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Brazil

Managing Pollution Problems

The Brown Environmental Agenda

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Policy Report

FOREWORD	VII
SUMMARY OF MAIN FINDINGS AND RECOMMENDATIONS	IX
1. INTRODUCTION	1
2. PROBLEMS AND PRIORITIES	3
2.1. LACK OF BASIC SANITATION.....	6
2.2. AIR POLLUTION.....	6
2.3. URBAN WATER POLLUTION	7
2.4. MUNICIPAL ENVIRONMENTAL PROBLEMS.....	10
2.5. LOCALIZED SEVERE POLLUTION	10
2.6. TRENDS AND PERSPECTIVES.....	11
3. POLICIES, INSTRUMENTS AND INSTITUTIONS	15
3.1. PROBLEMS OF THE CURRENT POLLUTION MANAGEMENT APPROACHES.....	16
3.2. ENVIRONMENTAL POLICY AND PLANNING.....	20
3.3. MODERNIZING INSTRUMENTS	22
3.4. WATER AND SANITATION SECTOR MODERNIZATION	27
3.5. INDUSTRIAL POLLUTION	31
3.6. OTHER SECTORAL POLICIES.....	35
3.7. ACCOUNTABLE INSTITUTIONS.....	39

Annexes (in Volume II)

- 1. NATIONAL POLLUTION MANAGEMENT PRIORITIES**
- 2. BENEFITS OF WATER AND SANITATION SERVICES**
- 3. MOBILIZING PRIVATE FINANCE FOR WATER AND SANITATION SERVICES**
- 4. INSTITUTIONS FOR WATER RESOURCE MANAGEMENT**
- 5. POLLUTION CHARGES AT THE RIVER BASIN LEVEL**
- 6. URBAN ENVIRONMENTAL MANAGEMENT**
- 7. MUNICIPAL SOLID WASTE MANAGEMENT**
- 8. INFORMATION IN POLLUTION MANAGEMENT: THE NEW MODEL**
- 9. POLLUTION MANAGEMENT IN A FEDERAL SYSTEM**
- 10. POLLUTION MANAGEMENT PRIORITIES IN MINAS GERAIS**
- 11. POLLUTION MANAGEMENT PRIORITIES IN PERNAMBUCO**
- 12. LESSONS FOR POLLUTION MANAGEMENT FROM WORLD BANK FINANCED PROJECTS**

TEXT BOXES

BOX 1: SETTING PRIORITIES BASED ON ECONOMIC PRINCIPLES	2
BOX 2: GUANABARA BAY IN RIO DE JANEIRO	7
BOX 3: RIO DAS VELHAS IN MINAS GERAIS	8
BOX 4: MERCURY POLLUTION FROM INFORMAL GOLD MINING	10
BOX 5: CURRENT POLICIES AND INSTITUTIONS	17
BOX 6: FAILURE OF ENVIRONMENTAL MANAGEMENT IN RIO DE JANEIRO	20
BOX 7: COST-EFFECTIVE INDUSTRIAL POLLUTION CONTROL IN BELO HORIZONTE, MG	21
BOX 8: ENVIRONMENTAL ACTION PLANS	22
BOX 9: EXPERIENCE WITH THE USE OF ECONOMIC INSTRUMENTS	23
BOX 10: SIMULATED POLLUTION CHARGES FOR THE RIO PARAIBA DO SUL	26
BOX 11: PRIVATIZATION AND ENVIRONMENTAL LIABILITY	32
BOX 12: EXPERIENCE WITH DIRECTED CREDIT FOR INDUSTRIAL POLLUTION CONTROL	33
BOX 13: INDONESIAN POLLUTION PERFORMANCE RANKING SYSTEM	34
BOX 14: THE ROLE OF ISO 14000 AND ENVIRONMENTAL MANAGEMENT SYSTEMS	34
BOX 15: SECTORAL PROJECT EXPERIENCE	36
BOX 16: IMPOSSIBLE SOLID WASTE DISPOSAL IN THE GUARAPIRANGA BASIN, SP	36
BOX 17: URBAN ENVIRONMENTAL MANAGEMENT IN CURITIBA, PARANÁ	37
BOX 18: CAR-USE RESTRICTIONS BACKFIRE IN MEXICO-CITY	38
BOX 19: PROALCOOL AND THE ENVIRONMENT	38
BOX 20: PARTICIPATORY ENVIRONMENTAL POLICY MAKING IN MINAS GERAIS	41
BOX 21: BANK EXPERIENCE WITH ENVIRONMENTAL INSTITUTIONS STRENGTHENING IN BRAZIL	42

TABLES

TABLE 1: POLLUTION PROBLEMS, SOURCES, IMPACTS, AND CONTROLS	4
TABLE 2: WHERE ARE THE PROBLEMS?	5
TABLE 3: AIR QUALITY IN SELECTED CITIES	7
TABLE 4: WATER QUALITY IN SELECTED LOCATIONS	8
TABLE 5: BRAZIL'S TOP FIVE POLLUTION PROBLEMS	12

FIGURES

FIGURE 1: COST PER LIVE SAVED FOR ADDRESSING DIFFERENT POLLUTION PROBLEMS	11
FIGURE 2: POLLUTION PROBLEMS IN INTERNATIONAL COMPARISON	14
FIGURE 3: ABATEMENT LEVELS IN SELECTED STATES	18

ABBREVIATIONS

BOD	Biological Oxygen Demand
CETESB	São Paulo State Environmental Agency [<i>Companhia de Tecnológica de Saneamento Ambiental</i>]
CNG	Compressed Natural Gas
CONAMA	National Environmental Council [<i>Conselho Nacional de Meio Ambiente</i>]
COPAM	Council of Environmental Policy (Minas Gerais) [<i>Conselho de Política Ambiental</i>]
EIA	Environmental Impact Assessment
EMS	Environmental Management System
FEAM	State Environmental Control Agency of Minas Gerais [<i>Fundação Estadual do Meio Ambiente</i>]
FEEMA	State Environmental Control Agency of Rio de Janeiro [<i>Fundação Estadual de Engenharia do Meio Ambiente</i>]
GHG	Greenhouse Gases
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources [<i>Instituto Brasileiro de Meio Ambiente e dos Recursos Renováveis</i>]
ICMS	Value Added Tax [<i>Imposto Sobre Operações Relativas Circulação de Mercadorias</i>]
IPEA	Institute for Applied Economic Research [<i>Instituto de Pesquisa Econômica Aplicada</i>]
MMA	Ministry of Environment, Water Resources, and Legal Amazon [<i>Ministério de Meio Ambiente, dos Recursos Hídricos e da Amazonia Legal</i>]
ODP	Ozone Depleting Substances
OEMA	State Environmental Control Agencies [<i>Orgãos Estaduais de Meio Ambiente</i>]
PROALCOOL	National Ethanol Program [<i>Programa Nacional de Alcool</i>]
SISNAMA	National Environmental System [<i>Sistema Nacional de Meio Ambiente</i>]
SWC	State Water Company
WHO	World Health Organization

FOREWORD

For many years, the World Bank has supported the efforts of the Brazilian Government in addressing a large range of environmental problems. The World Bank has financed a large number of projects that support natural resource management and conservation, environmental institutions strengthening, industrial pollution control, basic sanitation and water pollution management, and urban environmental improvements. As administrator of the Rain Forest Trust Fund, the World Bank helps Brazil address problems related to the threats to the Amazon ecosystem. Finally, the World Bank supports Brazil's effort to address global environmental challenges through projects financed by the Multilateral Fund of the Montreal Protocol and the Global Environment Facility.

Recently, the Brazilian Government and several Brazilian States requested the World Bank's assistance in pulling together the lessons of experience of past efforts to address environmental pollution problems in Brazil and developing a more proactive strategy for addressing the increasingly important "brown environmental agenda." The present policy report is part of the response to this request. It follows a policy study on pollution problems in the State of Rio de Janeiro (Brazil: Managing Environmental Pollution in the State of Rio de Janeiro, World Bank Report No. 15488-BR, August 1996) and focuses on environmental pollution problems whose costs are predominantly domestic. The report does not address questions related to natural resource management and conservation (see Brazil: The Management of Agriculture, Rural Development and Natural Resources, World Bank Report No. 11783-BR, July 1994) and contributions to international environmental problems (such as emissions of ozone depleting substances and greenhouse gases). International environmental issues involve a number of important concerns and choices for Brazil. The World Bank is assisting the Government in these concerns through its operations under the Montreal Protocol and the Global Environment Facility. Issues of industrial and occupational safety as well as problems strictly confined to the household level (such as indoor air pollution) are also outside the scope of this report.

This report is based on the findings of visits to Brazil in September 1996 and March 1997. The report was prepared by a World Bank team comprised of Messrs./Meses. Joachim von Amsberg (Task Manager), Carl Bartone, Gordon Hughes, Karin Kemper, Sergio Margulis, John Redwood III, Laura Tlaiye, and David Wheeler. Susmita Dasgupta, David Gray, Kseniya Lvovsky, and Muthukumara Mani contributed background analysis for different parts of the report. Andrew Hurd assisted in the editing of the report. Furthermore, the report draws freely from a large number of previous studies and documents prepared by other Bank staff. The report was produced under the supervision of Mr. Gobind T. Nankani, Director, Ms. Constance Bernard, Division Chief, Natural Resources, Environment, and Rural Poverty Division, and Mr. Homi Kharas, Lead Economist and Country Unit Chief, Country Department I, Latin America and the Caribbean Region. The peer reviewers for this task were Sudhir Shetty and John Redwood III (who later also contributed an Annex for this report).

This report was produced in close collaboration with various institutions and individuals in Brazil whose cooperation is gratefully acknowledged. The following institutions contributed, in particular: *Ministério de Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal* (MMA); *Secretaria de Política Urbana, Ministério do Planejamento e Orçamento* (SEPURB); *Fundação Instituto Brasileiro de Geografia e Estatística* (IBGE); *Instituto de Pesquisa Econômica Aplicada* (IPEA); *Fundação Estadual de Meio Ambiente, Minas Gerais* (FEAM), and *Companhia*

Pernambucana de Controle da Poluição Ambiental e da Administração dos Recursos Hídricos (CPRH).

This report consists of two volumes. Volume I is the Policy Report which is directed at policy makers and a general audience interested in environmental management. The Policy Report contains a summary of the most important policy recommendations without providing full analytical support. Volume II is the Technical Report which provides the analytical backup to the Policy Report. The Technical Report is directed at policy makers working specifically on environmental issues and anyone interested in the more detailed background analysis.

Brazil: Managing Pollution Problems

The Brown Environmental Agenda

SUMMARY OF MAIN FINDINGS AND RECOMMENDATIONS

Brazil suffers from a range of different pollution problems which cause real economic damage in terms of human health, quality of life and ecological losses. The most serious problems are, in order of importance:

- (a) Pollution problems at the household and community level caused by lack of safe water supply and/or lack of safe sewage removal. This includes primarily the problems of urban settlements without sewage networks, and rural communities which lack safe water supply, often relying on contaminated water sources.
- (b) Particulate air pollution in the mega-cities of São Paulo and Rio de Janeiro affects millions of residents in both cities. Other air pollution problems, such as ground-level ozone, are likely to exist but require more careful analysis.
- (c) Surface water pollution in urban areas (creeks, rivers, bays and beaches) that causes damages in lost amenity (reduced recreation, offensive smell) and production and income (fisheries, tourism), but generally does not cause widespread and severe health damages unless untreated water is consumed by humans. The problem affects a large number of residents and the aggregate damages can accumulate to significant amounts.
- (d) Lack of collection of solid waste, particularly in low-income neighborhoods, and improper solid waste disposal as well as clogging of drainage systems and improper sewage sludge disposal lead to the spread of vector-borne diseases and, in many locations, water contamination.
- (e) Severe localized pollution includes cases of industrial zones with poor levels of pollution control where localized populations suffer from health threatening pollution levels (mostly air pollution or contact with hazardous substances) or severe toxic water pollution (mercury water pollution).

Brazil has made important progress in addressing several severe pollution problems. Its environmental regulations are reasonably complete. The management system of some states can be considered advanced in comparison with many developing countries. However, after more than 20 years of active pollution management, many pollution problems remain unresolved and, in many instances, pollution levels in Brazil are well above internationally acceptable and economically optimal levels. Current pollution management policies not only fail to achieve reasonable environmental objectives but also contribute to unnecessary economic damages due to ineffective pollution control expenditures and bureaucratic obstacles to economic development. It is unlikely that current policies will resolve the problems in the near future. Overall, while regional differences are large, governments are not effectively managing pollution problems. In particular, the common problems of the current management system are as follows:

- (a) lack of prioritization of problems and cost-effective interventions;
- (b) reliance on an outdated approach of command and control instruments;
- (c) lack of integration of environmental aspects in sectoral and spatial policies and planning;
- (d) lack of effective implementation, equal application and enforcement; and
- (e) excessive reliance on Government financing.

This report recommends a modernization of pollution management policies in Brazil, in line with the reforms that have taken place in other sectors of the economy over the last years, towards a more open and market-orientated approach, including budgetary discipline and more private sector participation. The overall strategy underlying this report focuses on the following four elements:

- (a) A narrow prioritization of the pollution problems with the highest economic cost and the implementation of policies that follow cost-effective intervention strategies for priority problems.
- (b) A modernization of the instruments of pollution control to be driven by ambient quality targets and decentralized implementation, including a reform of licensing, the use of economic instruments, and the integration of water quality management in the new institutional framework for water resource management.
- (c) Improved accountability of environmental institutions based on a clear division of responsibilities between environmental and sector agencies and between levels of Government, driven by responsibility for attaining agreed ambient environmental quality targets, and supported by increased public environmental awareness.
- (d) Establishment of the framework for attracting more private financing for implementing cost-effective strategies, particularly in industry and the water and sanitation sectors.

The following table contains a succinct summary of the main findings and recommendations of this report with references to the respective section in this policy report and the annexes (in a separate volume).

Pollution Problems and Priorities (Policy Report Section 2, Annexes 1, 2, 10, 11)
<p>Issues and Problems</p> <ul style="list-style-type: none"> • A large number of pollution problems have serious economic costs in terms of health, production costs, tourism, quality of life and ecology that exceed the alternative cost of pollution control; however, there is little prioritization of these problems in terms of their economic costs. Therefore, limited financial and institutional resources are dissipated and do not achieve the greatest possible effect.
<p>Strategy and Recommendations</p> <ul style="list-style-type: none"> • <u>First priority</u>: many people affected with serious damage by lack of water supply and sewage collection.

- Second priority: many people affected with serious damage by particulate air pollution in São Paulo and Rio de Janeiro.
- Third priority: many people affected with mostly moderate damage by metropolitan water pollution, suggesting a gradual approach focusing on low-cost control options and sewage disposal adequate to the specific local conditions.
- Fourth priority: many people affected with mostly moderate damage by poor solid waste management.
- Fifth priority: few people affected with serious damage by severe localized pollution from industry, mining, etc.
- Much more work is needed to prioritize problems by their economic costs and rank alternative policies and interventions by their cost-effectiveness. A preliminary ranking of problems focuses on those with high economic costs and leaves less important problems to be addressed through a gradual strategy of medium and long term targets.
- Pollution management strategies should be cost-effective across sectors (industry and sewage for water pollution and industry and transport for air pollution).
- Higher environmental quality targets in higher income regions are acceptable if they reflect local demand for environmental quality and are financed out of local charges and revenues. Interventions that improve environmental conditions and benefit the poor (for example water and sewage infrastructure expansion) have a particularly high priority.

Pollution Management Problems (Policy Report Section 3.1)

Issues and Problems

- After 25 years of environmental management, pollution levels are still excessive (pollution costs above control costs) in many locations and costs imposed by environmental regulation are often unnecessarily high (actual control costs above cost-effective control costs) due to:
 - a) lack of priority setting and cost-effective strategies;
 - b) limited and inconsistent enforcement;
 - c) use of outdated pollution management instruments;
 - d) no sectoral integration of pollution management;
 - e) weak environmental institutions; and
 - f) excessive reliance on Government budgets.

Modern Pollution Management Instruments (Policy Report Sections 3.2 and 3.3 , Annexes 4, 5)

Issues and Problems

- Environmental information is incomplete, dispersed between different agencies, and often not accessible to policy makers
- There are no transparent ambient quality targets over time determined through some balancing of costs and benefits that can be used as the basis and yardstick for pollution policies.
- Licensing creates bureaucratic burdens without commensurate environmental gains since it is not focused on aggregate environmental impact and ambient quality targets.
- The creation of the new institutional framework for integrated water resource management creates a unique opportunity for introducing more effective water pollution management.

Strategy and Recommendations

- Additional generation and compilation of data on ambient quality, emissions, impacts of pollution and control options and costs is one of the core tasks of environmental agencies. In addition, more detailed research and analytical work is necessary to better understand sources and impacts of, in particular, air pollution problems.
- Dynamic environmental quality targets should be set involving environmental agencies, polluting sectors and the public through the development of environmental action plans at the national, state, metropolitan and municipal level.
- The licensing process needs to be modernized including (a) reduced bureaucratic requirements; (b) more focus on aggregate environmental impact and ambient quality objectives; and (c) decentralization of licensing of minor activities to municipalities.
- Economic instruments and concepts should be introduced into the licensing process (i.e., compensation through abatement at existing sources) and in river basin systems.
- Pollution management and coastal zone management needs to be integrated with the new framework for water resource management, requiring (a) priority for completing the legal and regulatory framework for water resource management; (b) a clarification of roles of the environmental agencies vis-à-vis the river basin arrangements; and (c) the use of pollution charges including tradable pollution allowances. A comprehensive dialogue between water resource agencies, pollution management agencies, and water and sanitation sector agencies needs to be urgently established.

Water and Sanitation Sector (Policy Report Section 3.4, Annex 3)**Issues and Problems**

- The ongoing process of modernization of the water and sanitation sector and the beginning privatization of services presents a unique opportunity to increase investment in environmental infrastructure and to integrate the water and sanitation sector with overall planning of environmental quality. However, environmental problems and poor coordination between environmental and sector agencies can derail the privatization process.

Strategy and Recommendations

- A full concession offers the most attractive option for private sector participation in water and sanitation services, especially for the larger urban centers. It requires a clear regulatory framework and ex-ante definition of targets and obligations of the concessionaire over time to avoid, as much as possible, later renegotiation of the concession contract. Concession design needs to ensure adequate coverage of the poor.
- A key factor for success in privatization of water and sanitation services will be the harmonization of environmental regulations and obligations under the concession contract. Close coordination is required between environmental and sector agencies to agree on wastewater treatment targets before the time of concessioning and to adjust these targets in the future. Depending on local environmental conditions and impacts, secondary and tertiary wastewater treatment requirements will often only apply in the medium to long term.

Industrial Pollution (Policy Report Section 3.5, Annex 8)**Issues and Problems**

- The expanding role of the private sector and the increasing openness of the Brazilian economy imply that bureaucratic licensing and pollution control financing through public banks are inappropriate instruments of industrial pollution control.

- Financing facilities for industrial pollution control suffer from limited demand and dissipated environmental effects unless linked closely to specific environmental quality targets and enforcement program.

Strategy and Recommendations

- New economic conditions require a reform of industrial pollution policies toward a more collaborative approach with industry building on the synergy between more flexible regulation with effective enforcement, on the one hand, and market driven incentives for improved environmental management systems, on the other hand. Negotiated aggregate emission targets derived from ambient quality targets would increasingly replace uniform standards.
- Privatization of major industry offer a unique opportunity for better environmental performance if environmental obligations are clearly defined before the time of privatization. If major uncertainty exists, it may be advantageous to explicitly exempt the new owner of a privatized enterprise from liability for environmental damages from past emissions.
- The use of directed credit for pollution control should be discouraged unless it is closely tied to an enforcement strategy for a specific environmental problem.
- Public release and dissemination of emissions data and environmental performance ranking can be a powerful tool to promote pollution control.
- The key to increasing the environmental content of private investments is the reduction of risks involved in these investments, caused by weak and non-enforced regulations and gaps between legality and reality.
- A clear regulatory framework is required for the environmental services sector (wastewater treatment, hazardous waste management). Government guarantees for enforcement would reduce investment barriers in these areas.

Other Sectoral Policies (Urban, Transport, Energy) (Policy Report Section 3.6, Annex 6, 7)

Issues and Problems

- Environmental aspects are rarely considered in other sectors' policy planning resulting in unnecessary environmental damage and higher costs of environmental management.

Strategy and Recommendations

- Better urban environmental management would include: (a) systematic urban and metropolitan environmental planning through Environmental Action Plans; (b) increased metropolitan coordination; (c) improved water supply, sewage and solid waste collection in low income neighborhoods using low-cost approaches; and (d) increased commercialization of solid waste services. Sanitary landfill siting problems can be alleviated by encouraging compensation payments among municipalities.
- Supported by fiscal incentives (especially differential fuel and vehicle taxes), vehicle emission standards, fuel specifications and vehicle maintenance and inspection programs should continue to be tightened; a more active policy promoting public transport will reduce air pollution but is likely to be driven by other benefits (time savings, accidents, urban space, etc.). The cost-effectiveness of reducing vehicle emission through ethanol as a gasoline substitute (as opposed to its use as an additive) and circulation restrictions is doubtful and needs to be carefully assessed before continuing these programs on environmental grounds.
- Environmental aspects need to be better integrated into other sectoral policies, such as energy pricing and fiscal policies.

**Establishment of Accountable Environmental Institutions (Policy Report
Section 3.7, Annex 9)****Issues and Problems**

- Typically, environmental agencies pursue objectives that are often not accepted by sectoral and planning agencies, which later deny political support for their implementation. As a result, there is a large enforcement gap and lack of accountability.
- The absence of a clear legal basis for the division of responsibilities between levels of Government has left an extremely confused role of the federal government in pollution management.
- Technical assistance is only effective if objectives are clearly defined and institutions enjoy necessary political support.

Strategy and Recommendations

- Environmental policy needs to be based on dynamic targets agreed upon across sectors, for example through Environmental Action Plans. Performance contracts with environmental agencies could be written based on the targets of these plans.
- Better integration of environmental agencies in sectoral policy making and planning is important. It requires, on the one hand, more realistic and gradual environmental targets and, on the other hand, early participation of environmental agencies in sectoral policy making and planning. A cross-sectoral participatory decision making forum, such as COPAM in Minas Gerais, can help achieve this integration.
- The generation and active dissemination of environmental information as well as environmental education should be used more actively to build public support for, and increase the effectiveness of, environmental policies.
- The establishment of a National *Lei Complementar* to clarify the roles of different government levels should have high priority.
- The responsibility of the national Government should focus on and be limited to: (a) the management of genuine national pollution problems, (b) integration of environmental aspects in national policies; (c) setting federal framework regulations; (d) setting some national minimum ambient quality standards; (e) preventing unfair competition between states; and (f) providing assistance and information services, especially for weaker states.
- Outside of the direct national responsibilities, the federal Government and its agencies should not enforce regulations directly with polluters unless explicitly contracted to do so by the responsible State.

Recommended Actions for the Main Actors**National Government**

- Provide technical assistance and analytical support to states and municipalities in the prioritization of pollution problems and intervention strategies, focusing on tasks with country-wide economies of scale (such as estimation of pollution impacts and abatement costs and comparison of abatement options).
- Compile key ambient quality information and environmental indicators in an annual report on the state of the environment.
- Establish the framework for complementing ambient standards with realistic ambient quality targets over time for key ecosystems.
- Reform the framework of the licensing system, including (a) reduced bureaucratic requirements; (b) more focus on aggregate environmental impact and ambient quality objectives; and (c) decentralization of licensing of minor activities to municipalities.
- Develop the framework for the use of economic instruments and concepts in the licensing process (i.e., compensation for new sources through abatement at existing sources) and in river basin systems (pollution charges).
- Establish the necessary dialogue between water resource agencies, pollution management agencies, and the water and sanitation sector on how to address water quality issues in the new river basin management framework.
- Systematically incorporate environmental aspects into policy planning and sectoral policies.
- Establish a National *Lei Complementar* to clarify the roles of different government levels.
- Focus on and limit the actions of the national Government to: (a) the management of cross-state and cross-border pollution problems; (b) integration of environmental aspects in national policies; (c) setting federal framework regulations; (d) setting health-related national minimum ambient quality standards; (e) preventing states from not enforcing environmental regulations in order to attract industry; and (f) providing technical assistance and information services, especially for weaker states.
- Do not enforce regulations directly with polluters outside of the direct national responsibilities unless explicitly contracted to do so by the responsible state; instead apply sanctions, such as withholding of federal grants, to states which fail to enforce binding regulations.

State Governments

- Generate and compile data on ambient quality, emissions, impacts of pollution and control options and costs in regular intervals and publish in annual state reports on the state of the environment.
- Develop a prioritization of pollution problems and intervention strategies, and establish realistic ambient quality targets over time for key ecosystems (for example, through the development of state environmental action plans).
- Reform the licensing system, including (a) reduced bureaucratic requirements; (b) more focus on aggregate environmental impact and ambient quality objectives; and (c) decentralization of licensing of minor activities to municipalities.
- Use economic instruments and concepts in the licensing process (i.e., compensation for new sources through abatement at existing sources) and in river basin systems (pollution charges).
- Integrate pollution management in the new framework for water resource management, requiring: (a) priority for completing the legal and regulatory framework for water resource management; (b) a clarification of roles of the environmental agencies vis-à-vis the river basin agencies; and (c) the use of pollution charges including tradable pollution allowances.
- In industrial pollution control, increasingly rely on negotiated aggregate emission reduction targets and the use of public information release and performance ranking.
- Clearly determine environmental obligations before the time of privatization of major state-owned enterprises.
- More systematically incorporate environmental aspects into policy planning and sectoral policies. Implement a cross-sectoral participatory decision making forum, such as COPAM in Minas Gerais.
- Implement performance contracts for environmental agencies based on ambient quality targets established in State Environmental Action Plans.

Municipalities and Metropolitan Entities

- Establish systematic urban and metropolitan environmental planning through Environmental Action Plans.
- Where appropriate, increase coordination and planning among metropolitan municipalities on issues such as landfill siting, transport planning and land use through metropolitan planning agencies and processes but focus on implementation at the municipal level.
- Alleviate sanitary landfill siting problems by encouraging compensation payments among municipalities.
- Increase commercialization of solid waste services.

Sanitation Sector

- Address the inefficiency of state water companies and the lack of investment resources through full private sector concessions wherever feasible. This requires a clear regulatory framework and ex-ante definition of targets and obligations of the concessionaire over time to avoid, as much as possible, later renegotiation of the concession contract. Concession design needs to ensure adequate coverage of the poor.
- Coordination with environmental agencies to agree on wastewater treatment targets before the time of concessioning and to adjust these targets in the future. Depending on local environmental conditions and impacts, secondary and tertiary wastewater treatment requirements will often only apply in the medium to long term.

Brazil: Managing Pollution Problems

The Brown Environmental Agenda

1. INTRODUCTION

1. International interest has for a long time focused on the "green" environmental problems of Brazil, including the need to protect ecosystems in *Amazonia*, the *Pantanal* and the *Mata Atlântica*. Largely as the result of international pressures, environmental discussions and initiatives at the federal Government level have tended to focus on problems of natural resource and ecosystem protection. At the same time, however, many Brazilians are acutely aware of the cost of severe urban environmental problems, primarily in the highly urbanized and industrialized South-East, but also in other parts of the country. Without diminishing the importance of natural resource management and conservation problems and without suggesting a separation of brown issues from overall integrated environmental management, it is important to recognize that 80% of the Brazilian population lives in urban areas and is exposed to pollution problems on a daily basis.

2. In fact, the States most affected by pollution have long been focusing on "brown" environmental problems. The environmental agency of São Paulo, CETESB, has long been the countrywide leader in defining and promoting pollution management policies. The World Bank has been involved in many of the efforts of Brazilian subnational governments to address pollution-related environmental problems. World Bank loans have financed a large number of studies and projects that directly or indirectly deal with the management of pollution problems in Brazil. This report attempts to systematically assess these past endeavors and pull together the lessons of these experiences.

3. This report has two distinct audiences and objectives. The first audience consists of policy makers in Brazil whose actions affect pollution problems. The objective is to help these policy makers improve the management of pollution problems and reduce the related costs. The report aims at helping define the **policy agenda** for pollution management in Brazil. The report proposes a series of specific actions by policy makers in environment, planning, and sectoral agencies of the federal Government and two specific States (Minas Gerais and Pernambuco). For a broader audience, the report will serve as an example of prioritization and economic analysis applied to pollution problems. The second audience is Bank operational staff. The objective for the Bank audience is to enhance understanding of pollution management priorities in Brazil and ensure that the Bank's **operational strategy** supports the policy agenda.

4. The report has four specific objectives which represent themes that are carried throughout the report. These four themes are:

- (a) The need for prioritization of environmental problems at the national, state and local (urban, metropolitan, river basin) levels, focusing on explicit targets and cost-effective strategies for attaining these targets.
- (b) Adoption of a more effective approach to environmental management, including better integration of environmental aspects in overall Government planning, and decentralized implementation through the application of economic instruments for pollution management.
- (c) Changes in policy and improvements in the regulatory framework that would

Box 1: Setting Priorities Based on Economic Principles

Financial and institutional resources are scarce and need to be focused on limited priorities. If complete information was available, pollution policy choices and priority actions could (and should) be determined on the basis of cost-benefit analysis. Different measures to address a specific pollution problem would be ranked according to their marginal costs (the cost of installation of filters, substitution of fuels, or proper operation and maintenance of equipment per unit of ambient pollution reduced). The marginal costs would be compared to the marginal benefits of pollution reduction (the monetary value of health, amenity and other benefits per unit of ambient pollution reduced at different levels of pollution). All abatement options whose marginal benefits exceed the marginal costs should be implemented.

In reality, much of the necessary information is uncertain or simply not available. In many cases, the exact dispersion of pollutants is not fully understood. Many of the physical consequences of pollution are subject to ongoing research. Finally, the monetary valuation of health effects such as premature death is difficult and controversial.

The prioritization in this report follows a pragmatic approach using available local data complemented with international data. Emissions data are estimated from the Brazilian industrial and population census using international emissions coefficients adjusted for available Brazilian emissions data. Abatement costs are estimated based on international data adjusted for Brazilian price levels. The effects of pollution are estimated on the basis of international dose-response functions, that in the case of water and sanitation infrastructure, were validated with Brazilian data. Finally, it was not attempted to estimate a monetary value of premature mortality. Instead, comparisons are made between the costs per life saved through different types of interventions in different parts of the country (cost-effectiveness analysis). The cost and benefit ranges determined in this report are sufficient to determine a broad order of important pollution problems and priority interventions. However, their precision is insufficient to justify specific measures such as enforcement in a specific municipality or plant.

The analysis that this report uses to determine broad country-wide priorities can be replicated at the state or local level. While the detail of such local analysis will depend on locally available data, much progress can be achieved with the estimation techniques illustrated in this report. In practical terms and within the constraints of limited data, prioritization would typically include the following steps:

(a) Determining priority pollution problems and their causes/sources. Priority problems are those which cause the highest economic cost, for example in terms of damages to human health. While costs alone do not imply the desirability of interventions, the determination of priority problems helps direct attention to the most important problems and reduces the distraction of policy makers by minor problems.

(b) Establishing reasonable environmental quality targets in terms of specific ambient quality indicators over time at a range of locations within a specific ecosystem. These targets should reflect a balance between damage cost reductions and control costs, thus, reflecting the demand of the population for environmental quality. The preliminary targets would be revised after control costs are determined (see the following step), and if the costs of achieving the preliminary targets turn out too high or too low compared to the willingness to pay for addressing the problem.

(c) Determining a cost-effective strategy for addressing priority pollution problems and attaining environmental quality targets over time. This step requires comparing the costs of achieving the same improvements in ambient environmental quality through alternative interventions in different sectors. The result of this step is a list of priority interventions and their costs.

The technical analysis described here should be combined with a participatory process involving all relevant stakeholders (see Box 8 on Environmental Action Plans).

create greater incentives for private sector participation and investment in environmental improvements.

- (d) Policy reforms aimed at increased institutional accountability and improved complementarity between pollution management policies of the three levels of Government.

5. Given the complexity and diversity of pollution problems in Brazil, this report does not attempt to develop a comprehensive strategy for the management of pollution problems throughout Brazil. At the na-

tional level, a rough prioritization of pollution problems underpins recommendations for national action and external assistance. Beyond this broad prioritization, the report focuses on thematic and geographic areas where the World Bank can contribute based on its past and current involvement in lending operations and policy dialogue. The report consolidates and builds on a large number of previous studies and reports, including a recently completed World Bank report on pollution problems in the State of Rio de Janeiro.

6. This policy report discusses in subsequent sections: (a) the main pollution problems of Brazil, their impact and the priorities for action; (b) the modernization of instruments and policies for managing the problems; and (c) the institutional arrangements for implementing the strategy. The Annex Volume contains a number of background papers which serve as technical support for the policy report and also contain technical material which is not summarized in the policy report (in particular, more detailed management strategies for the States of Minas Gerais and Pernambuco).

2. PROBLEMS AND PRIORITIES

7. Brazil suffers from a range of serious pollution problems that affect human health, reduce the quality of life, increase production costs and cause long-term ecological damage. The impact of pollution problems can be divided into four broad categories:

- (a) **Health Damages.** Intestinal diseases are caused by pathogens in drinking water and the household environment. Their consequences include elevated rates of infant mortality. Direct health effects of surface water pollution include the contraction of intestinal, skin and liver diseases from bathing in polluted waters. Air pollutants, such as fine particulates, sulfur dioxide, and ozone, cause respiratory diseases including premature mortality. These health effects cause human suffering, reduce human productivity, and require medical treatment costs.
- (b) **Production and Material Costs.** Toxic water pollution causes increased costs for expensive water treatment or piping of water from cleaner sources. Water pollution reduces fish production that can lead to the loss of income for the fisheries sector. Air pollution

causes staining and damages to buildings that lead to additional repair and cleaning costs.

- (c) **Loss of Environmental Amenities.** Pollution can lower the quality of life, for example, through reduced opportunity for bathing and recreational activities in rivers, bays and ocean beaches; smells from air pollutants and polluted surface waters; and physical discomfort and loss of visibility from air pollution. Amenity losses are often translated into tangible economic losses, such as reductions in property values, tourism and business in polluted areas.
- (d) **Ecosystem Damage.** The existence of intact ecosystems and wildlife not only has use value for tourism, recreation, research and future economic activities, but also non-use value since people value wildlife simply for its existence.

8. Pollution problems are highly location specific. Therefore, specific actions need to be prioritized at the local level following the steps outlined in Box 1. In this section, only a broad national prioritization of pollution problems is attempted according to how many people are affected by a specific problem and how severe these effects are. Subsequently, the five top problems are discussed with indications of the overall damages of each problem and the possible costs for addressing them in a cost-effective manner. Costs and benefits are estimated mostly on the basis of comparable international experience. While the estimated orders of magnitude are believed to be accurate, specific interventions need to be justified based on more detailed analysis. The available information -- while insufficient for a detailed cost-benefit comparison -- indicates that actions to address all five top pollution problems can be justified on economic grounds.

Table 1: Pollution Problems, Sources, Impacts, and Controls

Pollution Problem, Pollutants and Locations	Source	Impact	Typical Control Options
Pollution at the household and community level (lack of basic sanitation)	Polluted drinking water or sewage	Transmission of intestinal and other diseases	Piped supply of treated water; sewage collection
Water: Organic Material (most urban surface waters: rivers, bays, beaches)	Mostly sewage (collection systems and runoffs); also industry and landfill runoffs	Reduced dissolved oxygen, damage to aquatic wildlife, offensive smell	Conventional sewage and wastewater treatment
Water: Fecal Bacteria (rivers, bays and beaches near large cities)	Sewage	Acute intestinal, skin and liver diseases from drinking or bathing	Sewage disinfection (uncommon)
Water: Nutrients (phosphorous, nitrogen)	Mostly sewage, also agricultural runoff	Eutrophication killing fish and causing aesthetic problems; algae, in turn, generate biological load	Chemical precipitation of wastewater
Water: Toxics and Metals	Mostly industrial effluent, also landfill runoffs	Chronic disease from drinking or consuming fish, accumulation in sediments	Wastewater pretreatment
Air: Fine Particulates (most serious in São Paulo, Rio de Janeiro, elsewhere local)	Combustion (mostly industry, also transport and solid waste burning)	Chronic and acute respiratory disease including premature death	Filters and precipitators in industry; switch to low-sulfur and other cleaner fuels
Air: Ozone/smog (likely serious in São Paulo, Rio de Janeiro, and possibly other cities)	Mostly transport emissions of NO _x and VOC (ozone precursors)	Respiratory disease, brown haze reducing visibility	
Air: Carbon monoxide, aldehydes (areas with high transport density, tunnels, main intersections)	Transport	Localized and temporary health effects; however serious effects possible	Catalytic converters in vehicles; vehicle maintenance; transport system strategies
Hazardous Wastes (air, water, land)	Mostly industry	Acute poisoning and chronic disease; pollution of water bodies/aquifers	Waste minimization, industrial landfills, incineration
Poor Solid Waste Management (uncollected solid waste, unsuitable disposal)	Domestic and industrial solid waste	Transmission of diseases; aesthetic effects; clogging of streams; water pollution	Complete coverage with solid waste collection, disposal in sanitary landfills

9. The first priority is accorded to two problems which affect a large number of people (several millions) and at the same time cause significant individual effects (including premature mortality):

(a) Pollution problems at the household and community level caused by lack of safe water supply or lack of safe sewage removal. This includes limited urban areas without water and large urban areas without sewage networks, as well as rural communities which lack safe water supply and often rely on contaminated water sources.

(b) Particulate air pollution in the megacities of São Paulo and Rio de Janeiro affects millions of residents in both cities. Other air pollution problems, such as ground-level ozone, are likely to exist but require more careful analysis.

10. The next highest priority would be accorded to problems where either many people are affected but the damage is only moderate (amenity loss but no severe or widespread health effects) or to problems which affect only a few people (several hundreds or thousands) but damage to those individuals is serious (including major health damage). These problems include:

Table 2: Where are the Problems?

Problem/ Region	Center-West	North	Northeast	South	Southeast
Lack of Basic Sanitation (percentage gap to full coverage)	Water gap moderate: 11%	Water gap large: 27%	Water gap moderate: 11%	Water gap low: 5%	Water gap moderate: 10%
	Sewage gap large: 67%	Sewage gap huge: 95%	Sewage gap huge: 86%	Sewage gap huge: 85%	Sewage gap large: 59%
Air Pollution	Localized and street-level pollution	Localized and street-level pollution	Localized and street-level pollution	Localized and street-level pollution	Serious in São Paulo and parts of Rio de Janeiro
Urban Water Pollution	Moderate and localized in major cities	Moderate to serious in major cities	Moderate to serious in major cities and at many beaches	Moderate to serious in major cities	Moderate to serious in major cities and at many beaches
Localized Severe Pollution (only examples given)	Mining effluent	Air pollution from forest burning; mining effluent	Pollution from sugar factory and distilleries	Coal Mining	Volta Redonda, RJ; Cubatão, ABC, SP
Solid Waste and Urban Problems	Problems are present in all major urban areas but differ from case to case. Overall, there is greater capacity to address problems in the South and Southeast				

- (a) Surface water pollution in urban areas (creeks, rivers, bays and beaches) that causes damages in lost amenity (reduced recreation, offensive smell) and production and income (fisheries, tourism), but generally does not cause widespread and severe health damages unless untreated water is consumed by humans. This problem affects a large number of residents and the aggregate damages can accumulate to significant amounts.
- (b) Inadequate solid waste collection in low-income neighborhoods and improper solid waste disposal, as well as clogging of drainage systems and improper sewage sludge disposal, lead to the spread of vector-borne diseases and water contamination.
- (c) Severe localized pollution includes cases of industrial zones with poor levels of pollution control where localized populations suffer from health-threatening pollution levels (mostly air pollution, toxic water pollution, or contact with hazardous substances).
11. Other problems that do not affect many people and do not have particularly severe individual effects are accorded a lower priority. This does not mean that these problems are unimportant and should not be addressed wherever possible. However, these problems should not divert limited institutional capacity and financial resources away from the higher priority problems. In the following cases, a strategy of encouraging low-cost control measures and gradual improvements while avoiding deterioration or irreversible damages would be appropriate:
- (a) Conventional pollutants entering waterbodies in thinly populated areas that are not used as direct source of drinking water and cause no major economic damage should be addressed in a gradual manner.
- (b) Street-level air pollution and regional air pollution outside of the Metropolitan Areas of São Paulo and Rio de Janeiro and heavily polluted hot-spots should be addressed -- and deterioration prevented -- through improved vehicle inspection and maintenance and industrial controls.
- (c) Groundwater pollution from sewage and industrial effluent is likely in many areas, but data is almost non-existent. Routine groundwater monitoring

should be introduced and measures taken to prevent irreversible deterioration of aquifers.

- (d) Agricultural burning can cause health threats and interrupt the operation of airports. In addition, the excessive use of agrochemicals can lead to toxic water pollution. However, while unsafe handling of agrochemicals by the operator at the farm level is known to be a serious occupational safety problem, there is no evidence of large scale toxic pollution from agrochemicals in the waterbodies.

2.1. LACK OF BASIC SANITATION

12. Absence of safe water supply and sewage disposal are one of the main causes of high rates of intestinal and other diseases in low-income countries. The relationship between sanitation infrastructure and important health indicators, such as infant mortality, has been analyzed by various empirical studies and confirmed by recent work in Brazil (see Annex 2). In the absence of safe water supply, households frequently use water that transmits water-borne diseases, mostly of fecal origin. In the absence of safe sewage disposal, fecal material remains in the household or neighborhood and leads to the direct transmission of disease.

13. Piped water supply coverage has increased significantly and now reaches 84% of the urban population in Brazil (up from 60% in 1970), reaching more than 90% in the South and South-East. The remaining problem with respect to urban water supply is the inferior coverage of low income populations (35% of which are unserved compared to 3% of the middle and high income population). Piped water supply only reaches 9% of the rural population. Even though wells and springs supply safe water to many of the unserved rural population, a significant percentage lack access to safe water. Sewerage networks reach only 49%

of the urban population. Another 14% of the urban population have better-than rudimentary septic tanks whose safety depends on maintenance and operating conditions. More than a third of the urban population has no safe disposal of sewage. Coverage of sewerage networks in rural areas is negligible while coverage with septic tanks is significant and can provide safe disposal in low density areas.

14. Lack of safe water and sanitation in Brazil's urban areas is estimated to cause about 8,500 annual cases of premature mortality and additional morbidity. The costs of saving one statistical life through investments in urban water supply are estimated around US\$ 17,000-115,000. The analysis suggests costs per life saved through investments in sewerage networks of around US\$ 20,000-110,000. Within the given ranges, the costs per life saved are lowest in the Northeast, followed roughly by the North, Center-West, South-East and South. These costs can be justified by taking into account the additional amenity benefits of water supply and sewage removal for which a large share of the population is willing to pay. Willingness to pay for services also justifies their provision in most rural areas. This analysis suggests a focus on the immediate expansion of safe water supply to all urban households with concurrent or subsequent installation of sewerage networks for currently unserved urban areas.

2.2. AIR POLLUTION

15. Large parts of the Metropolitan Areas of São Paulo and Rio de Janeiro suffer from severe regional air pollution problems. Of greatest concern are fine particulates that enter the lungs and cause respiratory diseases and premature mortality. They are the result of emissions from combustion sources (industry, transport and others such as garbage burning). In contrast to particulate air pollution problems elsewhere in the world

Table 3: Air Quality in Selected Cities

Averages of stations over different time periods	PM-10 ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)
<i>WHO guideline and ambient standard for annual average</i>	50	40
São Paulo Metropolitan Area, SP	70	20
Cubatão, SP	90	15
Rio de Janeiro, RJ (Basin III)	88	38
Belo Horizonte, MG	37	n.a.
Contagem, MG	48	25
Betim, MG	40	13
Porto Alegre, RS	54	23
Volta Redonda, RJ	66	n.a.

which are mostly linked to the burning of coal, Brazil's air pollution problems are caused to a significant extent by transport sector emissions. These emissions are more important than implied by emission inventories since they are near the ground and consist of finer particulates than typical industrial emissions. The health costs of particulate pollution in São Paulo and Rio de Janeiro are estimated to include about 4,000 annual cases of premature mortality and about 38 million restricted activity days.

16. The effects of air pollution can only be mitigated by reducing emissions. The design of a cost-effective control strategy for fine particulates is hindered by the complicated atmospheric processes leading to pollution. For example, sulfur dioxide is not a problem in the major cities. However, sulfur emissions contribute to the formation of sulfates which form a significant part of particulate pollution. Large reductions of particulate emissions can be achieved by industry at moderate costs. The transport sector will have to implement more expensive controls in order to address the problem of fine particulates. The costs per live saved through particulate emission reductions in the major metropolitan areas are estimated at around US\$ 10,000-25,000 for industry and US\$ 50,000-85,000 for diesel vehicles. Given these relatively low costs, much tighter controls of emissions leading to particulate pollution (particulates and gases) can be justified by lower bound estimates of health costs without waiting for results of further -- nevertheless important -- analysis.

17. Both São Paulo and Rio de Janeiro, and possibly other cities, are likely to have a significant problem with health damages from ground level ozone caused by emissions of nitrogen oxides and hydrocarbons, mostly from vehicle sources. Only limited information is available. All bigger cities have problems of street level pollution from vehicle emissions, in particular carbon monoxide and aldehydes, the latter caused by ethanol-fueled vehicles. The main effect of this street-level pollution is discomfort and loss of urban quality of life. As the vehicle park is modernized and replaced by vehicles equipped with catalytic converters (already mandatory for new gasoline vehicles), and vehicle maintenance is improved, street-level pollution problems can be gradually reduced at relatively low incremental costs.

2.3. URBAN WATER POLLUTION

18. Streams, bays and beaches in or near almost all major urban and industrial areas are severely polluted from sewage, industrial effluents and solid waste run-off with high levels of solids, organic material and fecal coliform:

Box 2: Guanabara Bay in Rio de Janeiro

Guanabara Bay is a symbol of Rio; yet its waters and beaches are badly polluted, making it unsuitable for recreational activities and emitting an offensive smell in certain areas. The direct and daily contact of millions of people with the Bay has made clean-up a high political priority. A study of pollution control options shows that if investments are prioritized according to cost-effectiveness, significant water quality improvements (BOD concentration reductions between 7 and 24%, phosphorous concentration reductions between 4 and 34%) can be achieved in the medium-term at an annualized cost of US\$ 33 million, which is considered justified by the benefits to the population of Rio. Interestingly, the cost-effective strategy includes almost no secondary treatment of sewage.

Source: World Bank, 1996, Managing Environmental Pollution in the State of Rio de Janeiro, Report No. 15488-BR

(a) Creeks and smaller rivers flowing through urban areas are often used as open sewers or solid waste dumps. These waters are unsuitable for any

Table 4: Water Quality in Selected Locations

Averages of stations over different time periods	BOD ₅ (g/l)	Dissolved Oxygen (g/l)	Fecal Coliform MPN/100ml	Phosphorus (µg/l)
<i>Ambient standards</i>				
- Water used for simple treatment (Class I)	<3	>6	<200	25
- Water used for recreation/swimming (Class II)	<5	>5	<1000	25
- Water used for conventional treatment (Class III)	<10	>4	<4000	25
Rio Paraíba do Sul (SP, RJ, MG)				
- Main river	0-3	4-7	200-1500	
- Tributaries with major population/industry	3-5	0-4	>1500	
Guanabara Bay Northwest, RJ	6.1	5.1		211
Tieté, SP				
- Headwater	4.5	4.1	0	28
- Metropolitan Area SP	41.5	0.2	4070	1875
- Medium Tieté	2.5	7.3	0	29
Rio Cuiabá, MT, downstream of Cuiabá	1.0	7.0	8900	160

Beaches RJ: Out of 70 monitored beaches in the State, 44 beaches are within the fecal coliform bathing standard of 1000 MPN/100ml for 80% or more of the samples. Within the 14 beaches of the Municipality of Rio, the standard is met between 15% (Botafogo) and 82% (Leme) of samples.

Beaches SP: Out of 103 monitored beaches, 36 meet the bathing standard all the time, 39 meet the standard more than 50% and 28 less than 50% of samples.

recreational activity. Moreover, they are an ugly sight and often smell offensively. This problem affects almost all major cities.

- (a) Larger rivers and bays that receive urban effluent have higher dilution capacity and do not normally smell offensively. However, they still suffer from high pollutant concentrations which make them unsuitable for bathing, reduces fish production and damages valuable ecosystems, such as mangroves. Typical examples include the Rio Paraíba do Sul (SP, RJ, MG), the Capibaribe in Recife (PE), and the Guaíba in Porto Alegre (RS). Except for locations with high concentrations of heavy metals and toxic pollutants (from industries), water can be treated for domestic supplies at modest costs.
- (a) Nutrients from sewage and agricultural runoff enter lakes, reservoirs and bays where they can lead to eutrophication. Eutrophication reduces or eliminates recreational uses, kills fish, and can lead to the production of toxic algae that can threaten drinking water sup-

plies. Guanabara Bay (RJ) is one of the waterbodies most affected by eutrophication.

- (b) Water quality at some ocean beaches is adversely affected by pollution discharges from nearby rivers. More commonly, however, beach quality is compromised by local sewage discharges or overflow of sewerage systems. Fecal contamination makes

Box 3: Rio das Velhas in Minas Gerais

Through the construction of interceptors, industrial and domestic wastewater from most of the Belo Horizonte Metropolitan Area is being removed from the *Ribeirões Arrudas* and *Onça* which flow through the city center. This measure has undoubtedly improved the urban quality of life. Effluents now enter the *Rio das Velhas*, a tributary to the *Rio São Francisco* outside of the city. As the result of these effluents, the downstream river is badly polluted (with dissolved oxygen levels below 2 mg/l for about 50 km, with recovery to 7 mg/l over the next 200 km). However, the *das Velhas* crosses a thinly populated area with few direct water users or uses. Should the construction of wastewater treatment plants be required at an investment cost of US\$ 45-135 million even though there are few tangible benefits of treatment (recently estimated at only US\$ 610,000 per year)? While a decision should ultimately be made based on more thorough analysis of local willingness-to-pay, it seems clear that other investments, such as the expansion of sanitation services, should have higher priority, at least in the short term.

beaches unsafe for swimming. The economic effects are most severe where beaches are used by a large number of urban residents (e.g., Rio de Janeiro) or have high potential for tourism (Northeast).

19. Analysis of specific cases (see Box 3) shows that there is a danger of spending large amounts of money on sewage treatment without achieving commensurate gains in improved environmental quality and reduced costs of pollution. The costs of eliminating all forms of water pollution in the short to medium term are prohibitive. For example, investment costs for secondary treatment (which removes more than half of the organic pollution load) for 96% of Brazil's urban population would be on the order of US\$ 11 billion (not including previous investments in collection systems). On the other hand, the benefits of a universal requirement of secondary treatment would be limited, since it removes neither bacteria nor nutrients and would clean up many waterbodies that have only limited use.

20. Industries typically have many options for reducing emissions through pollution prevention and waste minimization at a cost much lower than treatment of either sewage or industrial effluent. While these low-cost measures should be encouraged, they will be insufficient to solve water pollution problems since industrial emissions account for less than 15% of total organic load in most municipalities.

21. Rather than requiring high levels of effluent treatment for all pollutants, polluters and locations, it is important to determine the location-specific impacts of specific pollutants and determine priorities based on the comparison of costs and benefit of pollution control (see Box 3 and Box 2). However, some generalized considerations can assist in assessing this tradeoff:

- (a) Heavy metal and toxic pollutants drastically restrict water use and often cause long-lasting or irreversible damage. Pollutants that frequently exceed acceptable values include phenol, mercury, oil and fats. Strict control at the (mostly industrial) sources to attain ambient water quality targets for these pollutants is an obvious priority.
- (b) Open sewers within urban areas cause an amenity loss and can become breeding grounds for disease vectors. Gradual construction of interceptors or conversion of these canals into closed sewers will resolve the problem in the medium-term (see Box 3).
- (c) Some of Brazil's ocean beaches are world famous, attract a large number of national and international tourists, and are an important economic asset. Beaches with high tourism value or potential that are threatened by pollution need to be identified and systematically protected. Often this will require improvements in the local sewage collection and disposal system. In some cases, the most cost-effective option will be the construction of well-designed sewage ocean-outfalls.
- (d) In locations where eutrophication of receiving water bodies is a significant problem, nutrient removal from effluent entering the waterbodies should be a high priority given the potentially high cost of eutrophication for recreation, fishing, and drinking water supply.
- (e) In many rivers, moderate to severe organic and solid loads cause only limited economic costs through reduced recreational and fishing opportunities. Often, the damage will not justify secondary or tertiary sewage treatment in the short-term. In these situations, simplified low-cost sewage treatment op-

tions can be attractive. Also, load reductions can often be achieved by industry at source at a much lower cost. Where water is used for domestic supplies, the cost-effective solution is typically the installation of simple water treatment systems.

2.4. MUNICIPAL ENVIRONMENTAL PROBLEMS

22. Failure of municipal services, such as the collection and proper disposal of solid waste, construction of storm sewer systems and urban land use planning and regulation, contributes to unsanitary housing conditions, environmental hazards, flooding and landslides, reduces the urban quality of life and leads to pollution of local rivers and streams. Solid waste, urban drainage, flood control, and sewage treatment problems are closely interrelated through solid waste that obstructs drainage canals and sewage treatment sludge that requires proper disposal. These problems need to be addressed in a comprehensive and integrated manner. In addition, serious deficiencies exist in the handling of industrial hazardous and pathological wastes and need to be addressed.

23. While significant progress in solid waste management has been achieved in many large and intermediate cities of the South and South-East, other cities lag be-

hind. Individuals cannot easily be excluded from most municipal services. Therefore, these services are often financed through general municipal revenues, thus, making them dependent on the fiscal situation of the respective municipality.

2.5. LOCALIZED SEVERE POLLUTION

24. Localized pollution problems are caused by a small number of major polluters or many polluters which have a limited geographical impact. These problems are often located outside of the major metropolitan areas and can have a drastic impact on the local area in terms of health damages and ecological losses. Widespread examples of such problems include:

- (a) Smaller cities with a small number of major industrial polluters that are poorly controlled (i.e., Cubatão, ABC Paulista, SP, and Volta Redonda, RJ, Camaçari, BA). Estimates of industrial emissions (see Annex 1) suggest the locations of other possible hot-spots. Industrial emission controls are generally possible at a reasonable cost.
- (b) Toxic water pollution from mining is severe in many locations (e.g., toxic mercury pollution from wildcat gold mining). Modern mining techniques avoid such problems, but the problem

Box 4: Mercury Pollution from Informal Gold Mining

Informal gold mining (*garimpagem*) is widespread in the Amazon region. The mercury used in the amalgamation of gold is released into air and water and creates a serious threat to human and animal health and to ecosystems. Selective measurements indicate that health standards are dramatically exceeded in specific locations:

Samples	Standard Values	Measurements in Rondonia
Water	0.002 µg/l	< 0.1 - 8.6 µg/l
Sediments	0.1 µg/g	0.06 - 157 µg/g
Fishes	0.5 µg/g	0.04 - 2.1 µg/g
Air	0.02 µg/m ³	0.02 - 292 µg/m ³
Human Hair	0.7 - 6.4 µg/g	0.22 - 40 µg/g

Inexpensive corrective technology is available. Policies that have been suggested to encourage the use of corrective technology include education campaigns, incentives to use alternative technologies, and regulation through the mercury distribution chain, the gold purchase chain, and directly at the site of the *garimpero*. Implementation is hindered by the dispersed and unregulated nature of *garimpagem* and limited enforcement capacity, especially in the thinly populated areas of the North.

Source: Dan Biller, 1994, Informal Gold Mining and Mercury Pollution in Brazil, World Bank Policy Research Working Paper No. 1304.

of dispersed operators in frontier areas is institutionally difficult to tackle (see Box 4).

- (c) Forest burning (especially in the Amazon) and seasonal agricultural burning (i.e., before the sugar cane harvest) causes severe and harmful air pollution which affects small populations in the respective areas.
- (d) Sites polluted from inadequate industrial hazardous and toxic waste disposal pose a poorly understood but potentially significant health and safety risk. International experience suggests that cleanup costs for polluted sites can be extremely high, focusing attention on better handling of currently generated toxic wastes.

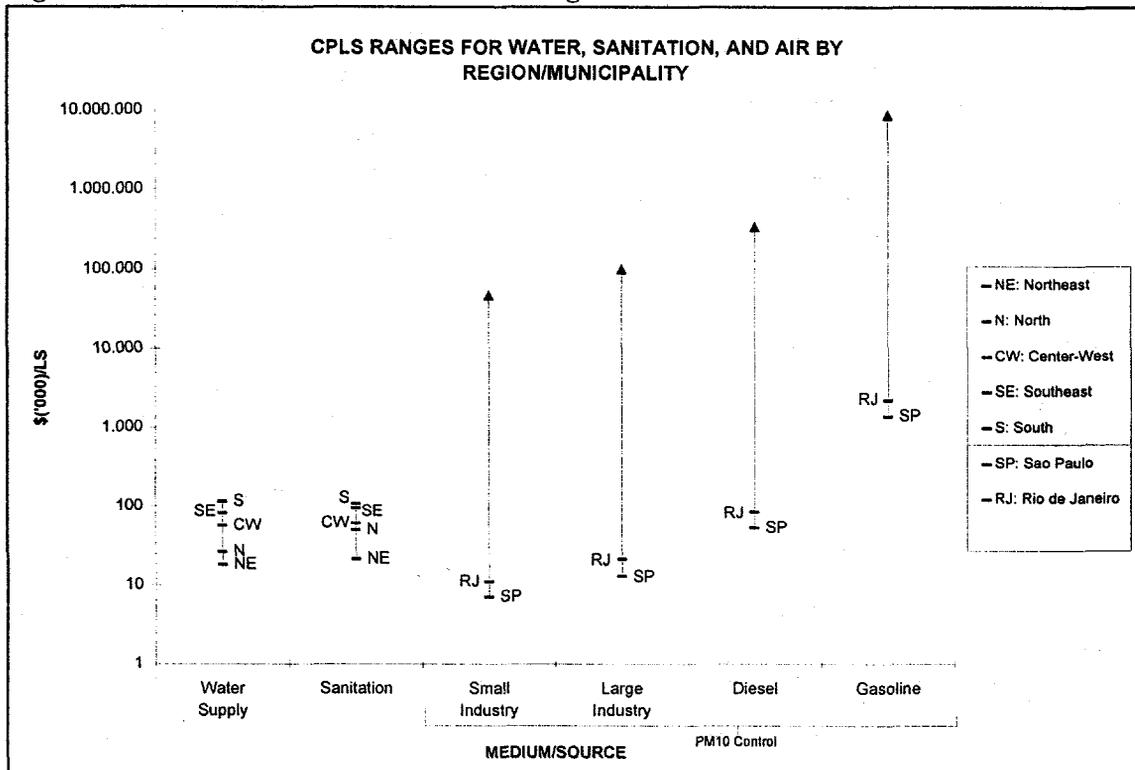
25. In many of these cases, health damages to a small number of individuals are so severe that interventions are justified by

these individuals' right to a safe environment without having to rely on cost-benefit comparison. The strategy for these problems is the definition of clear pollution reduction targets for main polluters. Directly reaching a larger number of dispersed polluters (agriculture, small-scale mining) is more difficult but can be aided by collaboration with industrial federations, unions, or other groups representing the polluters.

2.6. TRENDS AND PERSPECTIVES

26. As one of the most industrialized and urbanized developing countries, Brazil suffers from pollution problems that are bad by international comparison. However, significant efforts have been made over the past 20 years to achieve a basic level of pollution control. Also, many distortionary policies that tended to aggravate pollution problems (such as subsidies for heavy industry, poorly run state owned enterprises),

Figure 1: Cost Per Live Saved For Addressing Different Pollution Problems



have been removed in recent years. As a result, pollution problems are serious, but in most cases, not among the worst in the world (see Figure 2):

(a) By comparison with other countries at the same income level, Brazil has a decent level of coverage with basic sanitation services (water supply and sewage collection); however coverage of the low-income population is inadequate, and a major challenge lies ahead

to achieve comprehensive coverage.

(a) Like other countries with a similar income level, Brazil has extremely limited sewage treatment. Overall, treatment levels are likely to increase but remain low and concentrated in a few critical areas for some time since demand for the amenities provided by universal secondary or tertiary sewage treatment will justify the costs only at significantly higher income levels.

Table 5: Brazil's Top Five Pollution Problems

Problem No. 1: Inadequate Basic Sanitation

The Problem and its Cost: An urban population of 17.9 million lacks safe water (internal plumbing), and an urban population of 45.6 million lacks safe sewage removal (sewage network or septic tanks; the problem is concentrated in North, Northeast and Center-West and in low income areas), causing about 8,500 annual cases of premature mortality and additional morbidity.

The Solution and its Cost: Universal coverage of urban water and sewage requires investments of about US\$ 13 billion and annualized costs of about US\$ 1.7 billion; tariffs should fully recover the costs from most households. The implicit cost of a life saved through urban water supply is around US\$ 17,000-115,000 and through urban sewage US\$ 20,000-110,000.

Problem No. 2: Metropolitan Air Pollution

The Problem and its Cost: 16.5 million people in São Paulo and 10.4 million people in Rio de Janeiro are exposed to excessive levels of particulate air pollution causing around 4,000 cases of premature mortality and 38 million restricted activity days per year.

The Solution and its Cost: Tight industrial and vehicle emission controls in São Paulo and Rio de Janeiro would have annualized costs on the order of US\$ 75 million which would be born by industry and vehicle owners. The implicit cost of a life saved through industrial emission control is around US\$ 10,000-25,000 and through diesel vehicle emission controls US\$ 50,000-85,000.

Problem No. 3: Urban Water Pollution

The Problem and its Cost: Surface water pollution reduces the recreational value of many water bodies. Total costs could be US\$ 300 million per year (3.6 million families - 40% of eight major metropolitan areas - willing to pay US\$ 7 per month for improvements of water to bathing quality) in addition to ecosystem damage and lost income from tourism development.

The Solution and its Cost: Abatement of industrial emissions is possible at relatively low cost. Treatment of sewage is costly (investment cost for universal secondary sewage treatment in Brazil would be around US\$ 11 billion), suggesting a gradual strategy of sewage disposal appropriate to the specific local conditions.

Problem No. 4: Poor Solid Waste Management

The Problem and its Cost: 40% of solid waste generated in Brazil (about 40,000 tons per day) remains uncollected. Only 28% of collected solid waste receives environmentally sound treatment or disposal. Solid waste littered in streets, yards and empty lots causes spread of vector-borne diseases and flooding from clogged streams; open dumps cause water pollution. Assuming that 40% of Brazil's households presently do not receive waste collection services and are willing to pay \$1 per month for collection, annual costs of lack of collection would amount to US\$ 380 million.

The Solution and its Cost: Complete urban coverage of solid waste collection with disposal in sanitary landfills complemented by recycling and composting systems. Seek integrated solutions to solid waste management, urban drainage and sewage sludge disposal problems. Additional cost of complete collection is about US\$ 290 million annually; additional costs of disposal in sanitary landfills are about US\$ 130 million annually.

Problem No. 5: Localized Severe Pollution

The Problem: Severe but localized pollution from large industrial plants, (large and small scale) mining, burning and hazardous waste has severe health effects on an unknown number of directly affected people.

The Solution: The solution depends on the individual problem and may include negotiated pollution reduction targets with the main polluters, negotiated aggregate targets for polluting sectors, better housekeeping and cleaner production to reduce hazardous waste generation and shutting down of worst offenders.

(b) Air quality in the megacities of São Paulo and Rio de Janeiro is quite poor and causes severe health damages. It is not as bad as in cities like Mexico City, Santiago, Beijing and industrial areas in Eastern Europe, but is much worse than in the cities of high-income countries. Some inland cities (such as Belo Horizonte) could face future air pollution problems if no measures are taken.

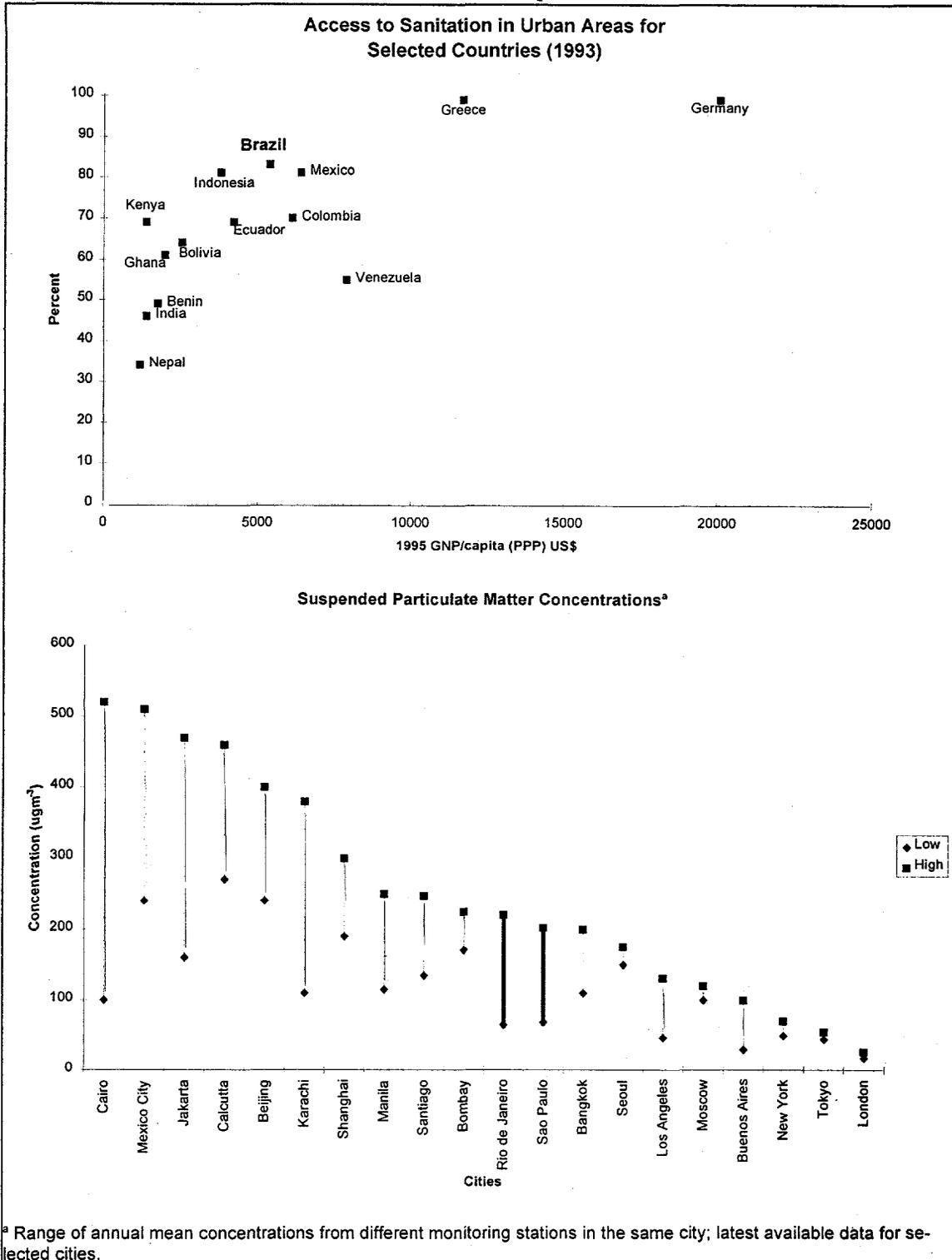
27. In Brazil, as elsewhere, there are important linkages between the nature and severity of environmental problems and the level of income and economic development that are driven by two often opposing forces. On the one hand, the increase in certain economic activities is linked to the increased generation (or supply) of pollution. On the other hand, increased income leads to increased demand for environmental quality and the availability of resources to invest in pollution control.

28. Typically, the health impacts of air pollution and the contamination of drinking water are so severe that these effects alone justify significant control measures at any income level. The first priority, even at low levels of income, is therefore the removal of pollutants from the immediate household and community environment. This priority may be pursued even at the cost of increased pollution at the regional level (for example in rivers that receive the collected sewage) if this does not undermine tourism development and other important income opportunities. As incomes rise, the demand to remove pollution from the cities will increase. Then, production losses and environmental amenity values will justify water quality improvement measures, especially in densely populated areas. At even higher incomes, demand for environmental amenities and ecosystem protection leads to environmental controls even in areas without immediate and direct use.

29. The unequal income distribution and the large regional disparities in economic development in Brazil have important implications for environmental policy making. In areas where income and coverage of basic sanitation services are low, improvements in these services should be the top priority even if this implies a temporary worsening of other environmental indicators. On the other hand, the demand for the aesthetic and leisure benefits of environmental quality is more likely to be justified in higher income areas. An important implication is that the desired level of pollution control will differ between regions with different income levels. Importantly, in order to avoid a perverse subsidization of the more affluent part of the country, the costs of higher environmental quality in higher income regions should be paid from user fees or local taxes in these higher income regions.

30. The health costs of pollution particularly affect low-income families which typically live in more polluted areas and lack the resources for protective expenditures and investments. Environmental improvements will, therefore, often more than proportionately benefit the low-income population. Measures that improve environmental conditions and generate benefits primarily for the poor, such as the extension of basic sanitation, are an obvious top priority. On the other hand, it would be misguided to try to address income inequalities through environmental improvements that would not otherwise be a priority. For example, investments in secondary and tertiary sewage treatment would in many locations not likely be a priority for the poor who might instead prefer faster expansion of sewage collection or better health care and education.

Figure 2: Pollution Problems in International Comparison



31. The timing of different pollution control measures is critical for their economic costs because: (a) the effect of discounting in an economy with high real inter-

est rates means that expenditures that may cause severe financial problems in the present may well be affordable in the medium term; and (b) the cost of retrofitting installa-

tions with pollution control devices is often much more expensive than the integration of pollution reduction measures in new investments. Gradualism and flexibility in timing can therefore greatly aid in the reduction of pollution control costs, especially if clear medium to long-term pollution reduction targets are set now, rather than deferred to some unspecified future time. Unfortunately, the time dimension is too often ignored in the design and implementation of policies.

32. Rational policies would follow the priorities established by demand while taking care that initial efforts do not undermine, or render unduly expensive, future efforts for more comprehensive pollution reduction. The overall strategy recommended in this report focuses first on measures to address pollution problems with (a) important health effects (e.g. lack of sanitation services); (b) significant economic damages (e.g. pollution of major tourism beaches); or (c) long-lasting or even irreversible damages (de-

struction of mangroves, toxic and heavy metal pollution). On the other hand, pollution problems which do not fall into the above categories would be addressed through a policy of low-cost abatement (good housekeeping and pollution prevention) complemented by appropriate medium and long term targets.

3. POLICIES, INSTRUMENTS AND INSTITUTIONS

33. On the one hand, Brazil has made important progress in addressing several severe pollution problems. Environmental regulations are reasonably complete. Many gross distortions such as subsidies on highly polluting products have been removed. The management system of some states can be considered advanced in comparison with most developing and the other MERCOSUL countries. On the other hand, after more

Summary: Pollution Problems and Priorities

Issues and Problems

- A large number of pollution problems have serious economic costs in terms of health, production costs, tourism, quality of life and ecology that exceed the alternative cost of pollution control; however, there is little prioritization of these problems in terms of their economic costs. Therefore, the limited financial and institutional resources are dissipated and do not achieve the greatest possible affect.

Strategy and Recommendations

- First priority: many people affected with serious damage by lack of water supply and sewage collection
- Second priority: many people affected with serious damage by particulate air pollution in São Paulo and Rio de Janeiro
- Third priority: many people affected with mostly moderate damage by metropolitan water pollution suggesting a gradual approach focusing on low-cost control options and sewage disposal adequate to the specific local conditions.
- Fourth priority: many people affected with mostly moderate damage by poor solid waste management
- Fifth priority: few people affected with serious damage by severe localized pollution from industry, mining, etc.
- Much more work is needed to prioritize problems by their economic costs and rank alternative policies and interventions by their cost-effectiveness. A preliminary ranking of problems focuses on those with high economic costs and leaves less important problems to be addressed through a gradual strategy of medium and long term targets.
- Pollution management strategies should be cost-effective across sectors (industry and sewage for water pollution and industry and transport for air pollution).
- Higher environmental quality targets in higher income regions are acceptable if they reflect local demand for environmental quality and are financed out of local charges and revenues. Interventions that improve environmental conditions and benefit the poor (for example water and sewage infrastructure expansion) have a particularly high priority.

than 20 years of active pollution management policies in Brazil, many pollution problems remain unresolved and, in many instances, pollution is well above internationally acceptable and economically optimal levels as demonstrated in the first section of this report. This means the country as a whole would benefit from implementing more effective pollution controls.

34. Similar to many other countries, Brazil has imported a pollution management model that is based primarily on environmental command and control regulation in the USA and other high-income countries. In countries with effective institutions and rigorous law enforcement, this model has achieved remarkable environmental improvements, albeit at an extremely high financial cost. However, in Brazil, similar to other middle-income countries in East Asia for example, this model is not working well. Polluters do not pay the full cost of the damages they cause. Policy instruments used for pollution control are limited, but the combination of federal, state and local environmental regulations has created a highly complex system of requirements that are not systematically implemented and enforced. It is unlikely that current policies will resolve these problems in the near future. Moreover, current pollution management policies not only fail to achieve reasonable environmental objectives but also contribute to unnecessary economic damages due to ineffective pollution control expenditures and bureaucratic obstacles to economic development.

35. There is no well-tested alternative model for effective and affordable pollution management in middle-income countries with weak environmental institutions. However, there are clear indications for the necessary direction of change and the analytical approaches that can support this change. The purpose of this section is to demonstrate the need for change, indicate its direction and benefit from the experience of other

countries which have experimented with different pollution management approaches.

3.1. PROBLEMS OF THE CURRENT POLLUTION MANAGEMENT APPROACHES

36. The quality of pollution management policies differs widely across Brazil. Some of the more industrialized states have substantial experience with pollution management from which other states have learned. Other states have less pressing problems and less experience in dealing with those problems that have emerged. Overall, however, governments are not effectively managing pollution problems. The common problems of the current management system include: (a) lack of prioritization of problems and interventions; (b) reliance on outdated command and control instruments; (c) lack of integration of environmental considerations in sectoral policies and planning; (d) ineffective implementation and enforcement; and (e) excessive reliance on Government financing.

37. **Lack of Priorities and Cost-Effectiveness.** Overall, Brazil's pollution policies try to do too much and achieve too little. As in many countries, environmental policy making is characterized by conflict between environmental groups demanding unrealistic levels of environmental protection and polluters who claim that environmental requirements would reduce economic growth. As a result, there is little rational debate and quantitative analysis and little consideration of the need for careful choices about the tradeoffs involved in setting and implementing environmental targets and policies.

38. The efforts of environmental agencies are often not directed at the most important problems nor the most cost-effective solution to these problems. There are few systematic policies that target polluters in areas where ambient conditions suggest the existence of high costs of pollution and

Box 5: Current Policies and Institutions

The heart of Brazil's pollution control policy is a licensing system that requires a valid environmental license for every potentially polluting activity. States have implemented their own licensing systems based on national framework regulation. Most States issue three types of licenses (Planning License, Installation License, Operating License). For activities with a large polluting potential, an Environmental Impact Assessment (EIA) is part of the licensing process. States have implemented different systems of fines for environmental violations, considering levels of toxicity, frequency of infraction and the quantity of effluent. Even though the states are responsible for most licensing, the federal agency (IBAMA) is responsible for licensing multi-state projects and certain large facilities, e.g., sea ports.

Several States have implemented load-based industrial sewage charges. Effluent charges for pollution, which directly enters surface waters or the air have been discussed in different states at several times. However, these initiatives have not received the necessary political support nor led to the implementation of such a system. The new national water resource law, approved in 1997, opens the door to the use of effluent charges in the context of river basin management systems. This law reflects an increasingly broad consensus about the desirability of such charges.

Monitoring of ambient environmental quality is performed in many water bodies. Limited continuous monitoring over extended periods of time is complemented by more detailed monitoring campaigns often supported by, or conducted for, bilateral or multilateral projects. Monitoring is performed by a large number of separate agencies, which complicates the access of policy makers and others to recent and comprehensive environmental quality data. Only a small number of States aggregate existing ambient information in reports on the status of the environment.

Environmental legislation in Brazil dates back to 1973 and was modeled mostly after US law relying heavily on standards, licenses, and zoning. The objectives of environmental policy are defined in minimum ambient environmental standards which the Federal Government has established for water and air. Air quality standards are uniform and broadly follow WHO Guidelines. CONAMA Resolution 20/1986 determines ambient standards for nine water use classes. Water quality classes have been assigned to some waterbodies by state agencies. There is non-compliance with these standards in many areas. Vehicle emission standards have been developed by CETESB and adopted at the federal level.

Since 1973, the national environment management framework has undergone periodic revision. In 1981, the Government established the National Environment System (SISNAMA). In 1984, a National Environment Council (CONAMA) was established to oversee SISNAMA. In 1988, the federal agencies were integrated into the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), which maintains a superintendency in each state and focuses mainly on resource management and conservation issues. In 1994, a national Ministry of Environment, Water Resources and Legal Amazon (MMA) was established, of which IBAMA is now a part. The Secretariat of Urban Policy (SEPURB) in the Ministry of Planning carries main responsibilities at the federal level for policies for the sanitation sector and solid waste.

Responsibilities of the States include environmental licensing, classification of water-bodies, vehicle emission control and water and sanitation services in metropolitan areas. Beginning in 1974, most States have created Environmental Protection Agencies (OEMAs – *órgãos estaduais de meio ambiente*) which are in charge of licensing, monitoring and enforcement of environmental regulations. Some of these agencies have acquired significant experience. CETESB of São Paulo and, to a lesser extent, FEEMA of Rio de Janeiro have been acknowledged as leading agencies in the developing world. CETESB and FEEMA are the largest state environmental agencies in Brazil with staff of 2,200 and 900, and budgets of about US\$ 90 and US\$ 25 million respectively. The environmental control agencies of States such as Minas Gerais, Pernambuco and Rio Grande do Sul have staff between 100 and 200. Smaller States have agencies with a staff of less than 100. In line with macroeconomic deterioration, and in particular, deterioration of state fiscal situations, several OEMAs have suffered serious decline in recent years.

Municipalities play an increasingly important role in pollution management and are responsible for zoning, water, sanitation, solid waste and drainage services. In addition, larger municipalities are assuming licensing functions for activities with local polluting potential. Through the regulation of land use and the granting of building permits, municipalities have significant impacts on pollution problems. While the municipalities of large cities have their own secretariats for environment with significant administrative capacity, such capacity is limited or non-existent in most.

The legal system plays an important role in the enforcement of environmental laws and regulations in Brazil. The Attorney General's Office has an environmental unit that specializes in the prosecution of violations of environmental laws. The *Ministério Público* at the federal and state levels is the main plaintiff for law suits relating to the environment, making this agency an important actor in pollution management.

where pollution abatement costs are relatively low. Instead, action is often politically motivated and enforcement focused where political resistance is least. The result is that less environmental quality is achieved than possible at the same social cost, or more money is spent than necessary to achieve a

given environmental target. Priority setting is further hindered by poor information and limited analytical capacity.

39. **Lack and Inequality of Enforcement.** A major problem is the unequal implementation and lack of enforcement of

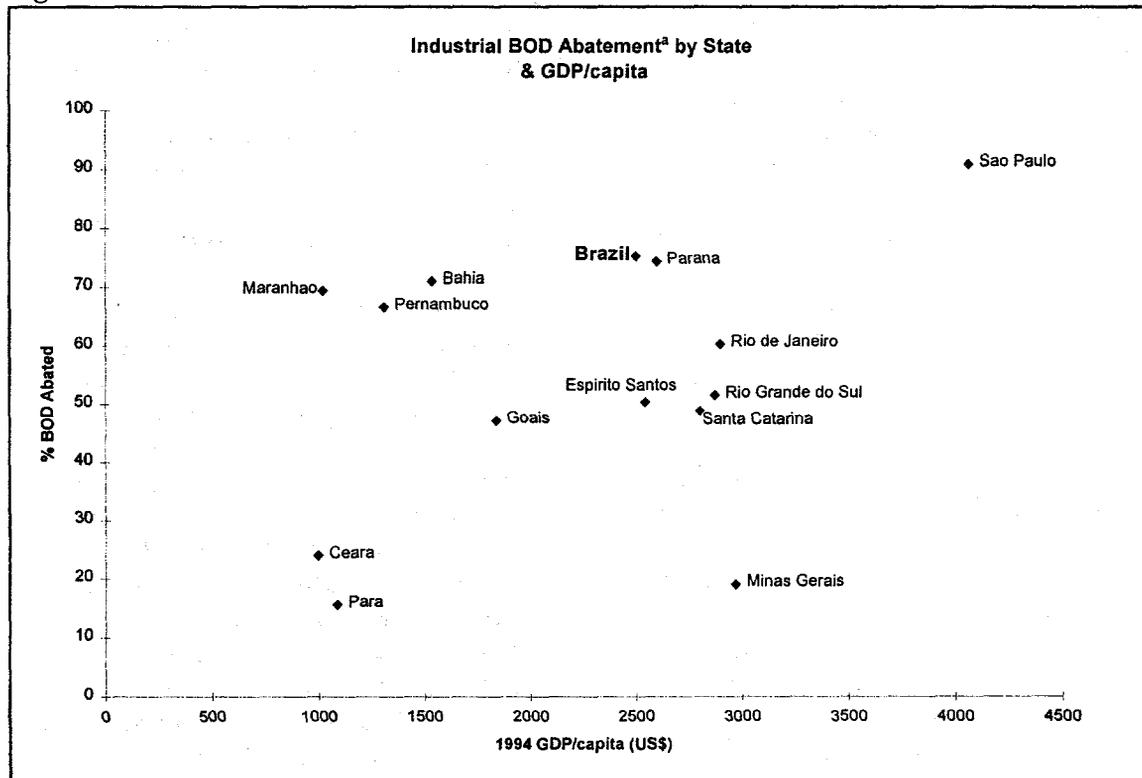
existing regulations. Federal norms typically follow the higher demand for environmental quality in São Paulo with little involvement of the poorer states. As a consequence, some of these norms are too stringent for states that have neither the capacity nor the willingness to enforce them. Thus far, however, there has been little willingness to accept regional differences in environmental quality targets. As a reflection of their lesser demand for environmental quality, poorer states allow much wider non-compliance with ambitious uniform standards (see Figure 3). The resulting large gap between standards and reality undermines predictability and accountability.

40. **Outdated Instruments.** Management of pollution issues in Brazil essentially means licensing and -- with some notable exceptions -- little follow-up or inspections. Licensing is applied in a bureaucratic fashion geared toward intervention at the level of individual polluters rather than oriented at

defined environmental improvements. Instruments focus on the state's police power and provide little assistance to polluters for improving their environmental performance. With the exception of industrial sewage fees, more flexible economic instruments, such as negotiated emission reduction targets for groups of industries, are quite incipient and still encounter resistance. Formation of river basin committees and agencies is only beginning. Cooperation among stakeholders -- the private sector, affected communities, NGOs, the scientific community and government -- is limited.

41. **Lack of Sectoral Integration.** Neither horizontal (between sectors) nor vertical coordination (between municipalities, states, and federal Government) functions effectively. For strong sectoral actors (industry, transport, water and sewage), pollution management is only a marginal concern. Environmental agencies are generally weak, often perceived as costly obsta-

Figure 3: Abatement Levels in Selected States



^a Source: World Bank, 1993, Brazil: Water Pollution Control Management - Selected Issues, Draft Report No. 11402-BR

Summary: Pollution Management Problems

Issues and Problems

- After 25 years of environmental management, pollution levels are still excessive (pollution costs above control costs) in many locations and costs imposed by environmental regulation are often unnecessarily high (actual control costs above cost-effective control costs) due to:
 - a) lack of priority setting and cost-effective strategies;
 - b) limited and inconsistent enforcement;
 - c) use of outdated pollution management instruments;
 - d) no sectoral integration of pollution management;
 - e) weak environmental institutions; and
 - f) excessive reliance on Government budgets.

cles to other sectors' policies, and left outside of important decision making processes. All levels of government show great resistance against incorporating environmental considerations in the selection between investment and policy alternatives. Environmental licensing and environmental impact assessments, therefore, only function as bureaucratic obstacles for finalized projects rather than as planning tools.

42. **Excessive Reliance on Government Financing.** There is a prevalent perception that more effective pollution management is constrained by lack of financial resources. However, excessive reliance on Government financing has created unnecessary constraints for more effective management of pollution problems. Public banks have put significant amounts of (subsidized) loans into industrial pollution control. Water and sanitation infrastructure investments have been financed mainly from public or official external sources. Solid waste services are paid out of public budgets with low cost recovery in most places. In addition to these direct costs, governments bear the costs of public administration, including the cost of running environmental agencies. These costs have been inflated as a result of rigid and inefficient public service employment rules as well as the use of instruments that are only effective with expensive source monitoring. The reliance on public budgets makes pollution policy hostage to the serious budget constraints of all levels of Gov-

ernment. This is unnecessary, since financial constraints are not, in general, binding if effective policies of cost recovery are used and incentives are corrected for market failures, as proposed in this report.

43. **Weak Institutions.** Failure of accountability, poor incentives, and in some cases, inadequate funds have led to a poor level of performance of many environmental agencies. Civil service rigidities and budget cuts have led to the deterioration of working conditions and erosion of capacity in environmental agencies of several states. Many agencies lack the skills, incentives, and budgets necessary for systematic collection of ambient environmental data and the speedy processing of license applications. Most agencies lack the political backing necessary for effective enforcement.

44. The failure of environmental agencies creates a serious cost for business and – since predictability of environmental regulations is most valued by businesses – undermines Brazil's effort to attract investments, especially by international companies without access to informal information from policy makers. Predictability is undermined by inconsistent application and enforcement of regulation and low capacity of the regulators. In the absence of systematic monitoring of ambient conditions and emissions, businesses fail to receive the information that would allow them to form rational expectations about future regulation. Cur-

Box 6: Failure of Environmental Management in Rio de Janeiro

Environmental management in the State of Rio de Janeiro has collapsed as the result of a fiscal crisis of the State Government and lack of political support for the environmental agency, FEEMA, under previous administrations. FEEMA is paralyzed by lack of accountability, an excessive number of poorly paid and unmotivated staff and serious budget rigidities. The State cannot adequately perform its core functions including ambient monitoring and enforcement of important environmental regulations. Bureaucratic environmental requirements, unpredictable application of regulations and a lack of reliable environmental information and planning impose significant costs on economic development without achieving commensurate environmental gains. The processing of license applications currently takes up to two years and has become a significant bureaucratic obstacle for business, forcing firms to either accept the uncertainty of illegal operation or delay planned investments and spend significant effort in feeding the environmental bureaucracy.

rently, environmental agencies fail to fulfill basic functions, such as the speedy processing of licenses and generation of critical environmental information. This results in costs to industry that far exceed the cost of adequately equipping the agencies.

3.2. ENVIRONMENTAL POLICY AND PLANNING

45. The strategy proposed in this report focuses on integrated cross-sectoral environmental planning but decentralized sectoral implementation. River basin committees and agencies, to be established soon, would undertake cross sectoral planning and formulation of targets and cost-effective control-strategies. Most pollution control measures would be implemented by polluters in industry and sanitation. Similarly, air quality management plans would be developed with participation by polluting sectors and municipalities and include cross-sectoral cost-effective control strategies. Again, most pollution control measures would be implemented by polluters. Urban and metropolitan problems would be addressed jointly by the municipalities involved.

46. The implementation of the proposed strategy for more effective pollution management will not be a budgetary problem if the "polluter pays principle" is systematically applied and problems are addressed through regulation and economic incentives rather than government expenditures. This general principle will allow governments to focus expenditures on a small number of justified exceptions, in particular: (a) strictly time-bound subsidies to ease resistance against the introduction of new regulations; (b) responsibilities for environmental liabilities of state enterprises to be privatized if liabilities create undue risks for the new owners; and (c) subsidies for low-income sanitation services where these cannot be generated internally through careful design of concession areas. Even though regulation does not require significant budget expenditures, it imposes a cost on the economy. The cost of regulations that follow clear priorities and cost-effective strategies (see Box 7) are well affordable for the industry, transport and most of the sanitation sectors. However, environmental agencies should account for these costs as they have to account for expenditures from their budget (see Box 8 and section 3.4 on the sanitation sector). Finally, the shift toward self-financing regulatory bodies, including river basin agencies, and adequate service fees for specific identifiable services would reduce the administrative costs for public budgets.

3.2.1. Environmental Information and Planning

47. The basis for rational environmental policy making is sound information on ambient environmental quality, sources of emissions, impacts of pollution, and costs of alternative controls. In Brazil, large quantities of environmental data exist; however, the information is incomplete, fragmented between agencies or within agencies, buried in individual consultant reports, collected without clear understanding of the demand

for information and, in general, not well linked to decision making. Environmental information will always remain incomplete; however, some key improvements are urgent for producing information that is relevant for decision making:

- (a) Ambient environmental data is the foundation of policy making but is currently incomplete and dispersed among entities. All states should follow those environmental agencies that annually compile and publish the available ambient quality data (even if it is collected by other agencies or consultants) to present a picture of state environmental quality. The aggregation of ambient quality data to indices can make data more useful for policy making.
- (b) The compilation of emission inventories should have high priority for all important ecosystems. Rough estimates of emissions from international coefficients (as used in this report) are the starting points, but should be refined by systematically incorporating data from the licensing process and other sources.
- (c) Environmental agencies need to focus more on the impact of pollution and attempt to quantify damages in order to determine policy priorities. These efforts require collaboration with medical researchers and the incorporation of economists into environmental agencies.
- (d) Typical pollution control studies, conducted for specific ecosystems, estimate the costs necessary for attaining standards. The resulting costs are generally huge, thus deterring any serious action. Future work should focus on the different costs of different policies and control scenarios over time, thus contributing to a rational debate about affordability and appropriateness of different targets.

Box 7: Cost-Effective Industrial Pollution Control in Belo Horizonte, MG

A simple example from the Belo Horizonte Metropolitan Area illustrates the cost reductions that can be achieved through cost-effective pollution control strategies. A recent report identifies the 32 largest water polluters in the urban river basin. If the environmental agency required uniform treatment of 50% of effluent from these 32 plants (already a reasonably focused strategy), annual compliance costs would be around US\$ 1.5 million. In contrast, a least-cost strategy would focus on reduction of the same volume of effluent at a single plant (by far the largest polluter in the area) at an annual cost of US\$ 1.1 million, a 36% saving on top of the reduction in enforcement efforts.

3.2.2. Setting Targets

48. There is a large gap between rather stringent legal environmental requirements, some of which are not in line with the economic realities of Brazil, and actual implementation and enforcement. This gap undermines accountability for environmental performance since the responsible agencies do not have the resources or political leverage required to close the gap. Environmental standards as they exist today are often copied from other countries without much consideration of their costs and benefits. These standards are expressions of a desire for a clean environment without having undergone the necessary process of weighing environmental benefits against other benefits that could be achieved with the same resources spent in other areas, such as education and health. The first step toward closing the gap between norm and reality would require adjustments in standards toward more realistic targets, adequate for local conditions. Second, the requirements following from these targets need to be strictly and systematically enforced.

49. Realistic targets imply the commitment to spend the resources necessary for their attainment. They take the form of a schedule of location-specific improvements in ambient environmental conditions over time with the actual intention to achieve compliance. Targets need to be understood and accepted by the affected sectors to ensure that policy makers are willing to accept

Box 8: Environmental Action Plans

Many countries have developed National Environmental Action Plans, and subnational entities are following with State, Metropolitan or Urban Environmental Action Plans. An Environmental Action Plan is a dynamic document that can help set environmental targets and policies over time. Environmental Action Plans ensure that environmental policies are based on careful technical and economic analysis, public support and political backing from the relevant sectors. An Environmental Action Plan can be part of an active policy to build support among stakeholders for improved environmental management that includes the building of alliances with the Legislative Branch, municipalities and NGOs.

International experience suggests that successful Environmental Action Plans include three elements: (a) the identification of priority problems; (b) the definition of priority actions based on the diagnosis of the causes of priority problems, and the analysis of cost-effective solutions; and (c) efforts to ensure effective implementation including involvement of key stakeholders, improvements in institutional performance, mobilization of financial resources, setting and monitoring of performance indicators, and integration with broader development objectives. To be successful, the process of preparing an Environmental Action Plan requires skillful merging of sound technical and economic analysis with the active participation of key stakeholders. An Environmental Action Plan spells out targets and priorities for action. Based on these targets, performance contracts can be prepared for the environmental agencies. Environmental agencies would periodically report back on environmental improvements and resources spent for these achievements.

Source: World Bank, 1995, National Environmental Strategies: Learning from Experience

the costs of their implementation. For targets to be effective, their definition should be based on some explicit or implicit weighing of benefits and costs. Moreover, the definition of targets needs to reflect the integration of environmental policy with broader policy objectives. For example, targets for domestic wastewater treatment need to be consistent with overall development and social objectives for the water and sewage sector. The transparency of the target setting process and the publication of the final targets is important to ensure public trust and commitment of the government. Environmental Action Plans (EAPs) at the national state, metropolitan and municipal level can be suitable mechanisms for the participatory and cross-sectoral process of setting environmental targets and determining priorities (see Box 8).

3.3. MODERNIZING INSTRUMENTS

3.3.1. Reform of the Licensing System

50. Brazil's licensing system represents a useful overall framework for relations between regulators and polluters. It allows both the systematic application of policies across polluters and the determination of specific targets over time for individual polluters. The conditions imbedded in an environmental license serve effectively as a compliance agreement between industry and

regulator. In practice, however, there are serious problems with follow-up and enforcement of these conditions. Moreover, the weakness of most state environmental agencies means that the licensing process presents a bureaucratic obstacle with significant time delays without commensurate environmental benefit. The main problem is that licensing is much more focused on individual polluters and detailed plant engineering and too little driven by pollution loads and overall environmental quality targets. The problems of the current system are most obvious in the case of the sanitation sector. At times, environmental agencies have rejected licenses for limited sewage treatment facilities requiring secondary or tertiary treatment, or for simplified solid waste disposal. As a result, licensing requirements have stalled environmentally beneficial investments.

51. The national licensing system is currently under revision by a national committee. A reformed licensing system would give investors simplicity, consistency and rapid response in their relationship with regulators, while assuring that the requirements of environmental protection are respected. The revised licensing mechanism would include adequate licensing fees and a link to future pollution charges (see section 3.3.3). The most important changes should include:

- (a) The rigid and often bureaucratic requirements of licensing would be simplified and the licensing process be combined with other required environmental permits ("one-stop shopping"). A transparent process and time limits for specific processing steps would ensure simple and speedy processing of licensing applications, with the exception of those few large projects where a more elaborate process of approval is truly useful.
- (b) The licensing process would be linked to clear environmental targets. The focus on the output (emissions) and outcome (ambient quality) would leave choices about technology and plant design to polluters. Economic incentives would be introduced through aggregate targets for groups of industries or compensation requirements (a new facility is licensed only if compensatory control investments at another plant with lower control costs are undertaken).
- (c) The decentralization of licensing for polluters with strictly local impact (gas stations, laundries, bakeries, garages) to local governments would reduce the burden on state agency and bring the process closer to the real problems. Careful thought needs to be given to changes in licensing in relation to fu-

ture river basin instruments and agencies (see Section 3.3.3).

3.3.2. Use of Economic Instruments

52. Economic instruments provide incentives for pollution reduction instead of prescribing specific behavior, such as the use of a specific technology, by the polluter. Economic instruments decentralize detailed decisions about pollution abatement and implementation to the polluter. Theoretical work has shown the cost-effectiveness of economic instruments compared to traditional command-and-control regulation since economic instruments equalize marginal abatement costs across polluters. The practical experience with economic instruments as incentive devices (rather than revenue collection) is limited. Economic instruments and market incentives present an important opportunity for reducing compliance costs and increasing environmental quality. The most important opportunities for economic instruments in Brazil are in the following areas:

- (a) Water pollution charges within river basin management systems (see section 3.3.3);
- (b) informal economic instruments implemented through aggregate emission reduction targets agreed to by industry

Box 9: Experience with the Use of Economic Instruments

Most practical experience with the use of economic instruments exists in OECD countries, primarily through the use of charges in a number of European countries and some applications of tradable permits in the US. The potential gains of economic instruments, however, are larger in developing countries where overall control levels are lower, and it matters more which sources are controlled. Examples of effective economic instruments include:

- a) A charge on emissions of NOx by power and heat producers in Sweden is refunded based on energy production and thus revenue-neutral. The charge has achieved emission reductions of 44% from 1990-1993.
- b) A system of tradable credits for leaded gasoline phaseout in the US has greatly aided the phaseout (1982-87) and reduced its cost.
- c) SO₂ allowance trading in the US aims at reducing SO₂ emissions from 19 million tons in 1980 to 9 million tons in 2000. The system complements an elaborate system of existing command and control regulations.
- d) Wastewater discharge fees in the Philippines were introduced in 1997 and are the first batch of environmental user fees that will ultimately cover all major pollutants and media (water, air and land).

Source: Andres Liebenthal, 1995, Economic Instruments for Pollution Management, World Bank LAC Country Department 1 Economic Notes No. 3; World Bank, 1997, Five Years After Rio, Innovations in Environmental Policy.

groups, or used within the licensing process, for example by focusing license conditions on emissions load and allowing compensation for emissions from new sources at other existing sources;

- (c) load-based sewer charges and weight/volume-based industrial solid waste charges (most actual sewer charges do not depend on actual pollutant load; they help recover system costs but do not serve as an incentive for treatment at source);
- (d) presumptive charges (charges levied on the presumed level of untreated emissions unless the polluter provides evidence of lower emissions) that reduce the administrative burden and, at the same time, improve the information base of environmental agencies;
- (e) inter-jurisdictional revenue sharing rules that provide incentives for environmentally responsible behavior by states or municipalities (already used for ICMS in some states); and
- (f) fuel and vehicle taxes that are differentiated by environmental impact of the respective fuel and vehicle.

3.3.3. Managing Pollution at the River Basin Level

53. Over the last years, broad consensus has emerged on the principles of an integrated water resource management strategy for Brazil, namely that: (a) water resources are managed in an integrated manner across users and sectors; (b) water resources are managed at the lowest appropriate level, usually the river or river basin; and (c) water is treated as an economic good whose use has an opportunity cost. Several states have already passed water resource laws that follow these broad principles. Also, a similar national water resource law has finally been

approved in early 1997. The new framework foresees the formation of river basin committees as decision making bodies composed of representatives of all major river basin users and assisted by river basin agencies as their executive arm. Water resource councils at the state and federal levels would oversee management at the basin level. Implementation of the new framework has proven to be slow due to a combination of inertia and resistance from those who previously have controlled water resources or fear the costs that could be imposed on them. The completion of the legal framework required and its implementation now needs to proceed as a top priority.

54. While discussions of river basin management in Brazil have tended to focus on issues of water allocation within river basins, the structure that is emerging can be used to meet much broader concerns. In particular, it allows for the integration of pollution management and coastal zone management with river basin management. As such, the creation of the new institutional framework for water resource management and the shift of responsibility for water resource management from sectoral agencies to environmental planning agencies are both an opportunity and a challenge for more effective pollution management. However, as a result of the recent institutional shifts, the necessary dialogue between the entities responsible for water resources and water pollution is still lacking. The next set of questions that needs to be addressed by policy makers includes: (a) the appropriate level for basin or sub-basin management; (b) the process of target setting and instrument implementation and their relation to existing instruments; and (c) the relation between incentive and revenue functions of pollution charges.

55. **The Level of Management.** The design of the institutional arrangements should be based on a broad understanding of a basin's specific water use conflicts and

their geographic and social reach. In cases where pollution problems do not interact between sub-basins in an important way, the appropriate management unit may be a sub-basin. If all problems were to be addressed at the basin level, the continued participation by water users who are not really affected by many problems would be difficult to maintain. Considering that even major sources of water pollution rarely have a significant effect more than 100 km downstream, the sub-basin will often be the most appropriate level for pollution management. In this case, only targets for aggregate transfer loads between sub-basins would be agreed at the basin level.

56. Relation to Other Instruments and Institutions. Typically, the river basin committee or its agency would develop a water quality management plan for the basin. This plan would be presented for approval to the responsible state agency. The approved plan would constitute an agreement that would specify: (a) levels of ambient water quality to be achieved in different parts of the river basin; (b) the date by which these targets are to be met together with, if appropriate, intermediate water quality goals; (c) general targets for the reduction of pollution loads required to meet the ambient water quality goals; and (d) the measures that the river basin committee intends to implement in order to achieve the water quality targets. If the water quality and load reduction targets specified in the agreement with the State environmental management agency are not met at the specified time, some collective penalty would be imposed on the users in the basin, for example, in the form of an increase in the pollution charge.

57. The process of arriving at an agreement on aggregate targets is likely to be time-consuming and difficult. River basin committees, on behalf of their users, may have an incentive to delay such agreements, so the environmental agency must have the

ultimate power to impose interim targets if negotiations continue beyond some reasonable time period and to impose penalties for failure to abide by these targets. To avoid the potential incentive against the formation of a river basin committee on the grounds that this will lead to the imposition of pollution charges, states must take the power to introduce a pollution charge that would be levied on all water polluters unless their discharges were regulated by a river basin agency for the relevant basin (which would also use pollution charges as one of its instruments).

58. Pollution management instruments applied at the level of the river basin have to be closely coordinated with those applied by State environmental agencies. River basin level arrangements cannot replace environmental licensing since the environmental impact of a polluter may include aspects outside the responsibility of the river basin agency. However, the licensing process needs to be made compatible with the rules and instruments implemented at the river basin level. In terms of institutional arrangements, one option is for the state environmental agency to retain responsibility for the entire licensing process and to replace current emission standards with the parameters on emissions and charges established by the river basin committee. The other option is for river basin agencies to take over the water pollution related aspects of the licensing process. In this case, the river basin agency would prepare the applicable license for water pollution. Both arrangements are feasible as long as clear rules and unambiguous responsibilities are established, and the actions of both entities are consistent and coordinated. Legal considerations may determine the preferable options. In particular, it would be desirable that the agency responsible for preparing a license also has the legal power to enforce its conditions.

59. **The Role of Charges.** The new framework includes as a critical element the use of charges levied for water use and effluent discharges. These charges would be reinvested in the same basin following decisions by the basin committee. Pollution charges, levied on emissions entering the waterbody, have first of all an incentive function. An efficient incentive charge per unit of pollution load would be set at the level of marginal environmental damage costs (Pigouvian Charges) or at the level of marginal abatement cost at the targeted aggregate abatement level. The revenues generated by (and also the financial burden on polluters of) a pure incentive charge would be significant. These revenues can be reduced without reducing pollution control incentives by refunding a large share of the charges to polluters on the basis of some formula unrelated to emissions, i.e. number of households served by a sewage system. Alternatively, a two-step charge can be used. In this system, polluters who hold tradable pollution allowances would only pay the lower first-step charge. Tradable emission allowances are declining over time and could be allocated on the basis of historic emission levels. Only emissions above the level of the allowance would be subject to the full incentive charge.

60. The second function of charges is to raise revenues which are needed to operate the river basin management system including water quality monitoring and planning. In addition, revenues are needed for communal investments for the improvement of water quality such as watershed protection measures. A critical decision that has to be made is whether revenues from pollution charges would also be used to finance investments in wastewater treatment plants. This would require a significantly higher level of charges than a charge to cover only administrative costs. The key considerations

Box 10: Simulated Pollution Charges for the Rio Paraíba do Sul

A simulation of pollution charges (see Annex 5) for the Rio Paraíba do Sul (a basin with a population of 4.8 million people in the States of São Paulo, Rio de Janeiro, and Minas Gerais) illustrates the choices in the design of charges. A full incentive charge would reach US\$ 1,100 per ton of BOD at 50% of abatement, raise revenues of about US\$ 100 million per year and could finance the necessary investments. However this charge would not be affordable for the sanitation sector. In contrast, a pollution charge to finance only system administration would start at US\$ 12 per ton of BOD and later reach US\$ 150. In this case, capital for investments would have to come from outside the system. In a more realistic intermediate scenario, first-step charges would be set at US\$ 200 per ton of BOD. This charge would initially raise US\$ 30 million per year which would finance 75% of investments. This scenario could lead to 78% abatement after 15 years with costs affordable to polluters.

in choosing between these different charge systems include: (a) the ability to access outside capital to finance necessary investments; and (b) the acceptability and affordability of charges to polluters and households.

61. A (low) administrative charge appears preferable if outside capital is available and sanitation companies have the clout to raise household tariffs to the necessary levels. It would clearly lead to less resistance by polluters. It would avoid the danger of inefficient and politicized funding allocations and the distortion of polluters' incentives through subsidies. On the other hand, a system with higher charges that would finance investments has advantages at the level of an individual sanitation company. With higher charges, the burden of treatment investments by individual companies would be spread among all companies that contribute through their charges. As a result, individual companies would be less likely to resist the need for investing in treatment once it is their turn. Also, higher charges would provide a rationale for the early but gradual increase in consumer tariffs that will be crucial for many municipal utilities.

Summary: Modern Pollution Management Instruments

Issues and Problems

- Environmental information is incomplete, dispersed between different agencies, and often not accessible to policy makers.
- There are no transparent ambient quality targets over time determined through some balancing of costs and benefits that can be used as the basis and yardstick for pollution policies.
- Licensing creates bureaucratic burdens without commensurate environmental gains, since it is not focused on aggregate environmental impact and ambient quality targets.
- The creation of the new institutional framework for integrated water resource management creates a unique opportunity for introducing more effective water pollution management.

Strategy and Recommendations

- Additional generation and compilation of data on ambient quality, emissions, impacts of pollution and control options and costs is one of the core tasks of environmental agencies. In addition, more detailed research and analytical work is necessary to better understand sources and impacts of, in particular, air pollution problems.
- Dynamic environmental quality targets should be set involving environmental agencies, polluting sectors and the public through the development of environmental action plans at the national, state, metropolitan and municipal levels.
- The licensing process needs to be modernized including (a) reduced bureaucratic requirements; (b) more focus on aggregate environmental impact and ambient quality objectives; and (c) decentralization of licensing of minor activities to municipalities.
- Economic instruments and concepts should be introduced in the licensing process (i.e., compensation through abatement at existing sources) and in river basin systems.
- Pollution management and coastal zone management needs to be integrated with the new framework for water resource management, requiring (a) priority for completing the legal and regulatory framework for water resource management; (b) a clarification of roles of the environmental agencies vis-à-vis the river basin arrangements; and (c) the use of pollution charges including tradable pollution allowances. A comprehensive dialogue between water resource agencies, pollution management agencies, and water and sanitation sector agencies needs to be urgently established.

62. From a purist point of view, the benefits of a low-charge system in which polluters are fully responsible for financing their control investments appear to outweigh the benefits of a high-charge system with investment financing from revenues. In practical terms, however, many sanitation companies simply do not have the necessary access to outside financing, and a high-charge system may be the only path available. If this is the case, financing from external sources, such as the World Bank Group, can assist in tilting the balance toward a lower charge system which ultimately has a higher chance of successful implementation.

3.4. WATER AND SANITATION SECTOR MODERNIZATION

63. Water and sewage services are a municipal responsibility (except for systems

of common interest which are under the states' responsibilities). In practice, however, 80% of the services are provided by State Water Companies (SWC) with only the remainder served by municipalities and municipal agencies. Urban water supply coverage is around 84% and sewage network coverage around 49%, with large differences between regions and income segments. About 20% of collected sewage is treated in some form. Expenditures on expanding access to water and sanitation services rank among the most cost-effective options for reducing the burden of ill-health and disease in Brazil.

64. Ensuring access to piped water for almost all of the urban population should be straightforward. The total investment required to expand urban piped water supplies to cover all people currently without piped water would be about US\$ 2.3 billion,

though additional investment will be required to maintain 100% coverage as the urban population grows over the next 15 years. Further, most urban households are willing to pay sufficient amounts to cover the marginal costs of urban water supplies. Given an appropriate set of prices and incentives, a set of competently managed and efficient urban water utilities should have no difficulty in reaching a target of 98% or 99% access to piped water supplies for all households in their service area within a period of 5 years at most.

65. Providing water supplies for poor rural populations is more an institutional than a financial problem. In aggregate terms the costs involved are modest -- IPEA estimated an investment cost of US \$2.8 billion over the 20 years 1992-2011 -- but it is difficult to provide the right incentives. State water companies with cumbersome bureaucracies and high costs have not been interested in devoting much effort to rural water supplies, while municipal and communal authorities may find it difficult to maintain the organizational and technical capacity to operate such services. There may, therefore, be a case for establishing specialized rural water agencies (or cooperatives) -- along the lines of rural electrification utilities in many countries -- at either state or meso-region level.

66. The scale of the urban sanitation problem is altogether different. IPEA's estimates of investment needs for 1992-2011 amount to US \$23.5 billion, which covers both sewers and sewage treatment. However, it is important to distinguish various categories within this overall total, since the urgency of the problem and options for financing the investments required are quite different. Replacement of functioning septic tanks with sewage networks can be deferred. Moreover, as discussed elsewhere, the damages from the release of untreated sewage differ by location, and a uniform treatment requirement would be unnecessarily costly.

67. The financial position of many SWCs is dire. Typically, they have relied upon inflationary accounting practices to preserve their balance sheets, so that the balance between current operational revenues and expenditures allows limited resources for debt service, let alone for financing new investments. The states which own them are not any more creditworthy. As a result, both states and companies rely primarily upon the availability of subsidized investment funds either from the federal government or from multilateral lenders to finance new investments. This creates perverse incentives and encourages a 'boom and bust' pattern of investment spending. There is little likelihood that state water company or state finances will permit the scale of investments in urban sanitation required over the next two decades to fill existing deficits in sewer coverage and to meet the expansion in demand due to the growth in urban populations. Thus, attention has been turning increasingly to the role that might be played by the private sector in both improving the operational efficiency of water and sanitation companies and in providing the finances required to meet current and future demands.

68. **Private Sector Participation.** Performance contracts can improve operating efficiency and thus generate savings in the medium-term. However, such contracts do not address the immediate and significant investment gap. Build-operate/own-transfer (BOT) schemes are, in principle, suitable for water and sewage treatment facilities. Their problem is typically low revenues during the initial project years and dependence of revenues on (near insolvent) SWCs, which makes the investment more risky and increases the difficulties in arranging financing for such projects. The best answer to both the investment gap and the operating inefficiency of existing SWCs, therefore, is a full private sector concession. However, the clear specification of concession targets and a clear and credible regulatory frame-

work are critical requirements for a successful outcome of such concessions.

69. A clear set of obligations and requirements needs to be defined by the government before the bidding for a concession contract. This approach requires more initial analysis but ultimately helps avoid some of the troubles that some water sector concessions have encountered in Brazil. A well defined set of obligations will reduce and delay the need for renegotiations, which should be avoided since they allow the concessionaire to exploit its private information and reduce the benefit from initial competition for the concession. Preparatory work requires decisions on the difficult tradeoff between various objectives: (a) increased service coverage; (b) increased wastewater treatment; (c) low tariffs; and (d) a high lease payment for the Government. Financial modeling of alternative scenarios would typically be used to fix all but one of these parameters. The concessionaire would be selected based on the best bid on the remaining parameter, typically lease payment or tariff levels. Obligations should be defined in terms of objectives and targets rather than specific investment requirements. Finally, careful thought should be given to the design of, and the incentives from, different types of penalties and performance bonds.

70. The establishment of a credible regulatory framework is necessary to give potential investors the confidence that the government will live up to its obligations and that critical processes, such as tariff revisions, will be handled in fairness. Politically and financially independent regulatory agencies need to be established to ensure contract implementation based on sound economic and technical criteria and protect it from political interference. An important institutional challenge is the design of a system in which municipal concessions can be overseen by a regulatory entity that, for

practical reasons, corresponds to the state level.

71. **Social Issues.** Household surveys from various countries suggest that people are willing to pay on the order of 3% of household income for piped water and 2% for sewers. With a median household size of about 4 for urban households, the annualized cost of piped water is US\$ 120, and of sewers, US\$ 100 per household. On this basis, household willingness to pay exceeds the costs of supplying piped water if household income is greater than US\$ 4,000 per year, while the similar threshold for sewers is US\$ 5,000 per year. Typical social tariffs for water and sanitation in Brazil currently range between US\$ 60 - 120 per year but reach US\$ 210 in Belem, almost equal to costs, indicating willingness-to-pay higher than suggested by international studies. In 1995, 33% of Brazilian households had an annual income of less than US\$ 3,800.

72. On the one hand, privatization has the potential to significantly increase service coverage for the urban poor through increased investments, which make services more accessible, and lower operating costs, which make services more affordable. On the other hand, care needs to be taken to avoid a situation in which profitable areas would be served by private concessions while poorer areas are left with financially further weakened SWCs. The following steps can help ensure that increased private sector participation will increase service provision to the poor:

- (a) Tariffs for existing customers need to cover the full cost of services provided. This will ensure that returns to existing investments contribute to internally generated resources that can be invested to extend coverage to currently unserved (mostly poor) areas.
- (b) Concession contracts need to be clear in service coverage extension targets

including coverage of poor populations. To cover the investment needs in poor areas, these should be combined into one concession with richer areas that already generate significant revenues. In the case of concessions with large poor areas, the concessions lease payment may have to be negative, but could be paid from the positive lease payments of other concessions.

- (c) Inclusion of low cost alternatives and public participation in the design of investment plans and options can lower costs, and thus make services more affordable to the poor.

73. **Treatment Requirements.** Sewage treatment costs can be a large share of the total cost of building and operating water and sewage systems. Therefore, priorities between investments in collection networks and treatment and their implications for total systems costs and tariff levels need to be carefully assessed and weighed against the environmental impacts of different alternatives. In particular, the benefits of faster improvements in the household environment through extension of sewer networks needs to be weighed against slower progress, or even temporary reversal, in surface water quality improvements. The result of careful consideration of these tradeoffs will depend on local conditions, but will often favor sewage network extension, particularly in the poorer parts of the country where network coverage is low. Gradual sewage treatment requirements will be determined by comparing the cost-effectiveness of different treatment or disposal alternatives.

74. Even though the sanitation sector is the main polluter of water courses with conventional pollutants, there is no effective coordination mechanism between the envi-

ronmental agencies and the water and sanitation sector. In theory, Brazilian regulations require an environmental license for water and sanitation facilities. In practice, environmental agencies can not effectively impose treatment requirements and have no effective control over sewage discharges. Moreover, environmental agencies have little capacity for managing sewage related pollution problems. This situation creates unacceptable risks that can create serious obstacles for the privatization process. On the one hand, potential investors will fear imposition of unrealistic environmental targets by environmental agencies after concession signing. On the other hand, environmental agencies will have little hope that their requirements can be enforced more effectively in the future.

75. The privatization of the water and sanitation sector provides a unique opportunity for improving the environmental performance of the sector. However, the risk of unclear requirements for investors highlights the need for careful coordination within the public sector in order to create the regulatory certainty required by the private sector. The following steps can be part of a workable coordination arrangement that would ensure, on the one hand, the accountability of environmental agencies for environmental quality and, on the other hand, the integration of treatment targets in overall sanitation sector priorities:

- (a) Clear wastewater treatment targets over time need to be specified consistently in environmental licenses and concession contracts. These targets need to be set before the time of concessioning in a process involving both the environmental agency and the entity in charge of the overall concession design.

- (a) Adjustment to the initial treatment targets should be avoided; but, if necessary, should be agreed upon by the economic and environmental regulators and reflected in the economic parameters of the concession, i.e. tariff levels or lease payments.
- (b) Whether private or public, water and sanitation companies would become members of river basin committees. In these cases, there would be a transition from initial treatment targets determined in the contract to the river basin management regime, in which water and sanitation companies would be represented as users within the river basin management structure and would be subject to the same pollution charges, monitoring, and inspection requirements applied to other companies.

3.5. INDUSTRIAL POLLUTION

76. For several decades, Brazil's industrial sector was dominated by state-owned enterprises and companies that were protected from foreign competition. The only significant source of medium to long term capital used to be, and in many cases still is, credit offered by public-sector banks. The inward-looking character of past industrial policies in Brazil meant that most businesses

were relatively isolated from both: (a) the external economic pressures that have stimulated the adoption of new practices and/or technologies which reduce both costs and pollution; and (b) the discussion and publicity about environmental issues and technologies that has alerted businesses elsewhere to ways of improving their environmental performance.

77. The changes that have been taking place in Brazil's economy over the past years have had an impact on both of these issues. Liberalization of trade and capital flows has opened up new horizons for many businesses, which are beginning to recognize that they will have to improve both their economic and their environmental performance. There are strong grounds for believing that the opening up of Brazil's economy will bring environmental benefits by: (a) accelerating the adoption of newer, cleaner technologies, (b) the influence of foreign investors who expect their local operations to achieve higher levels of environmental and operating efficiency, and (c) the preferences of customers in some foreign markets that suppliers should, where possible, conform to environmental certification requirements, such as ISO 14000, or use environmentally sound production methods. Several examples of recently privatized industries in Brazil (e.g. CSN in Volta Redonda) already demonstrate the

Summary: Water and Sanitation Sector

Issues and Problems

- The ongoing process of modernization of the water and sanitation sector and the beginning privatization of services presents a unique opportunity to increase investment in environmental infrastructure and to integrate the water and sanitation sector with overall planning of environmental quality. However, environmental problems and poor coordination between environmental and sector agencies can derail the privatization process.

Strategy and Recommendations

- A full concession offers the most attractive option for private sector participation in water and sanitation services, especially for the larger urban centers. It requires a clear regulatory framework and ex-ante definition of targets and obligations of the concessionaire over time to avoid, as much as possible, later renegotiation of the concession contract. Concession design needs to ensure adequate coverage of the poor.
- A key factor for success in privatization of water and sanitation services will be the harmonization of environmental regulations and obligations under the concession contract. Close coordination is required between environmental and sector agencies to agree on wastewater treatment targets before the time of concessioning and to adjust these targets in the future. Depending on local environmental conditions and impacts, secondary and tertiary wastewater treatment requirements will often apply only in the medium to long term.

Box 11: Privatization and Environmental Liability

Uncertainty about the nature and extent of environmental responsibilities (regarding both future emissions and past environmental damages) is a significant discouragement to foreign investment. A survey of American and European corporations conducted by the World Bank and OECD found that companies rated environmental risks equal to decision factors such as exchange rate and political risks. Companies in environmentally sensitive sectors (mining, chemicals, pulp and paper, petroleum refining, metals) were most concerned.

It is critical that, before the privatization, the government define the environmental standard that the privatized enterprise is expected to meet and the period of adjustment that will be permitted. In the Brazilian context, a valid environmental license, which spells out the environmental responsibilities over time, should be issued before privatization and be available to potential investors. Potential investors will be less concerned about the level of environmental requirements than about their clarity and equal application. However, the level of environmental requirements will obviously influence the bid value and should therefore be agreed between the environmental agency and the agency in charge of the privatization before issuing the bidding documents. Future investments by the new owner will be subject to the standard requirements for licensing and Environmental Impact Assessment. Credible assurances by the government that these processes will be transparent and expeditious will help create a business environment attractive for foreign investors.

Some of the expected future privatization in Brazil involve companies with potentially large liabilities from past environmental behavior. It is essential that responsibility for environmental problems caused in the past be decided before privatization. This requires: (a) clear legal rules defining how costs will be allocated between the government and the investor; (b) where possible, technical information on the extent of existing contamination and the potential costs of rectifying damage; and (c) an administrative decision about what remedial action is required. Once an environmental audit has been completed, the terms of the privatization can specify the environmental clean-up that is to be undertaken by the new owner. On isolated sites where the nature of past pollution can be clearly identified, it is likely to be advantageous for the Government to accept a lower purchase price in return for the purchaser's commitment to undertake specific remedial action. However, where multiple sources or great uncertainty about damages are involved, governments would be best advised to retain the responsibility for rectifying past damage. In these cases, investors require a legally binding agreement with the government that indemnifies them from any liability for environmental problems caused by past emissions.

Source: Environment for Europe, 1994, Environmental Action Program for Central and Eastern Europe

ample environmental benefits of industry restructuring. The privatization of some other major polluters, which are still Government-owned, also presents a unique opportunity for improving their environmental performance (see Box 11).

78. Until now, industrial pollution control policies have focused on bureaucratic licensing requirements complemented by directed credit lines from Government banks. This approach was consistent with the inward-looking and state-driven industrial policies of the past and has achieved some modest success in terms of environmental improvements. However, this approach is financially unsustainable and inconsistent with the new model of private-sector driven development with a state focused on regulatory functions. Key reforms would focus on the following:

- (a) Regulation would concentrate on impacts and overall targets -- derived from ambient quality targets -- rather

than details of plant design and leave implementation choices to the private sector. Licensing would be de-bureaucratized (see section 3.3.1).

- (b) Where feasible, regulators would negotiate aggregate targets with groups of polluters (for example in a river basin committee), and leave implementation to that group, but monitor the outcome and impose stiff penalties in cases of non-compliance.
- (c) The ultimate power of regulators to enforce the law cannot be in question. However, agencies would increasingly focus on their environmental planning function and adopt a more collaborative approach with industry.

79. Most large enterprises recognize the need to improve their environmental performance and have access to the necessary management, technical and financial resources. Some large enterprises have multi-

Box 12: Experience with Directed Credit for Industrial Pollution Control

Financing facilities for industrial pollution control can eliminate a common excuse of companies that want to avoid enforcement of environmental regulations. In practice, however, industrial pollution control projects have suffered from limited demand and dissipation of environmental effects. Credit has been underutilized mainly due to lax enforcement and adverse macroeconomic conditions (high interest rates). Credit programs are difficult to administer since unintended uses of funds need to be controlled, which leads to bureaucratic reviews and approvals. The resulting bureaucracy in credit administration is seen by beneficiaries as a serious drawback. Moreover, government administered credit suffers from interference and interruption of the flow of funds. When pollution control programs were targeted and effectively enforced (Cubatão, Tietê), credit was utilized and helped agencies overcome excuses by polluters. In most cases, however, credit programs become ends rather than means for assisting enforcement of environmental quality objectives. Moreover, long-term credit carries financial risks that banks are unwilling to accept for the typical compensation paid (2.5%), except for the most creditworthy firms. Therefore, beneficiaries tend to be large firms that would be able to finance investments from their own resources. Overall, financing for industrial pollution control is only effective if it is tied closely to a priority pollution problem with specific ambient environmental targets and a systematic enforcement effort. Private financing should take priority, and this area will not be a priority for future Bank lending.

national owners with standards of good environmental practice that ensure that local management adopt technologies and operating procedures that reflect the best experience of environmental management around the world. International and domestic firms looking to European markets are interested in meeting the requirements of ISO 14000 on environmental management (see Box 14). Many of these firms have implemented environmental management systems and use environmental audits to identify areas for further improvements. Investments in new plants should ensure a steady reduction in emissions as improved environmental technologies are embodied in new capital equipment.

80. The role of the environmental authorities with respect to large enterprises is to reinforce economic and other internal pressures to improve environmental per-

formance and to establish a clear framework of priorities and incentives. In the case of major emission sources, the environmental agencies and management must negotiate an agreement on bringing the plant into compliance with local and national environmental regulations. This agreement should cover the initial priorities to be addressed, the relevant standards for air, wastewater and solid waste emissions that will apply in the longer term, and a schedule for bringing the plant into compliance with the standards over a period of a few years, plus any explicit exemptions from this compliance requirement. Such agreements should be backed up by clear economic incentives including load-based charges and stiff additional penalties for violating the provisions of the agreement.

81. Concern is focused on the emissions from a limited number of industries dominated by medium and small enterprises. Many of these enterprises will resist the pressure to improve their environmental performance, fearing that this will increase their costs and erode their competitive position. This resistance has to be overcome by the environmental agencies relying upon a combination of incentives, education and information about regulation and technical options. It must be emphasized that the abatement costs involved are likely to be small in total and may, indeed, even be zero for many firms. Just as for large enterprises, there are a number of alternatives for dealing with liquid and solid wastes which will reduce the operating costs of enterprises, though some transitional costs of changes in process and management may be involved. Environmental audits can help small and medium enterprises identify the areas where environmental improvements can be achieved at no or low cost. On the regulatory side, presumptive charges are an attractive instrument that can reduce administrative costs of enforcement for small and medium enterprises.

82. Evidence from Brazilian and international experience shows that many companies value their environmental reputations. Accordingly, public disclosure of environmental performance can be a powerful tool for encouraging pollution reduction. In the US, public disclosure through the Toxic Release Inventory has had a major impact on emissions reduction by plants which are heavy toxic polluters. In both Rio de Janeiro and São Paulo, the pollution control agencies have also experimented with programs for public disclosure of poor environmental performance. Based on this experience, this report recommends the adoption of a sequenced strategy for public disclosure, based on ratings in a few performance categories (see also the Indonesian experience, Box 13).

83. Lack of enforcement remains the major problem of industrial pollution management and will not be solved by market-driven changes alone. Effective enforcement can be improved by strategically focusing limited capacity on those polluters with the highest potential pollution impact and the lowest control costs, but ultimately requires political backing. The requirement of a valid environmental license for access to credit from government banks is another method for improving compliance (included in a recent policy by the Federal Government, "Green Protocol"). Care should be taken not to multiply environmental review functions

Box 13: Indonesian Pollution Performance Ranking System

In 1995, Indonesia's pollution control agency, BAPEDAL, introduced a public disclosure and rating system. Based on BAPEDAL's evaluation of environmental performance, polluters are assigned a rating (GOLD: World-class performance standards, including aggressive adoption of clean technology, waste minimization, etc.; GREEN: Performance which exceeds national standards in all respects; BLUE: Satisfactory compliance with national standards; RED: Below-standard performance; and BLACK: Extremely poor performance; no pollution control effort; serious damage to the local environment). In the pilot phase 187 plants were rated. Preliminary evidence suggests that the system has a significant impact on pollution abatement. In the first six months, 50% of the plants rated black and 6% of the plants rated red took the necessary measures to move up in the rating scale.

but rather focus on, and give more teeth to, the instruments of the environmental agencies.

84. Directed credit lines are a common instrument of Brazilian Government policy since there are few if any other sources of medium to long-term capital available to smaller companies. Unfortunately, directed credit is not particularly effective in achieving cost-effective pollution control. Preferential credit conditions for environmental purposes are prone to misuse and unsuitable for directing investment according to environmental priorities. Unless a close link can be established between the enforcement strategy for a well-defined environmental problem and a temporary financing program, the use of directed credit

Box 14: The Role of ISO 14000 and Environmental Management Systems

An environmental management system (EMS) is a structured program of continuous environmental improvement. An EMS, such as ISO 14000, can serve as a mechanism for achieving improvements in environmental performance and for supporting the trade prospects of "clean" firms. The potential advantages of EMS are clear but the adoption of ISO 14000 is quite recent and various practical issues remain to be resolved.

ISO 14000 does not by itself ensure that an enterprise achieves improved environmental performance. However, the standard requires a company policy which "includes a commitment to continual improvement and pollution prevention" and "a commitment to comply with relevant environmental legislation and regulations". It also requires that the enterprise establish procedures for taking corrective and preventive action in cases of non-conformance.

An EMS does not substitute for a clear environmental regulatory framework and enforcement. However, the monitoring and reporting systems under the EMS of a well managed enterprise might substitute for some of the statutory inspections, audits and reports normally required under government regulations. It remains to be seen when and how the government can trust the capabilities and commitment of an enterprise to self-monitor its environmental performance, and whether formal EMS or certification systems would provide the mechanism to convince the regulators that scarce government resources are better used elsewhere in pursuing less cooperative organizations.

Summary: Industrial Pollution

Issues and Problems

- The expanding role of the private sector and the increasing openness of the Brazilian economy imply that bureaucratic licensing and pollution control financing through public banks are inappropriate instruments of industrial pollution control.
- Financing facilities for industrial pollution control suffer from limited demand and dissipated environmental effects unless linked closely to specific environmental quality targets and enforcement program.

Strategy and Recommendations

- New economic conditions require a reform of industrial pollution policies toward a more collaborative approach with industry building on the synergy between more flexible regulation with effective enforcement, on the one hand, and market driven incentives for improved environmental management systems, on the other hand. Negotiated aggregate emission targets derived from ambient quality targets would increasingly replace uniform standards.
- Privatization of major industry offer a unique opportunity for better environmental performance if environmental obligations are clearly defined before the time of privatization. If major uncertainty is involved, it may be advantageous to explicitly exempt the new owner of a privatized enterprise from liability for environmental damages from past emissions.
- The use of directed credit for pollution control should be discouraged unless it is closely tied to an enforcement strategy for a specific environmental problem.
- Public release and dissemination of emissions data and environmental performance ranking can be a powerful tool to promote pollution control.
- The key to increasing the environmental content of private investments is the reduction of risks involved in these investments, caused by weak and non-enforced regulations and gap between legality and reality.
- A clear regulatory framework is required for the environmental services sector (wastewater treatment, hazardous waste management). Government guarantees for enforcement would reduce investment barriers in these areas.

should be discouraged.

85. Typically, the costs of incorporating environmental controls in the flow of new investments are low compared to the cost of reducing the emission flow from the stock of existing investment, which in turn, are low compared to the cost of cleaning up existing pollution stocks (as the US Superfund cleanup effort amply demonstrates). This cost hierarchy provides broad guidance for prioritizing regulatory efforts. Available data consistently shows that environmental control costs are a small component of total production costs and value-added. For example, pollution control costs by industry in the US (which would overstate Brazilian costs since many enterprises still have scope for modifying processes and operations in ways that bring both economic and environmental benefits) show the costs of water pollution control (including sewage fees) as being less than 3% of value added for all traded sectors with most being less than 1%.

86. The costs of regulatory uncertainty and bureaucratic harassment in the wake of environmental regulation are likely to generate much higher costs and are a more serious impediment to investments than tighter pollution control requirements per se. Overall regulatory uncertainty, of which unpredictable behavior by environmental agencies is one factor, can be a significant deterrent to investment. Thus, concerns about the potential impact of environmental improvements on international (or inter-state) competitiveness are not good reasons to postpone such improvements. They should be seen, instead, as reinforcing the need for care in setting priorities and for the adoption of flexible and cost-effective mechanisms to meet Brazil's environmental goals.

3.6. OTHER SECTORAL POLICIES

87. Environmental problems are better and more cheaply addressed by comparing the environmental impacts of alternative investment or policy options rather than just

Box 16: Impossible Solid Waste Disposal in the Guarapiranga Basin, SP

Most municipalities in the Guarapiranga Basin have local ordinances prohibiting the import of solid waste for disposal or treatment. This leaves municipalities within the watershed in an impossible situation since they are prohibited by state law to site landfills within watershed limits. Solid waste continues to be dumped since no sanitary landfill can be built without solving this dilemma. Compensation payments from waste-generating to waste-receiving municipalities would clearly go a long way toward a solution.

remediating adverse environmental impacts of an already designed investment project or policy. Therefore, the integration of environmental aspects in overall policy planning and priority setting in polluting sectors is critical. This integration requires a shift in environmental agencies from police functions to planning and service functions and a fundamental change in the relationship between the environmental agencies and other sectors. On the one hand, a realistic gradual and cooperative approach by environmental agencies is needed. On the other hand, sector agencies must be open to early and full participation by the environmental agencies.

3.6.1. Urban Services

88. Local environmental conditions and the quality of the housing environment are closely related to the provision of urban services, including drinking water, sewage collection, solid waste collection, street cleaning, urban transport, drainage, and

zoning. Most of these services fall under the responsibilities of municipalities. While the capacity for management of environmental problems by some larger municipalities exceeds the capacity of the respective state, this capacity is non-existent in many other cases. Urban environmental management is complicated by the medium to long-term time horizon required to bring about lasting improvements in urban environmental conditions. Serious coordination problems typically arise due to the role of multiple municipalities in the management of common problems (water pollution, solid waste, transport management, and others) in metropolitan areas. For example, conflicts about the siting of sanitary landfills abound and often stand in the way of cost-effective solutions.

89. A metropolitan-wide environmental planning process can help alleviate urban environmental problems and would include careful identification of priority problems based on consultation of stakeholders, analysis of alternatives and cost-effective interventions and priorities for public and private sector action. A well-prepared strategic planning document (Environmental Action Plan) can be helpful in making prioritization explicit and in catalyzing public participation.

90. Solid waste, and some other urban

Box 15: Sectoral Project Experience

Overall, water quality and sanitation projects have been or will be able to achieve environmental improvements through the implementation of the projects' hardware components. The projects have helped catalyze the debate about the establishment of basin management in Brazil and have supported preparation of enabling legislation at the State level. The studies under the project are contributing to a deeper understanding of water quality dynamics from a more integrated perspective. However, these studies need to better incorporate economic analysis and trade-offs in setting long-term water quality objectives. The actual setting of long-term water quality objectives ought to take into account the views of users, state and national environmental objectives and affordability of investments. Legal problems and political inertia have slowed the process of establishing river basin management system linked to water quality/sanitation projects. Policy dialogue needs to increase its emphasis on achieving progress here and encourage focus on appropriate interim mechanisms. Overall, Bank lending to sanitation sector can be an important lever to introduce incentives for pollution reduction when actively managed in that direction. However, the Bank needs to reassess the interests of stakeholders in each basin to identify how best to channel lending as a catalyst for negotiations about devolution of power from state to river basin agencies.

Sectoral projects (municipal, sanitation, transport) can be quite effective for improving environmental policy but achieve environmental objectives only if they have clear targets and strong follow up during implementation. Several municipal projects have included solid waste management and other environmental activities. However, progress has been limited due to institutional difficulties and priorities for more visible and more short-term urban improvements.

services, can be commercialized relatively easily through private sector concessioning. Private contractors already collect 65% of the solid waste from Brazil's urban population. Well-designed private sector concessions improve incentives and accountability, can dramatically improve services, and to some extent, reduce the dependency of services on public budgets. Establishment of sound municipal finances and separate revenue sources for identifiable services (full-cost charges for solid waste) are additional steps to ensure service delivery. A critical step for overcoming landfill siting problems is to allow and encourage the negotiation of compensation payments between municipalities.

91. Urban environmental problems are closely linked to urban poverty. Urban slums (*favelas*) are the source of the worst local environmental conditions, which also affect the poor most severely. Population dynamics and land use incentives have so far undermined attempts to improve urban land use through zoning. While an ultimate solution will remain elusive without solving urban poverty problems, temporary measures can improve environmental conditions

Box 17: Urban Environmental Management in Curitiba, Paraná

Curitiba clearly demonstrates that urban policies and environmental management can make a difference. In the 1960s, Curitiba adopted a master plan focusing on linear growth patterns (integrating road network, public transport and land use planning) and decongestion of the central city. Amazingly, the principles of the plan were adhered to for thirty years. The result is a city with efficient public transport, little congestion, efficient recycling systems, large amount of green spaces, and as a result a high quality of urban life. The lessons of Curitiba include: (a) integration between road planning, public transport and land use planning can effectively channel urban growth; (b) technological solutions should be chosen based on affordability; (c) priority should be given to public transport and pedestrians; (d) integrated solutions can be implemented through partnerships between key actors; (e) public information, education and awareness are critical; and (f) strong political commitment and continuity over a significant time-span are important.

Source: Jonas Rabinovitch and Josef Leitman, 1993, *Environmental Innovation and Management in Curitiba, Brazil*.

in the slums, including innovative provision of solid waste collection in collaboration with residents, and emergency measures to reduce the risks of flooding and landslides.

3.6.2. Transport

92. Brazil has internationally comparable national vehicle emission standards with a tightening schedule over time. New gasoline vehicle standards require the use of catalytic converters. Several states are introducing vehicle maintenance and inspection programs to ensure compliance with emission standards for in-use vehicles. Even though such programs have implementation difficulties, they can contribute significantly to emission reductions. The costs of vehicle maintenance and inspection programs are generally borne by vehicle owners, as is the case in the recently introduced vehicle inspection program in the State of Rio de Janeiro.

93. The type and composition of vehicle fuels are important for emissions. Leaded gasoline is essentially no longer used in Brazil. The introduction of CNG as vehicle fuel, and the use of ethanol in regular gasoline and as a gasoline substitute, all contribute to reduced emissions of the worst pollutants. The sulfur content of diesel fuel sold in metropolitan areas has recently been reduced to 0.3%. A 0.3% sulfur content is high in comparison to the requirements in other countries (as low as 0.025%), and the cost differential is small; therefore, a tighter limit should be considered together with a review of all fuel specification standards.

94. Transport planning, particularly the development of an effective public transport system, can contribute to the reduction of total emissions from the transport sector. The city of Curitiba has become an international model for transport planning and public transport (see Box 17). However, in terms of overall transport sector planning, air pollution is a relatively minor concern if

one compares the costs of air pollution to other aspects such as time savings from reduced congestion, reduced accidents and use and quality of urban spaces.

3.6.3. Other Sectors

95. **Energy.** The large share of hydro-power in Brazil's electricity generation limits air pollution from the energy sector, including low emissions of greenhouse gases. For future decisions on the expansion of power generation, it is important that clear rules for atmospheric emissions from the energy sector be established so that cost comparisons between different energy sources can be made on the basis of full costs, including environmental externalities. The use of high-sulfur fuels in areas with (potential) air pollution problems should be discouraged or prohibited.

96. **Agriculture.** Agriculture contributes in unknown proportions to siltation and, through fertilizer application and land use changes, to the release of nutrients into waterbodies and subsequent eutrophication. With the elimination of organo-chlorine

Box 18: Car-Use Restrictions Backfire in Mexico-City

In 1996, São Paulo followed Mexico City, Santiago, and other heavily polluted cities by introducing a system that prohibits the use of any car at a specific day of the week (*rodizio*). It is too early for a comprehensive evaluation of the program. While such a program can be helpful in raising public awareness for air pollution problems, at least two concerns need to be raised: First, the São Paulo program excludes buses and trucks which are the main emitters of PM-10, the most important pollutant (8% of all PM-10 emissions come from gasoline-powered vehicles compared to 32% for diesel-powered vehicles). Second, rationing generally leads to higher compliance costs than the use of economic instruments (such as gasoline taxes). In the specific case of Mexico, recent research suggests that the rationing system may actually have increased car use since wealthier families would own two (instead of one) cars in order to avoid the use-restriction and end up using the second car for additional trips.

Source: Gunnar Eskeland, Rationing Can Backfire, 1995, The World Bank.

pesticides, water pollution from pesticide application is no longer a relevant problem when compared to operator poisoning, food contamination, safety issues for local communities and pest resistance. One of the important challenges of future river basin management systems will be improvements in watershed management including improved farm practices in fragile areas. Government

Box 19: PROALCOOL and the Environment

In 1975, the Government initiated PROALCOOL -- a program that promotes ethanol produced from sugar cane as a vehicle fuel -- in response to the global oil price shock. While technically successful -- around one third of Brazil's cars are fueled with ethanol and all gasoline contains 22% ethanol (*gasool*), the Program requires large subsidies that have been estimated between US\$ 650 million and 2.5 billion per year. As a side effect, the program has achieved some vehicle emission reductions and allowed the early phase-out of leaded gasoline in Brazil.

The conditions that have motivated PROALCOOL have changed drastically. World market petroleum prices are low, sugar prices are attractive, and ethanol is a potentially attractive export good. As the result of supply disruptions and reductions in subsidies, purchases of new ethanol-powered vehicles have dropped to less than one percent in 1996. The use of ethanol as an octane enhancer in gasoline is becoming increasingly popular in many countries. However, the use of ethanol as a substitute fuel is expensive. Is it worth saving PROALCOOL based on environmental benefits? Focusing entirely on particulate (PM-10) as the most serious air pollution problem, the cost of reducing a ton of PM-10 emissions through the substitution of *gasool* with ethanol is estimated in the order of US\$ 49,000. (Based on a gasoline cost of US\$ 27/bbl and a production cost of US\$ 45 for the energy-equivalent amount of ethanol, vehicle fuel consumption of 9l/100 km and emissions of 0.21g of PM-10 by *gasool* and zero by ethanol vehicles). This cost is very high compared to control costs in industry and diesel vehicles.

In addition, the ethanol program is associated with various types of environmental problems of its own: (a) the loss of biodiversity and soil erosion as the result of huge sugar cane monoculture plantation; (b) water pollution associated with the production of sugar and ethanol; and (c) high vehicle emissions of acetaldehyde and formaldehyde. On the other hand, ethanol fuel has advantages such as the reduction of net emissions of carbon dioxide and carbon monoxide.

In sum, there is serious doubt whether there is a sound environmental justification for a continuation of the PROALCOOL program. Certainly, a detailed economic analysis would be required to verify whether there are serious merits to the environmental claims in favor of PROALCOOL.

Sources: Asif Faiz, Christopher Weaver and Michael Welsh, 1997, Air Pollution From Motor Vehicles, World Bank, and World Bank, 1994, Brazil: The Management of Agriculture, Rural Development and Natural Resources, Report No. 11783-BR

programs, such as those supported by past World Bank land management projects in the South of Brazil, can support more sustainable and environmentally sound farming practices.

97. **Mining.** Large scale commercial mining operations are subject to the standard environmental licensing procedures and -- overall weak -- enforcement. Some serious pollution problems are caused by large-scale mining operations, for example coal mining in the South. Small scale wildcat miners (*garimpeiros*) cause significant environmental damage including severe siltation and mercury pollution of waterbodies. Management approaches should attempt to capture the upward and downward linkages and attempt to collaborate with representatives of small scale miners to induce a shift toward more environmentally sound mining techniques.

98. **Fiscal Policies.** There are interesting examples for the use of fiscal policies and intergovernmental transfers as incentives for environmental protection by lower levels of Government. Paraná, for example, has introduced a revenue sharing rule for the ICMS that rewards municipalities which preserve headwater areas. Minas Gerais distributes a share of the ICMS revenues according to solid waste and sewage disposal projects implemented by municipalities. These experiences should be evaluated carefully and expanded if judged successful.

3.7. ACCOUNTABLE INSTITUTIONS

3.7.1. Horizontal Coordination and Accountability

99. Conflicts between a Government's sectoral agencies (industry, sanitation, transport) responsible for the economic development of their respective sector and the environmental agencies responsible for improving environmental quality are natural and occur in most countries. Different

countries have opted for different models of responsibilities between environmental and sectoral agencies. In Brazil, environmental agencies have relatively far reaching responsibilities, and most environmental regulation is under their responsibility. In practice, however, environmental agencies lack the political support and capacity to carry out their mandate. As a result, polluters receive inconsistent signals and incentives from different government agencies. Moreover, the environmental agencies' accountability for improved environmental conditions is seriously compromised.

100. Institutional reforms would focus on better intra-government coordination and improved accountability by environmental agencies and include the following elements:

- (a) The ambient quality targets of environmental policy need to be made more explicit and be agreed upon by the agencies responsible for the sectors which bear the cost of implementing the measures necessary to attain these targets. Environmental action plans can be used as mechanisms for agreeing on these targets and ensuring the necessary political support for their implementation (see Box 8). Minas Gerais has had positive experiences with a broad-based decision forum for environmental policy (see Box 20). This model of cross-sectoral coordination deserves replication in other states.
- (a) Once environmental quality targets are agreed upon and environmental agencies have the tools and political support for their implementation, environmental agencies need to take on explicit responsibility for attaining these targets. This responsibility can be formalized through performance contracts.
- (b) With a shift toward economic instruments and impact-oriented environ-

mental regulation, environmental agencies would reduce their role with respect to detailed technical interventions. Polluters themselves, and government agencies responsible for polluting sectors, would carry increased responsibility for the implementation of aggregate targets prescribed by the environmental agencies. This will require increased capacity by major polluters, such as the water and sanitation companies, to manage their own pollution problems.

101. In most countries, the development of environmental policy has been driven by public concern, participation of non-governmental organizations and their often vocal protest. Environmental education and awareness, as well as the public release and active dissemination of emissions and ambient quality data and indices (see Box 13), are important for building lasting political support for active environmental policy and to direct public pressures toward rational and informed policy choices. Overall, the active generation and dissemination of environmental information will gain increasing importance and should be actively pursued. Well-designed mechanisms for public participation in environmental decision making are most effective at the local level. They

encourage a responsible role for non-governmental organizations and can help establish effective oversight for environmental agencies and improve their accountability (see Box 20).

3.7.2. Vertical Coordination and the Role of the National Government

102. In practice, states exercise most responsibilities on pollution management. While the Federal Government has been playing a extremely limited and often confused role, federal agencies have the legal power to intervene if the State does not fulfill its responsibilities. The Constitution establishes concurrent responsibility over environmental matters, however, the law specifying the attributions of the three tiers of government (*Lei Complementar*) has not yet been passed. This legal vacuum has resulted in disputes between states and municipalities on zoning and licensing and inspections of polluters by IBAMA in parallel to state environmental agencies. As a result, valuable resources are wasted as agencies from different tiers of government engage in similar activities, often competing for political visibility rather than attempting to provide better public service. To reduce the confusion over a number of legislative and enforcement issues, the federal government

Summary: Other Sectoral Policies (Urban, Transport, Energy)

Issues and Problems

- Environmental aspects are rarely considered in other sectors' policy planning leading to unnecessary environmental damage and higher costs of environmental management.

Strategy and Recommendations

- Better urban environmental management would include: (a) systematic urban and metropolitan environmental planning through Environmental Action Plans; (b) increased metropolitan coordination; (c) improved water supply, sewage and solid waste collection in low income neighborhoods using low-cost approaches; and (d) increased commercialization of solid waste services. Sanitary landfill siting problems can be alleviated by encouraging compensation payments among municipalities.
- Supported by fiscal incentives (especially differential fuel and vehicle taxes), vehicle emission standards, fuel specifications and vehicle maintenance and inspection programs should continue to be tightened; a more active policy promoting public transport will reduce air pollution but is likely to be driven by other benefits (time savings, accidents, urban space, etc.). The cost-effectiveness of reducing vehicle emission through ethanol as a gasoline substitute (as opposed to its use as additive) and circulation restrictions is doubtful and needs to be carefully assessed before continuing these programs on environmental grounds.
- Environmental aspects need to be better integrated into other sectoral policies, such as energy pricing and fiscal policies.

Box 20: Participatory Environmental Policy Making in Minas Gerais

The environmental management system in Minas Gerais is largely centered around the decisions and actions by COPAM - the council of environmental policy - and its executive secretariat. The main feature of COPAM is its extremely democratic and participatory nature. With 24 representatives from government, NGO's and private business, COPAM is responsible for establishing norms, giving licenses for polluting activities, establishing sanctions, and even serving as a specialized tribunal on environmental matters. Such activities are carried out by special chambers comprised of 7 members each, meeting once a month. COPAM also serves as a forum for education, integration, dialogue and coexistence among the agents representing different interests. COPAM's executive secretariat functions are essentially carried out by the state environmental agency, FEAM.

The use of a transparent system that avoids litigation and works essentially on consensus building has rendered significant progress in environmental management in the State, particularly in terms of actions by industry, mining companies and larger enterprises. According to FEAM, there has been a noticeable qualitative change in the relations between the various stakeholders, now capable of working more constructively in partnerships. For instance, COPAM has signed a number of agreements with unions and federations of the more polluting sectors to work on consensus solutions and deadlines. Less promising results have been achieved with state companies and the public sector more generally, as well as with the agricultural sector. With small enterprises the experiences have been mixed, although the negotiated agreements with the federation of industries is a good approach to address diverse sources of problems. The issuing of licenses by COPAM is a strong barrier against corruption, since decisions are made in a public forum.

should urgently prepare and submit a proposal of the *Lei Complementar*.

103. Since most environmental problems are local in nature, decentralized environmental management has two main advantages: (a) it reduces information costs - residents of a jurisdiction know their interests best; and (b) it allows environmental quality and policy instruments to vary across regions according to their priorities and budgetary constraints. However, there are limitations to decentralized management: (a) local governments may not set environmental standards high enough for the preference of the national government; and (b) a state or municipality may have no incentives to curtail pollution that affects another jurisdiction. While states and municipal governments are responsible for implementing most environmental policies, the question arises as to whether there is a role for the federal government, and what that role should be.

104. Accountability requires the clear allocation of responsibility for who sets environmental objectives, who chooses instruments, and who implements the control strategy. This section discusses the core responsibilities of the federal government in a federal system of pollution management. Two functions relate directly to national environmental policies: (a) the management of

national pollution problems; and (b) the integration of environmental aspects in national policies. There are four more functions which relate to oversight of the federal system: (c) environmental framework regulation; (d) certain national minimum standards; (e) prevention of unfair competition between states; and (f) assistance to States.

105. **Management of National Pollution Problems.** The Federal Government is directly responsible for a range of pollution problems of international or national scale and pollution from multi-state projects and a small number of sectors where highly specialized knowledge is required for regulation, such as nuclear energy. These problems include the implementation of commitments to address global environmental issues (greenhouse effect and ozone layer depletion) and the management of the main international and federal rivers (rivers that cross State boundaries) and the coastal zone.

106. **Environmental Aspects of National Policies.** Environmental concerns need to be addressed at the design and planning stage of national public policies (trade, industry, energy, water supply, sanitation, and transport policies), as well as projects and programs of national scope (privatization, energy and fuel programs, such as PROALCOOL). Policies and actions in these various sectors may both affect and be

affected by environmental considerations. The neglect of environmental factors will typically lead to excessive social costs while prevention will typically impose little or no costs on projects and policies. Therefore, there is a need for national environmental agencies to constructively participate in the design and implementation of relevant national policies.

107. Federal Framework Regulation.

The federal government has an important role in developing and maintaining the federal regulatory framework for pollution management. While actual environmental quality targets and requirements may differ from state to state, there are large benefits from having a relatively uniform framework for environmental policy which increases transparency and simplifies compliance and understanding by industry and other sectors. While allowing considerable differences in implementation, the federal framework includes the following aspects: (a) broad outline of the institutional structure and responsibilities that are replicated at the state level,

(b) establishment of criteria, norms and procedures for environmental licensing and environmental impact assessments; (c) establishment of criteria for the classification of waters; (d) standardization of data collection and information management; (e) criteria for penalties and fines; (f) criteria and procedures for the utilization of environmental funds; and (g) establishment of national environmental zoning.

108. **National Minimum Quality Standards.** Since most environmental problems are local in nature, states should be free to differ in their ambient quality standards as long as such standards do not impose an external cost on other States or the federal Government. This principle would allow states to set different priorities for environmental quality compared to other policy objectives, following the preferences and the demand by the state's population (often determined by income differences). The federal Government has an obvious role in setting standards for federal rivers and other multi-state ecosystems. In addition, Brazil's

Box 21: Bank Experience with Environmental Institutions Strengthening in Brazil

Technical assistance projects and components without clear focus have a limited impact. In order to be successful, technical assistance and institutional strengthening needs to be tied to well-defined policy objectives that are well understood and supported by the political leadership. Moreover, the political environment for the supported institutions needs to be favorable. Agencies which do not enjoy the necessary political support will rarely be able to benefit effectively from technical assistance.

Preliminary lessons from concluded and ongoing institutional strengthening projects (Minas Gerais, Espirito Santo, National Environment Project and National Industrial Pollution Control Project) include the following:

- a) the financial support provided by the components represent a significant contribution to the investment budget of the agencies and represent, at times, the only source to build the agencies' asset base (both human and capital);
- b) a typical aspect that is neglected in designing these components is strengthening first the capacity to administer resources, i.e., efficiently spend the allocated resources -- planning, budgeting, and procurement aspects should be addressed during preparation;
- c) a clear definition of the specific policy objectives and associated functions to be strengthened tend to be missed, as well as the indicators to measure improvement;
- d) building institutions takes time and requires consistent strategic support over many years, sometimes over the course of several lending operations; and
- e) political support to the component's objectives is highly desirable; however, since priorities shift in political cycles, some portion of the component need to be flexible to respond to changing circumstances.

The important question to ask after the studies have been completed, the computers have been installed, and the staff's technical skills have been enhanced, is how have these inputs changed this agency's performance? Some outcomes are easier to evaluate (e.g., faster information processing capabilities provide more reliable and faster issuance of licenses) while others depend on decisions by policy-makers (e.g., the results of a study leading to changes in regulations). The ultimate outcome of these efforts often depends on the ability to raise conclusions to political decision-making levels. This task is oftentimes difficult and is a place where the Bank can make an important contribution.

health care system is national, and the federal Government ultimately bears the cost of environmental health damages. Therefore, the federal Government has a legitimate interest in setting national minimum standards that are motivated by health reasons. This would suggest a focus of national standards on air quality, which are primarily designed for health protection. A transparent and effective system of sanctions must be developed for states that do not comply with national minimum standards. Importantly, these sanctions (for example, in the form of withheld federal grants or transfers) should apply to the state rather than to individual polluters.

109. Prevention of Unfair Competition between States. Competition among States for the installation of major industrial plants has often caused pressure on environmental agencies to not apply or enforce environmental regulations. As discussed above,

states should in many cases be free to set different environmental standards according to the vulnerability of local ecosystems and the preferences of the population. However, the non-application of requirements (that may differ between states) reduces transparency, undermining accountability and should be discouraged. Therefore, it would be a federal role to sanction states for engaging in unfair competition through non-enforcement of environmental regulation. Again, for the purpose of clear accountability, sanctions would be directed against the state and not directly against polluters.

110. Assistance and Information Services. The federal Government has an important role in providing assistance, especially to the weaker states. Federal activities would include: (a) determination of national pollution management priorities; (b) dissemination of best-practice information; (c) dissemination of environmental quality and

Summary: Establishment of Accountable Environmental Institutions

Issues and Problems

- Typically, environmental agencies pursue objectives that are often not accepted by sectoral and planning agencies which later deny political support for their implementation. As a result, there is a large enforcement gap and lack of accountability.
- The absence of a clear legal basis for the division of responsibilities between levels of Government has resulted in a confused role for the federal government in pollution management.
- Technical assistance is only effective if objectives are clearly defined and supported institutions enjoy necessary political support.

Strategy and Recommendations

- Environmental policy needs to be based on dynamic targets agreed upon across sectors, for example through Environmental Action Plans. Performance contracts with environmental agencies could be written based on the targets of these plans.
- Better integration of environmental agencies in sectoral policy making and planning is important. It requires, on the one hand, more realistic and gradual environmental targets and, on the other hand, early participation of environmental agencies in sectoral policy making and planning. A cross-sectoral participatory decision making forum, such as COPAM in Minas Gerais, can help achieve this integration.
- The generation and active dissemination of environmental information as well as environmental education should be used more actively to build public support for, and increase the effectiveness of, environmental policies.
- The establishment of a National *Lei Complementar* to clarify the roles of different government levels should have high priority.
- The responsibility of the national Government should focus on and be limited to: (a) the management of genuine national pollution problems, (b) integration of environmental aspects in national policies; (c) setting federal framework regulations; (d) setting some national minimum ambient quality standards; (e) preventing unfair competition between states; and (f) providing assistance and information services, especially for weaker states.
- Outside of the direct national responsibilities, the federal Government and its agencies should not enforce regulations directly with polluters unless explicitly contracted to do so by the responsible State.

emissions data; and (d) development of guidelines for regulation and licensing in specialized areas. Finally, weaker States should be able to contract federal agencies for policy implementation and enforcement. In this case, the federal agency would act on polluters on behalf of the State but never on its own initiative.

111. The future *Lei Complementar* should clarify the federal government's role along the outlined functions and establish clear relations between the levels of gov-

ernment, including the mechanism for the sanctioning of states. In the reformed system, the federal Government would never directly act on polluters unless: (a) pollution affects a national environmental asset; or (b) the respective State has contracted the federal Government for enforcement assistance. Also, the Federal Government would not subsidize (a) the richer States in which pollution problems are mostly concentrated, or (b) States which, due to poor policies, have particularly bad pollution problems.

