the Lake: Case Studies of Lake Biwa*. Sinzansya. (in Japanese)

Levitt, Roger, (1996). 'Business, the Environment and Local Government,' in Richard Welford and Richard Starkey (eds.), *Business and the Environment*. London: Earthscan Publications Ltd.

Matouq, Mohammed, (1999). 'ISO14001 and Regional Environmental Management; A Case study of Central Japan,' *UNCRD Research Report Series No.33*. Nagoya: UNCRD.

O'Conner, David C., (1994). *Managing the Environment with Rapid Industrialization: Lessons from the East Asian Experience*. Paris: Organization for Economic Co-operation and Development (OECD).

Pargal, Itoli and David Wheller, (1996). 'Informal Regulation of Industrial Pollution in Developing Countries: Evidence from Indonesia,' *Journal of Political Economy*,**104**,.1314-1327.

Shiga Prefecture, *Quality of the Environment in Shiga Prefecture*, each year edition.

Shiga Prefecture, (2000). *Materials for the Meeting of the Water Environment Section*, Environmental Committee of Shiga Prefecture. (in Japanese)

Shiga University Joint Research Center, (2000). *Summary of the Inquiry of Investigation on the New Industry and Technological Development Support*. (in Japanese)

The Association for Machine Industry and Industrial Machinery Industry, (1998*). Research Report on Environment Business: Projection of Environmental Business in 2010*. (in Japanese)

Tsuchiya, Masaharu, (1999). "Environmental Policy in Shiga Prefecture", Abe, Yasutaka and Nakamura Masahisa (eds.), *Environment and the Law of the Lake: Case Studies of Lake Biwa*. Sinzansya. (in Japanese)