SOURCES OF WATER POLLUTION

SOURCES OF WATER POLLUTION

There are three main sources of water pollution - domestic (municipal), industrial, and agricultural. They can be classified further as either point sources, which emit harmful substances directly into a body of water, or non-point sources, which are scattered and deliver pollutants indirectly. The technology to monitor and control point sources is well developed, while non-point sources are difficult to monitor and control.

Solid waste is a major non-point source of water pollution that needs to be better controlled. Solid waste, disposed either at a dumpsite or directly into water-bodies, generates high loads of organic and inorganic pollution through biological disintegration. Leachate seeps through the ground and its aquifer and contaminates groundwater or seeps into rivers, lakes, and coastal waters directly. Despite the passage of the Ecological Solid Waste Management Act (RA 9003) into law in January 2001, open dumpsites are still operated around Metro Manila and all over the Philippines.

The major pollutants monitored for water pollution are: Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO); Suspended Solids (SS); Total Dissolved Solids (TDS); Coliforms; Nitrates; Phosphates; heavy metals like Mercury and Chromium; toxic organics like pesticides and others. Of these pollutants, extensive data has been compiled for BOD and DO between 1995 and 2001, while data for the other highly toxic pollutants are still incomplete.

Domestic Wastewater

Domestic effluents are generated by activities such as bathing, cleaning, sanitation, laundry, cooking, washing, and other kitchen activities. Domestic wastewater contains a large amount of organic waste with suspended solids and coliforms.

Half the organic waste is from domestic sector based on the calculations as outlined in Box 4. As shown in Table 8 and Figure 5, domestic wastewater is the main contributor to BOD pollution with 1,090,000 metric tons (48 percent of the total load), followed by agricultural with 822,000 metric tons (37 percent), and industrial with 325,000 metric tons (15 percent). On a regional basis, Metro Manila has the highest total share of BOD loading (15 percent), followed by Region IV (14 percent). Meanwhile, CAR has the lowest share (1.8 percent) as shown in Table 8 and Figure 6. These estimates do not include pollution from solid waste discharge and leachate, as well as other informal non-point sources.

One-third of domestic BOD generation comes from Metro Manila and Region IV. Table 8 shows that Metro Manila and Region IV account for the highest amount of domestic BOD wastes at 18 and 15 percent, respectively, or one-third of the country's generation. This is further elaborated in the Urban Sanitation and Sewerage section.

Industrial Wastewater

The volume and characteristics of industrial effluents differ by industry and depend on the production processes and

Box 4 Computing Wastewater Generation in Table 8

Domestic Wastewater Generation. The average water consumption is 120 liters per capita per day (lpcd) in urban settings, where the water supply is piped individually into each household. Of this, 80 percent would be wastewater. In rural settings, where the water supply is rarely connected to households individually, water consumption would be, on the average, 60 lpcd, of which 80 percent would be wastewater.

Domestic BOD Generation. Calculated by multiplying the regional population of year 2000 with a BOD factor of 37grams per person per day (unit pollution load). The BOD factor is taken as the national average and was applied to all regions except Metro Manila. Depending on the income class of households, unit pollution load ranges from 26 to 53 grams per person per day for low- and high-income groups, with the latter applied to the Metro Manila area (Table 8).

Industrial Wastewater Generation. Estimated by industry type using the WHO Rapid Assessment of Sources of Air, Water, and Land Pollution. The annual amount of BOD generation was calculated by multiplying the annual volume of production output by the appropriate effluent factor.

Agricultural Wastewater Generation. The volume of wastewater generation and BOD were estimated by using animal type and the WHO Rapid Assessment Method. The method uses the annual number of heads of livestock and poultry multiplied by the appropriate effluent factor. Adjustments were made on those farm animals (e.g., chickens) with a short production cycle.

scale of production used. Industrial wastewater may be organic and / or inorganic. There are industries that are water-intensive and correspondingly discharge large amounts of wastewater such as food and dairy manufacturing; pulp, paper and paperboard products; and textile products, and others.

Other types of waste include thermal waste, created by cooling processes used by industry and thermal power stations. The increase in temperature can change the ecology of water-bodies. Additionally, hospital wastes are usually infectious and have to be controlled at the source. Thermal, health care (hospital or medical), and toxic and hazardous wastes are created by industrial sources and can pose long-term risk.

Once again, Metro Manila and Region IV account for the highest amount of industrial BOD at 43 and 14 percent, respectively, or 57 percent of the country's total (see Table 8).

Agricultural Wastewater

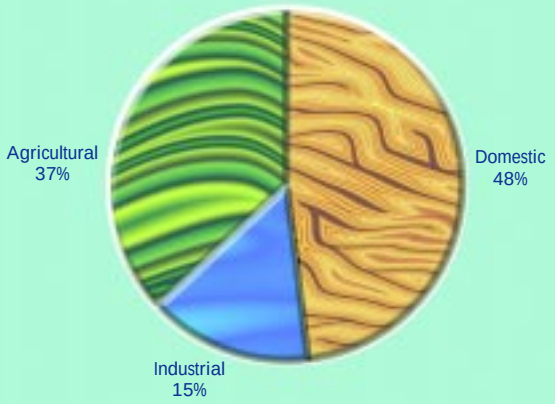
The major source of water pollution in rural areas is agricultural farms. The absence of facilities to intercept surface runoffs from agricultural farms degrades the water quality of surface and groundwater, especially in the downstream urban areas. Major sources of agricultural effluents considered in the estimates of agricultural BOD generation include livestock and poultry. Major sources of agricultural runoffs include: organic wastes such as decayed plants, livestock manure, and dead animals; soil loss in the form of suspended solids; and pesticides and fertilizer residues.

Regions IV and I generate the highest load of agricultural BOD, accounting for 13 and 12 percent of the total generation, respectively (Table 8).

Non-point Sources

Monitoring of non-point sources, including solid waste contribution, is scarce, and no attempt has been made thus far to create an inventory. The common non-point sources are urban runoff and agricultural runoff. For example, the BOD pollution reaching water-bodies, derived from solid waste of the Metro Manila area and surrounding provinces, is estimated at an additional 150,000 metric tons per year. If solid waste is not collected, treated and disposed properly, the organic and toxic components of household, industrial and hospital waste are mixed with rain and groundwater. This creates an organic and inorganic cocktail, composed of heavy metals and poly-organic and biological pathogenic toxins, which causes illness and even deaths. (See Philippines Environment Monitor 2001 for further details on solid waste issues).

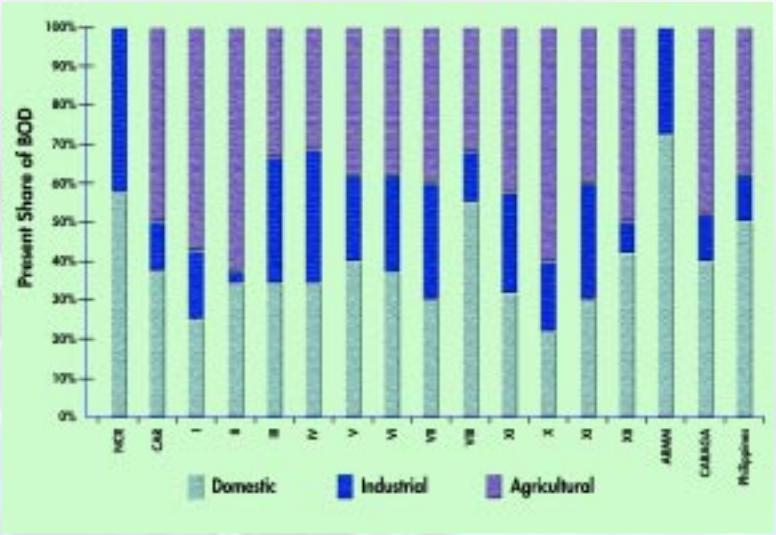
Figure 5 Share of Domestic, Industrial, and Agricultural BOD at the National Level



Total BOD Generation = 2,236,750 mt/year

Refer to Table 8 for estimated total BOD generated by source.

Figure 6 Regional Contribution of Domestic, Industrial, and Agricultural BOD



Refer to Table 8 for estimated total BOD generated by source.

Table 8 Estimated Water Effluent by Source

Region	Volume of Wastewater in Region			% Share of BOD Generation in Sector			BOD Generation in Sector			Total BOD Generation	% Share of Total BOD Generation in Sector
	Domestic 2000 (1)	Industrial 1998 (3)	Agricultural 1999 (5)	Domestic 2000	Industrial 1998	Agricultural 1999	Domestic 2000 (2)	Industrial 1998 (4)	Agricultural 1999 (6)		
	In '000 m^3 per Year			%	%	%	In '000 metric tons per Year				
NCR Metro Manila	430,046	272	-	17.6%	42.5%	0.0%	192	138	-	330	14.8%
IV Southern Tagalog	406,696	80	7,499	14.6%	14.1%	13.3%	159	46	109	314	14.0%
III Central Luzon	272,471	49	4,646	9.9%	9.0%	9.1%	108	29	75	213	9.5%
VI Western Visayas	188,042	55	4,574	7.7%	5.1%	8.1%	84	17	67	167	7.5%
VII Central Visayas	180,065	57	6,394	7.1%	7.4%	10.6%	77	24	87	189	8.4%
XI Southern Mindanao	160,025	47	4,888	6.4%	6.6%	8.6%	70	22	70	162	7.2%
V Bicol	128,849	22	3,036	5.8%	3.1%	5.4%	63	10	44	117	5.2%
I Ilocos	121,268	24	7,260	5.2%	3.3%	11.5%	57	11	95	162	7.3%
X Northern Mindanao	87,085	15	5,568	3.4%	2.2%	9.1%	37	7	75	119	5.3%
IX Western Mindanao	88,734	24	3,058	3.8%	3.3%	5.2%	42	11	43	95	4.3%
II Cagayan Valley	74,556	1	3,541	3.5%	0.2%	6.1%	38	1	50	89	4.0%
VIII Eastern Visayas	101,307	8	1,236	4.5%	1.1%	2.6%	49	4	21	73	3.3%
XII Central Mindanao	74,964	4	2,346	3.2%	0.5%	3.9%	35	2	32	69	3.1%
ARMM	64,402	0.07	1,905	3.0%	0.0%	3.0%	33	0.05	25	57	2.6%
CARAGA	62,311	6	539	2.6%	0.9%	1.2%	28	3	9	41	1.8%
CAR	40,614	4	1,379	1.7%	0.6%	2.3%	18	2	19	39	1.8%
TOTAL	**2,481,435**	**668**	**57,869**	**100%**	**100%**	**100%**	**1,091**	**325**	**821**	**2,237**	**100%**

Notes:
1/ Thousand cu.m. per year using unit volume factor of 120 lpcd for urban population and 60 lpcd for rural population.
2/ Thousand metric tons per year using BOD effluent factor of 37 grams/person/day and applied to all regions except Metro Manila where 53 grams/person/day was applied.
3/ Thousand cu.m. per year using WHO unit waste volume by type of industry taken from Rapid Assessment of Sources of Air, Water, and Land Pollution.
4/ Thousand metric tons per year using WHO effluent factor for BOD by type of industry taken from Rapid Assessment of Sources of Air, Water, and Land Pollution.
5/ Thousand cu.m. per year using WHO unit waste volume by animal type taken from Rapid Assessment of Sources of Air, Water, and Land Pollution.
6/ Thousand metric tons per year using WHO effluent factor for BOD by animal type taken from Rapid Assessment of Sources of Air, Water, and Land Pollution.

CRITICAL REGIONS

In the hot spots map, four regions were found to have an unsatisfactory (U) rating for the water quality and quantity criteria (see Annex 1 for details). These are National Capital Region (NCR) or Metro Manila, Southern Tagalog (Region IV), Central Luzon (Region III), and Central Visayas (Region VII). Other regions that are not rated as critical will not be discussed.

NATIONAL CAPITAL REGION

NCR, or Metro Manila, is the national capital and main hub of all socioeconomic, industrial, cultural, and political activities. Metro Manila is bounded on the north by the Central Luzon region, on the southeast by the Southern Tagalog region, and on the west by Manila Bay. While NCR is the smallest in terms of land area, it has the highest number of households (28 percent of the total) and manufacturing activity (Table 1). With the highest population density of 16,497 persons/km^2, it has no area for agriculture, and a limited land area for development expansions, except coastal reclamation. Metro Manila's industries, population, and development are spilling to Central Luzon and Southern Tagalog.

There is insufficient good quality water available in the region. The largest source - Laguna de Bay - is under threat with rivers discharging large amounts of pollutants. Coliform testing of deep wells shows contamination and the need for treatment facilities.

Water Resource

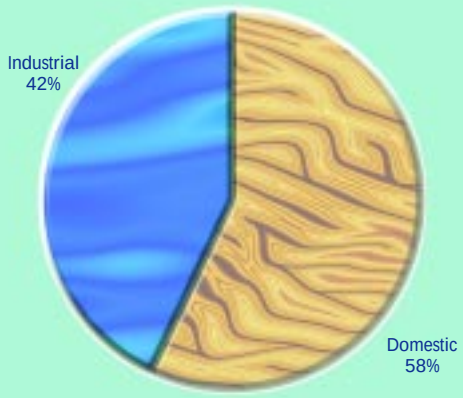
The Pasig-Laguna River Basin is the major river basin of the region. It has a drainage area of 4,678 km^2 with an annual runoff of 7,485 MCM. The Pasig River is the principal river system (see Boxes 1 and 5). Flood plains of the basin occupy 23 percent of the total area.

Since a river basin is the basis for regional water resource planning, Metro Manila is considered part of Water Resource Region IV (WRR IV). For the Pasig-Laguna Basin, the water resource potential is taken at 1,816 MCM. The projected water demand is taken at 2,977 MCM for the year 2025. The ratio between water potential and projected demand is very low at 0.61 (see Water Quantity Scorecard in Annex 1).

Water Quality

In Metro Manila, 58 percent of its BOD loading (192,000 metric tons) was generated by domestic waste, and the remaining 42 percent (138,000 metric tons) was from industries (see Figure 7 and Table 8).

Figure 7 Sector BOD Loading Metro Manila



Total BOD Generated = 330,000 mt/year

For assumption refer to Table 8.

Box 5 Improving Laguna de Bay through LISCOP

The Laguna de Bay watershed includes some of the fast growing urban and industrial centers of Luzon and doubles both as resource provider and a waste sink. The unchecked pollution continues to degrade the environmental resources of the lake and its watershed. This is caused by excessive discharge of pollutants, expanding development activities, and inefficient institutional arrangements and capacity constraints. A strategic change in the management of the lake and its watershed is needed.

The Laguna de Bay Institutional Strengthening and Community Participation Project (LISCOP) is a five-year project of the Government. Laguna Lake Development Authority (LLDA) will begin implementation in 2004. The envisioned change in the management of the Laguna de Bay Region is two-fold: (1) co-managed micro-watershed environmental interventions, which will support demand-driven LGU investments focusing on four sector issues (waste management and sanitation, natural resources management, soil erosion and localized flood prevention, and eco-tourism); and (2) strengthening institutions and instruments, which will strengthen LLDA, LGUs, RCs and communities and develop/expand regulatory and market-based instruments. The implementation of these components is expected to reduce pollution loading of the lake and erosion of the watershed; mainstream watershed concerns in LGU planning and investments; increase the involvement of communities in watershed management; and develop mechanisms for planning, development and financing of environmental investments. The goal of the project is to reduce organic pollution loading of regulated parameters from sources by 10 percent in five years.

Sources: LISCOP and World Bank Reports.

Rivers and Lakes

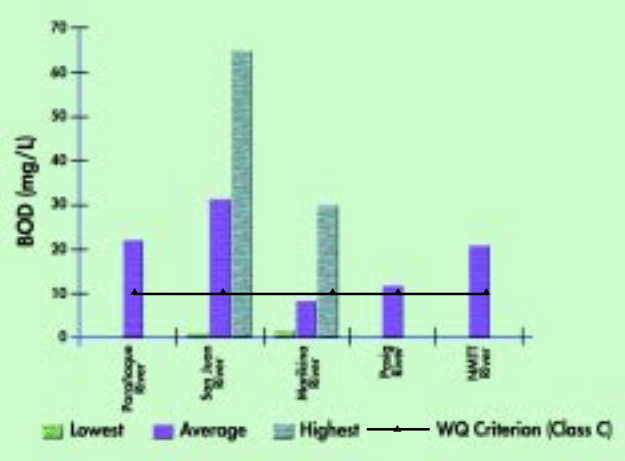
The EMB sampled five rivers for the period 1996 to 2001: Parañaque, San Juan, Marikina, Pasig, and Navotas-Malabon-Tenejeros-Tullahan (NMTT). The San Juan River exhibited the highest average of BOD (32.5 mg/l) and the lowest average DO content (less than 2 mg/l), which did not meet criterion for Class C waters. Marikina River had the lowest BOD average of 8.1 mg/l, which met the quality criterion set for its beneficial use (Figures 8 and 9).

All these rivers, at one point during the sampling period, exhibited a zero reading for DO, indicating that these rivers were "biologically dead" during certain periods. Through the rehabilitation effort of the Government, the water quality of the Pasig River showed improvement over the last five years (see Box 6).

Laguna de Bay is estimated to receive approximately 74,300 tons per year of BOD pollution. Domestic sources contribute 69 percent while the remaining 31 percent is from industrial and agricultural sources. Additionally, with the sedimentation rate of 0.5 centimeters per year, an estimated 66 percent of the land area in the watershed is vulnerable to erosion.

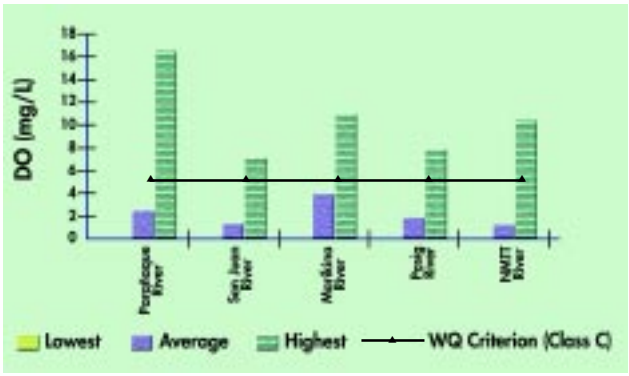
Routine monitoring of BOD in Laguna Lake shows that it meets the Class C water quality criterion (Figure 10). This indicates that BOD is not an issue, but siltation may be the main problem. While the lake water exhibited a good quality, half of the rivers (four) that fed the lake had high BOD values (Figure 11). To improve the management of the lake and its watershed, the government is implementing the Laguna de Bay Institutional Strengthening and Community Participation Project (LISCOP Box 5).

Figure 8 BOD Level in NCR, 1996 - 2001



Source: DENR-EMB, 2003.

Figure 9 DO Level in NCR, 1996 - 2001



Source: DENR-EMB, 2003.

Box 6 Cleaning up the Pasig River

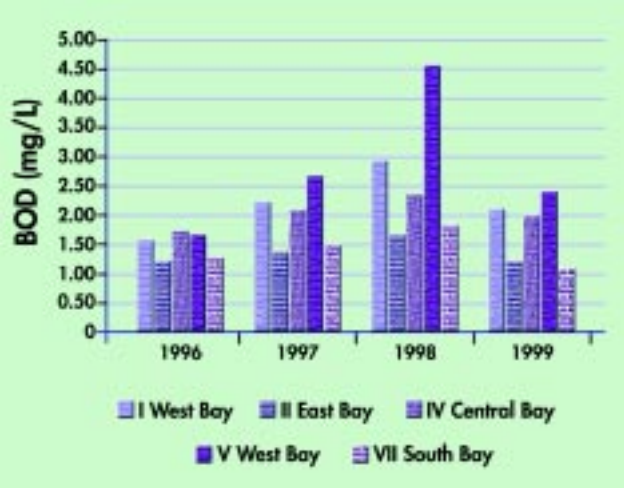
The Pasig River Rehabilitation Program aims to attain minimum Class C conditions by 2014. Infrastructure and municipal services in urban renewal areas adjacent to the riverbank are to be upgraded, septic tank maintenance service and a septage treatment facility provided, and illegal dumping of municipal solid waste into the river system eliminated.

Water quality changes for the past four years include:

- Improvement of the DO levels from 1998 to 2001 in nearly all stations;
- Increasing number of stations is passing ambient WQ criteria;
- Improvement of the BOD levels from 1998 to 2001 in nearly all stations;
- Odor of the river is reduced; and
- BOD load (from domestic sewage, solid waste, and commercial and industrial liquid wastes) and floating solid wastes have been reduced which shows the importance of solid waste as a source.

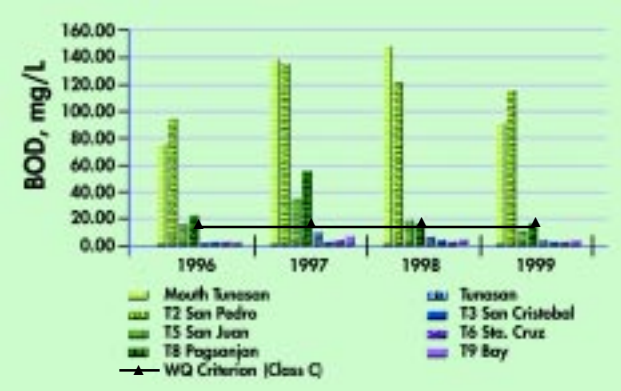
Sources: DENR-EMB, 2003 and ADB, 2003.

Figure 10 Annual Average BOD, Laguna de Bay, Monitoring Period, 1996 - 1999



Source: LLDA, 2003.

Figure 11 Annual Average BOD, Tributary Rivers in Laguna Province, 1996 - 1999

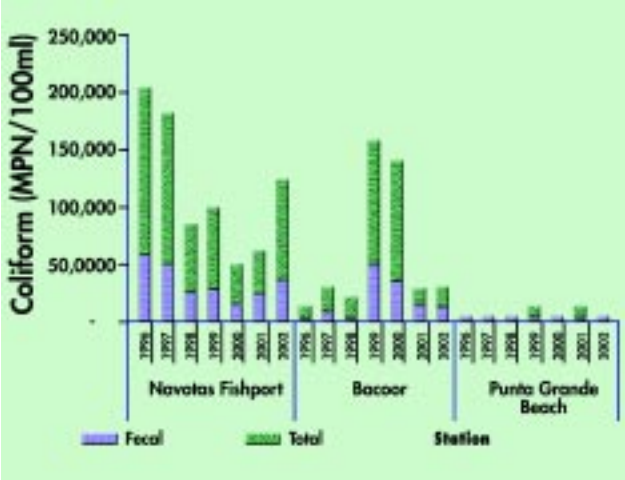


Source: LLDA, 2003.

Bays and Coastal Waters

The annual geometric mean for fecal coliform in the Eastern Manila coastal area was 15,545 MPN / 100 ml in 1999, higher than the 11,103 MPN / 100 ml in 1996 (Figure 12). This alarming bacterial load was attributed mainly to the voluminous untreated sewage and waste from households and commercial establishments. Except for some values in 2002, all the values exceeded the criterion for Class SB waters for contact recreation, e.g., swimming (see Box 7 for the program being undertaken to clean up Manila Bay). A major contributor to bay and coastal water pollution is solid waste. For example, dumpsites such as Navotas, Pier 18 in Manila, and Cavite City discharge untreated leachate directly into Manila Bay.

Figure 12 Total and Fecal Coliform for Selected Coastal Areas and Beaches in Manila Bay, 1996 - 2002



Source: DENR-EMB, 2003.

Box 7 Manila Bay – A Challenge

Domestic wastewater discharge is the highest contributor to Manila Bay's organic pollution. Only 18 percent of the wastewater generated in Metro Manila households was collected by localized separate sewerage systems. Nearly all of this was discharged through an outfall into Manila Bay. Most residential wastewater (82 percent, or around 7.5 million people) was discharged into the public drainage system either directly or through one million septic tanks. These septic tanks were not desludged and the effluent poured into the water-bodies was essentially untreated, causing heavy pollution everywhere in Metro Manila, and particularly in high density areas.

Industrial waste water also contributes to the pollution of the Manila Bay as indicated in the analysis of the sediments containing high levels of Metal pollutants.

Through its Manila Second Sewerage Project (MSSP), Metropolitan Waterworks and Sewerage System (MWSS) aims to expand its septage management program to provide low-cost improvement of sewerage services. Further, it will reduce pollution in waterways and in Manila Bay, thus reducing the health hazards. The project includes construction of a pilot septage treatment plant; rehabilitation of the Central and the Ayala Sewerage Systems, the Ayala and the Dagat-Dagatan sewage treatment plants, and individual sewer connections; and provision of on-site treatment community sanitation.

Sources: http: / / www.worldbank.org.ph *and MWSS, 2003.*

Groundwater

The average turbidity level of groundwater in Metro Manila is above the drinking water standard (Nephelometric Turbidity Unit - NTU 5). Some of the wells tested exhibited values higher than the standards for conductivity, hardness, manganese, iron, and sodium.

REGION IV - SOUTHERN TAGALOG

Bounded on the northwest by Metro Manila, Regions II and III, and on the southeast by Region V and Visayas, Region IV is comprised of 11 provinces, six of which are on mainland Luzon and five are island provinces. It has the largest land area for a region. Three of its provinces are located on mainland Luzon and have special economic and industrial zones. The island provinces of Region IV are coastal tourist destinations.

Water Resource

Three of the six largest lakes of the country are located in the region: Laguna de Bay, Lake Taal in Batangas (with an area of 266.77 km^2), and Lake Naujan in Oriental Mindoro (69.93 km^2).

The total water resources potential in the region is estimated as 7,780 MCM at 80% dependability. The annual amount of water use is 3,636 MCM with agriculture the largest consumer, followed by industrial uses and domestic demand.

Sharing the same water resources with Metro Manila, it is projected that by 2025, there will be a shortfall of water supply if no water management program is in place. The basin occupies the major part of Metro Manila and of Rizal, Laguna, and Cavite provinces, which are the most populated areas in the Philippines.

Water Quality

The estimated contribution of domestic, agricultural, and industrial sources to BOD loading are 51 percent (159,000 metric tons), 35 percent (109,000 metric tons), and 14 percent (46,000 metric tons), respectively (see Table 8 and Figure 13).

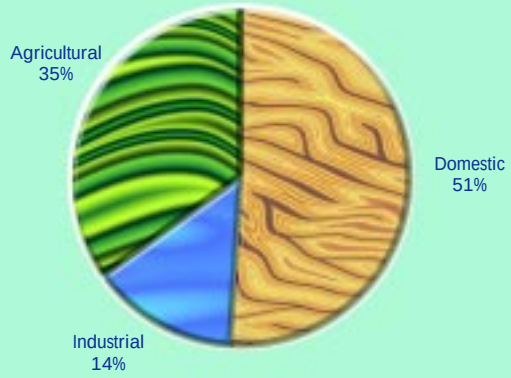
Rivers and Lakes

Rivers were not monitored for BOD and DO from 1996 to 2001. However, Taal Lake and Naujan Lake were sampled. Taal Lake met the Class C criterion for BOD, while Naujan Lake exhibited higher average value than the Class C criterion (see Figure 14).

Bays and Coastal Waters

Four bays were monitored from 1996 to 2001: Cajimos Bay in Romblon, Calancan Bay in Marinduque, Puerto Galera Bay in Oriental Mindoro, and Pagbilao Bay in Quezon. The minimum values of DO in the bays did not pass the Class SC criterion (see Figure 15).

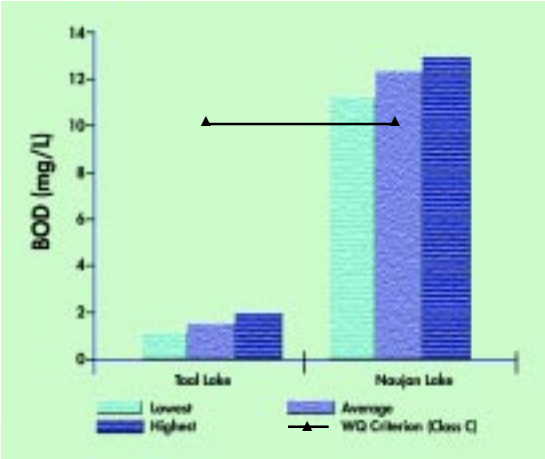
Figure 13 Sector BOD Loading Southern Tagalog



Total BOD Generation = 314,100 mt/year

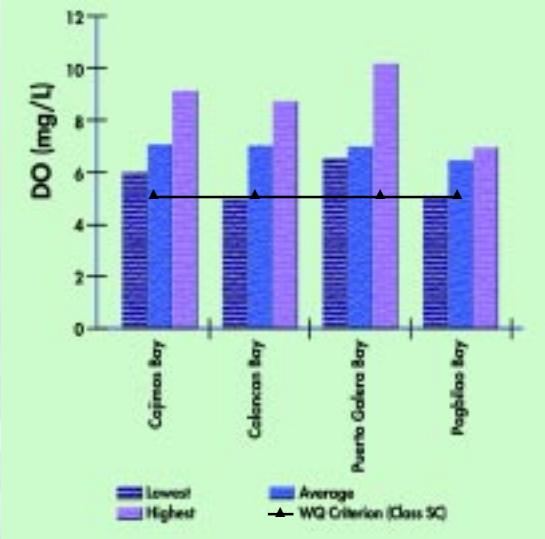
For assumptions refer to Table 8.

Figure 14 BOD Level, Southern Tagalog, 1996-2001



Source: DENR-EMB, 2003.

Figure 15 DO Level , Southern Tagalog Monitoring Period, 1996-2001



Source: DENR-EMB, 2003.

Groundwater

Only a small number of the wells in the Laguna province tested passed the drinking water criterion for total dissolved solids and coliform content (see Water Quality Scorecard).

REGION III - CENTRAL LUZON

Region III, bounded by Metro Manila on the south, is the gateway to northern Luzon. Although one of the regions with small land area, it has the third highest numbers for manufacturing establishments and households and is the third highest contributor to the country's income from manufacturing and agriculture sectors and other economic activities (see Table 1).

Water Resource

Region III principally consists of the Agno and Pampanga River Basins and covers an aggregate area of 23,600 km^2. The combined drainage area of the two rivers is 15,704 km^2 with annual runoffs of a total of 17,584 MCM. Floodplains area is 8,543 km^2.

The annual groundwater and surface water resources potential in Pampanga River Basin is estimated at 4,688 MCM. The annual water demand for 2025 is estimated at 9,015 MCM or a potential to demand ratio of 0.52, the lowest in the country. This means the demand may be two times higher than the water potential.

The same occurs in the Agno River Basin where the water resource potential is 2,275 MCM. The projected annual water demand for 2025 is 4,063 MCM or a potential to demand ratio of 0.56, the second lowest in the country.

Water Quality

At the regional level, 51 percent of the BOD loading (108,000 metric tons) is generated by domestic sources. Only 14 percent (29,000 tons) is contributed by the industrial sector and 35 percent (75,000 metric tons) by the agricultural sector (see Table 8 and Figure 16).

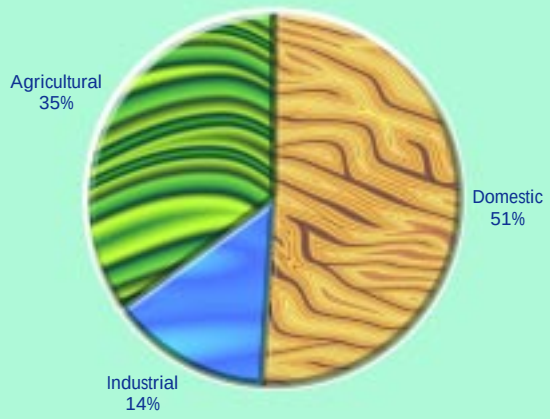
Rivers and Lakes

From the EMB monitoring, the rivers of Marilao, Meycauayan, Sta. Maria, Guiguinto in Bulacan, and San Fernando in Pampanga province had showed zero DO levels and high BOD levels, indicative of high organic pollution (see Figure 17). Based on the river classification, 60 percent of the rivers in the region fall under Class C waters.

Bays and Coastal Water

Monitoring in the Bataan coastal area at Matell, Villa Carmen, Villa Leonora, and Barangay Wawa stations show total coliform count above the water quality criterion of 5,000 MPN / 100ml for coastal and marine water (Class SC). Suitability of these waters for recreational use is thus questionable (see Figure 18). An eco-watch program, similar to the one for industries, where beaches are flagged according to their water quality and suitability should be initiated to bring attention to the poor quality water (e.g., Beach Eco-watch program called Blue Flag System in Turkey and other Mediterranean countries).

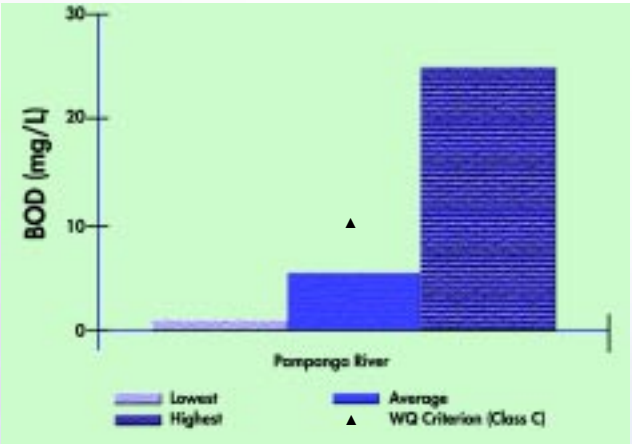
Figure 16 Sector BOD Loading Central Luzon Region



Total BOD Generation = 212,700 mt/year

For assumptions refer to Table 8.

Figure 17 BOD Level in Central Luzon, 1996-2001



Source: DENR-EMB, 2003.

Groundwater

A high percentage of the wells tested by NWRB and Local Water Utilities Administration (LWUA) were positive for coliform bacteria. The total and fecal coliform levels for selected beaches in the Bataan coastal area for April to October 2003 are shown in Figure 18. All four beaches fail the total coliform criteria while one does not pass the criteria for fecal coliform. Additionally, total dissolved solids found in most tested wells were higher than the drinking water criterion in Bulacan, Tarlac, and Zambales provinces.

REGION VII - CENTRAL VISAYAS

Central Visayas has a small land area and the fourth highest number of manufacturing establishments. Cebu, a province in this region, is a known international commercial and business hub. Cebu City, which is its capital, is the second largest metropolis in the country.

Water Resource

The region as a whole has no large rivers. The estimated water resource potential is 2,939 MCM at 80% dependability. The water demand for 2025 is estimated at 2,226 MCM, with a potential to demand ratio of 1.32. The island of Cebu has a drainage area of 5,088 km^2 with a water resource potential of 708 MCM. The projected water demand for year 2025 is taken at 932 MCM with a potential to demand ratio of only 0.76 (See Annex 1). Because of its significant role in the Visayas area, there is an urgent need to address the water shortage problem in Cebu.

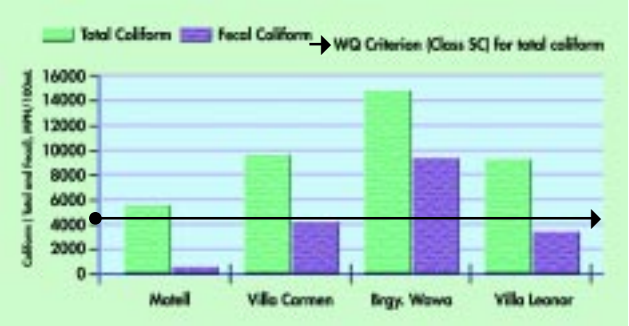
Water Quality

In the region, 41 percent of the BOD loading (77,000 metric tons) is generated by domestic waste, while the remaining 46 percent (87,000 metric tons) and 13 percent (24,000 metric tons) are from agricultural and industrial activities, respectively (see Table 8 and Figure 19).

Rivers and Lakes

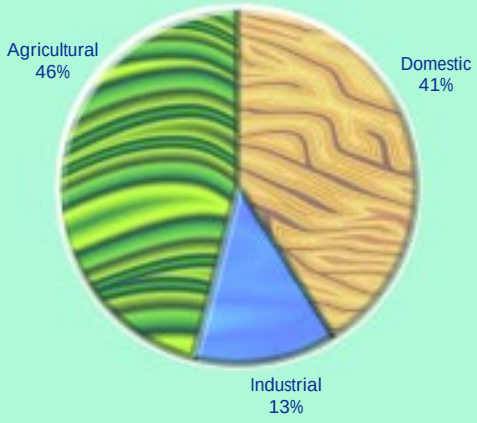
Except in rivers that traverse the urban areas of Cebu, such as Guadalupe and Cotcot, the water quality of the rivers in the region are considered satisfactory (see Water Quality Scorecard Annex 1).

Figure 18 Total and Fecal Coliform for Selected Beaches in Bataan Coastal Area (April to October 2003)



Source: DENR-EMB, 2003.

Figure 19 Sector BOD Loading, Central Visayas Region



Total BOD Generation = 188,500 mt/year

For assumptions refer to Table 8.

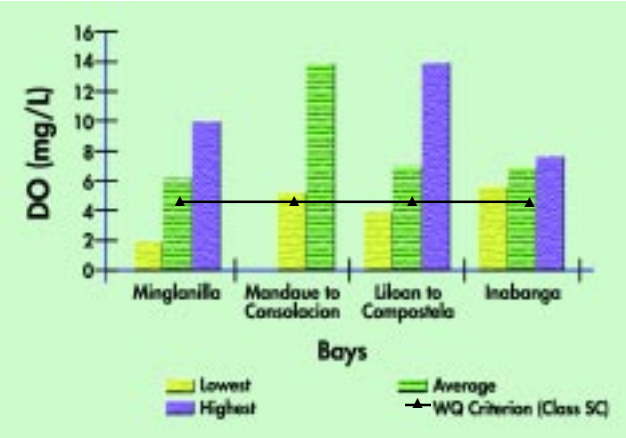
Bays and Coastal Waters

Four bays were sampled in the region from 1996 to 2001, including Minglanilla, Mandaue to Consolacion, and Liloan to Compostela in Cebu, and Inabanga in Bohol. Only DO levels were tested, and the results showed that the average readings did not pass the Class SC criterion (see Figure 20).

Groundwater

Total dissolved solids in many of the wells tested in the provinces of Cebu, Bohol, and Negros Oriental were found to be very high, higher than the criterion set for drinking water (see Water Quality Scorecard Annex 1).

Figure 20 DO Level in Central Visayas, 1996- 2001



Source: DENR-EMB, 2003.