WORLD BANK TECHNICAL PAPER NO. 532
Environment Series

THE WORLD BANK
Work in progress
for public discussion

WTP532
2002

Brazil: Managing Water Quality

Mainstreaming the environment in the water sector

Sergio Margulis
Gordon Hughes
Martin Gambrill
Luiz Gabriel T. Azevedo

Recent World Bank Technical Papers

No. 429 Gary McMahon, José Luis Evia, Alberto Pascó-Font, and José Miguel Sánchez, *An Environmental Study of Artisanal, Small, and Medium Mining in Bolivia, Chile, and Peru*

No. 430 Maria Dakolias, *Court Performance around the World: A Comparative Perspective*

No. 431 Severin Kodderitzsch, *Reforms in Albanian Agriculture: Assessing a Sector in Transition*

No. 432 Luiz Gabriel Azevedo, Musa Asad, and Larry D. Simpson, *Management of Water Resources: Bulk Water Pricing in Brazil*

No. 433 Malcolm Rowat and José Astigarraga, *Latin American Insolvency Systems: A Comparative Assessment*

No. 434 Csaba Csaki and John Nash, eds., *Regional and International Trade Policy: Lessons for the EU Accession in the Rural Sector—World Bank/FAO Workshop, June 20–23, 1998*

No. 435 Iain Begg, *EU Investment Grants Review*

No. 436 Roy Prosterman and Tim Hanstad, ed., *Legal Impediments to Effective Rural Land Relations in Eastern Europe and Central Asia: A Comparative Perspective*

No. 437 Csaba Csaki, Michel Dabatisse, and Oskar Honisch, *Food and Agriculture in the Czech Republic: From a "Velvet" Transition to the Challenges of EU Accession*

No. 438 George J. Borjas, *Economic Research on the Determinants of Immigration: Lessons for the European Union*

No. 439 Mustapha Nabli, *Financial Integration, Vulnerabilities to Crisis, and EU Accession in Five Central European Countries*

No. 440 Robert Bruce, Ioannis Kessides, and Lothar Kneifel, *Overcoming Obstacles to Liberalization of the Telecom Sector in Estonia, Poland, the Czech Republic, Slovenia, and Hungary: An Overview of Key Policy Concerns and Potential Initiatives to Facilitate the Transition Process*

No. 441 Bartlomiej Kaminski, *Hungary: Foreign Trade Issues in the Context of Accession to the EU*

No. 442 Bartlomiej Kaminski, *The Role of Foreign Direct Investment and Trade Policy in Poland's Accession to the European Union*

No. 443 Luc Lecuit, John Elder, Christian Hurtado, François Rantrua, Kamal Siblini, and Maurizia Tovo, *DeMIStifying MIS: Guidelines for Management Information Systems in Social Funds*

No. 444 Robert F. Townsend, *Agricultural Incentives in Sub-Saharan Africa: Policy Challenges*

No. 445 Ian Hill, *Forest Management in Nepal: Economics of Ecology*

No. 446 Gordon Hughes and Magda Lovei, *Economic Reform and Environmental Performance in Transition Economies*

No. 447 R. Maria Saleth and Ariel Dinar, *Evaluating Water Institutions and Water Sector Performance*

No. 449 Keith Oblitas and J. Raymond Peter in association with Gautam Pingle, Halla M. Qaddumi, and Jayantha Perera, *Transferring Irrigation Management to Farmers in Andhra Pradesh, India*

No. 450 Andrés Rigo Sureda and Waleed Haider Malik, eds., *Judicial Challenges in the New Millennium: Proceedings of the Second Summit of the Ibero-American Supreme Courts*

No. 451 World Bank, *Privatization of the Power and Natural Gas Industries in Hungary and Kazakhstan*

No. 452 Lev Freinkman, Daniel Treisman, and Stephen Titov, *Subnational Budgeting in Russia: Preempting a Potential Crisis*

No. 453 Bartlomiej Kaminski and Michelle Riboud, *Foreign Investment and Restructuring: The Evidence from Hungary*

No. 454 Gordon Hughes and Julia Bucknall, *Poland: Complying with EU Environmental Legislature*

No. 455 Dale F. Gray, *Assessment of Corporate Sector Value and Vulnerability: Links to Exchange Rate and Financial Crises*

No. 456 Salman M.A. Salman, ed., *Groundwater: Legal and Policy Perspectives: Proceedings of a World Bank Seminar*

No. 457 Mary Canning, Peter Moock, and Timothy Heleniak, *Reforming Education in the Regions of Russia*

No. 458 John Gray, *Kazakhstan: A Review of Farm Restructuring*

No. 459 Zvi Lerman and Csaba Csaki, *Ukraine: Review of Farm Restructuring Experiences*

No. 460 Gloria La Cava and Rafaella Y. Nanetti, *Albania: Filling the Vulnerability Gap*

No. 461 Ayse Kudat, Stan Peabody, and Caglar Keyder, eds., *Social Assessment and Agricultural Reform in Central Asia and Turkey*

No. 462 T. Rand, J. Haukohl, and U. Marxen, *Municipal Solid Waste Incineration: Requirements for a Successful Project*

No. 463 Stephen Foster, John Chilton, Marcus Moench, Franklin Cardy, and Manuel Schiffler, *Groundwater in Rural Development: Facing the Challenges of Supply and Resource Sustainability*

(List continues on the inside back cover)

Brazil: Managing Water Quality

Mainstreaming the environment in the water sector

Sergio Margulis
Gordon Hughes
Martin Gambrill
Luiz Gabriel T. Azevedo

Brazil Country Department
THE WORLD BANK

December 2002

1818 H Street, NW
Washington, DC 20433

1 2 3 4 04 03 02

Technical Papers are published to communicate the results of the Bank's work to the development community with the least possible delay. The typescript of this paper therefore has not been prepared in accordance with the procedures appropriate to formal printed texts, and the World Bank accepts no responsibility for errors. Some sources cited in this paper may be informal documents that are not readily available.

The findings, interpretations, and conclusions expressed here are those of the author(s) and do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent.

The World Bank cannot guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply on the part of the World Bank any judgment of the legal status of any territory or the endorsement or acceptance of such boundaries.

ISBN: 0-8213-5347-0
ISSN: 0253-7494

Sergio Margulis is a Senior Environmental Economist at the World bank. Gordon Hughes is a Consultant at the World Bank. Martin Gambrill is a Senior Water Engineer at the World Bank. Luis Gabriel T. Azevedo is a Sector Leader at the World Bank.

Library of Congress Cataloging-in-Publication Data has been applied for.

Contents

Note on the English version

The English version of this report was published following discussions of the Portuguese version with various Brazilian counterparts. The authors thought that while it would not be appropriate to incorporate changes which would make the Portuguese and English versions different, it would be nonetheless appropriate to introduce the following two paragraphs which provide a summary description of the recent evolution of the water sector in the country. This may be helpful to those readers less familiar with the details of the sector in Brazil.

Brazil's recent accomplishments in the water sector are significant. Over the last 40 years Brazil has expanded water supply to an additional 100 million people, and sanitation services to 50 million. Today, 77 percent of the population has access to potable water and 47 percent to some kind of sewerage service. The area under irrigation has grown from 0.5 million hectares in 1970 to 3.5 million hectares in 2002. Inland navigation has also increased steadily and has been integrated into a multi-modal transport system. These accomplishments have relied heavily on large investments in water infrastructure. The contribution of many of these investments to the country's development are unquestionable, but the overall return on that infrastructure has not been consistently positive.

Brazil's national water resources management system was promulgated with the 1988 Constitution. The Constitution divided the country's water resources between the States and the Federal Government. In 1991 São Paulo became the first State to implement its own water resources management system. Since then, 18 other States and the Federal District have adopted legislation to modernize water resources management. After six years of negotiation, Congress adopted a national water policy (Federal Law 9433) in January 1997, incorporating most modern water resources management principles and instruments, including management by river basins, creation of basin committees and agencies, and introduction of abstraction and pollution charges. The National Water Agency ANA was created in 2000 with a mandate to implement the National Water Resources Policy. These recent achievements have placed Brazil internationally as an innovator and an emerging leader in water resources management. Such progress in the development of legal framework and policy instruments, however, has not been followed by equivalent progress in effective implementation.

Foreword

This report presents a comprehensive approach to alternatives for Brazilian society to improve the quality of life of present and future generations, in what concerns those matters related to water. Three complementary dimensions are examined:

(a) Water resources – with regard to water resources, the issue of concern is how to implement an integrated river basin management system, specified in the Brazilian Water Law (9433/97), in order to achieve the sustainable use of rivers and lakes for present and future generations. This management system seeks to balance the interests of different sector users (hydropower, water supply and sanitation, irrigation, navigation, etc.). Presently there is a lack of reliable supplies of bulk water in the Brazilian Northeast, for industry, agriculture and domestic consumption. This scares away potential investments that would bring jobs and wealth to the region. Also, water in the rivers around Brazilian cities is heavily polluted because wastewater is not properly collected and treated. As a consequence the population has to live with high levels of water borne diseases and high costs of water supply, as the water intakes periodically have to be moved further away to still uncontaminated rivers.

(b) Environment - water in rivers and lakes is a natural asset. Most infrastructure, like dams, (b) Environment - water in rivers and lakes is a natural asset. Most infrastructure, like dams, navigation locks and wastewater treatment plants, have impacts that alter the environment. The present challenge centers around the question of how to develop an institutional and legal arrangement that provides a clear interface between water resources and environmental systems, particularly after the recent creation of the National Water Agency and the National Water Resources Council. The first system, which is still in its infancy, is currently implementing integrated water resources management in a decentralized and participatory way, using 'economic tools' – like the polluter-user-pays-principle. The second approach has been in use for many years and is based on 'command and control' mechanisms. A great deal of work is still to be done to get the best results from the combination of these two approaches.

(c) Water supply and sanitation – like in other developing countries, these services are not universally provided in Brazil partly because the poor cannot always afford to pay the real cost of service and also because government subsidies do not reach all of those in need. Efforts to deal with this question often result in inefficient legal and institutional arrangements that benefit many, but not those most in need. To change this situation, it is necessary to undergo reform in the water sector which aims at replacing "bad subsidies" with good ones. A good subsidy gives the right economic signal, and results in better services to all, with minimum costs, contrary to the

current situation. In order to implement the necessary reform, it is first essential to conclude the discussion and pass the legislation concerning the water supply and sanitation regulatory framework, which should be enforced regardless of whether the service provider is a public or a private company. Unfortunately the discussion has been obscured by a political dispute in Congress around which level of government, either city or state, would play the leading role for granting concessions of these services in metropolitan regions.

Brazil is presently undergoing an important change of government administration at the Federal and state levels. This is therefore a perfect time for this report to be released because an outside view may be helpful in the transition. New administrators will get clear and critical analysis of what is going well in the sector, and should not be changed, and of what could be improved or modified. The World Bank has good credentials to perform this job: it accumulates worldwide experience but also first-hand knowledge of Brazilian realities, gained through many years of cooperation

Jerson Kelman
President, National Water Agency

Abstract

This study reviews how environmental issues have been addressed in the water sector in Brazil, within the context of activities of the Federal Government, generally, and those implemented under Bank sector operations more specifically. The core focus of the study lies in the management of water quality, as it affects both the users of raw water and those who are primarily concerned with the disposal of wastewater. The report considers the following three sectoral areas concomitantly – water resources management, water supply and sanitation, and the environment – thus limiting its review and focus to those themes which are key to the over-arching issue of water quality.

The management of water resources in Brazil, as in many other developing countries, has relied upon heavy investments in medium and large scale projects and programs to provide basic infrastructure for the different services related to water use. Historically, there has been a strong tendency to favour large, highly visible projects, which have shown disappointing overall returns, have resulted in little improvements in water quality, and have produced questionable impacts in terms of reducing poverty and inequality. One of the key reasons for such results has been the poor management of the installed infrastructure, the importance of which has been largely underestimated. Improving the utilization of existing infrastructure is therefore seen as being critical to achieving significant and rapid progress throughout the water sector. This needs to be complemented by adequate incentives to both service providers and water users to make more efficient use of the infrastructure and the resource itself.

The low economic, environmental and social returns generated by investments in the water sector also reflect the systematic tendency to pay insufficient attention to overall objectives in the design and implementation of programs and projects. If the improvement of water quality in Brazil is an issue that is to be taken seriously, then a first step should be to undertake a proper assessment of water quality goals for each river basin in the country. The current classification of these goals seems to be arbitrary, and should, instead, be based on a systematic evaluation of the costs and benefits of setting and reaching alternative standards, as well as on explicit social objectives such as expanding service provision and service quality to the poor.

Acknowledgements

The report was prepared by a large team consisting of the following people: Sergio Margulis (Task Manager), Gordon Hughes (main report), Luiz Gabriel T. Azevedo, Alexandre Baltar and Musa Asad (Water Reources Management), Martin Gambrill and Abel Mejia (Water Supply and Sanitation), and David Hanrahan (Environment). The report reflects the views of the entire team.

This report also partly relies on three background papers which will be made available in electronic format on the World Bank's Web Site. The papers (all in Portuguese) are: 1) "Water Resources Management", prepared by Antônio Eduardo Lanna; 2) "The Brown Environmental Agenda and the Water Supply and Sanitation Sector in Brazil: the Problems of Supply to the Urban Poor and of Water Pollution Control", prepared by Alceu Guerios Bittencourt and Ricardo Araújo; and 3) Brazil: Environmental Issues in the Water Sector, prepared by Sergio Margulis, David Hanrahan, Elizabeth Lima and Francisco Lobato.

The authors wish to thank various institutions and individuals interviewed: Jerson Kelman, Dilma Seli Pereira, Benedito Braga and Gisela Foratini (National Water Agency – ANA), Marcos Thadeu Abicalil (Second Water Sector Modernization Project – PMSS2), Paulo Canedo Magalhães (Federal University of Rio de Janeiro – UFRJ), Luis Edmundo (Former State Sanitation Secretary for Rio de Janeiro), Evandro Rodrigues de Britto (Rio de Janeiro State Water Company – CEDAE), Luis Paulo Correa da Rocha (Former State Vice-Governor of Rio de Janeiro), Rui Brasil Assis, Luiz Carlos da Costa and Dirceu Rioji Yamazaki (São Paulo State Secretariat for Water Resources, Sanitation and Works), Ricardo Araujo (São Paulo State Water Company – SABESP), Alceu Bittencourt (consultant), Renato Tagnin, Sílvio Leifert and Stela Goldenstein (São Paulo Municipality Secretariat for the Environment), Neusa Marcondes (São Paulo State Environmental Agency – CETESB) and José Claudio Junqueira (former President of Minas Gerais State Environmental Agency – FEAM). The authors would also like to thank all those from federal, state and municipal government institutions, from academia and from the private sector, who participated in, and provided rich contributions to, the day-long workshop held in São Paulo on June 4, 2002, to discuss a draft version of the aforementioned report, 'The Brown Environmental Agenda and the Water Supply and Sanitation Sector in Brazil: the Problems of Supply to the Urban Poor and of Water Pollution Control'. The authors wish to additionally thank John Penney for his editorial contributions, and Karen Ravenelle-Smith f and Juliana Garrido or putting together the document for printing.

Finally, the entire team wishes to thank the Government of the Netherlands which partly financed the study through the Bank-Netherlands Partnership Program's Environmental Window with the World Bank.

Acronyms and Abbreviations

ANA	Agência Nacional de Águas
ANEEL	Agência Nacional de Energia Elétrica
AOM	Administration, Operation and Maintenance
BOD	Biochemical Oxygen Demand
BR	Brazil
CEDAE	Companhia Estadual de Águas e Esgotos (Rio de Janeiro)
CEPT	Chemically Enhanced Primary Treatment
CETESB	Companhia de Tecnologia de Saneamento Ambiental (São Paulo)
COMPESA	Companhia Pernambucana de Saneamento
CONAMA	Conselho Nacional do Meio Ambiente
COPASA	Companhia de Saneamento de Minas Gerais
FEAM	Fundação Estadual do Meio Ambiente (Minas Gerais)
FEEMA	Fundação Estadual de Engenharia do Meio Ambiente (Rio de Janeiro)
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
IBGE	Instituto Brasileiro de Geografia e Estatística
ICR	Implementation Completion Report
IDB	Inter-American Development Bank
PDBG	Programa de Despoluição da Baía de Guanabara
PLANASA	Plano Nacional de Saneamento
PMSS	Programa de Modernização do Setor de Saneamento
PNAD	Pesquisa Nacional por Amostra de Domicílios
PRODES	Programa Nacional de Despoluição de Bacias Hidrográficas
OECD	Organisation for Economic Co-Operation and Development
SABESP	Companhia de Saneamento Básico do Estado de São Paulo
SISNAMA	Sistema Nacional do Meio Ambiente
SNIS	Sistema Nacional de Informações sobre Saneamento
US	United States
WRM	Water Resources Management
WSS	Water Supply and Sanitation
WWTP	Wastewater Treatment Plant

1

Introduction

Study context and background

Since the Bank became more involved with projects in the Brazilian Amazon region in the early 1980's, it has placed much of the emphasis of its environment work in Brazil in the area of natural resources management. Even today, the environment portfolio and the main dialogue with the Federal Government focus primarily upon the 'green agenda'. Issues of air and water pollution as well as water resources management have not been neglected, but they have been addressed mainly in the context of the concerns of particular sectors – urban development, water supply and sanitation, energy, transport, etc. Hence, this study was prompted by the recognition that it would be useful to review environmental issues linked to water quality from a cross-sectoral perspective.

One important issue for the Bank is whether the practice of addressing environmental problems within the framework of sectoral projects and other activities produces satisfactory results. The advantage is that it ensures that efforts to tackle particular problems are, or should be, fully integrated with sectoral policies and priorities. The disadvantage is that there is a tendency to promote environmental improvements that are within the compass of the standard activities of a particular sector. In effect, this leads to an approach that addresses environmental problems in terms of the solutions that are available to the sector – e.g. wastewater collection and treatment — rather than from the perspective of identifying the most efficient options for improving environmental quality. Neither is sufficient on its own, but experience suggests that too much of a focus on solutions leads to the adoption of expensive programs for reducing pollution which generate only limited benefits.

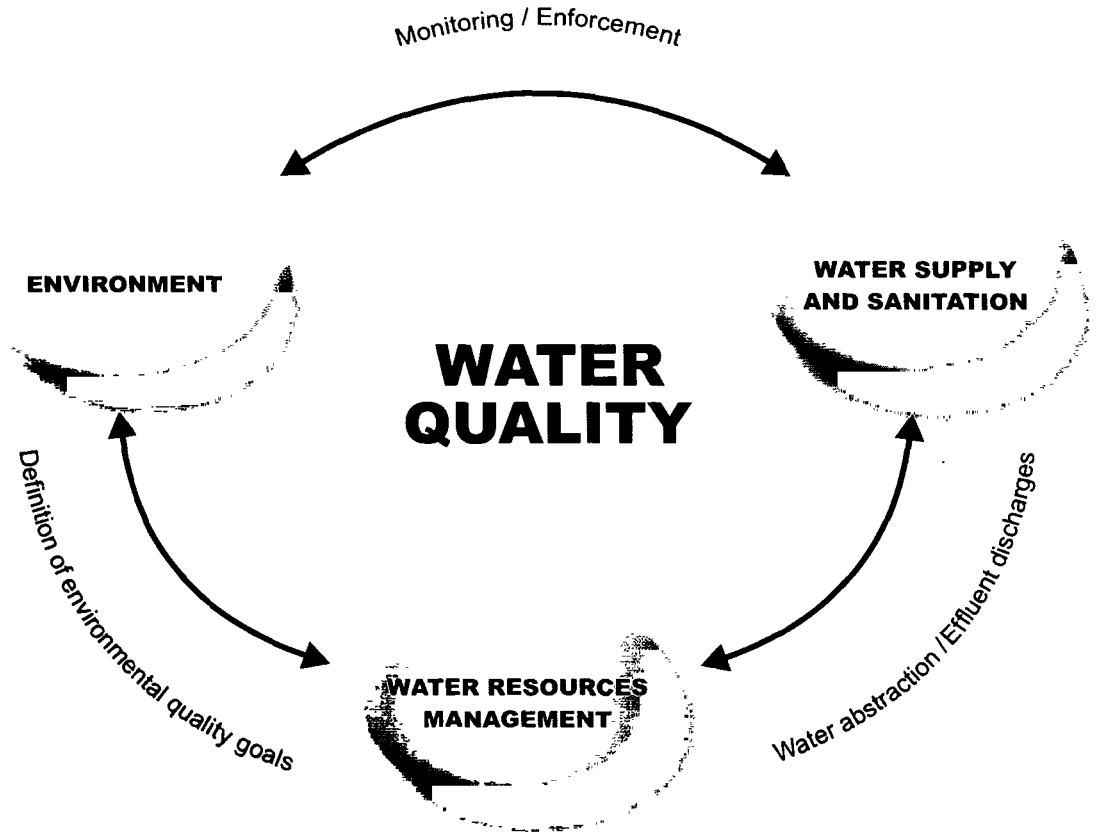
Anecdotal evidence from several sectoral projects in Brazil with substantial environmental management components indicated that their environmental benefits have fallen short of what had been expected. This matters because the attempt to design sector-based projects which will also generate substantial environmental benefits – usually referred to "mainstreaming environmental issues" – is an important aspect of the Bank's approach to linking better environmental management with traditional instruments for lending. The goal is to go beyond the minimum requirement to carry out an environmental impact assessment in order to incorporate the goal of better environmental quality as an integral aspect of project conception and design.

Thus, the Bank decided to review how environmental issues have been addressed in Bank sector operations and more broadly within the Federal Government, and it was decided to start with the water sector. The reason for this choice is that, across the country as a whole, water quality is perhaps the most important environmental problem in Brazil. Within the broad theme of the management of water quality, water supply and sanitation is the sector with the

most obvious links with the environmental agenda. However, as Figure 1 illustrates, looking at water and sanitation alone, disconnected from broader issues of water resources management, would simply repeat the one-sided perspective of sector-based activities. Water and sanitation is 'only' one user of water resources for both abstraction and discharges, though it may be the most important one in terms of its social and environmental impacts. The role of water and sanitation policies and investments must, therefore, be viewed in the large context of strategies for water management within river basins, coastal zones, etc.

Water resources management is a crucial starting point for policies that impinge upon water quality. This is obvious from a physical point of view because the flows of water consumed or redistributed over time by irrigation or hydro-power affect the absorptive capacity of rivers and thus the impact of discharges of industrial or municipal effluent on water quality. But, equally important, the creation of Agência Nacional de Águas (ANA) with responsibility for oversight of both water quantity and quality highlights the importance of developing policies and institutional arrangements that go beyond the specific concerns of irrigation, hydro-power, or water and sanitation. ANA, together with complementary institutions at State levels, can fill an institutional gap and provide a basis for developing an integrated approach to the management of water quality.

Figure 1: Managing water quality



Hence, this study has considered the three sectors together -- water resources management, water supply and sanitation, and the environment. Three separate reports (in Portuguese) on each of the sectors were prepared by three sectoral teams and will be available in electronic format on the World Bank website. Each of the three sectors reviewed has its own characteristics and faces specific problems. But the core focus of this study lies in the management of water quality as it affects the users of raw water and those who are primarily concerned with the disposal of wastewater.

For too long in Brazil policies and institutions with responsibilities in the sphere of water resources management have operated largely independently of policies and institutions that address issues concerning urban and/or industrial water supply and wastewater management. This divorce between the upstream and downstream water sectors has severely hindered the development and implementation of coherent policies for the management of water quality.

In response to this situation, the environmental authorities have responded to their relative lack of influence over any stage of the 'water cycle' by adopting a licensing regime which concentrates almost entirely on point sources of pollution but ignores the broader strategic issues affecting environmental quality. This pattern is not unique to Brazil. A focus on point sources is all too common among OECD environmental policies with respect to water pollution, even though non-point sources are variously estimated to account for 50-80% of the organic and nutrient loads in major rivers. In Brazil, the effects of this bias are made worse by the fact that many point sources, particularly existing sewer outfalls and wastewater treatment plants controlled by public water companies, are not subject to any effective system of monitoring and control.

If problems of water quality and pollution are to be addressed effectively, the starting point should be a framework that encourages the various agencies to develop a strategic vision for water management within a river basin or similar geographical unit. Investment priorities, abstraction policies, water management regimes, and environmental licenses should all be consistent with that strategic vision. Hence, the structure of river basin institutions and management that is being developed following the passage of legislation in 1997 and the creation of ANA in 2000 is absolutely fundamental to the prospects for better management of water quality.

Finally, in a limited study it is necessary to be selective in concentrating on a limited number of themes which are relevant to the over-arching issue of water quality. For this reason we have not attempted to address many of the broad linkages between water, land use, and urban development which are important determinants of the level and distribution of sources of water pollution. Issues such as erosion, sedimentation, and agricultural run-off that are linked to agricultural land use or solid waste, flood control, and urban land use are extremely complex and go well beyond the scope of this study.

Some critical issues

Brazil's fresh water resources represent approximately 12% of the world's total, but these are very unevenly distributed since 80% of the total is concentrated in the Amazon basin. The semi-arid Northeast region, including most of the São Francisco river basin, has only 4% of the country's water resources but 35% of the population and a much higher proportion of the poor. The humid South and Southeast regions with 60% of the population used to have ample water resources. Now, they face a prospect of increasing local or generalized water scarcities as a result of rapid urbanization and economic growth unless both the quantity and the quality of water resources are better managed.

Historically, the management of water resources has relied upon heavy investments in medium and large scale programs and projects to provide basic infrastructure for irrigation, hydro-electricity, water supply, sanitation, flood control, and navigation. The total level of government investment in water infrastructure is difficult to assess because it is spread across the budgets of many Ministries and State Governments. Nonetheless, even partial figures suggest that the average investment has exceeded R$5 billion per year, while estimates of the 'needs' for new investment in the water sector over the next 5-10 years start at R$20 billion per year and could be much larger.

These sums are not particularly large in relation to the size of the Brazilian economy and the broad range of activities affected by the water sector, provided that they are properly spent and the resulting infrastructure is well managed. Unfortunately, neither of these conditions have been met in the past. **The overall return on water infrastructure has to a great extent been disappointing.** Projects have been abandoned or have taken so long to complete that the original goals were overtaken by new circumstances. Even where projects have stimulated regional economic growth or met the demands of growing cities, the lags between investment and downstream benefits have greatly reduced the present value of those benefits.[1] **Equally, the management of the existing water infrastructure has been poor at best.**

The impact of past investments on water quality and even water scarcity has been mixed. Progress in addressing water pollution and meeting water demands in some areas must be balanced against evidence of increasing salinity of irrigated land, greater vulnerability to intermittent droughts and water shortages. **There have been limited or no improvements in key indicators of water quality.**

Similarly, **there are doubts about the extent to which investments have contributed to reducing poverty and inequality.** Small scale expenditures on improving access to water resources can have a large impact on the quality of life of poor households, especially in semi-arid regions. The link between larger projects and poverty reduction is not so direct. For example, it does not make economic sense to use most of the land irrigated by large schemes for subsistence agriculture. The benefits to poor households of such schemes are associated with opportunities to shift from subsistence to cash crops, the creation of employment by medium and large farmers, and the broader growth in service and other activities in surrounding areas that depend upon agricultural prosperity. However, only a small number of projects seem to have achieved such benefits on a significant scale. Even in these cases, the lag between investment and benefits has been of the order of 10-15 years rather than 5 years.

An important underlying reason for the poor performance of many infrastructure projects is a culture of investment which focuses on engineering and finance. Consideration of project objectives and of their relationship to project design has been neglected. Equally, little attention has been paid to the design of incentives for the efficient management of infrastructure. Managers and planners firmly believe that the sector has been and remains perennially short of resources for investment relative to its needs. This can easily lead to the assumption that any investment is better than none, so that priority is given to the development and implementation of new investment projects that can be justified to potential sources of finance.

This type of attitude was also common in the formerly socialist countries of Eastern Europe

[1] This is widely acknowledged for irrigation projects, but it is equally a problem for large investment programs in water supply & sanitation such as the Tietê River or Guanabara Bay Programs in São Paulo and Rio de Janeiro, respectively.

and the former Soviet Union. New investment was seen as being critical to the extension and improvement of services, while getting the most out of the existing capital stock was a minor concern. In both the formerly Socialist countries and in many Brazilian projects the capital stock has often been used at a fraction of its potential capacity.

The failure to ensure that new infrastructure delivers the performance expected and promised is only possible because the performance of programs is rarely evaluated against a clear and monitorable set of objectives. The assumption that any investment will contribute to narrowing the gap between the existing stock of infrastructure and what is needed relieves project sponsors of the requirement to define concrete targets for their particular projects. Instead, projects tend to be justified on the basis that sewer coverage in a particular city is x% (far short of 100%) and the project will raise it to x+y% (but still less than 100%). No-one tends to ask (a) whether the population of the area where the sewers are to be built are willing and able to pay for wastewater collection, (b) whether priority should be given to investments in sewers rather than to the expansion of water supply networks in other areas, and (c) whether investment in other forms of water pollution control would bring greater benefits than the investments proposed.

The low economic and social returns generated by investments in the water sector over the last two decades reflect the systematic tendency to pay insufficient attention to project objectives in the design and implementation of projects. Hence, the following sections of the study focus on identifying priorities and objectives for future investments in the water sector. This includes the issue of poverty reduction. Many types of water infrastructure have an impact on the standard or quality of life of poor households. But, with limited resources, more attention must be paid to the efficiency of different investments in contributing to the goal of poverty reduction and/or to improving environment al quality.

In order to maintain, let alone improve, the level of service and the proctection of the environment, it will be necessary to increase investment in water infrastructure over the next 5 years. To achieve this, it is important (a) to identify ways in which the economic, social and environmental returns on future investments can be improved, and (b) to draw up a set of priorities as the basis for the assessment of projects and policies. In this study we undertake two limited but crucial tasks:

- to review the results of Bank and other work in the water sector in Brazil in order to draw lessons about ways in which past and new investments in water infrastructure can be directed and managed so as to yield a better return in terms of their economic, social and environmental benefits; and
- to help to identify a core set of issues which, in our understanding, should be regarded as priorities for the new Government which will take office at the beginning of 2003.

Our work does not attempt to be comprehensive either in its coverage of the sector or in the nature of the policy reforms that will be proposed. Instead, we identify a set of critical questions and assess the broad implications and benefits of new approaches to old problems.

2

Water resources management

It is generally agreed that the management of water resources over the past two decades has suffered from basic weaknesses. These include: (i) a fragmented and often incoherent institutional approach to water management; (ii) an over-emphasis on new investment programs combined with limited attention to ensuring effective administration, operation and maintenance (A, O & M) of existing infrastructure; (iii) poor integration of environmental considerations; and (iv) allocation of resources on an *ad hoc* basis rather than in accordance with sound priorities identified through assessments of benefits and costs or through explicit schemes aiming to privilege the poor.

The combination of centralized and decentralized management of water resources has led to very uneven development. Large sums have been invested in major hydro and irrigation projects, while poor and/or remote populations — particularly those in the North and Northeast – have been neglected or remain under-served. In periods of drought, many rural inhabitants of the Northeast must walk several miles to obtain low-quality water, while others await the arrival of public water trucks.[2] The costs of supplying water in drought-prone areas during emergencies are substantial, but these funds have not been effectively mobilized to finance investments in long term security of supply.

[2] World Bank, Brazil-Federal Water Resources Management Project, Report 17541, pg. 3.

Recent legislative and administrative initiatives, focusing particularly on the creation and development of ANA, attempt to address some of the problems which have been identified. The creation of a new regulatory framework for the sector is an important step in the direction of developing more coherent policies. At the same time, ANA is being asked to find administrative solutions within a framework of incentives and legal provisions, much of which remains largely unaltered. This raises questions about expectations concerning the role of regulatory agencies and other branches of government in developing both policies and institutional arrangements for water infrastructure.

The experience of the crisis in the power sector in 2001 should provide a warning of the dangers of attempting to rely upon regulatory intervention to tackle major issues within a flawed structure. The actions of the Agência Nacional de Energia Elétrica (ANEEL) in the 2-3 years preceding the crisis may be criticized for failing to provide the degree of regulatory certainty required to stimulate new entry and investment in generation. Still, at worst, ANEEL's performance may have marginally worsened the severity of the crisis, whose root causes are to be found in the structure of the energy sector and the incentives facing current suppliers, potential investors, and other firms in the sector. The consequences of structural weaknesses and poor incentives were masked for a time by the lack of progress in addressing the problems of the large public generators. These

became the residual holders of many of the market and physical risks as well as contractual liabilities created by the partial liberalization of the sector.

The lesson for the water sector is that ANA may have neither the mandate nor the capacity to resolve some of the fundamental issues which underpin the poor performance of water resources management. The agency can help to promote informed debate of these issues and, even, to push the Government and the sector to adopt necessary legal and structural reforms. Even so, its role ***should be*** a limited one. The regulatory function is important, but it does not extend to attempting to resolve every conflict in the management of water resources. Some of these conflicts will inevitably require broader political negotiations or even judicial resolution.

In this respect there is a tension built into the powers granted to all Federal regulatory agencies. They are authorized to act on behalf of the Federal government in awarding concessions of various kinds. This should not be a problem so long as the agencies are expected to act in a technical and advisory role – i.e. preparing contracts, managing bidding procedures, etc. – while the key political decisions affecting the creation or transfer of property rights are made by the President, Ministers, or the Congress. However, if the responsibilities of these regulatory agencies come to be seen as extending beyond the technical interpretation and implementation of political decisions, then their independence and credibility in carrying out their regulatory functions may be challenged. Any suspicions will be reinforced by the lack of effective appeal mechanisms regarding their decisions, because the courts are ill-equipped to handle challenges based on the argument that an agency has made technical mistakes in reaching a decision. For these reasons, ANA and its sister agencies must be very careful in the way in which it exercises its power with respect to the creation of new property rights, concessions, etc.

ANA can provide the focus for initiatives in developing new incentives and demonstrating good practice in water management. Equally, however, it must be remembered that the beneficiaries of the existing structure, however inefficient it may be, are numerous and well-entrenched, so that resistance to change has been and will remain substantial. Experience in other countries demonstrates that reforms which threaten the 'rights' and position of existing users have little prospect of success unless these 'rights' are effectively recognized and grandfathered.

The application of concepts of transferable property rights to water is extremely controversial on both legal and social grounds in Brazil[3], so that it is unlikely that legal reforms of the kind adopted in Chile could be accepted within the foreseeable future. Nonetheless, it is essential to find ways forward which allow for the transfer of practical usage rights from the beneficiaries of the existing system to those who are able to make more efficient use of the water. Such transfers must be accompanied by the actual payment of compensation by the new users to existing users in some appropriate form.

There are examples in Brazil, as well as Mexico and California, of the re-allocation of water use accompanied by compensation to current users under pressure of water scarcity in severe droughts. To the extent that existing resources are sufficient to fulfil current demands in periods of normal or plentiful rainfall, this approach may be adequate for the short and medium term. Even so, the negotiation of temporary re-allocations places exceptional demands on those responsible for water

[3] For example, some lawyers argue that the management of water resources is fundamentally a public function, so the right to use water cannot be alienated (in the Common Law sense of being transferred permanently to a new owner). Even if this line of reasoning is accepted, it is not inconsistent with the creation of limited property rights for the use of water for a specific period via licenses, leases, concessions, etc.

management and will usually occur only when the discrepancy between the value of water in competing uses is very large. Thus, it is, at best, a stopgap measure that should be accompanied by experiments which set out to develop either quasi-markets or transfer-compensation schemes in basins facing longer term scarcity of resources – e.g. the Piracicaba in São Paulo.

Thus, it is important to understand the existing system of water rights so as to identify the direction and nature of changes that may be required in order to improve water resources management. This need have no implication that water rights should be subject to market arrangements which may be thought to be inequitable, inefficient, or otherwise undesirable. Rather, thinking about property rights provides an essential framework for analyzing the implications of alternative approaches to managing water resources. In particular, it helps to understand the incentives created by present arrangements as well as by proposals for the financing and management of major new projects. Hence, this section employs the framework of water rights as a prism to examine the various elements of water resources management in Brazil.

There are, however, some crucial dimensions that must not be neglected in thinking about property rights for the use of water in Brazil. At present, water is not a scarce resource in most river basins in normal and wet years in the sense that the total quantity of water available is sufficient to meet demand from the agricultural, electricity, industrial, and residential sectors as well as to protect environmental resources. But, the time profile of these demands over the seasons may not be consistent with preserving adequate flows for downstream users and environmental protections. As a consequence, any analysis must take account of the seasonal dimension to the (implicit) value of water rights. In some cases, seasonal variations in water values may provide a signal that investment in storage capacity or other measures to manage flows would be justified. In other cases, they may provide a basis for assessing the benefits of adjusting despatch rules and other provisions which affect the management of storage capacity for reservoirs.

Similarly, water rights must be viewed as being contingent on the amount of rainfall during the rainy season or some other relevant measure of the availability of water, perhaps summed over a sequence of years. The power sector uses sophisticated programming models to control the use of the water stored in key reservoirs which take account of variations in weather conditions and attempt to value the probabilistic benefits of storing water rather than using within the current season or year. As the crisis in 2001 showed, these models may have technical limitations – at least in the manner in which they are linked to operating practice – but they do recognize the contingent value of stored water.

There are mechanisms by which this contingent value can be signalled to other users, but they are not being used in Brazil, in particular in agriculture[4]. As an illustration of what is possible, following a run of droughts in the early 1990s water utilities in Southern California have adopted a structure of seasonal tariffs including provisions for fixed percentage increases when reservoir levels fall below certain thresholds associated with drought conditions. These are, in turn, linked to offers of higher prices to farmers for diverting water which they have been allocated for irrigation use.

Location is a third dimension which is not adequately represented in the way water rights are managed. This is particularly important in the consideration of water transfer schemes. The

[4] An exception has been with rice producers in the State of Ceará where, with the intervention of ANA, a compromise between different water users was reached based on their opportunity costs of using water.

reasons for the tendency to ignore the locational dimension are clear. It is widely believed that providing access to water, especially for irrigation, is an effective mechanism for poverty alleviation, especially in the semi-arid region of the country. The construction of water infrastructure is seen as an investment in redistribution which would be undermined by requiring the beneficiaries to contribute to the cost of transport. But, cost-recovery schemes or development plans which neglect location may lead to very inefficient utilization of the available water resources. They create a strong incentive to promote projects which are much larger than would be efficient in terms of the volume of water transferred and/or the distance over which it is transferred.

In the remainder of this section we will focus on (a) the impact of institutional reform in the management of water resources, and (b) the financing and management of infrastructure investments. For each theme we will consider how the *de facto* allocation of water rights shapes the existing use of water resources and what changes may be required to improve the incentives and structural framework that will determine future performance.

Decentralization and river basin institutions

In parallel with a general shift towards greater decentralization of policy in many areas, the reforms embodied in Law 9433/97 represent an important attempt to move away from central control of water resources management to basin approaches. However, the implementation of these reforms has proceeded more slowly than was anticipated, in part because of the reluctance of States and water users to provide adequate resources for the operation of river basin institutions. The continued reliance of much of the sector upon investments financed either by or through the Federal Government means that the effective extent of decentralization is likely to be much less than might have been expected or would be desirable.

The institutional and economic structure defined in Law 9433/97 is closely modelled on the river basin model that has been developed in France over the last four decades, but there is one critical difference. Traditionally, France has a highly centralized administrative structure and the river basin institutions operate within a framework that is directly subordinate to the central government, in particular the Ministries of Environment and Finance. They have overall responsibilty for all water resources management in their basins, even where this is delegated for minor rivers.

In contrast, Brazil's federal constitution means that responsibility for water resources management is unavoidably divided between the Union and the States. Major rivers such as the Paraná, Paraíba do Sul, and São Francisco may be Federal rivers but almost all of their tributaries are State rivers because they lie entirely within a single state (up to their junction with the Federal river). This greatly increases the difficulty of establishing and operating river basin institutions. In the classic French model there would be, for example, a single river basin committee and agency for the São Francisco, which would then form sub-basin committees for major tributaries. In Brazil this top-down framework must be replaced or supplemented by a bottom-up structure reflecting the interests of the many states within the São Francisco basin.

When the number of states involved is small and there are no major conflicts over water rights, this structure may be just workable. The example of the Paraíba do Sul suggests that the costs of co-ordination are likely to be high while effective institutions may be quite slow to develop because of a reluctance to devolve responsibility to inter-State bodies. Nonetheless, it is generally agreed that the Paraíba do Sul plus a number of State rivers in the South and

Southeast represent the best prospect for the full implementation of the classic river basin model.

For large rivers affecting many states, the problems of co-ordination and resource allocation are multiplied many times. It may be argued that the São Francisco and Paraná basins are too large to be managed by single committees and agencies. Unfortunately, the creation of multiple basins (e.g. upstream and downstream) with independent institutions only shifts the focus of conflict over water rights and scarce resources to the interface between the separate basins.

The complexity of reaching agreement between independent authorities with substantially different agendas and interests in order to establish effective river basin institutions has meant that progress has been very slow over the past 4 years. This is particularly important with respect to the creation of river basin agencies which have been the main engine of change in France. While attention may focus on the role of river basin committees in attempting to reconcile the competing interests of different groups of water users, these committees cannot function properly without substantial and expensive technical support from the agencies.

Currently, the development of river basin management is trapped in a vicious cycle. The new institutions must demonstrate their competence and future role in order to gather support and establish credibility. To do this they need resources, both human and financial in order to undertake good technical work and to fund new investments. However, to fund their activities they must levy charges on water users which will only be acceptable once they have demonstrated their competence.

In France, the river basin agencies – as arms of the central government – were given ample resources for their technical work as well as strong political support. This enabled them to establish their position and to raise charges for water use gradually as the actual or potential benefits of river basin management became more widely accepted. Following a similar pattern in Brazil would imply extensive involvement of the Federal Government in funding river basin agencies. However, the implication of such funding – greater influence by the Federal Government over management decisions – may not be acceptable.

The example of the US as a Federal country in which river basin management has been very slow to develop is instructive. There is a long history of legal disputes between States over water rights which have made inter-state cooperation in river basin management either impossible or ineffective – e.g. the Colorado and Mississippi Rivers or the Chesapeake Bay system. In some cases, the Federal Government has stepped in to insist on some degree of joint management as a condition of providing funds for infrastructure investments in flood control, irrigation, power generation, or water navigation. More recently Federal environmental laws reinforced by law suits files by environmental groups have been forcing States and others to act to protect certain categories of water use.

Unfortunately, both infrastructure funding and environmental regulations are unsatisfactory ways of addressing the complex problems of water resources management. The former has resulted in the construction of severely under-utilized or, sometimes, completely counter-productive infrastructure projects in many parts of the US. Reliance upon environmental regulations, especially when implemented through court judgements, gives priority to one set of interests at the expense of others without any balancing of the trade-offs between the costs and benefits of alternative options.

Naturally, it is possible to envisage an effective framework of river basin management supported by Federal financial incentives and environmental/regulatory threats. The experience

of the US and the record to date of Brazil suggest, however, that implementing such a system is not really an easy task. Still, Brazil's Constitution gives more control over water resources than the US Constitution with respect to shared rivers and water controlled by infrastructure funded by the Federal Government as well as in defining general rules and guidelines for the whole sector. These underpin the key responsibilities of ANA and allow it the possibility of exercising substantially more initiative than any Federal agency in the US.

In summary, Brazil's federal structure means that it cannot follow the French model of strong and centralized river basin management. This explains the limited progress in developing river basin institutions since the passage of Law 9433/97. Equally, the US example suggests that a purely consensual approach will not work. There are too many reasons why states are unwilling to bind themselves to implement the decisions of river basin institutions, even these may be apparently Pareto-improving in the sense that "everyone" can gain. The problem is that individual decisions have to be seen in the context of larger strategic games which may involve clear winners and losers.

The way forward must involve a substantial commitment of finance, technical resources, and political effort by the Federal Government to ensure that a number of river basin agencies are operating within the next 2-3 years. This will break the vicious cycle outlined above. At the same time, linking federal funding for infrastructure projects to the implementation of river basin or state water resources plans will encourage all parties to push ahead more rapidly with the development and implementation of strategic plans. To a very large extent this is precisely the perception of ANA's directorate and the way they are moving forward.

The setting of in-stream water quality goals is a responsibility of river basin authorities, while effluent discharge standards fall within the spheres of responsibility of various public agencies, including both river basin authorities and State environmental agencies. Hence, close co-ordination between water users (utilities, industry, agriculture, etc.) and the various public bodies is critical and must be built into the strategic plans of each river basin authority.

Initially, it should be possible to achieve significant improvements in aspects of water resources management by a combination of Federal support for new institutions and infrastructure backed up by a certain amount of cajolery and arm-twisting. In the longer term, the inherent weaknesses of a purely consensual model are likely to come to the fore. Both the Federal Government and other agents will need to consider how far the Federal Government should take reserve powers to adjudicate in situations where major differences of interest stand in the way of adopting and implementing necessary solutions to difficult water management issues.

A concrete recommendation for ANA in this respect is that it should (a) prioritize its system of water rights allocation and management, and (b) establish a sequence for advancing it. First, it should select priority basins (e.g. Paraíba do Sul, Piracicaba, Paraná, São Francisco) with which they would be directly involved with and provide rapid response: water rights requests cannot be denied or their issuance delayed for months because of a lack of clear procedures or the absence of information databases to cover all river basins in Brazil. Secondly, it should establish clear and simple procedures that could be improved as the agency matures. For instance, at first concentrating only on quantitative aspects and progressively evolving to the integration of quantity and quality issues for the allocation of water rights. Finally, the role of ANA in the allocation of effluent permits should be clear and the interfaces with the environmental sector (e.g. IBAMA) need to be well defined.

Making better use of existing infrastructure

The focus on new investments at Federal and State levels – a common feature of water resources management around the world – has meant that management systems for existing infrastructure have been inefficient and ineffective. The limited attention paid to rehabilitation as well as A, O & M has led to infrastructure degradation, poor delivery of reliable water, and stranded investments. Similar problems affect water and wastewater systems operated by State water companies and municipalities. In particular, the deterioration in water distribution networks has compromised their ability to maintain uninterrupted supplies, leading to problems of contamination. Equally, poor maintenance and operating practices have degraded the performance of many wastewater treatment plants.

Improving the utilization of existing infrastructure is critical to achieving significant and rapid progress throughout the water sector. The framework and measures necessary to achieve better utilization are both widely agreed and familiar to policy makers in Brazil. Hence, the failure to implement them can not be ascribed to uncertainty or lack of knowledge about appropriate policies. It must, instead, be interpreted as a consequence of conflicting objectives and pressures on those responsible for the sector clearly exacerbated by a tendency to under-estimate the costs of poor management.

The critical issues are autonomy, finance and accountability by water institutions. The cost of A, O & M is small in relation to the initial investment in infrastructure, but a failure to allocate adequate resources for this purpose can rapidly reduce the benefits of investment. Power generators and water companies recognize this and, thus, have a strong incentive to operate and maintain their infrastructure so as to ensure continuity of supply of either power or treated water. Further, they have access to a flow of revenues from their operations which are ample to cover the costs of A, O & M. However, for water operators this will only happen if the institutional arrangements are realligned so that suppliers are accountable to users, and charges become a real tool guiding service provision.

The real problem lies with irrigation, navigation, flood control, and similar infrastructure. The beneficiaries of the infrastructure are more diverse, so that it may be more difficult to charge directly for infrastructure services. Much of this infrastructure may be seen as being redistributive rather than productive in character. Hence, those wishing to promote particular projects are often more interested in the profits and political benefits that accrue during construction than in the longer terms rewards of mobilizing water as a factor of production, particularly since these benefits are often insignificant, as in the case of irrigation, and accrue in the longer term; rent seeking during construction accrues up-front.

There are, of course, various ways to remedy the bias in favour of new construction at the expense of better use of existing infrastructure. The most reliable is to require that whoever builds the infrastructure shares in a large part of the risks associated with the future use of the water. Unfortunately, this is rarely more than a counsel of perfection. If state-owned enterprises act as project sponsors, they are likely to be exempt from any serious financial or market discipline on their investments. For large projects it is usually argued that the private sector cannot raise the necessary finance and/or will be unable to bear the risks of potential cost over-runs or uncertainty about future demand. The fact that these are good reasons to conclude that some of these projects are misconceived and uneconomic is often ignored.

Since it is very difficult to link appropriate incentives for the construction of infrastructure to

those for its subsequent management and utilization, it may be best to separate the two clearly. This implies that, after completion, water infrastructure should be transferred to financially autonomous and accountable organizations ("infrastructure managers") which are responsible for administration, operations, and maintenance drawing upon revenues from water charges and other sources. Where there are clear economies of scope or scale in managing several projects, there may be a case for allowing a single infrastructure manager to operate a group of projects which are not inter-linked. In such cases, it is important to insist on separate accounting in order to ensure that any cross-subsidies are reasonably transparent.

For such arrangements to work it will usually be best to award concessions to the infrastructure managers for periods of 10 to 30 years. Under the concessions of up to 15 years, the infrastructure manager will be responsible only for A, O & M, though it may have a significant incentive to make minor investments which generate additional revenues from water charges. Under longer concessions, the infrastructure manager may be willing to make larger investments in, for example, extending irrigation networks or enhancing the time profile of the water yield from the project.

This framework implies the need for independent regulation of infrastructure managers in setting water charges and to resolve disputes about the quality of service. Charges may be set at a level to achieve full cost recovery (i.e. including a lease payment that is designed to amortize the cost of the investment over its expected life) or merely operational cost recovery. This will depend upon the objectives of the project and the nature of any subsidies which have been provided.

Even in reforming States, public enterprises responsible for water resources management continue to manage and finance new investment projects as well as being responsible for the operation and maintenance of existing infrastructure. There is an obvious appeal to this structure from the perspective of spreading overheads and making good use of scarce technical staff. The disadvantages emerge when the enterprise comes under financial pressure. The usual response is to shift resources from the operation and maintenance of existing infrastructure to continue to meet investment commitments.

These problems can be avoided with good management and, if necessary, tied funding arrangements designed to ensure that a significant proportion of the revenues generated by within specific project areas are ploughed back into operation and maintenance. However, practical experience suggests that separation of responsibilities is often the only way to get the incentive structure right.

But, again, a structure under which water infrastructure is managed by competent specialist enterprises, either public or private, may be an unrealistic goal under current circumstances. For example, it assumes a willingness to establish – and collect – reasonable charges for water users. Even though there is a gradual acceptance of the principle of charging water users, there is still great reluctance to implement charging systems for small and medium farmers. This is understandable because many of these consider that, in effect, they have an established right to free water though the service may be unreliable or the amounts of water delivered insufficient. Thus, generating the resources to pay for better operation and maintenance may depend upon improvements in the quality of service or the volume of water delivered which will permit the adoption of a two part tariff with a low charge for an initial allocation supplemented by a much higher charge for extra water.

The next best alternative is probably some form of radical decentralization of responsibility

for operation and management, giving a substantial role to local user associations or similar organizations. There are examples from various countries where this approach has proven effective in improving water management, rehabilitation and A, O & M in the irrigation sector. In such cases, the level of charges can be directly linked to the expenditures on operation and maintenance required to achieve the level of service and volume of water sought by users. Like many other community-based or co-operative solutions the success of this approach depends on the level of commitment of both the users and those responsible for the infrastructure. User groups are most likely to be able to play an effective role when they are relatively homogeneous and well-organized. In large and even medium-sized irrigation schemes a substantial diversity of interests among the users will greatly increase the difficulties of agreeing on priorities and charging for operations and maintenance activities. Further, the organizational and administrative costs of setting up and sustaining an effective system of user groups can be high, so that this approach should not be regarded as a universal palliative.

A basic difficulty with most mechanisms that are designed to guarantee adequate resources for A, O & M and better utilization of existing infrastructure is that they are open to the charge that they discriminate against small farmers and other poor water users. Many studies have demonstrated that current arrangements tend to benefit large water users. They are not required to pay for the water that they use but are usually able to ensure that they receive better service – greater reliability or higher volumes – than other users. Thus, large users are likely to have relatively less to gain from the adoption of charging and other arrangements designed to sustain better management, though still sufficient for them to support the adoption of a new management structure. Small users, even where they should gain over a run of years, may be understandably reluctant to support a change which brings the certainty of higher cash payments combined with less certain promises of better services and higher incomes.

Investing in new infrastructure

For decades water resources management has been equated with the construction of water infrastructure. In some cases, water infrastructure has resulted in major economic, social, or environmental damage. Nonetheless, this is no reason to stigmatize all water infrastructure as unnecessary or destructive. A balanced approach based on a proper evaluation of the benefits and potential dangers associated is essential. For example, in 1998 and 1999 the Federal Government alone spent about R$1.5 billion on emergency measures to alleviate the effects of the drought in the Northeast. With better water management and enhanced capacity to store water much of this expenditure could have been avoided. Similarly, opportunities to develop irrigated agriculture and hydropower in a sustainable manner will contribute to poverty alleviation and economic growth.

As noted above, there are strong pressures to use most of the available resources to fund new investment projects which would be serving important social and/or economic needs. This can lead to a variety of biases in the way in which project designs are developed and evaluated. In particular:

- There is a strong tendency to favour large, visible, projects which can command political support from a range of interest groups and areas.
- Projects are too often designed to meet a variety of needs or demands with the result that often they become highly complex and difficult to manage.
- As a consequence, projects that might reasonably be considered and funded as quite separate investments are bundled together in order to gain support as a package, especially

if some components can only be justified by some internal transfer of benefits or sharing of cost within the package.

- Project evaluations are based on unreasonably optimistic assumptions about construction times, future demand for water, complementary investments, etc. so that estimated rates of return are likely to be much higher than would be obtained from an appraisal based on assumptions reflecting past experience.
- Further, the evaluations tend to rely upon average outcomes rather than taking proper account of uncertainty in analyzing the value of the water management services being proposed.
- Little thought is given to whether the beneficiaries of the project are or will be willing and able to pay for the water or other 'benefits' of the project at a level sufficient either to ensure full recovery or to generate the funds required for operations and maintenance.
- Despite progress achieved in Brazil regarding social and environmental concerns, project designs still tend to focus on engineering and investment studies with much less attention being paid to issues of project sustainability after the investment phases are complete.

Many of these problems are systemic and are equally important in the water and sanitation sector. In both sectors, they are a consequence of the incentives facing project sponsors, public bodies, and other agents. Attempts to improve the process by which projects are identified and evaluated will only have a limited impact so long as the underlying incentives remain in place. However, the problems may be particularly acute in water resources management. The scale of many projects leads to an almost complete divorce between (a) the arrangements for planning and financing water resources infrastructure, and (b) the assessment of the practical consequences of project for their beneficiaries and the day-to-day management of the infrastructure.

In its current version, the proposed São Francisco inter-basin transfer project provides a clear example of many of these features. It packages quite distinct projects to transfer water to meet (a) urban demand in the metropolitan region of Recife and in inland areas of the state of Paraíba, (b) urban demand in the metropolitan region of Fortaleza, (c) rural residential demand in various parts of the semi-arid region, (d) the extension of irrigated agriculture in Pernambuco and Paraíba, and (e) the extension of irrigated agriculture in Ceará and Rio Grande do Norte. The value of urban water demand is critical to the claim that the project is economically viable. However, more detailed studies of options for meeting this demand would identify lower cost options relying either on local sources or on the better management of water currently used for irrigation. Similarly, the transfer of water from the São Francisco alone is not sufficient in solving the problems of ensuring adequate water supplies for small towns and villages in the Sertão. This is a case in which a potentially beneficial project falls into a vicious cycle and becomes a major cause of political and institutional disputes among all levels of government when it could be developed into a sound proposal through the establishment of clear objectives, comprehensive technical and economic analysis, adequate development of the institutional frameworks for its implementation and future A, O & M, and setting the appropriate timing for implementation.

Evaluating the benefits of using water from the São Francisco to develop irrigation in various parts of the semi-arid region is no simple matter. The balance of the evidence, based on the experience of irrigation projects in the São Francisco basin itself, would suggest a need to be rather skeptical about the economic and social returns from committing huge investment resources to such a project or projects. But,

again, a case might be made in future that sufficient experience has been acquired to ensure that the project(s) will be better managed and can produce a reasonable return from additional agricultural production and the alleviation of poverty. What cannot be justified is an attempt to push the project through on the grounds that it is "essential" to meet urban or rural demands other than for irrigation.

The biases in the design and appraisal of investments in water infrastructure must be addressed and either eliminated or at least reduced. In one specific issue – project sustainability – ANA has been asked to whether projects put forward for Federal assistance contain reasonable provisions to ensure adequate funding and management capacity for operations and maintenance after the projects are completed. The recognition of the problem is a significant step forward, but it is far from clear how effective this scrutiny can be, and it places a huge responsibility upon ANA. Unfortunately, very often plans put forward by States or other project sponsors have limited credibility. What will happen if a sponsor makes a commitment to levy user charges which are sufficient to finance A, O & M expenditures but later fails to honor it? Is it realistic to believe that the Federal Government can insist on repayment of the original assistance? These questions should not immobilize ANA, but it should be fully aware of such risks when taking its own decisions.

The key issue is that the incentives facing project sponsors and beneficiaries are not time-consistent. They are encouraged to promise one thing before the project starts and then to renegotiate or break their promises after project completion. They know that, once a project has been built, the Government has nothing to gain by imposing penalties which might jeopardize the full utilization of the infrastructure. The resolution of this problem depends on either (a) requiring project sponsors to put some of their own capital at risk, or (b) appointing an infrastructure manager after completion of the project. In both cases, the operator is compensated on the basis of the performance of the project.

Even so, difficulties that are familiar to any capital-intensive project remain. Since a failure to operate and maintain infrastructure does not have immediate visible effects, potential or actual water users may argue that zero or minimal charges will encourage a rapid take-up of the newly available resources. Public bodies responsible for the construction or regulation of the infrastructure will be strongly inclined to waive charges or set them at a level well below the long run cost of operations and maintenance. This makes economic sense in the short term provided that charges are increased as demand builds up. Unfortunately, the expectations created by low initial charges are easily converted into a quasi-property right with users believing that they should never be required to pay realistic charges for their water. Again, this is an example of the time-inconsistency of a policy strategy.

Similar problems afflict roads and railways. These examples suggest a way of limiting the impact of perverse incentives. Under standard pricing rules the difference between the actual charge for an infrastructure service and the variable cost of A, O & M is a congestion charge. For a particular project, this should be increased as demand for the services provided by the project infrastructure grows. The standard investment criterion is then that the discounted present value of congestion charges paid over the life of the project should exceed the present value of the project investment.

For a bundle of infrastructure projects built over a period of 10 or 20 years the net revenues generated by the infrastructure projects (i.e. the total revenues from charges and other sources of income minus expenditures on A, O & M) should be treated as a return on the past investment embodied in the projects. If the Government

were to treat bygones as bygones, then it may be argued that, at a minimum, no further investments should be made unless they can be financed out of the net revenues generated by earlier projects. This approach would provide some economic and financial discipline on investments in water resources infrastructure that is absent now.

There is a further issue concerning the complexity of project design and objectives. There are two, possibly irreconcilable, perspectives on the nature and design of water management projects. Practitioners emphasize that it is critical to take account of the many different users of water resources with, perhaps, divergent interests. Large projects should not be dominated by the concerns of one dominant sector or group of users but must recognize the competing needs of small and large farmers, the power sector, industrial and residential consumers, and environmental protection. On the other hand, practical experience and much of the literature on management tell us that focus and clarity of objectives is an essential element in the effective design and execution of projects or in managing successful enterprises.

Over-complicated project designs are likely to satisfy no-one and may be extremely prone to failure either in implementation or peformance after completion. The understandable tendency to fudge difficult trade-offs leaves those responsible for project management and performance with few guidelines on priorities and constraints when adjustments have to be made in response to unforeseen developments.

3

Water supply and sanitation

Following the recent demise of the proposed law on the regulation of water supply and sanitation, several of those familiar with the drinking water and sanitation sector in Brazil have characterized it as an 'orphan child' of PLANASA, the federal program which led to the creation of the State water companies and financed investments in water and sanitation for nearly 20 years. Most of the agents in the sector still expect that they will be able to rely upon the Federal Government to provide the resources required to invest in extending and improving services.

At the same time, the sector is subject to an almost totally dysfunctional process for adopting new quality and environmental standards. During the last 5 years CONAMA and the Ministry of Health have introduced new, more stringent, regulations when few operators are able to get close to complying with the existing regulations. Determination of these new standards is not based on an assessment of their respective costs and benefits, particularly the costs implied by the imposition of more stringent regulation. The outcome is usually very limited or no real improvements in social or environmental well being. The situation is sufficiently perverse that the incentives created by these regulations may, in practice, hinder the improvement of water services because of the way in which they interact with the existing circumstances of the operators.

Despite the manifest disadvantages of the present institutional structure there seems to be little prospect of a major change in the institutional 'rules of the game' over the next few years. Some private concessions will continue to be awarded for small and medium towns and cities in various states, mostly in place of municipally operated services or in areas outside the major metropolitan areas which have been neglected by the State water companies. A few large municipalities may agree to renew the concessions of the State water companies in return for commitments on investment and improvements in service. However, the underlying operational performance and financial situation of these companies is not likely to improve substantially while institutional arrangements and incentives remain as they are.

In their present condition the majority of State water companies in Brazil and their municipal counterparts are simply unable to generate the resources required to fund the investments needed to meet targets for the improvement and extension of services sought by municipalities, environmental agencies, and other interest groups. Furthermore, progress in adopting a variety of basic operational measures that would improve the efficiency, reliability, and quality of their services is also likely to be very slow, given current incentives for managers and staff.

The continuation of 'business as usual' will mean that the future level and nature of investment will depend primarily on the allocation

of funds provided either directly by the Federal Government or through Federal financial institutions such as the Caixa Econômica Federal. There are many other claims on the limited volume of budgetary resources and debt finance that will be available for investments in infrastructure. Thus, it is essential to think carefully about what should be the priorities for the allocation of Federal funds for water and sanitation.

Even if the logjam of the different interests which block reforms proposed for the institutional structure of the sector were to be overcome, it will take some 2-3 years before significant changes are put in place. After that, new managers and/or operators will be obliged to give immediate priority to upgrading the performance of, and service provided by, existing systems. Hence, any program of reform will only bear significant fruit, in terms of extending the coverage of services, over a period of 4-5 years. Such changes could be facilitated if the government funded selective programs to promote efficiency gains and changes in the sector's incentive structure, such as the Second Water Sector Modernization Projects (PMSS2) and ANA's Compra de Esgoto Program (see later). Even so, for the longer term it is critical that structural reforms are adopted. In parallel, it is also important to consider how the Federal Government, working with the states and municipalities, can tackle the most urgent problems of access to and the quality of water and santiation services.

Needs and priorities

For reasons of public health and the preferences of the households affected, there is general agreement that immediate priority should be given to extending access to piped water supply, especially in urban areas. According to the results of the 2000 Census – see Table 1 – just over 10% of Brazilian households living in urban areas, or about 3.9 million households containing about 14.4 million inhabitants, are not served by network water connections. However, the majority of these households do have water supply piped to or within their dwelling from some other source, usually a well or a spring. The number of urban households with no piped water of any kind is just under 1.5 million, representing some 5.2 million urban inhabitants.

There is little information about whether households who rely upon piped water from wells or springs receive water of satisfactory quality and in sufficient quantity. With the exception of almost half a million in the state of Rio de Janeiro, many of them live in thinly populated but expanding states in the North and Center-West such as Goiás, Mato Grosso, Pará, and Rondônia. It is likely that the majority live in peri-urban areas at the edges of towns and cities, so that their water sources may be of reasonable quality but they will deteriorate as urban populations expand. Using some rough assumptions about the proportion of such households which could be served by network water connections in each state, about 1.6 million households with piped water from other sources might benefit from network connections.

From these figures, we estimate that the total need for extending access to urban water services amounts to about 3.1 million households. In addition, it is necessary to allow for the continuing growth in urban populations which may add 2.8 – 3.0 million households to the number requiring service over the next 5 years. The average investment per additional household served would be of the order of R$ 800-1,000 at current prices[5], so that the total

[5] As might be expected, there are large variations in the average cost of expanding water supply networks to serve additional customers. Some preparatory studies in the Northeast and Center-West prepared for the World Bank-financed PMSS2 yielded average costs of R$ 500-600 per household at 2002 prices, whereas the usual figures for large urban areas in the Southeast lie in the range R$ 1,200-1,400 per household. We have adopted a range midway between these estimates as a

investment required to meet the needs of the unserved population plus population growth would be of the order of R$ 5 – 6 billion over a period of 5 years or about R$ 1 – 1.2 billion per year. Such an investment should be easily within reach for a sector which ought to be earning revenues in excess of R$ 14 billion per year from water supply alone at current levels of tariffs and consumption, if it were properly managed. The current level of Federal grants for urban water and sanitation is about R$ 1 billion per year. Hence, **a target of ensuring that at least 98% of urban households have access to piped water connections within 5 years is both achievable and should be the first priority of the new administration.**

In addition, priority should also be given to improving the quality of service received by the residents of poor urban neighborhoods and peri-urban areas who have network connections but whose service is frequently interrupted or whose water may be contaminated by pathogens or other pollutants. Unreliable and/or contaminated water supplies are a manifestation of the poor operational performance of many water utilities. Under competent management, these problems can usually be remedied within 6-12 months without the need for large investments.

Urban water supply is particularly important because public health and epidemiological studies suggest that the benefits of providing access to adequate quantities of piped clean water are significantly larger for urban populations than for rural populations. The institutional and financial mechanisms for achieving a target for access to urban water supply are more straightforward than for rural water supply. The main barrier to achieving the target proposed above is the poor financial and operational performance of the existing operators.

compromise between the cost of accommodating population growth in the Southeast plus the lower cost of extending access to customers without service in the North, Northeast, and Center-West.

None of the above is to suggest that rural water supply should be neglected, but identifying priorities is rather more difficult. The 2000 Census results show that about 18% of rural households are connected to network water supplies, while 43% (3.3 million households) have no piped water of any kind. About 15% of rural households live in areas that are classified as "rural - aglomerado", either extensions of urban centers or other concentrations of population.[6] Without access to detailed tabulations, it seems reasonable to work on the hypothesis that most of the rural households with network connections live in these areas, though the quality of the service which they receive may be very poor. Thus, the focus must be on providing adequate water supply for households living outside rural agglomerations who do not have access to piped water.

Meeting this need over the next 5 years would involve the extension of services to about 3.1 million households, after allowing for a continued decline in rural population. Over 85% of these households live in the Northeast and North regions with about 2.2 million in the Northeast and 0.6 million in the North – representing about two-thirds of all rural households in these two regions. The average cost of providing a piped water supply with no more than simple water treatment in small communities of 100 to 1,000 households that are able to draw upon a nearby spring or groundwater will typically be in the range of R$ 800-900 per household. So, the investment cost of providing access to this underserved population should be

[6] The definitions which underpin the distinction between urban and rural households complicate the interpretation of the Census results. Rural households are those which do not live in municipal or district centers (*sedes municipais* and *sedes distritais*). However, the definitions of the extent of agglomerations and of which agglomerations count as municipal or district centers are determined by municipalities themselves. There is little problem for medium and large towns or cities, but practice for small towns and less densely settled areas seems to be confused and inconsistent.

less than R$ 2.7 billion over 5 years. A sum of about R$ 550 million per year is almost trivial when compared with Federal spending in other areas, especially as this will have a direct impact on the quality of life of many poor rural households.

The real problem should not be one of finance but of how best to organize the use of the available money to ensure that appropriate systems are both built and maintained so that they continue to provide reasonable service rather than rapidly falling into a state of disrepair and non-use.

A second major concern will be the best way of addressing the issue of intermittent water scarcity in the semi-arid region of the Northeast. In this case, solutions may be more expensive and have to be linked to a broader approach to the management of water resources. Even so, many communities rely upon small reservoirs, shallow groundwater, or rainwater harvesting for inter-seasonal management of water resources. The reliability and quality of their water supplies could be improved by relatively small investments that enable them to utilize deeper sources of groundwater or to improve the management of surface storage. On the other hand, the intermittent cost of supplying water to communities in the semi-arid region by water tankers in periods of drought is quite high. Investment in the construction of infrastructure required to manage water better and to draw upon alternative water sources may yield a reasonable return over the medium and longer term by reducing the costs of responding to droughts.

Again, the key issue is how to combine appropriate investments in rural water supply with the establishment of incentives and organizational structures which can ensure that the new infrastructure is properly managed, operated and maintained.

Investing in sewers

For wastewater collection and treatment, there is much less agreement on the basis for establishing priorities and how these should rank in comparison with, say, improving the quality of drinking water supplies beyond the basic goals discussed above. In this section we will focus on urban sanitation because the problems of rural sanitation are entirely different, being much more a matter of education and personal hygience than of infrastructure. For the urban population, there are three critical and related questions.

- What, given Brazil's current level of income and development, are reasonable or appropriate standards of sanitation and wastewater treatment for the majority of the urban population?
- Are urban households willing to pay for the cost of providing wastewater collection and treatment at the standards thought to be required to protect either public health or the environment?
- How should the sanitation needs of poor urban households, especially those living in the unplanned peri-urban fringes of cities and towns, be met?

From one perspective the proportion of households with access to wastewater collection and treatment falls well short of the coverage level that water and environmental specialists regard as desirable. The 2000 Census figures report that 56% of urban households discharge their wastewater to either sanitary or stormwater sewers. There is strong grounds for being somewhat skeptical about this statistic. It is not clear how many respondents actually have a clear idea of what happens to their wastewater, especially if they live in apartment or other multi-occupancy building. Furthermore, how did they answer the question if they have a septic tank whose overflow is discharged to some kind of sewer or a stormwater drainage channel? This is

a quite common arrangement in older and/or less densely settled areas of some cities.

On the other hand, over 92% of the urban population have some basic level of sanitation, defined as households with a sewer connection plus those with either a septic tank or a basic cesspit (*fossa rudimentar*). Again, the distinction between septic tanks and cesspits is likely to have been quite unclear to many respondents. From a public health perspective, all of these forms of sanitation reduce the risk of the exposure to diseases transmitted by contact with human excreta. The extent of the reduction depends upon where and how the overflow from sewers, septic tanks, and cesspits is discharged. Many communities rely upon open drainage channels which may flood intermittently. These expose all of the residents of the neighborhood to the risk of disease transmission as a result of flooding or children playing in open-air drainage channels. On the other hand, reliance upon septic tanks and cesspits which discharge to soakaways can lead to problems of cross-contamination of water supplies, especially when many people rely upon a shallow groundwater aquifer as is the case in Buenos Aires. While this is not common in Brazil, the use of shallow groundwater is increasing in some areas – e.g. Recife – where the water company has failed to supply an adequate quantity and quality of water to customers connected to its network. Contamination of network supplies is, of course, still a potential threat, but this is usually a consequence of bad management of water distribution networks. It makes no sense to spend heavily on sewers in order to avoid the risk of contamination of network water supplies.

A septic tank should be a perfectly acceptable form of sanitation for a large proportion of the population. Ideally, they should be desludged at regular intervals so as to ensure that the process of anaerobic digestion continues to work properly. The pressure to install sewers in place of septic tanks in Europe has been prompted by concerns over the eutrophication of inland and coastal waters as a result of discharges of nutrients from all sources. The risk of eutrophication of coastal waters is a potential or actual problem in some parts of Brazil, but it does not rank among the most urgent of environmental priorities. Even in Europe the total contribution of replacing septic tanks by sewers to the reduction of nutrient discharges is very uncertain. The policy on wastewater collection and treatment was driven as much by a complex set of trade-offs between the member states of the European Union as by any careful evaluation of the probable benefits. One important element in this process was the recognition that it would be extremely difficult to control non-point sources of nutrient discharges, particularly from agriculture. As a result, the installation of sewer systems was seen as a way of eliminating some non-point sources, directing the wastewater to tertiary treatment plants with high levels of nutrient removal.

The issue of what to do about cesspits is less clear. By removing excreta from the immediate household environment they provide most of the health benefits of better forms of sanitation. On the other hand, most cesspits lack any kind of a holding tank which permits anaerobic digestion to take place, so that their overflow will often contaminate groundwater and nearly waterways with pathogens as well as organic waste. If the community relies upon the ground or surface water for drinking, bathing, or washing, this may lead to the transmission of water- and excreta-related diseases and parasitic infections. So, it must be an empirical question about how far the use of cesspits for sanitation poses a significant threat to health in a specific locality. The threat is likely to be greatest in densely settled *favelas* which are not adequately served by reliable water distribution networks.

Other forms of wastewater disposal, including direct discharges to ditches, streams, and other surface water, are certainly not

satisfactory. The proportion of households without adequate sanitation varies from about 14% in the North and Northeast to less than 4% in the Centre-West. In absolute numbers the states with the largest number of households without adequate sanitation are São Paulo and Rio de Janeiro (about 470,000 and 410,000 respectively). In proportionate terms the worst states are Maranhão, Amapá, and Acre, each with about 25% of urban households without adequate sanitation.

The acknowledgement that lower cost alternatives to sewers may provide perfectly adequate sanitation for many households implies that setting targets to increase the overall coverage of sewers for urban areas from, say, 56% to 60% or 80% would make little sense.[7] Obviously the starting point must be to address the needs of those without any form of adequate sanitation. Even for them, the first priority must be to ensure that they have access to a reliable supply of piped water. After that, a choice has to be made between the installation of sewers and the promotion of septic tanks or other decentralized forms of sanitation. The latter are most likely to be an appropriate choice for peri-urban areas, small towns, and relatively thinly settled districts in larger towns and cities, where density of population and ground conditions permit.

At an average cost of R$ 1,800-2,000 per household[8] (including the cost of associated wastewater treatment capacity) a program to install sewers to serve all households which currently do not have adequate sanitation would cost R$ 5 – 6 billion. On top of this it is necessary to allow for the cost of providing wastewater infrastructure for a growing urban population. Over the next 10 years the number of urban households may be expected to grow by at least 6 million. This increase may be as large as 9 million if the average household size continues decline as rapidly as it did between 1991 and 2000. Depending upon what proportion of new households are served by sewers rather than other forms of sanitation, the investment required to keep up with urban population growth may be of the order of R$ 12 – 18 billion. Finally, there is the potential cost of connecting households which rely upon cesspits to sewer systems. There were about 7.5 million such households in 2000, so that the investment required would be of the order of R$ 13 – 15 billion.

Putting these estimates together yields the following total figures.

Potential investment requirements for urban sewers, 2003-2012

Connecting households with no adequate sanitation	R$ 5 – 6 billion
Growth in the number of urban households	R$ 12 – 18 billion
Connection of households with cesspits	R$ 13 – 15 billion
TOTAL	R$ 30 – 39 billion

[7] Obligations to meet targets of 60% or 80% sewer coverage within 5 or 10 years are quite frequently specified by municipalities in drawing up conditions for private water and sanitation concessions.

[8] Again, there is substantial variation in cost estimates for wastewater collection and treatment in different regions. Some estimates are as low as R$ 900-1,000 per household, while costs in the Southeast run to R$ 2,400-2,600 per household. If land is cheap, the capital cost of secondary wastewater treatment can be substantially reduced by using aerated lagoons, waste stabilization ponds, or constructed wetlands. This is usually impractical in large urban areas so that more compact but capital-intensive technologies such as activated sludge, with high running costs and sophisticated management

There seems to be little realistic prospect of mobilizing R$ 3 – 4 billion per year over the next 10 years to implement all of the elements of such a program. To the extent that the Federal Government is able to influence the allocation of investment funds for the construction or extension of sewer systems it must be much more selective than it has been in the past. This should imply the development of clear criteria to select the projects which will be supported on the basis of their expected health, social or environmental benefits. It seems likely that a focus on areas of dense settlement where many households do not have access to adequate sanitation is likely to yield the most cost-effective improvements in health, social and environmental conditions.

Many of the residents of these areas have relatively low and uncertain incomes. The installation of better sanitary infrastructure may be of dubious benefit for them. On the one hand most of these poor residents are not informed about the benefits of such works, so that with minimal educational campaigns they might well increase their willingness to pay for having services provided. Also, there is the issue of 'social inclusion' that can be an important factor in this equation – when public authorities are seen to be investing in wastewater and drainage, and associated slum upgrading (where this is an issue) then the peri-urban inhabitants themselves tend to start to believe in the permanence of their settlement and begin to invest in their houses too. Having an address for the first time (resulting from a slum-upgrading operation), or getting a water and/or sewer bill, can be a positive factor as householders look for work, open bank accounts, look to buy goods in installments, etc. The other position, however, is the immediate economic implications of having these services provided. They may be very reluctant to pay higher water bills to cover the additional cost of a sewer connection. In addition, the structure of water company tariffs means that most companies incur a significant loss for each additional sewer customer using less than 20 or 30 m^3 of water per month. The key factors relevant to this question are:

- Detailed analyses of the efficient costs of providing water supply, wastewater collection, and wastewater treatment suggest that the long run marginal cost of wastewater collection in Brazil is typically equal to 80-100% of that for water supply. Adding wastewater treatment pushes the ratio of long run marginal costs to 100-120% for wastewater collection plus primary treatment and 120-150% for wastewater collection plus secondary treatment. These ratios are typical of the cost ratios observed in Europe and North America. However, tariffs for wastewater collection and treatment together are set in Brazil at between 70% and 100% of water tariffs. This is justified either as a cross-subsidy to encourage customers to connect to sewers or on the basis of the negative externality associated with water consumption. However, the figures imply that the costs of serving additional sewer customers will, on average, exceed the extra revenue which they provide.
- At current prices the long run average cost of providing service is R$ 1.15 – 1.25 per m^3 for water supply and R$ 1.40 – 1.60 per m^3 of water for wastewater collection and secondary treatment. However, the average tariffs paid by customers consuming less than 20 or 30 m^3 are well below these levels. The financial viability of water companies relies upon large cross-subsidies from industrial, commercial, and large residential customers to small customers. However, this structure of tariffs is already threatened by large industrial customers, who may account for 25-40% of total revenue, seeking alternative sources of water in order to avoid the very

---

requirements, or biological filter systems must be substituted. We have used costs above the middle of the range because much of the investment will be in areas of dense settlement which are often difficult and expensive to serve.

high tariffs that they are charged. It will be necessary to reconsider the structure of tariffs in order to recover the extra capital and operating costs implied by a large expansion in sewer networks and wastewater treatment. Inevitably, the average tariffs paid by most small and medium consumers will have to rise to a level closer to the long run average costs of service.

Many studies of willingness to pay for water and sanitation services have established that households are willing to pay 3% or more of their income for water supply, but rather less for sanitation. In studies where households with septic tanks or cesspits were offered sewer connections the average willingness to pay for the service was no more than 1-1.5% of income.

Consider the implication of these proximate figures for a household consuming 15 m^3 per month – equivalent to 125 litres per person per day for a family of four. If tariffs reflect the long run average cost of providing the service, the water tariff would be R$ 1.20 per m^3 and the wastewater tariff would be R$ 1.50 per m^3. At these tariffs households with an income of R$ 600 per month or more would spend no more than 3% of their income for water supply, but household income would have to exceed R$ 1,500 per month to keep the cost of wastewater collection below 1.5% of income. Using data from the 1999 Household Survey (PNAD) adjusted to current prices, about 60% of urban households have a household income greater than R$ 600 per month but only 30% have a household income greater than R$ 1,500 per month.

Social tariffs and cross-subsidies from water supply to sanitation services can expand the number of households able and willing to pay for water supply alone or for both services. But, the reality is that a substantial majority of urban households who currently do not pay for sanitation services cannot afford or see little reason to pay for these services, even at tariffs that are much lower than the long run cost of providing the service. As a result, water companies in different parts of the country report connection rates for new sewer schemes that are much less than 90-100%, so that the presumed environmental and other benefits of these schemes are not being realized.

Of course, states or municipalities can adopt regulations requiring households to connect to sewer networks that pass within 25 or 50 meters of their property. These would deal with richer households who would otherwise see no reason to convert from an existing septic tank to a sewer connection, but they are a minor part of the problem facing water companies. Such legislation may be unenforceable in many neighbourhoods. Even if it is enforced, conversion may simply lead to accelerating problems of non-payment, so water companies have no great enthusiasm for relying upon mandatory connection to new sewer networks. An alternative might be to subsidize tariffs to poorer households for some 5 years but not the investment cost of connection. Once the household has been connected for a reasonable period, it will become accustomed to the service and understand its benefits. It is, thus, more likely to be willing to pay for the service at the end of the initial subsidized period.

In summary, the investments required to implement a full program to expand sewer networks to extend existing coverage to households without adequate sanitation, keep up with urban population growth, and replace cesspits, are far beyond the financial resources available from the cash flow of water companies and potential assistance from the Federal Government. The companies should not rely upon debt finance for the construction of sewer networks because the revenues that will be generated by extending sewer networks are likely to fall short of the amount required to cover operating and maintenance costs and to service debt. Thus, all parties – particularly the Federal

Government in its allocation of financial assistance – must be much more selective in deciding what type of projects deserve support and which ones should be deferred until resources and willingness to pay for service are less of a constraint. In all cases, funds for investment should be conditional on the operator demonstrating in its current performance that it has the financial resources and operational capability to ensure that new infrastructure is managed and maintained in a sustainable manner. Grants or other assistance should be clearly linked to the achievement of clear and substantial benefits from improvements to public health or the environment.

Wastewater treatment

The conclusions of the previous section apply even more strongly to the issue of wastewater treatment. According to data from the National Information System for Sanitation (SNIS) for 2000 about 47% of all wastewater that is collected is treated. This amounts to about 21% of the total volume of water that is consumed. Standards of treatment vary widely and there is ample anecdotal evidence to suggest that a significant proportion of wastewater treatment plants are largely ineffective. This may be due to maintenance problems or because a lack of sludge disposal facilities prompts the operators to discharge sludge to rivers or other surface waters. Underlying the specific factors in each case is the broader issue that inefficient and financially pressed utilities have no incentive to maintain and operate wastewater collection systems and treatment plants for which they incur large operating costs.

The total investment required to provide secondary treatment for (a) wastewater which is currently collected but not treated, and (b) wastewater which is nominally treated but to a lower standard would be about R$ 6 – 7 billion. In addition, the wastewater treatment component of the costs of extending sanitation services discussed in the previous section would be about R$ 9 – 13 billion over 10 years.

The benefits of treating domestic wastewater – as distinct from wastewater collection and the treatment of industrial wastewater - are almost entirely environmental. An investment of as much as R$ 15 – 20 billion together with operating costs of up to R$ 1.5 billion per year should, therefore, be compared with other options for achieving better environmental quality and/or other social objectives.

The environmental benefits conferred by wastewater treatment vary greatly according to the location of discharges and the nature of the treatment provided. Few would argue that the discharge of wastewater to or near the beaches of Rio de Janeiro in 2000 caused substantial loss of amenity and, perhaps, loss of income because of damage to the city's reputation as a tourist destination. However, the reason for the discharge was that CEDAE (the state water company) was forced to shut down the submarine outfall which takes wastewater from the city out into the ocean in order to repair it. The wastewater transported out to sea does not undergo prior treatment. This has minimal consequences for the residents of the city in normal conditions. Furthermore, standard methods of treatment would have little impact on the most serious consequence of ocean discharge, which is the risk that bathing waters contain excessive levels of pathogens, since conventional primary and secondary treatment have only a limited effect on bacteria, viruses, and other pathogens in wastewater. It is possible to treat wastewater in order to eliminate most pathogens, but this can be expensive either in terms of capital costs (for land-intensive waste stabilization ponds) or in terms of operating costs (for conventional treatment, disinfection, and microfiltration).

This example should not be interpreted as implying that wastewater treatment does not

matter. Rather, it emphasizes that decisions on whether and how to treat wastewater should be based on a careful analysis of the impact of treatment on the quality of the water to which untreated or treated wastewater is discharged. In the case of Rio de Janeiro, the major environmental problems are the eutrophication of parts of Guanabara Bay, as a result of the nutrients in wastewater discharged to the Bay, combined with the contamination of bathing waters (mostly in the Bay) with pathogens from the wastewater. Careful hydrodynamic modelling has shown that wastewater treatment will have only a very small impact on both of these problems while diffuse discharges of wastewater to canals and streams on the Western side of the Bay continue. Thus, extension of wastewater collection networks will have a much greater positive environmental impact on the bay than the treatment of wastewater that is currently collected. Furthermore, in the zones where wastewater treatment might have a significant effect the analysis indicates that environmental standards should put more emphasis on indicators related to the removal of nutrients and pathogens than on organic pollutants (BOD). Yet, despite this evidence a large primary treatment plant has been built and there are plans to upgrade it to provide conventional secondary treatment.[9]

Another example concerns Manaus. It is reported that the state environmental agency is insisting that the recently privatized water company which serves the municipality should build a secondary treatment plant for the wastewater which it collects. Manaus is sited next to the Rio Negro just upstream of its confluence with the Amazon. Given (a) the huge dillution and dispersion potential provided by this river, and its associated capacity to process the organic, nutrient and pathogenic content of the wastewater itself, and that (b) the raw water supply intake for the city is upstream of the existing wastewater outfall, this treatment plant will yield no observable environmental or health benefits relative to discharging the wastewater into the main stream of the Rio Negro as is done at present. Instead, investing these funds in wastewater collection and transport in those areas of the city which today discharge their wastewater directly to the city's ubiquitous small streams/ rivers, or '*igarapés*', would bring significant local health, social, and environmental benefits to the generally poor neighborhoods in questions, since these *igarapés* are grossly polluted.

On the other hand, much smaller and/or less expensive treatment plants may have a substantial impact on river quality in sensitive environmental and ecological zones. In the metropolitan region of Recife, treatment of wastewater collected in some of the upstream municipalities in the Capibaribe basin could have significant impact on the amenity and productive value of the river. Similarly, in other localities, fisheries and recreational uses of rivers can be protected by wastewater treatment plants which are appropriately located and designed.

Much of the discussion in Brazil concerning appropriate targets for wastewater treatment seems to be based on misleading comparisons with Europe and North America. Certainly, many of the OECD countries are moving towards universal secondary or tertiary treatment of wastewater. But, this is a lengthy – and very expensive – process which represents the culmination of nearly 150 years of gradual upgrading of wastewater collection and treatment systems. Sewer networks were first installed in many European and North American cities in the second half of the 19th century. Collected wastewater was initially discharged to rivers and coastal waters. Over the next 100-150 years,

[9] In practice it would be extremely difficult, if not impossible, to remove nutrients without first removing the organic content of wastewater. Since the most relevant parameters are pathogens and bacteria, their effective removal (as well as that of Nitrogen) would require a substantial reduction in BOD levels, but not through the usual standard for secondary treatment.

preliminary, primary, secondary and – eventually – tertiary treatment was installed or is still being installed.[10] Even today there are large cities in Europe which still discharge preliminary treated wastewater (namely that which has only undergone screening and possible grit removal) directly to receiving waters.

The cost of this gradual process was that most rivers in dense urban areas were polluted by wastewater discharges. However, the water quality in many of these rivers was often already poor because of discharges of industrial effluent, so reducing pollution from sewer systems only became a priority once the problem of industrial pollution had been tackled. Even then, it will have taken some 50 years in many European and North American cities to install new treatment plants or upgrade existing ones to current standards.

This is not to suggest that Brazil should follow exactly the same path and time span as Europe and North America. It is nonetheless equally important to be realistic about the time frame that is involved in moving from a 50-60% coverage of sewer networks to, say, 95% coverage with full treatment. This is not a program for 5 years or even 10 years, but a process that is likely to take 30-50 years – i.e. longer than the life of the treatment plants that are being built today. Hence, it is perfectly reasonable from an environmental perspective to permit lesser level of treatment today, on the basis that the level of treatment will be gradually upgraded or that stricter standards will be adopted when the plants need to be modernized or replaced in 20-25 years from now.

It should also be recognized that the institutional problems that stand in the way of effective maintenance and operation of treatment plants have been and in some cases remain equally important in many OECD countries. So, this report's emphasis on the importance of addressing problems of operation and maintenance before spending large amounts on new infrastructure reflects a common experience in rich countries as well as in Brazil and many other middle income countries.

As a first step towards a more efficient use of Federal resources, the Government has initiated through ANA a pilot program which establishes the principle of payment by results in the area of wastewater treatment (*Programa Compra de Esgoto*). Until now, the Government has provided capital grants or low interest loans to finance investment. This encourages a transition from capital intensive projects that are often badly managed, to an approach in which payment is based upon results achieved in wastewater treatment. The pilot program provides payments for achieved reductions in discharges of wastewater over a period of 5 years. The level of the payments is set so as to reimburse up to 50% of the capital cost of the project over this period. Thus, elements of a capital grant remain but project sponsors have a stronger incentive to adopt low cost methods of reducing pollution and to ensure that their plants continue to operate in accordance with the original design specifications. The problem of the credibility of the Government's commitment to make recurrent payments for pollution reductions is dealt with by putting the total sum committed into an escrow account at the time when the commitment is made.

With some modifications this pilot program could provide a framework for the allocation of Federal support for wastewater treatment and other infrastructure intended to improve water quality. These adjustments might include:

- An extension of the period over which

[10] The wastewater treatment plant that is planned for Brussels, the capital of the European Union, will not be fully completed until 2003-2004. Until recently most of the wastewater collected in Brussels was transported away from the city and discharged without any kind of treatment.

payments are made to the project sponsor from 5 to 10 years to reinforce the importance of good operational performance.

- The adoption of weights for reductions in discharges based on an assessment of the benefits of improving water quality in different locations. The weights could depend upon (a) the impact of a reducing discharges of BOD by, say, 1,000 tonnes per day on water quality downstream of the discharge; (b) the gap between actual and desired water quality based on the water quality targets for the river; (c) the number of people who would benefit from the improvement; and (d) the extent to which the segments of the river affected by current discharges are important for recreational users or for other health, social and environmental reasons. These weights would be an approximation to a set of environmental values for improvements in water quality. It is, nevertheless, not necessary to go as far as putting monetary prices on environmental benefits. What matters is that the weights should reflect a reasonably consistent set of priorities.

- The consideration of pollutants other than BOD such as nitrogen or phosphorus in river basins or coastal regions where eutrophication is a matter of concern, and of pathogen where recreational use such as bathing is an issue.

In the longer term, the Federal Government may wish to consider whether the scope of the program could be extended to provide incentives for companies or other agents who are able to reduce discharges by methods that do not rely upon the installation of treatment facilities or other end-of-pipe controls. In its current format, however, ANA has opted for a simpler model, which is perhaps a sensible approach, and a good way to launch the program.

Improving operational performance

There is little point in making large investments in water and sanitation infrastructure if the networks and plants are not operated or are utilized at below their design levels. Low levels of utilization are characteristic of much of the water and sanitation sector in Brazil. One estimate provided during this study was that only about 20% of the installed nationwide treatment capacity is being used. This is consistent with estimates from Mexico, where a figure of 18% was estimated, and from a sample of Chinese cities where the figure was 25-30%. Few of the treatment plants built during the course of the projects examined in the next section operate at more than 50% of their capacity and most operate at one-quarter to one-third of their intended capacity.

A part of the problem is poor planning. There are dozens of examples of wastewater treatment plants which were completed years before the sewer networks which they were intended to serve. In other cases, disputes about access and other problems have delayed the construction of the interceptors which should transport wastewater that is being collected to the treatment plant(s). However, there is a more serious underlying problem. Over the last decade the Ministério Público, supported by state environmental agencies and based on existing State legislation, has gone to court on a number of occasions to block the issuance of operating permits for new sewer networks if the wastewater to be collected is not to be treated from the time when the sewer networks start functioning. In a few cases, the action was intended to oblige the water company to construct a wastewater treatment plant when none had been planned. But, more often, the issue at stake was whether the sewer network could be used before the completion of the associated wastewater treatment plant. The position taken by the environmental authorities has been that it cannot, perhaps because they believe that without such

pressure the water companies will indefinitely delay the construction of wastewater treatment plants.

Even as part of a strategic game between the water companies and environmental authorities, the actions of the environmental authorities result in a huge waste of resources and, on balance are probably harmful to the environment. There are substantial economies of scale in the construction of wastewater treatment plants, so it is normal for plants to be built with a design capacity to handle the volume of wastewater expected 5 or 8 years after completion. But, in the face of long delays in the construction of sewer infrastructure and large uncertainties concerning expected rates of connection, the environmental authorities are effectively forcing water companies to build over-sized treatment plants well before there is any established requirement for them. So scarce investment resources are committed to treatment plants that are bound to be under-utilized for many years, while there are insufficient resources to finance the extension of water or sewer networks in areas where these may have a major impact on public health, on the quality of life of the poor, and on the improvement of the immediate environment in which people live. The choices are further complicated if there are legal requirements for treating collected wastewater.

This is just one example of the extent to which the 'regulatory framework' for water and sanitation has lost sight of the social and environmental objectives of policy. By focusing exclusively on the enforcement of emission standards, the environmental authorities are neglecting their broader responsibility to work with other sectors to develop, implement, and enforce if necessary, programs that reduce pollution and improve the environmental quality of life enjoyed by the population.

Similarly, the water companies should not be regarded as innocent parties in the current situation. A major reason for the actions of the environmental authorities is the often blatant disregard of environmental permits and other regulations by many water companies. The regulators have little confidence that the companies will comply with the agreements that allowed them to collect wastewater as soon as networks are completed, on the basis that treatment will commence within 1 or 2 years.

This combination of poor operational performance and a lack of trust between parties is bad for all of those involved. The next section of this report outlines some ways in which the focus of environmental policy could be improved. Progress also depends upon tackling the widespread problems of water companies in Brazil in maintaining the operational performance of their systems. To achieve this it is crucial to examine and correct the incentives – or lack thereof – which encourage the poor operational performance and the neglect of maintenance of both water and sewer systems.

Many state or municipal water operators in Brazil are unable to provide uninterrupted service 24 hours per day throughout their service areas. Yet in every case where a private operator has taken over a system previously operated by a state or municipal company, the new operator has been able to ensure reliable service within a period of 6 to 12 months. Equally, there are public companies in Brazil and other countries which are able to sustain a good level of service for their customers. In all cases, the key is good operational management, requiring simple attention to detail, combined with the application of small amounts of investment which should be well within the capacity of existing operators to finance.

The World Bank experience from numerous projects around the world and in Brazil suggests that providing technical assistance and investment resources is rarely sufficient to achieve a sustained improvement in service delivery

performance as long as the incentives facing public sector operators remain unaltered. Hence, the critical issue is how to alter the incentive framework under which service providers operate so that good management practices are promoted and rewarded. Just as importantly, operators must be protected from political interference in their technical and managerial decision-making.

One option is to contract with a private sector operator. However, the success of private sector participation will depend on the quality of the contract, the transparency of the bidding process, and the clarity of the legal and regulatory framework within which the service provider will be operating. The latter factor determines the level of risk that the private operator perceives and, consequently, the price that the operator will charge for providing the service. The reality in Brazil today is that the regulatory framework is unclear and progress in adopting regulatory reforms is likely to be slow, so that private investment in the water sector will be limited.

The majority of state and municipal water utilities will remain public companies for some time, so that other changes in the incentive framework are required to promote efficient service delivery in the short to medium term. The state of Paraná has followed the route of selling a significant number of shares to a strategic private sector partner. This allows private sector expertise to be brought to bear on a public company's management. Another approach is to tie investment funds to improvements in key operational and financial performance indicators, as proposed under the World Bank's PMSS2 Project.

The goal is to identify and implement the structural changes necessary to correct the incentives which allow or encourage poor operational performance in existing companies. This involves:

(i) reviewing the relationship between (public or private) service providers and the public authorities (*poder público*), so that it becomes a contractual relationship with clear roles, responsibilities, performance targets, etc., and which is competently regulated;

(ii) providing federal and state investments only for companies that have demonstrated efficiency in operating existing infrastructure and only for municipalities/states which have demonstrated their desire to seriously reform the sector institutional/regulatory framework, and implement real changes through regulatory control and enforcement, in order to promote efficient service delivery; and

(iii) working with customers so that they appreciate that by paying their bills they have consumer rights with regard to decent WS&S services.

The pay-off to ensuring reliable water supply is large because it greatly reduces the long term damage to water systems which is caused by the pressure changes associated with interruptions in supply. Furthermore, it avoids the contamination of water supplies by back-siphonage during such pressure changes when there are leaking pipes in areas polluted by cesspits, septic tanks or wastewater lines. Sewer networks, pumping stations, and wastewater treatment plants can equally suffer long term damage from inappropriate operation and a lack of preventative/curative maintenance. Also, since wastewater collection, transport and treatment is usually undertaken by the same entity that supplies water, if the water supply system is not being properly operated, and is not providing the appropriate revenue, then the wastewater systems are likely to be suffering from disproportionately worse operation and maintenance. Customers will complain immediately about interruptions in water supply services, whereas wastewater collection and treatment can be ignored continuously by utilities with no public reaction. Wastewater systems are hence treated as poor relatives of water supply systems, and are the

first to which a 'blind eye' is turned by the operator.

Similarly, there are frequent examples of wastewater treatment plants whose removal rates for BOD and other pollutants are far below design standards and which discharge effluent at far greater concentrations than permitted by their environmental licenses. There are many plants in Brazil where activated sludge tanks are bypassed or the aerators in aerated lagoons or oxidation ditches are switched off, in order to reduce operating and maintenance costs, particularly electricity bills. Other plants are unable to handle and dispose of their sludge properly. The net effect is that such plants provide no effective treatment and may, indeed, discharge effluent that contains more concentrated organic matter and nutrients than in the raw wastewater. Such plants simply represent a waste of capital and operating expenses and provide none of their intended environmental benefits.

A wastewater treatment plant in Recife is a case in point. The plant was built in the 1970s but is not functioning properly. The operational problems are linked to the inability of the utility, Compesa, to run the plant properly as well as the lack of incentives (for the operator, for the conceding power, etc.) to change this situation. When the plant was visited a couple of years ago it was found that:

- the pumping/lifting stations that feed wastewater to the plant were mostly not working due to ineffective maintenance (pumps burnt out, rising mains leaking, etc.);
- the plant's biofilters were allowed to deliberately flood by the operators to discourage the swarms of flies that would otherwise be attracted to the 'dry' filters – this was done to improve the working conditions of the plant operators, but renders the biofilters largely ineffective in treating the wastewater;
- the secondary sedimentation tanks were being bypassed and the partially treated wastewater being discharged straight to the river, because the tyres that allow the scraper arms in the sedimentation tanks to rotate were blown out (they probably cost some US$50-100 to replace); and
- the anaerobic sludge digestors were not functioning because they had been allowed to 'grit up' over the years, and the working volume had been compromised (such degritting was designed as a manual activity which had not been undertaken).

This example illustrates that most of the problems were operational in nature and had nothing to do with investment in additional plant or treatment capacity.

It is critical to tackle the problem of the operational performance of the water and sanitation sector. Until this is done the economic, social and environmental benefits of new investment will remain extremely low. Indeed, a strong case can be made for withholding all financial assistance for investment from any water company which fails to meet certain goals for its operational performance. As mentioned above, this approach/incentive structure is central to the logic behind the Bank's PMSS2 Project, which allows for different levels of investment to be made in utilities as long as, either, certain operational or financial efficiency gains are made, or reforms are made to the legal and regulatory framework and private sector participation is promoted.

4

Environmental management in the water sector

Water resources and environmental issues are closely interrelated and, in theory at least, inseparable. Although water-related matters worldwide have substantial impact on the environment, water resources management has traditionally fallen within the remit of water agencies, while environmental subjects are dealt with by separate environmental bodies. These organizations have little incentive to work together to ensure efficient use of resources and simultaneously to pay due attention to environmental concerns.

Water agencies need to ensure that water resources are allocated efficiently among competing users in a given water basin. Standard economic principles determine that efficient allocation occurs when the marginal net benefits among all users are equal, while making allowances for seasonal variations (e.g. supply scarcity). This approach tends to focus on water availability as the main deciding factor, regardless of water quality or the effects of water abstraction on the ecosystem and the aesthetics of a given location, as well as on activities ranging from fishing/fish spawning and shipping to recreational pursuits.

The water supply and sanitation sector follows a similar pattern. Water companies in Brazil, mainly State-owned, establish targets for water supply, wastewater collection and sewage treatment in line with their own financial capacity or on the basis of regulations and standards laid down by outside regulatory bodies. Performance therefore largely depends on the institutional structure and especially on the degree of regulatory independence governing the sector. Brazilian state water companies have enjoyed a long history of independence from outside regulation and have thus been able to define their own targets for wastewater collection and treatment levels. Meanwhile, state environmental agencies have the power to block certain developments but little or no capacity to promote investment and identify other measures to improve water quality. As a result, resource allocation tends to be driven by technical considerations rather than any coherent strategic plan.

State environmental agencies should have the power to ensure that water resources agencies and water companies are fully apprized of the impact of their decisions on water quality. Unfortunately, they lack the political support and the resources needed to carry out this responsibility, the net result being that they tend to focus narrowly on emission standards rather than on the quality of the receiving water bodies. Their ability to influence strategic issues is also severely restricted by their failure to establish effective mechanisms for (a) monitoring water quality and polluting discharges and (b) enforcing

license and permit conditions, particularly those involving the state water companies.

The problems encountered by environmental agencies in developing a sound approach to water quality reflect broader questions of environmental management in Brazil. Substantial public, political, and legal support exists for reducing pollution and improving environmental quality. However, this is not based on a comprehensive understanding of, or consensus about, the trade-offs between economic costs and environmental benefits. The upshot is that, since the various environmental authorities have no direct responsibility for financing implementation, they tend to adopt legislation and promulgate regulations that set unrealistic goals and unenforceable standards.

The courts, at the behest of the Ministério Público, are obliged to accept these goals and standards as legally binding. At the same time the courts are unable to mediate constructive, practical solutions or to oblige state authorities to finance the means for ensuring compliance with the standards imposed. The resulting overall picture is one of strict environmental policies disconnected from the performance of much of the water sector but which can seriously impede the adoption of cost-effective methods for improving environmental quality.

The costs of degradation of surface waters and underground aquifers are not widely realized. They include the short-term, reversible impact of degradation (amenity, increased water supply costs, reduction in fish population) and longer term largely irreversible effects (loss of ecosystems, accumulation of toxins, etc.). The role of the various government authorities concerned is to (a) assess the costs; (b) define priorities for damage reduction; (c) allocate responsibilities for addressing priorities; and (d) establish an appropriate framework of financial support and incentives to ensure implementation of the measures required.

The lack of a consensus about the benefits of improving water quality in relation to other social objectives is especially notable in the case of water companies. There are strong and understandable pressures to hold down water and sanitation tariffs. However, tariffs calculated to satisfy social and political objectives or charges that can be afforded by low income households may be too low to finance investment in wastewater collection and treatment. This problem is compounded by the inefficiency and poor performance of many of the country's state and municipal water companies. Nonetheless, the trade-off between setting tariffs to meet social goals and ensuring the financial sustainability of water companies would not be an issue if these companies were better managed, both by the public sector or through the introduction of private participation.

Managing water quality

Water quality targets are the key expression of public objectives for environmental management in the water sector. Such targets should reflect the various environmental, social, and economic factors involved. This inevitably involves consideration of resource constraints and environmental priorities, and should take into account public and political choices about the relative importance of competing goals. Once defined, these targets need translating into measurable indicators that can be used by those responsible for the day-to-day decisions regarding project selection and operational management, as well as by those charged with the enforcement and monitoring of compliance with the agreed goals.

What emerges strongly from the analyses undertaken for the present study is the lack of clarity and consistency concerning the objectives of those agencies with responsibilities for the management of water quality. Unsurprisingly, it follows that complex projects or resource allocation mechanisms appear to be poorly designed and insufficiently coordinated.

Before entry into force of Law 9433/97 establishing water management by river basin committees, all Brazil's rivers were deemed to be classified according to target quality levels. The latter was based on existing or projected uses, environmental conditions and other factors. This classification is obviously crucial from the environmental point of view, informing water users of the objectives to be achieved by controlling discharges. Environmental quality targets are in effect more important than specific emission standards, which should be employed only as part of the endeavor to achieve environmental quality. The practice has however fallen short of the theory in the case of Brazil.

The state environmental agencies are responsible for classifications which in turn are subject to CONAMA Resolution 20. "By default", all rivers are in principle classified as "Class 2". With the exception of a few rare cases, no rivers in Brazil have been subject to a serious analysis of desirable quality levels and compliance costs. Furthermore, no external institutions have been set up to undertake or participate in such analyses. Classification has been substantially based on unilateral assessments by the environmental agencies, with minimum consultation with those affected regarding, for example, their funding capabilities.

Environmental agencies have chosen to focus on emission standards - simpler to establish and more easily monitored. The emission standards appear to be unrelated to environmental quality objectives and are applied with no consideration for the impact of existing discharges on the quality of receiving water bodies. In many cases, the result is severe pollution caused by existing discharges, even where emissions standards are applied to new sources. In others, stringent treatment standards are required when there is little or no environmental and/or social justification for them. This is the core of the problem arising from sub-optimal economic allocation of resources.

The quality of many water bodies falls well below that of their nominal classifications. This gives rise to:

- inconsistencies encountered in the various classifications, in environmental licensing, and in the awarding of permits (new enterprises continue to be awarded licenses on the basis of emissions standards, even when the receiving water bodies do not meet the relevant standards)[11];
- reluctance to negotiate phased programs to reduce existing discharge levels;
- difficulties encountered by enterprises and environmental authorities in defending negotiated solutions if these are challenged in court by the Ministério Público or others; and
- a general lack of credibility of the entire scheme governing water quality targets.

With the adoption of Law 9433/97, which instituted the National System of Water Resources Management, and is embodied in complementary legislation[12] of the different states, the subject of classification of water bodies has stimulated more vigorous debate. Within the new legal framework, classification is intended to embrace environmental goals regarding both quantity and quality, linked to a water resources plan for a given water basin. This plan aims to incorporate a workable financial framework which also takes account of, *inter alia*, fees charged for water use and discharges. The aim is for the initial proposals for water resource plans to be drawn up by river

[11] It is not uncommon for the standards governing concentrations of pollutants to be lower than the quality of the water in the river receiving the discharge.

[12] At present, 19 states and the Federal District are regulated by the legislation. The states not included are mainly those in the North where water resource problems differ substantially from the other states given the abundant water resources in the Amazon region (the Amazon basin accounts for 80% of the country's freshwater resources).

basin agencies before review and/or amendment by river basin committees. This consultation/ negotiation arrangement should forge a consensus on objectives and responsibility-sharing and thus endow the agencies responsible for the granting of abstraction or discharge licenses with a degree of legitimacy.

Brazil's river basin committees will be eventually responsible for agreeing on acceptable levels of pollution. This will involve balancing the various interests of water users (including those of the general population) with environmental concerns. Agreement reached on the basis of discussion among different parties will hopefully reflect a balance between the costs and benefits of water quantity/ quality goals, water allocation arrangements, and the requirements of the beneficiaries and purchasers.

The new system, supervised by ANA, is a key step towards the integration of environmental issues with traditional arrangements for water allocation. One aspect of ANA's approach is to make water quantity and quality commensurable, by assessing polluting discharges in quantity terms (by calculating the flow of water required to dilute the discharge) so that the quality of the receiving body remains within the range of concentrations consistent with the water quality classification and any downstream uses. Effluent discharges may thus be regarded as pre-empting a given flow in order to maintain water quality. In short, the new system gives formal expression to the intuitive notion that river flows must be maintained in order to dilute wastewater discharges in urban or heavily industrialized areas. Initially, the calculation of the diluting flow focuses on levels of BOD, but it can be extended to encompass a range of pollutants.

The crucial additional step is that ANA envisages that those responsible for effluent discharges must acquire water rights/permits for a flow not less than the diluting flow calculated in the above manner. While this proposal is naturally being strongly resisted by those who have hitherto enjoyed free rights of effluent disposal, it is wholly consistent with the new approach, providing appropriate incentives for the reduction of the concentration and/or volume of discharges. If eventually widely accepted and implemented, it will transform the basis for managing water quality in Brazil.

A substantial investment in monitoring and data analysis linked to permits enforcement will be required. Many irrigation intakes, small hydroelectric plants and wells operate with no authorization or registration. Waste discharges are rarely monitored, and untreated urban and industrial effluents are commonly released directly into rivers and lakes. The degradation of environmentally sensitive areas, such as the Pantanal, by non-point source pollution is also a growing concern. In the coastal areas of the Northeast, strategically located aquifers are being contaminated and/or rapidly depleted. Rather than monitor users and discharges to safeguard against subtle but obvious forms of contamination, public agencies tend to react only to high-profile accidental spills. If the attitudes governing this kind of *modus operandi* fail to change, the new framework will be undermined by a lack of credibility in those responsible for overseeing its implementation.

The institutional framework for water quality management

Despite proposals for joint action at state or local level between those engaged in water resources management and practitioners in the environmental field, existing links are still in their infancy. Conflicts have arisen when various agencies make different requirements and demands on those seeking environmental licenses and/or authorization to abstract water or discharge wastewater. The challenge is to minimize or eliminate such conflicts within a framework consistent with the national water resources policy and state legislation. Cooperation between

resources management and environmental agencies has been encouraged mainly in the states of São Paulo and Paraná.

The new system of water resources management prescribed under Law 9433/97 is based on river basin management. This foreshadows greatly improved co-ordination between the various sectors and institutions. The river basin committees possess adequate mechanisms for resolving conflicting demands on water resources, including environmental ones. Since the system is still evolving, its strengths and weaknesses are difficult to assess at this stage. As can be expected, the basin committees appear to be most active where there are significant issues to be resolved.

The river basin committees and agencies should not be seen as a panacea to solve all the problems associated with previous structures and arrangements. Environmental agencies and those responsible for water resources will continue to perform their essential regulatory functions of licensing and authorization.

Not surprisingly, the issue that is causing the most difficulty is the financial dimension of river basin management. Since the costs and benefits of managing water quality often fall on different users, a key question for every river basin organization is how to finance improvements that yield benefits that are widely distributed. Arrangements for financial transfers often make economic sense but are difficult to introduce, particularly when several jurisdictions are involved. Moreover, it is easier to introduce levies on water users when the benefits of better water management are visible. The main problem is how to finance the necessary technical studies, together with other initial investments, before a case for providing adequate finance for river basin management has been made. ANA is able to provide some support to river basin committees, but the ongoing debates about charges for water use in different basins reflect the difficulties involved in identifying suitable transfer mechanisms.

The bulk of the resources for implementing river basin strategies will be provided by the principal user sectors – water and sanitation, energy, and large industrial companies. These may be supplemented by (a) income from charges for water abstraction and effluents discharge, and (b) limited budgetary support from the Federal Government, states, and municipalities.

Integrating programs and projects

Until the early 1990s, water projects in Brazil were sector-based, dominated by infrastructure engineering. Institutional considerations were generally confined to operator performance and/or the fine-tuning of the instruments for recovering costs. Environmental questions were limited to specific environmental licensing arrangements, based on emissions standards for enterprises[13].

More recently, as concerns for a more holistic approach to the problems have grown, efforts have been made to develop integrated projects. The main aim of these projects is to bring about a sustainable improvement in the quality of life, in its broadest sense, in the catchment areas or sub-basins. But, as complex projects with a variety of broad objectives, they have proved difficult to implement. Criticism has for example been leveled at the "overloading" of the capacity of the implementing agencies and the "Christmas Tree" approach - weighing down different agencies with too many unrelated responsibilities. A key question is therefore how best to manage such multi-sectoral and multi-agency "integrated" projects to justify the complexity of the entire coordination effort, and how they can focus better on genuine environmental priorities.

[13] The representative case is Loan Agreement no. 3102-BR, a sector loan for the Sanitation Company of the State of São Paulo – SABESP.

The key objectives and components of the projects reviewed for the present study are summarized in the Annex. It became apparent in the course of the review that the projects were designed to address a range of goals of varying complexity, incorporating components from several different agencies. All of them possessed institutional capacity and policy development goals, together with physical and operational objectives. All of them, despite certain deficiencies, appear to have been broadly satisfactory. This study also took into account ICRs available for two projects[14] and anecdotal evidence obtained during field interviews. It does not attempt a detailed performance analysis and project comparison (although such an analysis might be worthwhile, particularly as regards the implementation lessons and the organizational learning – both of the clients and the Bank). Some emphasis was given to understanding the operations in the State of São Paulo where the World Bank and the IDB have been involved with the sector since the late 1980s and are now considering "third generation" projects. Consideration of the objectives and outcomes of the set of projects suggests a number of broad findings:

*A. **Institutional Questions.*** Looking back at the appraisal documents, the experimental nature of the programs can be seen as attempts to bring together concepts and methodologies that were not consolidated at the outset. In addition, extremely ambitious institutional goals were set. For example, the basin agencies and the charges for water use were to be implemented in Guarapiranga, Alto Iguaçu, and Arrudas/Onça over the short space of three years. In reality, ten or more years were needed for the management systems to come on stream, which meant that a long delay was incurred in introducing charging for water use – and in some cases these institutional and legal reforms are still pending. Paradoxically, the tenacity with which the objectives were followed made it clear that long-term goals were needed to produce the institutional development that can be observed today. Furthermore, it is important to consider the institutional capability of the executing agencies. This was seen as a constraining factor given the level of complexity demanded by the programs, and although the projects involved an institutional reinforcement component, the difficulties of managing the experimental programs clearly show that inter-institutional rivalries cannot be discounted[15], even when the executing agencies are strongly supported by specialized consultants.

Concern over institutional arrangements needed to go hand in hand with that regarding potential sources of financing, in order to eschew dependence on transfers from state or municipal governments and to attract private capital. In general, the programs improved absorption capacity, cost-effectiveness and the quality of the receiving bodies. However, little attention was given to achieving broader social returns, in contrast to the more recent case of the Guarapiranga Project, where much attention was given to such broader social returns in terms of slum urbanization, resettlement, improved and expanded basic infrastructure, and of community infrastructure (parks, community centers, etc.).

*B. **Need to Focus on Specific Areas.*** The chances of success of integrated projects are improved when they focus on a specific geographical area and when the broad

[14] Loan 3102-BR: Water Supply and Sewerage Sector Project in São Paulo (1989) and Loan 3554-BR: Minas Gerais Water Quality and Pollution Control Project (1993).

[15] The internal difficulties and lack of incentives for the World Bank to undertake collaborative projects itself across internal units and departments should also be viewed in this context.

objectives of all the parties involved happen to coincide. In poor urban areas, environmental problems of drainage, solid waste, and sanitation overlap and certainly need to be addressed in an integrated way. In this respect, concentrating on specific geographical areas appears to be one practical way towards finding common objectives.

In Minas Gerais, the objective was to improve the urban waterways and adjacent areas. The project management unit came from outside the implementing sectors and was thus able to focus on the overall goal. In Guarapiranga, the main purpose was to upgrade the "informal areas" so as to protect the water quality in the reservoir and thus ensure a reliable water source for the metropolitan area. In this case, the implementing agencies, including the State Water Agency (SABESP) and the Municipality of São Paulo, possess strong technical capabilities as well as common objectives – further degradation of the reservoir would have imposed substantial additional operating costs on SABESP, while the Municipality's aim was to find ways of dealing with the impact of continuing migration to the metropolitan area. In the two cases, an integrated approach was the only practical way to achieve institutional and operational objectives.

C. ***Incentives for the Implementing Agencies.*** Issues falling within the mandate and competency of a single agency call for focus on a single clear goal. The Water Sector Project in São Paulo was designed to improve SABESP efficiency in providing water and sanitation services. The project successfully strengthened the agency - the largest in Brazil and acknowledged as one of the better performers. However, when the project goals expand beyond the mandate (or area of interest) of the implementing agency without providing incentives for the agency to become involved, problems can arise. Many of the difficulties encountered in achieving the objectives of the Guanabara Bay Project – PDBG – occurred because the main implementing agency (CEDAE) omitted to internalize those objectives, tending instead to focus on those components and activities which were of most interest to it. Unlike the case of the Guarapiranga Reservoir, where SABESP had a real stake in the water quality, the clean-up of Guanabara Bay is of little direct relevance to CEDAE, beyond the support it provided for constructing wastewater treatment plants.

It is useful to review the objectives, preliminary results, and implementation incentives of three major projects[16] – (a) the Basic Sanitation Program for the Guanabara Bay Basin (PDBG) in Rio de Janeiro, (b) the Tietê River Cleanup Project in São Paulo, and (c) the Environmental Sanitation Program for the Metropolitan Belo Horizonte (PROSAM) in Minas Gerais.

In the case of the PDBG, CEDAE as a state water and sanitation company was left with the responsibility of dealing with matters which fell outside its remit, although there were no incentives for the company to do so. Unlike SABESP, which directly benefits from the maintenance of good water quality in the Guarapiranga reservoir, CEDAE is not overly concerned about improvements to the water quality of the bay. This is true at least in terms of its fundamental responsibilities of water supply and/or revenue generation. As for pollution control, the environmental agency FEEMA had been mandated to control industries and was allocated specific funds to improve enforcement. Meanwhile, urban discharges remained the responsibility of CEDAE, which

[16] Also see the Annex for a short description of these projects

paid scant attention to FEEMA regulations and standards, in the absence of the likelihood of rigorous sanctions. CEDAE was therefore in a position to decide its strategy for dealing with urban discharges without interacting with other agencies, except insofar as it was obliged to respect the agreements covered by the IDB-financed project. Despite evidence that some of the proposed wastewater treatment measures foreseen in the project were technically weak, CEDAE has been reluctant to reconsider its strategy. CEDAE continues to follow its own traditional approach to sewerage collection and treatment, frequently incurring unnecessary costs and on occasions worsening, rather than improving, water quality in the bay.

A number of high-profile negative consequences have been registered, including:

- The solid waste treatment plants have effectively been abandoned;
- The large Alegria wastewater treatment plant (WWTP) is functioning well below project capacity, owing to the difficulties in installating trunk sewers in urban neighborhoods. The upgrading of this plant to secondary treatment is being planned for the next phase of the Program, but no increase in tariffs is foreseen to cover the costs involved;
- The CEPT (chemically enhanced primary treatment) plant is operating at half of its nominal capacity owing to problems in making domestic connections. CEDAE has no agreement with the municipalities of Baixada Fluminense to collect and treat sewage discharges which means that investments are being made there with no guarantee on returns;
- The secondary treatment plant in São Gonçalo (on the East side of the Bay) with a nominal capacity of 780 l/s has been operating with 280 l/s, due to construction difficulties encountered in carrying out domestic connections and to the unwillingness of the local population (among the poorest in the metropolitan region) to pay for wastewater collection.
- The most successful component of the Program has been the construction of a submarine outfall linked to the Icaraí WWTP to transport effluent out into the Bay, thus protecting nearby bathing beaches.

PDBG, which was initially foreseen as a sanitation project with a social objective - focused on improving the life quality of the user population through provision of a sewer network - has become increasingly focused on the construction of large treatment stations using conventional technologies. Unfortunately, little contribution has been made to reducing the environmental problem of the receiving water body. The project was originally negotiated without sufficient involvement by the municipalities which effectively obliged the state government to assume exclusive responsibility for it. This has been the root cause of the problem - an integrated sanitation project definitely calls for close involvement by local governments and local populations.

The IDB's Tietê Project can on the other hand be termed a large conventional sanitation project. The first stage of this project favored the construction of large treatment plants, along the same lines as the PDBG. In the event, the waste water treatment plants (WWTPs) constructed in the Tietê Project also operate below the nominal capacity because of difficulties in transporting the wastewater to the new WWTPs. There is clear evidence that the primary objective of the project was confined to meeting state legislation that demands a minimal level of treatment for municipal sewerage, without considering goals specifically related to improving the quality of the receiving water body.

Another weakness of the wastewater treatment systems is related to the treatment and the disposal of the sludge, screening and grit resulting from their operations. Although efforts are in train to find a technically and economically viable solution to the problem, there is little clarity about current practices for disposal of sludge generated in SABESP's wastewater treatment works.

Given the delays in collecting and transporting wastewater before entering the treatment plants, the second phase of Tietê Project is primarily aimed at achieving full utilization of the capacity of the WWTPs constructed in the first phase. This will be achieved through extending the network system of interceptor and trunk collectors and improving the collector network, together with detailed *in situ* investigations in order to detect and impede inflows and clandestine connections.

An institutional component will support the continued modernization of the company, including the establishment of a geographic information system. It will also include a financial study for calculating necessary tariffs and marketing studies that seek to identify new markets for the company, since the industries with a large demand for treated water are interested in establishing premises outside Metropolitan São Paulo or have resorted to installing their own groundwater supplies.

Although the environmental goals lack clear definition, the second phase of the Project seeks to adopt the format of a genuinely integrated project, with more wide-reaching objectives from the point of view of financial and social sustainability and fewer ambitions in terms of construction projects. The second phase of this project can thus be viewed as a complement to the first, aiming to define a more sustainable direction by focusing more substantially on indicators of public health and environmental quality - both of which should serve to demonstrate the project's achievements.

Finally, in Minas Gerais, the one major "failure" in an otherwise successful project was the exclusion of two large treatment plants, mainly due to lack of counterpart funds from the State and the two municipalities involved (Belo Horizonte and Contagem). This absence of funds was not unexpected but in the event was fortunate. The project contracted a team to carry out a cost-benefit analysis to decide whether or not a treatment plant would be justified and to examine an appropriate level of treatment. The study revealed that the downstream benefits would be minimal given the small size of the population in communities in the area up to 50 km downstream affected by the wastewater discharge. All these communities had either alternative, non-polluted sources of raw water or treatment plants that could easily handle raw water of equivalent quality as that in the river without the wastewater treatment plants. Finally, the study concluded that the net benefits of the project would be much higher if the funds allocated for the treatment plants were used instead to (a) extend coverage of drinking water supply to the entire Metropolitan Region of Belo Horizonte, and/or (b) extend the sewer coverage in poorer neighborhoods.

This illustration demonstrates the importance of the political and institutional context in environmental infrastructure investment decisions. Both the State and the municipal governments in Minas Gerais agreed to re-allocate the project funds from the wastewater treatment plants to the expansion of the sewer network, with the option of installing the two treatment plants originally contemplated in the project at "some later date". Using State funds, COPASA then decided to go ahead with both treatment plants. A primary treatment plant has already been inaugurated at Onça – treating 65% of the wastewater – and another at Arrudas is nearing completion – treating the remaining 35% of the wastewater. Projects to upgrade both plants to secondary treatment have been prepared or are underway.

There would appear to be three reasons why COPASA has made these investments in wastewater treatment plants with minimal resultant economic benefits. All reflect the intractable incentives created by poor charging mechanisms and institutional arrangements:

- COPASA faces extensive legal action challenging its right to charge "wastewater fees" without treating the wastewater;

- COPASA has to renew its concession agreement with the Prefeitura of Belo Horizonte for water and sanitation services. The revenues from wastewater collection alone in Belo Horizonte represent 20% of all COPASA's income. Thus, COPASA is concerned that its concession may not be renewed unless it is seen to invest in these services – in other words the construction of wastewater treatment plants is a visible sign of its commitment, although the plants make little economic sense.

- COPASA is also concerned that industries that are charged heavily for "wastewater services" may simply discharge their effluents to storm water drains if the wastewater that it collects is not treated.

The general lesson to be learned from the above is that perverse incentives give rise to inefficient and economically unsustainable outcomes. In the latter case, the problem mainly derives from the consistent failure of the water companies to adopt tariff structures which clearly differentiate between tariffs for wastewater collection and those for wastewater treatment. The companies would be in a better position to explain and defend their sewerage charges if they made efforts to identify the costs involved in each activity and then charge tariffs for wastewater treatment only in municipalities where most of the wastewater collected is actually treated. Furthermore, the tariffs for wastewater treatment should vary in accordance with the level of treatment so that municipalities and their customers are left with a clear understanding that there is a real cost to insisting on higher levels of wastewater treatment. If the population is willing to cover the costs of treatment, such tariffs would provide a clear incentive for water companies to expand their treatment systems and operate them efficiently, allocating the extra revenue specifically for this purpose.

5

An integrated approach to water quality

The preceding sections have reviewed aspects of the water resources, water and sanitation, and environmental sectors which influence their performance from the perspective of their role in the management of water quality. In each case, the sector's investments and performance have a major impact on water quality in particular river basins or coastal zones but this is barely reflected in the criteria which shape priorities and the allocation of resources. Instead, each sector tends to focus on inputs – dams, irrigation infrastructure, sewers and wastewater treatment plants, emission standards, etc. – rather than their impact on water quality, health, quality of life, or other relevant outputs. What has been lacking is any kind of integrated approach to the assessment and management of water quality, taking account of the overlapping interests of water users and those who discharge to rivers and other water bodies.

In this concluding section, we will (a) highlight a number of consistent themes which have emerged from our review of the individual sectors, and (b) outline an agenda that focuses on the development of an integrated approach to water quality. The themes are familiar from other analyses of infrastructure but they bear repeating because they are so critical to understanding the steps required to improve both performance and outcomes.

A. Incentives and regulation

Both policy and major investment projects are characterized by a failure to establish a coherent set of priorities and pursue them on a sound basis. To some extent this is an unavoidable consequence of the need to build coalitions of support, but all too often the lack of clarity about priorities and objectives reflects an approach that focuses on building something, even anything, rather than designing measures to attain particular goals. Underpinning this approach is a system of political and economic incentives that emphasizes public expenditure and investment without proper regard to the benefits actually generated by policies or investments (rather than those which may be promised).

The 'Compra de Esgoto' pilot program for financing wastewater treatment is a first step towards putting the emphasis on outcomes, but even this is limited by the link to investment in wastewater treatment rather than a broader set of possible measures. Nonetheless, it highlights the need for a fundamental shift in the manner in which the Federal Government provides support for projects and policies which affect water quality.

The World Bank and other multilateral agencies are also not immune to the pressures which lead to projects without clear objectives and priorities. Unfortunately, the commendable

desire to develop programs which integrate various aspects of water quality management has resulted all too frequently in the approval of 'Christmas tree' projects covering an ill-assorted set of activities, some of which may have little more than a marginal impact on the stated project objectives. Despite the overall poor record in terms of their impact on water quality or environmental management, experience also suggests that disregard for related problems which may have only a minor or indirect impact on water quality may end up generating future problems, also undermining the original project's more narrow objectives.

It is very difficult to judge *a priori* which approach is more indicated for specific conditions. There are some early experiences of relatively successful integrated projects – and the Guarapiranga may be a good example in Brazil. They are perhaps the only response to a myriad of extremely complex and mutually reinforcing problems of different nature. Extreme caution must be taken in both design and implementation of such projects in order to ensure cohesion of actions, avoiding the bad consequences of classic "Christmas tree" projects.

As highlighted earlier, incentives that emphasizes public expenditure and investment without proper regard to the benefits potentially generated by them operate to focus the efforts of sectoral institutions on the construction of large infrastructure projects, neglecting both proper provision for the costs of ádministration, operation, and maintenance as well as opportunities for smaller projects which may yield much higher returns. Since there are large gaps between perceived needs and what is currently available, all of the sectors are inclined to the view that any investment is desirable and should be promoted. Unfortunately, this ignores the constraints on human and other resources which means that the obsession with large investment projects results in a neglect of more cost-effective actions, particularly those concerned with achieving better performance from existing infrastructure.

Another reason for the neglect of operating performance is the failure to implement reasonable mechanisms for charging for many infrastructure services in the water sector. This is closely linked to the lack of incentives for the proper management of infrastructure. Without such charges, funding of recurrent expenses will always be a problem and there will be less pressure from users who expect a proper service in return for their payment. In the case of water resources management the challenge is to introduce charges for all water users, not merely those with the highest willingness to pay for service. This, in turn, is linked to the question of developing a framework of water rights for different uses, including mechanisms for transferring them between users – either within or across sectors. For both the water and sanitation and the environment sectors the key issue is to find appropriate ways of charging for wastewater services and discharges, taking account of the constraints on willingness and ability to pay for these services.

B. Institutional arrangements

Each of the sectors has evolved along different lines, reflecting the role of Federal Government *vis-à-vis* the States and the priority given to the sector by the various States. The environment sector, as a relatively new and marginal player, has a stable Federal structure (SISNAMA) which combines clear decentralization of responsibilities to States. Differences across the States are primarily a response to differences in the nature of the problems that state environmental agencies have to deal with. On the other hand, water resources management is going through a period of major institutional change from a structure dominated by the Federal Government towards greater decentralization, primarily to the river basin level, rather than to States. Little progress has been made in developing a better institutional

framework for the water and sanitation sector because of unresolved disputes over the crucial issue of the *poder concedente* which have blocked progress on the scope and nature of regulation and on addressing the economic and financial problems of the sector.

All institutional changes are likely to be slow, so that improvements are likely to come in a piecemeal fashion. This will be especially true for the process of establishing river basin committees and agencies with the capacity to develop and implement management strategies as a basis for reaching negotiated agreements with major water users. On the other hand, it should be possible to tackle some of the issues of incentives and regulation on a basis that they are independent of specific institutional arrangements.

Whatever institutional arrangements emerge, one immediate concern is the poor integration of environmental issues with sector policies and projects. In the water resources sector, the challenge is to ensure that attempts to integrate quality and quantity do not end up either causing political clashes between water and environmental agencies and/or giving inconsistent signals to water users. In water and sanitation, the issue is how to persuade or, if necessary, compel the State water companies to comply with environmental norms and regulations. On the other side, environmental agencies have to learn how to work in a more constructive manner with other actors which will involve the adoption of more flexible instruments with a shift from emission standards (focusing on wastewater discharges) to quality standards (focusing on the quality of receiving waters).

C. Poverty reduction and equity

There are often difficult trade-offs between project designs that will generate high economic returns and/or will be more cost-effective and those that set out to meet specific objectives of serving poorer populations. Thus, the net value of water used for large scale and relatively capital-intensive irrigated agriculture may be much higher than that allocated to subsistence farming or low value cash crops. One difficulty is that the overall impact of irrigation projects on poverty reduction and equity is complex and rarely considered within a consistent framework. Projects which allocate water to subsistence and small farmers may generate immediate benefits for an existing population of poor farmers. In the longer term, projects that give more emphasis to large farms and high value crops may yield higher incomes for poor households through both farm and off-farm employment, but the beneficiaries may be migrants or urban workers rather than the rural poor in the project area. This can create tensions between meeting the needs of specific populations versus the wider goal of poverty reduction. There are no simple answers, but much greater care is required during project design to think through and present a clear analysis of the effects of project alternatives.

In the case of water and sanitation, the allocation of resources to fund sewer networks and wastewater treatment in the South and Southeast is an example of potential conflicts between meeting environmental objectives and improving the quality of life of poor households. Using funds to extend coverage of urban and rural water supply would yield higher economic returns as well as contributing to poverty reduction and social well-being.

However, since there should be no major financial barrier to meeting targets for extending water coverage, the real issue here is how any remaining subsidies for wastewater should be utilized. This raises questions of willingness to pay for wastewater services as well as the overall structure of tariffs. Careful thought needs to be given to the ways in which available funds are allocated. Should they be used to subsidize capital costs of developing sewer networks or installing sewer connections? Or, is it better to

subsidize monthly water supply and wastewater collection tariffs for poor households or those with low volumes of water consumption? There are few good answers to such questions at present because too little is known about the distribution of the benefits of, and the willingness to pay for, wastewater services in different types of communities and different income groups.

Much of the problem in reconciling poverty reduction with traditional environmental and water sector objectives is the frequent assumption that the provision or extension of certain services is inherently a "good thing". In some cases, that assumption may be fully justified, but the lack of clear analysis about project objectives and their implications for project design often means that projects could have a much greater impact on the quality of life of the poor by relatively simple adjustments.

As an illustration, the State's commitment to the PDBG in Rio de Janeiro was strengthened by a sense that the provision of basic sanitation services in the low income areas of the Baixada Fluminense would improve the quality of life of local residents. Indeed, that perception was certainly correct for the water supply component, as also for earlier flood control projects. However, the presentation of the project as an effort to "save" Guanabara Bay from water pollution, which it did not and could not achieve, diverted substantial effort and resources into investments in wastewater collection and treatment as well as other environmental components with only marginal returns.

Further, in the case of the PDBG the burden of repaying project loans will fall more heavily on water users because of cross-subsidies from water tariffs to sewer tariffs, so that the overall impact of the project on equity may be adverse despite the benefits accruing to poor households who were provided with water connections through the project. This could have been avoided by a more careful analysis of the project's longer term consequences for tariffs. In the same way, other environmental projects should be examined not only in terms of their (immediate) impact on the environment and the poor, but also in terms of their longer term implications for incentives for water use and management, the cost of services, and the real distribution of income.

An agenda for water quality management

The passage of Law 9433/97 followed by the creation of ANA with an explicit goal of integrating the quantity and quality aspects of water management provides a unique opportunity to construct a better framework for the future. However, this process can not be driven by ANA alone and requires support from other Federal bodies as well as many different State agencies. Here we summarize the key steps that must be taken and issues that should be addressed in moving to an integrated approach for water management.

- If water quality is to be taken seriously, the first step must be to undertake a proper assessment of water quality goals for each river basin. The current classification seems to be arbitrary and is certainly not based on any systematic evaluation of the costs and benefits of setting and reaching alternative standards, nor of explicit social objectives such as expanding service provision and service quality to the poor.

- At present, it is environmental agencies that have taken the lead in establishing water quality goals. However, ANA has indicated that it envisages a much greater, perhaps dominant, role for river basin committees and agencies in future. This is critical if consistency of policies with respect to the management of water quantity and quality is to be achieved. Of course, environmental agencies would be participants in the process

by which water quality goals are elaborated and adopted, but they would have to be able to put forward sound, economically justified arguments for their proposals.

- The technical work on which the development of water quality goals should be based would be either undertaken or supervised by river basin agencies. This means that these agencies must be provided with adequate start-up funds in order to ensure that the necessary work is not delayed by a reluctance to levy charges on water users.

- In addition to the technical work that will be necessary, the process of forging a consensus about goals will be difficult. There is little experience in Brazil of relying upon participatory mechanisms to shape the goals of public policy and the levels and allocation of public expenditures needed to achieve these goals. There is much at stake in the early experiences of river basin committees. Thus, ANA will have to provide a large amount of technical and high-level support for their work. At the same time, it may be necessary to make clear that participants who are unwilling to contribute constructively or to make necessary compromises will prejudice future applications for licenses or other permits that must be granted by ANA or State water resources agencies.

- Once water quality goals have been established, it should be mandatory for environmental agencies to frame decisions concerning the award of licenses for sewer developments and wastewater treatment within the context of programs designed to meet these targets over a reasonable time period – which may be from 5 to 15 years.

- If necessary the goals and the program to achieve them should be given legal force in order to avoid the current situation where the Ministério Público goes to court to block the award of licenses for projects which do not comply with strict but often irrelevant emission standards.

- There are also institutional implications to such a system. Instead of water companies deciding for themselves on levels of wastewater collection and treatment, as is currently the case, these companies will be bound by outside decisions on these matters. Of course, they will be important participants in river basin committees. They should have particular weight in negotiating feasible targets for wastewater collection and treatment, but their influence will depend on the quality of their technical and economic proposals combined with their operational performance with respect to existing systems.

- A related issue is that the system will also require inter-sectoral coordination since the obligation to comply with specific treatment levels will limit the availability of investments in other, related infrastructure, such as water supply and flood protection, which in turn may have even higher social returns.

- The development of water quality programs must, of course, be linked to the decisions of river basin institutions on the allocation and exercise of water rights and the construction of water management infrastructure. Thus, licenses to abstract or to store water may be conditional on the maintenance of adequate water flows to ensure that water quality goals can be met – i.e. the volume of water that can be abstracted or stored is reduced in low flow years or increased in high flow years.

Table 1 - Households without access to water or sanitation

State	Total number of households (thousands)		% of households					
			Urban			Rural		
	Urban	Rural	No network water	No piped water	No sanitation	No network water	No piped water	No sanitation
Rondônia	230	122	55.4	13.2	7.6	96.5	47.4	28.9
Acre	91	40	50.0	23.6	24.6	97.1	81.1	54.4
Amazonas	455	123	26.1	13.8	17.6	94.7	87.8	50.7
Roraima	59	16	5.3	2.6	5.0	82.9	67.6	39.1
Pará	914	411	44.6	20.0	12.8	87.4	75.5	39.9
Amapá	89	10	45.4	16.5	25.9	87.6	74.2	45.1
Tocantins	213	71	16.2	7.0	15.0	89.3	67.1	73.0
Maranhão	758	484	25.0	18.5	26.3	82.2	75.4	72.2
Piauí	431	233	13.1	10.5	20.1	88.0	80.2	87.8
Ceará	1,295	469	20.5	14.0	12.1	91.7	80.0	66.6
Rio Grande do Norte	505	169	8.0	6.0	5.3	63.9	52.5	30.5
Paraíba	624	228	10.3	8.0	10.2	89.3	78.6	61.7
Pernambuco	1,558	421	14.8	8.7	11.9	85.4	72.7	60.5
Alagoas	463	192	20.1	10.2	12.2	78.5	67.2	52.5
Sergipe	321	119	8.4	6.0	8.1	69.3	60.6	40.6
Bahia	2,218	977	11.1	7.1	13.2	76.4	61.2	66.0
Minas Gerais	3,977	806	3.6	0.8	6.2	85.2	16.5	47.7
Espírito Santo	685	160	3.9	0.7	10.0	86.8	5.2	35.8
Rio de Janeiro	4,107	157	14.6	2.8	10.0	78.7	11.3	35.7
São Paulo	9,756	639	2.9	0.5	4.8	66.5	4.2	13.7
Paraná	2,217	465	3.5	0.8	4.0	80.8	10.9	14.5
Santa Catarina	1,206	299	11.1	0.7	5.5	84.7	5.0	20.9
Rio Grande do Sul	2,518	534	7.6	1.1	5.0	81.8	10.2	21.1
Mato Grosso do Sul	480	89	10.6	2.0	2.3	87.1	18.6	13.7
Mato Grosso	525	134	23.5	5.9	5.1	92.9	37.4	30.6
Goiás	1,232	177	22.7	2.9	3.8	89.6	17.9	29.0
Distrito Federal	526	23	8.4	2.5	0.6	82.7	6.2	5.0
Brazil	37,455	7,567	10.5	3.9	7.9	82.2	43.3	44.7

Source: IBGE, Census 2000 tabulations.

ANNEX: Summary description of projects reviewed

BOX 1 – Basic Sanitation Program for the Guanabara Bay Basin (Programa de Despoluição da Baía de Guanabara – PDBG) – IDB Loan 782/OC – BR

The general objectives of the program were to: (a) clean up the Guanabara Bay and adjacent basin area; (b) improve the quality of life of the 7.3 million residents of the basin; and (c) strengthen local government institutions whose activities could positively affect the bay. The Project was jointly financed by the IDB and the Japan Bank for International Cooperation – JBIC, with resources of US$ 793 million.

The initial priority of the First Phase of the Program was the construction of a sewerage collection network and primary treatment plants, so as to reduce the degradation of the waters of the bay and at the same time comply with the requirements of the State Constitution.

The Program relied largely on a JICA Project initiated in the beginning of the 1990s – a Directing Plan for the Recuperation of the Ecosystem of the Guanabara Bay. This included a hydrodynamic model focusing mainly on eutrophication of the bay. The studies involved indicated that the pollution generated in the bay itself, originating from primary productivity, makes up a significant portion – around 60%, of the global organic pollution. This provided evidence for the need to remove nutrient discharges from effluents flowing into the bay, in order to reduce the problem of eutrophication and to recuperate the ecosystem.

The expected impacts of the Program's first phase included direct benefits to the population located in the areas of project influence, the vast majority consisting of low-income people, diminishing the incidence of infant mortality and of waterborne diseases. Other benefits included the non-interruption of socio-economic activities following floods and improvement in water quality of the beaches in the interior of the bay.

BOX 2 – Guaíba Watershed Environmental Management Project (PRÓ-GUAÍBA) – IDB Loan 776/OC – BR

The overall objective of the program was to improve the environmental quality of the Guaíba River watershed by reducing pollution and preserving its natural resources. In order to achieve such objective, the project comprised a broad set of actions: (a) expanding the coverage of sewage systems and treatment plants in Porto Alegre; (b) controlling pollution in Lake Guaíba and its tributaries; (c) implementing a rural extension program that targets soil management, reforestation and pollution control; (d) strengthening the infrastructure of five conservation units; (e) implementing a pilot environmental education program in six cities and drawing up an environmental education plan for the state; and (f) providing institutional strengthening for participating agencies.

This set of actions implied a complex institutional arrangement incorporating entities of distinct cultures and executive capacities, from the Municipal Department of Sewerage of Porto Alegre (DMAE) to the Zoo-botanical Foundation (FZB). These agencies were under the orientation of the Project Management Unit (UGP) that was installed in the sphere of the State Secretariat of Coordination and Planning (SCP), responsible for carrying out Pro-Guaíba.

The Program benefited an area equivalent to 30% of the territory of Rio Grande do Sul (80,000 km²), where almost 5.9 million habitants live (56% of the state population), in 251 municipalities that generate 86% of the state GNP. Although the geographic reach and the concentration of the investments of Pró-Guaíba occur in the Metropolitan Region of Porto Alegre, the most critical field of urban-industrial pollution (53% of raw discharge of domestic sewage of the basin) affects the Guaíba Lake (10,360 km²), where the waters of 8 sub-basin components converge.

To reach its goals, the Program will spread actions over a period of 15 years in successive stages. One of the positive aspects of the implementation of the Pró-Guaíba project is that it occurred in parallel with the installation of the State System of Water Resources Management, allowing the effective decentralization of many decisions to the Water Basin Committees and/or to the State Water resources Council.

BOX 3 – Tietê River Pollution Control Projects – IDB Loans 713/OC-BR and 1212/OC-BR

Thirty four of the thirty nine municipalities that make up the Metropolitan São Paulo Region (MSPR) are located in the water basin of Alto Tietê. At the end of 1990, only 20% of the sewage collected was treated. Another major problem was the progressive pollution of the Billings Dam, which limited its usage as source of potable water and for generation of electric energy.

In 1991 the State Government of São Paulo launched the Tietê River Pollution Control Project with the overall objective to improve environmental quality of the Tietê River watershed in the MSPR, conserving and making efficient use of water resources in the upper reaches of the basin, including a pilot program to reduce unaccounted for water losses. The project was the first in a series of three projects financed by the IDB.

During the first phase (1992-1998), SABESP prioritized investments with higher social returns through the construction of collection networks and connections that took wastewater away from direct contact with the population. This benefited around 250,000 families. Three new Wastewater Treatment Works were constructed, and the treatment capacity of the existing Barueri Works was increased. As a result of this project, the indices for wastewater collection in MSPR went from 63% in 1992 to 83% in 1999. The indices for treatment rose from 20% to 60% in the same period.

The main objectives of the second phase (2000-2004) are: to increase the quantity of wastewater treated, by directing it to the treatment works to the greatest extent possible; to extend the sewage collection service to 400,000 more families, therefore, increasing the service index to 90% of the population of MSPR; and, finally, to control the emission of effluents from over 290 industries. It also includes an institutional component focused on modernization of the company, including implementation of a geographical information system, a financial study for calculating the sewage tariffs, and marketing studies that seek to identify new markets for the company.

BOX 4 – Water Quality and Pollution Control Project (PQA) – World Bank Loan 3503-BR

The 'PQA' Project was conceived in the beginning of the 1990s and structured through four Loan Agreements from the World Bank. Loan 3503-BR was the Federal Component; the others were specific State loans and are presented below. The general objective of the Federal loan was to assist Brazil in developing cost-effective approaches to control water pollution. It was also designed to provide finance for project preparation and technical assistance to states and local institutions, specifically for the preparation of investment plans and strategies for a number of major urban river basins spread throughout the country.

The Federal loan, which closed in September 1999, produced its investment plans and strategies based on the prioritization of interventions following the same logic used in the three state PQA investment loans described below. The studies were carried out on the following river systems: Paraíba do Sul; Piracicaba, Capivari and Jundiaí (state of São Paulo); Beberibe, Capibaribe and Jabotão (Recife metropolitan area); and Paraguaçu and Subaé (state of Bahia).

The conceptual base of the PQA loans included innovative approaches to integrated and prioritized actions in the context of strong fiscal restrictions. The use of land use planning strategies, which are derived from measuring the impact of the resulting pollution on the water body for different land development scenarios, proved to be a powerful tool for municipal and metropolitan decision makers; environmental valuation and the search for cost-effectiveness, and striking a balance between social and environmental outcomes were also key ingredients of the loans.

BOX 5 – São Paulo Water Quality and Pollution Control Project (Guarapiranga Basin Environmental Sanitation Program, SP) – World Bank Loan 3504-BR

The São Paulo PQA loan had the main objective of guaranteeing the Guarapiranga reservoir as a reliable water source capable of supplying the Metropolitan Region of São Paulo (MRSP). The reservoir produces some 20% of the potable water supplied to MRSP but, as a result of domestic and industrial pollution, was suffering – at project inception – from frequent algal blooms and the associated difficulties of water treatment and the problems of taste and odor for consumers. Despite legislation to control formal urban development in the catchment area, the reservoir basin has suffered from decades of informal invasion and settlement by those looking for places to live close to the heart of São Paulo. The population of the basin consequently increased from some 500,000 in 1990 to 800,000 today, many of whom live in slums or irregular settlements, including more than 200 *favelas* with over 100 thousand habitants in irregular housing. These are high density poverty areas lacking most basic services, including sanitation infrastructure.

Given this context, the Guarapiranga loan was designed from a multi-disciplinary and integrated perspective with two main objectives: (i) the development of institutional capabilities to manage the water basin in an environmentally sustainable manner through the introduction of modern land-use incentives, cost recovery mechanisms, and an efficient legal and regulatory framework; and (ii) the improvement of the quality of life of the 550,000 inhabitants of the water basin through the rehabilitation and expansion of basic sanitation infrastructure, namely sewers, solid waste collection, and disposal and drainage in four municipalities. The loan consisted of the following components: water and works; municipal solid waste management; urban rehabilitation; environmental protection and water basin management.

One key intervention of the Guarapiranga loan was the urbanization of slums, and the improvement of irregular settlements, that are major contributors to the domestic pollution of the reservoir. The river basin was used as a context for the upgrading of such slums, allowing for the prioritization of investments in urban upgrading which not only provided much needed improvement in the living conditions of these vulnerable communities but also had an overarching objective of reducing urban water pollution. The project developed both technical and legal instruments which allow for the prioritization of investments and which help guarantee their sustainability. The use of land use planning strategies, which are derived from measuring the impact of the resulting pollution on the water body for different land development scenarios, proved to be a powerful tool for municipal and metropolitan decision makers.

The implementation of the project was coordinated by a Project Management Unit within the State Secretariat of Water Resources, Sanitation, and Works and comprised five State and municipal executive agencies. At closing in December, 2000, the total investments of the Guarapiranga loan reached US$ 336 million. One of the most important outcomes of the Program was the development, and later approval, of State Legislation to protect watersheds.

BOX 6 – Water Quality and Pollution Control Project – Alto Iguaçu Water Basin (Environmental Sanitation Program for Metropolitan Curitiba – PROSAM/PR) – World Bank Loan 3505-BR

In the Metropolitan Region of Curitiba (MRC), the State capital of Paraná, there are major irregular settlements in watersheds located to the East of the city. The occupation of the Iguaçu watershed by poor families result in serious and recurrent floods, without many technical alternatives for making the river channel deeper, because of poor declivity. The deposition of solid residue on the banks of the rivers and streams further aggravates the situation.

In order to confront these problems, PROSAM/PR sought to create an integrated set of interventions which included: the construction of the Iraí River Dam (on one of the tributaries of the Iguaçu River), with the dual purpose of supplying water to MRC and regulating river flow; the construction of a canal parallel to the Iguaçu River capable of absorbing excess flows and also serving as a physical barrier to the irregular settlements; increase in coverage of collection and treatment of domestic solid waste; relocation and housing for 1,800 families located in areas of greater risk; structuring a regional system for the collection and disposal of solid waste; construction of linear parks in the depths of the valley, providing localized control of rivers and streams, in addition to other complementary actions.

The Program was managed by a single unit installed within the State Secretariat of Planning and General Coordination and had five State and municipal executing agencies. As in the case of Guarapiranga, PROSAM/PR was also directly responsible for the concept and approval of the Special Law for the Protection of Metropolitan Curitiba Water Sources (State Law no. 12.248/98) and the State Law of Water Resource Management.

BOX 7 – Environmental Sanitation Program for Metropolitan Belo Horizonte (PROSAM/MG) – Arrudas and Sarandi/Onça River Water Basins (MG) – World Bank Loan 3554-BR

The Arruda and Sarandi/Onça rivers drain large parts of Belo Horizonte and Contagem, including their industrial districts. Recurrent floods and the transport of effluents in open canals from Contagem to the urban areas of Metropolitan Region of Belo Horizonte (MRBH), together with the lack of domestic wastewater treatment prompted the launching of PROSAM/MG.

The principal objective of the project was to recuperate the environmentally deteriorated urban basins of the Arrudas and Onça rivers in MRBH. The project consisted of five main components: (i) flood control and urban drainage, including macro drainage of all rivers and creeks in the water basin; (ii) municipal and industrial wastewater collection and treatment; (iii) municipal and industrial solid waste collection and disposal, (iv) urbanization, including the creation of public areas, reforestation and resettlement; and (v) environmental protection and water basin management, including studies and institutional strengthening of the State Environmental Agency (FEAM).

The project resulted in the restoration of the Arruda and Onça basins, which are now less flood prone, wastewater discharges are largely intercepted, and land use in areas near the rivers has been redefined. Industrial discharges are now controlled, both directly by the industries themselves or through COPASA, and discharges into rivers after treatment are regularly monitored by FEAM. A new regulatory and institutional framework for the management of water resources in the river basins is now in effect, with the Velhas River Basin Commission having been created.

Recent World Bank Technical Papers *(continued)*

No 465 Csaba Csaki and Zvi Lerman, eds., *Structural Change in the Farming Sectors in Central and Eastern Europe: Lessons for EU Accession—Second World Bank/ FAO Workshop, June 27–29, 1999*

No. 466 Barbara Nunberg, *Ready for Europe: Public Administration Reform and European Union Accession in Central and Eastern Europe*

No. 467 Quentin T. Wodon with contributions from Robert Ayres, Matias Barenstein, Norman Hicks, Kihoon Lee, William Maloney, Pia Peeters, Corinne Siaens, and Shlomo Yitzhaki, *Poverty and Policy in Latin America and the Caribbean*

No. 469 Laurian Unnevehr and Nancy Hirschhorn, *Food Safety Issues in the Developing World*

No. 470 Alberto Valdés, ed., *Agricultural Support Policies in Transition Economies*

No 471 Brian Pinto, Vladimir Drebentsov, and Alexander Morozov, *Dismantling Russia's Nonpayments System: Creating Conditions for Growth*

No. 472 Jit B. S. Gill, *A Diagnostic Framework for Revenue Administration*

No. 473 Esen Ulgenerk and Leila Zlaoui, *From Transition to Accession: Developing Stable and Competitive Financial Markets in Bulgaria*

No. 474 Ioannis N. Kessides, ed., *Hungary: A Regulatory and Structural Review of Selected Infrastructure Sectors*

No. 475 Csaba Csaki, Zvi Lerman, and Sergey Sotnikov, *Farm Sector Restructuring in Belarus Progress and Constraints*

No. 476 Katherine Terrell, *Czech Republic. Labor Market Report*

No. 481 Csaba Csaki, John Nash, Achim Fock, and Holger Kray, *Food and Agriculture in Bulgaria: The Challenge of Preparing for EU Accession*

No. 482 Peter Havlik, *Trade and Cost Competitiveness in the Czech Republic, Hungary, Poland, and Slovenia*

No. 483 Mojmir Mrak, *Communal Infrastructure in Slovenia. Survey of Investment Needs and Policies Aimed at Encouraging Private Sector Participation*

No 484 Csaba Csaki and Laura Tuck, *Rural Development Strategy Eastern Europe and Central Asia*

No. 488 Nina Bubnova, *Governance Impact on Private Investment*

No. 489 Tim Schwarz and David Satola, *Telecommunications Legislation in Transitional and Developing Economies*

No. 490 Jesko Hentschel and Radha Seshagiri, *The City Poverty Assessment. A Primer*

No. 491 Daniel Müller-Jentsch, *The Development of Electricity Markets in the Euro-Mediterranean Area*

No. 492 Tuntivate Voravate, Douglas F Barnes, and V Susan Bogach, *Assessing Markets for Renewable Energy in Rural Areas of Northwestern China*

No. 496 Jerry Lebo and Dieter Schelling, *Design and Appraisal of Rural Transport Infrastructure: Ensuring Basic Access for Rural Communities*

No 497 Julian A. Lampietti, Anthony A. Kolb, Sumila Gulyani, and Vahram Avenesyan, *Utility Pricing and the Poor. Lessons from Armenia*

No. 498 Gillian Perkins and Ruslan Yemtsov, *Armenia: Restructuring to Sustain Universal General Education*

No. 499 Rogrigo A. Chaves, Susana Sanchez, Saul Schor, and Emil Tesliuc, *Financial Markets, Credit Constraints, and Investment in Rural Romania*

No 500 Zvi Lerman and Karen Brooks, *Turkmenistan: An Assessment of Leasehold-Based Farm Restructuring*

No. 501 Aldo Baietti, *Private Infrastructure in East Asia Lessons Learned in the Aftermath of the Crisis*

No 505 Ali Hashim and Bill Allan, *Treasury Reference Model*

No. 506 Omer Gokcekus, Nick Manning, Ranjana Mukherjee, and Raj Nallari, *Institutional Environment and Public Officials' Performance in Guyana*

No 507 Ranjana Mukherjee, Omer Gokcekus, Nick Manning, and Pierre Landell-Mills, *Bangladesh: The Experience and Perceptions of Public Officials*

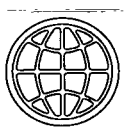
No. 509 World Bank, *Kosovo: Economic and Social Reforms for Peace and Reconciliation*

No. 510 Anatoly Vinokur, Joana Godinho, Christopher Dye, Nico Nagelkerke, *The TB and HIV/AIDS Epidemics in the Russian Federation*

No. 512 Geremia Palomba, Milan Vodopivec, *Financing, Efficiency, and Equity in Albanian Education*

No. 513 Thomas O'Brien, Christian Filipov, *The Current Regulatory Framework Governing Business in Bulgaria*

No. 514 Carmela Martín, Francisco J. Velázquez, Bernard Funck, *European Integration and Income Convergence: Lessons for Central and Eastern European Countries*



THE WORLD BANK

1818 H Street, N.W.

Washington, D.C. 20433 USA

Telephone: 202-473-1000

Facsimile: 202-477-6391

Internet: www.worldbank.org

E-mail: feedback@worldbank.org

ISBN 0-8213-5347-0