Water pollution control policies and instruments in Asian region
アジア地域諸国の水環境管理の政策と方法論に関する国際比較

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Pollution control is impossible without the establishment of adequate legislative and institutional bases in a country. Information on the history and status of various regulatory and economic measures so far used for water pollution control in South and East Asian countries have been analyzed and presented after rigorous search of literatures and country-based documents. Data and information are mainly presented in compiled form to make it a reference to understand the regional profile in this regard. Environmental administration and legislation are growing in almost all the countries, however, present status mainly resembles varying according to the socio-economic development level of the countries.

Keywords: *Asia, Water pollution, Environmental quality standards, Economic instruments, Environmental agency*

1. INTRODUCTION

Asia is a diversified continent of countries all levels of socio-economic development and environmental problems. For the last 2-3 decades, however, pace of industrialization and urbanization has accelerated at an unprecedented rate in almost all the countries. A number of rivers and water bodies in the Asian countries have already suffered from severe pollution, some even on the verge of biologically dead. The Agenda 21 of 1992 earth summit states: fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; and water resource should be considered as a social and economic good with a value reflecting its most vulnerable potential use. Thus, water pollution control has become a prime task and a great challenge in the region.

Pollution abatement and control is not possible without the establishment of adequate environmental legislative and institutional bases in the country. Effective policies and share of experiences could further help curb the pollution at least cost and time. Although environmental management is gaining increasing priority in Asian developing countries for about a decade, there is lack of studies and literatures let one understand the regional scenario comparatively. In that background, this paper is mainly aimed at presenting in compiled form, the development and several features of water pollution control policies and instruments in South and East Asia. The topics deliberately discussed include history of development and present status of regulatory and economic instruments used in water pollution control, existence of various environment related institutions, data on environmental water quality and effluent standards and some pertinent issues on pollution prevention and control in the region. This work could be not only important to understand how the region is acting on water quality management but also serve a reference to fulfill data and information needs in this regard. Data tables are to be viewed as a first hand effort in such extent of compilation and presentation, which have been collected rigorously by a number of ways, referring country-wise literatures and documents to regional reports and Internet sources. As a part of data collections, authors also visited several countries of Asia to obtain data and available literatures at maximum possible.

2. REVIEW ON GENERAL POLLUTION CONTROL APPROACHES AND INSTRUMENTS

Various measures taken against pollution abatement, control and management are basically classified into two groups: (i) Legislative and Regulatory measures (popularly known as command and control approach); and (ii) Economic instruments (also called market-based instruments). However, there are also some other measures such

as; R&D of Eco-technologies, Eco-labeling, public awareness and environmental education, and voluntary reduction of pollution, those are often viewed under any of the above two categories or even separately as supporting measures to environmental conservation (Table 1). Some measures and actions are aimed at controlling pollution generated by any activity or discharged into the environment and thus can be said direct measures of pollution management. Whereas others may contribute to indirectly change the behavior or abate pollution sources or their quantity.

Legal and regulatory measures are the most traditional and conventional approach of pollution abatement and control all over the world. The underlying principle is to achieve environmentally responsible behavior and goal by enforceable laws, regulations and standards. Regulatory tools influence environmental outcomes by regulating processes or products, limiting the discharge of specified pollutants and by restricting certain polluting activities to specific times or areas. Several environmental management and pollution control laws and standards are usually formulated. In water pollution control sector, some of the most common instruments are water quality standards (objectives), effluent standards, EIA (Environmental Impact Assessment) system for development projects and trade business, regulation on hazardous and toxic substances, land use zoning and industrial siting permits etc. The success rates of command and control instruments largely depend on the enforcement capacity of the regulating agency and also on economic and technological strength of the country. One of the drawbacks is that the cost of complying with the regulations is usually unknown.

Economic or market-based instruments, on the other hand, rely on market forces and changes in relative price to modify the behavior of public or private polluters in a way that supports environmental protection or improvement. The main guiding principle is polluter should pay for the pollution, first advocated and encouraged by OECD in 1972 and later by European Union. It supports the notion of environmental economics that the cost of pollution should be internalized. There are hundreds of economic instruments devised so far, but the principle categories can be pollution tax, tradable pollution permits, deposit-refund system, liability and subsidies (financial incentives). It is, however, often viewed as supplementary to regulatory system but not the substitution. Water quality is a few environmental policy areas where economic instruments have already played a significant role in OECD countries and in transitional economies.

Table 1. A taxonomy of instruments used for water pollution control.

Type	Direct	Indirect
Legislation and Regulatory (also called command and control approach)	1. Standards: Ambient water and effluents 2. Permits (License) and non-tradable quotas for effluents. 3. Regulations or ban on use and handling of materials (hazardous substances)	1. Restrictions (on products, process and inputs) 2. Industrial siting and zoning regulations 3. Environmental impact assessment system and clearances.
Economic Instruments (also called market-based instruments)	1. Pollution tax 2. User/ Service charges 3. Tradable pollution permits 4. Deposit-refund system 5. Performance bonds 6. Strict Liability payment	1. Taxes (on products, inputs, raw materials and business). 2. Tax Subsidies (on products, equipment, raw materials; income tax, custom duty, excise, sales tax) 3. Tax and price differentiation (public utilities) 4. Financial incentives (Grants and soft loans) 5. Creation of property rights
Supportive and other measures	1. R&D of Eco technologies and goods 2. Public participation in decision making process 3. Voluntary reduction of pollution	1. Eco-labeling 2. Information openness

3. LEGISLATIVE AND REGULATORY MEASURES IN ASIA

3.1 Evolution and development of legal system in water pollution control

It barely goes earlier than 1950s that a definite policies and enforceable laws on pollution control could be seen in Asian countries. Yet, there are distinct phases of time across countries when such laws were promulgated for the first time. In general, such times were the ones when a country entered into high economic growth phase through industrialization (also called transitional economy, from agricultural to industrialization) and assumed rapid urbanization. Obviously, industrialization and urbanization are major agents to necessitate the pollution control mechanisms. Considering the countries those moved to economic transitional phase earlier have better economic strength (in terms of GNP, gross national product) today, the first enactment of environmental or pollution control laws seems correlated to the per capita GNP of the country at present days. This means, the higher the country's GNP, the earlier was the enforcement of pollution control laws (Figure 1).

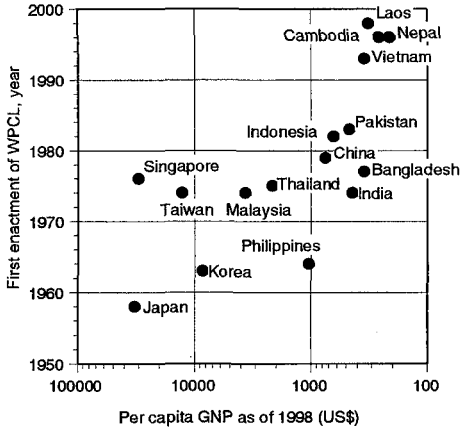

Figure 1. Year of first enactment of Water Pollution Control Law (WPCL) verses present economic level of the countries/region in Asia. (Data: References 4, 8, 12-14, 17-23, 27, 31, 33).

Figure 2 presents the year of standards enforcement, ambient surface water quality and effluent (industrial) standards, in Asian countries. While some countries have enforced both at the same time, many developing countries such as,

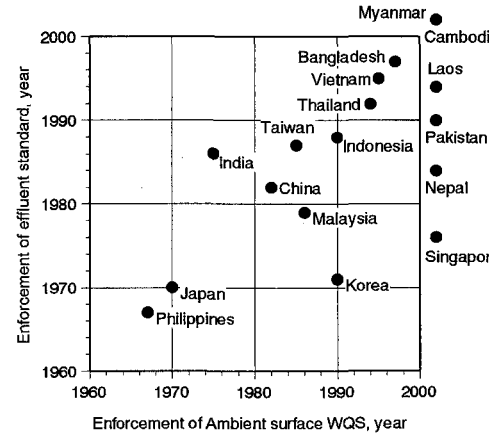

Figure 2. Year of enforcement of ambient Water Quality Standard (WQS) verses effluent (industrial) standards. (Plotted out of frame is meant for not yet established). [Data: References 4, 8, 12-14, 17-22, 24, 27-28, 30-31]

Nepal, Laos, Pakistan etc. haven't set water quality standards yet.

The history of first promulgation or further broadening (strengthening) of water pollution control laws also reveals on that it has been often prompted in Asia either after occurrence of some environmental disaster in the countries or international move (convention or treaties) towards environmental protection. During the reconstruction and high economic growth period after World War II, Japan, for the first time, led to enact two laws on pollution control simultaneously in 1958. They were water quality conservation act (implemented by economic planning commission) and Control of effluent emission from factories (implemented by ministries of trade and industry; transport; health and welfare and others) (Sumikura, 1998). Although the water pollution problem had already become serious in many public water bodies throughout Japan, particularly in industrialized area, it is said that promptness was due to tragic incident of Minamata disease (organic mercury poisoning). Later, however, Japan's diet passed basic environmental laws in 1967 by unifying several sectoral laws, when it was felt not sufficient to cope with wide-spreading problem of water pollution. Then, Korea promulgated its pollution prevention act in 1963 and Philippines formed a National water and air pollution control commission in 1964, presumed both followed the legislative developments in USA. Other middle economic

developing countries/region such as; India (1974), China (1979), Malaysia (1974), Thailand (1975), Taiwan (1974) and Philippines (1977) seem prompted to launch water pollution control laws and policies only after United Nation's Stockholm conference (on human environment) in 1972, during the decades of 1970s. In the same chain, few other countries like Pakistan (1983) and Indonesia (1982) happened to enact such regulations by early 80s. India also promulgated basic environment law in 1986 (previously it had separate laws on water, 1974, and air, 1981) after a tragic chemical accident of Bhopal in 1984. The latest breakthrough in promulgating environmental laws by much poorer and agrarian nations came after historic earth summit of 1992. The countries in this category are Nepal (1995), Vietnam (1993), Cambodia (1996) and Laos (1998). Yet few countries like Myanmar and Bhutan are lagging behind in such laws.

The pollution control laws appear also gradually grown from being mere an ad-hoc regulation or sectoral law (separate for each media, for instance, air, water and soil, and also sometimes place specific) to the status of uniform umbrella law on environment, often named as basic environment law or environmental protection act. Basic environmental law lays down principals on environmental management and pollution control of each sector in an integrative way to be administered by a separate ministry or agency made for it. Such tendency of unification is observed in many countries, for instance, Japan, India and Singapore, however, few countries/region like Taiwan are yet functioning on separate laws for each environmental media. Korea, in contrary, has disintegrated its original environmental protection law (of 1977) into six sectoral laws in 1990, however the implementing agency is same.

Environmental laws in some countries, especially those which were framed before early 1980s, have undergone amendments, some re-written and promulgated as a new law, to deal with ever-increasing challenges and to incorporate newer policies and instruments. Among re-promulgators are Japan (1993), Thailand (1992), China (1989), Taiwan (1991), Bangladesh (1995) and Pakistan (1997), and major amendments have been carried out in Malaysia (1996) and Indonesia (1997).

3.2 Status and components of environmental laws to water pollution control

The major tools applied for water pollution control under legislative and regulatory regime in Asian countries consists of: enforcement of environmental quality standards (water quality and effluent standards); regulations on hazardous and toxic substances (handling and disposal); EIA (Environmental Impact Assessment) system and environmental clearances of development and business activities; licensing to pollution discharge and industrial siting; regulations on domestic and municipal sewage, night soil and solid waste disposal. However, a great variation exists among countries using one, more or all of these instruments, depending upon the socio-economic development of the countries. The details on various instruments adopted and their history of enforcement in each country are presented in Table 2.

In general, almost all countries have adopted EIA system. In little industrialized countries such as, Laos, Cambodia and Nepal, EIA has been the backbone of environmental management, and so water pollution control is heavily dependent upon it. The second most common feature is the enforcement of effluent standards for industries. Control over municipal sewage, however, is limited to only developed countries, Japan, Korea and Singapore. Among developing countries, Thailand and Malaysia has imposed standards on the effluent discharged from large buildings, business centers and institutions. Environmental water quality standards are not yet formed in Nepal, Cambodia, Laos, Pakistan, and Myanmar. In India, Bangladesh, Indonesia and Malaysia, however, it is given for surface waters only, not the ground or coastal waters.

Regulation regarding control of hazardous and toxic substances was formulated in many countries only after Basel *Convention in 1989*. Yet it doesn't exist in many countries including Bangladesh, Nepal, Vietnam, Cambodia, Laos and Myanmar.

3.3 Classification of water resources and water quality standards

The main objective of water quality management is to maintain the desired quality of public waters. It is a common practice to classify the water bodies i.e. Inland surface (rivers and lakes), Groundwater and Coastal, according to their prevailing or intended use such as drinking, recreation, wildlife, industry and agriculture.

Table 2. Status and Development of Environmental protections laws and standards in Asian countries/region

	Bangladesh	Cambodia	China	India	Indonesia	Japan	Korea	Laos	Malaysia	Myanmar	Nepal	Pakistan	Philippines	Singapore	Taiwan	Thailand	Vietnam
Main Laws																	
Basic (framework) law on environmental protection	1977, 1995*	1996	1979, 1989*	1986	1982, 1997	1967, 1993*	1963, 1971, 1977	1998	1974, 1985, 1996	X	1995	1983, 1997*	1977	1999	X	1975, 1992*	1993
Separate law on water pollution control	X	X	X	1974	1990	1958 1970	1990	X	X	X	X	X	1964, 1976	1976	1974, 1991*	X	X
Other laws or regulations																	
EIA (or IEE) system	1997	1996		1994	1993	1971	1981	Ad-hoc	1987, 1990	Ad-hoc	1993	1998	1978, 1996	Ad-hoc	1994	1992	1994, 1998
Hazardous/Toxic substance control	X	X		1989	1994, 1995	1971	1991	X	1989	X	X	1999	1990	1988	1986, 1997	1982, 1992	X
Standards																	
Ambient water quality																	
Inland surface (River and lakes)	1997	X	1982	1975	1990	1970, 1999	1990	X	1986	X	X	X	1967, 1978, 1990	NR	1985	1994	1995
Ground water	X	X		X	X	1997	1990	X	X	X	X	X	X	NR	X	1978	1995
Coastal or Marine	X	X		X	X	1970	1990	X	X	X	X	X	1990	NR	1985	1994	1995
Effluents																	
Industrial (general)	1997	X	1982	1986	1988	1970	1971	1994	1979	X	1984	1990	1967, 1978, 1990	1976	1987, 2000	1978, 1996	1995
Industry-based (categorical)	1997	X	1982	1986	1988	1972	1977	1994	1977	X	X	X	X		1987, 2000	1996	X
Sewage from commercial centers and large buildings	X	X		X	X	X		X	1979	X	X	X	X	NR	1987, 2000	1985, 1994	X
Municipal sewage	1997 STP	X		1986 STP	X	1970	1977	X	X	X	X	X	X	NR	1987, 2000		X

Multiple years denote major amendments held; X- Doesn't exist; * - New promulgated law raplaced the existing one

NR- Not required; STP- applicable to municipal sewage treatment plants

Table 3. Number of parameter value set in water quality standards

Parameters	Bangladesh	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Taiwan	Thailand	Vietnam
Surface Water (Rivers)											
Phy-chem-org-bacterial	7	20	8	21	5	5	40	14	7	10	15
Toxic Heavy metals	×	8	×	10	7	N	13	6	6	8	10
Hazardous/Pesticides/Radio-activity	×	2	×	20	16	N	20	13	3	11	6
Total	7	30	8	51	28	N	73	33	16	29	31
Ground Water											
Phy-chem-org-bacterial					×	5				15	12
Toxic Heavy metals					7	5				8	8
Hazardous/pesticides/Radio-activity					16	5				×	2
Total	×	N	×	×	23	15	×	×	×	23	22
Coastal water											
Phy-chem-org-bacterial					6			10	4	18	15
Toxic Heavy metals					7			6	×	7	8
Hazardous/pesticides/Radio-activity					17			13	×	6	3
Total	×	N	×	×	30	N	×	29	4	31	26

N- data not available; ×- standard doesn't exist.

Then prescribe the water quality standards (or objectives) for each type and class (uses) of water. In Asian context, it doesn't seem more than a decade that such classifications have been made and quality standards prescribed, except in some countries like Japan, India, Chine and Philippines. Moreover, standard is largely limited to the surface water alone and not at all in Nepal, Pakistan, Cambodia (Table 2). Parameters in WQS are generally given in two categories, one aimed at preserving the living environment i.e. control of organic pollution and eutrophication; (parameters are generally pH, DO, BOD, SS, N, P and Coliform bacteria), which, in turn vary with different classes of water. The other set is intended to protect the human health such as heavy metals, hazardous chemicals and pesticides. In many less developed countries, however, there is no such categorization. In any case, parameters in WQS usually differ with water use classification, both in number and their concentration limits. The total number of parameters to be monitored as per WQS greatly differs among countries. Bangladesh and India's standards yet requiring only the parameters for conservation of living environment and therefore no standards are given on heavy metals and hazardous substances (Table 3). Where as the classification of water bodies and selection of parameter variables (for standards) for each category depend on local condition and potential pollution threats, setting of permissible limits is a crucial task that needs proper consideration of both the scientific criteria and techno-economic condition of a country. Table 4 presents how surface water bodies have been classified in Asian countries based on water use and illustration has been made by the permissible limit of BOD in each class. Although each country has own use classification and standards, the following class division, in general, is perceived according to quality criteria.

1. BOD 1-3 mg/l: Natural reserve, public water supply after disinfection, spawning water of rare fishes and wildlife.
2. BOD 1.5-5 mg/l: Public water supply after conventional treatment, bathing, Body contact recreation water and for sensitive fishes.

Table 4. Stream water use classification and EQS for BOD in Asian countries/region

	Use categories	Bangladesh	China	India	Indonesia	Japan	Korea	Malaysia	Philippines	Taiwan	Thailand	Vietnam
1	National natural reserves		<3			1	≤1	1	1			
2	Sources of public water supply											
	Use as natural		<3									
	After disinfection	≤2	3	≤2	I[+]	1	≤1	1	1	≤1	N	
	After conventional treatment	≤3	4	≤3	II	2	≤2	3	5	≤2	1.5	4
	After extensive treatment					3	≤6	6		≤4	4	
3	Recreational water (General)	≤3									1.5	25
	Body contact											
	Bathing			≤3		2			5	≤1		
	Others (swimming etc.)		4						5			
	Non-body contact (boating etc.)		6					3	7			
4	Fisheries and wildlife (General)	≤6		*	III				7			25
	Rare species		3			2	≤2	1			N	
	Sensitive species		4			3	≤2	3		≤2	1.5	
	Common to tolerant species						≤6	6		≤4		
5	Industrial use (General)		6		IV			6			4	25
	Manufacturing use after treatment					5-10	6-10		7	≤4		
	Cooling purposes	≤10		*					10	*		
6	Livestock watering				III				10			
7	Agriculture and Landscape	≤10	10	*	IV	8	≤8	12	10	*	2	25
8	Navigation										*	
9	All others and conservation of living environment					10	10	12	10	*		25

* Classification is made but value for BOD is not given; [+] Indonesia's EQS doesn't prescribe concentration limits on BOD though it sets on other parameters. Water classification has been made from I to IV based intended use.

3. BOD 3-10 mg/l: Non-contact recreation, common to tolerant fishes and industrial water for manufacturing after treatment
4. BOD 8-12 mg/l: Industrial water for cooling, water for irrigation, landscape and livestock.
5. BOD 10-25 mg/l: Navigation, conservation of living environment (visual aesthetic and non-odor)

3.4 Effluent standards and pollution discharge control:

In order to achieve the desired goal on natural water qualities, pollution discharge limits are set on the polluters in the form of effluent standards. It generally gives the concentration limits on various parameters but sometimes also in terms of allowable mass loading rate. In Asian countries/region, effluent standards are mainly given to industries, municipal sewage (transported by municipal sewers) and on-site facilities attached to buildings. However, based on receptor (media-land or water and category of use) there can be several sets of standards corresponding to each condition. A typical effluent standard for sewage or industrial wastewater discharged into inland water bodies (public supply to wildlife protection use) is presented in Figure 3. Although it varies from 20mg/l (minimum) to 160 mg/l (maximum) among countries, most of the country's value lies between 20 to 80 mg/l.

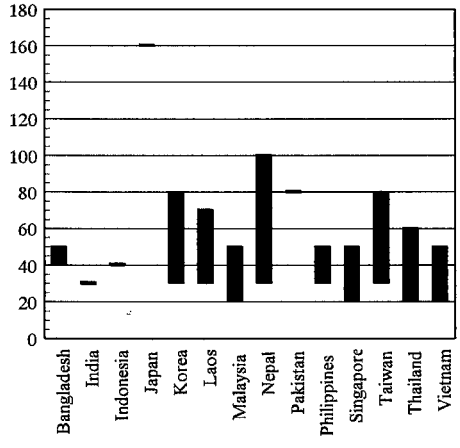

Figure 3. Sewage and industrial effluent standards to be discharged into inland water bodies. [Data: References 4, 8, 13, 19-22, 24, 27, 28, 31]

Deriving effluent standards generally follow any or mix of the two approaches; River quality objectives (RQO) and Best Practical Technology (BPT) (Chamlers, 1984). Although it couldn't be known which country followed what, it is observed that some countries such as Japan and India, have provision of two tiers of effluent standards. One is uniformly applied nation-wide by central government and the other is more stringent standard that a local government (state/province) can enforce as per sensitivity of the place or resource. In Japan, national effluent standards for BOD is 160 mg/l (daily average 120 mg/l), which can be said the most liberal compared to all of the other Asian countries (Figure 3), but it does have more stringent effluent standards at local level. For example, effluent standard for BOD is 15-25 mg/l in Kanagawa and 50-80 mg/l in Shiga prefectures (Okada and Peterson, 2000).

Standards for industrial effluents are common in most of the countries and generally it is found under two heads; general standard and categorical industry-based standards. Application of effluent standards also observes some strategy and incentives to allow polluters comply with the discharge in the nearest possible time. One of such strategies is providing a transition period to old industries, during which standards are gradually stiffened as practiced. This has been practiced in Malaysia (for crude palm oil and natural rubber industries) and Philippines. Korea's effluent standards categorization is somewhat different and is based on mass loading of wastewater, for instance, whether it is less or more than 2000 m^3 a day.

Standards for general municipal effluents have been enforced in only few developed countries such as Japan, Korea and Singapore. Others are limiting only partially or not at all. For instance, Thailand has enforced effluent standards to large building (apartment and real estates), hotels, and institutions before they discharge into the public sewers. Malaysia and Taiwan have also regulated in almost similar fashion. India and Bangladesh imposes effluent standards to municipal sewage treatment plant wherever exists. Fully control of municipal effluents by enforceable standards might have been bared due to lack of adequate sewerage infrastructure followed by sewage treatment plants. In Nepal and Vietnam, for example, although partial sewerage system exists in the cities, no control exists due to lack of wastewater treatment plants.

Regarding private residential buildings in unsewered area, many countries/region such as, Taiwan and Philippines mandates on compulsory on-site sanitation facilities (by septic tanks or such) but enforceable effluent standards and regular monitoring doesn't seem to be existed. Overall, except Japan and Korea, control over municipal and domestic effluents appears minimal in other Asian countries.

4. ECONOMIC (MARKET-BASED) INSTRUMENTS

Economic instrument, as it needs developed market and controlling mechanism, is more like introducing in Asian developing countries. Japan and Korea, being developed and in OECD, have become successful in applying to more diversified fields including use of deposit-refund system, product tax and effluent charges. But none of the countries in Asia so far have practiced the tradable permit system in effluent discharge. Among developing countries, China is forerunner in the field of levying charge on effluents (based on the amount over permissible limits) which has been practicing for nearly two decades.

Since 1998, Philippines has also introduced similar effluent charges to industries in Laguna lake basin. India has so far practiced accelerated depreciation, income tax subsidies, investment allowance, rebate on custom and excise duty and sales tax, but all relating to tax subsidies pertaining to pollution control equipment (Mehta et al. 1997). Malaysia has also provision of similar incentives as Investment tax allowance for the companies undertaking re-processing of certain agricultural and chemical wastes and exemption of import duty, sales tax and excise duty on machinery and raw materials to manufacture pollution control equipment (EETC, 1999). Likewise Thailand provides exemption of import duty on pollution control equipment and soft loans and grants. Some details on various economic instruments used in Asian countries are presented in Table 5.

Table 5. Key economic instruments used in water pollution control sector in Asian countries

Types of instrument	Bangladesh	China	India	Indonesia	Japan	Korea	Malaysia	Nepal	Philippines	Singapore	Thailand	Vietnam
User Charge												
Royalty on water resource use			•					•				
Sewage (to sewer) disposal charge			•		•	•	•	•		•	•	
Pollution charge/ tax												
Industrial effluent		•		•		•	•		•	•		
Institutional/domestic						•						
Tax												
Products tax					•			•				
Sales tax		•						•				
Tax on raw material/ substitution								•				
Liabilities												
Compensation/ redressing	•		•		•		•				•	•
Non-compliance fee											•	
Deposit-refund system	×	×	×	×	•	•	×	×	×		×	×
Performance bond												
Tradable pollution (effluent) permit	×	×	×	×	×	×	×	×	×	×	×	×
Tax Subsidies/ Financial Incentives												
Rebate on custom/excise duty			•			•	•		•		•	
Accelerated depreciation			•		•		•					
Tax subsidy on eco/ recycled products		•										
Grants/ soft loans												
On recycling activities		•			•							
Pollution reduction efforts		•			•							
Eco-labelling			•			•	•				•	

• Yes; × No; Vacant- Data not available

Table 6. Environmental institutions and public utility providers in Asian countries/region

	Environmental policy and standards			Infrastructure/services provider (urban)			
	Formulation		Enforcement	Sewerage (large cities)	Sewerage (towns)	Night soil disposal (treatment)	solid waste disposal
	Previously (as section or department)	Existing (As ministry or equivalent)					
Bangladesh	DEPC 1977	MOEF 1989 (DOE 1989)	DOE	AA (public)*	MLGRDC (DPHE)	Municipality	Municipality
Cambodia		MOE 1993					
China	SEPB 1973, NEPA 1985	SEPA 1998	SEPA, Province				
India	DOE 1980	MOEF 1989 (CPCB & SPCB 1974)	SPCB	AA (public), Municipal.		Municipality	Municipality
Indonesia		SME 1988, BAPEDAL 1990	Provincial govt., MOI, MHA	AA, MPW	MPW		Municipality
Japan		EA 1971	Prefecture government	Municipality	Municipality and Pref.	Municipality	Municipality
Korea	EA 1980	MOE 1990	MOE				
Laos	DOE	STENO 1993					
Malaysia		MOSTE (DOE 1974)	DOE	MHLG	MHLG		Municipality
Myanmar	NCEA, 1990	×	NCEA under MFA				
Nepal	MOFE 1992	MOPE 1995	MOPE, MOI (industry)	AA (NWSC, public)	MHPP	×	Municipality
Pakistan	EPA, 1983	MELGRD (EPA)	EPA				
Philippines	NAWAPCO 1964, NPCC 1976	DENR 1987	DENR, NCR, LLDA	AA (MWSS in Manila)		Municipality, DOH	Municipality
Singapore	DOE 1970	MOE 1972	MOE	MOE	MOE	MOE	MOE
Taiwan	WPCA 1975	EPA	EPA				
Thailand		MOSTE 1992 (PCD 1992)	PCD, MOI (Industry), MPH (Hospitals)	AA (public/ private)		Municipality	Municipality
Vietnam		MOSTE 1992 (NEA 1993)	MOSTE 1992 (NEA 1993)	MOC	MOC		DTPWS

×- *Doesn't exist. Refer to Appendix 1 for the full form of abbreviations used in the table.*

5. ENVIRONMENTAL ADMINISTRATION

Environmental administration in Asian countries has been developed from the status of a department or section to the full-fledged environmental ministry. Most of the ministries have been formed after late 1980s. Environmental ministry is supposed to look after all environmental management and pollution control related policies, plans and administer the basic environmental laws. But this is not the lone executor, especially in case of enforcement responsibilities of laws and standards, which is distributed to many sectoral line agencies such as Ministries of industry, agriculture or fisheries in the area of their competence (Table 6). One reason can be the short history of environmental ministries, which had been otherwise dealt by sectoral laws under their jurisdiction.

Similarly, authorities responsible for the supply and management of various public utilities as, water supply, sewerage, night soil collection and treatment/disposal, and solid waste disposal are also different in many countries. Dispersed responsibilities may hinder sometimes on formation

or effective execution of environmental sanitation related codes if the mutual co-operation and co-ordination become weak. Needless to cite examples but literatures on any country often points out such conflicts due to unclear responsibility or overlapping rights.

6. SOME CRITICAL ISSUES ON POLLUTION CONTROL AND LESSONS FROM DEVELOPED COUNTRIES

Asian rivers and water bodies are, by far, principally polluted by urban pollution sources (industrial and municipal sewage) and so critically threatened near urban segments (Karn and Harada, 2001). Thus pollution controls policies and instruments need to be designed in such a way to adequately cope with the pace of rapid industrialization and urbanization in these countries. While effective enforcement is the core of success of any policy and programs, it depends on several socio-economic factors and conditions as, infrastructural development (sewerage expansion, on-site or off-site wastewater treatment facilities), institutional aspects (adequate human resources and clear responsibilities) and proper co-ordination among various line agencies. Unless such bases are strengthened and properly tied up, mere formulation of laws and standards mayn't achieve the goal. To understand well, one needs to analyze on each aspect separately, however, few critical problems and focus areas are discussed here.

(1.) Industrial pollution control: Although almost all the countries have set standards on industrial effluents, enforcement and supervision part is limited and reportedly feeble in most of the countries. Besides competent agency's weakness in enforcement, scattering of industries (established unplanned) and less supervising staffs with the pollution control department are also hindering to the progress. For example, India has so far been able to impose effluent standards on only large and medium scale industries, yet achievement is only about 74% (CPCB, 1997), and small scale industries are largely untouched. While in one hand it is practically difficult to enforce them (small-scale industries) build own treatment plant, on the other, their total pollution discharge potential (specifically of industries releasing toxic wastes such as from leather tanning, electro-plating etc.) is no less. For example, there are only 45 medium to large industries in Delhi but more than 95000 small-scale industries. Nearly similar situation prevails in most of other developing countries of Asia too. Therefore, it could be recommendable to have clear mandates on industry relocation, construction of common effluent treatment plants for small-industries and so on to curb such pollution. In parallel, strengthening of human resources to pollution control department is necessary to achieve sufficient monitoring on defaulters.

(2.) Municipal pollution control: An effluent standard for municipal sewage is virtually non-existing in developing countries. The major obstacle seems little coverage of sewerage system and even if it existed in some cities, they lack sewage treatment plants. Few countries have laid down standards on effluents from major point sources such as; large commercial and institutional premises and effluents of sewage treatment plants. Similarly, most of the households outside of sewerage facilities practice on-site sanitation like septic tanks, but very few countries have given standards on such effluent. As such pollution source points are discrete and innumerable, monitoring by competent authorities is rarely done on septic tank holders.

(3.) Sanitation infrastructure development: It will be worthful to note that Japan, which enjoys most of her waters now relatively clean, has also fought a long battle against water pollution in the past. Not only all types of regulatory and market-based approaches of pollution control were implemented time to time, environmental infrastructure also developed at great priority considering it a complement to pollution management efforts. Statistics shows that Japan had only 6% of population covered by sewerage system (almost similar situation that of other developing countries in Asia now) in 1960 but steadily grew up to become 54% in 1996 (Kubo 1991, Okada and Peterson 2000). Consequently, compliance rate to environmental water quality standards for BOD in rivers was increased from about 45% in 1974 to about 75% in 1995 (Okada and Peterson 2000). In Korea, whereas it had constructed first publicly owned municipal sewage treatment plant in 1976, it achieved 31% population serviced by sewerage system in 1990 and expected expansion by 2000 was 75% (Fujie, 1995).

7. CONCLUSION

The history and status of water pollution control policies and instruments, regulatory as well as economic, in South and East Asia have been presented with extensive supply of the relevant data and information in compiled form. There is growing awareness on environmental concerns revealed by introduction and gradual expansion of pollution

control laws and environmental institution, in almost all countries but the extent largely resemble with the level of socio-economic development of the countries. A significant milestone in this regard is UN's earth summit in 1992 that resulted in establishment of environmental institutions (status as a ministry), new promulgation or amendment in environmental laws in most of the developing countries.

Comand-and-control method is yet the major backbone of pollution control policies in almost all the countries and it mainly employs effluent (industrial) standards and environmental impact assessment systems as means to achieve the desired water quality standards. The environmental laws and standards in many countries are almost silent or only partially tackling in deal with municipal sewage, the largest pollution source, but it can be due to the lack of adequate sewerage systems followed by sewage treatment plants. As economic instruments, developing countries are mainly practicing with financial incentives (mainly tax subsidies given against pollution control equipment or efforts), but some countries such as China, Philippines and Malaysia have also introduced effluent charges.

Viewing recent global trend to pollution control in developed countries, a greater use of economic instruments would help curb the pollution at least efforts and time. For industries, application of cleaner technology concept to wastewater treatment plants will be more effective. Considering municipal source as the biggest polluter in developing countries, expanding urban sewerage and wastewater treatment (both the on-site and off-site) is inevitable.

APPENDIX 1: ABBREVIATION

AA- Autonomous Agency (Public)
BAPEDAL (abbr. of Indonesian)- called for Environmental Management Agency of Indonesia
CPCB- Central Pollution Control Board
DENR- Department of Environment and Natural Resources
DEPC- Department of Environmental Pollution Control
DEPH- Department of Public Health Engineering
DOE- Department of Environment
DOH- Department of Health
EPA- Environmental Protection Agency (called Administration in Taiwan)
LLDA- Laguna Lake Development Authority
MELGRD- Ministry of Environment, Local Government and Rural Development
MFA- Ministry of Foreign Affairs
MHPP- Ministry of Housing and Physical Planning
MHLG- Ministry of Housing and Local Government
MLGRDC- Ministry of Local Government, Rural development and Co-operatives
MOE- Ministry of Environment
MOEF- Ministry of Environment and Forest
MOI- Ministry of Industry
MOPE- Ministry of Population and Environment
MOSTE- Ministry of Science, Technology and Environment
MPH- Ministry of Public Health
MPW- Ministry of Public works
MWSS- Metropolitan Water Supply and Sewerage
NAWAPCO- National Water and Air Pollution Control Commission
NCEA- National Commission on Environmental Affairs
NCR- National Capital Region
NEA- National Environment Agency
NEPA- National Environment Protection Administration
NPCC- National Pollution Control Commission
NWSC- Nepal Water Supply Corporation
PCD- Pollution Control Department
SEPA- State Environment Protection Administration
SME- State Ministry of Environment
SPCB- State Pollution Control Board
STENO- Science, technology and environmental Organization
WPCA- Water Pollution Control Agency
WPCC- Water Pollution Control Commission

REFERENCES

1. Central Pollution Control Board (CPCB) India, 1997. National inventory of large and medium industry and status of effluent treatment and emission control system, Vol I & II. CPCB, Ministry of Environment and Forest, Govt. of India, New Delhi.
2. Chamlers R. K., 1984. Standards for waters and industrial effluents. Water Science and Technology. 1984, Vol 16, pp 219-244.
3. Environmental and Energy Technology Center (EETC), 1999. Status of Environmental management and state of environmental quality in Malaysia. SIRIM Berhad, Shah Alam, Malaysia.
4. Fugie Koichi (ed.), 1995. Assessment and promotion of human resources for River water quality management. United nations environment program and Japan society on water environment, 1995.
5. Karn, S.K and Harada H., 2001. Surface water pollution in three urban territories of Nepal, India and Bangladesh. Environmental management, Vol 28, No 4 (in Press).

6. Kubo Takeshi, 1991. Recent developments in wastewater management in Japan. Water Science and Technology. 1991, Vol 23, pp 19-28.
7. Mehta Shekhar, Mundle Sudipto and Shankar U., 1997. Controlling pollution- Incentives and regulations. Sage publications, New Delhi, India.
8. Mitsumasa Okada and Spencer A. Peterson (ed.), 2000. Water pollution control policy and management: the Japanese experience. Gyosei, Tokyo, Japan.
9. Sumikura Ichiro, 1998. A brief history of Japanese environmental administration: A qualified success story? Journal of Environmental law, Vol 10, No 2. Oxford University Press 1998.
10. Asian Development Bank, 1997. Strategy for the use of Market-based Instruments in Indonesia's Environment. Environment Division, Office of Environment and social development.
11. Badan Pengendalian Dampak Linkungan (BAPEDAL), Indonesia, 1991 (In Indonesian). Tentang Pedoman Penetapan Baku Mutu Lingkungan, 1988, Indonesia
12. Badan Pengendalian Dampak Linkungan (BAPEDAL), Indonesia, 1995 (In Indonesian). Tentang Pengendalian Pencemarian air, 1990, Indonesia.
13. Central Pollution Control Board (CPCB) India, 1992. Pollution control acts, rules and notifications issued thereunder. CPCB, Ministry of Environment and Forest, Govt. of India, New Delhi.
14. Department of Environment, Malaysia, 1998. Malaysia Environmental Quality Report 1998, Ministry of Science Technology and Environment, Malaysia, Quala Lumpur.
15. Florig, H. K.; Spofford, W.O.; Ma, Xiaoying; and Ma, Zhong, 1995. China strives to make the polluter pay. Environmental Science & Technology, Vol 29, No 6, pp 268A-273A.
16. http://envfor.nic.in/legis/legis.html
17. http://global.nus.edu.sg/apcel/dbase/
18. http://svr1-pek.unep.net/soechina/water/standard.htm
19. http://www.environment.gov.pk/
20. http://www.epa.gov.tw/english/laws/effluent.htm
21. http://www.gov.sg/env/info/rules/limit.html
22. http://www.moenv.go.kr/english/
23. http://www.psdn.org.ph/emb/dao-34.htm
24. http://www.psdn.org.ph/emb/dao-35.htm
25. Lee, Chin-Dee, China (Taiwan), 1984. Strategy in water quality Management in the republic of China. Water Science and Technology, Vol 16, pp 443-452.
26. Legal Research Board, Malaysia, 1998. Environmental Quality Act 1974 (Act 127) & subsidiary legislations. International Law Book Services (publisher), Kuala Lumpur, Malaysia
27. Ministry of Environment and forest, Bangladesh, 1997. Environmental protection rules, 1997, Dhaka.
28. Ministry of Industry, Nepal, 1984. Standards for industrial effluents, NS 229-2047, Department of Nepal Standards and Metrology, Ministry of Industry, Kathmandu, Nepal.
29. Ministry of Population and Environment, Nepal, 1998. State of the Environment Nepal. Ministry of Population and Environment, Kathmandu, Nepal.
30. Mino, Takashi, Japan, 1993. Comparison of legislation for water pollution control in Asian countries. Water Science and Technology, Vol 28, No 7, pp 251-255.
31. Pollution control department, Thailand, 1997. Laws and standards on pollution control in Thailand, 4th edition, Ministry of Science, Technology and Environment, Thailand.
32. Tannetje Bryant and Keith Akers, 1999. Environmental controls in Vietnam. Environmental law, Vol 29:133, pp 133-183.
33. World Bank, 2000. World Development Indicators 2000.