# Outlook of Water Environmental Management Strategies in Asia

# WEPA

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Water Environment Partnership in Asia (WEPA)

Ministry of the Environment, Japan
Institute for Global Environmental Strategies (IGES)

**Water Environment Partnership in Asia (WEPA)**

The Water Environment Partnership in Asia (WEPA) is a five-year project initiated by the Ministry of the Environment of Japan in 2004, which aims to strengthen good water environmental governance through the establishment of an information platform and enhancement of water management capacities of WEPA's 11 partner countries in East Asia. The first phase of WEPA concluded in March 2009. The second phase will begin in April 2009.

One of the outputs of WEPA is an online database that is accessible to the public. The database includes four sections on the water policies, technologies, non-governmental and community-based activities and additional information resources. For more information on WEPA, please visit **http://www.wepa-db.net**

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# Contents

# Background to the publication

This publication is one of the major outputs of the Water Environment Partnership in Asia (WEPA). WEPA aims to strengthen water environmental governance in Asia through the collection and dissemination of information and capacity development of relevant stakeholders in partnership with eleven countries in the region, namely Cambodia, China, Indonesia, Japan, Republic of Korea, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand and Viet Nam.

Information on the state of the water environment and its management exists in various media, but it is provided in different ways and is not available in one place. In recognition of the importance of extracting such pieces of information and making it available to the public in one platform as a source of knowledge to promote good water environmental governance, WEPA has developed a database (http://www.wepa-db.net/) in partnership with the program's partner countries. This database, which contains information on policies, technologies and activities of non-governmental/community-based organizations involved in conservation of the water environment, is open to all interested in water environmental issues.

Having the same objective as the WEPA database, this publication provides summaries of basic information on the status and management of the water environment in each WEPA partner country, including legislative frameworks and existing and future management challenges. By organizing such basic information in the same format, the outlook intends to facilitate mutual understanding among WEPA partner countries and provide a basis to share future lessons for better water management. This outlook may also serve as a helpful reference for those interested in water environmental issues in other countries throughout the world.

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Ministry of the Environment, Japan
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# Abbreviations and Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| ADIPURA | Letter of Clean City (Indonesia) |
| BOD | Biochemical Oxygen Demand |
| CBOs | Community-Based organizations |
| Chl-a | Chlorophyll a |
| COD | Chemical Oxygen Demand |
| CNMC | Cambodia National Mekong Committee |
| CWQM | Continuous Water Quality Monitoring |
| DDA | Department of Development Affairs (Myanmar) |
| DENR | Department of Environment and Natural Resources (Philippines) |
| DO | Dissolved Oxygen |
| DOE | Department of Environment (Malaysia) |
| DWR | Department of Water Resources (Lao PDR) |
| EC | European Commission |
| E. coli | Escherichia coli |
| EIA | Environmental Impact Assessment |
| EMB | Environmental Management Bureau (Philippines) |
| EQS | Environmental Quality Standards |
| EQA | Environmental Quality Act (Malaysia) |
| EQR | Environment Quality Report (Malaysia) |
| EWQS | Environmental Water Quality Standards |
| FAO | Food and Agriculture Organization of the United Nations |
| FCB | Fecal Coliform Bacteria |
| GDP | Gross Domestic Product |
| GMS | Greater Mekong Sub-region |
| HABs | harmful algal blooms |
| IRBM | Integrated River Basin Management |
| ISES | Industry-Specific Effluent Standards (Philippines) |
| IUCN | International Union for Conservation of Nature |
| IMWQS | Interim Marine Water Quality Standards (Malaysia) |
| JICA | Japan International Cooperation Agency |
| LEP | Law on Environmental Protection (Lao PDR) |
| LGUs | Local Government Units (Philippines) |
| LLDA | Laguna Lake Development Authority (Philippines) |
| MBAS | Methylene Blue Active Substances |
| MCDC | Mandalay City Development Committee (Myanmar) |
| MEP | Ministry of Environmental Protection (China) |
| MIC | Ministry of Industry and Commerce (Lao PDR) |
| MoE | Ministry of Environment (Cambodia) |
| MOE | Ministry of Environment (Republic of Korea) |
| MONRE | Ministry of Natural Resources and Environment (Viet Nam) |
| MoWRAM | Ministry of Water Resources and Meteorology (Cambodia) |
| MPN/100mL | Most Probable Number (unit for coliform bacteria count) |
| MRC | Mekong River Committee |
| MWQM | Manual Water Quality Monitoring (Malaysia) |
| MWR | Ministry of Water Resources (China) |
| NAHRIM | National Hydraulic Research Institute of Malaysia |
| NCEA | National Commission for Environmental Affairs (Myanmar) |
| NGOs | Non-Governmental Organizations |
| NPC | National People's Congress (China) |
| NRE | Ministry of Natural Resources and Environment (Malaysia) |
| NSDW | National Standards for Drinking Water (Philippines) |
| NWQS | National Water Quality Standards (Malaysia) |
| OECD | Organization for Economic Co-operation and Development |
| PCB | Polychlorinated Biphenyl |
| PCD | Pollution Control Department (Thailand) |
| PDA | Population and Development Association (Thailand) |
| pH | Power of Hydrogen (hydrogen-ion concentration) |

| | |
|---|---|
| PHP | Philippines Peso |
| PNDWQS | Proposed National Drinking Water Quality Standards (Myanmar) |
| PROKASIH | Letter of Clean River Program (Indonesia) |
| PROPER | Letter of Program for Pollution Control Evaluation and Rating (Indonesia) |
| PRPC | Pasig River Rehabilitation Commission (Philippines) |
| SEPA | State Environment Protection Administration (China) |
| SMEs | Small and Medium Enterprises |
| SS | Suspended Solids |
| STEA | Science Technology and Environment Agency (Lao PDR) |
| STORET | Short for STOrage and RETrievalt (Indonesia) |
| SUPERKASIH | Letter of Declaration for Clean River (Indonesia) |
| SUPER | Letter of Declaration (Indonesia) |
| SWMA/ LUAS | Selangor Waters Management Authority (Malaysia) |
| SWPZ | Source Water Protection Zoning (China) |
| SWP | Sources Water Protection (China) |
| TC | Total Carbon |
| TCB | Total Coliform Bacteria |
| TCE | Trichloroethylene |
| TDS | Total Dissolved Solids |
| TKN | Total Kjeldahl Nitrogen |
| TN | Total Nitrogen |
| TOC | Total Organic Carbon |
| TP | Total Phosphorus |
| TPLC | Total Pollution Load Control |
| TS | Total Solids |
| TSS | Total Suspended Solids |
| TWPLMS | Total Water Pollution Load Management System (Korea) |
| UNICEF | United Nations Children's Fund |
| US EPA | United States Environmental Protection Agency |
| VOC | Volatile Organic Carbon |
| WEPA | Water Environment Partnership in Asia |
| WHO | World Health Organization |
| WQI | Water Quality Index |
| WQMA | Water Quality Management Areas (Philippines) |
| WREA | Water Resources and Environment Administration (Lao PDR) |
| WRUD | Water Resources Utilization Department (Myanmar) |
| YCDC | Yangon City Development Committee |

# Executive Summary

Deterioration of water quality signifies a reduction of accessibility to water resources available for domestic, agricultural and industrial use. It is closely connected to international sustainable development goals such as access to safe water and sanitation facility. In spite of the importance of this issue, it has not been well addressed in the international arena, in comparison with water quantity related issues.

WEPA's partner countries differ in their management of the water environment, although they may have much in common culturally, geographically, and environmentally. In terms of water environmental management, WEPA partner countries share spatial and seasonal variations in water availability, which makes water environmental management that much more complicated.

Legislative frameworks for water environmental management have been strengthened in most WEPA partner countries, especially since the World Summit for Sustainable Development (UNCED) in 1992. Most partner countries view the protection of human health and the quality of environment as the goal of water environmental management, recognizing that it is an essential element for sustainable development in each country. However, the status of implementation is different in each country. In some countries, water quality has improved in general, but there are still severe pollution problems in some areas, especially in urban and peri-urban areas. Even in countries such as in Lao PDR and Cambodia where water is believed to be generally good in quality, water pollution in areas with rapid population increase has become a significant problem, especially during dry seasons.

The framework of water environmental management has been strengthened since 2000 in many WEPA partner countries, reflecting the actual state of the water environment in each country. For example, in the Philippines, the national government has revised the Clean Water Act and overhauled water quality management at the local level to take suitable actions to the local situation with involvement of local stakeholders. Thailand has been promoting public participation and voluntary approach in their water environmental policy. Korea has also introduced total pollution load control at the basin level. In Japan, the Law concerning Special Measures for Preservation of Lake Water Quality was amended to strengthen the non-point source control measures. In Viet Nam, water quality and effluent standards were revised to reflect the real situation in the country. The revision of effluent standards is now under consideration in such countries as Malaysia and the Philippines, in view of each country's industrial structure. As such, legislative frameworks have evolved to improve the enforcement of water environmental management laws and regulations.

However, enhancing the effectiveness of water environment management remains the major challenge for most countries. In this publication, the following common concerns for effective implementation are identified:

(1) Decentralization of management

Responsibility of water environmental management has been delegated to local governments in some countries, but unclear demarcations of responsibility between national and local governments and insufficient capacity of local government staff has been identified as a management challenge. In countries where basin level management is promoted, policymakers must consider how to involve and mobilize local stakeholders.

(2) Proper monitoring and collection of monitoring data to identify if targets/objectives of water environment conservation have been achieved

Water quality standards have already been established in most WEPA partner countries as the targets for water environmental management. However, water quality is not always monitored sufficiently to evaluate water quality in comparison with water quality standards. The technical capacity of staff must also be addressed to ensure the proper monitoring and collection of data.

(3) Introduction and management of wastewater treatment facilities

For countries that do not have centralized wastewater treatment facilities, especially in urban areas, the introduction of wastewater treatment facilities is crucial to allow countries to cope with increasing pollution loads. The operation and management of wastewater treatment facilities are often also issues in countries where wastewater treatment facilities have already established. Wastewater from small- and medium-sized industries and farms is also a common and critical issue among WEPA partner countries when addressing the improvement of water quality. For domestic wastewater treatment in rural areas, the introduction of decentralized wastewater treatment is an issue that must be looked at in detail.

(4) Consistency of water environment management policies and river/lake basin management policies

Integrated water resource management, or river basin management, is an important concept to improve water environmental governance. Basin level management has been introduced in some countries, but water quality management aspects are not always well addressed. The issue of how water quality and quantity should be managed together is a common challenge for all WEPA partner countries. Pollution of enclosed bodies, such as lakes, is another prevailing issue for WEPA partner countries.

(5) Awareness raising and capacity building

Raising the awareness of stakeholders is very important to promote the enforcement of laws and regulations. For example, raising the awareness of local residents through participation in water quality management programs will heighten people’s interest in the water environment and can facilitate future action. Capacity building of all stakeholders at different levels should be highlighted in the promotion of good water environmental governance. In particular, it is important to develop the capacity of policy makers to be more effective in finding solutions to water environmental issues.

Although many countries have promoted water environmental management within their own borders, the pressure on the water environment is expected to grow. In addition to existing social and economic factors, the potential impact of climate change on water availability and its use may further increase the vulnerability of the water environment. To overcome such pressures and conserve the water environment, it is crucial to place good water environmental governance at the forefront in every country.

# Cambodia



## Country Information

| | | |
|---|---|---|
| Area (km$^2$) | | 181,035 |
| Population | | 14.4 million (2007) |
| GDP (USD) | at current prices | 8,639 mil (2007) |
| | per capita | 598 (2007) |
| Mean annual precipitation (mm) | | 1,000-2,500 |
| Renewable water resources (m$^3$) | | 476 billion |
| Total water withdrawal (m$^3$) | | 520 million (1987) |
| Water use by purpose | Agriculture | 56 % |
| | Industry | 4 % |
| | Domestic | 17 % |
| | Livestock | 13 % |
| | Other | 10 % |

## Water Bodies in Cambodia


## State of Water Resources

The Mekong catchments make up 86 percent of the country area. The country is amply supplied with water from the Mekong River, Tonle Sap River, Bassac River, Tonle Sap Great Lake, and other tributaries during the rainy season. However, most parts of the country confront water shortages especially for domestic and irrigation use during the dry season because of insufficient infrastructure development such as water storage, reservoirs, canals and irrigated systems.

The main beneficial use of water is agriculture of which the share of total water use is 56 percent, followed by domestic use 17 percent, livestock use 13 percent, industrial use four percent and other purposes 10 percent (Sunthan 2008).

*The Tonle Sap Great Lake*

The Tonle Sap Great Lake, a unique hydrological and ecological system located within Cambodia, is a natural resource of great regional importance to the Greater Mekong Sub-region (GMS). More than 60 percent of the floodwater in the lake comes from the Mekong River and less than 40 percent comes from its own catchment areas. In the dry season (November to April), the Tonle Sap Great Lake occupies an area of about 3,000km$^2$ (about 100km long and 32km wide), with an average depth of 0.8 to 1.0m. During the rainy season (May to October), it expands to about 16,000km$^2$, with an approximate depth varying from 10 to 12m. The Tonle Sap River reverses its flow, draining the Tonle Sap Great Lake into the Mekong River during the dry season, and partially filling the lake from the Mekong River during the wet season.

The Tonle Sap Great Lake provides water, soils, inundated forest, fish, waterfowls and various plants and animals for supporting livelihoods of much of the Cambodian population. It is the most productive lake in terms of fish, and almost 60 to 70 percent of the fish consumed throughout the country are derived from the Tonle Sap Great Lake. Flooded forests of different types are playing many roles in sustaining biodiversity and the Tonle Sap ecosystem. Flooded forests are the breeding and feeding habitats for fish and other species. It is also considered one of the wetlands of international significance in Southeast Asia, in which many waterfowls, including a dozen rare and endangered water birds such as pelicans, lesser adjutants, greater adjutants, etc., are found. Other wild animals such as snakes, turtles, crocodiles, wild pigs, monkeys, otters, and macaque are also found in the Tonle Sap Great Lake.

Presently, more than 30 percent of the total Cambodian population lives in the six provinces around the Tonle Sap Great Lake (Kampong Chhnang, Pousat, Bat Dambang, Banteay Mean Chey, Siem Reab, and Kampong Thum), and depend on the Tonle Sap Great Lake and its floodplain for their livelihood. Cambodia is believed to support 120 mammal species, 600 bird species, and an unknown number of reptiles, amphibians and other animal groups. More than 500 fish species inhabit the inland waters of Cambodia, of which 280 are known from the Tonle Sap Great Lake.

Because of very flat topography of the plain around the Tonle Sap Great Lake, variations in water volume stored in the lake result in large variations of the flooded surface. Two national highways around the lake (i.e. National Road No. 5 and No. 6) correspond approximately to the limit of the expansion of the lake water at its highest level. The storage volume of the lake estimated by Carbonnel and Guiscafré (1963) by water balance method (which is not very accurate) is approximately 72 billion m$^3$, or 16 percent of the annual discharge of the Mekong River. More accurate estimations of the lake storage capacity would require bathymetric and topographic surveys of the lake, which have never been carried out.

## State of Water Quality

Water quality is generally in a good condition in Cambodia, but water quality in some areas is threatened, especially during the dry season, by various socio-economic activities, such as discharges from industries and mining, agricultural practices using agro-chemicals, untreated urban wastewater, solid and liquid waste discharges from slaughterhouses and livestock farms, and transportation by waterway.

*River water*

The analysis outcomes of water samples taken from designated sampling points in the Mekong River, Tonle Sap River, Tonle Sap Great Lake and Bassac River from 2004 to 2007 (MoE 2008) indicate that these natural water sources meet the standards in the National Water Quality Standards in public water areas for biodiversity conservation. However, during the dry season, especially in April, BOD values exceeded the water quality standard at some public water areas, and the value of coliform noticeably increased from February to July. Increased levels of agricultural herbicides, fertilizer and pesticides, and sedimentation, resulting from land clearing for agricultural objectives, is contributing to the overall decrease in water quality.

*Lake water*

The Tonle Sap Great Lake is the largest permanent freshwater lake in Southeast Asia, and lies in the center floodplain of Cambodia. A number of literatures have indicated that the general level of pollution is still low, although some problems exist locally in and around floating villages.

*Groundwater*

Since there has not been a comprehensive groundwater study to date, there is insufficient information, knowledge and understanding of this natural resource by key stakeholders. Groundwater resources are estimated to be 17.6 billion $m^3$ (Sokha 2005). It is primarily used for household water supply and for irrigation. At least 25,000 communities were reported to use water supply tube wells and large diameter motorized tube wells for irrigation, and about 2,000 manually operated shallow wells are being installed annually. A big driver of groundwater extraction is the industrial sectors that are located in the outskirts and/or provinces (Sokha 2005). The alluvial deposits of the Tonle Sap and Mekong floodplain/delta are believed to be very good shallow aquifers, with high recharge rates and a water table generally within 5 to 10m of the surface water. Shallow wells could be used in an estimated 48,000$km^2$ of the country.

However, data and information about groundwater utilization is still inadequate. However, if free groundwater extraction by industrial and agricultural sectors continues without regular control from responsible institutions, there may be adverse consequences in the future, unless it is strictly controlled by specific regulations with reasonable and equitable purposes.

*Coastal water*

Cambodia's coastal shoreline is 435km long on the Gulf of Thailand. The seaward boundary of the coastal zone has been delimited as the outer limit of the Exclusive Economic Zone with an area of 55,600$km^2$. The landward boundary of the coastal zone has not yet been satisfactorily defined, but it has been temporarily considered to be about 5.0km from the shore. The coastal zones are situated in the four provinces of Koh Kong, Kampot, Sihanoukville and Kep. A deep seaport facility considered to be one of the economic centers of Cambodia is located in Sihanoukville province. The coast receives two tidal regimes per day with amplitudes of 1.50m, and approximate surface current of 0.2 to 0.7 miles per hour. Wave amplitudes of 2.0 to 3.0m (during the rainy season) and 0.25 to 0.50m (during the dry season) are not uncommon.

The oxygen concentration of the coastal waters remain almost stable; in the early part of the dry season, saturation at surface water is 102 to 104 percent and dissolved oxygen (DO) fluctuates between 4.2 and 4.8ppt. During the dry season, phosphorus on the surface water is mosaic in character and varies from 0.0 to 2.0ppb, which remain the same value to the bottom. During the wet season, phosphorus concentrations at the surface water vary between 0.1 and 3.8ppb and increase slightly at the bottom.

Designation as economic zones by policies of the Royal Government will result in coastal waters being confronted with negative influences from environmentally unsound management of solid and liquid wastes at generating sources, and coastal development and seaport activities, unless transparent action plans and legal tools are widely applied.

## Legislative Framework for Water Environment Management

The objective of environmental management in Cambodia is the protection and promotion of environmental quality and public health (Article 1, Law on Environmental Protection and Natural Resource Management). Under this law (1996), which is the basic law on the environment in Cambodia, several sub-decrees have been established. The Law on Water Resources Management (2007) states that socio-economic development and welfare of the people is the objective of water resources management.

Details of water environmental conservation measures are explained in the Sub-Degree on Water Pollution Control that was established in 1999. The sub-decree aims to regulate various activities that tend to pollute and/or polluted public water for protection of human health and biodiversity. The sub-decree has three main parts: management of public water areas, wastewater management within and outside of the industrial sector, and inspection. Other sub-decrees such as on solid wastes and environmental impact assessments also contain articles related to water environmental conservation.

The Ministry of Environment is responsible for protection and management of the environment and natural resources in the country. The major function of the ministry is to develop guidelines for waste management, including water environment management and protection, and local authorities, such as provincial and municipal environmental departments that are in charge of implementation. The Ministry of Water Resources and Meteorology is another major organization related to water environmental management.

*Water quality standards*

Water quality standards in public water areas are set by the Sub-Decree on Water Pollution Control. There are two kinds of water quality standards. One is water quality standards for biodiversity conservation that is designated for rivers (five parameters), lake and reservoirs (seven parameters), and coastal water (seven parameters), respectively. The second is water quality standards for public health. The water quality standards in public water areas for public health protection sets standard values for 25 parameters, which have harmful effects on human health.

The water quality standards in public water areas for biodiversity conservation are applied to three water areas: rivers, lakes and reservoirs, and coastal waters. It sets standard values for five to seven parameters, such as pH, COD, BOD, and coliform.

*Effluent standards*

Aiming at managing effluents discharged from pollution sources, the effluent standards were developed under the Sub-Decree on Water Pollution Control to strictly control effluent prior to discharge into receiving sources, e.g. public water areas and sewers. The standard values are set for 52 parameters, such as temperature, pH, BOD, heavy metals, agricultural chemicals, and organic solvents.

Pollution sources are regularly monitored and controlled by the Ministry of Environment such as factories, handicrafts, and hotels. There are two types of monitoring programs at pollution sources: (i) regular effluent monitoring at normal factories and hotels that is conducted within an interval period of 90 days; and (ii) regular effluent monitoring at factories that use chemicals and/or chemical compounds for production that should be conducted in an interval period of 45 days.

*Monitoring of water quality in public waters and groundwater*

The Ministry of Environment is responsible for the regular control and monitoring of water pollution in public water areas throughout Cambodia. The details of monitoring are shown in Table 1. Although decentralization has led to local governments and departments handling various tasks, the main constraint to this process is a lack of experienced officials and laboratories for water quality analysis. Therefore, central officials at the Ministry of Environment still carry out these tasks in parallel with local capacity building and institutional strengthening.

Table 1. Current Status of Water Quality Monitoring (2008)

| | |
|---|---|
| Items | BOD, DO, pH, Temperature, TSS, Coliform |
| Sampling site | Chroy Chang Var, PP Port, Ta Kmao, Kien Svay, Prek Kdam, Stoeung Sangke, Stoeung Porsat, Stoeung Sen, Stoeung Chinit and Tonle Sap Great Lake |
| Frequency | Once a month |

Under the Water Quality Monitoring Network (Mekong River Committee (MRC) Program) the Ministry of Water Resources and Meteorology also takes water samples monthly at designated stations in rivers and relevant tributaries for analysis and reports back to MRC via the Cambodia National Mekong Committee (CNMC).

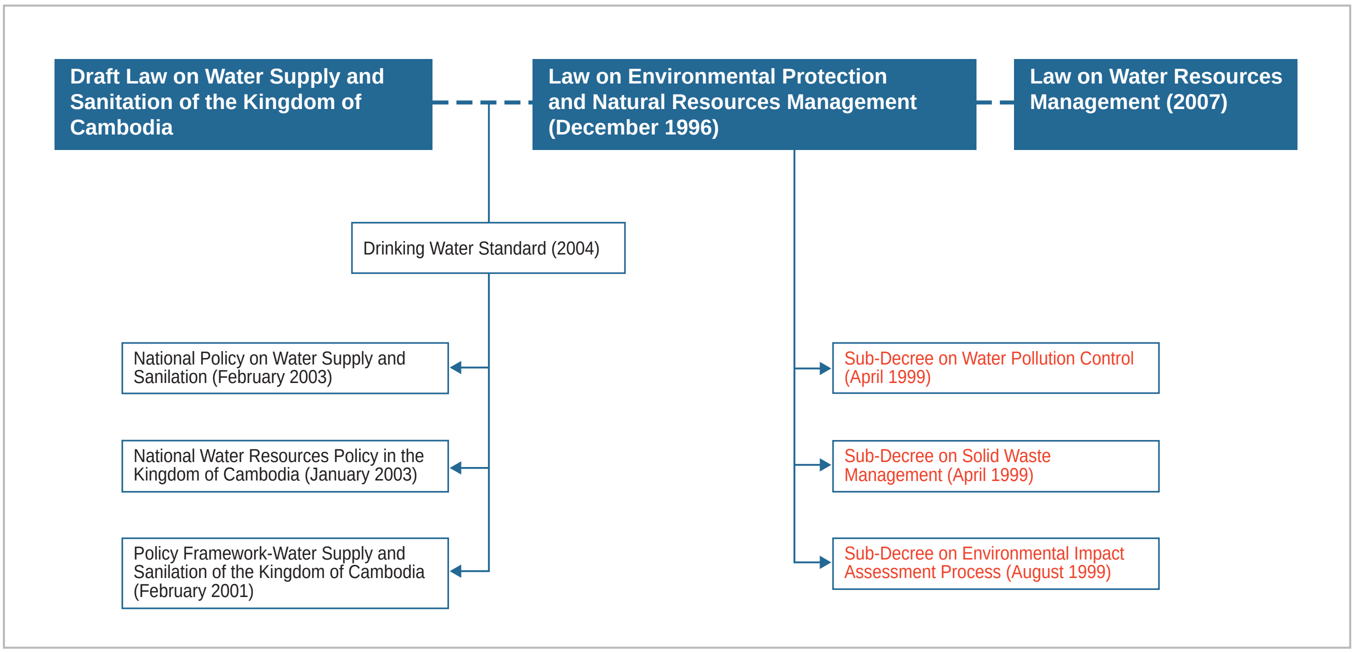



Figure 2. Legislative Chart for Water Quality Management

(source: WEPA database)

### Community Participation for Water Quality Management in Tonle Sap Great Lake (Kampong Chhnang Province)

Kampong Chhnang province is one of five provinces located around Tonle Sap Great Lake. The total population of Kampong Chhnang was 475,014 in 2008, and around 47 percent of the populations live in six districts and 32 communes that located in Tonle Sap Great Lake Biosphere Reserve. There are also people living in 11 floating villages.

The number of people living along the lake is decreasing in Kampong Chhnang, as people in the floating village moved to upland villages to be workers where income is available. The reason for the move was that they thought the resources in the Tonle Sap Great Lake had decreased and could no longer support their lifestyles.

The Tonle Sap Great Lake Project was started to improve water quality and conserve the natural resources of the Tonle Sap Great Lake. The project has three goals: organizing conserving areas in Tonle Sap Biosphere Reserve, monitoring and investigating biodiversity, and capacity building of local people on natural resource management. The capacity building project focuses on strengthening the capacity of 32 communes that are located in the Tonle Sap Biosphere Reserve of Kampong Chhnang.

Many agencies, in addition to the local environment agency, focus on the water quality management of Tonle Sap and cooperate on various activities, including water quality monitoring in the project. Local community participation has also increased. In order to better manage water quality and natural resources, it is important to strengthen the capacity of people in communities and combat poverty, as well as use natural resources in a sustainable way.

(Source: Sothea 2008)

## Existing and Future Challenges for Water Environment Management

The efforts in protecting and conserving the environment and water environment are being conducted in close collaboration with stakeholders, including international communities, with remarkable outcomes. However, some constraints are recognized and required to improve such as: (i) capacity building and institutional strengthening in terms of both national and local levels; (ii) technical support from international communities/donors; (iii) public awareness raising by other means and public participation; (iv) strengthening the implementation of environmental legal instruments; (v) expansion of the national budget to encompass the promotion of public awareness and related matters; and (vi) close cooperation among countries in the region.

It is expected that in the decade ahead there will be great social and environment changes driven by a mix of demographic, economic, technological, and social factors, such as population growth, and increasing demands for food and water supply as a result of economic growth. To deal with these changes and improve water environment management, it is important for institutions to coordinate and collaborate to ensure the sustainable use of water resources in both quality and quantity (Sokha 2008).

# China

Outlook of Water Environmental Management Strategies in Asia

## Country Information

| | | |
|---|---|---|
| Area (km²) | | 9,598,100 (2007) |
| Population | | 1,320.0 million (2007) |
| GDP (USD) | at current prices | 3,400,351 (2007) |
| Mean annual precipitation (mm) | | 648 |
| Renewable water resources (m³) | | 2,829.6 billion |
| Total water withdrawal (m³) | | 630 billion (2000) |
| Water use by sector (2000) | Agriculture | 68% |
| | Industry | 26% |
| | Domestic | 6% |

## Water Basins in China


## State of Water Resources

The total volume of water resources in China ranks sixth among all the countries in the world, however, because of the country's large population, the per capita volume of water resources is low at about 2,200m³, which is equivalent to only one-fourth of the world average. In addition, water resources in China are distributed unevenly -- rich in the southern areas and poor in the northern areas -- which is inconsistent with the distribution of population, farmland and the economy (MWR website).

River runoff varies greatly from year to year with the ratio of maximum annual runoff to minimum exceeding more than 10 in some areas (MWR website).

## State of Water Environment

In China, the following standards are established as the target levels of water quality: environmental quality standard for surface water, quality standard for groundwater, sea water quality standard, and other standards for specific purposes of water use such as irrigation and fisheries (MEP website).

*The seven major rivers*

There are seven major rivers in China: the Yangtze River, Yellow River, Pearl River, Songhua River, Huaihe River, Haihe River and Liaohe River. About half of the monitoring sections of the major river basins under national monitoring programs have recently met Grade I to III of the environmental quality standard for surface water. Water quality in the Pearl River and Yangtze River is good. The Songhua River, Yellow River and Huaihe River were subject to intermediate pollution. The Liaohe River and Haihe River were heavily polluted. Permanganate index, oils and ammonia nitrogen are the main parameters of pollution observed (SEPA 2007).

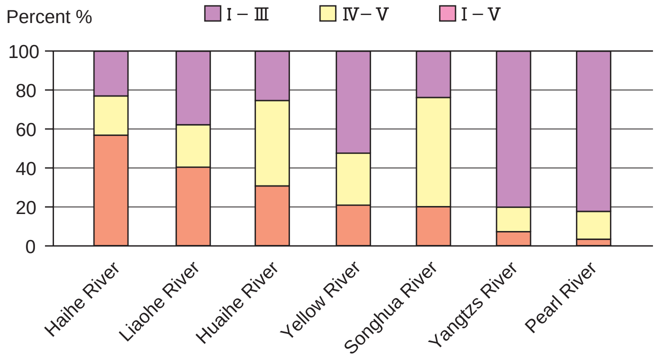



Figure 1. Comparison of Water Quality of 7 Major Rivers in 2006

(Source: SEPA 2007)

Table 1. Grades for Environmental Quality Standards for Surface Water

| Grade | Description |
|---|---|
| I | Mainly for headstream and the national nature preserves. |
| II | Mainly for drinking water resources in first-class protected areas, protected areas for precious fish, and spawning areas for fish and shrimp |
| III | Mainly for drinking water resources in second-class protected areas, protected areas for fish, and swimming areas |
| IV | Mainly for industrial water resources and recreational use in which people do not contact water |
| V | Mainly for agricultural water resources and water areas required for landscape |

(Source: MEP website)

*Lakes and reservoirs*

Of the 27 major lakes (reservoirs) under national water quality monitoring programs, about half of them failed to meet the standards of Category V. Major pollutants included total nitrogen (TN) and total phosphorus (TP). Reservoir water had better quality than that of lakes, which had relatively light eutrofication (SEPA 2007).

Table 2. Water Quality of Major Lakes and Reservoirs in 2006

| Waters \ Amount | Amount | Grade | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | >V |
| Three lakes * | 3 | 0 | 0 | 0 | 0 | 1 | 2 |
| Large freshwater lake | 9 | 0 | 1 | 1 | 1 | 2 | 4 |
| Urban lakes | 5 | 0 | 0 | 1 | 0 | 0 | 4 |
| Large reservoirs | 10 | 0 | 1 | 4 | 0 | 2 | 3 |
| Total | 27 | 0 | 2 | 6 | 1 | 5 | 13 |
| Percentage in 2006 (%) | | 0 | 7 | 22 | 4 | 19 | 48 |
| Percentage in 2005 (%) | | 0 | 7 | 21 | 11 | 18 | 43 |

* "Three lakes" are Taihu Lake, Dianchi Lake, and Chaohu Lake.

(Source: SEPA 2007)

### *Groundwater*

Most of the major groundwater monitoring sites had "good" or "relatively poor" water quality in 2006. Quality of groundwater resources in the region with high development degree is worse than that in the region with low development degree (SEPA 2007).

Among cities with monitoring programs for shallow groundwater quality (125 cities), those in the northeast, northwest, eastern and central southern areas of China showed trends for degradation in water quality (SEPA 2007).

### *Sea water*

Most of the coastal sea areas experienced good water quality despite continued severe pollution in some areas. In terms of coastal seawater quality of the four major sea areas, the South China Sea and the Yellow Sea enjoyed overall good water quality, the offshore water was slightly polluted in the Bohai Sea, and the East China Sea suffered from medium level of water pollution (SEPA 2007).

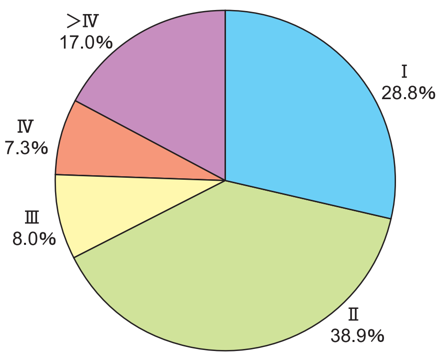



Figure 2. Water Quality in Coastal Sea Areas Nationwide in 2006

(Source: SEPA 2007)

Table 3. Grades for Sea Water Quality Standard

| Grade | Description |
|---|---|
| I | Suitable for marine fishing, marine nature preserves and protected areas for rare or endangered marine organisms. |
| II | Suitable for marine cultivation, bathing, marine sport or recreation activities involving direct human contact with marine water, and for sources of industrial use of water related to human consumption. |
| III | Suitable for water resources for general industrial use. |
| IV | Suitable only for harbors and ocean development activities. |

(Source: MEP website )

## Legislative Framework for Water Environment Management

In China, the objectives of water environmental preservation are to ensure human health, maintain the effective use of water resources and the conservation of marine resources, maintain the ecological balance, and enhance the development of modern socialism (The Environmental Protection Law of People's Republic of China in 1989).

The Environmental Protection Law of the People's Republic of China in 1989 as a basic environmental law. The Marine Environment Protection Law of the People's Republic of China and the Law of the People's Republic of China on Prevention and Control of Water Pollution were formulated for the protection of the water environment in 1982 and 1984, respectively (The Marine Environment Protection Law was revised a few times until the formulation of the current law) (MEP website).

With regard to institutional arrangements, the Ministry of Environmental Protection has a mission to prevent and control environmental pollution at the national level (MEP website).

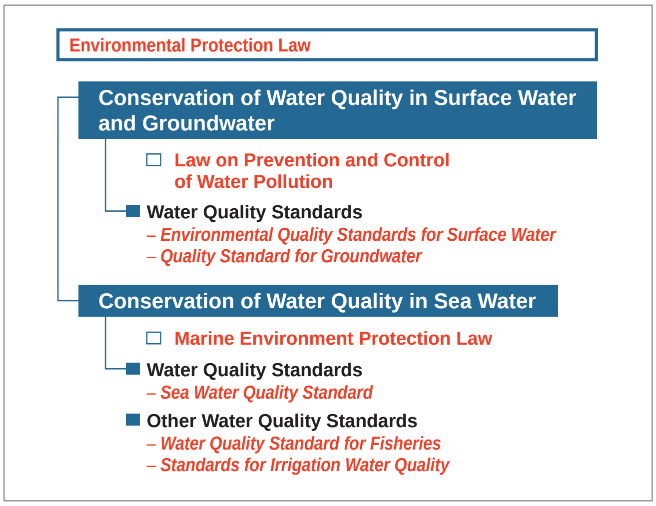



Figure 3. Legislative Chart for Water Quality Management

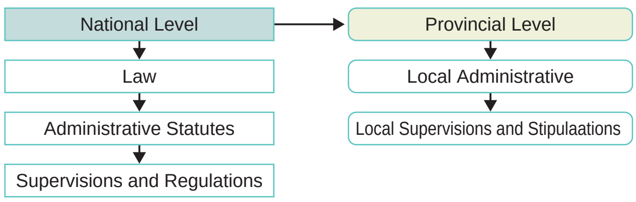



Figure 4. Sketch Map of the Laws Related to the Water Environment

(Source: WEPA database)

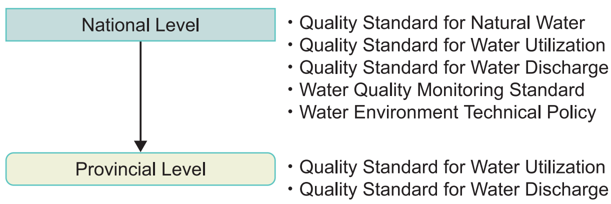



Figure 5. Sketch Map of the Standards Related to the Water Environment

(Source: WEPA database)

### *Environmental quality standards*

The Environmental Quality Standard for Surface Water stipulates standard values for 24 basic parameters in the five above-mentioned categories. The Quality Standard for Groundwater stipulates standard values for 39 parameters, and 35 parameters in Sea Water Quality Standard (MEP website).

Water Quality Standard for Fisheries and Standards for Irrigation Water Quality are established as other water quality standards (MEP website).

### *Monitoring of water quality in public waters and groundwater*

Water quality monitoring is conducted in stations established across the country to check water quality of rivers, groundwater, lakes, and sea water. In 2006, monitoring was implemented in 408 stations for seven main rivers, 163 cities for groundwater, and 27 lakes (SEPA 2007).

The analytical methods of water quality are provided in each water quality standard (Environmental Quality Standards for Surface Water (GB3838-2002), Quality Standard for Groundwater (GB/T14848-93) and Sea Water Quality Standard (GB3097-1997)) (MEP website).

### *Effluent standards*

Effluent quality of domestic wastewater at the discharge points of urban wastewater treatment plants is regulated by the Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants (GB18918-2002) (MEP website).

Regarding industrial wastewater, the Integrated Wastewater Discharge Standard (GB 8978-1996) regulates effluent levels. However, for various types of industries such as the iron and steel industry and meat packing industries not covered by the above standard, individual standards have been established (see List of Effluent Standards below). Different target values of specific pollutants are designed for industry constructed before 31, December 1997 and after 1 January 1998 in the Integrated Wastewater Discharge Standard (GB 8978-1996) (MEP website).

#### List of Effluent Standards

- Effluent Standards of Pollutants for Heterocyclic Pesticides Industry (GB 21523-2008)
- Discharge standard of water pollutants for pulp and paper industry (GB 3544-2008 Replacing GB 3544-2001)
- Discharge standard of water pollutants for down industry (GB 21901-2008)
- Emission standard of pollutants for electroplating (GB 21900-2008)
- Emission standard of pollutants for synthetic leather and artificial leather industry (GB 21902-2008)
- Discharge standards of water pollutants for pharmaceutical industry -- Fermentation products category (GB 21903-2008)
- Discharge standards of water pollutants for pharmaceutical industry --Chemical synthesis products category (GB 21904-2008)
- Discharge standard of water pollutants for pharmaceutical industry -- Extraction products category (GB 21905-2008)
- Discharge standard of water pollutants for pharmaceutical industry --Chinese traditional medicine category (GB 21906-2008)
- Discharge standards of water pollutants for pharmaceutical industry --Bioengineering products category (GB 21907-2008)
- Discharge standards of water pollutants for pharmaceutical industry-- Mixed preparation products category (GB 21908-2008)
- Discharge standards of water pollutants for sugar industry (GB 21909-2008 Putting into effect as of August 1, 2008)
- Emission standard for pollutants from coal industry (GB 20426-2006 partially replacing GB 8978-1996 GB 16297-1996)
- Discharge standard of water pollutants for sapogenin industry (GB 20425-2006 replacing GB 8978-1996)
- Discharge standard of water pollutants for medical organization (GB 18466-2005)
- Discharge standard of pollutants for beer industry (GB 19821-2005)
- Discharge standard of pollutants for monosodium glutamate industry (GB 19431-2004)
- Discharge standard of pollutants for citric acid industry (GB 19430-2004)
- Discharge standard for water pollutants from ordnance industry: ammunition loading (GB 14470.3-2002)
- Discharge standard for water pollutants from ordnance industry: Powder and explosives (GB 14470.1-2002)
- Discharge standard for water pollutants from ordnance industry: Initiating explosive material and relative composition (GB 14470.2-2002)
- Discharge standard of pollutants for municipal wastewater treatment plant (GB 18918-2002)
- Discharge standard of pollutants for livestock and poultry breeding (GB 18596-2001)
- Discharge standard of water pollutants for paper industry (GB 3544-2001)
- Standard for pollution control of sewage marine disposal engineering (GB 18486-2001)
- Discharge standard of water pollutants for ammonia industry (GB 13458-2001)
- Integrated wastewater discharge standard (GB 8978-1996 replacing GB 8978-88)
- Discharge standard of water pollutants for phosphate fertilizer industry (GB 15580-95)
- Discharge standard of water pollutants for caustic alkali and polyvinyl chloride industry (GB 15581-95)
- Discharge standard of water pollutant and standard of analytical method for space propellant (GB 14374-93)
- Discharge standard of water pollutants for meat packing industry (GB 13457-92)
- Discharge standard of water pollutants for iron and steel industry (GB 13456-92)
- Discharge standard of water pollutant for dyeing and finishing of textile industry (GB 4287-92)
- Effluent standards for oil-bearing waste water from offshore petroleum development industry (GB 4914-85)
- Emission standard for pollutants from shipbuilding industry (GB 4286-84)
- Effluent standard for pollutants from ships (GB 3552-83)

(Source: MEP website)

*Source Water Protection Zoning Policy (SWPZ Policy) for protection of drinking water sources*

Drinking water security is vital for public health and industrial and agricultural production. Since water pollution cannot be fully controlled for economic and technological reasons, source water protection is one of the most important barriers to achieving drinking water security (Guo 2007).

The governments at or above the provincial level may delineate surface Sources Water Protection Zones (SWP Zone) for domestic and drinking water according to the Law of the People's Republic of China on Prevention and Control of Water Pollution (Article 20). Certain water areas and land-based areas near the intakes of domestic and drinking surface water sources may be delineated as first-grade SWP Zones. Certain water areas and land-based areas beyond first-grade protected zones may be delineated as second-grade SWP zones and protected zone of other grades (Guo 2007).

The SWP zone delineation principles are as follows: to ensure that the water quality of first-grade SWP zones meets Grade II Standards under the Environmental Quality Standards for Surface Water, and to ensure that the water quality of second-grade SWP zones meets Grade III Standards. The principle and methods for SWP zone delineation are listed and illustrated in the Technical Guideline for Delineating Source Water Protection Areas (HJ/T338-2007). Until 2005, about 70 percent of centralized drinking water sources had been designated as SWP zones for different grades of protection (Guo 2007).

Within the first-grade SWP zones for drinking water, the construction or expansion of any projects that have no relation with water supply facilities and protection of water sources is prohibited. Within second-grade SWP zones for drinking water, new construction or expansion of any projects that discharge pollutants into the water body is prohibited. Any reconstruction projects in second-grade SWP zones must lower its pollutant discharge (Guo 2007).

*Goal for total emissions reduction of pollutants*

To improve water quality in surface water, a goal for COD reduction is that COD emissions in 2010 should be reduced by 10 percent from 2005 levels. This is set in the National 11th Five-Year Plan for Environmental Protection which is the basis for the country’s environmental policies between 2005 and 2010. In order to achieve the goal, centralized wastewater treatment plants should be constructed in all urban areas by 2010. In addition, the total treatment ratio and the capacity of wastewater treatment throughout the country should be over 70 percent and 100 million t/day, respectively (Website of the Sino-Japan Friendship Center for Environmental Protection).

*Pollution control in broad areas*
*- Integrated River Basin Management Policy (IRBM Policy)*

To manage water resources and water quality effectively, it is important to take river basins into account.

In China, the state formulates the strategic plan for water resources in the country according to the Water Law. The development, utilization, preservation and protection of water resources, and the prevention and control of water disasters, are planned in a unified way on the basis of river basins or regions. In order to draw up a river basin plan, a comprehensive scientific survey and an investigation and assessment of water resources must be undertaken first, and the region plan within a river basin shall be subject to the river basin plan. The development and utilization of water resources should take into consideration the interests of upstream and downstream areas, of the left and right banks, and of all regions concerned to make full use of the comprehensive benefits of water resources (Guo 2007).

The Water Pollution Prevention Law formulates the integrated river basin pollution prevention and control policy, and it stipulates as follows: To prevent and control water pollution, it is necessary to make unified plans on the basis of river basins or regions. The water pollution prevention and control plan for major river basins, which should be put forward by the environmental protection department and other concerned departments under the State Council, together with the governments of relevant provinces, shall be submitted to the State Council for approval. The water pollution prevention and control plan for other trans-jurisdictional river basins should be approved by the government at higher jurisdiction levels. Once approved, the water pollution prevention and control plan shall serve as the essential basis for prevention and control of the river basin, and any modification of such plans shall be subject to approval of the original departments that approved the plans. In accordance with the approved river basin (water) pollution prevention and control plan, local governments at or above the county level shall work out plans for water pollution prevention and control of their own administrative regions (Guo 2007).

From 1995, Huaihe River, Haihe River, Liaohe River, Taihu Lake, Chaohu Lake and Dianchi Lake were listed as the major basins for water pollution prevention and control by National People's Congress (NPC), and the ninth (1995-2000) and tenth (2000-2005) five year plans for the pollution prevention and control of these major basins were approved by State Council and then implemented. To date, the water pollutant discharge in the major river basins has decreased greatly, the deterioration trend for the water environment has basically been controlled, and the quality of some water bodies has visibly improved (Guo 2007).

## Existing and Future Challenges for Water Environment Management

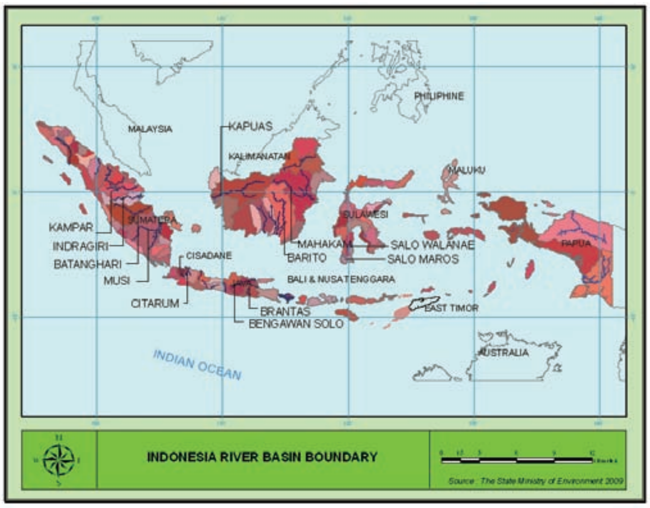
According to the National 11th Five-Year Plan for Environmental Protection, the following priority issues are identified: ensuring the achievement of COD reduction target; ensuring safety of drinking water sources; and facilitating the prevention and control of water pollution of key river basins (MEP website).

# Indonesia

## Country Information

| | | |
|---|---|---|
| Area (km²) | | 1,904,600 (2007) |
| Population | | 225.6 million (2007) |
| GDP (USD) | at current prices | 432,817 mil (2007) |
| Mean annual precipitation (mm) | | 1,825 |
| Renewable water resources (m³) | | 2,838 billion |
| Total water withdrawal (m³) | | 82.8 billion (2000) |
| Water use by purpose (2000) | Agriculture | 91% |
| | Industry | 1% |
| | Domestic | 8% |

## River Basins in Indonesia




## State of Water Resources

Water resources in Indonesia account for almost six percent of the world water resources or about 21 percent of total water resources in the Asia-Pacific region. Water consumption trends are on a significant rise; total water demand in 2000 was approximately 156,000 millions m³/year and it is predicted that the figure will double to 356,575 million m³/year by 2015. On the other hand, the availability of clean water is decreasing and becoming a challenge in the country because of environmental degradation and pollution. The rate of water resource degradation accounted for 15-35 percent per capita annually in 2006.

It is reported that at least 80 percent of the 250 million Indonesian have no access to piped water. Due to difficulties and limited access to clean water, a large number of people still directly use river water for drinking water, bathing, and washing, although such trends have tended to decrease in recent years (WEPA datadase).

## State of Water Quality

The state of water quality is evaluated according to the water quality criteria designated by the Management of Water Quality and Control over Water Pollution Government Regulation. Water quality in rivers and lakes are degraded due to wastewater from domestic activities, agriculture, and industry.

### *River water*

The result of water quality monitoring in 35 rivers in 2006 shows that water quality in most of the rivers does not meet the water quality criteria for Class II (water that can be used for water recreation infrastructure/means, freshwater fish nurturing, animal husbandry, water for irrigating gardens, and/or other usage that requires the same water quality for such usage).

A major pollution source is untreated domestic wastewater and direct waste dumped into river bodies. A survey of 56 million households in Indonesia in 2007 shows that 49 percent of them use septic tanks for toilet waste, and about 51 percent of households dispose their toilet waste directly to environment, including into river bodies.

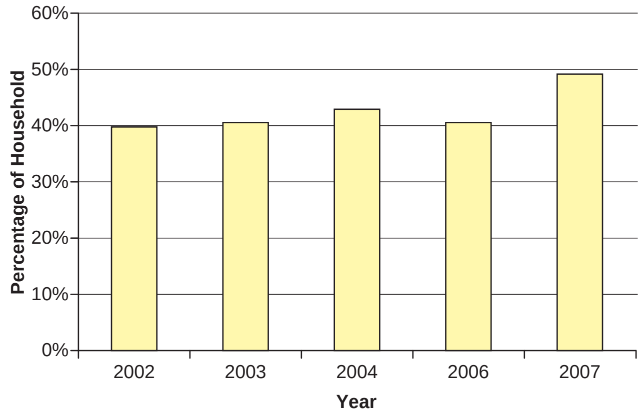



Figure 1. Percentage of Households Using Septic Tanks for Toilet Waste

(Source: Statistics Indonesia of The Republic of Indonesia 2007)

Wastewater from industrial activities of small-scale industries such as agriculture, textiles, pulp and paper, petrochemicals, mining, and oil and gas is another cause of water pollution.

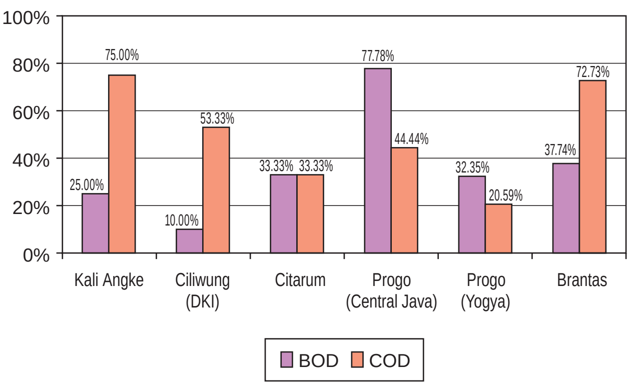



Figure 2. Percentage Compliance to the Water Quality Criteria of Class II for BOD and COD in 2006

(Source: The State Ministry of Environment Indonesia 2007)

*Lake water*

Similar to river bodies, there is significant pressure on lake water quality from domestic, agricultural, and industrial activities. Monitoring data in four lakes, namely, Diatas, Dibawah, Batur, and Maninjau, shows that minimum concentrations of DO parameters in Lake Diatas and Batur are below water quality standards for Class II criteria (Gov-Regulation No. 82/2001).

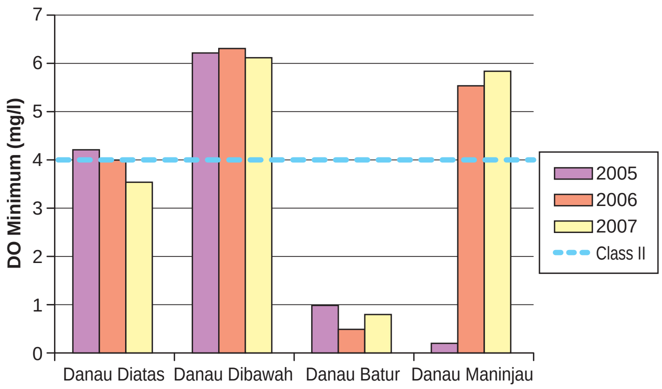



Figure 3. Minimum Concentration of Dissolved Oxygen (DO) in Lake Water, 2005 – 2007
(Source: The State Ministry of Environment Indonesia 2008)

For total phosphate, Lake Maninjau has maximum concentration that exceeds water quality standards for Class II criteria.

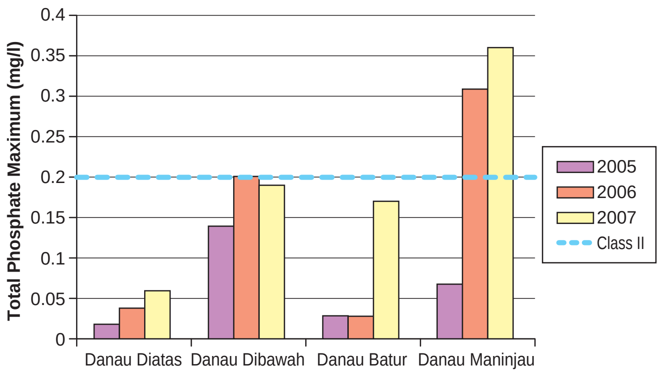



Figure 4. Maximum Concentration of Total Phosphate in Lake Water, 2005 – 2007
(Source: The State Ministry of Environment Indonesia 2008)

*Marine water*

Monitoring data from four harbors in Java, namely, Tanjung Priok (Jakarta), Tanjung Emas (Semarang), and Tanjung Perak (Surabaya), shows that concentrations of phenol exceeds the marine water quality standards for harbor areas (Decree of the State Minister of the Environment Number 51 of 2004 Concerning Marine Water Quality Standards). High concentrations of phenol in harbor areas are caused by antiseptic substances from ship wastewater.

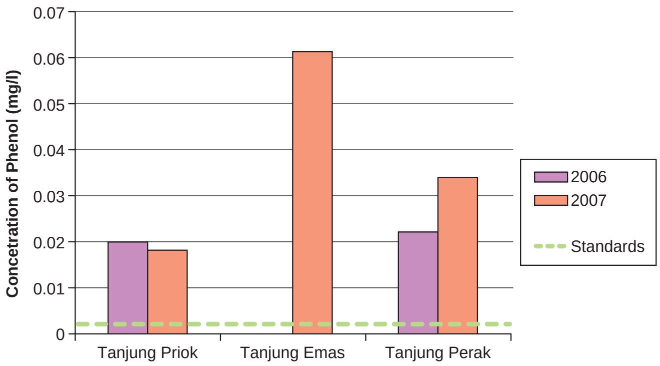



Figure 5. Concentration of Phenol in Marine Water in Harbor Areas
(Source: The State Ministry of Environment Indonesia 2008)

*Groundwater*

Quality standards for groundwater are based on the Decree of Health Minister No. 416 of 1990 concerning the provision and control of water quality. In the Jakarta area, about 39 percent of monitoring wells have concentrations of E. coli that exceed standards and most of the wells are in densely settled areas.

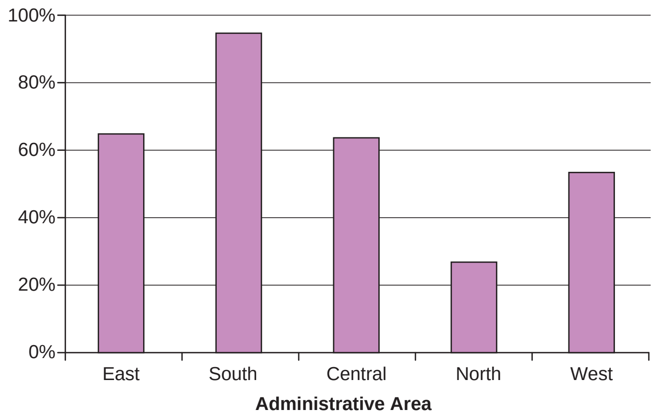



Figure 6. Percentage of Monitoring Wells in Jakarta which are Compliant to the Water Quality Standard of Clean Water for E. Coli
(Source: Environmental Management Agency of DKI Jakarta 2007)

## Legislative Framework for Water Environment Management

The objective of environmental management in Indonesia is to enable environmentally-sustainable development. It have been recognized that water has important functions to achieve development and the well-being of humans and other creatures, and that it needs to be conserved through wise management, taking into account the interest of present and future generations, as well as an ecological balance.

Environmental acts and regulations were established in the 1980's in Indonesia. The Law Concerning Environmental Management Law No. 23 of 1997 is the basic law of environmental conservation of the country, which is a replacement of the Basic Law concerning Environmental Management Law No. 4 of 1982. The Management of Water Quality and Control over Water Pollution Government Regulation Number 82 of 2001 is the basic law of water pollution control.

*Water quality standards*

For inland water quality conservation, "water quality criteria" are set as the benchmarks for water quality conservation under the Management of Water Quality and Control over Water Pollution Government Regulation Number 82 of 2001. Values for 46 parameters are determined for four classes, which are based on the type of water usage (Table 1).

For marine water quality conservation, the "seawater quality standard" is ordained as the benchmark of water quality, under the Decree of the State Minister of the Environment Number 51 of 2004 Regarding Standard Quality of Seawater. The three kinds of standard quality of seawater are set based on the usage or characteristics of seawater: standard quality for harbor waters, marine tourism, and marine biota.

The Ministry of Environment established guidelines for water quality that show the minimum standard of services that includes minimum requirements for water quality with which local governments must comply. The standards (criteria)[i] set by the guideline are uniform among the country, and provincial governments can set tighter water quality standards than the national standards, as well as additional parameters according to the local characteristics and situation of the region.

Table 1. Classes of Water Quality Criteria (for inland water)

| Class | Use |
|---|---|
| Class I | Water that can be used as raw water for drinking water, and/or other usage that requires the same water quality for such usage. |
| Class II | Water that can be used for water recreation infrastructure/means, freshwater fish nurturing, animal husbandry, water for irrigating gardens, and/or other usage that requires the same water quality for such usage. |
| Class III | Water that can be used for fresh water fish farming, animal husbandry, water for irrigating gardens and/or other usage that requires the same water quality for such usage. |
| Class IV | Water that can be used for irrigating gardens and/or other usage that requires the same water quality for such usage. |

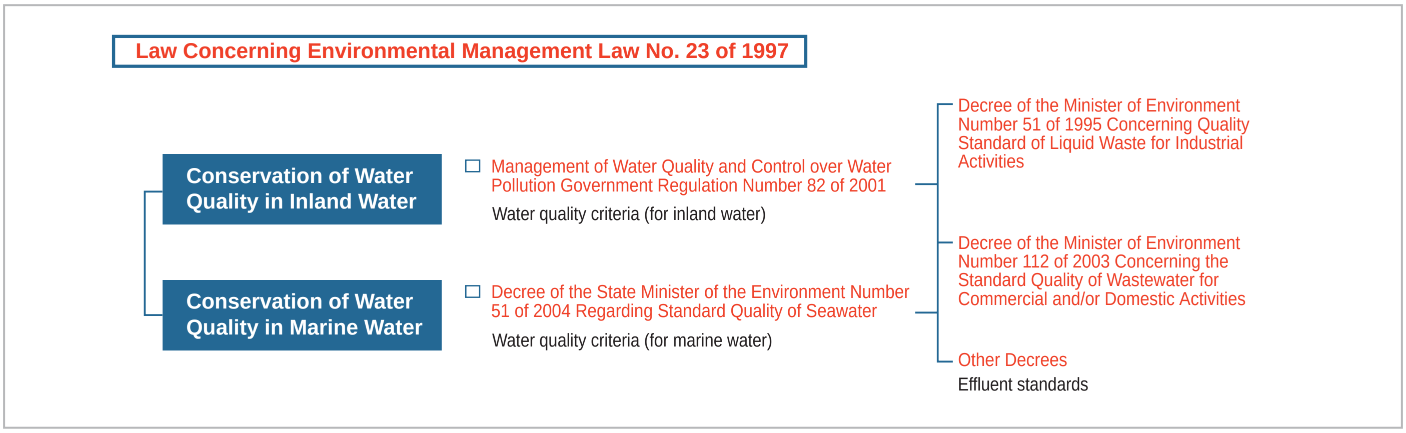



Fig 2. Legislative Chart for Water Quality Management

*Monitoring of water quality in public waters and groundwater*

The scheme of water quality monitoring is determined under the Management of Water Quality and Control over Water Pollution Government Regulation as follows:

(1) Monitoring of water sources in the regency/municipal region is carried out by the regency/municipal government,

(2) Monitoring of water sources in two or more regency/municipal regions within one province is coordinated by the provincial government and is carried out by each Regency/municipal government,

(3) Monitoring of water sources in two or more provincial regions and/or water sources on the border with other countries are observed by the national government.

Water quality observation is carried out at least once over a period of six months and the results of the observations are submitted to the Minister. The mechanisms and procedures for water quality monitoring are stipulated further in detail with a Ministerial Decree.

The authority for water management was moved to the local governments as a result of decentralization, although, water quality monitoring is not conducted appropriately in some states due to a lack of equipment, capacity, and/or financial resources.

In 2006, 30 Regional Environmental Impact Control Agencies in the provinces monitored water quality parameters in 35 rivers in Indonesia. In the "State of Environment Report in Indonesia 2006," the results of monitoring are evaluated compared to the water quality criteria for Class II. Additionally, the water quality of each river is shown in four levels: "compliant," "slightly polluted," "polluted," and "heavily polluted." This classification is made based on the results of calculations using monitoring data. Calculating methods are stipulated in the decree of the Minister of Environment No. 115 of 2003 (STORET method or Pollution Index Method).

*Effluent standards*

The Management of Water Quality and Control over Water Pollution Government Regulation ordains that the national wastewater quality standard is specified with a Ministerial Decree by taking into account suggestions from related government agencies. Additionally, the provincial government can specify the same or tighter wastewater quality standards than the national wastewater quality standard.

[i] Water quality standards and water quality criteria are the same in concept.

Effluent standards have been established gradually in Indonesia. Firstly, effluent standards for 21 industrial activities were set by the Decree of the Minister of Environment Number 51 of 1995 Concerning Quality Standard of Liquid Waste for Industrial Activities. Afterwards, effluent standards for various economic activities were separately established mostly in 1990's, including hotel activities, hospital activities, oil, gas and geothermal activities, industrial estates, and coal mining activities.

The Decree of the Minister of Environment Number 112 of 2003 Concerning the Standard Quality of Wastewater for Commercial and/or Domestic Activities was established for domestic effluent.

In 2006, effluent standards for other activities, including those in the agricultural sector, were established (slaughterhouses, vegetables and fruit treatment centers, seafood treatment centers, nickel refiners, vinyl chloride monomer and polymer factories, and ethylene factories).

The effluent standard for industry and other activities was set up based on the best practical technology. Depending on the process of each type of industry, the effluent standard was set to decrease pollution loads to 90–95 percent.

### Promotion of Voluntary Actions for Clean Water

To alleviate pollution from industry so as to improve the environment in Indonesia, the State Ministry of Environment established PROKASIH (Clean River Program) and PROPER (Program for Pollution Control Evaluation and Rating) as special programs to promote voluntary activities by private companies. The programs contributed to the promotion of water quality monitoring and improvements in water quality. In these programs, achievement statuses of companies are open to the public through the mass media, which has put pressure on companies to promote compliance. Clean City (ADIPURA) is another program to promote environmental conservation at the local level, in which the targets of water quality of municipal rivers and waste emissions are stated as a part of indicators. In ADIPURA, an award is given to local governments that show significant achievements. Such award programs also encourage the compliance of entities that participate in the ADIPURA.

*PROKASIH, SUPERKASIH*

PROKASIH originally started in 1989 and was temporarily stopped in 1999. The program was reinstated in 2003 as the SUPERKASIH (Surat Pernyataan Kali Bersih – Letter of Declaration for Clean Rivers).

The program targeted the worst industrial polluters of 24 highly polluted rivers. These companies signed letters of commitment, which outlined their goals to reduce their pollution loads and the timeline to achieve this. In principle, provincial governments are in charge of the program with the support of the national government.

From 2003 to 2006, there were already 249 companies that signed the SUPER, which has been distributed in seven provinces. As of 2005, 25 companies have been listed as compliant with the regulations listed in the SUPER.

*PROPER*

PROPER was started in 2002. This program is being implemented in order to maximize the outcomes of PROKASIH.

PROPER aims to promote companies' management of the ecosystem by using their reputation as an incentive. Under the PROPER, the environmental performances of companies are evaluated and the results of the evaluation are disseminated to the public. Performance levels are categorized in five levels of color, from the lowest to highest: black, red, blue, green, and finally, gold.

In 2006, there were 530 industries participating in the PROPER Program, comprising 254 manufacturing industries. Specifically there were 199 compliant industries in 2006 for industrial performances in water pollution control.

## Existing and Future Challenges for Water Environment Management

Although the authority of water management shifted to local governments with the progress of decentralization, a two-layer government structure of provinces and cities has been created, where the provinces and cities conduct direct regulation. Equipment and human resources were reallocated to local governments, however, there are various difficulties being faced in the appropriate administration of water environmental governance in some areas, such as budget insufficiencies and capacity development, the absence of measurement methods of water quality, as well as the inadequate dissemination of regulations such as effluent standards to the local area.

In 2007, the central government issued Government Regulation No. 38 concerning the assignment of authority between central, provincial and district/city governments. Within the regulation, central, provincial and district/city governments have been assigned different tasks (see Appendix I).

The promotion of capacity building for local governments on water quality management is considered to be a major issue in the future.

# Japan



## Country Information

| | | |
|---|---|---|
| Area (km²) | | 377,900 (2006) |
| Population | | 127.8 million (2007) |
| GDP (USD) | at current prices | 4,379,624 mil (2007) |
| Mean annual precipitation (mm) | | 1,690 |
| Renewable water resources (m³) | | 430 billion |
| Total water withdrawal (m³) | | 88.4 billion (2000) |
| Water use by sector (2000) | Agriculture | 62% |
| | Industry | 18% |
| | Domestic | 20% |

## Water Bodies in Japan


(Source: WEPA database)

## State of Water Resources

Japan is a country that has a large amount of precipitation, but the availability of water resources are subject to seasonal fluctuations of stream flow and therefore, are not stable throughout the year.

With population increases, increase in economic activity, and changes in lifestyles, such as the spread of flush toilets, from the mid-1960s to 2000, the water for domestic and industrial use increased almost three times. However, domestic use of water has been following a downward trend in recent years. Intake of water for industrial use is stable, due to developments in the recycling of industrial water. As a result, the amount of additional water required from water sources, such as rivers, is gradually decreasing.

More than 90 percent of water for agricultural use is used for rice-paddy irrigation. The rate of water use for dry-filed irrigation and livestock has slightly increased each year.

## State of Water Environment

The two major goals in the conservation of the water environment in Japan are protection of human health and conservation of the living environment. To achieve these goals, Environmental Water Quality Standards (EWQS) were established under the Basic Environment Law as the target levels for ambient water quality that are to be achieved and maintained in public waters and groundwater.

The first goal is met by setting uniform national standards applicable to all public waters. The second goal is met by classifying rivers, lakes, reservoirs, and coastal waters based on water usage and by establishing EWQS values for each class. These values are then applied to each public water body.

### *Water quality in public waters (Rivers, lakes, and estuaries)*

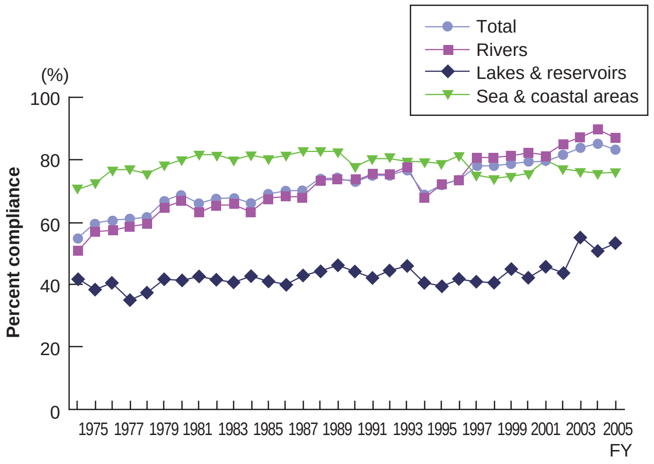
The EWQS for the protection of human health from substances, such as cadmium, were met at most of the locations (For example, the percentage compliance in FY 2005 was 99.1 percent).

The percentage compliance of EWQS (for biochemical oxygen demand (BOD) or chemical oxygen demand (COD) as a typical water-quality indicator for organic pollution) in the conservation of the living environment in public waters remains at around 80 percent, which are lower than those for the protection of human health (Figure 1).

In particular, percentage compliance in enclosed water areas, such as lakes, reservoirs, inner bays, and inland seas remain low. In addition, red tides occurred frequently; for example, in FY2005, there were 115 outbreaks of red tide in the Seto Inland Sea and 32 instances in the Ariake Sea. Blue tides were observed in Tokyo Bay and Mikawa Bay. Lakes also suffered from cyanobacteria blooms, as well as freshwater red tides.

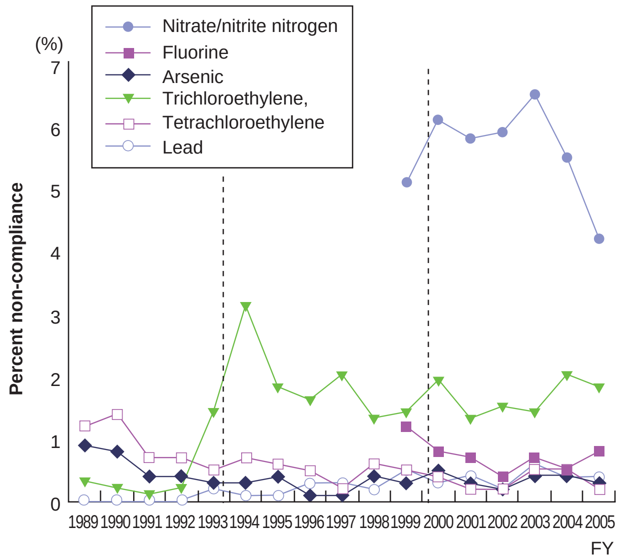
### *Groundwater*

Around 7 percent of the approximately 4,700 wells monitored do not comply with the EWQS (for one or more parameters). Specifically, the percentage compliance with the EWQS for nitrate-nitrogen or nitrite-nitrogen is low. Most of the wells are assumed to be polluted from fertilized soil, livestock excreta, and domestic wastewater. As well, contamination was observed from volatile organic compounds, such as trichloroethylene (Figure 2).




Notes: 1. BOD is used for rivers. COD is applied to lakes/reservoirs, and estuaries.
2. Percentage compliance (%) = (number of water areas compliant with EWQS/number of designated water areas) * 100.

Figure 1. Trends in Percentage Compliance with EWQS in Public Waters (BOD or COD)
(Source: Ministry of the Environment 2007)




Notes: 1. The survey teams monitor different sets of wells every year. (They do not necessarily collect data on the same wells every year.)
2. Until the EWQS for groundwater were established in 1997, the Assessment Standards had been used to evaluate groundwater quality. (The Assessment Standard for Arsenic was revised from “0.05 mg/L or less” to “0.01 mg/L or less” in 1993.)
3. The EWQS for nitrate/nitrite nitrogen, fluorine, and boron were established items in 1999.
4. The data contained in the chart is limited to those of the substances with relatively high rate of the data which exceeded the EWQS.

Figure 2. Percentage Non-compliance with EWQS in Groundwater
(Source: Ministry of the Environment 2007)

## Legislative Framework for Water Environment Management

The objectives of promoting policies for environmental conservation in Japan are to ensure healthy and cultured living for both present and future generations, as well as to contribute to the welfare of mankind. EWQS were established as the target for achieving and maintaining water quality in public waters and groundwater under the Basic Environment Law.

The Water Pollution Control Law was established to achieve policy goals. This law regulates effluent discharged by factories or commercial facilities into public water areas through effluent standards and monitoring of water quality.

### *Environmental water quality standards (EWQS)*

The EWQS for human health specifies standard values for twenty-six parameters. The EWQS was established with due consideration to potential health hazards associated with the intake of these substances through drinking water and/or fish and shellfish. In addition, twenty-seven other parameters were selected as parameters to be monitored (“monitored substances”[i]), and guideline values for these parameters set. In March 1997, EWQS for groundwater were also established.

The EWQS values for the conservation of the living environment have been established for BOD, COD, dissolved oxygen (DO), and other parameters. To prevent eutrophication, EWQS for nitrogen and phosphorus were established for lakes, reservoirs and estuaries.

### *Monitoring of water quality in public waters and groundwater*

In the Water Pollution Control Law, prefectural governors are instructed to constantly monitor water quality in public waters and groundwater.

Table 1. Current Status of Water Quality Monitoring

| | |
|---|---|
| Targeted parameters | The water quality survey of public waters covers 26 health related parameters under the EWQS, 10 parameters relating to the living environment and 27 monitored substances. Local governments check the substances to be monitored based on their status. Water quality surveys on groundwater cover 26 health parameters. |
| Sampling frequency | Water Quality Standards for Human Health: at least one day a month (sampling frequency: about four times per day).<br>Water Quality Standards for Conservation of the Living Environment: at least one day a month (sampling frequency: about four times per day) at reference stations located in areas monitored for compliance with the standards, or at locations of important water utilization (The sampling frequency may be modified depending on the situation).<br>In supplementary surveys at locations other than those mentioned above, water samples should be collected and analyzed at least four days a year. |
| Main body in charge | Prefectural governments and government-ordinance designated city governments |
| Publication of data | Survey results are published on “Water Environment Information Site” |

### *Effluent standards*

Based on Water Pollution Control Law, the ministry ordinance stipulated the standards to regulate effluent from factories and other commercial institutions with facilities used to discharge wastewater into public waters.

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i Substances which have potential hazards to human health, and which do not need to be as EWQS parameters now considering the current pollution level, but need to collect their quality data in public waters.

The effluent standards are national standards that define uniform standards for 26+1 parameters relating to human health, including cadmium and cyanide, and 15 parameters relating to the living environment. The effluent standards for human health are applied to all specified facilities, however the parameters related to the living environment are applied only those with effluent volumes of 50m$^3$ /day or more.

In addition to the uniform standards of the national government, prefectural governments and government-ordinance designated city governments may define stricter standards (also known as "stringent effluent standards") to control water quality effectively, in consideration of the socio-economic and natural conditions of each prefecture/city. The Water Pollution Law also requires entities who discharge effluents to measure and record the quality of effluents from their commercial facilities. The law also requires those discharging effluents from commercial facilities in the particular area designed by the Standard for Total Pollution Load Control (TPLC), to measure their total pollution load and record the quality of effluents (article 14).

To determine compliance with effluent standards, each prefectural governor and mayor of government-ordinance designated cities require factories and commercial facilities to report the quality of their effluents or can conduct inspections. Administrative actions, such as improvement orders, are taken against factories and commercial facilities on the basis of this monitoring.

*Total Pollution Load Control*

Water pollution in estuaries that have inflows of pollutants from densely populated or industrialized areas is a serious problem. The Water Pollution Control Law was amended in 1978 to implement a Total Pollution Load Control (TPLC) System for such large estuaries, in order to comply with the EWQS.

The Basic Policy for TPLC, which is formulated by the Minister of the Environment, sets pollutant load reduction targets for each specified water area, and the target year by which they are to be met. Based on this, the governor of each prefecture creates a management plan for TPLC to set the pollutant load reduction target for each pollution source in the prefecture and measures to meet the reduction target, as well as take required actions based on the plan.

Regulations in accordance with the TPLC standards are the core of load-reducing measures. These standards apply to designated commercial facilities with effluent volumes of 50m$^3$/day or more. The standards indicate the permissible limit for pollutant discharge loads per specified facility.

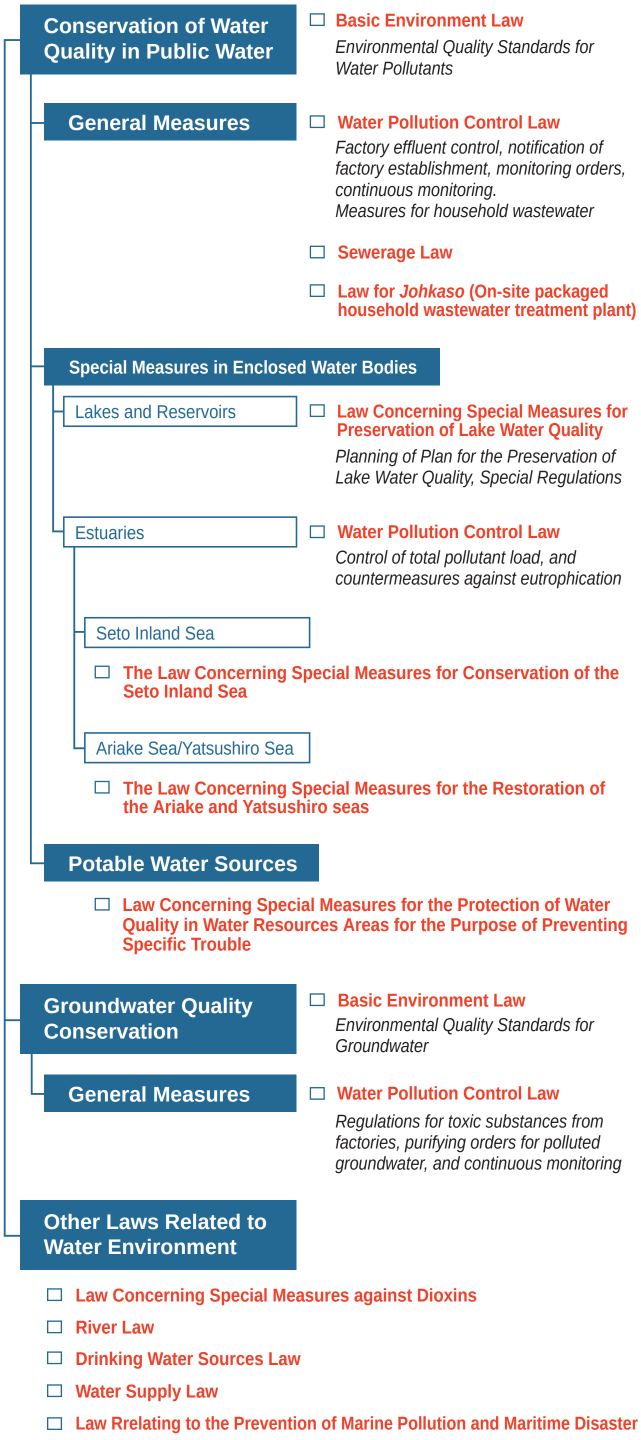


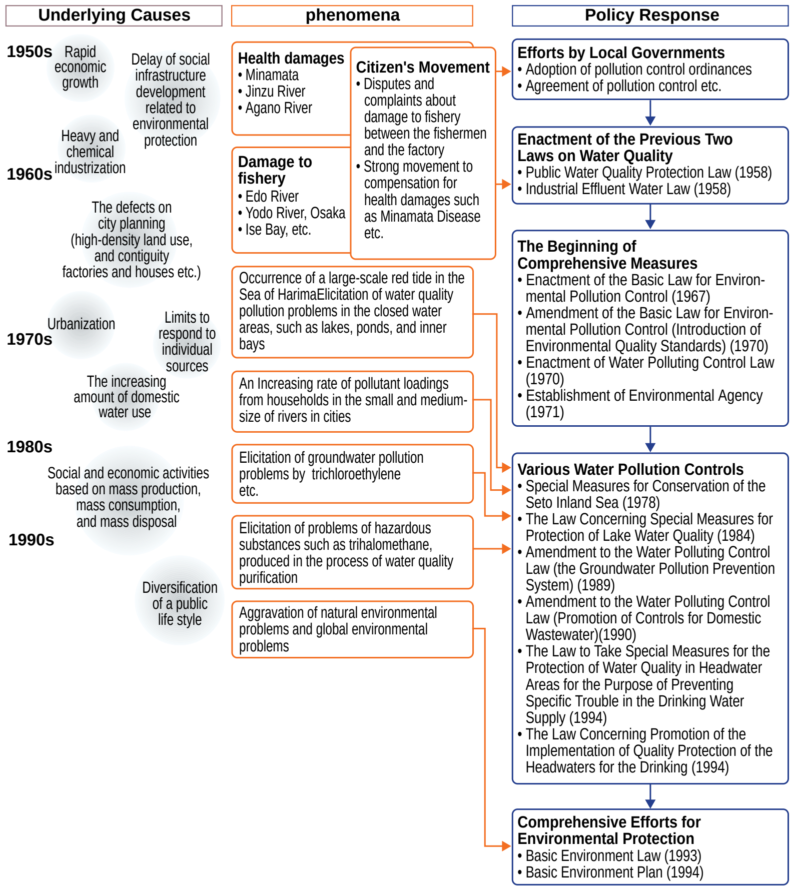

Figure 3. Legislative Chart for Water Quality Management

## History of Water Quality Management in Japan

Along with the economic recovery following World War II, water pollution became a serious problem primary in large cities, with incidents which resulted in damage to people's health. Frequent occurrences of environmental problems attracted attention from the general public. This made it impossible for industries to keep with their motto of "business as usual" without intervention from public authorities.

Local governments, therefore, began to take control measures, including adoption of pollution control ordinances. At the national level, the Public Water Quality Protection Law and, the Industrial Effluent Water Law were enacted. These two laws, however, failed to meet the requirements of environmental conservation, as they were intended for specific areas and did not contain clearly defined regulatory measures.

To implement pollution control measures in a comprehensive manner, the Basic Law for Environmental Pollution Control was enacted in 1967. In 1970, moreover, the "Pollution Diet" was convened to establish a legal framework for the prevention of pollution, and the Water Pollution Control Law replaced the two earlier laws governing water quality. Furthermore, in 1971, the Environment Agency (currently, the Ministry of the Environment) was established to integrate the management of water administration, with a focus on environmental conservation.




Steady economic growth and establishment of environmental policies led to general improvements in the environment in Japan. However, changes in people's lifestyles and increased urbanization have made impacts from human activities on the environment more complicated and diverse. Various water pollution controls were, therefore, introduced to address specific problems.

Driven by social and economic activities based on mass production, mass consumption and mass disposal, urban public nuisances, household pollution problems and global environmental problems have reached critical levels. Conventional approaches based on command-and-control mechanisms have not been sufficient to cope with these problems. This made it necessary to enact the Basic Environment Law in 1993. This law provided the philosophy for environmental policies, the direction for basic actions, and the comprehensive framework for environmental policy developments. The Basic Environment Plan, which was enacted under the Law, generally promotes various preventive and remedial actions while it invites those interested in water environments to participate in the actions, taking water quality and quantity, aquatic organisms and shoreline development into consideration.

(Source: WEPA database)

## Existing and Future Challenges for Water Environment Management

Water quality in estuaries, lakes and reservoirs, and urban rivers has not improved, and pollution from hazardous chemical parameters continues to become more prominent.

The percentage compliance with the Environment Water Quality Standards remains low for enclosed water bodies, especially estuaries, and lakes and reservoirs, which have large pollution sources in their drainage basin, than that in other water bodies. In addition, inflow of nitrogen and phosphorus causes eutrophication.

As for groundwater, 4.3 percent of the total wells monitored did not comply with the EWQS for nitrate-nitrogen or nitrite-nitrogen. Most of the wells were considered to be polluted from fertilized soil, livestock excreta, or domestic wastewater. Appropriate measures to prevent pollution are necessary to conserve groundwater. However, pollution of volatile organic compounds, such as trichloroethylene, with commercial facilities as the main pollution source, remains as a new field of study.

# Republic of Korea

## Country Information

| | | |
|---|---|---|
| Area (km$^2$) | | 99,300 (2007) |
| Population | | 48.5 million (2007) |
| GDP (USD) | at current prices | 956,788 mil (2007) |
| Mean annual precipitation (mm) | | 1,274 |
| Renewable water resources (m$^3$) | | 69.7 billion |
| Total water withdrawal (m$^3$) | | 18.6 billion (2000) |
| Water use by sector (2000) | Agriculture | 48% |
| | Industry | 16% |
| | Domestic | 36% |

## Water Bodies in Korea


## State of Water Resources

Annual precipitation in Korea is 1.3 times higher than the world's average, however it is one-tenth of the world's average in terms of per capita precipitation. Per capita availability of domestic water resources is also low at 1,550 ton/year, and according to the United Nations, Korea is one of the world's water-scare countries. Despite the high water usage rate compared to other OECD countries, Korea faces another challenge in undertaking the construction of dams due to the submission of civil complaints and environmental impacts in the areas surrounding dams. Additionally, Korea has accomplished the formidable task of improving water supply rates in metropolitan areas by 99.1 percent, yet the rate in rural areas had remained steady at 66.8 percent (in 2008) (WEPA database).

## State of Water Environment

### *Rivers*

Overall, water quality in the four major rivers (Han, Nakdong, Geum, and Youngsan) of Korea has improved since 1997, as a result of water management efforts made by the Ministry of Environment (Figure 1). Special measures for these rivers have been implemented since 1998, so as to put in place the river basin management system (e.g., the Total Maximum Daily Load Management System), expand environmental infrastructure, and reinforce emission standards.

All streams nationwide are classified into 114 sectors and target water quality (e.g., BOD levels) has been established for them. The rate of streams that meet the standard was 71.9 percent in 2007. Percentage compliance to the water quality standards has been on the rise from 12.8 percent in 1991 to 27.8 percent in 2000 and to 71.9 percent in 2007 (Figure 2).

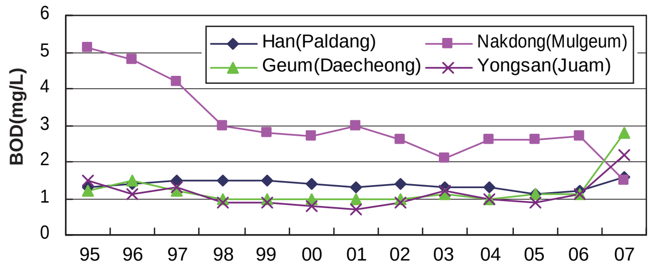
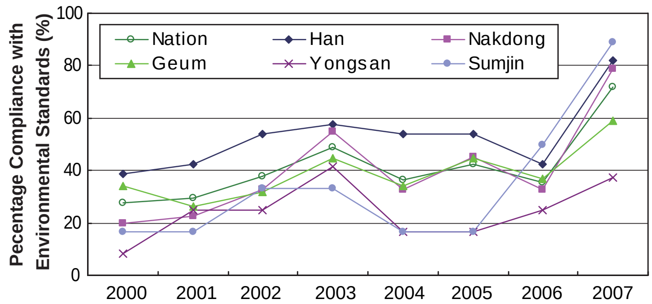



Figure 1. BOD Measurement Results of 4 Major Rivers (mg/L)
(Source: MOE Korea 2008)




Note: Heavy rainfalls in summer and an increase of non-point pollution sources resulted in a decrease in rates in 2006. Different evaluated methodology was applied to the data of 2007

Figure 2. Percentage Compliance with Water Quality Standards
(Source: MoE Korea 2008)

### *Lakes*

There are 18,898 lakes and marshes in the country, most of which are agricultural reservoirs (17,573). There are only five natural lakes, and the rest are man-made lakes that were formed when building dams.

The Ministry of Environment has set environmental standards for phosphorous and nitrogen, in consideration of various impacts of eutrophication. It has also set and is managing water quality grades, water quality targets and compliance periods for the 49 lakes in the country. Most lakes have been rated as grade Ia (Very Good) or Ib (Good).

Table 1. Standard for the Living Environment (Lakes)

| Grade | | State (Character) | Standard | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pH | COD (mg/L) | SS (mg/L) | DO (mg/L) | T-P (mg/L) | T-N (mg/L) | Chl-a (mg/m³) | E-Coliforms(No. of E-Coliforms/100mL) | |
| | | | | | | | | | | Total Coliforms | Facal Coliforms |
| Very Good | I a | | 6.5~8.5 | ≤ 2 | ≤ 1 | ≥ 7.5 | ≤ 0.01 | ≤ 0.2 | ≤ 5 | ≤ 50 | ≤ 10 |
| Good | I b | | 6.5~8.5 | ≤ 3 | ≤ 5 | ≥ 5.0 | ≤ 0.02 | ≤ 0.3 | ≤ 9 | ≤ 500 | ≤ 100 |
| Fairty Good | II | | 6.5~8.5 | ≤ 4 | ≤ 5 | ≥ 5.0 | ≤ 0.03 | ≤ 0.4 | ≤ 14 | ≤ 1,000 | ≤ 200 |
| Fair | III | | 6.5~8.5 | ≤ 5 | ≤ 15 | ≥ 5.0 | ≤ 0.05 | ≤ 0.6 | ≤ 20 | ≤ 5,000 | ≤ 1,000 |
| Fairty Poor | IV | | 6.0~8.5 | ≤ 8 | ≤ 15 | ≥ 2.0 | ≤ 0.10 | ≤ 1.0 | ≤ 35 | - | - |
| Poor | V | | 6.0~8.5 | ≤ 10 | No floating garbage | ≥ 2.0 | ≤ 0.15 | ≤ 1.5 | ≤ 70 | - | - |
| Very Poor | VI | | - | > 10 | - | < 2.0 | > 0.15 | > 1.5 | > 70 | - | - |

Note: 1. When the ratio of total nitrogen to total phosphorate is less than 7, the criteria of total phosphorate shall not be applied. When the ratio is more than 16, the criteria of total nitrogen shall not be applied.

(Source: MoE Korea 2008)

*Groundwater*

The Standards of Groundwater Quality set forth standard values for three purposes of water use: domestic, agricultural/fishery or industrial purposes. Groundwater used for drinking is subject to the standard of drinking water in accordance with the Drinking Water Management Act.

As a result of the 2007 groundwater quality study which monitored 2,499 sites once or twice a year, of the 4,828 test samples, 260 (5.5%) did not meet water quality standards (Figure 3). The criteria that were not met included general bacteria (31%), TCE (22.2%), $NO_3$-N (20%) and Cl (14.2%).

The reason that groundwater is not meeting general bacteria criteria is mainly due to insufficient management of groundwater wells. The main cause of non-compliance of $NO_3$-N parameter is sewage water and leachate infiltrating into the ground. In 2007, sites not meeting water quality standards decreased by 0.8 percent, compared to the previous year (6.3%). This has been on the rise for the past five years.

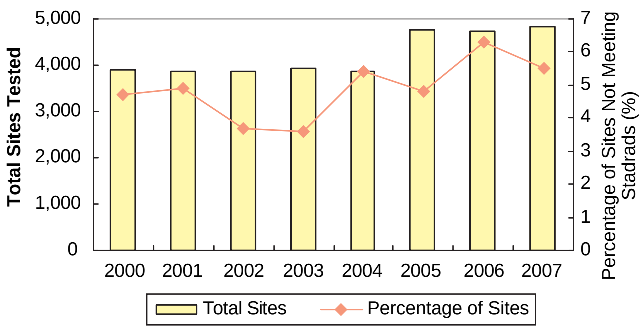



Figure 3. Yearly Status of Groundwater Exceeding Quality Standards

(Source: MoE Korea 2008)

*Coastal water*

Coastal water quality is categorized into three classes. About 35 percent of the coast meets the highest standard for Grade I. About 55 percent are ranked as Grade II and the remaining 10 percent is in the lowest grade, Grade III. "Red tides" of decomposing algae, resulting from nutrient pollution from agricultural and other sources, are also occurring in some coastal waters and impose a considerable economic cost on fisheries and aquaculture. The Ministry of Land, Transport and Maritime Affairs has formulated the National Marine Environment Preservation Plan to restore and maintain coastal water quality. Five severely affected areas, including Masan-Chinhae Bay on the south coast and the Incheon-Sihwa area near Seoul, were designated "Specially Managed Seas" under the Marine Pollution Prevention Act in 2000. Four other areas were designated as "Environment Preservation Seas" in the same year, to preserve their pristine environment.

## Legislative Framework for Water Environment Management

Prevention of people's health and environment and preservation of clean water and aquatic ecosystems are the major objectives of water environmental management in the country, according to the Water Quality and Ecosystem Conservation Act 2008. Water quality standards were established for human health and for conservation of the living environment as the target values of water quality to be achieved.

*Water quality standards*

There are two kinds of water quality standards. One is health standards for rivers and lakes (17 parameters such as Cd, As, and PCB). Another is standards for conservation of the living environment which were set for streams and lakes/mashes, respectively. The standards for the living environment for river include six parameters and nine parameters for lakes/marshes in seven categories.

Table 2. Classification of Water Quality by Grade and State of Aquatic Ecosystems (Rivers, streams, and lakes)

| Grade | Description |
|---|---|
| Grade Ia<br>Very Good | Higher concentrations of DO (Dissolved Oxygen), no pollutants, excellent condition of ecosystems, and residential use after a simple purification process (e.g., filtration and sterilization) |
| Grade Ib<br>Good | High DO levels, few pollutants, good condition of ecosystems, and residential use after a general purification process (e.g., sedimentation, filtration, and sterilization) |
| Grade II<br>Fairly Good | Good DO levels, some pollutants, good and moderate condition of ecosystems, and residential/ swimming pool use after a general purification process (e.g., sedimentation, filtration, and sterilization) |
| Grade III<br>Fair | Moderate concentrations of DO, general pollutants, moderate condition of ecosystems, residential use after an advanced purification process (e.g., sedimentation, filtration, carbon block filtration, and sterilization) and industrial use after a general purification process |
| Grade IV<br>Fairly Poor | Low concentrations of DO, many pollutants, agricultural and industrial use after an advanced purification process |
| Grade V<br>Poor | Lower concentrations of DO, a significant amount of pollutants, an industrial use after an advanced purification process (e.g., sedimentation, filtration, carbon block filtration, sterilization, and reverse osmosis), and no effect from bad or unpleasant odor on daily life |
| Grade VI<br>Very Poor | Little DO, polluted water, and few fish in existence |

(Source: MoE Korea 2008)

The standard values for groundwater were determined according to the purpose of water usage: drinking, agricultural, and industrial uses. Coastal water quality standards were established to protect human health and the living environment. The standard values for coastal water quality standards for the conservation of the living environment have been set for three grades (Table 3).

Table 3. Coastal Water Quality Standards for Conservation of the Living Environment

| Grade | pH | COD (mg/L) | DO (mg/L) | Total coli. (MPN/100mL) | Normal Hexane extracts (mg/L) | TP (mg/L) | TN (mg/L) |
|---|---|---|---|---|---|---|---|
| I | 7.8~8.3 | ≤1 | 7.5≥ | ≤1,000 | ≤0.01 | ≤0.03 | ≤0.3 |
| II | 6.5~8.5 | ≤2 | 5≥ | ≤1,000 | ≤0.01 | ≤0.05 | ≤0.6 |
| III | 6.5~8.5 | ≤4 | 2≥ | - | - | ≤0.09 | ≤1.0 |

## Revision of Water Quality Standards

The Korean water quality standards for the protection of human health have recently been expanded. The main reason for the expansion was to address the concern of increasing hazardous pollutants in water environments. A risk-based approach was used to derive the water quality standards for eight toxic substances including antimony, benzene, carbon tetrachloride, chloroform 1,2-dichloroethane, dichloromethane, diethylhexylphtalate, and tetrachloroethylene.

The same methodology has been applied to revise the existing substances, and the water quality standards for lead and cadmium were reinforced. The method for deriving water quality criteria was revised from the U.S. Environmental Protection Agency's (EPA) equation for deriving ambient water quality criteria. The Korean standard values were used for input parameters where possible. The water quality monitoring data from four major rivers in Korea were used as exposure data. Priority chemicals for the consideration of expanding water quality standards were determined based on the human health risk assessment.

Subsequent to the current water quality standards, the Korean Ministry of Environment plans to expand water quality standards to thirty substances by 2015. Ecological risk criteria were also derived and they will be incorporated in the water quality standards in the near future.

(Source: An et al. 2007)

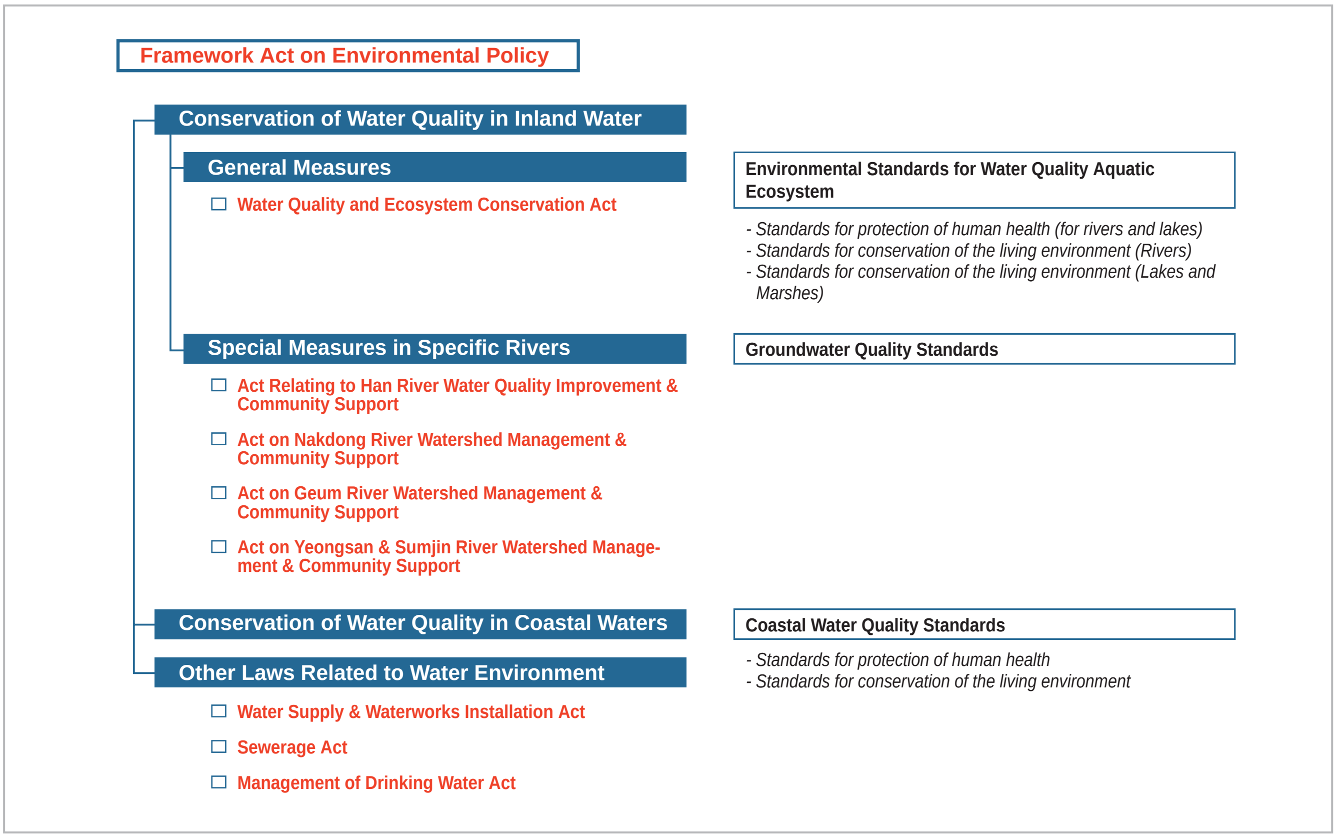



Figure 4. Legislative Chart for Water Quality Management

*Monitoring of water quality in public waters and groundwater*

Quality evaluations of river water are continuously conducted by a nationwide monitoring network. The data is collected and used for the formation of future policies for water quality control and water quality conservation.

Monitoring categories include 26 items for rivers, 30 for lakes and marshes, and 15 for groundwater. In particular, there are 52 automatic operating monitoring stations for surface waters. The water quality is being monitored by measuring five common items such as DO, TOC, pH and 17 optional items, including VOC.

For more efficient inspection, monitoring spots are classified according to usage: river water, lake water, drinking water, irrigation water, industrial water, and river water flowing through cities.

Table 4. Operation of Water Quality Monitoring Network (2008)

| Items | Number of Location Monitored | Frequency of Inspection |
|---|---|---|
| Rivers | 697 | 12 times/year<br>(48 times/year for key location) |
| Lakes | 185 | 12 times/year<br>(48 times/year for key location) |
| Industrial waterway | 71 | 12 times/year |
| Water course flowing through cities | 49 | 12 times/year |
| Agriculture water | 474 | 2 times/year |
| Groundwater | 2,499 | 2 times/year |

(Source: provided by the WEPA focal point person of Korea)

*Effluent standards*

Effluent standards are set by the Ordinance of the Ministry of Environment for discharged water from both public and private sewage treatment plants, waste treatment plants.

The Toxic Pollutants Effluent Standard is designated to protect human and animal health. Forty kinds of organic materials are designated as water pollutants. Heavy metals and phenols are designated as specific water pollution material.

*Total water pollution load management system*

The four major rivers, the Han-gang, Nakdong-gang, Geum-gang, and Youngsan/Sumjin-gang are important as they meet the water needs of more than 40 million people. The Ministry of Environment established the Comprehensive Water Quality Management Measures for the Four Major Rivers between 1998 and 2000. Major policies include the total water pollution load management system, riparian buffer zones, land purchasing, water use charges and resident support measures.

The Total Water Pollution Load Management System (TWPLMS) contributes to the sustainable management of water resources by setting a target water quality, which has been differentially set based on the results of an environmental survey conducted in each river basin and in consideration of the specific water use. For the Han river basin, using the TWPLMS is optional. Gwangju City was the first to voluntarily establish a total water pollution load management plan, to be implemented between July 2004 and the end of 2007. In other river basins, water quality goals have been established in 18 locations in the Nakdong river basin, three locations in the Geum river basin, and seven locations in the Youngsan/Sumjin river basin. To achieve these targets, five cities and provinces in the Nakdong river basin have already established Total water pollution load management plans in early 2004 and other local governments in the Geum and Youngsan/Sumjin rivers are following suit.

The Ministry of Environment allows local administrations to determine on their own whether they should implement the system in keeping with local environmental circumstances, thus striking a balance between environmental conservation and development. Hence, local administrations, including Gwangju City governing the Paldang Lake watershed, plan to establish and implement a basic plan for the total pollution load system in collaboration with the Ministry.

Towards this end, in 2002, the Ministry formulated basic guidelines on total pollution load management including the documenting of key pollutants and target water quality. It is now preparing to establish water quality targets at downstream points in watersheds by dividing the three river watersheds into unit watersheds for total pollution load management.

*Measures for non-point source pollution*

Policies focused on point source pollution have shown its limitations in achieving water quality improvement, pointing out the need for an advanced management system for river basin water quality beyond the scope of existing policies.

In March 2004, the Comprehensive Measures for Non-point Source Pollution Management in the Four Major Rivers were established under the leadership of the Prime Minister's Office and in cooperation with related ministries. The Comprehensive Measures contain three major policy fields: policy system improvements, pilot projects on the construction and management of non-point source pollution treatment facilities, and research and public relations. Such areas of concern will be addressed over three phases. The first phase (2004-2005) focused on policy system improvement and pilot projects, the second phase (2006-2011) focuses on best-fit management projects for major river basins of the four major rivers, and the third phase (2012-2020) focuses on nationwide implementation of non-point source pollution management.

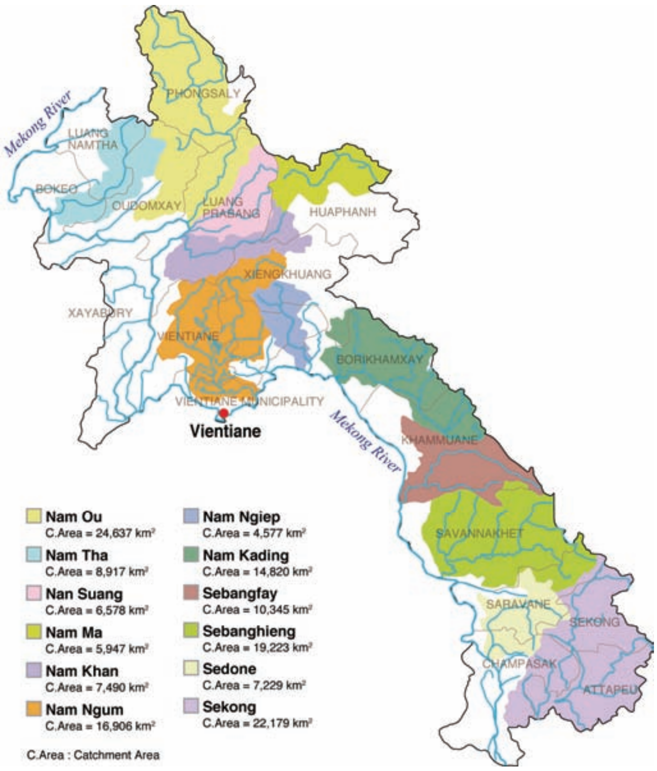
## Existing and Future Challenges for Water Environment Management

MOE’s water quality policy will focus more on non-degradable pollutants, and total phosphorus. The policy will encompass the management of water quality, even in small streams, estuaries and coasts that have been poorly managed due to the government’s water quality policy focusing almost solely on the upper regions of water supply sources and mainstreams of rivers. The Ministry plans to expand monitoring systems for sediment and non-point source and other measures, for comprehensive water quality assessment.

## Country Information

| | | |
|---|---|---|
| Area ($km^2$) | | 236,800 (2007) |
| Population | | 5.9 million (2007) |
| GDP (USD) | at current prices | 4,153 mil (2007) |
| Mean annual precipitation (mm) | | 1,600 |
| Renewable water resources ($m^3$) | | 270 billion |
| Total water withdrawal ($m^3$) | | 5.7 billion |
| Water use by sector (2000) | Agriculture | 90% |
| | Industry | 6% |
| | Domestic | 4% |

## Major Watersheds in Lao PDR




## State of Water Resources

In principle, Lao PDR is rich in water resources. Average annual rainfall at higher elevations in the southern part of the country is 3,700mm and 1,300 mm in the northern valleys. The monthly distribution of river flow in Lao PDR closely follows the pattern of rainfall: about 80 percent during the rainy season (May to October) and 20 percent in the dry season (November to April). For some rivers in the central and southern parts of the country (particularly Se Bang Fai, Se Bang Hieng and Se Done shown in the figure above), the flow during the dry season is less: around 10 to 15 percent of the annual flow. Rivers in Lao PDR provide water resources not only for the country but also for the lower Mekong Basin. Most of the rivers in the country are Mekong tributaries, which are about 270,000 million $m^3$, equivalent to 35 percent of the average annual flow of the whole Mekong Basin. About 85 percent of the land area of the country is located within the Mekong Basin.

The national population is approximately six million. This means that total available surface water resources of 332.5$km^3$ is equivalent to more than 55,000$m^3$ on an annual per capita basis. In comparison to other Asian countries, Lao PDR has the highest per capita water availability (FAO AQUASTAT). However, little of the national available water supply is developed. The total storage capacity of large reservoirs is 7$km^3$, which is equivalent to 2.8 percent of the annual surface water supply.

## State of Water Environment

The Water Quality Laboratory of the Ministry of Agriculture and Forestry reported that the quality of water in Lao PDR has generally been good according to the past 15 years of monitoring data. However, there are some water pollution problems in major urban areas caused by various water uses by communities (households, hotels, hospitals and entertainment centers). In addition, the actions of the agricultural and industrial sectors have resulted in water pollution, including mineral exploitation and hydropower generation. The degradation of water bodies and catchments due to sedimentation, land erosion and drying out continues.

### *River water*

The Mekong River Basin Diagnostic Study by the Mekong River Commission (MRC) (MRC 1997) indicates that “water throughout the Mekong River Basin is generally of good quality, but there are localized exceptions”. The comparison of available water quality indicators of some tributaries in Lao PDR with World Health Organization (WHO) standards and European Commission (EC) standards for drinking water shows that water quality of rivers in Lao PDR remains high.

Sediment is the primary pollutant source affecting river water quality. Tributaries and river reaches with high sedimentation are the Sebanghieng, Sedone, Nam Ou, and the upper and lower stretches of the Mekong (WEPA database).

According to the Diagnostic Study of Water Quality in the Lower Mekong Basin by MRC (March 2007), water quality was monitored at five stations in Lao PDR (LS3, LS4, LS5, LS6, LS8, and LP12 shown in Figure 1) during the water quality campaigns in 2003 and 2004. The number of sites and number of samples was limited, however, the analysis showed that the Mekong River system has a lower concentration of mineral ions than some other major rivers of the world (See Figure 2). In addition, the analysis also showed that the water quality in the Mekong tributaries in Lao PDR is generally good.

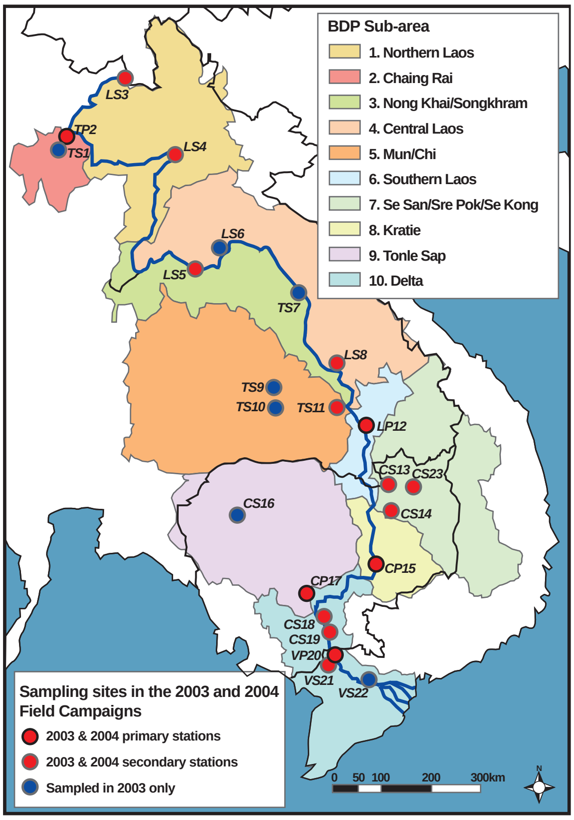



Figure 1. Sampling Stations in 2003 and 2004 during Water Quality Campaigns

(Source: MRC 2007)

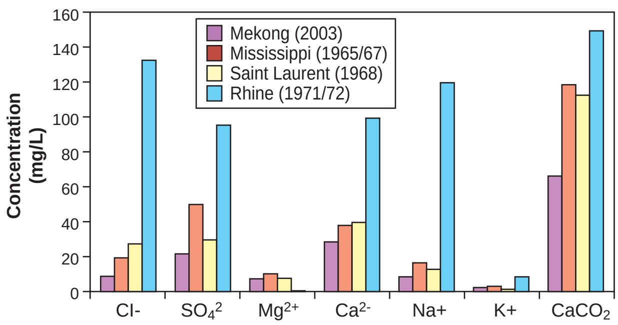



Figure 2. Comparison of the Chemical Profile of the Mekong with Other Rivers

(Source: MRC 2007)

*Lakes/Enclosed water*

Perennial ponds, marshes and oxbow lakes are fairly common in the lowland-floodplains in Lao PDR. These water bodies are usually shallow and vary greatly in size during the year. Because the water is relatively fertile and shallow in areas, many types of aquatic plants, molluscs, crustaceans, amphibians and reptiles are abundant.

*Groundwater*

The use of groundwater is considerably negligible and its status is still at baseline conditions. There is, however, limited available data and information on groundwater in Lao PDR. The only information available was the regional assessment of groundwater potential in Champasack and Saravane, southern provinces in Lao PDR, a decade ago, funded by the Japan International Cooperation Agency (JICA).

## Legislative Framework for Water Environment Management

The basic legislation on water quality management in Lao PDR is the Law on Environmental Protection (LEP) adopted in 1999, which specifies a set of rules for protection of the environment to protect human health and natural resources and to ensure the sustainable socio-economic development of the country (Article 1). Laws on Water and Water Resources (1996) and other laws such as the Forest Law and Mining Law are also relevant to water environmental management, as shown in Figure 3.

The Department of Environment, the Water Resources and Environment Administration (WREA) mainly manages water environments, and is responsible for setting ambient water quality standards and effluent standards for domestic wastewater.

The Environment Protection Law has been placed under review. Under the general direction of the Government, the law will mostly focus on pollution control of investment projects and activities rather than on green environment monitoring and control, such as biodiversity conservation. The law will also provide more centralized authority to the Department of Environment and its local counterparts as the legislative body undertaking the pre-assessment of environmental impacts from investment projects and activities, monitoring implementation, and taking appropriate actions during and after the implementation of investment projects and activities, in close collaboration with concerned agencies at all levels. The law will be submitted to the National Assembly at the end of 2009. Moreover, the roles of each agency relating to water quality monitoring and management will be reviewed upon the completion of updates to the Environmental Protection Law.

*Water quality standards*

As part of overall environmental standards (including air, noise and water), the Department of Environment is currently preparing national ambient water quality standards, in technical cooperation with the Department of Water Resources (DWR). Upon the completion of the standards, the DWR will take the key role in ambient water quality management, based on the mandate provided. The tentative ambient water quality classes for surface waters are designed based on the usage of water as

Table 1. Tentative Ambient Water Quality Classes for Fresh Surface Waters

| Class | Description |
|---|---|
| Class 1 | Unpolluted water supply safe for human consumption without treatment, provides habitat for sensitive aquatic biota and body contact recreation |
| Class 2 | Water supply safe for human consumption after normal treatment process, habitat for biota and suitable for recreation and aquatic biota |
| Class 3 | Medium quality water suitable for human consumption after normal treatment process, irrigation supply, and aquatic biota |
| Class 4 | Somewhat polluted water used for human consumption only after special treatment and for industrial supply |
| Class 5 | Polluted freshwater suitable for navigation |

(Source: World Bank 2007)

shown in Table 1 (World Bank 2007). The former Science Technology and Environment Agency (STEA) outlined water quality guidelines for surface water in the draft regulation for adoption of ambient environmental standards (1999).

Water quality standards for drinking water have been developed by the Ministry of Health in collaboration with WHO/UNICEF. The quality standards for drinking water and household water supply are defined by the Decision on the Management of Quality Standards for Drinking Water and Household Water Supply (2005).

*Monitoring of water quality in public waters and groundwater*

Some agencies carry out water quality monitoring, laboratory analysis and other functions. The main agencies with responsibilities for water quality monitoring are shown in Table 2.

Water quality monitoring is also conducted in the Mekong tributaries as a part of environment monitoring and management in the Mekong River by mostly MRC support program.

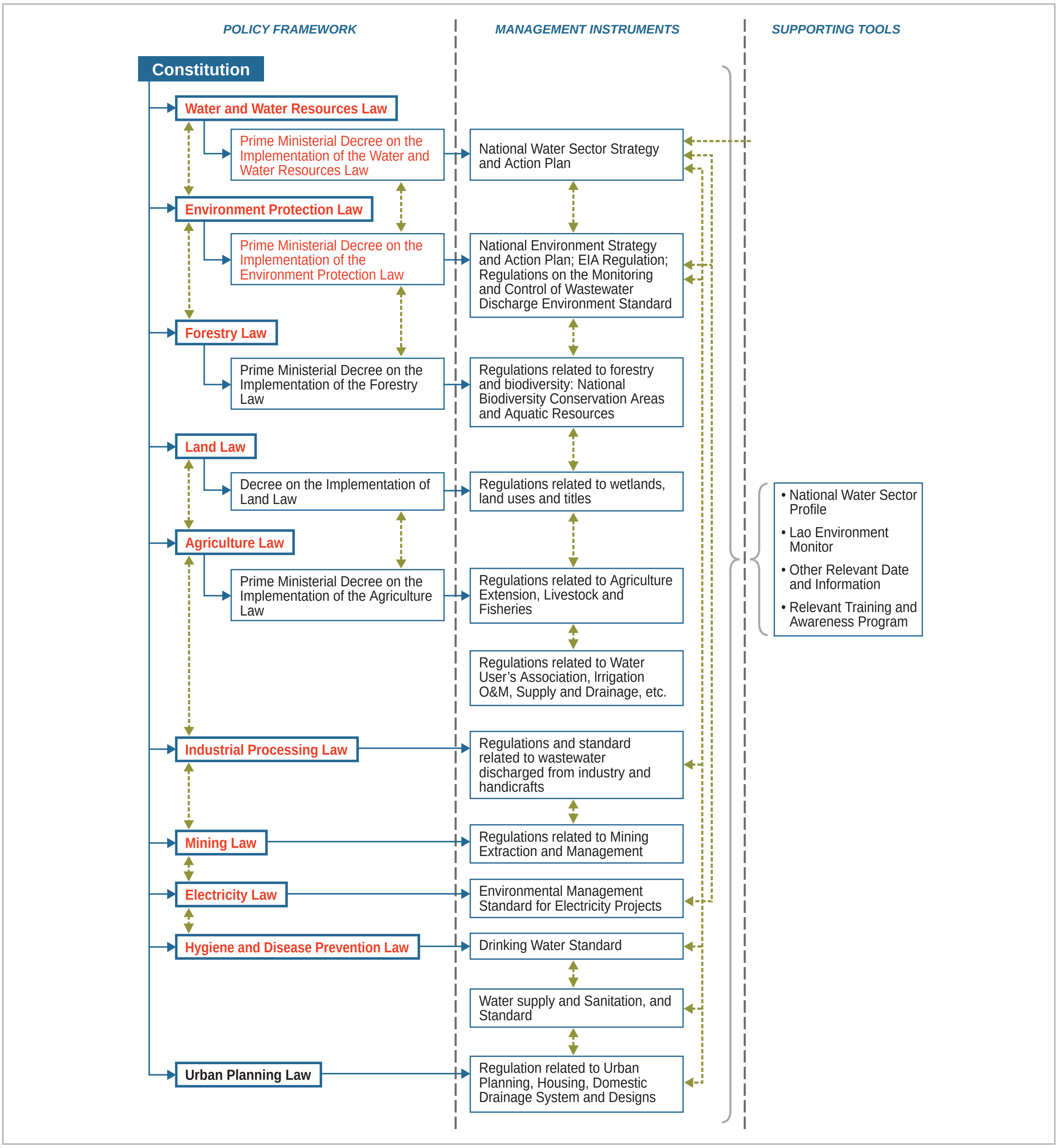



Figure 3. Legislative Chart for Water Quality Management

(Source: WEPA database)

Table 2. Public Agencies Conducting Water Quality Monitoring

| Institution | Type of Samples | Number of Stations | Parameters Monitored |
|---|---|---|---|
| Dept. of Irrigation (Ministry of Agriculture and Forestry) (Analysis is conducted in Water Quality Laboratory) | Surface water<br>Groundwater<br>Industrial wastewater | 23<br>*Ad hoc* samples taken from surface, ground and waste water as required | 14 parameters<br>(DO, dissolved salts, nutrients, and organic matter)<br>(Plans for As, Hg, Cd, and Pb) |
| Ministry of Public Health, Pesticide Laboratory | Surface water | (*Ad hoc* testing) | 24 parameters<br>(Organic compounds and pesticides) |
| Ministry of Energy and Mines | Surface water from Hydropower dams | *Ad hoc* sampling | Almost 8 parameters<br>(Including temperature, pH, DO, COD, etc.) |
| Environment Department (STEA) | Wastewater (urban/industrial) | 11 (Vientiane municipality)<br>3 (Vientiane province) | 4 parameters<br>(TSS, TDS, BOD, and pH) |
| Ministry of Industry and Commerce (MIC) | Industrial effluent (Samples collected by Dept. of Irrigation or STEA) | *Ad hoc* sampling | Parameters monitored are mainly related to industrial waste monitoring |
| Ministry of Public Health | Rural water supply | *Ad hoc* testing for groundwater and newly drilled bore holes, and surface water resources used in public water supply | 7 parameters<br>(Fe, Cu, Ba, pH, Ec, TDS, $NO_3$) |

(Source: Komany 2008)

*Effluent standards*

The Lao government sets standards for wastewater under the Water and Water Resources Law, taking the classification of the receiving water source into account. The standards deal with both waste and wastewater. The former Ministry of Industry and Handicraft (Ministry of Industry and Commerce at present) sets concentration standards of wastewater from industries such as sugar mills, the textile and garment industry, pulp mills, paper mills, slaughter houses, and battery plants. Wastewater standards for buildings, hotels, dormitories, hospitals, restaurants, and commercial centers are also designated by the former STEA.

## Existing and Future Challenges for Water Environment Management

Various challenges exist in the field of water quality monitoring, modeling and other technical strengthening, however, there is a need for a more systematic approach.

Currently, some ministries and departments responsible for water resources independently carry out water quality management, such as water quality monitoring and analysis. The WREA needs to play an active and leading role in water quality management in line with its mandate on water resources and environment.

Also, stronger water quality policies and strategies are needed to deal with the rapid development of water resources and possible impacts on water quality and ecosystems. The updating of the National Water Resources Policy and Strategy and the possible review of the Law on Water and Water Resources will provide the opportunity for this policy and strategy development.

Reviewing and setting coordinated water quality monitoring standards and procedures need to be considered. Furthermore, capacity and systematic coordination procedures and mechanisms among agencies responsible for overall and sectoral water quality monitoring and management need to be built.

### Multi-stakeholder Water Governance for Sustainable Livelihood in Lao PDR

Water resources are important resources for human livelihood. As there are various stakeholders involved in water resources, it is important to raise awareness and open up dialogue with these stakeholders. International Union for Conservation of Nature (IUCN) Lao PDR is working to bring a diverse group of stakeholders to the table to improve understanding of water resources, enhance effective governance and raise awareness of the rising pressures on Lao PDR's water resources.

The current objectives of its activities (2008-2010) are as follows:

- Provide opportunity for the state, civil society and businesses to participate in water dialogues: to inform and be informed.
- Encourage multi-stakeholder involvement in the process of debates on national water resources strategies and relevant regional strategies of ADB, MRC and the World Bank with focusing on agreed safeguard aspects.
- Enable the articulation of different perspectives about water-related development in the Mekong Region for consideration in the decision-making process.

Water networking committees and a panel of expert groups have been established in various areas, such as policy, science, water use, and the private sector. Also, a mechanism for decision support on water related development was established.

It is needed to continue promoting water governance through multi-stakeholder dialogues. Future work will be concentrated on establishing coordination mechanisms, exploring potential areas for collaboration with key stakeholders at different levels, improving access to funding sources to enable activities to be self-sustaining, and supporting information sharing with regional and global water networks.

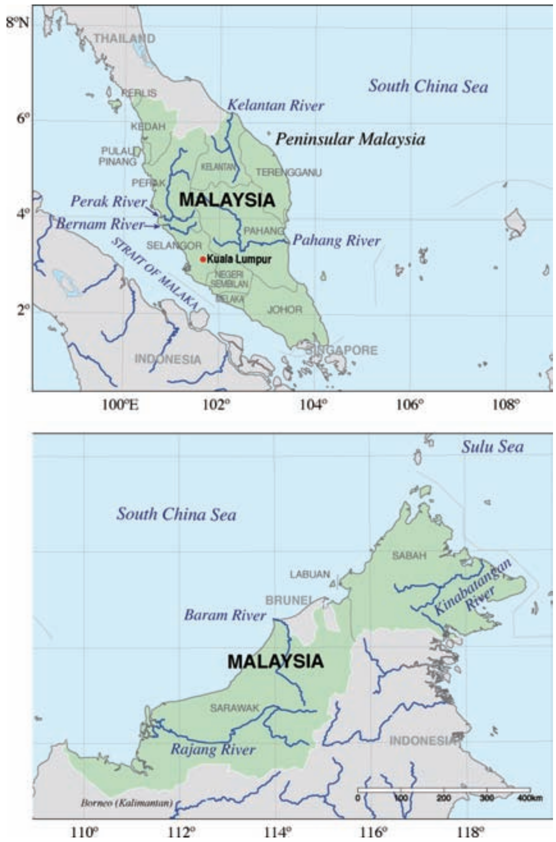
(Source: Sylavong 2008)

# Malaysia

## Country Information

| | | |
|---|---|---|
| Area (km$^2$) | | 329,700 (2007) |
| Population | | 26.5 million (2007) |
| GDP (USD) | at current prices | 186,720 mil (2007) |
| Mean annual precipitation (mm) | | 3,000 |
| Renewable water resources (m$^3$) | | 580 billion |
| Total water withdrawal (m$^3$) | | 9 billion (2000) |
| Water use by sector (2000) | Agriculture | 62% |
| | Industry | 21% |
| | Domestic | 17% |

## Water Bodies in Malaysia




## State of Water Resources

Water resources in Malaysia are generally abundant, with seasonal variations. Most areas in Peninsular Malaysia receive a national average rainfall of 2,500mm and 3,500mm in Sabah and Sarawak. High precipitation falls in the monsoon months during November to January, which affects areas such as the northeastern area of Peninsular Malaysia, West Sarawak and North East Sabah.

Droughts occur occasionally. The most prominent droughts happened in 1998 sometimes coinciding with the El Niño phenomena. Droughts are managed through the monitoring of dry events by the Department of Irrigation and Drainage. Floods are managed through various flood mitigation using structural and non-structural means.

Surface water provides 97 percent of water supply for domestic, industrial, and agricultural use. About 80 percent of the water withdrawn from the river system is used for irrigation purposes. In the future, the percentage of water use for domestic and industrial uses is expected to command a bigger share of the water withdrawn from surface water sources. Potable water supply coverage extended to most areas throughout the country, with the exception of a few isolated spots where water supply network coverage remains difficult or inaccessible due to physical or geographical factors. Groundwater well or rural water supply scheme system will be provided in those spots.

## State of Water Environment

*River water*

In Malaysia, the Water Quality Index (WQI) is used to evaluate the status of river water quality. The WQI is calculated using the values of six parameters: DO, BOD, COD, $NH_3$-N, SS, and pH. According to the WQI, the status of water quality is classified into three categories: “clean,” “slightly polluted,” and “polluted.”

Figure 1 shows the trend of water quality evaluated by WQI. The number of river basins classified as “clean” increased after 2000. In terms of water quality at monitoring stations, out of 1,064 stations within 146 river basins, 619 (58%) were found to be “clean,” 359 (34%) were “slightly polluted” and 86 (8%) were “polluted.” Stations located upstream were generally “clean,” while those downstream were either “slightly polluted” or “polluted.”

The major pollutants are BOD, $NH_3$-N and SS. The main sources of those pollutants are untreated or partially treated sewage, discharge from agro-based and manufacturing industries, earthworks and land clearing activities.

Analysis of heavy metals in 5,613 water samples revealed that almost all samples complied with Class III (Table 1), National Water Quality Standards for arsenic (As), mercury (Hg), cadmium (Cd), chromium (Cr), lead (Pb) and zinc (Zn), except iron (Fe) which was 83 percent compliant.

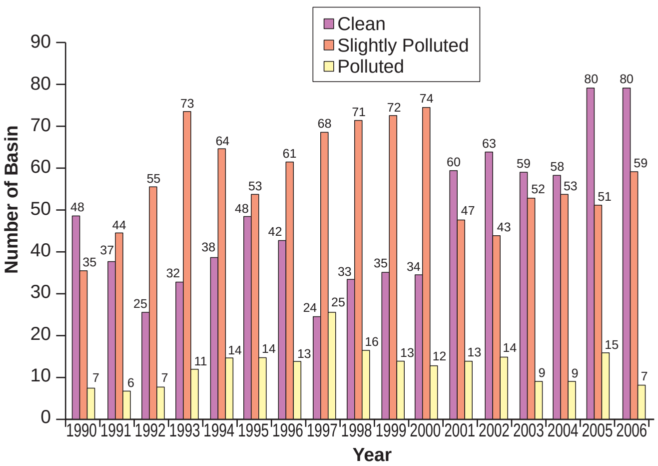



Figure 1. Water Quality Trend of River Basins, 1990-2006

(Source: DOE 2007)

*Groundwater*

Groundwater quality status was evaluated based on the National Guidelines for Raw Drinking Water Quality from the Ministry of Health (revised in December 2000) as a benchmark.

In 2006, 340 water samples were taken from monitored wells. Iron (Fe) levels exceeding the benchmark were recorded in all samples. Between 30 percent and 100 percent of the samples taken from all sites showed high levels of iron. The sampling results also showed that between 15 percent and 100 percent of samples taken from all areas recorded manganese (Mn) levels exceeding the benchmark. Between five percent and 13 percent of samples in rural areas (5%), landfills (5%), municipal water supply (5%), golf courses (7%), agricultural areas (9%) and industrial areas (13%) were found to exceed the nitrate benchmark except in urban/suburban, ex-mining areas and radioactive landfills. Arsenic levels exceeding the benchmark were recorded at radioactive sites (100%), ex-mining areas (67%), solid waste landfill (44%), municipal water supply (36%) and agricultural areas (20%).

*Marine water*

The Interim Marine Water Quality standards (IMWQS) have been used as the benchmark for the marine monitoring program in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak.

A total of 1,035 samples from 229 monitoring stations were analyzed in 2006. As in previous years, the main contaminants of the coastal waters of all states that exceeded the IMWQS were total suspended solids (75%), Escherichia coli (55%) and oil and grease (35%). Sources of the total suspended solids are agricultural activities, tourism development, coastal reclamation, logging and road construction. Sources of the E. coli are untreated or partially treated domestic and animal wastes. Sources of oil and grease are effluent discharged from vessels such as tank clearing, deballasting, bilges and bunkering, and leakages and disposal of engine oil from ferries and boats.

Overall comparison showed an increase in E. coli, mercury and arsenic levels in marine waters and a decrease in total suspended solids, oil and grease, copper, lead, cadmium and total chromium in 2006 compared to the previous year.

The islands monitored are categorized as development islands, resort islands, marine park islands and protected islands. A total of 344 samples were collected and analyzed. The major pollutants identified in island marine waters were total suspended solids, E. coli and oil and grease.

## Legislative Framework for Water Environment Management

The ultimate objective of Malaysia's environmental management (including water quality management) is improvement of living standards and the sustainability of its citizens' quality of life.

In Malaysia, environmental acts and regulations were established in the 1970s. The Environmental Quality Act (EQA) 1974 is an act related to the prevention, abatement, and control of pollution, and enhancement of the environment. The Act ordains that the Minister, after consultation with the Environmental Quality Council, may elaborate regulations for prescribing ambient water quality standards and discharge standards, and specifying the maximum permissible loads that may be discharged by any source into inland waters, with reference either generally or specifically to the body of waters concerned.

*National water quality standards*

National Water Quality Standards (NWQS), which is applied to surface waters, sets out standard values of 72 parameters in six water use classes. The goal is not to meet the standards of a particular water class in all surface waters, but to improve water quality gradually in order to meet the standards of a higher water class than the actual, current class.

Table 1. Water Use Classes in the National Water Quality Standards

| Class | Uses |
|---|---|
| I | Conservation of Natural Environment and Water Supply I: Little to no treatment necessary<br>Fisheries I: Very sensitive aquatic species |
| IIA | Water Supply II: Conventional treatment required<br>Fisheries II: Sensitive aquatic species |
| IIB | Recreational use with body contact |
| III | Water Supply III: Extensive treatment required<br>Fisheries III: Common, of economic value, and tolerant species; livestock drinking |
| IV | Irrigation |
| V | None of the above |

The IMWQS, which sets out standard values for nine parameters, is currently under review in order to cover other parameters and reexamine the current standard values, which are not easily complied with.

Groundwater Quality Standards for Malaysia have not yet been established, but considering the potential of groundwater as an alternative source for surface water, the Department of the Environment (DOE) instituted the National Groundwater Monitoring Program to determine the groundwater quality status. Since the standards have still not yet been established, groundwater quality status is determined based on the National Guidelines for Raw Water Quality as the benchmark.

**Conservation of Water Quality**

**General**

- Environmental Quality Act
- Environmental Quality Standards for Surface Water
- Effluent Discharge Standards

**Specific Area**

- Selangor Waters Management Authority Enactment (1999)
- Kedah Water Resources Enactment (2007)
- Sabah Conservation of the Environment Enactment
- Sabah Water Resources Enactment (1998)
- National Resources and Environment Ordinance Sarawak

**Specific Sector**

**Peninsular Malaysia**

1. Agriculture
   - Irrigation Areas Act (1953)
   - Drainage Works Acts (1954)
2. Forestry
   - National Forestry Act (1984)
3. Control of River
   - Water Acts (1920), Reviewed (1989)
   - River Rights Enactment of Perak
   - Kelantan River Traffic Enactment (1955)
   - Pahang River Launches Enactment 6/49
4. Land Management
   - National Land Code (1965)
   - Land Conservation Act (1960)
   - Earthwork by laws
5. Domestic Water Supply
   - Water Services Industry Act
6. Mining
   - Mining Enactment (1936)
7. Local and Regional Planning
   - Town and Country Planning Act (1976)
8. Fishery
   - Fisheries Act (1963)
9. Others
   - Local Government Act (1976)
   - Street Drainage Building By Law (1974, 1994-R)
   - Geological Survey Act
   - Ministerial Function Act (1969)

**State of Sabah and Sarawak**

1. Agriculture
   - Drainage and Irrigation, Sabah Ordinance (15/1956)
   - Drainage Works Ordinance Sarawak (1966)
2. Forestry
   - Sabah Forest Enactment (1965)
   - Forest Ordinance Sarawak, Cap126
3. Control of River
   - Sarawak Water Ordinance,
   - Sarawak Riverine Transport Bill (1993)
4. Land Management
   - Sabah Land Ordinance (1930)
   - Sarawak Land Code (1958)
5. Domestic Water Supply
   - Water Services Industry Act
6. Mining
   - Mining Enactment (1960 Sabah)
   - Mining Enactment (1949 Sarawak)
7. Local and Regional Planning
   - Town and Country Planning Enactment Sabah Cap 141
   - Town and Country Planning Sarawak Cap 87
8. Others
   - Local Authority Enactment, Sabah Ordinance (11/1961)
   - Local Authority Ordinance Sarawak Cap 117

Figure 2. Legislative Chart for Water Quality Management

(Source: NRE and NAHRIM 2009)

*Monitoring of water quality in public waters and groundwater*

Rivers: The DOE started its monitoring program in 1978 to establish baselines and detect water quality changes in river water quality. Water samples are collected at regular intervals from designated stations for in-situ and laboratory analysis to determine its physico-chemical and biological characteristics. There are two types of monitoring stations: manual water quality monitoring (MWQM) stations and continuous water quality monitoring (CWQM) stations. In MWQM stations, the frequency of the monitoring is determined by the status of the river water quality. Samples are taken a minimum of once a month, or once every four days at the most.

Marine water: Considering that marine water quality monitoring plays an important role in the conservation of marine resources which contribute to the stability and diversity of the marine ecosystem, DOE started a marine monitoring program in 1978 for Peninsular Malaysia and in 1985 for Sabah and Sarawak. The monitoring results are described in comparison to the IMWQS.

Groundwater: Recognizing the future potential of groundwater as an important alternative source of (surface) water, in 1997, the DOE initiated the National Groundwater Monitoring Program. As environment standards for groundwater are not established, the groundwater quality status is determined based on the National Guidelines for Raw Drinking Water Quality as the benchmark. By 2006, 88 monitoring wells had been established at 48 sites in Peninsular Malaysia, 19 wells in Sarawak and 15 wells in Sabah. The sites were selected and categorized according to the surrounding land uses.

**Integrated River Basin Management (IRBM) Approach in Water Quality Management – Case Study in Sungai Selangor River Basin –**

In Malaysia, there are many departments and agencies that oversee rivers. Each of these entities look at its respective needs, thus it is important that rivers are managed in an integrated and holistic manner taking into account needs of all stakeholders. The establishment of the Selangor Waters Management Authority (SWMA/LUAS) in 1999 was an important step for Malaysia towards the management of rivers in an integrated manner. The SWMA/LUAS was established to plan, research, facilitate, coordinate, operate, enforce, and supervise the development of an integrated management plan for water resources and the environment. The plan covers all areas in Selangor state, which has an area of 7,955km$^2$ and supports a population of about four million people within nine districts.

Water resources in Selangor, which come from rivers, reservoirs, groundwater, lakes, and ponds, are relatively abundant. Water in lakes and ponds are considered as alternative resources which may be used in times of drought.

Rivers in Selangor cross district boundaries. There are also rivers which form states boundaries and are shared by several states. As such there is an urgent need to manage rivers in an integrated manner.

An Integrated River Basin Management (IRBM) project was conducted in the Sungai Selangor Basin, which is the third largest river basin in the state. The objective of the IRBM project was to manage the natural resources of Malaysia on a long-term sustainable basis using an integrated river basin approach to resource management. The project was conducted from 2002 to 2007, with funding from both the Malaysian Government and the Danish Government via its overseas development agency, Danida.

Seven working groups (animal husbandry, land use, aquaculture, water resources, water quality, sand mining and an IRBM working group) were established in this project. In 2003 and 2007, a workshop and seminar were held to raise awareness on IRBM and prepare the Sungai Selangor Basin Management Plan.

Within the Sungai Selangor Basin Management Plan (2007-2012) four main policy were explored. In each of these four policies, issues are analyzed and policies and strategies are determined and ways of their implementation are indicated.

Policy 1: Ensure sufficient water
Policy 2: Ensure clean water
Policy 3: Protect against floods
Policy 4: Conserve the fireflies

With respect to Policy 2, water quality at the main water intake points are to remain at clean status (Class II). However, these points are being put under pressure especially from development activities especially in the Rawang area.

To address the issue of river water pollution and to ensure clean water for water supply and for the environment, the state is determined to reduce pollution from existing sources and prevent pollution from new sources. Various kinds of actions and activities are being carried out, including identification of sources of pollution in term of locality, type of pollution and quantity of pollution (domestic and industrial wastewater, wet market, animal husbandry, freshwater aquaculture, solid waste, soil erosion, and sand mining). After the sources of pollution are identified and locations visited, a meeting of the Task Force of the Sungai Selangor Pollution Control, which consists of various relevant organizations, is held and chaired by the Director of SWMA/LUAS. All relevant agencies take integrated action to address the problem.

The Sungai Selangor Basin Management Committee, chaired by EXCO Infrastructure & Public Utilities, manages the Sungai Selangor Basin using an integrated and holistic approach with the cooperation of government agencies, the private sector, stakeholders and communities.

*Effluent standards*

Environmental Quality (Sewage and Industrial Effluents) Regulations in 1979 established discharge standards. In addition, other discharge standards have also been established for the prescribed premises; raw natural rubber and crude palm-oil, under the Environmental Quality (Prescribed Premises) (Raw Natural Rubber) Regulations in 1978 and the Environmental Quality (Prescribed Premises) (Crude Palm-Oil) Regulations in 1977.

Currently, the regulations, including discharge standards, are under review in order to establish new discharge standards for each sector.

Section 25, EQA 1974 sets out restrictions on pollution of inland waters where no person shall, unless licensed, emit, discharge or deposit any environmentally hazardous substances, pollutants or wastes into any inland waters in contravention of the acceptable conditions specified under Section 21.

This provision allows for enforcement, whereby surprise inspections are carried out at all premises by DOE officials to ensure compliance with all provisions in the act. Non-compliance results in prosecution and punishment.

*Policy trends in water environmental conservation*

Both the act and effluent standards are being reviewed, in order to update the act and ensure that effluent standards are appropriate for current treatment technologies.

The effluent standards are being reviewed and placed into separate categories of industrial sources and sewage treatment plants. In addition, the ambient Marine Water Quality Standards are also being reviewed.

## Existing and Future Challenges for Water Environment Management

Insufficiently treated sewage, discharge of effluent from agro-based and manufacturing industries and effluent from livestock farming are the current causes of water pollution.

The trend of the monitoring results of river water quality from 1990 to 2006 shows that the quality of river water has improved. However, some river basins are still evaluated as “polluted” and improvement of the water quality of those river basins is an issue to be addressed. Restoration of rivers is another issue that water management should take up. In addition, Integrated River Basin Management (IRBM) is the approach to take for the proper management of water resources.

# Myanmar



### Country Information

| | | |
|---|---|---|
| Area ($km^2$) | | 676,500 |
| Population | | 48.8 million (2007) |
| GDP (USD) | at current prices | 18,510 mil (2007) |
| Mean annual precipitation (mm) | | 2,341 |
| Renewable water resources ($m^3$) | | 1,046 billion |
| Total water withdrawal ($m^3$) | | 33.2 billon (2000) |
| Water use by sector (2000) | Agriculture | 98% |
| | Industry | 0.5% |
| | Domestic | 1.5% |

### Water Bodies in Myanmar


### State of Water Resources

A potential of water resources in Myanmar is abundant to meet not only for domestic water supply but also the demand of agriculture production. The catchment area of Myanmar's eight principal river basins is approximately 737,800$km^2$, and the average annual inflow of water is 1,080.6$km^3$. Current utilization totals only about 39.55 $km^3$, and it is clear that the physical potential for further development of water resources in Myanmar is substantial. Freshwater resources are mainly used by the agriculture sector with small quantities being used for domestic, industrial and other purposes. The overall goal for water sector is the alleviation of poverty and improvements to living standards by means of sustainable development of water and water resources, and conservation of the environment. Although Myanmar has abundant water resources and no scarcity of water at present, proper management and a strong policy on sustainable and continuous development of the economy and environmental conservation are required for the security of future generations.

*Groundwater*

In Myanmar, where a perennial supply of surface water is not available, groundwater is naturally utilized, and sometimes at quite a cost. Groundwater has a greater advantage over surface water as it is usually free from pathogenic organisms and bacteria causing water related diseases. However, if the chemical quality of the water is poor, it may not be fit for drinking purposes, unless treated to acceptable levels. Nowadays, groundwater is being exploited not only for domestic water supply, but for industrial and agricultural purposes in areas where conditions are favorable, as well. The total estimated groundwater potential in Myanmar is 494.713$km^3$ per year. The annual groundwater water potential in Myanmar is shown in Figure 1.

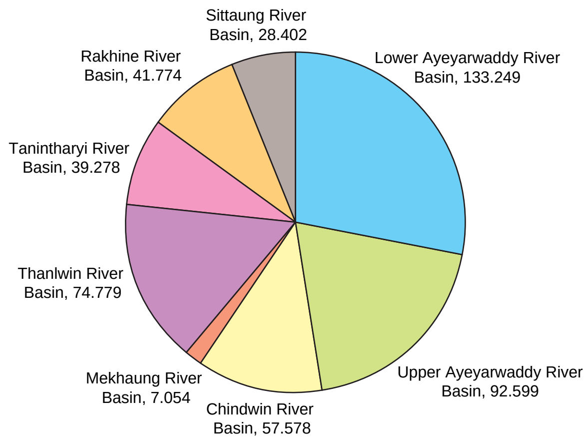



Figure 1. Annual groundwater water potential in Myanmar (million acre feet/year)

**Groundwater Utilization in Yangon City**

People in Yangon City, the most populated area of Myanmar, have been using groundwater from hand-dug wells for centuries to the present for their domestic, livestock and agricultural needs. Depths for surface wells dug by hand are limited, and in such cases, only the uppermost aquifer has been tapped. Water yield is usually diminished during the dry season with the exception of a few wells from which water is available throughout the year. In later years, drilling of deep wells by mechanical and electrical means was developed to tap groundwater from deep aquifers where a much higher and stable yield is obtained throughout all seasons of the year.

(Source: Tun et al. 2009)

## State of Water Environment

### *Water and sanitation status*

Safe drinking water supply and adequate sanitation facilities are essential elements in the protection of the environment, and improvement in health conditions and living standards. The population of Myanmar from 2007-2008 was estimated at 56 million, of which the Yangon Metropolitan area accounts for about 11 percent of population. The population is concentrated in the central area, particularly in and around the cities of Yangon and Mandalay. The population is unevenly distributed with greater density in urban areas. Also, as Myanmar's climate is hot and humid, the demand for water is high.

In Myanmar, several government agencies and departments under different ministries independently carry out programs for sustainable access to safe drinking water supply throughout the country. At present, there are a number of government water supply agencies such as the Department of Development Affairs under the Ministry for Progress of Border Areas and National Races and Development Affairs; Public Works (Department) and Department of Human Settlement and Housing Development under the Ministry of Construction; Yangon and Mandalay City Development Committee (YCDC,MCDC) under the respective mayors.

The government has given priority to implementing water supply program in villages that have inadequate water supply in central zone area. In this context, the Ministry for Progress of Border Areas and National Race and the Department of Development Affairs are undertaking program to ensure safe drinking water supplies in rural areas where water resources are scarce. YCDC and MCDC are also providing water supplies to Yangon and Mandalay from surface water as well as groundwater.

Myanmar strives to safely dispose of human excreta in both urban and rural areas, in order to improve sanitation conditions. Since 1982, a sanitation pilot project has been carried out in 13 townships in four geographical regions (dry zone, coastal, hilly and delta), in collaboration with the United Nations Children's Fund (UNICEF). Since 1996, The successful outcomes from the pilot project lent promise to the expansion and application of the program throughout the country with the implementation of the National Sanitation Program on self-help basis.

Myanmar has a plan to develop sanitation standards for cities and towns. As well, authorities are trying to improve and rationalize the wastewater disposal system throughout the country based on the experiences and examples set by the country's two major cities, Yangon and Mandalay.

In view of the importance of safe water sanitation to the well-being of the urban population, the government has initiated the establishment of a ministerial level National Water Supply and Sanitation Committee to set policy guidelines and oversee the performance of the sector, especially in the urban areas of the country. It has been increasing budgetary allocations for the sector and intensely cooperating with bilateral and multilateral parties to ensure universal access to safe drinking water and sanitation for the future development of the country.

### *Groundwater*

The physical and chemical quality of groundwater is not always at acceptable levels. In Yangon City, the quality of groundwater is tested periodically, since private owners who are interested in the quality of groundwater need to submit a request in to YCDC to have their tube wells checked. The most common tests conducted are on color, turbidity, pH, hardness, iron and chloride. Bacteriological tests are rarely carried out except in cases where authorities determine it to be necessary. Objections to groundwater quality usually arise from physical parameters such as color, turbidity, taste and odor. The presence of chemical impurities like iron and chlorides also presents problems to users. However once a tube well has been dug, it is seldom abandoned, even if the water quality if poor. Drilling a new tube well is an added cost which many private owners cannot afford. The water, though not totally potable, is therefore still utilized for domestic purposes other than drinking. In such cases bottled water is used for drinking. The tests for groundwater quality were evaluated in line with the Proposed National Drinking Water Quality Standards (PNDWQS), Myanmar 2006.

## Legislative Framework for Water Environment Management

### *Laws to control pollution*

Myanmar has no specific laws to control water pollution. There is a general provision in Section 9 of the Public Health Law of 1972, which empowers the Ministry of Health to carry out measures relating to environmental health, such as garbage disposal, use of water for drinking and other purposes, radioactivity, protection of air from pollution, and food and drug safety. However, detailed provisions do not exist to ensure more effective and comprehensive regulation of these matters. In the regulation of hotels and tourism, there are no provisions for pollution control. Although the Burma Port Act of 1908 contains a paragraph about harbor pollution, this merely focuses on the detriment to navigation. The only control of water pollution in the country is through guidelines issued in June 1994 by the Myanmar Investment Commission. These guidelines require that new investment projects have wastewater treatment systems. River and lake pollution from sewage, industrial waste and solid waste disposal are serious problems in Myanmar, but are not explicitly regulated by a particular law, so new laws relating to pollution must be enacted.

### *Water quality protection and standards*

The main causes of deteriorating water quality are sewage, solid waste, industrial waste and agrochemical waste. Water conservation is undertaken by local City Development Committees under protection of water quality. Wastewater management is both a municipal and industrial problem. In cities that are undergoing rapid industrialization, the municipal treatment issue is complicated by the addition of under-treated or semi-treated industrial waste discharged into the municipal sewage system, thus stricter laws to control water quality should be imposed. Moreover, the country is still facing problems from the direct discharge of wastewater from factories into rivers and streams. Recently, the National Commission for Environmental Affairs (NCEA) and NGOs proposed effluent standards for proper disposal of wastewater from factories.

In the agricultural sector, the government and ministries concerned have banned use of some toxic pesticides and encouraged the utilization of conventional bio-fertilizers as a substitute for chemical fertilizer to mitigate water quality deterioration. At present, the control of water quality is based on

World Health Organization (WHO) standards.

At present, ministries and departments involved in the control of water quality have organized a forum of experts on water quality issues. WHO proposed standards were adopted as reference. Water quality control measures were being taken case by case, especially for bottled drinking water production. Arsenic and other parameters have been tested in collaboration with the Water Resources Utilization Department (WRUD), Department of Development Affairs (DDA), and UNICEF. The Environmental and Sanitation Division under the Ministry of Health is implementing a program on water supply systems with health institutions and also carrying out a Water Quality Surveillance and Monitoring System Pilot Project in former capital of Yangon.

*Wastewater effluent standards*

YCDC convened a meeting in July 2001 to introduce proposed environmental standards for Yangon, which includes standards on emission, noise Wastewater Effluent and toxic chemicals. Similarly there are governmental departments, which have set their own standards with regard to the protection of a part of the environment in which they are fully involved.

The main objective of the National Commission for Environmental Affairs is to conserve the environment and prevent its degradation in the utilization of water, land, forest, mineral, marine and other natural resources. The current measures mentioned above are totally in line with the National Environment Policy of Myanmar initiated by the National Commission for Environmental Affairs.

### Chronology of Myanmar's Legal Framework with Environmental Implications

There are in existence a number of legal frameworks and legislations, some dealing directly and others indirectly, with the control of wastewater pollution. However, all of them deal with the general protection of the environment in one way or another. Some of the legislations date back to as far as the latter part of the 19th century, during which the very first law on water pollution, the Penal Code, was enacted in 1860. The following are the Myanmar legal frameworks on environmental protection enacted during a span of about one–and–a–half centuries, listed in chronological order.

In chronological order:

1. Penal Code, 1860
2. Yangon Waterworks Act,1885
3. Canal Act, 1905
4. Yangon Port Act, 1905
5. Port Act, 1908
6. City of Yangon Municipal Act, 1922
7. Emergency Provisions Act, 1950
8. Factories Act, 1951
9. Territorial Sea and Continuous Zone Law, 1977
10. Law Relating to the Fishing Rights of Foreign Fishing Vessels, 1989
11. Myanmar Marine Fisheries Law, 1990
12. Pesticide Law, 1990
13. Fresh Water Fisheries Law, 1991
14. Development Committees Law, 1993
15. Myanmar Hotel and Tourism Law,1993
16. Protection of Wild Animals, Wild Plants and Preservation of Natural Areas Laws, 1994
17. Myanmar Mines Law,1994
18. Conservation of Water Resources and River Law, 2006

All the legislations are in one way or another relate to the control of water pollution and the preservation of the environment.

In the Penal Code of 1860 it was stipulated that the person(s) who voluntarily corrupts or fouls the water of any public spring or reservoir so as to render it less fit for the purpose for which it is intended, shall be punished with imprisonment or with both.

Similarly the Development Committee Law of 1993, the Yangon Municipal Act of 1922, and the Yangon Waterworks Act of 1885 all deal with penalties for polluting bodies of water within the municipal jurisdiction.

The Protection of Wild Animals, Wild Plants and the Preservation of Natural Areas Law of 1994 deal indirectly with the control of water pollution by prohibiting the destruction of ecological and environmental conditions of the natural areas.

The Factories Act of 1951 is directly related to the development and establishment of factories by stating that factories are required to have effective plans for the disposal and cleaning of waste generated by the factory. In other words, industries shall provide their own treatment plants to remove or reduce potential pollutions from its wastewater before disposing its effluent.

The Conservation of Water Resources and Rivers Law was lastly enacted in 2006 and is intended to conserve and protect the water resources and rivers system for beneficial utilization by the public and to protect the environmental.

Evidently there are legislations, covering numerous sources of potential pollution, on the control of water pollution. What is lacking at this stage are appropriate standards for both domestic and industrial wastewater effluent. Setting effluent standards will guide industries from any unintentional infringement of the law, while also keeping the environment clean.

## Existing and Future Challenges for Water Environment Management

There are many water related sub-sectors in Myanmar such as irrigation and drainage, water for environment and ecosystems, drinking water and water utilization for industries and sanitation. These should be integrated to exchange views and promote understanding of the quality and quantity of water use and the value of water in the social sector and exchange of views.

Water use efficiency for on-farm levels is still very poor (approximately 40%-50%), which leads us to believe that 50% of irrigation supply is lost in canals and fields. Misuse of irrigation water results in water logging, and salinization of soil due to rising groundwater levels from the percolation effect. The over use of water at the upstream deprives downstream users from sufficient water amounts, and leads to pollution of freshwater resources by contaminated return flow.

Nevertheless, the Environmental Impact Assessment is still weak in water resources management. Due to the ongoing rapid industrialization in cities, there are so many factories around urbanized areas, and there is still a need to disseminate the knowledge about the proper disposal of wastewater to control the problems of the direct discharge of wastewater from factories into rivers or streams.

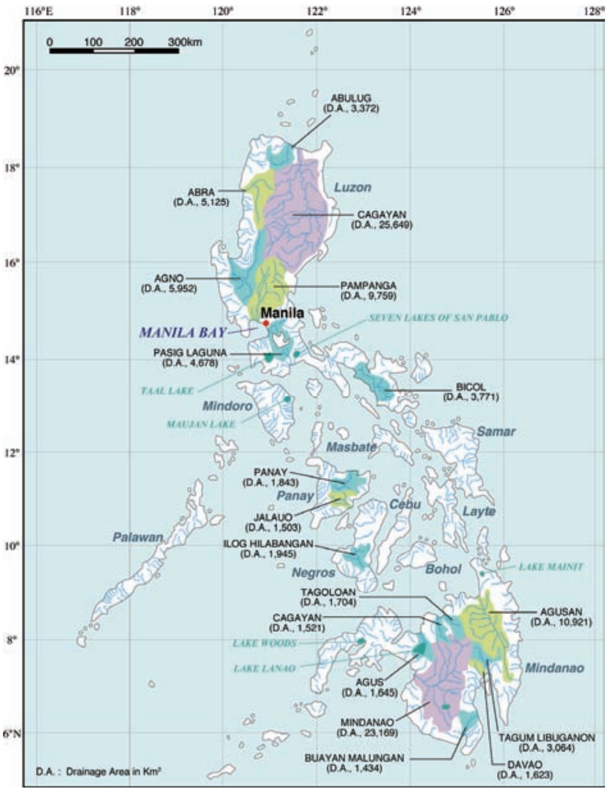
Other weaknesses in water environment management are a lack of appropriate monitoring facilities, proper and systematic keeping of records, regular monitoring and surveillance data for water quality control and basic standards of water quality for drinking water.

Although there are many laws, acts, legislations and regulations related to water sector, most of the laws and acts for water sectors still need to be modified. Therefore, these laws and regulations should be reviewed to enact unified water resources laws to promote a more effective legal framework for coordination and management of water resources.

## Country Information

| | | |
|---|---|---|
| Area | | 300,000 (2007) |
| Population | | 87.9 million (2007) |
| GDP (USD) | at current prices | 144,129 (2007) |
| Mean annual precipitation (mm) | | 2,373 |
| Renewable water resources (m³) | | 479 billion |
| Total water withdrawal (m³) | | 55,422 million (1995) |
| Water use by sector | Agriculture | 88 % |
| | Industry | 4% |
| | Domestic | 8% |

## Water Basins in the Philippines




## State of Water Resources

The Philippines enjoys its abundant water resources with availability of 5,580km³/year/capita, although water availability is subject to geographical and seasonal imbalances. There are 18 major river basins with 421 principle rivers and 79 natural lakes. The coastal line is 17,460km and about 60 percent of the Philippines municipalities and cities are located in the coastal areas where many people live. Surface water is the main water source of the country and also an important resource for fishing and transport. Groundwater is also an important source for domestic and drinking use in some regions. Groundwater consists of 14 percent of the total water resource potential, while about 50 percent of drinking water sources or 86 percent for piped water supply systems depends on groundwater.

Due to population growth and economic development, water demand is on the increase and water pollution has intensified. Access to clean water is an issue in some areas of the country especially during the dry season, according to the monitoring data of the government. Such areas include Metro Manila, Central Luzon, Southern Tagalog, and Central Visayas.

## State of Water Environment

Water quality is assessed based on the water quality criteria set by Department of Environment and Natural Resources (DENR) as embodied in DENR Administrative Order 34, Series of 1990 (DAO 90-34), which states that the quality of Philippine waters shall be maintained in a safe and satisfactory condition according to their beneficial usages (as shown in Table 1). As of 2005, the Environmental Management Bureau (EMB) had classified 525 water bodies, which is about 63 percent of the total water bodies in the country. The classification was based according to its beneficial use and water quality.

Table 1. Classification of Water Bodies

| Water Bodies | Classification | Beneficial Use |
|---|---|---|
| For Fresh Surface Waters (rivers, lakes , reservoirs, etc.) | Class AA | Public Water Supply Class 1<br>• Waters that require disinfection to meet the National Standards for Drinking Water (NSDW) |
| | Class A | Public Water Supply Class 2<br>• Waters that require complete treatment to meet the NSDW |
| | Class B | Recreational Water<br>• Waters for primary contact recreation (e.g. bathing , swimming, skin diving, etc.) |
| | Class C | Water for fishery production<br>• Recreational Water Class II (boating etc.)<br>• Industrial Water Supply Class I |
| | Class D | • For agriculture, irrigation, livestock watering<br>• Industrial Water Supply Class II |
| For Coastal and Marine Waters (as amended by DAO 97-23) | Class SA | Water suitable for fishery production<br>• National marine parks and marine reserves<br>• Coral reefs parks and reserves |
| | Class SB | • Tourist zones and marine reserves<br>• Recreational Water Class I<br>• Fishery Class I for milkfish |
| | Class SC | • Recreational Water Class II (e.g. boating)<br>• Fishery Water Class II (commercial)<br>• Marshy and/or mangrove areas declared as fish and wildlife sanctuaries |
| | Class SD | • Industrial Water Supply Class II<br>• Other coastal and marine waters |

Major pollution sources of surface and coastal waters in terms of BOD load are point sources. The type of point source and contributing ratio is shown in Figure 1. Among non-pollution sources, agricultural run off is the major source with 74 percent in terms of BOD.

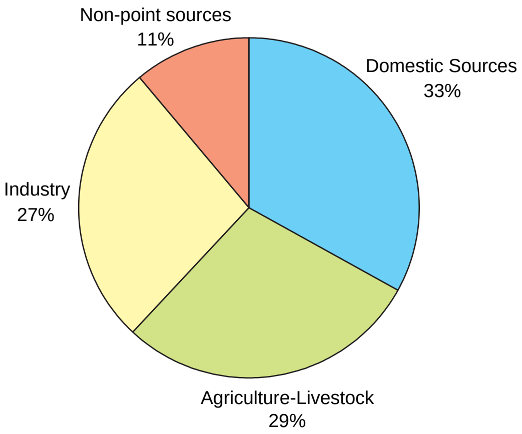
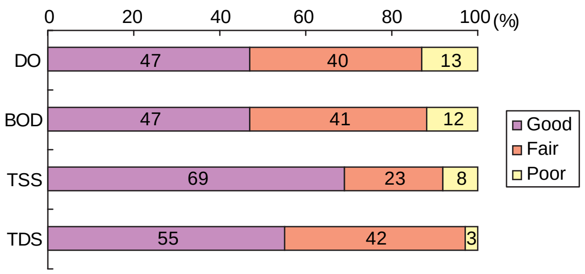



Figure 1. BOD loads from Key Potential Pollution Sources

(Source: EMB 2007)

*Surface water*

EMB conducted inland surface water monitoring for 192 rivers and four lakes from 2001 to 2006. Figure 2 shows the compliance ratio of some key parameters of water quality, according to the monitoring results. EMB prioritized 19 rivers for monitoring under the Sagip Ilog (Save a River) Program. The prioritized rivers are expected to satisfy 30 percent improvement of BOD and DO value by 2010, compared with 2003 monitoring results. According to the monitoring results from 2003 to 2005, out of 19 priority rivers, eight showed signs of improvement in DO levels and nine in BOD levels. On the other hand, the monitoring results showed that some rivers such as Meycauayan River (Central Luzon) and Pasig River (National Capital Region) had become further polluted during the same period. As for heavy metals, chromium, cadmium and lead values exceed the standards in some rivers, while cyanide levels in most sampling locations were below the standard.




Note (1): The rating is based on the criteria set by DAO 90-34. See the following table for details.

| Rating | Percentage | Significance |
|---|---|---|
| Good | 98-100 | Water body complies with the desired water quality criteria and fully supports its intended beneficial use. |
| Fair | 50-97.99 | Water body mostly complies with the designated water quality criteria and is not supporting its intended beneficial use at the percentage. |
| Poor | 0-49.99 | Not able to support its intended beneficial use at the percentage. |

(2) Only water bodies with at least four sampling events, representing water quality during the dry and wet seasons, were included. The rating is based on the percentage of the total number of samples that passed the prescribed water quality criteria. 98 margin is given to consider sampling and computation errors.

Figure 2. Percentage Compliance with the Inland Surface Water Quality

(Source: EMB 2007)

*Groundwater*

The Philippine National Standard for Drinking Water is used as the standard for groundwater quality assessment. Relevant parameters to indicate the degree of pollution includes fecal colifom, nitrates and salinity (chloride).

Under the tapwatch program, EMB monitored 88 shallow wells in the country. Of this, only 21 sites met the potable groundwater quality standard, while 27 failed the fecal coliform standard for drinking water. An additional forty sites required further testing to confirm potability. Nitrate level was monitored in Metro Cebu and Central Mindanao. Not many sites were contaminated.

Studies conducted for salinity levels in Metro Manila and Metro Cebu showed an increase in salinity level in some locations in Metro Manila due to over-abstraction.

*Coastal and marine water*

EMB has regularly monitored a total of 39 bays and coasts in the Philippines since 1996, while Manila Bay has its own monitoring program. With the exception of Puerto Galera Bay which is a protected seascape, the monitoring data indicated that 64 percent had DO levels below 5mg/L, the minimum criteria set for water suitable as fishery spawning areas and tourist zones. On the coasts of Mandaue to Minglanilla in Cebu (Central Visayas), DO levels varied from 0 to 14mg/L, which indicates that the ecosystem is already undergoing "stress" during certain periods.

Fecal coliform was also monitored. Among the 41 priority bathing beaches monitored, only seven beaches failed to comply with the criteria set for class SB waters which is 200 MPN/100mL. The monitoring results further showed that Region 5 has the best status, having all of its seven stations earning a satisfactory rating. On the other hand, Region 3 (Central Luzon) has the lowest compliance status.

Chemical and oil spill incidents are other threats to coastal and marine water quality. The Philippine Coast Guard reported more than 200,000 cases in 2001 and 2005, and 25 percent of incidents originated from illegal discharge, which was followed by accidental discharges or overflow (22%).

Except in Cawacawa (Zamboanga City), the maximum values of BOD were all within the criterion set for Class SB waters of 5mg/L. Manila Bay has BOD levels that are generally within fishery water quality criterion. However, seasonal high organic loadings from rivers draining into the bays and in particular, Manila Bay, also result in harmful algal blooms (HABs) that pose a continuing threat to marine resources and public health.

## Legislative Framework for Water Environment Management

Deterioration of water quality is a critical issue for sustainable development of the Philippines. It is estimated that the annual economic loss caused by water pollution is 67 billion Philippine Peso (PHP). This includes PHP 3 billion for health, PHP 17 billion for fisheries production, and PHP 47 billion for tourism.

The Philippines has many water-related laws, but their enforcement is weak and beset with problems that include inadequate resources, poor databases, and weak cooperation among different agencies and Local Government Units (LGUs). Figure 3 shows the legislative framework regarding water environment management. In addition to the laws/regulations

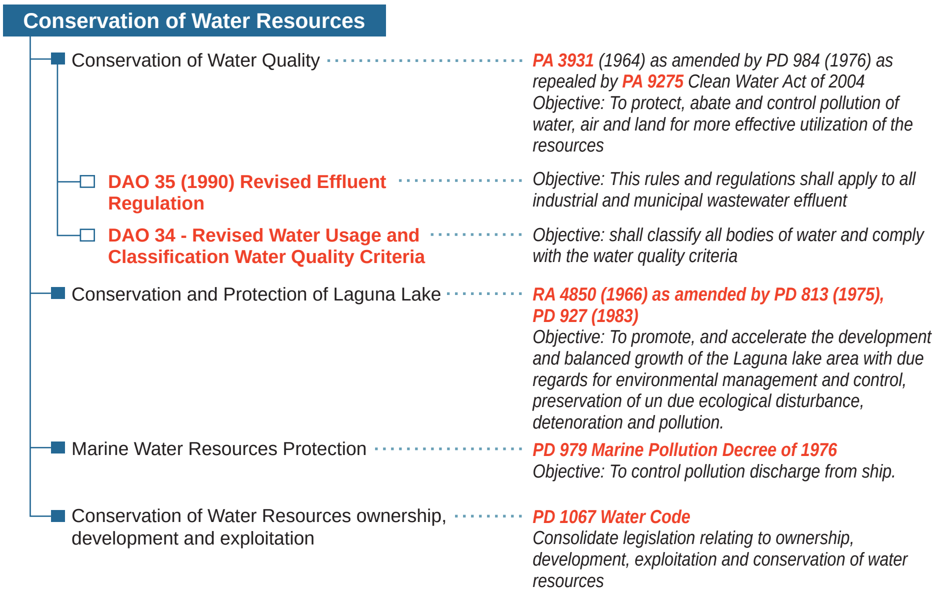



Figure 3. Legislative Chart for Water Quality Management

(Source: WEPA database)

shown in the figure, there are similar legislations related to water environmental conservation, such as the Philippines Environmental Policy (PD1151) and Solid Waste Management Act (RA9003). EMB is the governmental agency responsible for water conservation and protection.

The Philippine Clean Water Act 2004 (RA 9275) is the basic law for water environmental conservation, which amended the Pollution Control Law of 1964 (RA 3931) and Decree revising the RA 3931 (PD 984). The objective of the act is to protect the country's water bodies from pollution from land-based sources (industries and commercial establishments, agriculture and community/household activities). It provides for a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all stakeholders. Implementation of Rules and Regulations for the act was enacted in 2005 as DAO10-2005. The key elements of the act are described as follows.

### Key Elements in the Philippines Clean Water Act

The Clean Water Act (RA 9275) and its Implementation Rules and Regulations (DAO 2005-10) provide a framework for water quality management in the Philippines. The following are some examples of new and key elements of the new management framework.

#### a. Designation of Water Quality Management Areas

Water Quality Management Areas (WQMA) are to be designated by EMB to strengthen and promote efficient and effective water quality management at local levels which have similar hydrological, hydroeclogical, meteorological or geographic conditions. Governing Boards shall be created with participation of relevant stakeholders in each WQMA and chaired by DENR Regional Offices. The Governing Boards are responsible for the development of strategies to coordinate policies, regulations/local legislation, and other measures necessary for the effective implementation of the Clean Water Act. By the end of 2007, seven WQMAs were designated.

#### b. Designation of non-attainment areas

In cases where specific pollutants exceed the water quality guidelines, DENR shall designate "non-attainment areas." In the non-attainment areas, pollution control measures are strengthened to comply with the standards. For example, new sources of pollution will not be allowed in the non-attainment areas without plans to reduce total pollution loads from a facility below the guideline value.

#### c. National Water Quality Management Fund

Water quality management funds are to be established under DENR as a special account in the National Treasury. The fund will be used for such programs as water pollution clean-up operations; guarantees for restoration of ecosystems and rehabilitation; support for research, enforcement and monitoring activities; provision of technical assistance to implementing agencies; rewards and incentives; and support to information and educational campaigns.

#### d. Water pollution permits and wastewater charge system

A wastewater charge system shall be established on the basis of payment to the government for discharging wastewater into water bodies in all water management areas. It is expected that the system is to be an incentive for those who discharge pollutants to reduce their pollution loads such as through modification of production process and investment in pollution control technologies. DENR also issues discharge permits for wastewater, which includes the allowable value of both quantity and quality of effluents, compliance schedule and monitoring requirements.

#### e. Incentives and rewards

For outstanding and innovative projects, technologies, processes and techniques, and activities, rewards will be provided to individuals, private organizations and other entities from the National Water Quality Management Fund. Incentives for industries will also be provided, such as tax and duty exemptions for industrial wastewater treatment/collection facilities.

### *Water quality standards*

According to the classification under the DENR AO No. 34 Series of 1990 (Table 1), the following water quality criteria has been set up for freshwater and coastal and marine water, respectively.

a. Water Quality Criteria for Conventional and Other Pollutants Contributing to Aesthetics and Oxygen Demand
b. Toxic and other Deleterious Substances (for protection of public health)

*Effluent standards*

Section 14 of the Clean Water Act requires owners or operators of facilities that discharge regulated effluents to secure permits to discharge. Discharge permits are legal authorization granted by the DENR to discharge wastewater, provided that the discharge permit specifies among others, the quantity and quality of the effluent that said facilities are allowed to discharge into a particular water body, compliance schedule and monitoring requirements. DENR can also suspend and revoke permits when business entities are not in compliance with the rules and regulations and/or permit conditions.

Effluent standards (DAO 35, 1990) are set as follows:

a. Effluent standards for toxic and other deleterious substance. (Maximum limits for protection of public health)
For this category, effluent standards are set for arsenic, cadmium, chromium, cyanide, lead, mercury (Tot.), PCB, and formaldehyde. Different standard values for each substance are set in accordance with water classification. Stricter values are applied to "new planned industries."
b. Effluent standards for conventional and other pollutants in Protected Waters Category I and II and in Inland Waters Class C. Standards were set for the following:
Color, temperature, pH, COD and settleable solids, BOD, TSS, TDS, surfactants (MBAS), oil and greases, phenolic substances and phenols. These standards apply to protected waters (both fresh and marine waters) and inland waters.
c. Effluent standards for conventional and other pollutants in Inland Waters Class D and Marine Waters Class SC and SD and other coastal waters which are not classified.
The same parameters as in a. were considered with the exception of settleable solids.
d. Interim effluent standards for BOD applicable to old or existing industries producing strong industrial wastes (1990-1994)
e. Effluent standards for new industries producing strong wastes upon Effect of the regulations and for all industries producing strong wastes starting January 1, 1995.
The standard was based on BOD of raw wastewater. The standard covers old or existing industries producing strong waste whose wastewater treatment plants have yet to be constructed.

*Revision of effluent standards for industries*

Currently, the discussion on revision of the current effluent standards is on going. The new effluent standards intend to set Industry-Specific Effluent Standards (ISES). Current capacity and future potential of improvement of wastewater treatment facilities are also considered in the discussion.

*Water quality monitoring*

EMB and its Regional Offices conduct regular water quality monitoring throughout the country. From 2001 to 2005, 238 water bodies were monitored either for classification or for regular water quality monitoring. Depending on the resources, monitoring for these waters bodies is done monthly or quarterly. The information generated serves as an indicator of the present condition compared with past years.

In order to determine compliance by industrial establishments, a series of surveys and follow-up inspections are conducted by personnel of DENR's sixteen regional offices. The monitoring scheme for effluent and stream water quality is based on the guidelines stated in 1994 DENR-EMB Water Quality Monitoring manual.

## Existing and Future Challenges for Water Environment Management

There are many programs and activities implemented by governmental and non-governmental organizations in the country to achieve the objective of water quality improvement under the framework of the Clean Water Act and other relevant laws. Implementation of various programs and activities by different stakeholders should be ensured and promoted to meet objectives. Some of EMB's on-going programs and activities are listed below (EMB 2007).

- Full implementation of the Ecological Solid Waste Management Act (RA 9003) and Clean Water Act (RA 9275).
- Classification of water bodies of which only 64 percent of total principle water bodies were classified as of 2007.
- Implementation of the Sagip-Ilog Program to improve river water quality.
- Conduct of water pollution discharge inventory on both point and non-point sources.
- Monitor industrial effluent of all industries.
- Implement the Tapwatch Program to support improvement of drinking water quality in priority communities (Target: All 320 urban barangays nationwide).
- Implement the Beachwatch Program.
- Conduct information, education and communication campaigns on water quality management.

Programs conducted by other governmental organizations:

- Mining environment and protection program: Assessment of water quality in areas affected by past and present mining activities (Mine and Geoscience Bureau)
- Water resource assessment for prioritized critical areas (National Water Resource Board)
- Development of guideline for watershed resource management and development and national watershed information system (Forest Management Bureau)
- Formulation of the Integrated Coastal Management Framework (Coastal and Marine Management Office)
- Water District Development Project (Department of the Interior and Local Government Unit)

Programs and targets for specific water bodies:

- LLDA: Laguna Lake Development Authority (LLDA) set the milestones for the Bay to comply with water quality criteria in Class C.
- Pasig River: The Pasig River Rehabilitation Commission (PRRC), composed of national government agencies, the private sector and non-government organization, conducts various activities to rehabilitate Pasig River to its pristine condition. Activities undertaken include development of a database on industrial pollution, construction of a septage treatment plant, housing and resettlement, flood control and education and training on waste minimization.

# Thailand

Outlook of Water Environmental Management Strategies in Asia

## Country Information

| | | |
|---|---|---|
| Area (km²) | | 513,000 |
| Population | | 63.8 million (2007) |
| GDP (USD) | at current prices | 245 billion (2007) |
| Mean annual precipitation (mm) | | 1,700 |
| Renewable water resources (m³) | | 410 billion |
| Total water withdrawal (m³) | | 87.1 |
| Water use by sector (2000) | Agriculture | 95% |
| | Industry | 2.5% |
| | Domestic | 2.5% |

## Major Rivers and Lakes in Thailand


## State of Water Resources

Thailand can be divided into 25 river basins, according to geographical characteristics. The total annual rainfall of all river basins is about 800,000 million m³, of which 75 percent is lost through evaporation and the remaining amount stays in streams, rivers, and reservoirs (Office of National Water Resources Committee 2000). The quantity of water available was about 1,412m³/capita/year (FAO AQUASTAT).

## State of Water Environment

The results of water quality monitoring programs showed that most receiving waters met the water quality standards and guidelines. However, rivers in populated areas were polluted due to the discharge of wastewater from various point sources. Thus, mitigation measures such as construction of wastewater treatment plants, hazardous waste treatment, agricultural waste management, industrial waste control, and management of other pollution sources are required.

Regarding pollution sources, wastewater from industrial and domestic activities contributed to water pollution. The following figure shows BOD loads by sector.

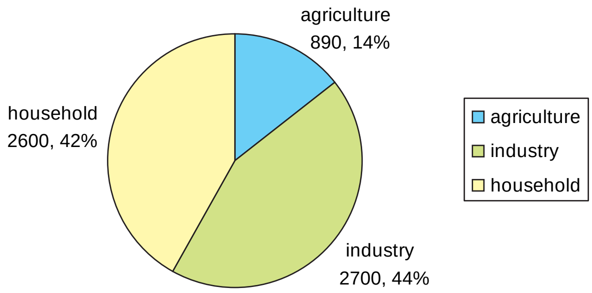



Figure 1. BOD load by sectors (ton/day)

(Source: PCD 2006)

### *River and lake water*

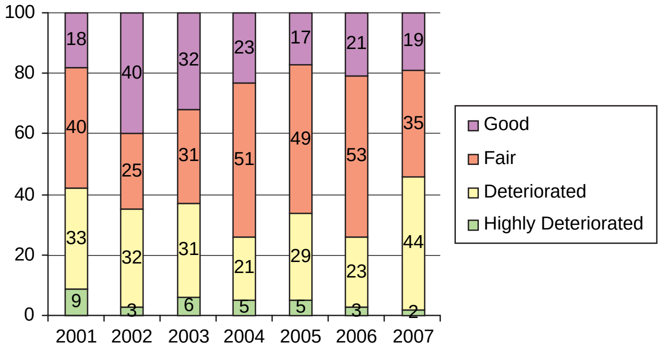
Surface water quality varies widely in the different regions in Thailand. The Pollution Control Department (PCD) of the Ministry of Natural Resources and Environment monitors the quality of 49 rivers and four lakes in Thailand. The state of water quality differs by region as shown in Table 1. Figure 2 also shows the chronological changes of water quality from 2001 to 2007.

Table 1. Average Water Quality in Selected Inland Waters in 2006

| Region | Water Resources (Class) | Average Water Quality*1 | | | | |
|---|---|---|---|---|---|---|
| | | DO (mg/L) | BOD (mg/L) | TCB (Unit*2) | FCB (Unit) | $NH_3$ (mg/L) |
| Northern | Ping (3) | 6.8 | 1.3 | 12,500 | 2,100 | 0.08 |
| | Wang (3) | 7.1 | 1.0 | 13,760 | 3,000 | 0.04 |
| Central | Upper Chao Phraya (3) | 5.4 | 1.3 | 0.520 | 2,150 | 0.12 |
| | Lower Chao Phraya (4) | 2.2 | 3.4 | 47,500 | 19,000 | 0.60 |
| North-eastern | Pong (3) | 4.4 | 1.9 | 1,180 | 60 | 0.25 |
| | Moon (3) | 5.8 | 1.7 | 11,000 | 7,170 | 0.58 |
| Eastern | Bangpakong (3) | 5.2 | 1.2 | 8,360 | 1,390 | 0.13 |
| | Prachinburi | 5.7 | 1.5 | 6,060 | 2,260 | 0.51 |
| Southern | Upper Tapee (2) | 8.2 | 0.6 | 790 | 20 | 0.34 |
| | Songkhla Lake (-) | 4.6 | 1.9 | 19,500 | 9,320 | 0.35 |

*1 The yellow highlighted value means that it exceeds the ambient water quality standard.

*2 Unit means MPN/100mL.




Note: "Good" to "Highly Deteriorated" corresponds to the following:
Good: Surface water quality standard Class 2 and Water Quality Index (WQI) 71-90
Fair: Surface water quality standard Class 3 and WQI between 61-70
Deteriorated: Surface quality standard Class 4 and WQI between 31-60
Highly Deteriorated: Surface water quality standard Class 5 and WQI between 0-30

(Source: PCD 2002, 2005, 2007)

Figure 2. Water Quality in Thailand, 2001-2007

*Coastal and estuarine water*

PCD has set up 240 monitoring stations in 23 provinces along the 2,600km coastline and significant islands in 2006. The monitoring results were evaluated with the Marine Water Quality Index and calculated with the monitored value of eight parameters. The evaluation results showed that 66 percent of the stations were of "very good" or "good" quality, while 24 percent of the stations were "fair" and only 10 percent were classified as "deteriorated" or "highly deteriorated." By region, deterioration was significant in the inner gulf of the country at the estuaries of the four main rivers (Chao Phraya, Tha Chin, Mae Klong, and Bangpakong Rivers). The concerned pollutants are DO and TCB. TSS values were also high in the Bangpakon area. The western seaboard, tourist areas, tiger shrimp and oyster culturing areas generally appeared to have "good" water quality. However, TCB levels in some particular areas where domestic wastewater is discharged into the sea without treatment exceeded the standard.

*Groundwater*

The country's groundwater potential is large in general, except the eastern region. The lower central plain area has the largest potential of groundwater resources, particularly in the Bangkok Metropolitan Region and surrounding provinces. Groundwater in the region has been exploited to meet the growing water demand and has caused severe land subsidence problems. High salinity is also observed in the area. Groundwater contamination is observed in some areas of the country because of agricultural run-off, coastal aquaculture, industrial effluents and domestic sewage.

## Legislative Framework for Water Environment Management

As the basis of sustainable development, environmental conservation has been emphasized by the five-year national economic and social development plan since 1992. Under the 10th National Economic and Social Development Plan (2007 - 2011), the rehabilitation of natural resources and the environment through strengthening environmental management and increasing local community participation is also emphasized. The polluter pays principle and decentralization are other key principles in environmental management in Thailand. The basic law for environmental conservation in Thailand is the Enhancement and Conservation of National Environmental Quality Act (1992). There are other laws related to water pollution control, such as the Factory Act (Figure 3). In terms of water pollution control, the PCD of the Ministry of Natural Resources and Environment takes a leading role in environmental management, including water.

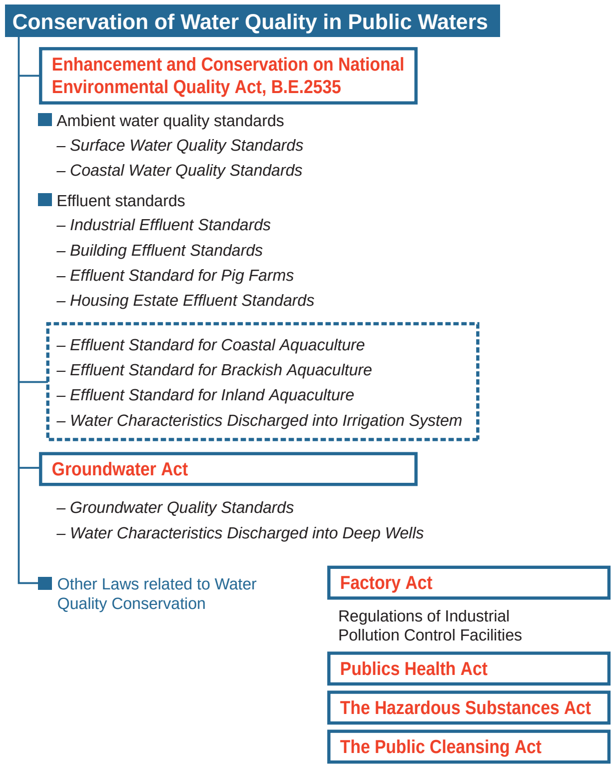



Figure 3. Legislative Chart for Water Quality Management

*Water environment quality standards*

Ambient water quality standards are set for surface, marine and groundwater. "Appropriated Water Quality Criteria for Aquatic Living" has also been established.

*Surface water quality standards*

This standard was the first ambient water quality standard established in 1994. Surface water quality standards have been established for 28 items under five classifications of water bodies which were designated according to water usage as shown in Table 2. The General Water Quality Index was established as an indicator to promote people's understanding of water quality, which was calculated with the values of eight parameters (pH, DO, TS, FCB, $NO_3$, TP, SS, BOD).

Table 2. Surface Water Quality Standard Classification

| Class | Objectives | Beneficial Use |
|---|---|---|
| Class 1 | Extra clean fresh surface water resources | Conservation not necessary pass through water treatment process only requires the ordinary process of pathogenic destruction; ecosystem conservation where basic organisms can breed naturally |
| Class 2 | Very clean freshwater surface water resource | Consumption requires ordinary water treatment process before use, conservation of aquatic organisms, fisheries, recreation |
| Class 3 | Medium clean fresh surface water resource | Consumption, but an ordinary treatment process is required before use, for agricultural use |
| Class 4 | Fairly clean fresh surface water resource | Consumption, but requires special treatment process before use, for industrial use |
| Class 5 | Source not included in Class 1-4 | navigation |

*Coastal water quality standards*

There are 30 parameters designated for coastal water quality standards in six classes, determined according to the usage shown in Table 3. Different classifications are applied for the west coast of Phuket Island.

Table 3. Coastal Water Standard Classification

| | |
|---|---|
| Class 1 | Natural resource conservation |
| Class 2 | Coral reef conservation |
| Class 3 | Aquaculture conservation |
| Class 4 | Recreation |
| Class 5 | Industries or ports |
| Class 6 | Resident districts |

*Groundwater quality standard*

The parameters included in groundwater quality standards are divided into four groups; volatile organic compounds (15 parameters), heavy metals (ten parameters), pesticides (nine parameters) and others (four parameters).

*Effluent standards*

There are a series of standards for effluent as follows.

*[Industry]*

- Industrial Effluent Standards
  The standards are applied to factory Group II and III categories and all industrial estates under the Factory Act B.E.2535 (1992). The standard value is designated for 15 parameters and 12 heavy metals are included in the standards. Regarding effluent quality control, the Regulations of Industrial Pollution Control Facilities (1982) stipulates that specific industrial plants must have supervisors and machine operators take responsibility for a pollution prevention. Such industrial plants include those using heavy metals in its production processes discharging wastewater at higher than 50m$^3$/day and having a heavy metal content in the discharged wastewater at the designated values.
- Gas Station and Oil Terminal Effluent Standard (2002)
  There are four parameters in these standards, namely pH, COD, SS, and fat oil and grease.

*[Domestic and Commercial]*

- Building Effluent Standards
  Effluent from buildings such as condominium, hotels, hospitals, schools, government offices/state enterprises, department stores, fresh food markets and food shops/restaurants. The parameters in these standards include pH, BOD, solids, sulfide, TKN, and fat, oil and grease. Different values are applied to the type and size of buildings.
- Housing Estate Effluent Standards
  Maximum permitted values for parameters are designated by the standards. Different values are applied to housing estates with 100 units but not more than 500 and those with more than 500 units. The parameters designated are the same as those in building effluent standards.

*[Agriculture]*

- Effluent Standards for Pig Farms
  Considering that pig farms contribute to water pollution such as in Tha Chin River and Bangpakong rivers, standards were established in 2001. The parameters designed by the standards include pH, BOD, COD, SS, and TKN and different values are applied to Type A (more than 600 livestock units) and Type B (60-600 livestock units).

*[Others]*

- Water Characteristics Discharged into Deep Wells
- Effluent Standards for Coastal Aquaculture
- Effluent Standards for Brackish Aquaculture
- Effluent Standards for Inland Aquaculture

*Monitoring of water quality*

Under the Enhancement and Conservation of National Environmental Quality Act, two types of monitoring programs have been conducted: effluent and receiving water quality monitoring. The owner or possessor of point sources of pollution is required to monitor effluent and collect statistics and data, and submit notes and reports on the effluent monitoring program. The governmental sector conducts monitoring of receiving water quality to maintain the quality of waters and to produce the annual state of water quality report for the country. There are 366 stations in 49 rivers in the country and water quality samples are taken three to four times/year considering wet and dry seasons. The methods of water sampling and analysis should follow the Standard Method for the Examination of Water and Wastewater (1998) (Yolthantham, 2007). The monitoring results of ambient water quality done by government are summarized and open to the public through publications of PCD.

## Existing and Future Challenges for Water Environmental Management

*Strengthening wastewater treatment*

Water environmental management in Thailand has been developed since 1992, in particular. Legislative frameworks have been developed and improved to promote implementation. Promotion of wastewater treatment is still one of the challenges in water environmental management in Thailand. In urbanized areas such as Bangkok, water pollution mainly caused by domestic wastewater remains serious and therefore sewage development has been promoted to reduce the pollution loads. However, there are a lot of challenges in the operation and maintenance of wastewater treatment facilities, including tariff setting and collection and lack of knowledgeable staff. All buildings are required to equip water treatment facilities and comply with effluent standards, but illegal discharge and discharge of insufficiently treated wastewater are still observed.

*Promotion of public participation and voluntary approach*

In the policy of the country, public participation and voluntary approaches by the private sector is encouraged to improve water quality in public waters. There are a lot of positive actions related to public participation. Regarding the promotion of voluntary approaches by the private sector, the green procurement project for small and medium enterprises (SMEs) is now under development by the Thai government.

*Promotion of basin management approach*

Promotion of basin management approaches is an emerging challenge for water environmental management. Water quality and water quantity management should be integrated to improve water quality by promoting the basin approach, but the current management system is not well coordinated to promote such integration. Integration of various activities and policy measures related to water environmental conservation should be also further addressed. Actions at basin levels are encouraged in community projects to promote such positive actions through the coordination of local actions, as seen in the Tha Chin river basin (Yolthantham 2007).

## Community Participation for Water Environmental Conservation beyond Administrative Boundaries

Community participation is encouraged by environmental policies in Thailand. Many programs/projects related to water environmental conservation encourage community participation. More significantly, many of such programs/projects are conducted across administrative borders. In the Tha Chin River which has significantly deteriorated over the past two decades, community-level activities, such as awareness raising programs, were conducted for water quality conservation. In 2002, basin-level actions were pledged to bring the river back to the original condition by the governors and deputy governors of the four provinces in the Tha chin River Basin (Chainat, Supanburi, Nakorn Pathom and Samut Sakorn Provinces) and four core NGOs ("We Love Tha Chin Clubs"). Various activities such as awareness raising, community water quality monitoring, and eco-restoration projects have been conducted at the basin level in collaboration with various stakeholders, including local governments, communities, and environmental groups (WEPA dababase).

In the Bang-Pa canal located in Ratchaburi province, a bio-monitoring project on water quality conservation was conducted to promote participation of local stakeholders. The canal is passing through six sub-districts and industrial and domestic activities in the upstream hindered water use in the downstream. Community-based organizations (CBOs) named conservation clubs were established in collaboration with the Population and Development Association (PDA), as well as with financial assistance from the Ratchaburi Power Plant. Sixty volunteers from four sub-districts were actively involved in the bio-monitoring project. Questionnaires were distributed to local people on current water use, and training on water quality techniques, water sampling and field analysis, and other awareness raising activities were conducted under the project. As the result, it was identified that local people still depend on canal water as a source of water and the daily activities of villagers contributed to the deterioration of water quality in the canal. Awareness of local residents on the relationship between their own activities and canal water quality improved and local participation was promoted as a result (Babel et al. 2008).

Activities for the conservation of Tha Chin River

# Viet Nam



## Country Information

| | | |
|---|---|---|
| Area (km²) | | 329,300 (2007) |
| Population | | 85.1 million (2007) |
| GDP (USD) | at current prices | 71,174 mil (2007) |
| Mean annual precipitation (mm) | | 1,960 |
| Renewable water resources (m³) | | 891 billion |
| Total water withdrawal (m³) | | 71.4 billion (2000) |
| Water use by purpose (2000) | Agriculture | 68% |
| | Industry | 24% |
| | Domestic | 8% |

## River Basins in Viet Nam


(based on "Hanh and Dong 2008")

## State of Water Resources

Viet Nam has a dense river network. There are 2,360 rivers that are longer than 10km, and eight of these have large basins with a catchment area of 10,000km² or more. All the rivers traversing Viet Nam provide an abundance of water (255 billion m³/year). However, only 53 billion m³/year is utilized because of inadequate development of physical infrastructure and insufficient financial capacity. Uneven rainfall distribution across Viet Nam and the prolonged dry season also cause serious shortages of water in many areas. The river network includes many rivers that have catchments that originate in other countries. This makes water resources in the country susceptible to the decisions of upstream countries on water use and development.

Groundwater resources are also abundant with the total potential exploitable reserves of the country's aquifers at nearly 60 billion m³/year. However, less than five percent of the total reserves are exploited for the country. In some areas, especially in the Mekong River Delta, groundwater is intensively exploited, which has resulted in falling water tables, associated further land subsidence, and salinity intrusion.

Agricultural use is higher than other uses. In urban areas, the need for water for domestic, service, and production purposes is increasing and has caused the depletion of water resources.

## State of Water Environment

Water quality in the country is generally good compared with environmental standards. However, there is increasing evidence of pollution of Viet Nam's surface, ground, and coastal waters.

### *River water*

According to the monitoring results shown in the "State of the Environment Report 2005," water quality in most of the main rivers of Viet Nam remains good in upstream areas, while in downstream areas, pollution is increasing due to the wastewater discharged from urban and industrial areas and waste leachate from dumping sites. The pollution levels of rivers are especially high during the dry season, when water volume flowing into the areas decreases.

Water quality monitoring along some points of the major rivers shows that concentration of $BOD_5$ and $N\text{-}NH_4^+$ has exceeded permitted standards by 1.5-3 times. In addition, the levels of total suspended solids recorded in rivers, lakes and main canal systems have exceeded permitted national standards for water sources in Category A (water for domestic water supply with appropriate treatments) by 1.5-2.5 times. Furthermore, there are signs of pollution from heavy metals and pesticide chemicals. Coliform parameters in some large rivers have also exceeded permitted standards for water sources in Category A by 1.5-6 times.

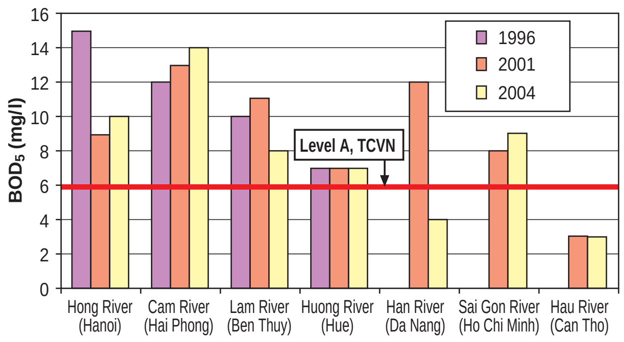



Figure 1. Changes of $BOD_5$ Concentration in Main Rivers of Large Cities

(Source: MONRE 2005)

Notably, $BOD_5$ in all rivers in Ha Noi is two to five times higher than permitted levels (Figure 2) and coliform in the main canals in Ho Chi Minh City is several times higher than the standards (Figure 3).

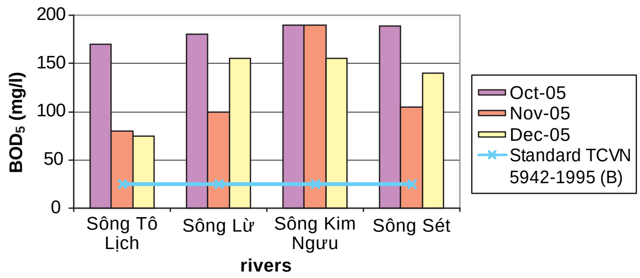



Figure 2. Water Pollution in Rivers in Ha Noi

(Source: MONRE 2005)

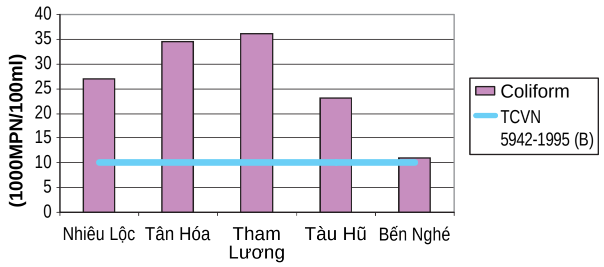



Figure 3. Water Pollution in Main Channels in Ho Chi Minh City

(Source: MONRE 2005)

*Lake water*

Most of lakes in the inner parts of cities are suffering from eutrophication. Mutative eutrophication and organic re-contamination occur in many lakes (MONRE 2005).

*Groundwater*

Most groundwater in coastal zones has been salinated mainly because the uncontrolled and indiscriminate exploitation of groundwater by households and water extraction in coastal areas. In addition, signs of phosphate and arsenic pollution have been observed in many places. Furthermore, groundwater has also been polluted by technically improper burials of domestic fowls infected by avian influenza epidemic (MONRE 2005).

*Marine water*

In general, water quality in coastal and marine areas still remains within permitted national standards, except some coastal estuaries where densely populated urban residential areas, industrial factories and seaports are located. However, the potential for marine pollution is becoming more obvious as a result of indiscriminate human activities (MONRE 2005).

## Legislative Framework for Water Environment Management

According to the principle stated in the Law on Environmental Protection (1994, amended in 2005), ensuring social progress in order to achieve national sustainable development is the objective for environmental protection. The Law on Environmental Protection is the basic law that includes the principle of the protection of the environment, including water resources. The law also stipulates the contents of environmental standards and their systems.

*Ambient water quality standards*

Ambient water quality standards are established for surface water, coastal water, and groundwater, referring to both international standards and standards in developed countries.

The Surface Water Quality Standard (TCVN 5942:1995), which was enacted in 1995 and revised in 2001, was applied until 31 December 2008 and then revised to QCVN 08:2008. The current standard (QCVN 08:2008) sets four classes as shown in Table 1 and standard values for 32 parameters in each class.

Table 1. Classes in the Surface Water Quality Standard

| Class | Objective of Use |
|---|---|
| A1 | Good for domestic water supply and other purposes in A2, B1 and B2. |
| A2 | Good for domestic water supply, but suitable treatment technology must be applied; conservation of aquatic lives, or other purposes in B1 and B2. |
| B1 | Good for irrigation or other purposes with demand for similar quality water or other purposes in B2. |
| B2 | Good for water transportation and other purposes with demand for low-quality water. |

The Coastal Water Quality Standard (TCVN 5943:1995) was revised to QCVN 10:2008 on 31 December 2008. The current standard sets standard values for 29 parameters for three categories: beaches, aquaculture, and other areas.

The Groundwater Quality Standard (QCVN 09:2008), which was revised to TCVN 5944:1995, sets standard values for 26 parameters.

*Monitoring of water quality in public waters and groundwater*

The Law on Environmental Protection stipulates monitoring and treatment of water pollution and degradation in river basins, however, a regular and routine water quality monitoring program is only now being established (World Bank 2006).

*Effluent standards*

Industrial wastewater discharge standards (TCVN 5945:1995) were revised in 2005 to TCVN 5945:2005. The revised standards (TCVN 5945:2005) take into account the best technology available in the country and the standards applied in some countries in the region. As a result, the current standards are less strict compared with older standards. The standard values are set for the usage of three types of water bodies into which wastewater is discharged.

In addition, there are other effluent standards such as those for domestic wastewater and specific industries (Figure 4).

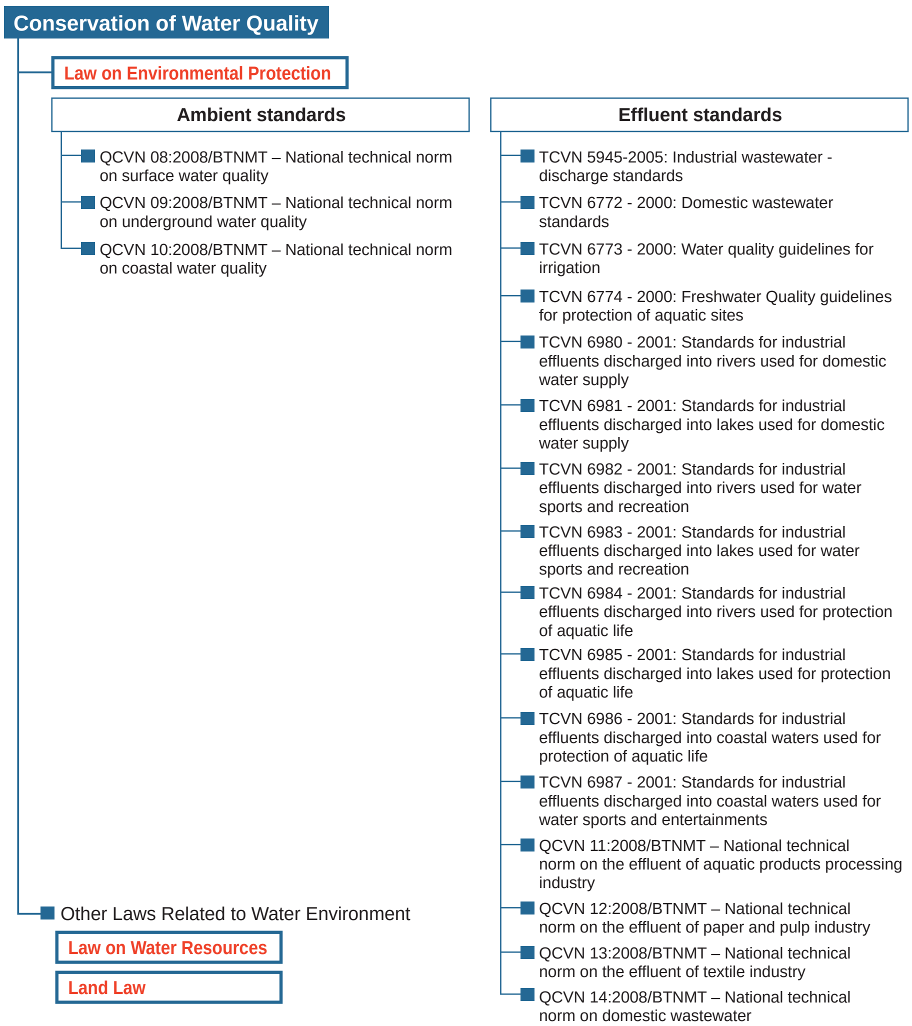



Figure 4. Legislative Chart for Water Quality Management

## Institutional Framework for Water Quality Management

As water is used in multiple sectors, many ministries take part in the management of water resources. The responsibilities of ministries concerned with water management are shown in the table below.

| Name of Ministry | Responsibilities |
|---|---|
| Ministry of Natural Resources and Environment | ➢ Management of water resources and water quality.<br>➢ Make plans on the use, overall management and protection for water resources in large river basins. |
| Ministry of Agriculture and Rural Development | ➢ Irrigation, flood and storm prevention, rural water supply, management of hydraulic engineering and dykes.<br>➢ Manage water for aquaculture and aquatic product processing. |
| Ministry of Planning and Investment | ➢ Guidelines for and check of ministries and sectors for the preparation and implementation of strategies on socio-economic development. |
| Ministry of Industry | ➢ Hydropower development via Viet Nam Electricity Corporation. |
| Ministry of Science and Technology | ➢ Appraise drafts and publicize water quality standards prepared by the Ministry of Natural Resources and Environment. |
| Ministry of Construction | ➢ Manage urban public works, design and build urban water supply and sewage works. |
| Ministry of Transportation | ➢ Manage and develop water traffic, manage aquatic engineering and port systems. |
| Ministry of Health | ➢ Manage drinking water quality.<br>➢ Responsible for preparing and supervising water quality standards. |
| Ministry of Finance | ➢ Prepare policy on taxes and fees for water resources. |

(Source: MONRE 2006)

## Existing and Future Challenges for Water Environment Management

The protection of the water environment is clearly mentioned in the Law on Environmental Protection 2005. It is very important to successfully implement the law and other programs related to the water environment in order to conserve water resources.

To improve policy enforcement in the country, inspections on the implementation and compliance with environmental regulations needs to be strengthened both with regard to financial investment and professional aspects. Training of staff and officials at the local level is also an important measure.

In addition, it is important to strengthen international cooperation in water resources management, especially regional cooperation with Cambodia, Lao PDR, Thailand, and China, as many international rivers flow in Viet Nam.

APPENDIX Ⅰ

# Government Regulation No. 38 in 2007 Concerning the Assignment of Authority between Central, Provincial, and District/City Governments (INDONESIA)

| Central | Provincial | District/City |
|---|---|---|
| Management of water quality on national /trans-boundary level | Management of water quality on provincial level | Management of water quality on district/city level |
| Setting water class of water resources on national and/or trans-boundary levels | Setting water class of water resources on provincial level | Setting water class of water resources on district/city level |
| Coordination and implementation of water quality monitoring of water resources on national /trans-boundary levels | Coordination and implementation of water quality monitoring of water resources on provincial level | Coordination and implementation of water quality monitoring of water resources on district/city level |
| Controlling water contamination in water resources on national /trans-boundary levels | Controlling water contamination in water resources on provincial level | Controlling water contamination in water resources on district/city level |
| Supervision of water contamination control on national level | Supervision of water contamination control on provincial level | Supervision of compliance with requirements for wastewater discharge permits into water or water resources |
| Establishment of water quality standard and/or replenishment of water parameter on national /trans-boundary levels | Establishment of more stringent water quality standard and/or replenishment of water parameter on national /trans-boundary levels | |
| Government Compulsory practice or compulsory money for the treatment of water contamination in national emergency situations and unpredictable conditions | Government Compulsory practice or compulsory money for the treatment of water contamination in provincial emergency situations and unpredictable conditions | Government Compulsory practice or compulsory money for the treatment of water contamination in emergency situations and unpredictable conditions of district/city |
| Water quality management and water contamination control | Water quality management and water contamination control on provincial level | Water quality management and water contamination control on district/city levels |
| Establishment of wastewater standard quality for other uses | Establishment of more stringent wastewater standard quality for other similar uses | Permission for wastewater discharge into water body or water resources |
| Establishment of river utilization standarts across the provinces | Development, supervision and evaluation of the approval to wastewater discharge to river across city/district | Permission to utilize wastewater into the ground for soil application |

(provided by the State Ministry of Environment, Indonesia)

APPENDIX II

## Legislative Framework for Water Environment Management

| | Basic Law on the Environment | Major Laws and Regulations related to Water Environment |
|---|---|---|
| **Cambodia** | - Law on Environmental Protection and Natural Resource Management | - Sub-Decree on Water Pollution Control<br>- Law on Water Resources Management |
| **China** | - Environmental Protection Law of the Peoples Republic of China | - Law of the People's Republic of China on Prevention and Control of Water Pollution<br>- Marine Environment Protection Law of the People's Republic of China |
| **Indonesia** | - Law concerning Environmental Management Law No. 23 of 1997 | - Management of Water Quality and Control over Water Pollution Government Regulation Number 82 of 2001 |
| **Japan** | - Basic Environment Law | - Water Pollution Control Law<br>- Law Concerning Special Measures for Preservation of Lake Water Quality |
| **Korea** | - Framework Act on Environmental Policy | - Water Quality and Ecosystem Conservation Act |
| **Lao PDR** | - Law on Environmental Protection *(Under review for amendment)* | - Laws on Water and Water Resources |
| **Malaysia** | - Environmental Quality Act | |
| **Myanmar** | | - Public Health Law |
| **The Philippines** | - Philippines Environmental Policy<br>- Environment Code of the Philippines | - Clean Water Act |
| **Thailand** | - Enhancement and Conservation of National Environmental Quality Act | - Groundwater Act<br>(The Enhancement and Conservation of National Environmental Quality Act is the law to control surface and coastal and estuarine water quality.) |
| **Vietnam** | - Law on Environmental Protection | (The Law on Environmental Protection is the law to control water environment.) |

APPENDIX III

# List of Environmental Water Quality Standards

| | Surface Water | Groundwater | Coastal and Marine Waters |
|---|---|---|---|
| **Cambodia** | **Water quality standard in public water areas for public health protection**<br>25 parameters | | |
| **Cambodia** | **Water quality standard in public water areas for biodiversity conservation**<br>- River: 5 parameters<br>- Lakes and reservoirs: 7 parameters | | ***Water quality standard in public water areas for biodiversity conservation**<br>- Coastal water: 7 parameters |
| **China** | **Environmental quality standards for surface water**<br>24 parameters (basic parameters)<br>(5 grades (the level of water quality described mainly by water usage)) | **Quality standard for groundwater**<br>39 parameters<br>(5 grades (the level of water quality described mainly by water usage)) | **Sea water quality standard**<br>35 parameters<br>(4 grades (the level of water quality described mainly by water usage)) |
| **Indonesia** | **Water quality criteria**<br>- Inland water: 46 parameters (4 water use classes) | | **Sea water quality standard**<br>35 parameters in maximum (3 categories determined by usage or characteristics of seawater) |
| **Japan** | **Environmental water quality standards for human health**<br>- 26 substances | **Environment water quality standards for groundwater for human health**<br>- 26 substances | **Environmental water quality standards for human health**<br>- 26 substances |
| **Japan** | **Environmental water quality standards for the conservation of the living environment**<br>- Rivers:<br>- 5 parameters(6 classes determined by water use)<br>- 1 parameter (Total zinc) for (4 classes determined by habitat condition)<br>- Lakes and Reservoirs:<br>- 5 parameters(4 classes determined by water use)<br>- 2 parameters(5 classes determined by water use)<br>- 1 parameters (Total zinc)<br>(4 classes determined by habitat condition) | | ***Environmental water quality standards for the conservation of the living environment**<br>- Coastal waters:<br>- 5 parameters<br>(3 classes determined by water use)<br>- 2 parameters (TN and TP)<br>(4 classes determined by water use)<br>- 1 parameters (Total zinc)<br>(2 classes determined by habitat condition) |

| | Surface Water | Groundwater | Coastal and Marine Waters |
|---|---|---|---|
| Korea | **Water quality standards for protection human health (rivers and lakes)**<br>- 17 items<br>**Water quality standards for conservation of the living environment (Rivers)**<br>- Rivers: 6 items (7 classes)<br>**Water quality standards for conservation of the living environment (Lakes)**<br>- Lakes: 9 items (7 classes) | **Ground Water Quality Standards**<br>- 20 items (3 categories (water use)) | **Coastal water quality standards for protection of human health**<br>- 19 items<br>**Coastal water quality standards for conservation of the living environment**<br>- 7 items (3 classes) |
| Lao PDR | **Currently being prepared** | | |
| Malaysia | **National water quality standards**<br>- 72 parameters (6 water use classes) | National Guidelines for Raw Water Quality is used as the benchmark. | **Interim marine water quality standards**<br>- 9 parameters *(under review)* |
| Myanmar | At present, the control of water quality is based on World Health Organization (WHO) standards. | | |
| The Philippines | **Water quality criteria for conventional and other pollutants contributing to aesthetics and oxygen demand for freshwater**<br>- 16 parameters (5 water use classes)<br>**Water quality criteria for toxic and other deleterious substances for freshwater (for protection of public health)**<br>- 17 items | Philippines National Standards for Drinking Water is used to evaluate groundwater quality. | **Water quality criteria for conventional and other pollutants contributing aesthetics and oxygen demand for coastal and marine waters**<br>- 12 parameters (4 water use classes)<br>***Water quality criteria for toxic and other deleterious substances for coastal and marine waters (for protection of public health)**<br>- 17 items |
| Thailand | **Surface water quality standard**<br>- 28 items (5 water use classes) | **Groundwater quality standards**<br>- 38 items | **Coastal water quality standard**<br>- 30 items (7 water use classes) |
| Vietnam | **National technical norm on surface water quality**<br>- Surface water: 32 parameters (4 water use classes) | **National technical norm on underground water quality**<br>- 26 parameters | **National technical norm on coastal water quality**<br>- 29 parameters (3 categories) |

APPENDIX IV

# List of Effluent Standards

| | Effluent standards | Target Industry and Facilities |
|---|---|---|
| **Cambodia** | **Effluent standard for pollution sources discharging wastewater to public water areas or sewer** | Any sources of pollution (discharging wastewater to public water area and sewer) |
| **China** | **Discharge standard of pollutants for municipal wastewater treatment plants** | Urban wastewater treatment plants |
| | **Integrated wastewater discharge standard** | Facilities discharging pollutant |
| | There are many other effluent standards for different types of industries | (e.g.)for pulp and paper industry, iron and steel industry, ammonia industry, dyeing and finishing of textile industry, phosphate fertilizer industry, coal industry, livestock and poultry breeding |
| **Indonesia** | **Quality Standard of Liquid Waste for Industrial Activities** | 21 industrial activities |
| | **Standard Quality of Wastewater for Commercial and/or Domestic Activities** | Commercial and/or domestic activities |
| | There are many other effluent standards for various activities. | Hotel activities, hospital activities, oil & gas and geothermal activities, industrial estate, coal mining activities, slaughterhouses, vegetables and fruits treatment centers, seafood treatment centers, Nickel refiners, vinyl chloride monomer and polymer factories and ethylene factories |
| **Japan** | **Effluent standards for <u>human health</u>** | All specified facilities. |
| | **Effluent standards for the <u>living environment</u>** | Specified facilities with effluent volumes of $50m^3$/day or more. |
| **Korea** | **Discharge water quality standard** | Both public and private sewage treatment plants and waste treatment plants |
| | **Toxic pollutants effluent standard** | |
| **Lao PDR** | **Concentration standards of wastewater from industries** | Sugar mills, the textile and garment industry, pulp mills, paper mills, slaughter houses, and battery plants. |
| | **Wastewater standards for buildings, hotels, dormitories, hospitals, restaurants, and commercial centers.** | Buildings, hotels, dormitories, hospitals, restaurants, and commercial centers. |
| **Malaysia** | **Environmental Quality (Sewage and Industrial Effluents) Regulations** | Sewage and industrial effluents, and prescribed premises (raw natural rubber, and crude palm-oil) |
| | **Environmental Quality (Prescribed Premises) (Raw Natural Rubber) Regulations** | |
| | **Environmental Quality (Prescribed Premises) (Crude Palm-Oil) Regulations** | |

| | Effluent standards | Target Industry and Facilities |
|---|---|---|
| **Myanmar** | No effluent standards. However, National Commission for Environmental Affairs (NCEA) and NGOs proposed effluent standards for proper disposal of wastewater from factories. Yangon City Development Committee convened a meeting in 2001 to introduce proposed environmental standards for Yangon, which includes standards on wastewater and toxic chemicals. | |
| **The Philippines** | **Effluent standards for toxic and other deleterious substance (maximum limits for protection of public health)** | Any wastewater discharge coming from a point source i.e. industrial plants and municipal sewerage systems. |
| | **Effluent standards for conventional and other pollutants in protected waters category I and II and Inland Waters Class C** | Effluent from domestic sewage and industrial wastewater treatment plants (except plants that produce strong wastewater (with BOD equal to or more than 3,000mg/L) |
| | **Effluent standards for conventional and other pollutants in Inland Waters Class D and Marine Waters Class SC and SD and other coastal waters which are not classified** | |
| | **Interim Effluent Standards for BOD Applicable to Old and Existing Industries Producing Strong Industrial Wastes** | Effluents from industries producing strong industrial wastewaters with high BOD (equal to or more than 3,000mg/L before treatment) |
| | **Effluent standards for New Industries Producing Strong Wastes upon Effectively of the Regulations and for All Industries Producing Strong Wastes.** | |
| **Thailand** | **Industrial effluent standards** | Effluent from factories group II and III categories and all industrial estates under the Factory Act |
| | **Gas station and oil terminal effluent standards** | Effluent from gas station and oil terminals |
| | **Building effluent standards** | Effluent from buildings (e.g. hotels, hospitals, department stores) |
| | **Housing estate effluent standards** | Effluents from hosing estates |
| | **Effluent standard for pig farm** | Effluents from pig farms |
| | **Water characteristics discharged into deep wells** | Effluents to be discharged to deep wells |
| | **There are three effluent standards for conservation of aquaculture** | Different standards are set for coastal, brackish, and inland aquaculture, respectively |
| **Vietnam** | **Industrial wastewater discharge standards** | |
| | **Domestic wastewater standards** | |
| | **Water quality guidelines for irrigation** | |
| | **Freshwater quality guidelines for protection of aquatic sites** | |
| | **National technical norm on domestic wastewater** | |
| | There are eight other effluent standards for industrial effluents. | The standards are separately established in consideration of both water bodies which effluents discharged into and the usage of water bodies. |
| | There are three other effluent standards for specific industries | For aquatic products processing industry, paper and pulp industry, and textile industry. |

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