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**Water Management – Policy, Research, Community and Business**

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There is no doubt water is seen as one of the most important and strategic natural resources in today's modern world. Water quality and availability constitute increasingly significant environmental problems and future international conflict is likely to occur over these issues, just as previous disputes over other resources such as oil and food have threatened our planet's well-being.

In December 2001 a successful international symposium on Water Management was held at Deakin University, Warrnambool, Australia. The sub-themes of the conference focused on policy, research, the community (including education) and industry roles in water management. Scholars from six countries representing a range of disciplines – from ecology to economics, from education to engineering – participated in the symposium. As well, a series of field trips and visits were held in which participants viewed local examples of successful water management, community involvement, education and industry activities.

Deakin University was proud to host this successful event which arose from fruitful discussions held with colleagues from the Faculties of Education and Education of Shiga University, Japan. We believe the symposium has been the springboard for productive research and education collaboration between participant organizations.

I am pleased that the inaugural issue of *The Asian Journal of Biology Education* presents some of the papers presented at the Symposium. I am grateful to the Editorial Committee of this special issue for their refereeing and editorial contributions: Associate Professor Brad Mitchell and Professor Gordon Duff from Australia, and Professors Manabu Kondo, Yasamasa Itakurs and Shuichi Endoh from Japan. Each paper has been rigorously reviewed by two independent referees to ensure the highest standards. The full proceedings, including papers which were not refereed, are to be published separately in paper format by Shiga University. I would also like to acknowledge the work of Dr Laurie Laurenson in ensuring the papers appear in the appropriate format in this exciting new electronic format.

The Asian Association for Biology Education is especially thanked for giving me the opportunity to act as editor of this special issue of the journal.

**Physical Change of Lake Biwa and its Consequences**

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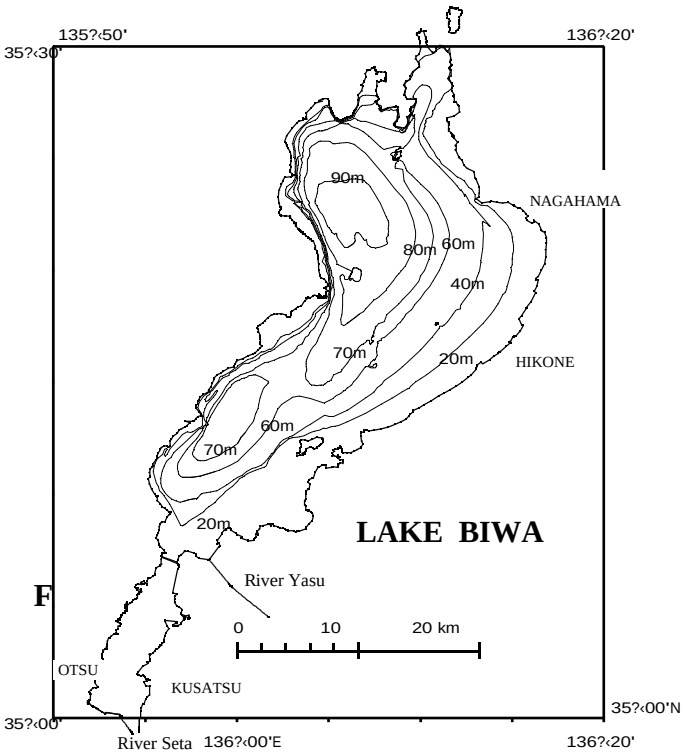
***Introduction***

Lake Biwa (Fig. 1) is the largest lake in Japan and one of the oldest lakes in the world . It contains 273 x $10^8$ $m^3$ water with a surface area of 680 $km^2$ and average depth of 40m. More than 1000 rivers with the watershed of 3840 $km^2$ drain into the lake, whereas lake water exits through the River Seta (the only outflow river) and a channel connecting with Kyoto City. The average residence time of the lake water is about 5 years, which is estimated from the annual discharge of about 50 x $10^8$ $m^3$ (International Lake Environment Committee, 1987).

**Fig. 1.** Lake Biwa.




Lake Biwa has maintained a rich natural environment and ecosystem not only in the lake basin itself but also in the surrounding watershed. There are many endemic species living in the lake. The lake water is used for drinking, industry, agriculture and many other purposes by 14 million people in the Kinki megalopolis. During the last 20 years, the lake environment has been rapidly changed by development accompanying economic growth, water demand increase, and life-style changes within the watershed. Lake water quality has deteriorated due to eutrophication, and the integrity of the lake ecosystem has been destroyed year by year. This environmental degradation has caused serious problems such as red tides, algal blooms, and ecosystem change due to alien species invasion. This article introduces recent observational results on the environmental changes of Lake Biwa.

***Water level depression***

On the basis of recent meteorological data, the water budget in Lake Biwa basin was estimated (Fig. 2). During the last 20 years, the precipitation in the lake watershed has decreased from 1900mm to 1800mm perhaps due to the global warming. This water input decrease and recent unusual weather systems have caused an extraordinary water level depression especially in summer. For example, water level went down to 123cm below zero in 1994 and 97cm below zero in 2000. Such a low water level condition causes serious problems in water use and impacts upon the ecosystem in the lake.

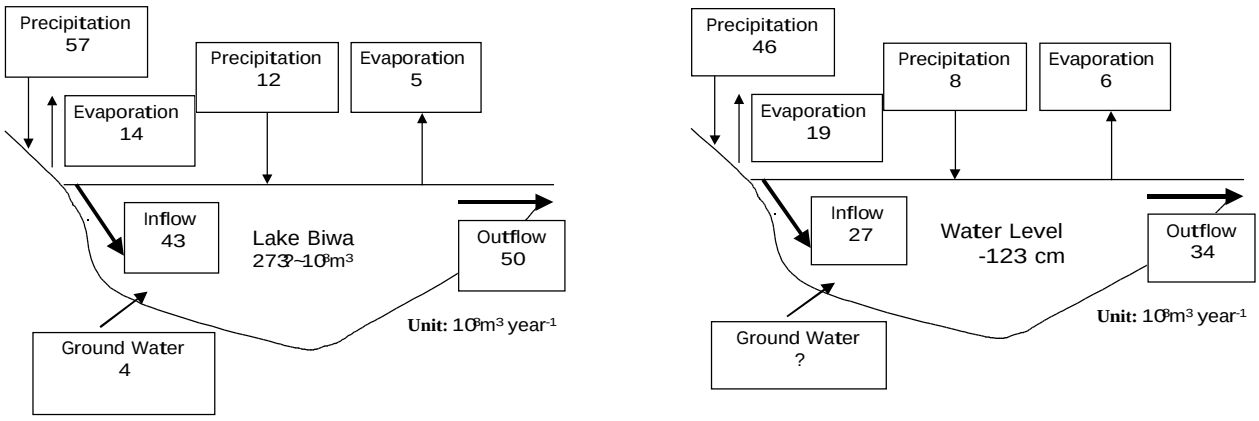



**Fig. 2.** Water budget in Lake Biwa basin; normal year (left) and in 1994 (right). Data derived from own measurements and those from Hikone Meteorological Observatory, Shiga Prefecture in 1993.

***Recent warming of lake water***

The global warming effect is also clear in the Lake Biwa watershed. Figure 3 shows the historical data of atmospheric temperature at Hikone City located on the eastern shore of the lake. The atmospheric temperature has increased about 1 ºC during the last 100 years.

Water temperature in the lake has also increased rapidly, especially in the last decade, undoubtedly caused by the global warming (Fig. 4). Deep water is now warmer due to successive warm winters in recent years. This warming of the lake water and the weakening of the overturn in winter may cause a serious problem to the lake's functioning.

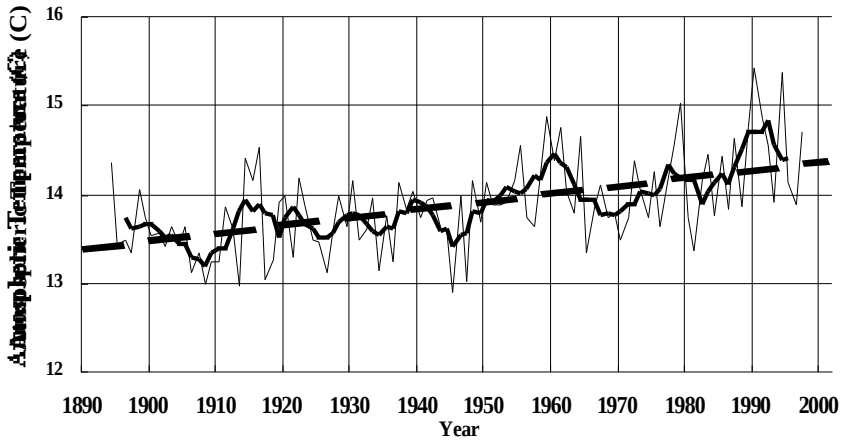



**Fig. 3.**
History of annual mean atmospheric temperature at Hikone since 1894. Thick line represents a 5-year running mean, and dashed line indicates a linear regression.

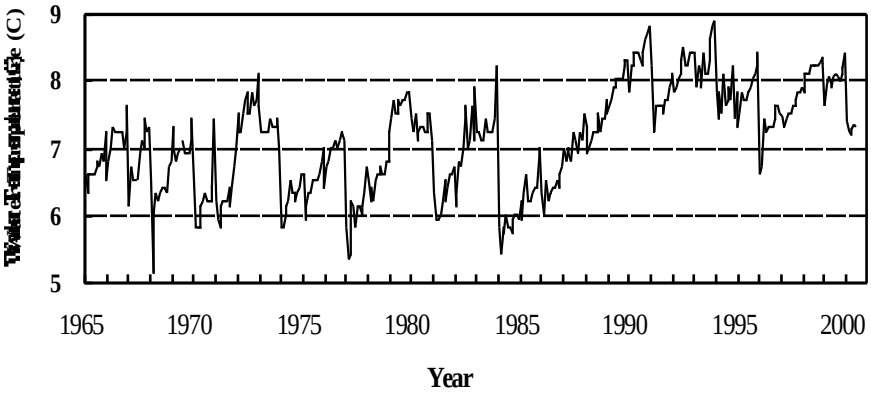



**Fig. 4.**
Seasonal change of water temperature at a depth of 70 m in Lake Biwa from 1965 to 2000.

***River water inflow to the lake***

The river water controls the lake water quality by the transportation of both dissolved and suspended materials into the lake. However, the behavior and the dispersion mechanism of the river water upon entering the lake are not clearly understood. Therefore, continuous observations were carried out to reveal the seasonal variation of the river water transportation into the lake. Attention was focussed on the River Yasu whose watershed area is largest among all rivers in the Lake Biwa watershed.

Figure 5 shows the seasonal changes of water temperature in River Yasu and Lake Biwa. It shows that water temperature of River Yasu is lower than the lake from autumn to spring, whereas it is higher from spring to early summer. During May and August, river water is warmer than lake water in the daytime but is cooler in the nighttime. From comprehensive analysis by using the water temperature data of the river and every 5m-depth in the lake, the seasonal change of inflowing depth of the river water was estimated. The result is shown in Figure 6. The river water intruded into the thermocline during summer and autumn, and into the bottom layer in winter. In early spring, the river water spread out on the lake surface. From these analyses, it is estimated that the exchange period of the lake water is about 20 years.

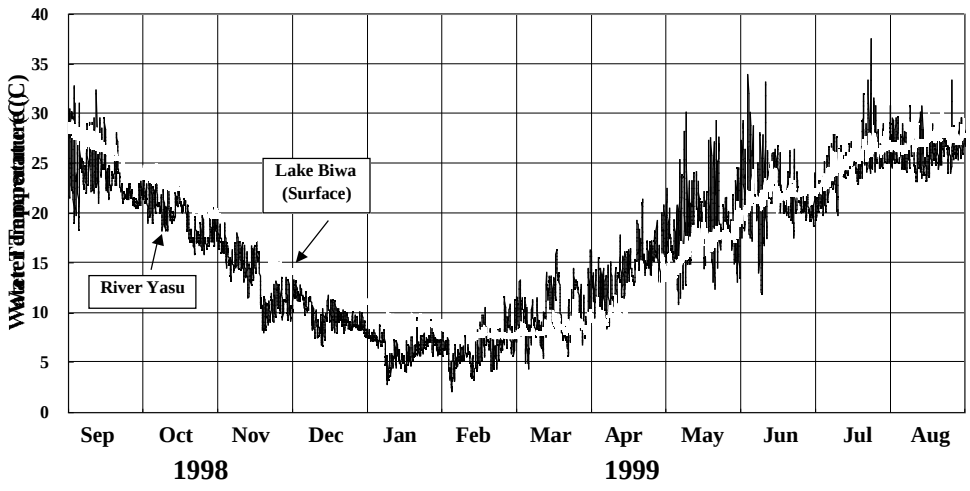



**Fig. 5.**
Seasonal change of water temperature in River Yasu and Lake Biwa (surface).

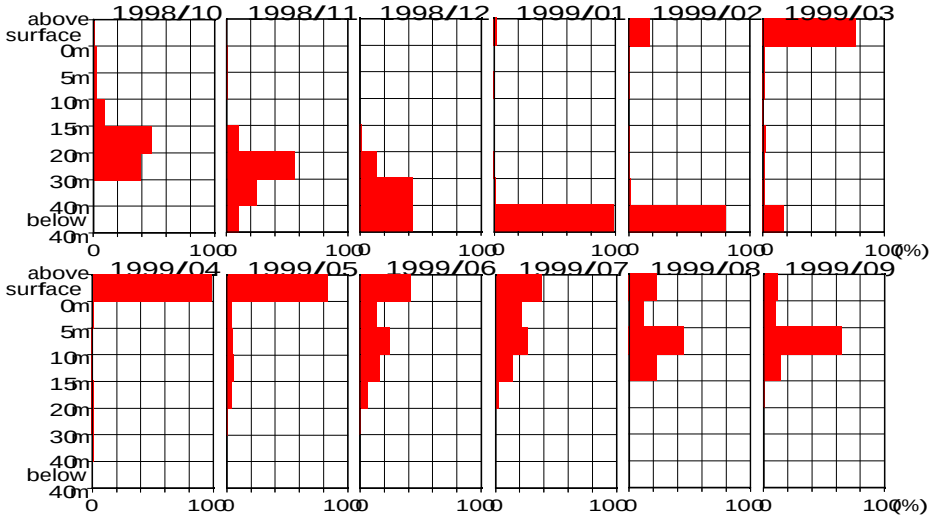



**Fig. 6.** Seasonal change of flowing depth of river water into Lake Biwa.

***Benthic nepheloid layer***

During the last decade, vertical and horizontal distributions of water temperature, turbidity, electric conductivity and Chlorophyll-a have been obtained both in the south basin and the southern part of the north basin of Lake Biwa. The benthic nepheloid layer (BNL), which is the layer just above the lake bottom with high turbidity, developed in the seasons of thermal stratification (Fig. 7), and was not detectable in the non-stratification period (winter). The BNL is maintained by organic matter sinking such as phytoplankton under decomposition. However, the turbidity in the nepheloid layer was much affected by the turbid water from rivers after heavy rainfall. In this case, the major component of the suspended substance in the nepheloid layer was inorganic soil. The particulate P concentration, which is originated from phytoplankton, also increased after rainfall. This suggests that phytoplankton in the surface layer sinks with clay and silt coming through rivers. From summer to the early winter, another kind of turbidity appeared in the bottom layer. This is caused by the chemical reaction of manganese under the anoxic condition. The resuspension of bottom sediment by strong currents also occurred, but it is not a major process for maintaining the BNL.

***Discussion***

It has been reported that the water quality of Lake Biwa has been almost stable during the last decade. However, there are many environmental and social problems associated with the lake. The alien species invasion, especially the releasing of some alien fishes has caused a rapid decrease of valuable endemic fishes and an increase of the sports fishing population. The high numbers of Great Cormorants has also caused serious environmental problems and is thought to have contributed to forest destruction and a downfall of the commercial fishery.

Recent water level depression is one of the most serious problems facing water management not only in Shiga Prefecture but also in Kinki megalopolis. The global warming effect in the lake basin should be carefully monitored focussing on lake water warming as well as the future trend of water evaporation. The warming of the lake water may also make water quality worse by the nutrient release from the sediment resulting from the reduction of the dissolved oxygen in the bottom layer. This may be caused by the combined effects of the decrease of vertical water mixing due to the warming of surface water and increasing demand for oxygen by the decomposition of phytoplankton that is predicted to increase due to the global warming trend.

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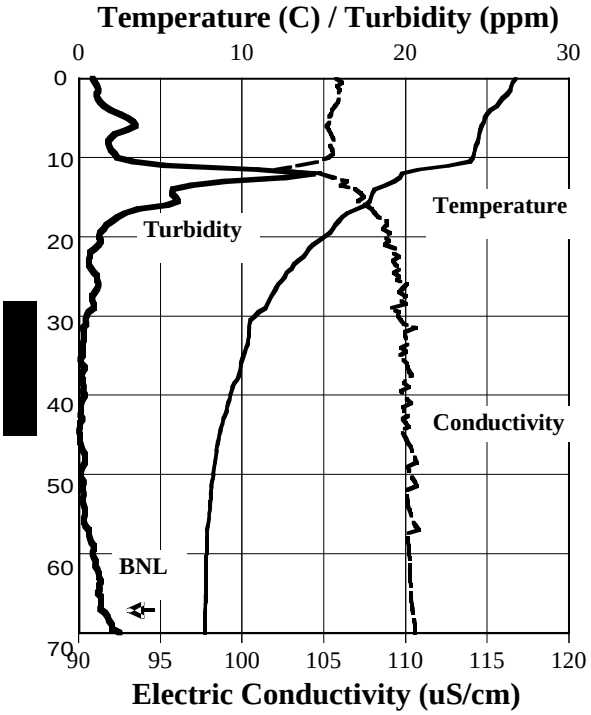


**Fig. 7.** Vertical profiles of water temperature, turbidity and electric conductivity.

# The Need for Effective Information Exchange Between Knowledge Generators and Knowledge Users in Water Management

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## *Introduction*

To say that the world is facing a water crisis is to understate the seriousness, extent and implications of the problems now confronting developed and developing societies. There are many problems related to water availability and quality and these are summarised, not in order of priority, in Table 1.

The aim of this paper is to investigate the need for effective information exchange between knowledge generators and knowledge users in water management. The global water crisis and humans' rights to water will be reviewed and the importance of regional initiatives involving community participation will be examined. The nature of the communication process relating to water management issues at a regional scale is then explored using models to illustrate the process and to identify the barriers to developing regional strategies. Finally some suggestions are made about developing 'network thinking' at the regional scale.

## *The Water Crisis and the Human Right to Water*

There are obvious linkages between environmental degradation, and in particular water-related problems, and economic development (Itakura et al., 1999). Somewhat paradoxically, however, there is also a link between water-related issues and wealth. Comparing countries there is a clear positive correlation between oxygen levels in rivers and income, and between and within countries there is a negative correlation between income and access to safe drinking water (World Bank, 1992).

**Table 1: A summary of the problems related to water availability and quality.**

- Increasing demand for water and overexploitation of surface waters. Resulting water scarcity is a problem in the Middle East, Northern Africa, Sub-Sahara Africa, Northern China, West and South India, and Mexico. This is placing increasing constraints on domestic supply and economic activity.
- Potential changes in rainfall patterns due to global climate change. This could exacerbate regional shortages.
- Soil erosion results in the world's rivers carrying 15 billion tonnes of sediment annually. This causes stream sedimentation, reduces channel capacity and contributes to flooding, and has negative impacts on in-stream biological communities.
- Increased runoff due to catchment clearing and compaction of soils.
- Increased damage from flooding. This results from increased rainfall and changes in runoff patterns due to catchment clearing.
- Increased production of "water hungry" foods. This results from changes in living standards and population shift from rural to urban environments.
- Loss of aquatic biodiversity. This results from habitat loss, river regulation, and reduced capacity of water to support life due to contamination.

- Water pollution is causing a decrease in water availability. Poor sanitation and inadequate water treatment processes. Major cities in South-East Asia discharge raw sewage to the aquatic environment. The most widespread form of water pollution is contamination with disease-bearing human waste. As recently as 5 years ago several Victorian coastal towns discharged poorly treated sewage to the marine environment.
- Poor access to safe drinking water supplies. 45% of the world's population in rural areas (excluding China) lacks access to safe drinking water. 80% of all human disease is due to unsafe water. In Asian countries diarrhoeal diseases kill 1.5 million children each year. As recently as a decade ago only 6% of the population of Victorian country towns consistently received water that met the WHO standards.
- Escalating costs for access to water. People living in slums on the fringes of major cities in the developing world may pay up to 10% of their annual income for water.
- Escalating costs of the application of water treatment technologies to supply drinking water.
- Water pollution is causing a decrease in water quality. There are numerous cases of contamination with toxic chemicals and heavy metals from industry.
- Overexploitation of groundwaters especially "fossil water" resources. This is causing subsidence, saltwater intrusion into aquifers and pollution.
- Reduced recharge of groundwaters due to surface sealing associated with urbanisation.
- Water logging and salinisation of soils. This is the result of elevated water tables due to irrigation and catchment clearing. This causes increased salinity in streams and rivers.
- Increasing eutrophication. This is causing an increase in the incidence of algal blooms. This affects oxygen levels in aquatic systems and impacts upon human health.
- Water diversion. This is causing changes to river flow patterns, reduction in surface area of major lake systems, ecological, social and economic impacts. The salinity in Lake Corangamite, Victoria, has increased due to diversion of inflowing river water; this has altered the biological communities of the lake and triggered a virtually permanent blue-green algal bloom.
- Conflict. This occurs between water user sectors within a region, between states within nations and between nations. International conflicts involving water have occurred 21 times in the last decade; 15 of these involved violence. Resources in dispute include the Jordan, Ganges, Mekong, Euphrates and Nile Rivers.
- Environmental, social and economic effects of river regulation and dam building.
- Decline in high value and artesanal fisheries.
- Threats to wetlands. 80% of wetlands in the Asian region are under moderate to severe threat.
- Increased vulnerability to water borne diseases due to irrigation schemes. The prevalence of malaria and Schistosomiasis has increased.
- Inefficiencies in irrigation contribute to scarcity and conflict. 80% of water transported in some schemes may be lost due to evaporation and seepage. 20 tonnes of water may be needed to produce 1 tonne of rice; 75% of the water may be used to manage weeds.

- Irrigation causes waterlogging and salinisation. Irrigation uses 60 to 90% of annual water withdrawals worldwide.
- Poor government planning and inappropriate pricing resulting in subsidies for inefficient water use.

Source: Ellis, 1990; World Bank, 1990 and 1992; Andreev, Andreeva, Filippov and Aladin, 1992; Andreev, Plotnikov and Aladin, 1992; Petr, 1992; Williams, 1992; AMICC, 1997; Smith, 1998; Eades, 1999; GACGC, 1999; Kim, Lee and Jung, 1999; Kira, 1999; Manopimoke, 1999; Meadows and Meadows, 1999; Gleick, 2000.

An holistic analysis of global environmental impacts by the German Advisory Council on Global Change describes the most important problems affecting the environment in terms of 16 syndromes (German Advisory Council on Global Change, 1999). These syndromes fall into three categories, utilisation, development and sink. These are listed in Table 2 together with the symptoms or water related problems characteristic of each (modified from German Advisory Council on Global Change, 1999).

The global dimension of the water crisis is inescapable. Water related problems of varying severity can be found across a range of geographical scales. Water related issues are not problems "there" but problems here, they are not problems "in the future" but problems now, they are not problems for "them" but for us. Aral Sea Syndrome, albeit on a smaller scale, is developing in western Victoria in the vicinity of Lake Corangamite. Water related conflicts occur on all scales viz. between nations (for example, see Table 1), between states within nations (for example, the Murray-Darling River and the "cap" on water extractions), between regions within states (for example, environmental flows in the Glenelg and Wimmera Rivers), and within regions (for example, different users of water in the Merri River).

> Against this backdrop there is a need to consider the human right to water. The Universal Declaration of Human Rights (1948), the International Covenant on Economic, Social and Cultural Rights (1966), the Declaration of the World Food Summit (1996) and the United Nations Conference on Human Settlements (1996) all affirm, either explicitly or implicitly, the human right to adequate water. These social rights are not legally binding but involve an obligation on the part of governments to attempt to ensure that this right is honoured. Attempts to address the water crisis that involve market-based solutions must take this fundamental right into account. It would seem that part of this right to water is the associated right of people to participate in the decision making process as it affects water-related issues.

***The Importance Regional Initiatives and Community Participation***

Community participation in water related decision making is most likely to occur at the local and regional levels and at this level the water crisis may differ in extent depending on the social, economic and environmental characteristics of the region.

A regional-specific assessment of the global water crisis can be made using the "criticality index" K (German Advisory Council on Global Change, 1999), which combines measures of the natural water resources of a region, the demand on those resources by humans, and the problem solving or response capacity of society. That is:

$$K = \frac{\text{water withdrawals}}{\text{water availability x problem solving capacity}}$$

**Table 2: The most important problems affecting the environment: syndromes and water related symptoms.**

| **Syndromes** | **Symptoms** |
|---|---|
| Utilisation | |
| 1. Sahel | - over-cultivation of marginal land |
| 2. Over-exploitation | - overexploitation of natural ecosystems |
| 3. Rural Exodus | - environmental degradation through abandonment of traditional agricultural practices |
| 4. Dust Bowl | - non-sustainable agro-industrial use of soils and water bodies |
| 5. Katanga | - environmental degradation through depletion of non-renewable resources |
| 6. Mass Tourism | - development and destruction of the environment for recreation |
| 7. Scorched Earth | - environmental destruction through war and military action |
| Development | |
| 8. Aral Sea | - environmental degradation through poorly managed or unsuccessful large-scale projects |
| 9. Green Revolution | - environmental and development problems caused by transfer of locally inappropriate farming methods |
| 10. Asian Tigers | - disregard for environmental standards during rapid economic growth |
| 11. Favela | - environmental degradation through uncontrollable urban growth |
| 12. Urban Sprawl | - destruction of the landscape through planned expansion of urban infrastructure |
| 13. Major accident | - singular anthropogenic environmental disasters with long-term impacts<br>- pollution of water resources resulting in scarcities<br>- health hazards<br>- failure of water resource development projects |
| Sink | |
| 14. Smokestack | - environmental degradation through large scale diffusion of long-lived substances<br>- contamination of surface and groundwaters<br>- health hazards<br>- eutrophication<br>- acid rain. |
| 15. Waste Dumping | - environmental degradation through controlled and uncontrolled disposal of waste<br>- contamination of groundwaters<br>- scarcity of drinking water<br>- health risks. |
| 16. Contaminated Land | - local contamination of the environment at industrial sites<br>- pollution of groundwaters. |

Where water is scarce, demand high and capacity to respond low, the global water crisis is manifested in an acute form. Measures that can be applied for each component are discussed in German Advisory Council on Global Change, 1999. Problem solving capacity could be measured in terms of economic strength, water-related expertise, infrastructure for supply and treatment of water, efficiency and stability of political institutions. Obviously, a key aspect of problem solving capacity is the education, motivation and political empowerment of the population. Another key aspect of problem solving capacity is 'network thinking' - the degree to which the regional community has developed effective linkages between the various sectors involved in water use and management. A major constraint to water management in many regions is that management is fragmented between sectors and water rights and ownership not are clearly defined. Even where fragmentation is not pronounced communication between sectors is a critical issue.

It is now recognised that regions and catchments are the most suitable scale for managing natural resources, particularly coastal and inland water issues (Alexandra, Higgins and White, 1998; Rhoades, 2000), and regional strategies are most effective when generated and overseen by the community with appropriate support from other sectors (National Natural Resource Management Task Force, 1999). The regional scale offers the best opportunities for planning and action, industry and community development, resolving conflicts and determining priorities, and integrating social, economic and environmental considerations. Most of the strategic planning for catchment management makes use of the adaptive management approach. The basis of this approach is the acceptance that people do not have full control over or understanding of their environment and therefore regular revision of management plans is necessary to account for unanticipated changes or development of knowledge (Alexandra, et al., 1998). In the adaptive management cycle the effects or outcomes of management are monitored so that the degree of success of management strategies can be assessed. This generates a management cycle wherein successive refinements of management activities occur in response to the testing of management strategy options (Alexandra, et al., 1998).

The philosophy of regional or catchment-based adaptive management strategies to tackle natural resource problems is based on the "bottom up" process of community involvement in identification of problems, understanding of problems and proposing solutions for which there is consensus (Robinson, 2000). This stems from the very real demand by the community for increased participation in the decision making process (Rhoades, 2000) which, in turn, reflects concerns by the community about the nature of representative government (Curtis and Lockwood, 1998, cited in Robinson, 2000). Public participation in decision making is essential if resource management is to be effective. Public support for environmental management relies on the community being well informed (Sani, 1999).

Regional strategies are most effective when generated and overseen by the community. This approach requires devolution of decision making and appropriate support. One aspect of this support is the requirement for ready access to relevant data and information. A key requirement for adaptive management is environmental, social and economic information. For effective natural (and in this case specifically water) resource management there is an increasing need to combine the experience, knowledge and preferences (or values) of the community with the expertise and knowledge base of managers, business and researchers (Robinson, 2000).

This raises two key issues - communication and decision making. Models and methodologies, such as multi-objective decision support systems (Robinson, 2000), have been developed to facilitate decision making at the regional scale. However, these decision making management tools assume effective communication between stakeholders (or the business, community, research and management sectors). Models and methodologies dealing with the communication process and communication strategies at the regional scale do not appear to be well developed. This is a barrier to decision making. While individual organisations involved in natural resource management may have knowledge exchange strategies and programs the key issue is the degree to which integration of communication between sectors occurs on a regional or catchment scale.

Alexandra, et al., (1998, pg 7) refer to a working partnership between regional stakeholders as the central element of an adaptive management system and an "informing system" as the means by which information is delivered to environmental managers. However, the informing system described by Alexandra, et al., (1998) stops short of proposing a regional strategy to effect knowledge exchange. The informing system that seems to have been adopted in Australia is biased towards data collection and transferral of the data to managers. An important issue regarding this system is whether knowledge based upon that data is transferred to the community and other sectors such as business. The involvement of the community in environmental monitoring, one of the key aspects of integrated catchment management and at the core of the current national approach to state of the environment reporting (Alexandra, et al., 1998), does not of itself improve knowledge or understanding. Environmental monitoring, whether it be conducted by managers, researchers or the community, generates data or information; this information must be assessed, interpreted and related to other data (environmental, social and economic) to increase understanding, that is, to become knowledge. This view is supported by Smith (1998) who concluded that the nature of the

water quality information available for Australia was such that the assessment of water quality issues had been constrained by the large amount of unprocessed data in some areas. Adding to this unprocessed data will not improve catchment management.

This should not be interpreted as a criticism of community involvement in environmental monitoring, either as a part of adaptive catchment management or in terms of the information generated by such programs, which is vast and can be of high quality (see the examples of Saltwatch, Watertable Watch and Waterwatch as described in Alexandra, et al., 1998). Rather it is a call for some critical self-analysis of the systems we have set up to determine whether they can be made more effective. The community can generate conductivity data by the database full but without some analysis of the data, over space and time, some interpretation of the trends, and communication of the outcomes of the analysis back to the community this will not improve knowledge or understanding. Critically, it will not aid the community in evaluating the options for management to address the problem. What is needed at the regional level is a review of how effectively the regional network or informing system is operating.

In essence the key question is, do regions have a knowledge exchange strategy and an effective informing system?

***The Socio-cultural Context of Water Management***

Each society, and particular sub-groups of society, has its own water culture, which will influence the resolution of water related management issues. Water related behaviour is learned early in the process of socialisation and becomes a habit that is generally not consciously perceived or reflected upon (German Advisory Council on Global Change, 1999). Any approach to dealing with water related issues must acknowledge and address this. The issue then becomes whether or not there are universal elements or aspects of water management or whether all aspects must be societally contextualised.

Part of the solution to water related management issues is a change in human behaviour. This is in addition to instruments which may be market-based or state-supported (German Advisory Council on Global Change, 1999), although it is likely that the future involves a change in the traditional role of government in this area (World Bank, 1992). Community-level responses to the water crisis involve education, public discussion of the issues, and communication between sectors. This will foster learning, which will result in changes in attitudes and behaviour. Behaviour relevant to the global water crisis occurs at various levels of society from the individual to the community to national and international organisations. However, it must be remembered that people always act in local contexts that are spatially and temporally specific and the socio-cultural context is important when considering community or regional initiatives (German Advisory Council on Global Change, 1999).

The critical role of individuals and their networks within regions in resource management is in network thinking. This can be illustrated using the Hinge Model as shown in Figure 1. The model is a five level conceptual model that describes the process by which environmental outcomes are determined, that is, how interactions, and exerting pressure at different scales result in management policies that have positive or negative environmental outcomes. The left-hand side of the model depicts a belief system based upon the market value of resources, a dependence upon financial capital, pro-development at local and national scales, pro-growth and economic development, market forces and “winners and losers”. The right hand side of the model depicts a belief system based upon essential ecosystem services, dependence upon natural capital, balanced development at local and national scales, sustainable growth and development and sustainability and equity. These are of course the extremes of a continuum of belief systems. The two belief systems work in opposition, that is they push each other backwards and forwards or up and down, depending upon factors operating at five levels: personal, community or regional, state, national, international.

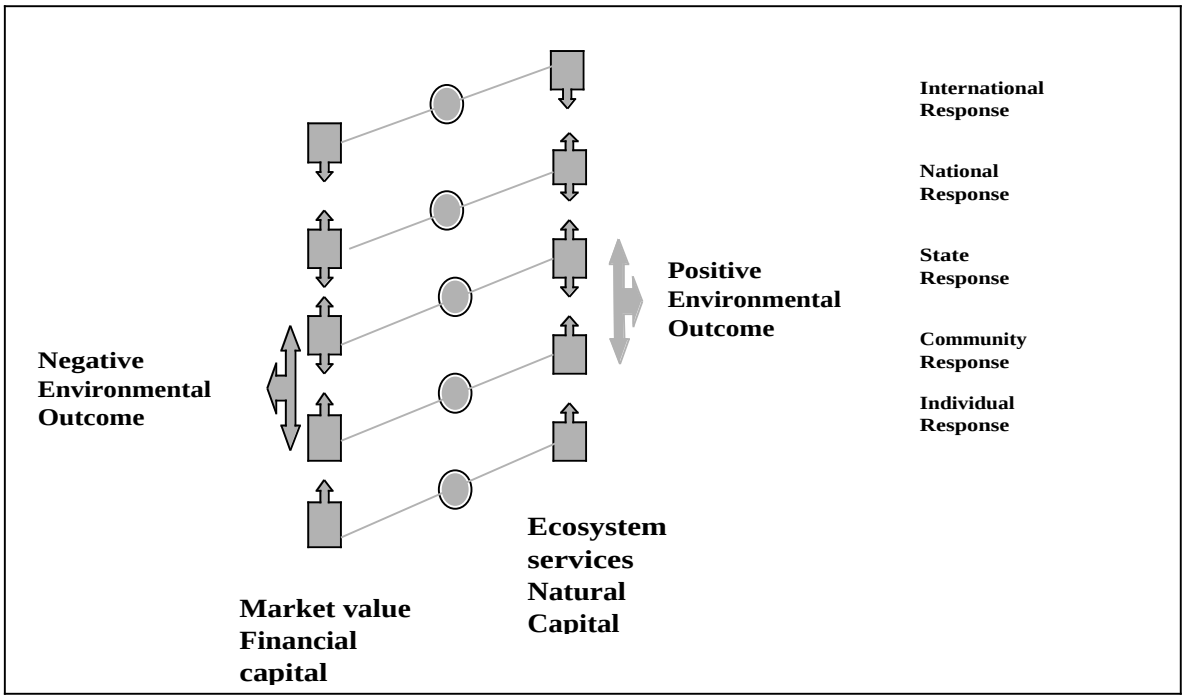


**Figure 1:** The Fulcrum Model - demonstrates the critical role of individuals and their networks within regions

Level 1 represents the individual's response. The process starts with key individuals working within their community and region. Despite the fact that education is undertaken at the community level, community responses do not occur spontaneously at a mass level. A community responds because key individuals, who can capture the imagination of the community, motivate others and mobilise the efforts of their networks compelling action. The response of the individual is based upon a personal cost-benefit analysis of the outcome or effect for a given issue. If the individual deems that the cost of development (what may be lost) exceeds the benefit (what may be gained) then they will be compelled to act within their community to effect support to oppose the development. If the individual deems that the benefit exceeds the apparent cost then they will be compelled to act within their community to effect support for the development. The response of individuals generates a community level response.

The community level response, Level 2 of the model, depends upon the persuasiveness and standing of key individuals in the community and how those key individuals mobilise resources. This has been termed "political entrepreneurship" (World Bank, 1992). This is possibly the most important determinant in the community level response. The political entrepreneur is not only able to motivate others but is able to engender trust and, critically, to demonstrate the benefits of community response. Response at the community level will depend upon the immediacy of the issue to the community, as influenced by the political entrepreneur, and the degree of education within the community on the issue. The community level response may be directly or indirectly effected. Directly by implicit and cultural needs, which will be based upon immediate needs or the apparent benefits of development in the absence of informed opinion on true costs. On the other hand it may be effected indirectly through education and training, which informs the community of true costs. The community level response may be one of valuing natural capital, in which case positive environmental outcomes will occur, or it may be one based upon emphasising financial capital, in which case negative environmental outcomes may occur.

To this point the process is bottom-up. The state level response, Level 3, can be part of a top-down process depending upon ideology of the party in power. If the response at the state level is one of balanced development then the effect of the community response will be a positive environmental outcome. If the response of the state is pro-development then there may be a negative environmental outcome.

The state level response will be influenced top-down by the national level response, Level 4. The national response will reflect the self-interest of the party in power. This may or may not be the same as the party in power at the state level. If the national level response is one of sustainable development then there may be a positive environmental outcome. This may be effected in partnership with the state level or it may be effected by overriding the state level response. If the national level response is one of pro-growth then there may be a negative environmental outcome.

The national level response may be influenced by the international view (Level 5), that is the international community may bring pressure to bear on a national government to force more positive environmental outcomes or to promote a "market forces" response, which may effect negative environmental outcomes. The international community response reflects power players within regions and globally. If the international community exerts pressure for sustainability and equity considerations then a positive environmental outcome is likely. If on the other hand the international community exerts pressure for economic development via market forces then negative environmental and social outcomes may occur.

The model highlights several key features of the network thinking process. Firstly, the crucial role of individuals operating within their community. Secondly, that it is both top-down and bottom-up, that is international, national and state responses may change individual attitudes via education, training and research; state, national and international responses are influenced by individuals exerting their views either by public action or through the ballot box. Thirdly, that it is not unidirectional, that it does not flow cleanly or simply from one level to the next and how action at one level affects the next level depends upon the receptiveness of the next level to the action occurring. This receptiveness varies depending upon political ideology and so at times the net effect is movement towards a positive environmental outcome while at other times the net effect is movement towards a negative environmental outcome. The balance between the two major forces (belief systems) shifts over time but not necessarily in a constant direction. The process shudders back and forth as nations move towards economic development and increased consumerism and as governments (national and state) change. The strength and direction of movement will be influenced by such factors as knowledge and understanding, climate and market.

The response to water management issues and hence the strength and direction of movement occurring will depend on the effectiveness of the communication process. In order to analyse this effectiveness a number of questions need addressing. What is the nature of the communication process at the regional level? What is communicated? Where does the knowledge come from? And from here, what are the barriers to developing regional strategies?

***The Nature of the Communication Process***

When considering how the process of network thinking works at a regional level there is a need to consider the nature of the communication process, that is how communication occurs. According to Cullen (1997), there are two recognised models of science communication. The first is the source-channel-sink model, which involves a transmitter, a channel of communication and a receiver. The receiver is conventionally viewed as passive that is it is largely a one way process. In the current context this one way process may be made worse by the notion of "the expert" communicating with the "poorly informed" which connotes information as power and a position of privilege. Inadequacies in the model have been documented (Campbell, 1996, cited in Cullen, 1997)

The second model is one of two-way communication through dialogue or conversation. This interactive model is based upon the idea that communication occurs so that the recipient acquires knowledge (i.e. learns) but in listening to the response of the recipient the communicator also learns and gains new insight into the problem. This makes the communicator and receiver partners in the communication process; if more than two partners are involved then this process involves the concept of an information network rather than a series of one-way channels. The current approach to resource management, which involves stakeholders in the consultation process, is obviously based upon this model.

Two way communication via a true network is essential if "deep learning" (after Cullen, 1997) is to occur. Deep learning occurs when the network partners experience the concept under discussion, put it into their

own language and apply it to their own problems. Deep learning depends upon dialogue between the "expert" and the community. This dialogue must allow the community to attempt to apply the knowledge gained and thereby to test their understanding and correct errors. The Landcare movement in Australia is an example of such a process whereby the landowners become the agents of management at the property or sub-catchment level.

It is important now to consider two questions. Firstly, how effective is our current model of communication between the sectors involved in water management issues at the regional scale? Secondly, what model can we use to think about communication relating to water-related issues at the regional level? Figures 2a to 2c present a model which simplifies the region into four sectors: the community, managers, business and researchers and illustrated the communication interactions between sectors within the regional envelope.

The sub-model shown in Figure 2a depicts the sequence of events when a management issue arises. The various sectors become aware of the issue (step 1). Key awareness considerations are how the various sectors become aware of the issue, who becomes aware of the issue first (and the implications of this) and who acts first to address the issue. Managers may become aware of the issue via long term monitoring programs; if such programs are not in place managers may be unaware of the issue. The community may become aware of the issue via first hand exposure (eg. loss of aesthetic amenities or effects on landowners) or via communication with managers. Business may become aware of the issue via first hand exposure (eg. effects on operations) or via communication with the community and/or managers.

Exposure to the issue results in communication between community, business and manager sectors (step 2). It is obvious that delays in communication resulting in differing levels of awareness between these sectors is an obstacle to addressing management issues. Critical communication considerations at this stage are coordinated communication between the sectors and providing for differing information needs between sectors. If communication between sectors is not coordinated and does not involve the two-way process described above then "push - pull" situations can arise. That is, the community may be informed ahead of managers and may feel that it has to "pull" reluctant or cautious managers into the issue. If managers are informed ahead of the community they may feel that they have to "push" a reluctant community into management action. If business is not informed along with other sectors it may feel pulled by the community and pushed by managers at the same time.

Communication between sectors leads to involvement of researchers in the issue (step 3). A key consideration here is how researchers become involved in the issue, that is who is responsible for their involvement? If the community involves researchers the research outcomes are often left to the researchers to develop; such outcomes may not be useful for management. If the managers involve the researchers then research may be limited to monitoring and not tackle fundamental processes because of time constraints. If business involves the researchers this is generally on the basis of consultancy and the outcomes may be useful for the businesses involved but not of more general applicability. It is also likely that research outcomes will be confidential and this may prevent information flow to the community and to managers. Sometimes researchers initiate the research themselves. In this situation the research may be narrowly focussed and strictly discipline-based because research funding may be limited.

The question of which sector initiates the research is important because it affects the important issue of ownership of the information collected. Sueishi (1999) argues that the involvement of researchers in an environmental issue has the potential for creating a monopoly in terms of the control of knowledge and/or systems for the collection of information. Sueishi (1999) goes further and poses the question of whether researchers need to be involved in all issues and whether there are some issues that do not need specialist information.

**Figure 2: Regional Communication Model**

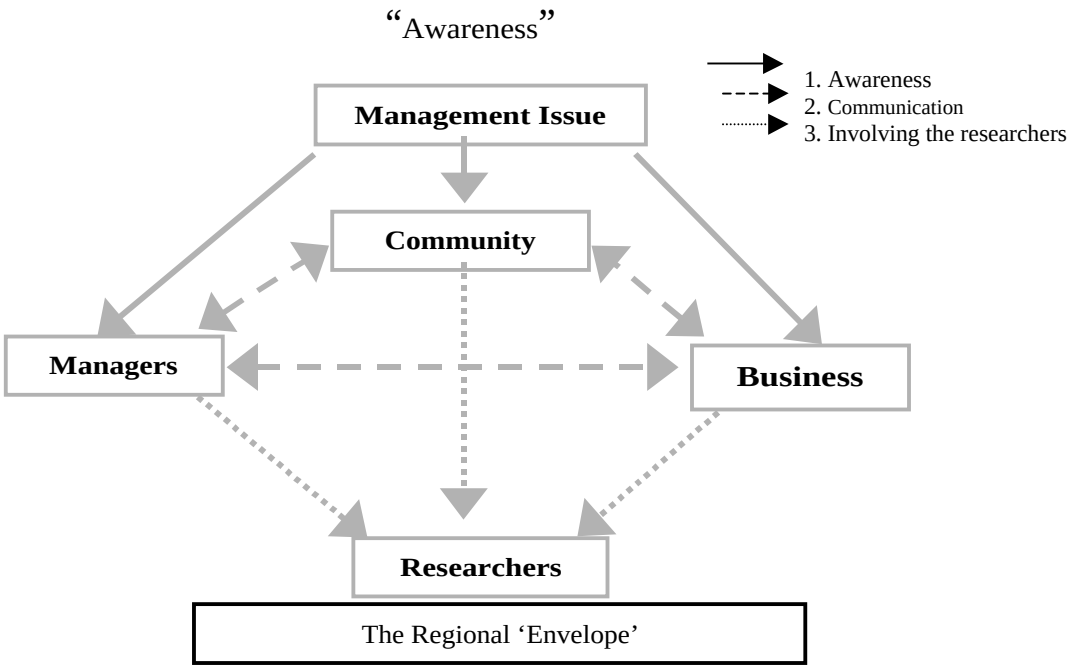


Figure 2a: Becoming aware of the management

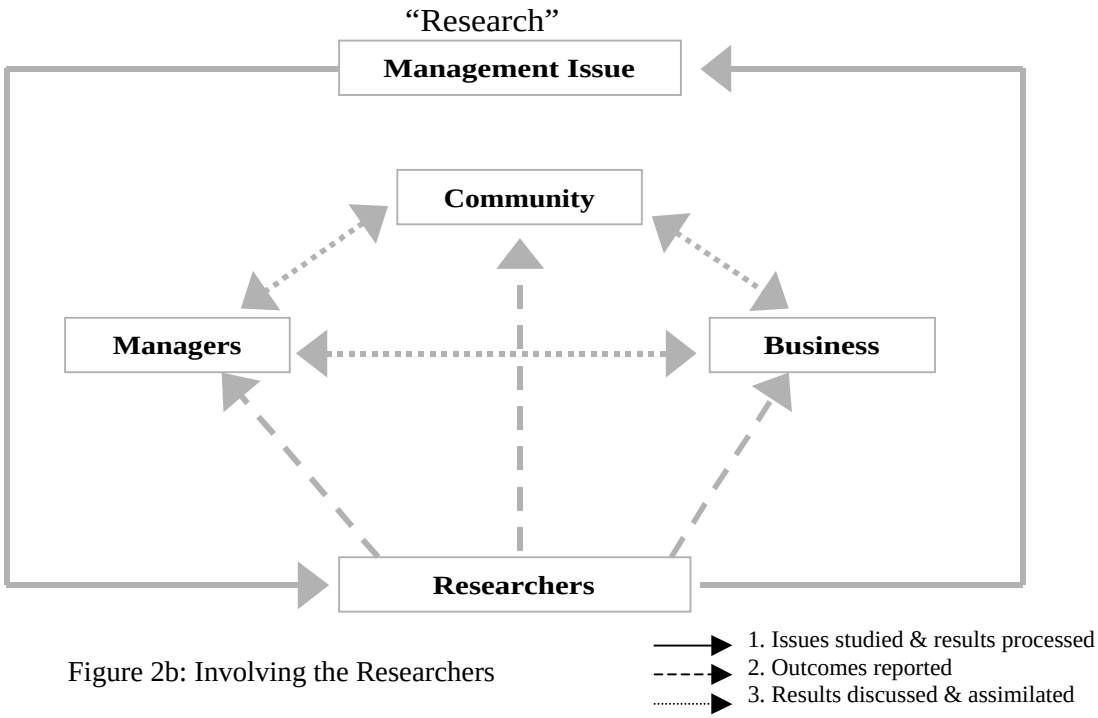


Figure 2b: Involving the Researchers

**Figure 2 ctd.: Regional Communication Model**

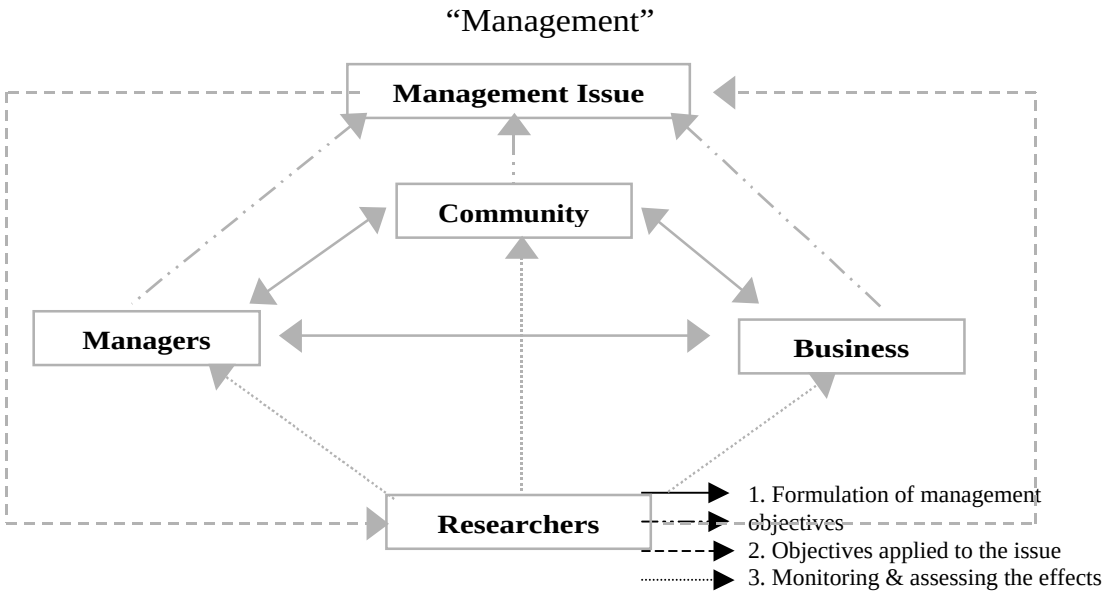


Fig. 2c: Applying the research outcomes to management

The sub-model presented in Figure 2b shows what happens when researchers are involved in the regional network. Researchers study various aspects of the management issue (step 1). As discussed above the exact nature of the aspects studied and the scope of the research is determined by which sector involves the researchers. Partnerships between sectors for conducting research into management issues should be explored at this step however, partnerships should not become knowledge cartels and result in exclusivity with respect to other sectors. The researchers (step 2) then process the outcomes of the research. A key consideration here is the integration of research outcomes particularly, as will be discussed later, if the research is broken down into discipline-specific questions.

The outcomes of research are then communicated back to the other sectors (step 3). The key issue at this step is which sectors the researchers communicate with. This will be largely determined by which sector(s) initially involved the researchers. Key to this process will be the methods by which researchers communicate with the other sectors and what information is communicated with those sectors. If researchers only present their findings to their peers (ie. within their research network) or in a highly technical form, even if this occurs at public seminars, then certain sectors may be locked out of the communication process. There is increasing pressure on researchers to publish their work in refereed journals rather than in the so-called "grey literature". If researchers initiate the research themselves or at the behest of managers or business then they may have no mandate to organise public meetings to disseminate the findings of that research. These issues are further discussed below.

Step 4 in the model involves communication between the other sectors to assimilate the research outcomes. This step is crucial and is where "deep learning" occurs. Key issues at this step are how the research outcomes are understood by the various sectors. It is essential at this stage that the other sectors be confident enough to interrogate the researchers and to push the researchers to put the research outcomes into forms that can be applied in management deliberations. The research sector must not remain aloof or isolated at this step.

The submodel presented in Figure 2c shows what happens when research outcomes are applied in management deliberations. Manager, community and business sectors assimilate the outcomes of research and formulate management objectives and strategies (step 1) which are then applied by the various sectors to the management issue (step 2). The various sectors may apply different components of the overall management strategy; in this way each sector is actively involved in management action. At step 3 the researchers monitor the effects of the various management actions. Key considerations for monitoring are is it being conducted and who is monitoring the effects of the management actions. Business and manager sectors generally conduct monitoring via professional researchers acting in research partnerships or as consultants. The community may be directly involved in monitoring but it is essential that the information collected actually be useful in assessing the efficacy of management action. The issue of who should be responsible for monitoring and who owns the information collected should be clearly addressed prior to the implementation of management action. The establishment of partnerships between all sectors for the purpose of monitoring should also be considered at an early stage.

The researchers, at step 4, assess outcomes of monitoring. The key issue at this stage is that the management objectives have been clearly enunciated so as to allow accurate assessment of the efficacy of management actions. The monitoring-feedback loop is essential if management is to be adaptive.

Partnerships between researchers and other sectors for monitoring are increasing. A major initiative of the National Heritage Trust for example, has been to foster partnerships between all levels of government, industry and the wider community (Conacher and Conacher, 2000). Part of the benefit of establishing partnerships for research and monitoring is that gateways that block information flow between sectors can be identified and information flow promoted as part of the process. However, as referred to above partnerships become counter-productive when they effectively become a network within a network and exclusive rather than inclusive.

***What is being communicated?***

Communication between sectors within the region could be through the exchange is of information, knowledge or wisdom. Generally, information is exchanged to share a point of view, to inform to bring about a change in attitude or behaviour. Information does not of itself change attitude or behaviour. Knowledge is more than information in that it includes discernment. Discernment is possible when sufficient familiarity with a particular subject has been gained to allow critical assessment of further information. Wisdom is what is needed in management - this is knowledge plus just judgement as to action. We need to communicate more than just information. Cullen (1997) argues that communication, in the context of environmental management, is not just about passing on knowledge but about imparting a clear message that will change attitude or behaviour in the receiver. This means ensuring information becomes knowledge by overview, critical assessment, weighing up conflicting pieces of information, assembling information into coherent groupings. It also means ensuring that, along with knowledge, some judgement as to appropriate action is also imparted to the receiver. When considering water management issues at the regional scale we need to ask several questions. Does this occur? What do the various receivers of information receive? What are we passing around the regional network?

Scientific knowledge about any environmental issue has four elements (after Cullen, 1997): what we know; what we think we know; what we would like to know; and what we do not know and are unaware of. 'What we know' is accepted knowledge that is widely agreed upon by researchers as a basis for predicting outcomes. 'What we think we know' is disputed knowledge where different ideas may compete or a false idea is accepted without scrutiny (this may result from the rush to manage which requires answers to problems which may not have been adequately researched eg. estuarine mouth opening, environmental

flows). 'What we would like to know', which is determined by what we think we need to know, which is determined by what we think we already know. This is determined largely by people familiar enough with 'what we do know' that they can "estimate" what further knowledge is needed. 'What we do not know and are unaware of' refers to areas where we do not have useful knowledge and are not aware of this.

A critical aspect of the communication process within a region concerns the nature of the information or knowledge that is communicated between the various sectors. In the ensuing discussion it will be assumed that it is knowledge that is transferred between sectors; in reality it is often information that is transferred and not knowledge. If different sectors are receiving different parts of the knowledge or different versions of the knowledge then the potential exists for misinterpretation or different interpretations. This can lead to conflict in management deliberations and different views on appropriate management actions. Exchange of different parts or version of knowledge can result from the filtering of information between sectors. Some sectors will possess detailed technical knowledge while others may only receive filtered or simplified knowledge. This means that the various sectors may have different levels of understanding on certain management issues. This is influenced by which sector integrates the research outcomes (and whether integration is conducted at all) and who "owns" the knowledge.

This aspect of regional communication is modelled in Figure 3. This model builds on the first, second and third stages of information dissemination as outlined by Sueishi (1999). This model depicts how knowledge is disseminated from researchers to the other sectors within the region in different forms and the role of the media in knowledge transfer. Knowledge is passed from the research sector to the manager sector in a detailed technical form; however, researchers generally simplify research outcomes for transfer to the media and for the community. Researchers generally communicate with the community within their disciplines. This means that the community may receive several lines of filtered knowledge from the research sector. Managers communicate detailed technical knowledge to business but generally simplify knowledge for transfer to the media or directly to the community. In all cases knowledge transfer from managers involves a government policy "filter" which may influence the extent or interpretation of knowledge transferred. The business sector also filters knowledge to the media. The media further simplifies knowledge before transferring it to the community and may "popularise" such knowledge by introducing a particular interpretation that suits editorial policy.

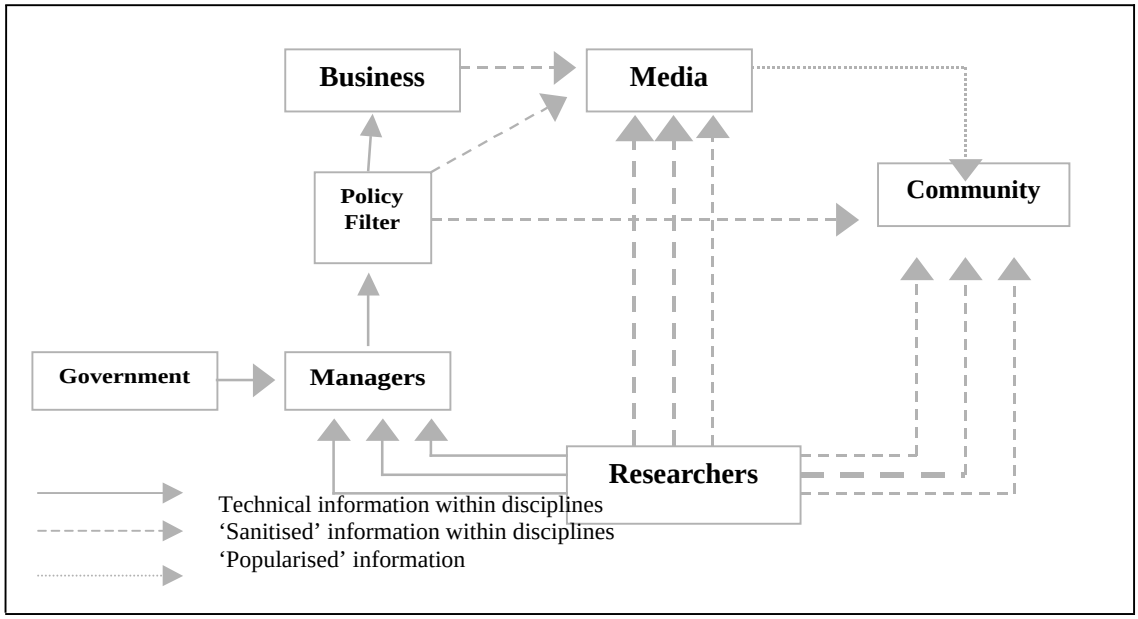


**Figure 3:** Knowledge Filtering within the Regional Envelope

This model suggests that the community receives selectively filtered knowledge from all other sectors. Certain sectors are in possession of detailed technical knowledge but interpretation may vary between sectors due to different filters being applied to that knowledge. A key issue in this model is which method of communication has most effect on the community sector and therefore exerts most influence on attitudes and behaviour. The crucial role of education is highlighted here. The importance of integration of knowledge across disciplines and across sectors and whose responsibility it is to effect such integration is critical. In the past such integration at a regional scale has not taken place. This has been addressed in Victoria to a certain extent by the formation of the Catchment Management Authorities.

This aspect of communication obviously affects the balance between the different elements of knowledge discussed above. Filtered information may contribute to disputed knowledge ("what we think we know") between sectors, may result in differences in research and management objectives ("what we would like to know") between sectors, and will result in different knowledge gaps ("what we do not know and are unaware of") between sectors.

***Where does the information come from?***

Scientists, managers and bureaucrats, landholders and the wider public communicate well amongst themselves. That is communication within sectors is good but communication between sectors is often poor. This is particularly true of scientists/researchers (Cullen, 1997). The model presented in Figure 3 depicts information flow within a region but information also flows into a region from outside. Key questions about this information flow are what information penetrates the regional envelope and how does this information pass through the envelope.

The relationship between the regional envelope and the wider context is modelled in Figure 4. In effect this model proposes that three communication networks exist. The first network (1 in the model) is the regional network, communication between sectors. Within this network communication is rapid and direct. The second network (2 in the model) is the sectoral network of which each regional sector is a part. This network sits outside of the regional network. This means that researchers communicate with other researchers outside of the region, managers communicate with other managers outside of the region and so on. Generally communication within the sectoral network takes place via professional publications and technical conferences. Communication within this network is less direct and tends to be slower, relying on publication cycles and annual conference timetables. The third network is the global information/knowledge network, which may be national or international. In this network, members of one sector may find out about knowledge in another sector by reference to the professional literature of that network and participation in professional meetings organised within that network. Communication between sectors within the global network is slow, indirect and "hit and miss", that is, the process of literature searching means that it is easy for key sources of relevant information to be overlooked.

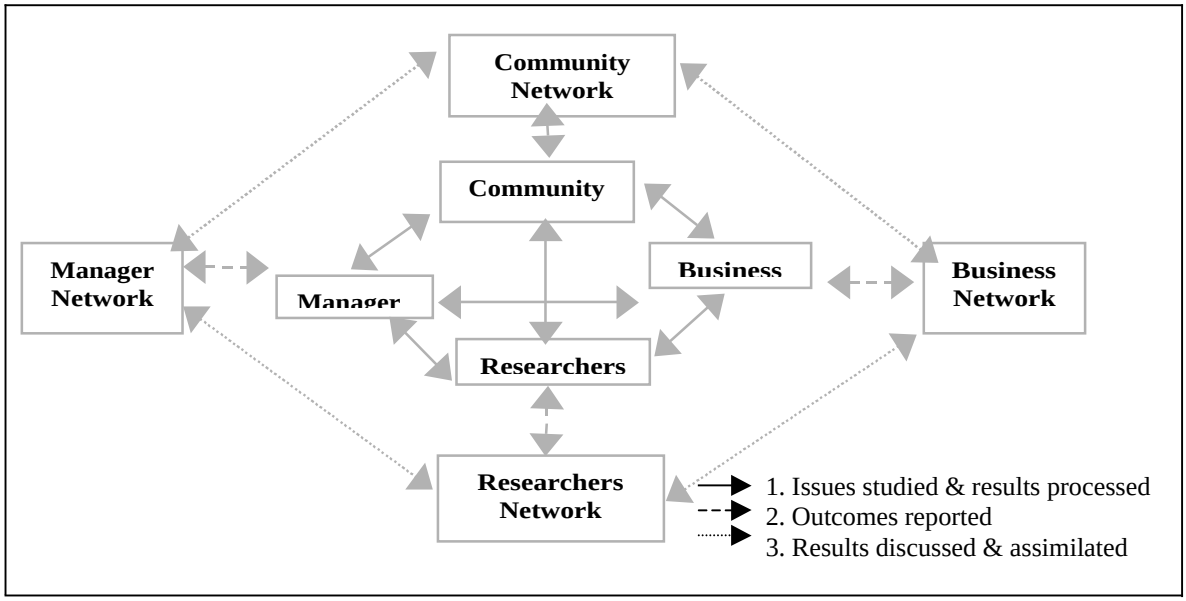


**Figure 4:** The Three Network Communication Model

The key issue raised by this model is whether the various sectors within a region are communicating with each other as part of the regional network or via the global network which involves slower and incomplete transmission of knowledge. It should be the objective of regions to short-circuit the knowledge communication process to ensure that it occurs within the regional network and not outside of it. The various sectors should be talking directly rather than communicating via the interrogation of each other's literature. If the sectors within a region communicate via sectoral and global networks rather than regional ones then there will be delays and gaps in knowledge transfer. This will exacerbate the problems discussed above.

For communication to be effective then "network thinking" should occur at the regional level. For each sector within the region the key question is what is our network? That is, does network thinking occur across sectors within a region or is it restricted to within the sectoral network?

***Barriers to Regional Solutions***

Severe gaps exist in information of all types (viz. technical, economic and social) – and particularly in information relating to sustainability (German Advisory Council on Global Change, 1999). Sustainable management of water resources is a cross-sectoral challenge, which requires new approaches to decision making. Network thinking is required but poorly developed in most contexts.

The integration barrier (Mitchell and DeSilva, 1992) shown in Figure 5 refers to the lack of interdisciplinary communication and research collaboration that has characterised the development of inland water resources, particularly in developing countries. This has resulted from networks being confined to within disciplines within sectors. Although research may be initiated to solve a broad problem, the manner in which research is undertaken often leads to it being fragmented into distinct disciplines. The outcomes of research tend to be narrow and often the necessary integration does not occur, either at the front end of the process (research design) or the back end of the process (application). The very nature of disciplinary-specific research provides barriers to the integration of research outcomes, and this is an impediment to the development of management strategies. Managers may be given incomplete information or may not have the necessary capability to undertake the integration of the various research outcomes. The community may be given partial insights into a mosaic of effects but the pieces may be insufficient to

give the community the overall picture. This prevents the community from participating in the management process.

The integration barrier limits the network boundary or envelope to that within sectors or within disciplines within sectors and therefore stifles true regional network thinking or skews it to a subset of the regional network. The need for a more interdisciplinary approach to research on natural resources management has been highlighted by the National Natural Resource Management Task Force, 1999. This would facilitate collaborative work and increase knowledge exchange across sectors. Institutional arrangements for research and development organisations should foster interdisciplinary approaches to water problems. This problem is being tackled to a certain extent through organisations such as the Cooperative Research Centres (CRCs), but one could easily ask who is integrating the research outcomes across CRCs? That is, where is the CRC for research integration? This problem is characteristic of all attempts to effect sustainable development of natural resources.

There appears to be a widespread and fundamental problem in adopting a truly holistic view of water resource development. Regional water management will not rely solely on multidisciplinary research but also on holistic programs which integrate research and education/communication (Meadows and Meadows, 1999).

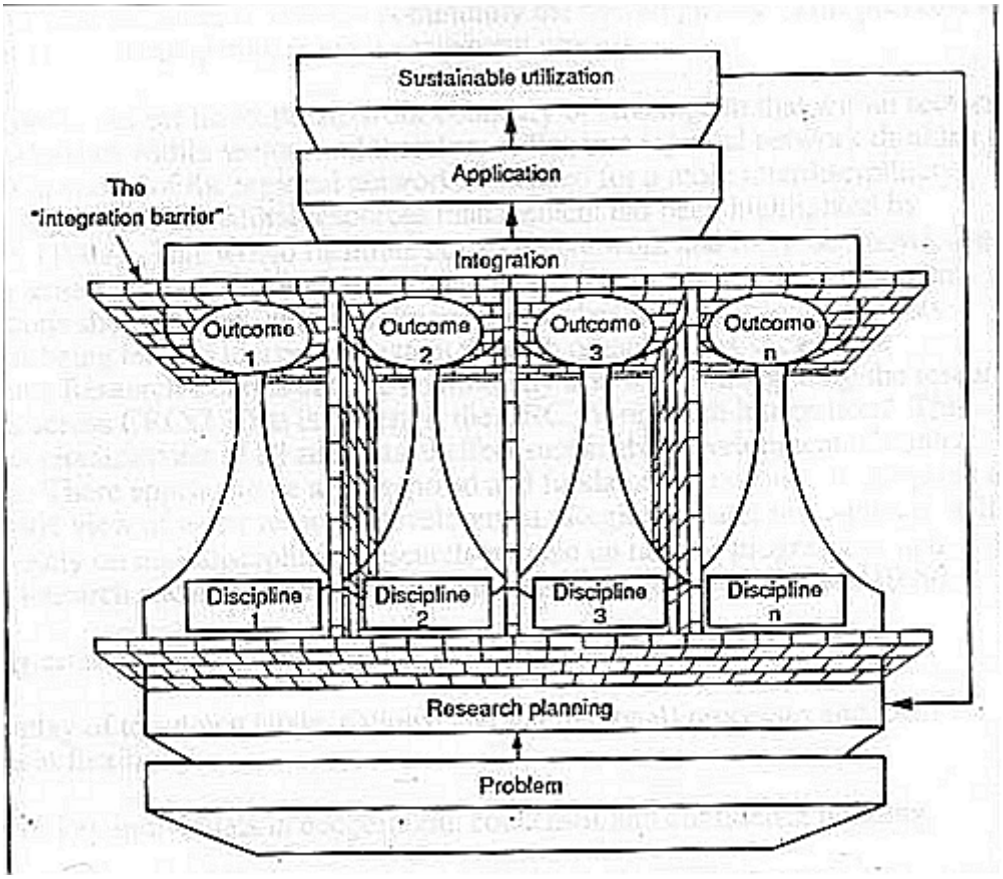


**Figure 5**: Conceptualization of impediments to the integration of information in multidisciplinary studies. The "integration barrier", shown as a series of brick walls, operates at both the research planning and completion stages.

*Source:* Mitchell and DeSilva, 1992.

As well as the failure to develop network thinking and the lack of integration of knowledge across disciplines a number of other barriers to establishing regional water strategies exists. These include

- the institutional reforms that may be involved in resolving cross-sectoral issues;
- the interplay of top-down (state, national and international) processes and local government flexibility;
- the role of key individuals in cooperation, consensus and confidence building;
- a lack of experience with new forms of participation and communication;
- a lack of feedback from the consultative or communication process;
- the time and energy required of volunteers in the community; and
- the conflicts between the strategic interests of organisations and immediate interests of individuals and the community.

Lack of effective community participation is shown to be a significant barrier to developing regional strategies. Education programs that incorporate ecological principles and are based upon local examples can enhance community participation in water management issues. These programs bring the community into contact with environmental problems in their immediate surroundings. In particular, such programs need to stress causes and processes of disruption to aquatic ecosystems. Examples include the International Lake Environment Committee Environmental Education Project (Kira, 1999) and the Saltwatch and Waterwatch programs referred to above. The involvement of the community in environmental monitoring is an integral part of current approaches to adaptive catchment management. Kawashima (1999) argues that the state of the environment should not be judged primarily by researchers or managers but by the community. If this is to be the case then on the one hand the community must understand environmental problems to a much deeper level than is likely to be the case at the present time. On the other hand there must be opportunities for local knowledge to be recognised and incorporated into the regional network thinking.

To meaningfully involve the community in adaptive catchment management requires that the community possess not only the required knowledge but also skills, attitudes and motivation to work with other sectors to manage water (Kawashima, 1999). Community understanding of water problems requires that the following knowledge is available and accessible:

- clear identification of the causes and effects of water related problems;
- an unambiguous assessment of the current severity of the problem;
- future perspectives via clear presentation of predictions and trends; and
- useable social, economic and technical information.

This reinforces the need for more effective communication of research outcomes within the regional context.

***The Development of Network Thinking at the Regional Scale***

To a large degree resolving regional level water related issues maybe a communication issue. It is clear that the development of network thinking at the regional scale is needed but it is also clear that communication between the various sectors within the regional network is fraught with difficulties.

There are numerous strategies for communication and these can be separated into those that communicate within sectoral networks (ie. within management, community, business, researcher networks) and those which cross sectoral networks and therefore have the likelihood of contributing to regional network thinking (see Table 3). The types of strategies being used within the region will determine the success or other wise of the communication process. If the communication strategies employed are exclusive (for example, largely technical reports and professional publications) then the result will be network contraction.

**Table 3: Examples of communication strategies available within and between sectoral networks**

| Within Sectoral Networks | Across Sectoral Networks |
|---|---|
| - presentation at conferences<br>- professional publications<br>- technical workshops<br>- technical reports<br>- technical models<br>- demonstration projects<br>- websites | - websites<br>- use of mass media<br>- community meetings<br>- education programs<br>- short courses/workshops<br>- direct contact on committees<br>- public presentations/displays<br>- technical reports and design guidelines<br>- decision support systems and simple models<br>- demonstration projects<br>- extension (in agricultural sense). |

*Source:* Adapted from Cullen, 1997

One factor that should not be underestimated that may prevent or discourage researchers, managers, and business from communicating with each other and the community is the very real possibility of the "hostile audience". This may occur because the management implications of the information being discussed are unpalatable or because the perception of the problem is different amongst the partners in the network ie. regardless of which sector is involved it may often be telling other sectors things they simply do not wish to hear. Even attempting to communicate that perceptions differ between sectors may be difficult. This discourages face-to-face communication and encourages communication through the safer networks within sectors. Cross-sectoral communication then relies upon serendipitous spill over across sectoral boundaries.

It is clear that effective communication will enhance network thinking within the region and promote the development of improved water management strategies. There are several ways to develop network thinking at the regional level. It can be achieved by developing a regional communication strategy and informing system that provides more knowledge not more information. It will require a community participation program that provides education based on local example, involvement of the community in environmental monitoring and improving community understanding of

- useable social, economic and technical knowledge;
- the causes and effects of water related problems;
- unambiguous assessment of the severity of problems; and
- the future perspective via predictions and trends.

The challenge for regions and participants at this symposium is to consider barriers to the exchange of information and knowledge, and those that prevent or hinder uptake of research and innovation, that is to critically self evaluate their current communication process. Each sector has to ask of itself: to what degree is participation in communication limited to within sectoral network strategies? Can we short-circuit global communication to strengthen regional network thinking? In this way it is hoped that strategies to promote communication between researchers and users to improve water management on a regional scale can be developed. The need for this type of approach is highlighted by Rhoades (2000). He concluded that, as of 1997, there were few published evaluations of whether participatory catchment management actually works, that no international conference had yet been held to critically compare experiences, and that the few studies evaluating such approaches to resource management had been in-house publications with limited dissemination of the findings.

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# Water Quality Techniques and Analysis: Teaching Activities for Philippine Schools and Communities*

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## *Introduction*

Water bodies are sources of water for domestic, agricultural and industrial activities, habitat for a diverse flora and fauna and are therefore major sources of food and livelihood, and used to transport people and goods, for recreation, for electricity generation, and even for waste disposal. Furthermore, they help moderate the climate.

The Philippines is surrounded by water. About 65 percent of Filipinos live in coastal areas. The scenic lakes are tourist attractions and supply water to many towns and cities. More than 300 river systems connect towns and people. Unfortunately, most of the water bodies are at different levels of pollution. Human activities contribute largely to the problem, reducing the quality and usefulness of these water resources.

**Safeguarding the quality of water resources as well as protecting and conserving the biodiversity of living organisms are major challenges to local and national governments. It is important to equip citizens with water quality monitoring skills so that they can participate in protecting and managing the water resources.**

The formal school has a big role to play in developing the skills in managing water resources. Students should be exposed to activities that will help them develop these skills so that they can share their knowledge and skills with their family members and friends. However, current textbooks and student manuals in basic education contain minimal activities along this area. Most teachers are not familiar with these skills because they were not given the training during their college days.

The National Institute for Science and Mathematics Education Development (NISMED) conducts training of classroom teachers and teacher trainers. One of the training programs spearheaded by the High School Earth/ Environmental Science Education Workgroup (HSES) is on water quality monitoring. The content of the training is based on the results of the Riverwatch Project started in 1997 under the Science and Mathematics Education Manpower Development Project (SMEMDP) funded by the Government of Japan through JICA.

This paper describes the experiential learning that NISMED staff underwent while conducting the Riverwatch Project and the objectives, activities and outputs of the training program on water quality monitoring.

## *The Riverwatch Project*

The major objective of this community-based project involved the monitoring of the physical, biological and chemical characteristics of the river near the University. The Riverwatch Team was made up of science education researchers and specialist from NISMED as well as students from the UP College of Science. JICA experts assigned in the SMEMDP served as consultants. The Local Government of Marikina, where the monitoring stations were located, gave support in terms of use of boats for monitoring and ensuring the safety of the researchers while they were conducting overnight on-site testing.

The main purpose of the project was to train our Riverwatch Team in monitoring the quality of a river so that they can pass on the skills to their trainees/participants. Because of limitation in funds and manpower,

on-site and laboratory tests were done and analyzed quarterly over two years. We realized later that our project could have made an impact if we did a more frequent observation and testing. In between our monitoring schedule, a fish kill episode occurred in the project site. The very low value for dissolved oxygen for that month was not monitored.

Despite the limitations of the project, the Riverwatch Team recognized that water quality monitoring provides many opportunities to make the school curriculum relevant and meaningful to students. The results of the tests were used to develop activities that enhance higher order thinking skills. These activities were tried out in selected schools around the river.

***The Training Course***

***The short-term course on water quality monitoring is a continuing activity at NISMED. An 18-hour course is regularly scheduled once a year (for three Saturdays) but some commissioned training on the same topic last for 36 hours.***

***After the training, the participants are expected to:***

***use correct water sampling procedures for the different chemical, physical and biological tests;***

***conduct the water quality tests;***

***analyze/interpret the results of the water quality tests;***

***explain the interconnectedness of the water quality parameters using relevant science concepts; and***

***enhance their participation in community activities related to water quality monitoring.***

The training exposes the participants to hands-on, minds-on and hearts-on activities, both on-site and in the laboratory. It also enables them to use commercial and improvised equipment.

Although the training program is prepared in advanced, an assessment of prior knowledge related to water quality monitoring is conducted to help the trainers focus on monitoring skills that need to be reviewed only and those that need to be given more time. The assessment includes a paper and pencil test to determine the participants' knowledge of terms and interconnectedness of the water quality parameters as well as a practical test where the participants are asked to identify the equipment used for the monitoring and what they are used for.

***An introductory session on the properties of water is conducted to provide justification for the need to monitor a body of water. This is followed by a workshop on making a water quality slide. This slide is later used to identify benthic macro- invertebrates (insects, worms, crustaceans, mollusks and other animals visible to the naked eye) living in the substrate of the river bottom. The water quality slide is also used as an indicator of the extent of pollution of that body of water. A discussion on how to prepare for and conduct a field study is held highlighting the safety precautions that need to be observed.***

***Early morning of the following meeting, the participants are brought to the nearest river. They make a profile of the riparian environment to determine the erosion condition of the riverbank, the plants that thrive in the area, the stream depth and width, the sources of water pollutants, and other characteristics. The participants are then assigned stations where to do the water sampling and/or conduct the on-site testing. Activities on-site include the following: observing the odor and color of the water, identifying the kind of macroorganisms using the water quality slide, and determining the dissolved oxygen, pH, temperature, turbidity, and electrical conductivity of the water using a water quality tester. They collect water samples for the biological test (BOD and coliform) and chemical tests (COD, chlorides, nitrate, phosphorus and ammonia) which are done in the laboratory***

Back in the laboratory, the participants store the water samples and are taught how to prepare the solutions needed for the different tests. In small groups, they perform the different water quality tests. A discussion of the results of the tests is done the next meeting, including the results of the 5-day BOD test and the presumptive test for coliform. The post activity discussion emphasizes the interconnectedness of the water quality parameters. The participants demonstrate their knowledge and skills when they play the ecological domino game or when they supply answers to the concept maps.

The results of the observations and tests are used to develop some student activities. This part of the training is necessary because in some schools, the equipment and chemicals may be difficult to obtain. Students can use the data to practice their analytical skills.

A post training assessment is done using the same questionnaire and checklist in the pre training assessment. Participants are also required to evaluate the course.

***Some Water Quality Monitoring Activities***

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| Making a River Profile<br><br>**This activity requires the participants to observe the various types of plants in the riparian zone (the area along the banks and the verge of the river), amount of bare soil and the degree of bank damage in the area and the other materials covering the river. Participants are asked to draw what they observe using symbols in the vegetation identification key and to interpret what they observe using the riparian assessment key.**<br><br>This activity helps them realize the importance of the riparian environment in maintaining the quality of the river. |
| **Identifying Macroorganisms**<br><br>Using a net, the participants collect organisms in the water sediment and examine submerged rocks and logs for organisms that are attached. They determine the biodiversity using the sequential comparison index which is computed using the formula: total number of organisms divided by total number of species or runs. They also compute for the pollution tolerance index. The kind and number of living organisms found in the substrate used as indicators of water quality. |
| **Determining the Water Quality**<br><br>This is the bulk of the training program. It includes testing some physical, chemical and biological parameters of the water suitable for secondary schools. A commercial multi-tester is used for the on-site testing of dissolved oxygen (DO), turbidity, pH, and electrical conductivity. The test for phosphorus, nitrates, ammonia, suspended solids, BOD, and<br>E. coli are done in the laboratory.<br><br>The results of the tests from three experimental stations are consolidated to give an overall picture of the quality of the riverwater. The results are also related to the profile of the river based on the observations of the riparian zone. |
| **Using Onion Seedlings for Monitoring Water Contaminants**<br><br>This activity shows that locally available materials like onion can be used in water quality monitoring. Using root index, mitotic index, and micronuclear frequencies as indicators, participants determine the effect of different water contaminants. |

***Some Student Activities Based on the Riverwatch Data***

**Some Student Activities based on the Riverwatch Activities**

**Some Activities Based on the Riverwatch Results**

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| ***Determining the Effect of Detergents on Fishes***<br><br>Detergents are commonly used at home and in washing clothes right in the river. In this activity, participants observe the behavior of fishes placed in four containers with the same amount of water but varying amounts of detergents. The activity sheet contains guide questions to help students focus their observations.<br><br>The POE (predict-observe-explain) strategy is utilized in this activity. At the end of the activity, students are asked to communicate their observations through drawings and their feelings about their observations in writing. |
| ***Interpreting Graphs***<br><br>The results of the physical and chemical tests were presented in graphic form. Students are asked to interpret the graphs and the possible reason for the pattern observed. |
| ***Recycling Paper***<br><br>**One of major pollutants in rivers is solid waste. In this activity, students make paper from newspapers, old notebooks, and other kinds of waste paper. They also learn how to control some variables to standardize the resulting product.** |
| **Using an Improvised Transparency Meter**<br><br>For schools that cannot afford to buy a multi-tester, some activities have to be done manually. This requires the use of improvised apparatus. To determine the depth at which sunlight can pass through, a transparency meter was developed. Water samples are collected and placed in the tube. The depth (height) of water that will allow the observer to see the cross at the base tell how far sunlight can penetrate. The observation can be used to explain the importance of light for aquatic plants under water. |

***Impact of the Training***

The training on water quality monitoring has been going on since 1997. It is still one of the most requested short-term courses at NISMED. The Team has also been invited in radio programs to discuss the river monitoring project especially as to how it can help solve the solid waste problem.

Perhaps one indicator of success and relevance of the training is that one of the first participants from Mindanao designed a school project similar to the Riverwatch Project. Their project won an award under the Department of Science and Technology search for model community-based projects. Their prize was a trip to Japan; the teacher and some of her research students attended and shared their experiences in conducting the project in a student forum.

***Future Activities***

The Riverwatch Project was suspended for sometime due to lack of funds and availability of manpower, but there is a plan to do a follow up project. But the training program on water quality monitoring continues. The Department of Environment and Natural Resources has taken an interest on the training and is making plans to conduct it at the regional level as part of their activity under the Local Environmental Planning and Management Project. NISMED training staff will be actively involved in this endeavor.

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# Environmental Studies on the Ashimori River in Okayama City, Japan

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***Abstract***

This paper summarizes a poster paper presented at the International Symposium on Water Management held at Deakin University, December 2000. The study was carried out by 14 members of the Science Club of Ashimori Junior High School in Okayama City under the supervision of Principal T Segawa and Director R Noto. The Ashimori River runs through the north-west of Okayama City and has many suitable natural habitats in it for study. However, since 1994 a decline in firefly numbers has been linked to a decline in water quality. We counted aquatic fauna over several years and related it to physico-chemical characteristics of the water. We found some animals indicated better quality water and were principally found in the upper reaches of the river (e.g. Ephemeroptera, Trichoptera), although the number of Ephemeroptera declined over time. Pollution has increased steadily in the river over time.

## *Introduction*

There have been recent curriculum developments in Japan which have promoted introduction of an Integrated Curriculum in which teachers largely control the content and delivery of the curriculum. Environmental education is a most appropriate way of delivering such integrated lessons, and has been advocated through various intergovernmental organisations and conferences, beginning with the UNEP Stockholm declaration of 1972.

Ashimori River is located in the Ashimori rgeion, northwest of Okayama City and has several branches feeding into it, such as the Uita and Hijaka Rivers. Recently there have been concerns about a decline in environmental health of the river – for example, there has been a reduction in firefly numbers. For this reason we commenced a long-term study of the Ashimori River in 1994, comparing aquatic faunas with indicators of pollution, such as water temperature, pH, COD, nitrite, phosphate and tachometry.

## *Methods and Materials*

### *Studies of aquatic fauna*

Fish, insects, molluscs and other invertebrates were collected and counted with the naked eye. Fauna on the bottom of a 25cm$^2$ frame quadrat were counted.

### *Water quality studies*

Water temperature was measured using a thermometer. PH was recorded with a Pakku test pH meter. Pakku test kits (Kyoritsu Chemical Check Lab Co.) were also used to test for chemical oxygen demand (COD), nitrite ion mg/l, phosphate ion mg/l. Velocity of flow (m/sec) was measured by timing a floating object across a fixed distance.

## *Results and Discussion*

### *Aquatic fauna*

Table 1lists animals detected in four categories of water: clean, slightly polluted, polluted and a fourth category in which animals were found in all three water types. Ephemeroptera and Trichoptera were especially common in the upper reaches of the rivers which were less polluted. *Semisulcospira libertina* (which feeds on fireflies) was found mainly in the upper reaches also, but was not uniformly found in all such clean waters. Table 2 shows how the total number of Ephermeroptera and Trichoptera changes over time in 12 sampling locations in the Ashimori River. This suggests conditions change with time; the decline in Ephemeroptera and general increase in Trichoptera perhaps mirrored a reduction in water quality.

***Chemical data***

COD, phosphate and $NO^{2-}$ were higher and pH lower downstream than in the upper reaches of the river system. Over time, COD increased in 22 of the 24 sampling sites, $NO^{2-}$ increased in 15 of 20 sites while phosphate only increased in 7 (of 18) sites. We suggest this indicates a decline in water quality over time.

Actual data for chemical and fauna were presented at the Symposium on Water Management held at Deakin University in the form of a poster.

**Table 1.** Species indicative of different categories of water quality.

I. Clean Water.

*Pungtungis harzi* Herzenstein, Cyprididae
*Zacco temmininckі* (Temminck et Schlegel), Cyprididae
*Odontobutis obscura* (Temminck et Schlegel), Eleotridae
*Acheilognathus limbata* (Temminck et Schlegel), Cyprididae
Ephemeroptera
Trichoptera
*Mataeopsephus japonicus* Matamura, Psephenidae
Odonata
*Potamon (Geothelphusa) dehaani (*White)
*Semisulcospira libertina* (Gould) Pleuroceridae
*Luciola oruciata* Motschesky, Lampyridae
*Gobitis biwae* Sordan et Snyder
*Parasilurus asotus* (Linnaeus)
*Dugesia japonica japonica* Duges, Kawakatsu et Ichikawa.

II Slightly Polluted Water

*Pseudogobio escocinus* (Temminck et Schlegel), Cyprididae
*Zacco platypus* (Temminck et Schlegel), Cyprididae
*Acheilognathus lanceolata* (Temminck et Schlegel), Cupprididae
*Rhodeus ocellatus smithi* (Regan), Cyprinidae
***Shigara distanti***
*Eucarida pandalus*
Pseudagrion
*Laccotrepes japonicus* Scott, Nepidae
*Unio douglesiae* (Griffith et Pidgeon), Unionidae
*Calopteryx atrata* Selys

III Polluted Water

*Carassius* spp.
*Pseudorasbora parva* (Temminck et Schlegel), Cyprididae
*Procambarus clarki* (Girard)
Porifera, *Ephydatia mulleri* (Lieberkuhn)
*Sinotaia quadrata histrica* (Gould)
*Radix japonica* (jay), Lymnaeidae
*Physa acuta* Draparnaud, Physidae

IV All sites

*Rhinogobius brunneus* (Temminck et Schlegel), Gobiidae
*Gerris paludum insularis* (Motschulsky), Gerridae
*Protohermes grandis* (Thunberg), Corydalidae

*Kamimuria tibialis* (Pictet), Perlidae
Larvae of Chironomidae
*Corbicula (Gorbiculina) leana* Prime, Corbiculidae
Hirudinea

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# Regional Policy Processes and Water Related Management Issues

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## *Introduction*

On October 15, 1998 the Corangamite and Glenelg-Hopkins Catchment Management Authorities announced that the district rate-payers would pay annual waterway tariffs of $32 per annum. Within two weeks of that announcement local headlines were trumpeting the rise of 'people power' in what was to become the $32 levy protest (Warrnambool Standard, December 1, 1999). Local protest meetings were called in all of the major towns in the catchment demanding and end to the tariff. Local politicians and local councillors became embroiled in the conflict and over six months the protests continued until the Victorian government finally relented and withdrew the tariff.

The whole episode of the water tariff could be analysed as a purely political response to another local taxation issue and the paper will address some of these issues. However, while such an analysis can be sustained, there are broader issues that need to be considered. Analysing the competing discourses in the debate is an important first step in understanding the nature of water politics in south-west Victoria. Accordingly the paper begins with a brief introduction to the nature of discourse and then analyses two major discourses in public policy; new public management and environmentalism. The impact of these two major discourses on water policy is analysed in the light of their affect upon the politics of water in south west Victoria. The paper concludes by arguing that the debates over water policy in the south west will continue to be dominated by major discourses that need addressing at all levels, from local through catchment to regional and national levels.

## *Discourse and the Policy Process*

Discursive practice, or discourse, in its simplest form, is people doing, saying or writing things in some social context (Fairclough 1993). This involves the processes of production and reproduction of texts that are dependent upon agents acting in different social settings (Fairclough, 1993). Since texts are made up of forms of past practice, and include a range of different meanings, they are open to interpretation (Fairclough, 1993). In this way discursive practice goes beyond the mere content of speaking, writing or some other symbolic form of expression, to the interpretations or meanings of the expression. In this respect texts are consumed differently in different social contexts.

Discourse is a social practice which focuses on the institutional and organisational circumstances of the discursive event, and how these shape the nature of the discursive practice. While discursive practice does not contrast with social practice in that the former is a particular form of the latter, the emphasis here is on how people's practices are shaped by social structures and relations of power in ways of which they are often unaware (Fairclough 1993). Conversely, people's practices have outcomes and effects which act upon social structures, social relations and social struggles. According to Fairclough, the relationship between discourse and social structure should be seen as a dialectical one (Fairclough, 1993). The major reason for this is to avoid the pitfalls of turning discourse into a mere reflection of some deeper reality, or seeing discourse as the source of the 'social' (Fairclough, 1993).

One way in which discourses become naturalised and normalised is in *common sense*. Discourses are naturalised in the sense that they are accepted in an uncritical and largely unconscious manner as the way to perceive and understand the world. Accordingly, when discourses are accepted as part of the common sense, they are accepted in an axiomatic way. But common sense is not rigid and unchangeable, and is 'continually transforming itself, enriching itself with philosophical opinions which have entered ordinary life' (Gramsci, 1978). Yeatman points out that the incorporation of oppositional interests can lead to a 'residualisation' of those interests in official discourse (Yeatman, 1990). Legitimacy is still maintained even though oppositional groups only gain recognition in official discourse as 'add ons'. Environment issues often fall into this category. The official language of the state often includes reference to ecological concerns, but the practical outcomes for many environmental issues are not always positive.

Discourse is political practice in that the power relations established and sustained in social institutions are social constructions which are amenable to change (Dant, 1991). In this respect, discourse as social practice is the capacity of actors to produce, distribute and consume different interpretations for their perceived needs. Fraser argues that there are three parts to this process. Firstly there is the struggle 'to establish or deny the political status of a need, the struggle to validate the need as a matter of legitimate political concern or to enclave it as a non-political matter'. Secondly there is the struggle over 'the interpretation of the need, the struggle for the power to define it and, so, to determine what would satisfy it'. Thirdly there is the struggle over 'the satisfaction of the need, the struggle to secure or withhold provision' for that need (Fraser, 1990).

Discourse as a relationship between ideas and practice helps to shape much of the policy process by helping to refine the language and communication processes. In this way the boundaries of debate are often set in a subtle way through the rationality of particular discourses. This in turn helps to define the policy agenda and what is considered legitimate in policy debates. The outcomes are that those whose positions are best served by dominant discourses tend to capture the political resources. Because some discourses tend to predominate, a hierarchy of discourse thinking is established. In this hierarchy some are given higher value, status or prestige than others. Furthermore, subordinate discourses are often seen as oppositional rather than complementary and are accorded a lower value. In this process the structure of rationality leads to a justification for the selection of one discourse over another.

***Competing policy discourses***

*New public management*

Within the context of water policy within Australia there have been a number of competing discourses. The awareness of the deteriorating water quality of water resources in Australia has seen a shift from engineering discourses to more ecological inclined discourses (Kellow, 1992). At the same time the increasing emphasis on economic rationalist discourses aimed at solving the fiscal problems of the state have resulted in radical changes to the process of public sector management in Australia.

Economic rationalism has been defined by a number of writers in recent times (Carroll and Manne, 1992; Horne, 1992; Pusey, 1991). The dominant value of economic rationalism is the belief in the efficacy of free market forces as a mechanism to determine the allocation of scarce resources among alternative uses. This belief leads to the political discourse of 'let the market decide' and 'the market knows best'. Economic rationalists advocate a minimalist role for government in the operations of the economy. They argue for the dominance of what is termed 'market forces' which means that the role of government should be limited. The outcome has been an emphasis upon free market discourses that emphasis the values of the free market such as competition, efficiency and private property rights.

Central to this discourse is the belief that small government is essential and new ways of operating the public sector are necessary or what is termed 'new managerialism'. According to Hughes, (1994) much of the change in the management structures of the state have been driven by the attack on the public sector in terms of its scale, scope and methods. Scale refers to the sheer size of the state which is accused of absorbing too much of the scarce resources available. Scope, refers to a wide range of state activities that could easily be done in the private sector. Methods refer to the bureaucratic organisation of the state that is seen as cumbersome and inefficient in the delivery of its services. The assumption is that the actions of public servants are all aimed at maximising their own position in the state. To redress this assumed justification of state programs by the self-interest of public servants the new managerialists argue that market mechanisms are required to test the efficiency of the process. They argue that for governments to perform properly there is a need for the separation between policy and management or what they call steering and rowing (Osborne and Gaebler, 1993). That is the state is meant to steer by setting the policy framework within which the rowers, the service providers, carry out the activities on behalf of the state. The result for Australia is a significant downsizing of the operations of the state.

In applying the market test the Commonwealth, State and Territory Governments agreed to examine a national approach to competition policy in 1991, engaging Professor Fred Hilmer to head up a National Competition Policy Review (National Competition Policy Review 1993). When his report was released in

August 1993, the Commonwealth, State and Territory Governments began extensive negotiations on implementation of its recommendations. The outcome was the Competition Policy Reform Act 1995 that changed the environment of public sector activity by marketising the activities of government. The 'Shield of the Crown' immunity for State and Territory Government businesses was removed and the reach of the Prices Surveillance Act was extended to the business enterprises of State and Territory Governments. The extension of competition to the public sector means that there has been increased privatisation and contracting out of services to private agencies to carry out the work of the state. The managers in the state moved from being managers of services to managers of contracts on behalf of the government and the people.

The response in Victoria over the past two decades has been the application of new public sector management practices to all levels of government. The 'public service' principle has largely been replaced by 'user pays' principle. Many of the public utilities have been privatised while other services have either been contracted out or privatised. An 'economic rational' planning process has seen the amalgamation and reorganisation of large sectors of the public sector including local government. The overall result has seen most government functions to meet the requirements of dominant economic discourses that emphasise market principles and 'small government'.

The impact of economic rationalist policies upon south west Victoria has been significant. Major local government services have been withdrawn from many of the main population centres (O'Toole, 1999). Hospital and health services have been 'rationalised' across the region (Mahnken, Nesbitt, and Keyser 1997; O'Toole *et al.,* 1999). Many schools were either amalgamated or closed down. (Victorian Education Department, 1992; Victorian Education Department, 1998). Other government services such as agriculture, social services and housing were 'rationalised' and staff either transferred or made redundant. The parlous state of local economies was further exacerbated by the effects of private sector as well. Banking facilities and other services in the smaller towns were generally wound down. The political environment of the south west became quite volatile as voters became angry about the reduction of services to the region.

***Environmentalism***

One discourse that both challenges and in some ways tries to accommodate the dominant economic discourses is environmentalism. Underlying this discourse are ideas of sustainable living practices, ecological preservation, harmonious production processes and biological diversity. The emphasis upon 'green' politics is an attempt to challenge the dominant processes of growth and unfettered exploitation of the 'natural' environment. Within the environmental movement there are a number of different approaches from the more radical positions that emphasise a total renovation of society to those who try to reform from within the present position (Ife, 1999).

The relationship of social and ecological forces is central to most environmental discourses. Social forces include the habits, customs, institutions, laws, ideologies, modes of reasoning, language and other elements of human practice. On the other hand ecological forces include climate, photosynthesis, respiration, radiation levels and all the elements that affect the physical environment (Hartman, 1998). The interaction between these two forces has repercussions for both human behaviour and environmental outcomes. 'Just as the sun's radiation can change the ecological balance of the climate so too human production and consumption patterns have an affect upon the climate' (Hartman, 1998) p. 338

Accordingly the discourse of environmentalism argues that ecology is not just instrumental for human species but right in itself (Eckersley, 1992; Fox, 1990) .Dealing with the environment is not purely an engineering or technical concern but also a social, economic and political process. In this respect environmentalism is often in opposition to the dominant economic discourses. The underlying assumptions of economic rationalism which emphasise the world view of individuals acting in their own interests is challenged by such environmental discourses.

Public policy has been influenced to some extent by environmental discourses at both national and international level (Gardner, 1999). At federal level there is a range of legislation dealing with environmental issues and a number of policies that support the natural environment both at home and abroad. The extent to which such policies are mere rhetoric or actual is often debated. However, there are

now standard practices in many areas of government policy that address environmental and ecological issues These range across a number of areas.

- Natural Heritage Trust
- Australia's Oceans Policy
- National Forest Policy Statement
- National Greenhouse Strategy
- National Strategy for Ecologically Sustainable Development
- National Strategy for the Conservation of Australian Species and Communities Threatened with Extinction
- National Strategy for the Conservation of Australia's Biological Diversity
- Wetlands Policy of the Commonwealth Government of Australia

In Victoria there has also been a wide range of environmental legislation:

- Catchment and Land Protection Act 1994
- Coastal Management Act 1995
- Conservation Forests and Lands Act 1987
- Environment Protection Act 1970
- Environmental Effects Act 1978
- Extractive Industries Development Act 1995
- Fisheries Act 1995
- Flora and Fauna Guarantee Act 1988
- Forests Act 1958
- Heritage Act 1995
- Land Conservation Act 1970
- Local Government Act 1989
- Planning and Environment Act 1987
- Water Act 1989 (updated)

***Water policies and CMAs***

A significant process in Australia is the federal structure of government which consists of one federal government, six states and two territories with limited powers (Northern Territory and the Australian Capital Territory). To overcome some of the jurisdictional problems between the various levels of government they often meet in forums to decide on policy issues. On February 25 1994 the Council of Australian Governments (COAG) agreed on a strategic framework to achieve 'an efficient and sustainable water industry' (Gardner, 1998). The major components of the policy were:

- Water pricing principles of consumption-based pricing, full cost recovery and removal or disclosure of cross subsidies
- The implementation of comprehensive systems of water allocation incorporating express environmental provisions of water and the creation of property rights in water separate from land titles
- The institution of trade in water rights
- Institutional reform to
  - separate the administration of water resource management and water services provision (the latter to be performed on a commercial basis)
  - implement integrated natural resources management (integrated catchment management)
- Programs of public consultation and education
- Support for the development of the National Water Quality Management Strategy by the Agricultural Resources Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC).

The outcomes of these reforms at both Federal and Victorian level saw the separation of water as a commodity and water as an ecological resource (Donahue and Johnston, 1998).

Water policy was tied to National Competition Policy and there were a number of significant outcomes. First all the states moved to implement water reforms and in Victoria there was significant change. Secondly, the issues of common law rights over water were all but removed and replaced by statutory rights. The changing legislative processes in the states is evidence of this process. (Gardner, 1998). Thirdly it meant a move away from command-and-control mechanisms to economic instruments such as tradeable resource rights (Kurz, 1999). Prior to 1994 tradeable resource rights such as trading in water

licences was limited to a few states but the process was now being investigated on a nation wide basis (Brennan and Soccimarro, 1999).

The outcomes for water in the south west Victoria was a separation of the administration of water resource management (Catchment Management Authority) and water services provision (Corporatised Water Companies). The first stage of this process was the implementation of integrated natural resources management (integrated catchment management) that occurred on 1 July 1997. The aim was to create a whole of catchment approach to natural resource management in the state. This involved a combination of River Management Boards, Catchment and Land Protection Boards and community based advisory groups such water quality working groups (Conacher and Conacher, 2000). The primary gaol was to ensure the protection and restoration of land and water resources, the sustainable development of natural resources-based industries and the conservation of our natural and cultural heritage.

However in October 1998 the State government announced that the Glenelg- Hopkins and Corangamite CMAs were going to levy a $32 community tariff on all households in the south west. The response from the public was overwhelmingly negative although 85% of ratepayers did in fact pay the first $32 tariff (Warrnambool Standard, April 21, 1999: 3). Meetings were held across the region protesting the imposition of the tariff with local councillors often leading the way. The CMAs, forced to 'defend' themselves against the growing protests, used a discourse of environmental protection to defend themselves with such statements as 'restoring the environmental qualities of our catchment is a huge task (Warrnambool Standard, December 4, 1998: 5).

The widely reported public response to the issue of the $32 tariff could be interpreted as the 'straw breaking the camel's back'. In the previous years the Victorian government had imposed what was called a $100 home tax purportedly to get the State's budget back into surplus. The opposition Labor Party opportunistically labelled the $32 tariff as similar to a home tax, using the issue as part of a lead to an election strategy aimed at painting the State government in a bad light (Warrnambool Standard, January 20, 1999: 3). The issue was further muddied by the Labor opposition when they expanded their attack by focusing on the way the tariff was collected by a private contractor (Warrnambool Standard, June 11, 1999: 13).

The mix of peoples' reaction to economic rationalist policies, bad timing, political opportunism and general lack of education may be blamed for the hostility engendered by the $32 tariff. However a further analysis would suggest that while these factors were important it also demonstrates the relative importance of the two discourses. The apparent rejection of economic rationalist policies by the community in south west Victoria does not hold entirely true. The user pays principle, a significant aspect of the new managerialism, is interpreted differently according to the strength of different discourses.

Since the people's identities with place change as the dimension changes the related discourses also vary. At the local or household level, maintenance considerations predominate. The dominant discourses here are sustenance related and focuses on the survival needs of individuals. Income generation and its relationship to the physical environment help to shape the type of local discourses here. Thus at farm and business levels, survival is dominated by market discourses that often conflict with ecological concerns. At the catchment or landscape level, it is often ecological concerns of maintaining life support systems over longer periods of time that predominate. The related discourses at this spatial dimension are not as immediate and are treated as peripheral to important 'local' dimensions. At the state and national levels macroeconomic considerations are limited by dominant discourses, especially new public management.

In this sense ecological discourses are squeezed between the more market driven discourses of the local and national dimensions. Water boards have legitimacy in the political and social system because they provide a needed commodity at local level. They can charge taxes because there is a clear relationship between the payment and the product consumed. The citizens, or consumers as they are now called, accept the practice of payment for water as they can see the outcomes of their market exchange. They receive water through their taps or irrigation systems and dispose of used water through waste disposal systems.

The change of term from citizen to consumer makes the relationship between water use and the market more transparent. This makes access to water for different functions whether business or domestic

dependent upon an economic exchange. The product is a private good in that it is divisible into separate components. People use the product 'water' in the amounts that they can afford. The state may run the enterprise presently but it is a business which supplies individual customers with a range of products. In this process a market discourse predominates and people are prepared to accept tariffs on water when it is used as a 'commodity'.

CMAs on the other hand find it difficult to raise taxes for their services. There is no direct market relationship and the product is perceived more as a public good in that it is not divisible. Further the immediacy of local concerns overrides the broader issues of catchment management. The ultimate quality of the product may have an affect upon private goods later in the process. To that extent the policy framework here tends more to the ecological. CMAs are still involved in delivering a product but it is not perceived as a private good that attracts direct market relations. As there is no discernible market exchange people are unwilling to pay the appropriate price. In this process the ecological discourse is jettisoned and a market discourse predominates once again.

The issue of the $32 tariff highlights the difficulties faced by CMAs in trying to bargain between the local, regional and to some extent the national levels. One strategy has been to try to 'mix' economic and ecological discourses into what is termed 'sustainable development'. It is hoped that by combining economic development in the catchment with practices that promote long term sustainability of the natural environment a new ecological discourse can emerge. And yet those agencies that manage natural resources and water are often peripheral in the government processes and become the brokers for discourses of 'sustainable' development (Day, 1996). Such strategies again reduce the environment to a resource that is exploited for the benefits of human consumption. Environmental claims are reduced to just another sectional or vested interest in the political market place (Eckersley, 1998). In the process sustainability becomes a competitor with development and is subordinated to economic discourses (Ife, 1999). Furthermore, since technology is geared to growth not social or ecological concerns sustainability becomes a process of creating the optimum conditions for economic growth while maintaining the resource base.

***Conclusion***

The argument in this chapter is that dominant economic discourses have been a significant factor in limiting the place of CMAs in the political agenda. Reactions to macroeconomic policies at state and national level, and the separation of water as a marketable commodity and an ecological value, have combined to reduce the significance of water agencies that attempt to treat water as a public good. The rejection of the $32 water tariff in the Glenelg-Hopkins and Corangamite catchments is evidence of the wide gap between economic and ecological discourses. What we learn from all this is that the dominant discourses of water policy are generally market oriented with ecological issues running a long second.

However long term economic development is dependent upon a partnership with sustainable management of natural resources. In this respect CMAs are a welcome addition to the policy process in that they are integral to reordering the competing discourses within and between different levels. As the overall objectives of integrated catchment management are new in the local political discourse CMAs have a lot of educating to do in the future. The ideas and practices of managing resources in a sustainable manner and minimising land degradation within river or drainage basins or other appropriate spatial frameworks requires a significant change in local economic discourses and CMAs are ideally placed to assist in that project.

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# Water Resource Management and Inclusive Democracy: a Case Study of the Environmental NGO Movement and its Role in Shiga Prefecture

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## *Introduction*

Today, the new role of local residents and environmental NGOs in fighting poverty or environmental preservation is becoming increasingly important not only on a local but also on a global scale. Even in the international conferences of the United Nations, such as the ”International Conference about Population and Development" (Cairo, 1994.9), the “U.N. Social Development Summit" (Copenhagen, 1995.3), the “U.N. World Conference on Women" (Beijing, 1995.9) and so on, the importance of the role of NGO is pointed out repeatedly.

The situation of NGOs in Japan is following global trends, but with some unique features to this country. The Law to Promote Specified Nonprofit Activities was enacted in March, 1998, doing away with the old highly restrictive system for establishing a juridical person, making the establishment of NGOs considerably easier. However, there is no provision for a clear-cut tax deduction system applying to donations to NPOs and NGOs. Another aspect in Japan is the rise of the so-called direct claim movement (in effect, the use of public referendums) to reassess or halt often grandiose and ineffective public works projects. Some examples are the referendums on the Nagara River Estuary Dam (January, 1992) and the Yoshino River Dam (June, 1999). Some positive results of these citizen actions include the revision of the River Law (June, 1997) regulating river construction nationwide. Also, citizens' participation in municipal affairs, until now almost nonexistent apart from elections, has become, in principle anyway, easier. There is also a modest movement in the direction of reassessing or even halting some public works projects such as dams, etc. At present, approximately 280 public works projects are under review, for possible cancellation.

This general trend is described by Professor Friedman as a sort of ‘development of inclusive democracy asking for alternative development’. Professor Salamon describes this same phenomenon as a "Global Associational Revolution".(Friedmann, 1992; Salamon, 1997) The rise of such citizens' movements shows that conventional development priority social systems are no longer responsive to the demands of residents and are failing to meet real present needs. There is growing recognition of this, but no clear solutions as yet. Through experiments and movements in quest of alternative social systems or development models, people everywhere, acting as citizens of a free democratic society, are groping for answers.

In this paper, I want to consider the meaning of citizens' movements in the field of environmental preservation, and their role in the development of inclusive democracy, taking as a specific example the experience of the environmental NGO movement of Shiga Prefecture, in connection with water-resources management and the preservation of Lake Biwa.

## *The Features of Japanese NPO/NGOs, and Scope of this Discussion*

The definitions used for NGO/NPOs here are partly according to Salamon (1997) as stated below. My definition has also incorporated Friedman's viewpoint, in which the advocacy function and alternative development efforts of NGOs are considered as important.

Definition: A spontaneous movement organization striving to realize a demand of residents through democratic procedures and lawful means, independently of civil administration or political party. However, when the interests of administration and those of residents are in agreement, this does not preclude accepting support of administration or carrying out common action.

Next, I will discuss the scope and the features of Japanese NPOs as defined above and according to the report of the Economic Planning Agency and Yamauch. (EPA, 1997; Yamauch, 1999) According to the first nationwide investigation of the EPA performed in 1996, the total number of NPOs of Japan was estimated at about 90,000 organizations (85,786 to be precise). By area of activity, 37% were social welfare

groups, 17% education, culture, and sport groups, 17% community groups, 10% environmental-preservation groups, 5% health and medical groups, and 5% international exchange/cooperation groups. Furthermore, according to the international comparison investigation of 22 nations of Salamon *et al*. (1998), the number of NPO workers in Japan is around 2,140,000 persons, and this figure amounts to 3.5% of the total employment (excepting agriculture). The ordinary expenditure of NPO is 195,600 million dollars (1995), and forms 4.5% of GDP. When seen in relation to total employment, Japan was in 12th place among 22 nations. Also, according to Yamauch (1999), the followings are pointed out as features of NPOs in his book:

(1) The per-year expenditure scale of NPOs shows that 80% had a budget of under one million yen (approx. 9200 USD) and on these, 35% were under one hundred thousand yen (approx. 920 USD). Only ten percent or less operated out of an exclusive office. As can be seen, there are a great many very small organizations in Japan.
(2) Income structure has a high dependence on membership fee income, and there is little contribution from the private sector. In comparison with Germany, the rate of public assistance is small, and the rate of private sector contribution is small as compared with the United States. The main reason for this discrepancy with the United States lies in the fact that contributions to NPOs are not tax-decutible under the Japanese taxation system.

Next, I will describe NPO of Shiga Prefecture, and environmental organizations' present condition. In the investigation of Shiga Prefecture performed as part of the above-cited investigation in 1996 of the EPA, NPOs within the prefecture numbered 1,773 organizations (September, 1996). When the number of organizations of NPO per 10,000 populations is considered, Shiga Prefecture has 13.8, more than twice as many as the national average of 6.8. If only environmental NGO are examined, there are 74 environmental NGO organizations in Shiga Prefecture, and this represents 1.75% of the national total of 4,227. Although the number of organizations of environmental NGOs is 0.34 per 10,000 populations in the national average, in Shiga Prefecture, it is 0.57 and this is 1.6 times of the national average, 8th among the nation's 47 prefectures.

Although Japan is already an advanced NGO state on a simple numerical scale, from a relative scale or terms of the content and scope of NGO activity, we are really more in the mid to lower range among countries. Regarding Shiga Prefecture, within Japan, it is one of more advanced prefectures in terms of total number of NGOs, and is one of the more advanced prefectures in terms of environmental NGOs, although hardly at the top of the class in Japan.

The scope of this paper is limited to discussing the efforts of environmental NGO in connection with water-resources development and the protection of nature of Shiga Prefecture. If the various efforts of environmental NGO of postwar Shiga Prefecture are surveyed, roughly two big waves can be perceived, one in the 70s, the so-called 'reformist local government period', and the other from 1987 onwards.

The first wave consisted mainly of the Synthetic Detergent Banishment Movement, which coincided with a prefectural government election, and the Lake Biwa Environmental Right Lawsuit which criticized and attempted to halt the Lake Biwa Comprehensive Development Project. This all took place against the backdrop of the conservatives/reformists confrontation of the 70s known as "Kakushin-jichitai no Jidai" or so-called reformist local government period.

The second wave made its appearance after the passing of the so-called 'Resort Law' in 1987. This law set off a storm of recreational facilities development projects, and was generally (but shortsightedly, as subsequent events proved) praised in Japan, as a trump card in the industrial structure conversion and regional economy activation schemes. This period also saw the inception of a series of huge public works, some related to resort development and some not, such as dams, airports, expressways and golf-courses everywhere, big amusement parks like Disneyland in the US, etc. There are many aspects of the environmental movement in Shiga, and many problems with the environment. These include environmental education efforts, garbage and waste clean-up campaigns (often involving local governments, labor unions, schools, etc.), industrial waste disposal, a dioxin problem, nuclear power plant

problems, some modest efforts towards lakeshore, inland pond and riverine biotope restoration and more. But for the scope of this paper, I wish to focus on the above first wave only.

***Eutrophication of Lake Biwa --- Lake Biwa Environmental Right Lawsuit and the Synthetic Detergent Banishment Movement***

*Lake Biwa Environmental Right Lawsuit*

Serious environmental problems in Lake Biwa began appearing one after another from 1969 onwards. At first, it was "foul-smelling water", then there appeared freshwater red tides in 1973 and have continued almost every year since. And in 1987, the toxic plankton known in Japanese as “aoko” (*Microcystis aeruginosa*) was first detected in the south basin of the lake. In 1996, it was also detected in the much larger and more important north basin, the main portion of the lake. People had a sense of impending crisis seeing such problems appear in the lake, and many workers, government officials, fishermen, farmers, residents, and scholars started trying to deal with the problems in various ways. Notable among those investigations and efforts was the so-called “sekken undo” or soap campaign. Focusing on domestic waste water, housewives began campaigns to reduce the amount of the detergent used, and suspicious eyes were turned on synthetic detergents or the orthophosphate which is contained in such detergents. The following paragraph describes these details. (Suzuki, 1992; Ikemi (1982) and Biwako Kaigi, 1999).

But even as eutrophication became a steadily increasing problem, and some people were trying to deal with it, the National government’s large scale development plan for Lake Biwa was, mostly unnoticed, steadily taking shape. Under the postwar high-speed economic growth, many human beings had moved into the lower drainage basin of the Kansai bloc, which includes Osaka, Kobe, and Kyoto, and the demand for city water and water for industrial use had increased rapidly. (See Table 1.) The rate of increase of industrial water demand from 1966 to 70 reached the remarkable annual rate of 5.99%. The business world at the time was convinced that the reservation of water for industrial use required for industrialization was a life-and-death matter, and demanded new water-resources development of the government. (Ikemi, 1982).

Table 1 Lake Biwa -Yodo River Basin Industrial Water Supply: Actual and Estimated Demand

| Annual Growth Rate (Geometric Mean) | Period | Source | Average Daily Volume (10000 t/day) |
|---|---|---|---|
| 5.21% (Estimate) | 1965-1985 | Broad Are a Water Use Primary Plan | 553 ?¨ 1526 |
| 3.31% (Estimate) | 1970-1985 | Broad Are a Water Use Secondary Plan | 778 ?¨ 1268 |
| 5.99% (Actual) | 1966-1970 | Ikemi, 1982 | 500 ?¨ 631 |
| -3.05% (Actual) | 1970-1977 | Ikemi, 1982 | 631 ?¨ 508 |

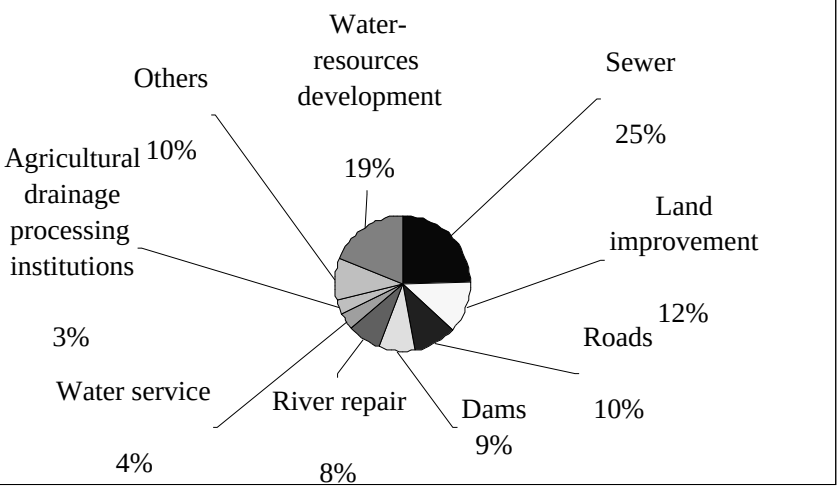
In order to respond to this demand not only in the Biwa basin but nationwide, the government passed a new law in 1961 with which they established Water Resources Development Public Corp (referred to hereafter as the WRDPC). This was intended to become a water-resources development promoting mechanism, to remedy the problems inherent in the previous system, basically a conventional Japanese vertical administrative system in which water for agricultural use was only controlled by Ministry of Agriculture, Forestry, and Fishery (MAFF), water for industrial use only by the Ministry of International Trade and Industry (MITI), and city water only by the Ministry of Health and Welfare (MHW). And, very importantly, this law transferred the right of river management from the prefectural governments to the WRDPC. Based on this law, the new WRDPC immediately began planning a grand water-resources development project for the entire Lake Biwa and Yodo River basin system, which became known for short as the “full plan”. According to the “full plan” proposal, for example, the water-for-industrial-use demand in the Kansai bloc was projected to increase at an annual rate of 5.21%, and to provide for the increase in total water demand, including this industrial water, a further 40 ton/sec of fresh water from Lake Biwa

would be required. A water volume of 1 t/s from Lake Biwa can provide the drinking water supply for about 200,000 people. So, 40 t/s would be enough for approximately 8 million.To assure such a supply, it was planned that the shore of Lake Biwa should be dammed with concrete levees wherever necessary, so the water level could be regulated within a range of 1.4 m above and 2 m below the Biwako Basic Surface Water Level (B.S.L.). In a political compromise, although the plan still states 2 m below B.S.L., in actual practice this is limited to 1.5 m below B.S.L.

During the planning stages, the Shiga Prefectural Government basing itself on its right to management of Lake Biwa, objected to some aspects of this plan. The prefectural government claimed that it agreed with water-resources development of Lake Biwa on Shiga Prefecture in exchange for 17 other regional development projects, such as road construction, sewer construction, agricultural land improvement, etc., which the Prefecture wanted in order to further its intention of transforming rapidly into an inland industrial prefecture from an agricultural prefecture. A political agreement was reached between Minister of Construction, and the Governors of Osaka, Hyogo and Shiga Prefecture in March, 1972. The Special Measures Act for the Comprehensive Development of Lake Biwa bill passed the National Diet, with the draft proposal fundamentally unchanged in June, 1972, although in response to citizens' movements in the urban lower reaches of the basin, there was some wording inserted to the effect that environmental preservation should also be sufficiently considered. While a concrete individual building plan had not been deliberated in the National Diet, it was recognized as a matter of fact by the cabinet meeting in secrecy in December of the same year. Before final determination of this building plan, there was no environmental assessment performed, nor was there any participation by the public, nor any presentation of concrete information to residents either.

This peculiar plan that mixed water-resources development and regional development was called the "Lake Biwa Comprehensive Development Project", and more commonly by the abbreviated "BIWASO". The final total expenditure for "BIWASO" came to about 2.3 trillion yen (approx. 22 billion USD) at present values. The construction period was originally planned to be for ten, was extended for ten more years in March, 1982 and further re-extended for five years in December, 1991, so it was performed over a 25 year period in the end, and became the longest-lasting and largest public works project in the history of Shiga Prefecture.

Figure 1 Composition of Working Expenses of BIWASO




As the contents of such a large-scale development plan gradually became known to elements of the public, many residents, workers, government officials and scholars felt misgivings and began to question many aspects of the plan. An opposition movement was born. The following points in particular were deemed problematic:

(1) Excessive prediction of water demand.
(2) Various environmental and water supply problems related to the projected potential 1.5 m water level fall.
(3) Construction of a huge basin-wide waste water treatment system with only four main plants, instead of smaller, more local facilities.
(4) The creation of an artificial island mainly for one of those treatment plants. (73ha area)

(5) Construction of lakeside levees and the Konan road construction. (length:14km,width:15m)
(6) Dredging the Seta River and Southern Lake.

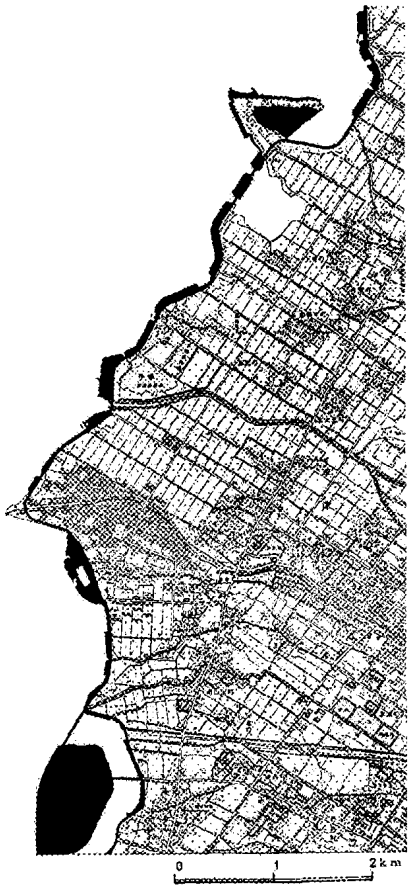
In the view of the opposition, these six points in particular were seen as deleterious to water quality, and leading to wide scale destruction of the lakeshore ecosystem, and the scenic beauty of the lake region, both immediately and over the long term.

Table 2 The Main Points at Issue in the Lake Biwa Environmental Right Lawsuit

| Point at Issue | Plaintiff | Defendant |
|---|---|---|
| Prediction of Water Demand | Excessive as compared with the actual figures. | Required since it is predicted to increase in the future. |
| Water Level Drop | Maximum water level drop of 1.5m and a high incidence of once in several years would have serious impact on ecosystem and water quality. | Incidence of maximum drop predicted at once in 10 years. No serious impact on ecosystem. |
| Basin-Wide Sewage Treatment System | -Factory effluent and domestic sewage should be separated and processed.<br>-Decentralized system, with more but smaller treatment plants is superior to centralized system in environmental efficiency. (“Too big, too late”)<br>-A sewage treatment plant can remove neither heavy metals nor organic compounds completely.<br>-In the present condition of concentration regulation, it is not effective in curtailment of a corruption substance.<br>-Forecast demand for sewage treatment is excessive. | Since the advanced treatment is used, system is satisfactory. |
| Artificial Island | -There is no need for it and making reclamation of Lake Biwa.<br>-An enclosed water area is formed and it becomes an unnecessary pollution source.<br>-Reclamation area is excessive. | For sewage treatment plant construction is difficult, so artificial island is unavoidable. |
| Construction of Lake Levees and Kogan Road (including maintenance road for management) | -Large area of reed belts, which have bio-filter purification capability, are destroyed by construction and water quality and fisheries severely impacted.<br>-Another route_should be considered, if a road is required.<br>-Construction route does not consider ecosystem preservation.<br>- The exhaust gas of traffic is dispersed into the lake. | -The purification capability of the reed belts is not high.<br>-It is indispensable water-resources development and management.<br>-In order to_minimize impact on farmland, construction route unavoidably concentrates on the lakefront. |
| Dredging the Seta River and Southern Lake | -Pollutants accumulated on the bottom of the lake dispersed by dredging.<br>-Processing of large quantities of sludge is difficult, and becomes cause of environmental destruction. | -It is an required for water-resources development, and there are no alternatives.<br>-Sludge can be used for the planned reclamation of the Karasuma peninsula. |

Figure 2 Lakeshore Area changed artificially by BIWASO, including Artificial Island and Kogan Road (about 200 ha here in total)

In order to challenge the necessity itself of such a plan, NGOs and residents in Osaka took the lead and the Lake Biwa Envt Rights Lawsuit was filed in March, 1976. The total number of plaintiffs amounted to 1,186 (after various disqualification




maneuveurs, the number was reduced to 1,089) and they came from all the prefectures of the Kansai area. The plaintiffs had the option of administrative litigation ("Gyosei Sosho" in Japanese, or litigation against government acts plaintiffs deem illegal) but all legal precendent suggested such a suit would be dismissed out of hand. So they opted, on legal advice, to file a civil action ("Minji Sosho") against the government, and based it on both environmental rights, and personal human rights on which the BIWASO project would infringe.

In the end, their legal action was rejected, although the legal proceedings went on for 13 years. However, this trial become the de facto stage of a substantial environmental assessment of the project by residents, and although they lost, their action was not without subsequent influence. The government gradually began to recognize the importance of ecosystem preservation of Lake Biwa, with the lakeshore reed belts preservation as a specific target. So this trial had an important influence on the establishment of the Reed Belt Preservation Ordinance of Shiga Prefecture in 1992, which became the first piece of legislation in Japan aimed at ecosystem preservation.

Two things bear special mention here. First, the extraordinary efforts of Professor Norio Suzuki of Shiga University as a witness for the plaintiffs in a long and difficult trial and under many restrictions. Second, the projected increase in water demand which was the greatest basis for this and other large-scale water-resources development projects failed to materialize, and in fact, in 1971 and afterwards, due to the increase in recycling and other efficiency measures, demand of water for industrial use actually fell sharply. (See Table 1.)

***Synthetic Detergent Banishment Movement***

At about the same time, In Shiga Prefecture, in response to the worsening eutrophication of the lake, a movement to ban the use of phosphate-containing detergents began. In those days, domestic waste water accounted for 48% of the total amount of phosphate discharge and 33% of the total nitrogen discharge. And synthetic detergents accounted for 18.2% of that total phosphate discharge. (1975 figures).

Domestic waste water with synthetic detergent containing orthophosphate is not only a problem for eutrophication, but also could be injurious to people's health. For both those reasons, it became a matter of concern for the people of Shiga Prefecture, especially housewives. It was also becoming a problem internationally. According to an article that appeared in the Asahi Newspaper on November 5, 1970, for example, in the United States, in Chicago, a group opposing pollution was actively trying to get the use of synthetic detergents forbidden, since the orthophosphate contained in them polluted the river and the lake. The city of Chicago revised regulations setting the allowable percentage at 8.7% or less, to take effect from February 1, 1971, and from June 30, 1972, phosphate content was to be extensively forbidden.

In Shiga Prefecture, environmental concerns began to have an effect on the political scene as well. In 1974, as the movements against the BIWASO and to ban phosphate-containing detergents began to develop, Shiga prefecture held an election for prefectural governor. The incumbent Mr. Nozaki, who had not received official political endorsement of any party but was conservative, and the challenger, Mr. Takemura, who also did not receive political endorsement by any party but was reformist, contested this election. As part of his campaign, Mr. Takemura appealed for the necessity of preservation of Lake Biwa,

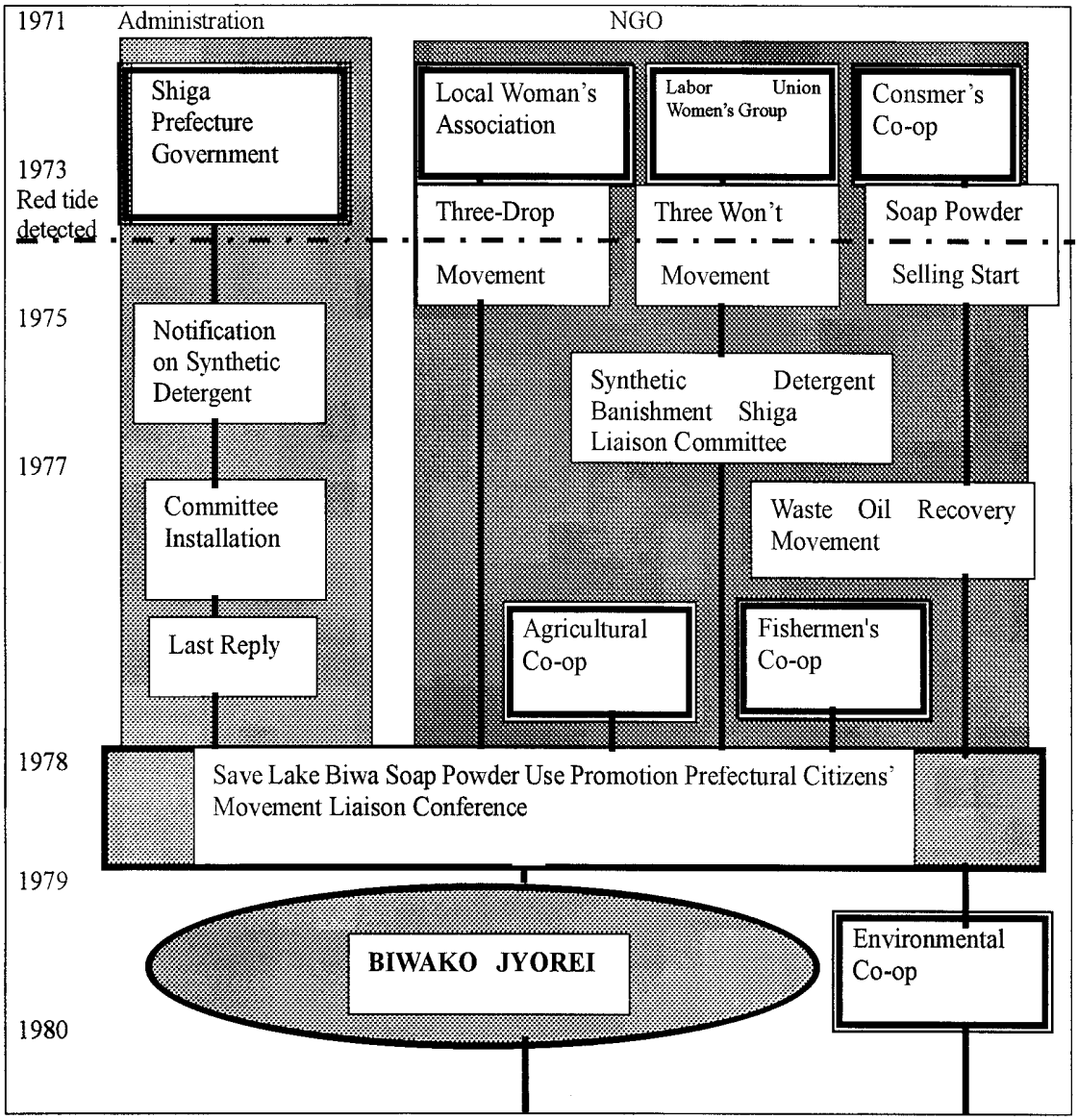
and for a review of the BIWASO plan, including such points as enforcement of environmental assessment requirements and scientific reexamination of projected down-stream water demand. Partly as a result of this position and his support for the movement to ban synthetic detergents, Mr. Takemura won that election. (At that time, he became the 8th reformist governor in the whole country, and Osaka, Kyoto and Shiga, the three prefectures most closely connected with Lake Biwa and the Yodo River, all had a reformist governor).

However, Mr. Takemura, on his first day as governor, December 8, 1974, stated, in regard to the BIWASO super-project, "There is no need to change the 40 t/s increase in water supply", in effect making clear that he was giving up any reexamination of the necessity for the BIWASO super-project itself. Moreover, although a committee was created to consider the plan for the artificial island construction and its influence on the environment, one of the aspects of the BIWASO super-project that had been highly criticized by NGOs, the committee was not able to reach any clear conclusion, and in its final report, basically just presented the arguments both pro and con. As a result, there was no meaningful environmental assessment of the project carried out, and in the absence of any opposition from Governor Takemura, the BIWASO super-project went ahead.

Although Mr. Takemura failed in bringing about any meaningful reexamination of BIWASO, he tackled the issue of banishment of synthetic detergent much more positively. The prefectural area Women's Organization Liaison Committee started the so-called "Three-Drop" Movement to reduce the amount of the kitchen synthetic detergent used at a time from five drops to three. They also began, in 1971, to cooperatively purchase soap powder, as a pollution-preventing alternative to synthetic detergents. Also, another NPO, the women's group of the association of labor unions of Shiga Prefecture started cooperative purchasing of soap powder, and initiated in 1972, with regard to synthetic detergents, the "Three Won't" Movement, with the slogan that they "Won't buy", "Won't use "and "Won't use as gifts". These two movements took the lead in promoting a shift away from synthetic detergents, and the soap powder use movement spread. These efforts lead to the creation of "The Synthetic Detergent Banishment Shiga Liaison Committee for the Clean Water of Lake Biwa and Healthy Life" in 1975. Study groups on the problem were formed, negotiations carried out with local governments, and negotiations with retailers were also pursued. In August 1978, the prefectural government also joined this citizen based synthetic detergent ban movement, which then was called the "Save Lake Biwa Soap Powder Use Promotion Prefectural Citizens' Movement". In the first prefecture/citizens general meeting establishing this NPO, a goal was set of raising the rate of soap powder use in the prefecture from around 10% to 50% or more. There were also calls for the enactment of prefectural regulation of synthetic detergent sales and use.

In response to this situation, Shiga Prefecture concentrated its efforts on sewage treatment plant construction, with advanced processing enabling massive removal of Nitrogen compounds and Phosphates. In 1978, only 26% of the whole country and barely 3.4% of Shiga Prefecture was connected to sewage lines, making the prefecture third worst in the country. On the other hand, though, the Shiga Prefectural government was the first in the nation to decide that the regulation of nitrogen and phosphates had to be an essential part of sewage treatment. Not only did the prefecture go beyond national legislation by adding N and P controls to industrial waste water regulations, but it also took the further step of also attempting to control these substances in

Table 3 Diagram of "Sekken Undo"




domestic waste water. The prefectural ordinance enacted for this purpose, the Lake Biwa Eutrophication Prevention Regulation (common name, BIWAKO JYOREI) bill added regulation not only to factory effluent but also imposed some on domestic sewage. It established regulation values for factory effluent, to be determined by concentration regulation method. A new type of regulation was devised to control excessive nutrients in waste water at the source by forbidding the domestic use of phosphate containing detergents.

At that time, a nationwide effluent standard for N and P simply did not exist. Therefore, the BIWAKO JYOREI became epoch-making legislation in Japan for the control of factory effluent. In Japan, it is rare indeed when local level regulation is more encompassing or higher than national standards, and it is known as "YOKODASHI". And in fact, five years after the enactment of the BIWAKO JYOREI ordinance, the national Water Pollution Control Law was also revised in 1985, incorporating regulation standards for N and P in factory effluent.

However, there was considerable opposition to BIWAKO JYOREI from both ordinary citizens and the industrial establishment. On the one side, some NPOs asserted that the regulations proposal had not dealt with phosphorus-free synthetic detergents, disregarding evidence of their toxicity. The industrial establishment, on the other hand, objected, claiming among other things, that "soap has organic nutrient

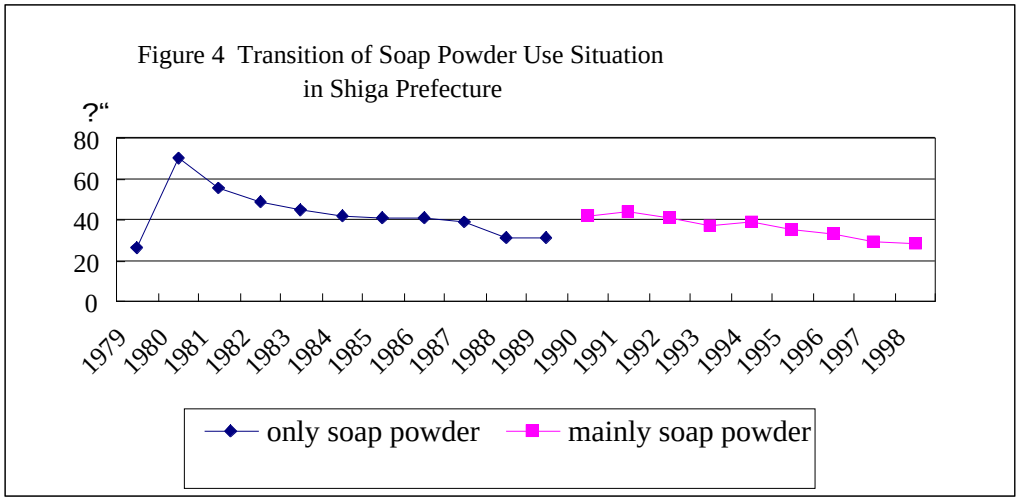
pollution potential larger than that of synthetic detergent, and the causal relationship of eutrophication and orthophosphates is scientifically unknown". However, the regulations proposal passed the prefectural legislature, in October, 1979, under the powerful leadership of the all-party organization of governor Takemura.

Ideally, especially if N and P are the main contributors to water pollution, legislation on a national level would be most effective. However, given the situation at the time with the conservative stance of the national government, the worsening water quality of the lake, and the convergence of public activism and a regional reforminst movement reaching power at prefectural levels, the enactment of the BIWAKO JYOREI was timely and had great political significance. But this ordinance, though significant politically, did not however have a major environmental impact, considering subsequent trends of synthetic detergent use and in the water quality levels of Lake Biwa are seen. See Fig. 4.

This story of the BIWAKO JYOREI is, in Japan, a rare example of how a citizen-originated movement can actually reach and influence the decision-making levels of government, and provides a good example of partnership between people and government in the field of environmental preservation not only of Lake Biwa but nationwide. These events in Shiga Prefecture influenced other prefectures facing similar lake environmental degradation problems, and even (rare for Japan) have been connected to the revision of the national Water Pollution Control Law in 1985. It is a notable example, given the prevailing situation at the time, where the actions of ordinary citizens, the residents of Shiga Prefecture, moved environmental administration or environmental policy of Japan as a whole.

However, reality has tarnished the glory of BIWAKO JYOREI. The industrial world's successful development of phosphorus-free synthetic detergents made the regulations of the BIWAKO JYOREI much less meaningful, especially if we consider the target of this movement which produced the BIWAKO JYOREI as not only to stop domestic use of phosphate-containing detergents, but also to stop the use of high-toxicity synthetic detergent in general. We have to consider this movement as still on-going. The rate of use of synthetic detergent remains high (See Fig. 4.), and whether the power of civic movement of Shiga Prefecture can rise up to the level of 70's civic movement as to banish all synthetic detergents is problematic, especially because there are so many factors involved in the degradation of the lake's water quality, especially because of public works in Japan. People realize that there is no one simple answer, but tackling all the problems at once seems too difficult, especially when there are powerful forces involved and even lack of agreement on which areas need the most attention.

Figure 4 Transition of Soap Powder Use Situation in Shiga Prefecture




Moreover, the movement which resulted in the BIWAKO JYOREI coincided with the calls for a ten-year extension of the BIWASO super-project, which was supposed to last only ten years, according to the original plan. The big changes in water demand, especially the fall of water-for-industrial-use demand, had become clear by that time. (See Table 1.) It was the best opportunity to re-examine the necessity and the objectives of the BIWASO, including such factors as the maximum allowable water level fluctuation (which has such a crucial impact on the lakeshore ecosystem), and it was a chance to change BIWASO into

mainly a ecosystem preservation plan. But, the more the synthetic detergent problem took center stage, the less the big fundamental problems of the BIWASO super-project attracted people's concern or attention. It should be mentioned in passing that the reformist governor Mr. Takemura, in the middle of his third term, resigned to become a member of the conservatives party in the National Diet, and became Minister of Finance in the conservative government after that. Basically, he left having established the BIWAKO JYOREI to deal with the problem of synthetic detergents, but left the BIWASO super-project essentially untouched. Comparing the negative impact which the BIWASO super-project had on Lake Biwa with the positive influence which the synthetic detergent banishment movement had on the lake, we dare to say that the negative influence which BIWASO had was clearly larger than the positive effect of the synthetic detergent banishment movement.

In spite of the efforts of the Prefectural administration and of prefectural citizens, the water quality of Lake Biwa is getting worse or leveling off at best, and there is no actual hope of any significant improvement in the present situation. For example, for lakes and marshes that are sources of drinking water, the national water quality standard specified as ideal to prevent eutrophication is 0.2mg/ l T-N and 0.01mg/l T-P. But the actual values for southern Lake Biwa in 1995 were 0.42mg/l T-N and 0.021mg/l T-P. Even worse, the quality of water discharged from the basin-wide sewer disposal plants, whose advanced processing represents the most outstanding and capital intensive enterprise in the whole BIWASO super-project, shows values of 5.8mg/l T-N and 0.07mg/l T-P, almost 30 times over the national ideal standard for nitrogen and seven times that of phosphate. In short, the sewer treatment plant is in fact one of the pollution sources under the existing conditions. This teaches us the limitations of the water purification achievable by centralized approach of the BIWASO sewage treatment system. Further lessons ought to include the need to go beyond the BIWASO system and incorporate more radical policies to improve water quality. These include, preservation and restoration of the lakeshore ecosystem (for its bio-filter role), and regulation of total emissions of N and P (as opposed to standards based on concentration per unit of volume. Moreover, we should design a new policy to stimulate the fishing industry, which would not only stimulate local business, but by the harvesting of fish, N and P nutrients would be removed from the lake.

### *Present and Future Objectives of the Environmental NGO Movement in Shiga Prefecture*

#### *Three functions and roles of Shiga Environmental NGOs*

Even now, the situation with water pollution of Lake Biwa and ongoing environmental degradation is not improved. Aggravation of water quality is serious and the influence of global warming is also appearing. And, although public works dam construction is being reconsidered at the national level, due in large part to the efforts of environmental NGOs, all of eight dam projects in Shiga Prefecture have not been touched. The Lake Biwa Resort Necklace scheme, though dormant, is still in effect. Moreover, we are only beginning to understand the problems of ecosystem destruction due to artificial water level fluctuations (as a result of human use), which was a fundamental problem of the BIWASO super-project.

It can be said that the following three functions and roles of Environmental NGOs of Shiga Prefecture evolved through various efforts carried out up till now.

The first role and function is as a counter-balance to the forces of environmental degradation. We can call this "defensive function for human and natural rights". This activity is the starting point of environmental NGOs, and they often fade away once their objective is either achieved or defeated. Some examples of this with environmental NGOs of Shiga Prefecture are the anti-golf course campaign, the movement against the artificial island construction of the BIWASO super-project, the movement against Biwako Airport construction, etc. Although they have various weak points, in some cases environmental NGOs were successful in stopping or postponing development projects, establishing some deterrent power to wasteful and destructive development. Prefectural public opinion is affected by the activities of environmental NGOs of Shiga Prefecture.

The second function or role that NGOs ideally play could be described as that of combining with local government to further local autonomy in a country notorious for centralization of power, and furthering the

ideal of democracy which got its start in the postwar period. We can call this the "supporting local autonomy function". This function can be realized when an NGO transcends merely local immediate concerns (the so-called NIMBY or Not In My Back Yard factor), and positions the role of the individual movement within bigger public responsibility. The efforts of environmental NGOs of Shiga Prefecture, which, working in tandem with the Prefectural government, helped to get the BIWAKO JYOREI enacted, could be considered an example of this function. This function will be needed increasingly from now on in order to achieve much-needed cooperation between local administration and such citizens' movements, leading to the evolution, from a simple opposition movement, to a continuing constructive movement. Another example of this function is the campaign for freedom of information, which resulted in access to municipal information in Hino-cho, site of the projected Biwako Airport. As a result of the opposition movement against Biwako Airport plan in Hino-cho, a Freedom of Information Ordinance was enacted in September, 1999 by the municipality of Hino-cho.

The third function or role is developing, presenting and advocating alternatives leading toward a sustainable recycling type society, and building greater citizens' participation in municipal affairs. We can call this "Presenting alternatives function". Put differently, it is a supplementary or compensatory function working through inclusive democracy to contribute to the solution of problems which either cannot be fully dealt with by market mechanism and governmental administration alone, or are actually being exacerbated because of "Market Failure" and/or "Government Failure". An example of these “Failures” in Japan is the problem of the so-called "iron-triangle", or collusive relationship web among the bureaucracy, the construction industry and the political establishment. This powerful triangular relationship is known variously in Japan as the “Sei-Kan-Zai Yuchaku” (politico-bureaucratic-industrial relationship), the “Public Works Complex” and the “Doken Kokka” (Civil Engineering and Construction State). (See Wolferen, 1996; McCormack,1986).

It is worth recalling here that the rash of resort development based on the ill-considered Resort Law is one of the main factors behind the mountain of non-performing loans left over after the collapse of the bubble economy, and also the ballooning national, thus resulting in economic as well as environmental destruction.

Environmental NGOs in Shiga have worked with the nationwide movement calling for a sweeping reassessment of Japan’s massive public-works program, easily the largest of all the industrialized nations. They have also initiated referendums on the Biwako Airport project, among others, and worked toward reassessment of the peculiar Japanese system giving priority to construction development. In addition, the environmental NGOs of Shiga Prefecture have advocated weaning the economic structure away from dependence on large-scale public works. And members of environmental NGOs have entered local politics, in several townships even winning the mayor’s office. In another example, once decided, public works projects were never reconsidered nor altered, but recently, due in part to the efforts of NGOs, this deplorable situation is beginning to change. At present, approximately 280 public works projects are under review, for possible cancellation. There is also a modest trend towards allowing some citizen participation on relevant committees. However, since most large-sized public works are not halted, let alone opened to revision once they have been decided on, survived, overestimation of the above positive effects should be avoided.

*Table 3* Three Functions and The Experience of NGO Movements in Shiga Prefecture

| | |
|---|---|
| Defensive Function | Anti-artificial inland construction campaign, Anti-golf course campaign, Anti-dam construction campaign, Opposition movement against Biwako Airport |
| Supporting Function | Synthetic detergent banishment movement, Information Freedom referendum, Direct democracy of Biwako Airport referendum |
| Presenting Alternative Function | BIWAKO JYOREI campaign and amendment of Water Pollution Control Law (revised Fundamental Law of Environment in 1993), Lake Biwa Environmental Right Lawsuit and establishment of Reed Belt Preservation Ordinance in 1992, Nation-wide public-works reexamination,_River Law Revision in 1997, Birth of environmental group's mayors |

***The Future of the Shiga Environmental NGO Movement***

As citizens' movements gradually become recognized socially and their influence increases, it is also clear that new aspects and problems associated with them will continue to arise. These problems could be divided into two groups, one in connection with NGO partnership with administration, and the other in connection with the partnership with a political party or movement.

The phenomenon of NGOs operating in partnership with government is already happening in Shiga Prefecture now, such as by tackling riverine ecosystem restoration with the cooperation of the community, or a joint government-and-people project aimed at restoring, for water quality improvement, one of the "naiko" (series of pond/wetlands large and small that used to line the periphery of Lake Biwa). Another example is the 9$^{th}$ International Conference on the Conservation and Management of Lakes, to be held in Shiga in 2001 with the cooperation of NGOs. The government has also organized, 'from the top' an umbrella organization of NPOs active in Shiga Prefecture (known as the Ohmi Network Center, it is funded by the prefecture and had 614 NPO members by May, 1999). Although establishing the partnership of administration and residents is important and many efforts have been made on the part of environmental NGOs, there are dangers and areas of concern. Citizens' movements, often only with a poor financial base, can find themselves confined within limits set or implied by administration, and they face the risk of losing independence, as a result of over-dependence on the power and financial support of administration. NPO/NGOs will need a substantial financial base in order to prevent this.

As far as partnership with a political party or organization is concerned, traditionally, environmental movements have stayed aloof of politics. But there is often the possibility that an environmental NGO, perhaps too eager to achieve its goals, would enter into partnership with a political group. There is the very real possibility, though, of achieving the political objective but not the environmental one, for a variety of economic, social, and political reasons. The NGO also runs the risk of splintering due to political disagreements unrelated to the original shared environmental objective. Although NGOs can potentially benefit from partnerships with government or with political groups, it is important for them to maintain a certain independence so as to preserve their freedom of action, accommodate the often varying political views of their membership, and avoid the danger of being used, and perhaps then ignored.

***Towards an Environmental Era in the 21st century***

Environmental NGOs of Shiga Prefecture have begun to explore new territory, such as exchanges or networking on an international scale, or moving towards a more comprehensive alternative approach to environmental problems, instead of narrowly focusing on single issues.

Examples of internationalization include environmental NGOs traveling abroad to inspect or experience first-hand the situation in more environmentally advanced nations like Germany or Denmark, engaging in a continuing independent international exchange with American NGOs regarding revision of U.S. dam policy, and so on. It is hoped that networking with Asian countries and Australia will develop in the near future.

Regarding the evolution of more comprehensive approaches, the environmental movement can and should build on the experience of years of activism to formulate the alternative of a comprehensive environmental-preservation strategy, keeping the vision of a recycling-based sustainable society, based on the efforts of citizens' movements, government and industry, indeed, of society as a whole. (Refer to Kasumigaura, 1995 for one example that is consulted as an alternative of a comprehensive environmental-preservation strategy). In order to for NGOs to preserve their originality and independence, it is imperative to have an alternative and well-formulated comprehensive preservation strategy to provide direction and withstand the pressures of government and/or industry-led development, which by and large does not tend towards the achieving of a sustainable society. The evolution and dissemination by NGOs of such an alternative comprehensive strategy is the key to democratic change of the present, non-sustainable, development-priority Japan social system and to the transition to a sustainable recycling-style society.

The environmental NGO movement of Shiga Prefecture in the 21st century must grow and change to achieve these goals. The recent history of the environmental NGO movement suggests that this is certainly possible and that there is light at the end of tunnel.

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# Industry and Water Management in Shiga Prefecture

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## *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.

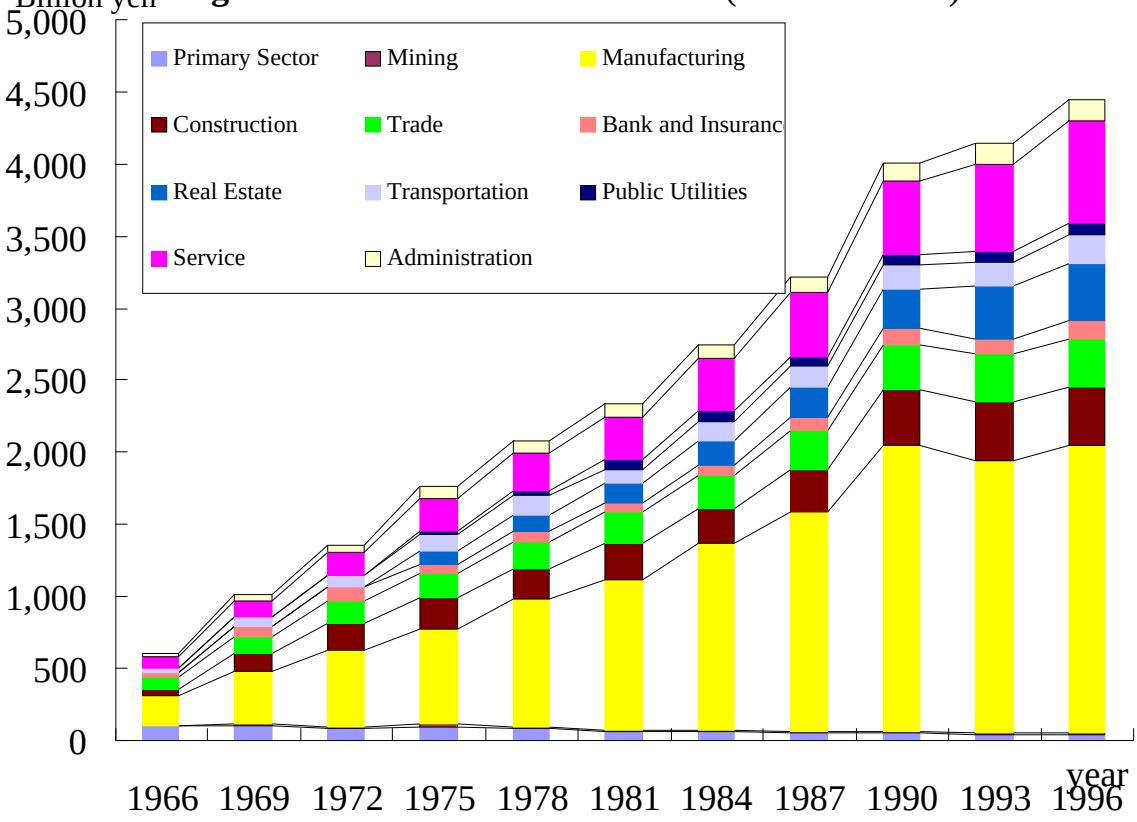



**Figure 1** Gross Prefectural Products (Constant Price)

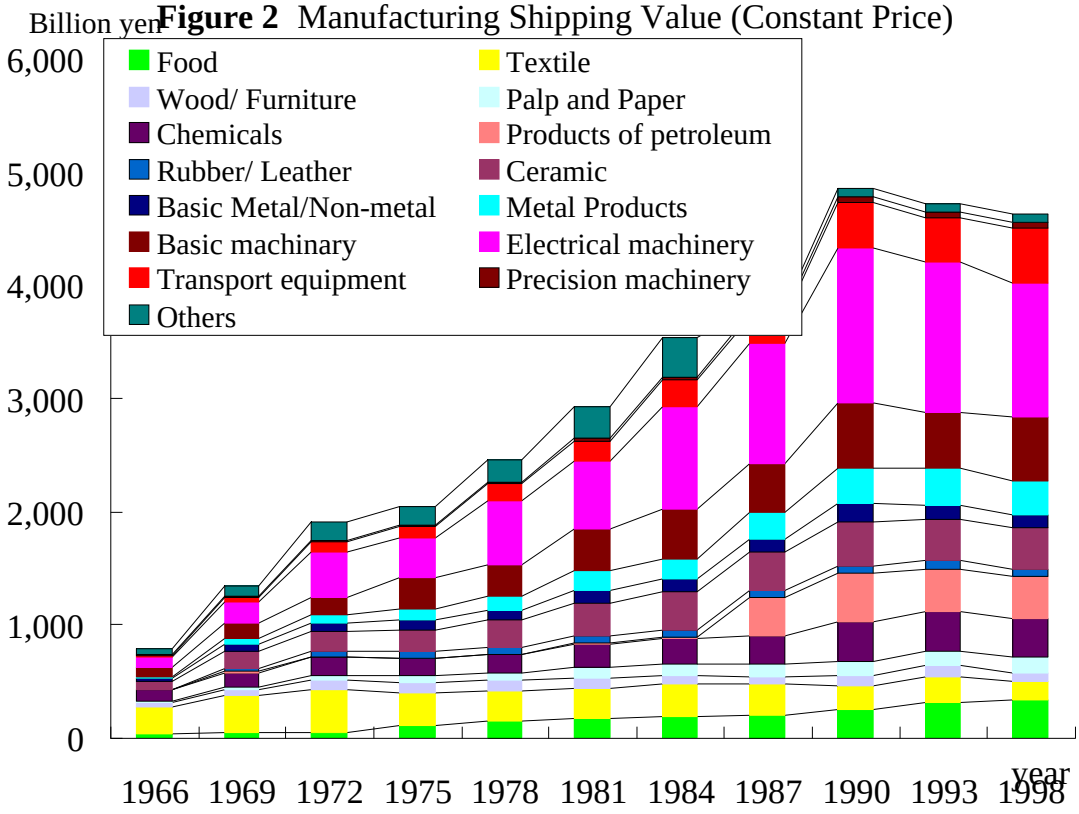



**Figure 2** Manufacturing Shipping Value (Constant Price)

***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.

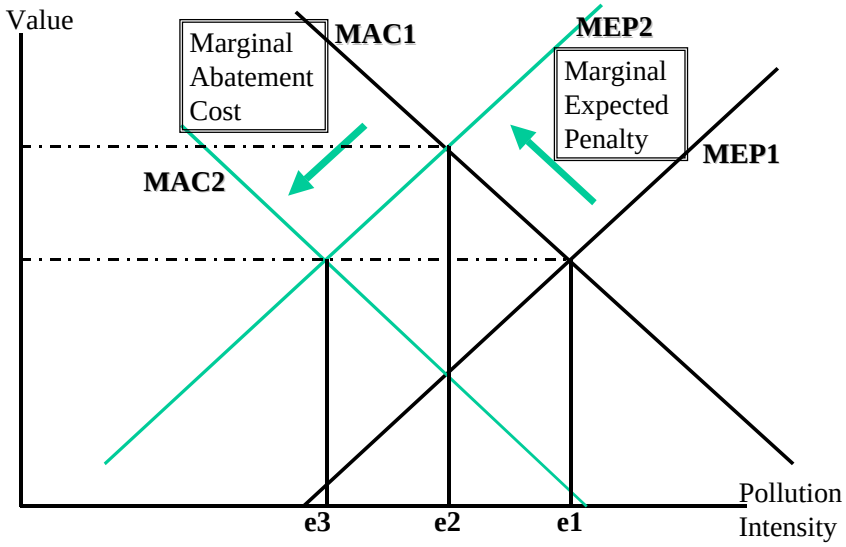
We can draw this relation as marginal expected pollution penalties (MEP) schedule in Figure 3. This upward-sloping line shifts with the changes in the income, education level, sensitiveness toward the environment risk of the local people and quality of information available to the stakeholders (Hettige *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<br>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<br>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:<br>night soil treatment plants for residential housings, hotel business, food processing industry such as tofu and beverage, and restaurants<br>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.

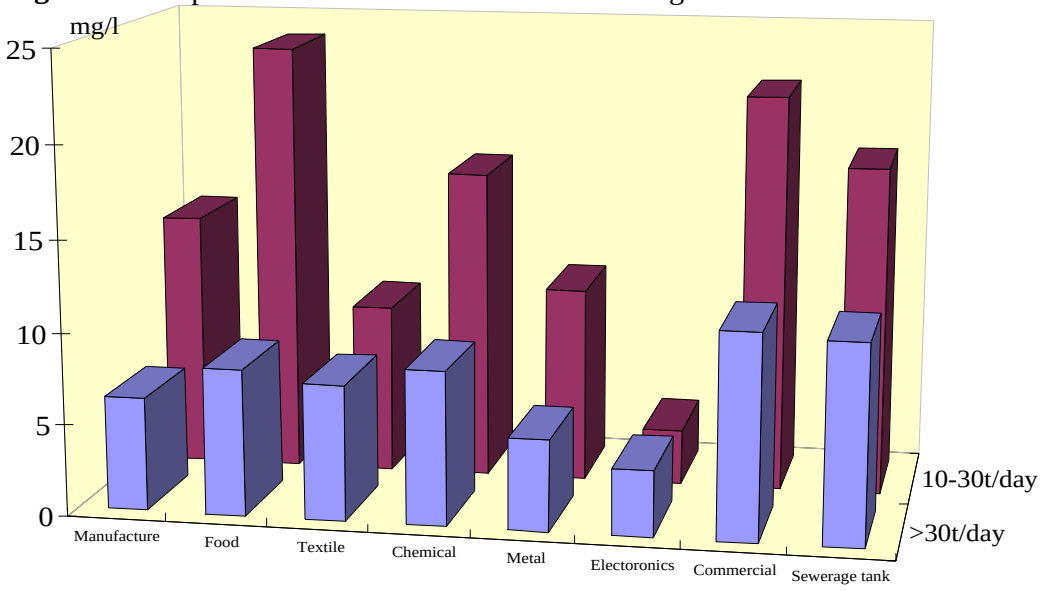
However, it soon became apparent that eutrophication has occurred in Lake Biwa. Red tides occurred in almost every year in 1970s. *Microcystis aeruginosa* was firstly detected in 1986 and has been done almost every year since then. With the help of local pressure, Shiga Prefecture government enacted 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<br>Food Processing | Electronics and Electrorical | Textile<br>Dyeing | Precision Equipment | Electoroplate |
|---|---|---|---|---|---|
| | Major | Major | Major | | Small |
| **Compliance**<br>Widespread use of end-of-pipe<br>Regulation as key motivating factor | | | | | |
| **Compliance plus**<br>Focus on process change and waste minimization<br>Internal eco-audit<br>Awareness of cost saving and benefit | | | | | |
| **Excellence**<br>Eco-management system beyond the firm<br>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

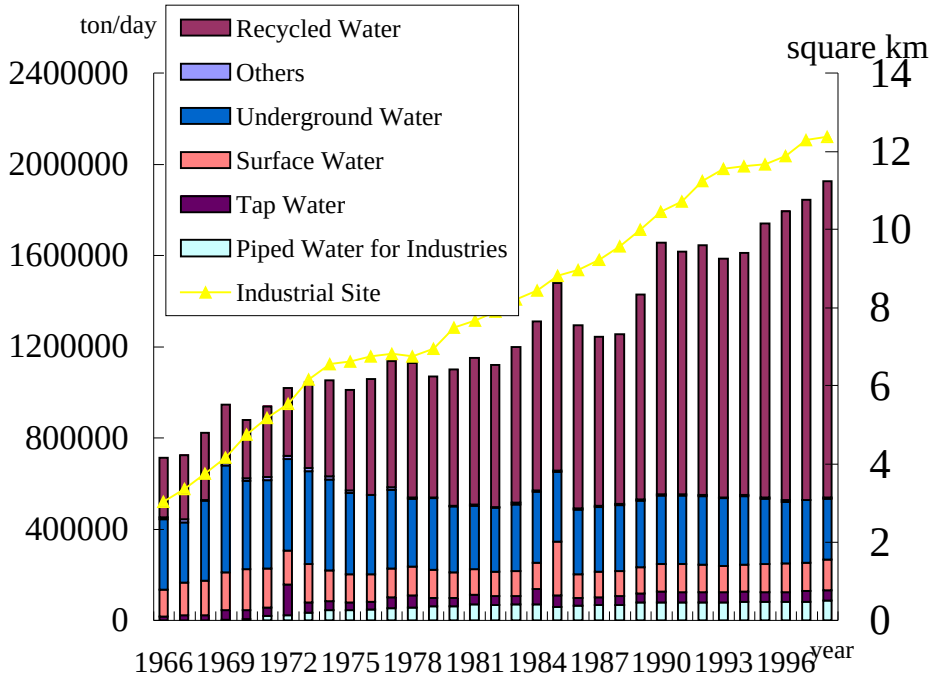
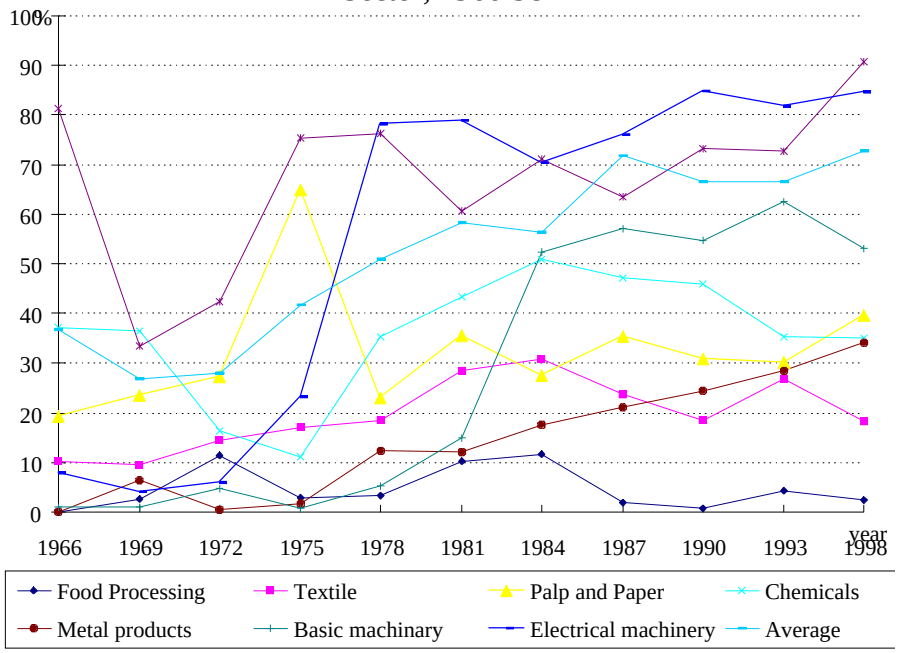



**Figure 6** Rate of Effluent Recycle by Industrial Sector, 1966-98

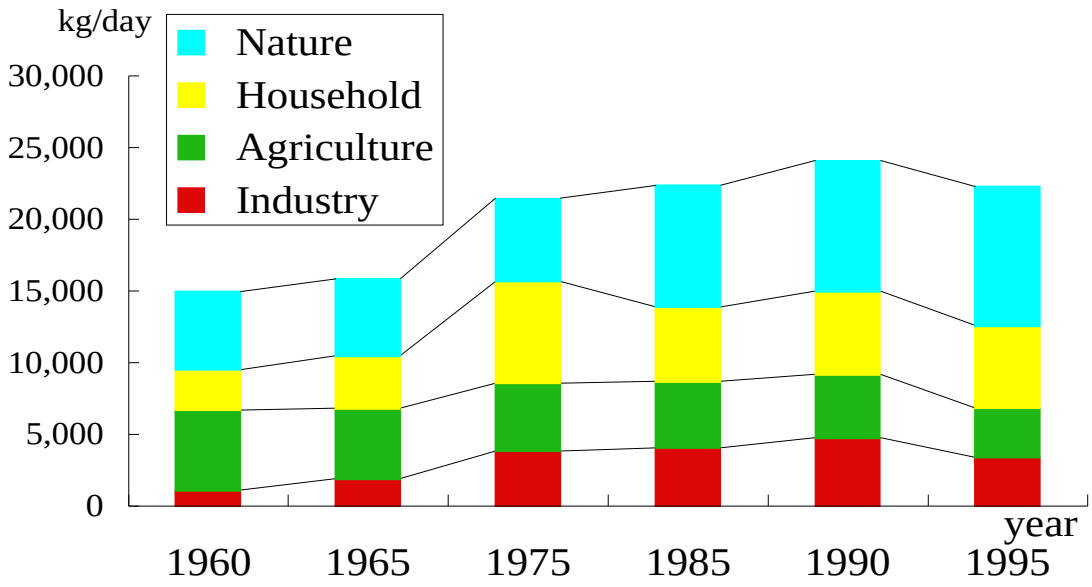



But even these sectors have not reduced water consumption significantly. Some plants employed closed system for all the effluent at one time, but adjusted the system only for the effluent that included toxic materials and discharged the rest to the river after treatment. Other plants increased water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

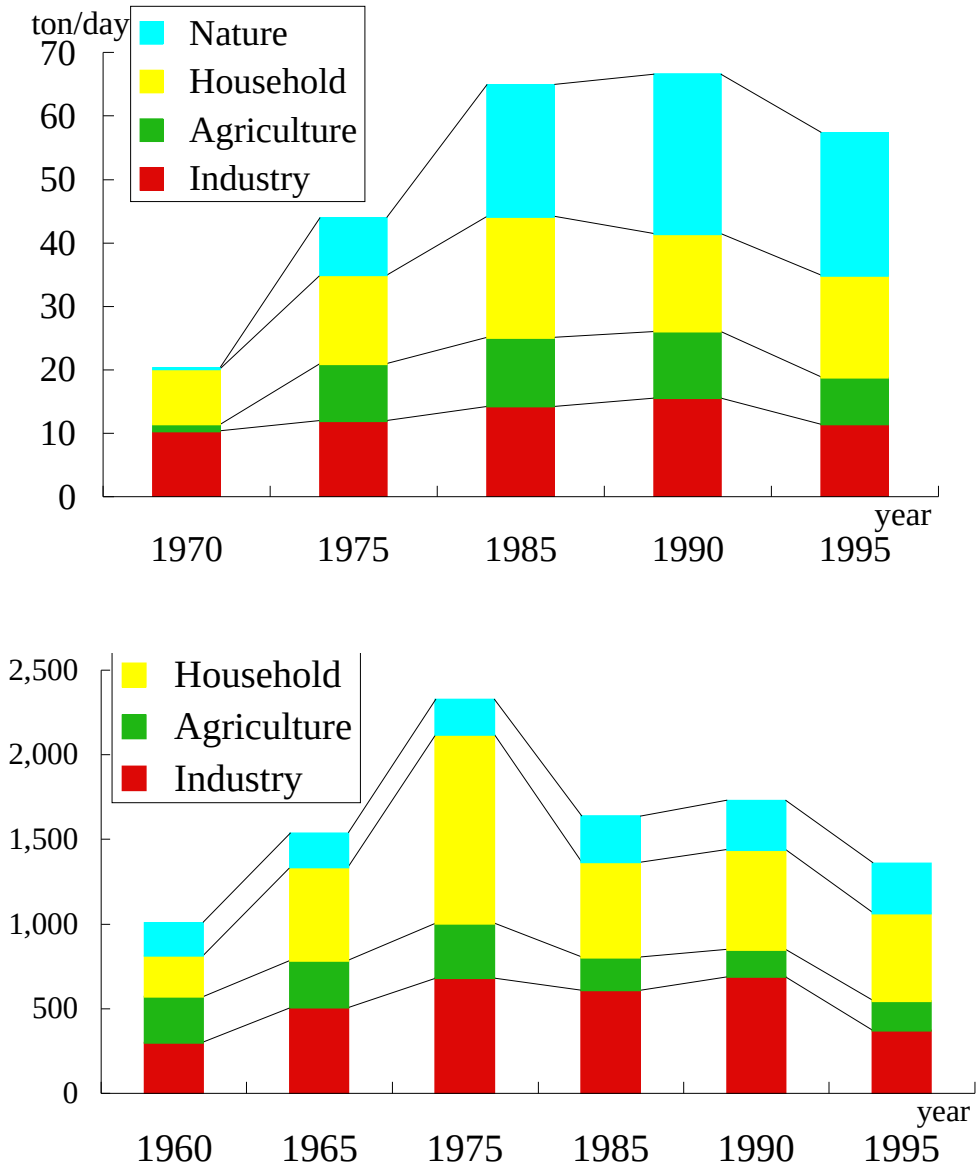
Pollutant load discharge in industrial waste water has not decreased significantly either. Nitrogen and phosphorus discharge turned into the decrease in 1975 (Figure 7and 8). This decrease may be partly a result of the tightened regulations. However, business cycle is considered to have had greater influence 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



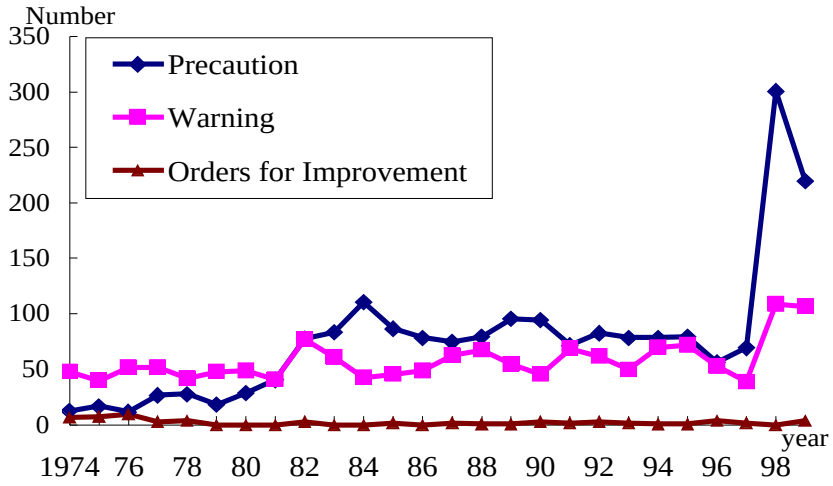
This trend may be inferred from the plants that have breached regulations. Figure 10 shows that there is little change in the breached plants. Exception is 1997 and 1998, when the target of regulations were expanded to small plants. However, considering the dramatic decrease in 1999 pollutant load discharge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

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# Water Management Policy in Lake Biwa Basin and Local Government Finance

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## *Outline of Sewerage Policy in Japan*

### *Institutional Framework*

This paper will initially survey the institutional framework of sewerage policy in Japan. Fig. 1 shows the institutional framework of Japan's sewerage policy. Fig.1 broadly classifies sewerage on the basis of management form, legal status, service provision, and government office executing jurisdiction. There is also a sanitary sewage disposal policy according to which construction and maintenance are carried out by the local public services; this covers the areas of public sewerage, valley sewerage, and rural sewerage. On the other hand, in order to promote installation of a combined septic tank for each household, autonomous local government funds provide subsidies for construction. Thus, the sanitary sewage disposal policy can be classified according to management form, local public services, or local government financial support. A sanitary sewage disposal policy can be classified legally according to the Sewerage Law and the Septic Tank Law. In Japan, sewerage means that which the Ministry of Construction approves under the Sewerage Law. This is "sewerage" in the narrow sense. Rural sewerage, a combined septic tank system and other types of system are based on the Septic Tank Law. Three ministries and government offices, the Ministry of Construction, the Ministry of Health and Welfare, and the Ministry of Agriculture, Forestry, and Fisheries, implement public policy in connection with sanitary sewage disposal. Therefore, although a municipality has primary responsibility for public policy in connection with sanitary sewage disposal within the local municipality, this autonomous policy decision is influenced by the policy of these three national ministries and government offices.

Fig. 2 explains the sanitary sewage disposal system according to government office. Three ministries and government offices perform the following roles. Although sewerage is an important part of a city's infrastructure, this so-called "infrastructure" is under jurisdiction of the Ministry of Construction. Therefore, a city municipality building a sewerage system receives a national subsidy and instruction from the Ministry of Construction. The Ministry of Construction is responsible for construction of public sewerage systems and valley sewerage based on the Sewerage Law.

On the other hand, the Ministry of Agriculture, Forestry, and Fisheries is responsible for construction of rural sewerage systems. In rural communities, sewerage systems are built using subsidies from the Ministry of Agriculture, Forestry, and Fisheries as a source of revenue. Rural sewerage systems are intended both to modernize the villages, providing the ability to flush toilets, and to preserve rural water sources.

The Ministry of Health and Welfare administers the sanitary sewage disposal policy for household drainage in the area of sewerage policy where the Ministry of Construction and the Ministry of Agriculture, Forestry, and Fisheries responsibilities overlap. When all the households of a particular area cannot have such services installed, they install a combined septic tank system, and the Ministry of Health and Welfare and the municipality give a subsidy to the households. Thus, a policy of autonomy is divided among three ministries and government offices, and is controlled through the vertical policy system.

### *The Development of Sewerage Policy*

The sewerage capacity level of Japan is low compared with Western countries. The main objective of postwar sewerage policy was the spread of sewerage systems. The situation of sanitary sewage disposal in Japan is shown in Table 1. The rate of sanitary sewage disposal expresses the percent of the population covered by the present sanitary sewage disposal systems. Currently, the rate of sewage health processing in Japan is 58.1%. The sewerage capacity level is 50.8%. The capacity for rural sewerage is 0.9%, and the capacity level of a combined septic tank is 6.4%.

As stated previously, the public sewerage system refers to the cities. Aside from public sewerage or a rural sewerage system, the spread of combined septic tanks have constituted a substitute sewage health

processing system. An individual home installs a combined septic tank for the purpose of processing of drainage from the household and human waste.

Table 1: The sanitary sewerage systems in Japan (1998)

| | All Population (A) | Public sewerage system | Rural sewerage system | Combined septic tank, others | Total of the sanitary sewerage system | Unsettled population |
|---|---|---|---|---|---|---|
| Population | 127,115,584 | 64,571,936 | 1,145,130 | 8,192,600 | 73,909,666 | 53,205,918 |
| /(A)*100 (%) | 100 | 50.8 | 0.9 | 6.4 | 58.1 | 41.9 |

Source: Ministry of Home Affairs

These three systems share sewage health processing. As a consequence, the problem of mutual adjustment between these distinct sewage health-processing systems has arisen. The mutual adjustment problem relates to the financial problems of sewerage policy, and the problems of a water preservation policy. Generally, since the financial base of a local municipality is limited, decision-making of a local municipality is dependent on a national subsidy policy. The local government has many self-governing bodies, which do not introduce a sanitary sewage disposal system suitable for a particular area, but are guided by subsidies and instead introduce valley sewerage and public sewerage. The following section uses the case of Shiga Prefecture to highlight these issues of public and valley sewerage in Japan.

***Development of Sewerage Policy in Shiga Prefecture***
***The Situation of the Sanitary Sewerage System of Shiga Prefecture***

Table 2 shows the situation of the sanitary sewerage system of Shiga Prefecture. In Shiga Prefecture, rural sewerage provision is offered to 6.5% of the population, and the combined septic tank system to 11.8%. A notable feature of Shiga Prefecture's situation is that the alternative sanitary sewage disposal system provides for 1/3 as many as the full-sanitary sewage disposal. The alternative sanitary sewage disposal system shares 12.6% of full-sanitary sewage disposal with all Japan.

Table 2: The sanitary sewerage systems in Shiga Prefecture (1998)

| | All Population (A) | Public sewerage system | Rural sewerage system | Combined septic tank, others | Total of the sanitary sewerage system | Unsettled population |
|---|---|---|---|---|---|---|
| Population | 1,326,683 | 511,968 | 86,840 | 156,611 | 755,419 | 571,264 |
| /(A)*100 (%) | 100 | 38.6 | 6.5 | 11.8 | 56.9 | 43.1 |

Source: Ministry of Home Affairs

***The Historical Features of the Sewerage Policy of Shiga Prefecture***
Sewerage policy in Shiga Prefecture has the unusual feature including policy for the redevelopment of the Lake Biwa area, a plan referred to as "BIWASO". BIWASO is also concerned with water-resources development for the Keihanshin area, and community development for Shiga Prefecture. BIWASO carried out public works amounting to 353,200 million yen, concerning water-resources development, and public works of 1,907,400 million yen for community development. Sewerage development of Shiga Prefecture was carried out according to the framework for community development of BIWASO. Four disposal plants for Lake Biwa valley sewerages will share the sanitary sewage disposal of Shiga Prefecture. The Lake Biwa valley sewerage development was an important development project of BIWASO, as described in detail by Kondo (2002). BIWASO, which is a national project, was treated as a special case with respect to some financial details. One of them was the valley financial adjustment system called 'down-stream burden charge'. The 'down-stream burden charge' was the system whereby a down-stream irrigation municipality shared the expenses required for the community development of sewearge infrastructure upstream in Shiga Prefecture because downstream users were also beneficiaries. The Lake Biwa valley sewerage development had two features concerning the 'down-stream burden

charge'. The down-stream burden charge promoted valley sewerage development as community development. Therefore, the down-stream burden charge provided funds for development which were generated from municipalities including Osaka, Kyoto and Kobe. In turn those down-stream urban areas were able to expect that the water quality of Lake Biwa and its status as water resources would be preserved as a result of construction of valley sewerage. In short, it was thought that the down-stream burden charge would ensure an even regulated spread of costs and responsibility for the valley sewerage. Shiga Prefecture collected and appropriated the down-stream burden charge. Since construction of sewerage was lagging behind other developed countries, promotion of sewerage construction was an important administration subject for Shiga Prefecture. Sewerage development was not left to an individual city or an individual town, rather Shiga Prefecture developed valley sewerage, and this method of managing a valley unitarily was adopted. Development of the Lake Biwa valley sewerage project was planned from the viewpoint of both compensation in the Shiga region as a whole, and the promotion of sewerage construction. In the framework of BIWASO, there was little room for autonomous policy selection. BIWASO is a national project and regulates a municipality policy through intergovernmental financial relations. In this way, Shiga Prefecture aimed at unitary valley management through the down-stream burden charge.

***The Challenges Facing Sewerage***

As stated previously, the Lake Biwa valley sewerage project has been carried out according to the framework of BIWASO. This problem of the valley sewerage in Shiga Prefecture is typical of valley sewerage in Japan. Three points summarize the criticisms of valley sewerage.

The first point is the long time period required for construction of valley sewerage. Therefore, household discharged and accompanying drainage problems, continued until construction of the sewerage system was completed. Eliminating the environmental load from drainage takes time.

The second point is that sewerage construction needs a large amount of capital. Furthermore, since half of the cost of construction materials are paid for through borrowing, payment of a large amount of debt is required after construction. The local municipality, which is responsible for construction, is faced with financial stress both at the time of construction, and with respect to maintenance management.

The 3rd point is that valley sewerage destroys the water cycle of an area. Valley sewerage collects the water of both home drainage and rainwater in an upper region. Consequently, valley sewerage forms an artificial water cycle so that the water resources of an upper region are passed down-stream.

Such criticism relates also to having changed the area where the valley sewerage and public sewerage are built. Table 3 shows the sewerage enforcement situation relative to autonomous population scale. Following from the construction of the sewerage in urban areas, sewerage came to be built in areas of low population density, which includes small villages. A problem arose in that the city-type sewerage system came to be built in a farm village situation. By such construction of the sewerage system, the municipality is faced with financial stress not only in the construction stage but also in the maintenance management stage. In order that sewerage is managed efficiently, management is undertaken by local public services and is maintained by the collection of charges and payments. However, under the present sewerage financial system, the cost of administrative and maintenance expenses and the debt from the time of construction cannot be met by those charges alone. For example, the cities, towns and villages in the municipality of Shiga Prefecture, which maintain sewerage services in the Lake Biwa valley sewerage system, receive some17, 505 million yen in assistance from the general account of autonomy in 1995. This is equivalent to 9.4% of the municipal tax of 186,184 million yen for the fiscal year.

Legend for box = Criticisms of a valley sewer system

The point of argument of the criticism of a valley sewer

(1) Since a valley sewer system is a huge institution, construction requires a long period of time. Cutting down the environmental load by drainage takes time.

(2) Valley sewer construction requires huge expense. Therefore, the local municipality, with responsibility for the project, is faced with financial stress both at the time of construction, and during subsequent maintenance.

(3) A valley sewer destroys the water cycle of an area.

***The Case of An Alternative Sewage Health Processing System***

As stated previously, the problems result from the construction of city type sewerage systems in rural areas. The following section uses case studies, to explore the possibility of an alternative sanitary sewerage system, which is suitable for areas of low population density, such as farm village areas.

***The Case of a Rural Sewerage System***

The case of Koto Town of Shiga Prefecture and its sewerage policy is considered here. Koto Town seceded from the valley sewerage plan upon which Shiga Prefecture had decided, and promoted the rural sewerage system. The municipalities of surrounding Koto Town have participated in the valley sewerage plan, which Shiga Prefecture is building. As a consequence of autonomous decision making with respect to sewerage policy, Koto Town's approach yielded benefits with respect to both environment and expense.

Table 3 compares the construction cost of an alternative sanitary sewerage system. Koto Town completed construction in a short period of time, 13 years, compared to surrounding municipalities which had, after 13 years, finished only 23.7% of their systems. If the Rural sewerage of Koto Town is compared with the valley sewerage of the surrounding municipalities according to construction costs per person, Koto Town's system would be built at a 30% reduction cost.

*Table 3* Construction cost comparison of the sanitary sewerage systems

| | Per capita construction costs (Yen/person) | Construction cost per ha (Yen / ha) | Term | Population served by sewerage systems |
|---|---|---|---|---|
| Koto town *Rural sewerage* | 1,090,000 | 32, 000,000 | 13 years | 100% |
| 1 city and 4town average *Public sewerage* | 1,570,000 | 64,020,000 | 13 years | 23.7% |
| Sangawa Town *Combined septic tank* | 227,000 | Measurement impossible. | 8years | 68% |

Source: Shiga Prefecture, Koto town, Sangawa Town

The rural sewerage of Koto Town returns the reclaimed water to the area, and it is aimed at environmental improvement, without destroying the water cycle of the area. Moreover, this rural sewerage has composted the sludge generated from the disposal plant. The compost is returned to farmland as manure. This is also a positive feature of this system.

*The Case of a Combined Septic Tank*

***The case of Sangawa Town in Kagawa Prefecture***

An alternative sanitary sewerage system can be seen in Sangawa Town of Kagawa Prefecture. Sangawa Town implemented a drainage-from-the-household policy using combined septic tanks as an alternative system to the 'city-type' sewerage system. An individual home installs a combined septic tank for the purpose of processing drainage from the household and also human waste. Sangawa Town attained a 68% rate of sanitary sewerage disposal in eight years. Consequently, the water of Sangawa Town showed rapid improvement. The construction cost of a combined septic tank is 227,000 yen/person, and was built at a cost of 1/7 of the 'city-type' sewerage system. Since a combined septic tank does not need a soil pipe, an individual home can install a combined septic tank at low cost in this way. The Sangawa Town system also yielded benefits in terms of both construction cost and environment. Sangawa Town also aimed at the improvement of water quality, without destroying the water cycle by returning reclaimed water to the water cycle.

Compared with other sanitary sewerage systems currently managed by the local public service, the combined septic tank has some disadvantages with regard to maintenance and management. However, in the case of Sangawa Town, maintenance and management of a combined septic tank is managed by the nonprofit residents organization. The nonprofit organization collects the charge aiming at maintenance and management from an installation household, and commissions a maintenance contractor. Sangawa Town established the maintenance and management system, which is based on the nonprofit organization.

***The Future***

The outline of a sanitary sewerage policy in Shiga Prefecture has been presented. As for the municipality of Shiga Prefecture, there was no room for policy selection within the framework of BIWASO. The example of Koto Town, where an original sanitary sewerage policy was implemented, and subsequently modified to incorporate an alternative sewerage system, shows that there are benefits both environmentally and financially. Furthermore, the example of Sangawa Town shows that a combined septic tank is not inferior to a public sewerage system in respect of local water and environmental preservation.

Moreover, a water and environmental preservation policy, which includes the combined septic tank, can be cheaply implemented compared with a public sewerage system. In a farm village area, a municipality can enjoy the benefits of both environmental improvement and the mitigation of a fiscal burden by utilizing a combined septic tank as an alternative sanitary sewerage. In Japan, construction of the ideal sanitary sewerage system in a rural area is dependent upon adoption of a policy, which preserves water, addresses environmental concerns, and also addresses the problem of local public finance.

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Fig. 1: Classification of sanitary sewerage systems in Japan

| | **Type of service provision** | **Legal status** | **Service provision** | ***Jurisdiction government office*** |
|---|---|---|---|---|
| Sewerage in the broad sense | Local public services | The Sewerage Law | Public Sewerage | *Ministry of Construction* |
| | | Valley Sewerage | | *Ministry of Construction* |
| | | The Septic Tank Law | Farm Village Sewerage | *Ministry of Agriculture, Forestry and Fisheries* |
| | Services financed by local government | The Septic Tank Law | Community plant (a kind of combined septic tank) | *Ministry of Health and Welfare* |
| | | Combined Septic Tank | | *Ministry of Health and Welfare* |

**Fig. 2: The triangle of the sanitary sewerage policy**