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Environment & Water Resources
OCCASIONAL PAPER SERIES



Overcoming Institutional and Governance Challenges in Environmental Management

Case Studies from Latin America and the Caribbean Region

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Environment and Water Resources

LCSEN Occasional Paper Series

Foreword

The Latin America and Caribbean (LAC) region has a unique mix of qualities and challenges when it comes to the environment. It is exceptionally endowed with natural assets, with globally significant biodiversity and valuable crops, and also harbors the world's greatest carbon sink in the Amazon. At the same time, however, the region registers the highest rates of urbanization in the developing world with pollution, overuse of its water and natural resources and detrimental impacts on the health of people, especially the poor, and the environment.

Over the past twenty years, the LAC region has made impressive gains in tackling these issues. It leads the developing world in biodiversity conservation and natural resource management and is at the forefront in reducing urban pollution. The World Bank has often been the partner of choice for those countries in the region that have had the initiative to pioneer innovative policies for environmental protection and natural resource management, strengthen institutions responsible for environmental management, enhance environmental sustainability, and introduce new approaches to water resources management. Such initiatives include fuel and air quality standards in Peru, carbon emission reduction in Mexico, payment for ecosystem services in Costa Rica, participatory and integrated water resources management in Brazil, and new approaches to irrigation management in Mexico.

In this context, it is our pleasure to introduce the Environment & Water Resources Occasional Paper Series, a publication of the Environment and Water Resources Unit (LCSEN) of the Sustainable Development Department in the World Bank's Latin America and the Caribbean Region. The purpose of the series is to contribute to the global knowledge exchange on innovation in environmental and water resources management and the pursuit of

greener and more inclusive growth. The papers seek to bring to a broader public – decision makers, development practitioners, academics and other partners - lessons learned from World Bank-financed projects, technical assistance and other knowledge activities jointly undertaken with our partners. The series addresses issues relevant to the region's environmental sustainability agenda from water resources management to environmental health, natural resource management, biodiversity conservation, environmental policy, pollution management, environmental institutions and governance, ecosystem services, environmental financing, irrigation and climate change and their linkages to development and growth.

As the LAC region continues to make its growth more environmentally sustainable and inclusive, the strengthening of environmental institutions and governance becomes paramount. In this particular context we present to you three successful case studies. The first case study describes how Colombia designed and implemented an air quality management program based on public awareness, evidence-based policy design, and political commitment to reform. The second case study examines how Brazil is promoting access to environmental justice through the public prosecutors model. A third case study shows how the modeling of climate change and monitoring of glacial retreat in the Andean countries is fostering decision making to address the increasingly important challenge of climate change adaptation.

We hope that this paper, just as the entire series, will make a contribution to knowledge sharing within the LAC Region and globally.

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Overcoming Institutional and Governance Challenges in Environmental Management

Case Studies from Latin America and the Caribbean Region

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Abstract

The strengthening of institutions and governance mechanisms is at the core of the environmental sustainability agenda, yet the record of development assistance for institutional strengthening is weaker than in other areas of environmental management. As revealed through the consultations with a broad range of stakeholders from the Latin America and Caribbean Region (LCR) on the World Bank's Environment Strategy, carried out in 2010, the following priority measures would help further the progress with improving the countries' environmental institutions and governance structures: (i) better setting of environmental policy priorities, (ii) strengthening regulatory and enforcement frameworks, (iii) improving access to environmental information and its usefulness for decision mak-

ing, and (iv) strengthening the role of civil society through providing clear forums and mechanisms for public participation in environmental decision making. Three case studies presented in this paper demonstrate successful approaches to strengthening the environmental institutions and governance in those four areas in LCR. Each case includes a discussion of the drivers of success and the role played by World Bank support and of the potential for replication in a broader range of countries. This policy note draws on the World Bank's engagement in environmental policy dialogue in Colombia, other Andean countries, and Brazil, identifies the critical elements of success and provides recommendations for development assistance in this area drawing on the lessons from these case studies.



I. Introduction

The strengthening of institutions and governance mechanisms is undoubtedly at the core of the environmental sustainability agenda. In a broad sense, institutions were defined by Douglass North in his Nobel Prize lecture as “the humanly devised constraints that structure human interactions,” including formal constraints such as rules and laws, informal constraints such as norms of behavior and conventions, and their enforcement characteristics (North 1993).¹ The area of environmental management is remarkable in terms of the complexity of institutional arrangements that often involve multiple actors at different levels and transcend environmental mediums and economic sectors. The analysis of the complex channels of interactions that lead to successful institutional and governance structures and sustainable use of natural resources has deepened the understanding of the factors behind successes and failures. Twenty-six years after North’s seminal work, in her Nobel Prize lecture Elinor Ostrom emphasized the lack of one-size-fits-all approaches and the need for customized solutions to strengthen environmental institutions and environmental governance (Ostrom 2009).² A failure by development practitioners to fully appreciate the complexity of building strong

environmental institutions and governance mechanisms may be responsible for the relatively less successful record in this area compared to other areas of environmental lending by the World Bank.³

The 2003 World Bank World Development Report “Sustainable Development in a Dynamic World” and the 2001 World Bank Environment Strategy recognized the importance of institutional strengthening and the establishment of effective regulatory and enforcement frameworks for achieving desired environmental outcomes. The participants in the 2010 World Bank Environment Strategy consultations in the Latin America and the Caribbean Region (LCR) highlighted four priority areas for the strengthening of environmental institutions and governance:⁴

- (i) **Setting Environmental Policy Priorities:** establishing medium- to long-term policy priorities that persist despite administration changes and have buy-in from other sectors apart from Ministries of Environment;
- (ii) **Strengthening Regulatory and Enforcement Frameworks:** enhancing the capacity of environmental institutions and strengthening

1 North, Douglass. “Economic Performance through Time.” Nobel Lecture, December 1993.

2 Ostrom, Elinor. “Beyond Markets and States: Polycentric Governance of Complex Economic Systems.” Nobel Lecture, December 2009.

3 The recent impact evaluation of World Bank assistance in the environmental area found that the performance record for stand-alone projects to strengthen the institutional capacity for environmental management tends to be worse than for other projects, probably due to the challenges of supporting institutional change in a country (World Bank 2008c).

4 These priority areas have emerged from the discussions with a group of 35 participants from Mexico, Central America and Colombia during the first round of multi-stakeholder consultations on the new World Bank Environment Strategy held in Mexico City from February 11 to 12, 2011 for the Latin America and the Caribbean Region of the World Bank.

environmental governance (e.g., the regulatory framework and compliance/enforcement mechanisms);

- (iii) **Improving Access to Environmental Information and its Usefulness for Decision Making:** increasing the availability and quality of environmental information, with guidance from research and informed by recent technologies and environmental data, and improving the evaluation of costs of environmental degradation;
- (iv) **Strengthening the Role of Civil Society:** involving civil society in the overall environmental management process in a structured and meaningful way, with clear forums for participation and access to environmental justice.

The cases presented in this paper demonstrate successful approaches to strengthening the environmental institutions and governance in these areas in LCR. Each case study includes a discussion of the drivers of success and the role played by World Bank support, and of the potential for replication in a broader range of countries. This policy note draws on the World Bank's engagement in environmental policy dialogue in Colombia, other Andean countries, and Brazil, and describes the following success stories:

Case 1: Improving Air Quality in Colombian Cities Through Better Priority-Setting and Communication of Environmental Information. The first case describes the strengthening of environmental regulations in Colombia with the help of a Programmatic Environmental Development Policy Loan (DPL), combined with a technical assistance project. Although this program supported a range of reforms in several areas, the documented achievements in terms of improving urban air quality provide particularly useful insights for projects that seek to support institutional strengthening for improved

environmental management. This experience highlights how evidence-based policy design, backed by political commitment to reform, public awareness of the severity of the problem, and earmarked financial resources to fund the identified priority actions, can help achieve remarkable environmental outcomes. This case study draws on the continuous dialogue between the Government of Colombia and the World Bank in the last ten years, and shows the drivers of success with Colombia's urban air quality reforms.

Case 2: Promoting Compliance Through Broader Access to Environmental Justice in Brazil's Public Prosecutors Model. The second case presents the uniquely successful experience of Brazil in promoting access to environmental justice through the public prosecutors model. Lessons from this case can inform a program of technical assistance to interested countries where this approach may also be successfully applied. World Bank support in this area has not been extensive, with a few exceptions such as the efforts to strengthen the capacity of public prosecutors in the State of Minas Gerais in Brazil.

Case 3: Bridging the Gap Between Science and Decision Making to Address Climate Change in the High Andes. The third case demonstrates the successful application of technological innovations in the area of environmental monitoring—modeling of climate change and monitoring of glacial retreat and runoff flows—with World Bank support in the Andean countries. This experience clearly shows that many opportunities have emerged as part of the climate change agenda for developing innovative and possibly low-cost and long-lasting environmental monitoring programs by fostering partnerships between government agencies and research institutes. This process of partnership building helps ensure the relevance of scientific findings for decision making and environmental policy.

II. Strengthening Environmental Regulation

The Case of Air Quality in Colombian Cities

Air pollution from the transport sector became a top priority on the environmental policy agenda by the mid-2000s. Air pollution levels in Bogotá, Medellín and Bucaramanga are comparable to those of Latin American cities with severe air pollution problems, including Mexico City and Santiago. Measured by average particulate matter (PM) concentration levels, pollution levels in those Colombian cities—between 50 and 70 $\mu\text{g}/\text{m}^3$ of PM_{10} —are nearly twice the levels observed in Los Angeles, Madrid and Rome, and more than twice the levels in New York and Paris.⁵ As estimated by the World Bank's 2006 Country Environmental Analysis (CEA) for Colombia, each year 6,000 people died prematurely in Bogotá, and there were 7,400 new cases of bronchitis each year as a result of urban air pollution. The annual cost of urban air pollution from PM was estimated at 0.8 of Colombia's gross domestic product (GDP); air pollution in Bogotá alone accounted for half of those costs.⁶

A preliminary assessment of pollution sources revealed the major contribution to pollution levels from mobile sources, making this a priority in the 2005 Air Pollution Prevention and Control Policy. Subsequently, the 2006 CEA identified the lowering of sulfur content in fuels as a priority measure to improve urban air quality. The CEA's striking findings about the high health and economic costs of air pollution helped to shape the strategic component of Colombia's 2006–2010 National Human Development Program (*Programa Nacional de*

Desarrollo Humano, PNDH) on air quality and to strengthen the program's emphasis on the urgent need to improve air quality.

After 2006, it became clear that curbing transport emissions was the single most effective step to reduce the health costs of urban air pollution.

A series of technical studies, which monitored and analyzed the sources of air pollution and constructed emissions inventories, as well as in-depth environmental health assessments, were conducted between 2006 and 2008 by the University of the Andes and Bogotá's District Environmental Secretariat. These assessments confirmed the urgency of improving air quality; their results were broadly discussed in the National Environmental Forum and the National Air Council (*Consejo Nacional de Aire*, CONAIRE). The studies indicated that pollution by PM_{10} , followed by ozone, is more severe in Bogotá compared to other air pollutants (carbon monoxide, nitrous oxide and sulfur oxide); PM_{10} levels are more often out of compliance with the national norms than are other pollutants. The assessments also revealed that around 60 percent of total PM_{10} emissions in Bogotá are from industrial sources and 40 percent from mobile sources. Of the latter, nearly 90 percent is emitted by around 50,000 diesel-powered vehicles (buses and trucks) in Bogotá and almost 10 percent by heavily polluting motorcycles with two-stroke engines.⁷ Furthermore, a series of epidemiological studies found that mobile sources may have higher health impacts than the

5 World Bank (2005). World Development Indicators. Cited in World Bank (2006).

6 World Bank (2006). Environmental priorities and poverty reduction: a country environmental analysis for Colombia. Washington, D.C.: World Bank.

7 Rojas, Nestor (no date). Air Pollution and Environmental Problems in Bogotá. National Environmental Forum.

more concentrated industrial sources. With this air pollution profile, the urgency of lowering the sulfur content of Bogotá's diesel—very high by international standards at 1,200 parts per million (ppm)—was identified by technical experts and decision makers as one of the key measures to reduce air pollution. The technical assessments, the development of standardized protocols for emissions monitoring, round table discussions in the National Environmental Forum and the National Air Council, and epidemiological studies were supported by the World Bank-financed Sustainable Development Investment Project and the Programmatic Environmental Development Policy Loan.

The Passage of the 2008 Fuel Quality Law and the Signing of a Voluntary Pact with ECOPETROL

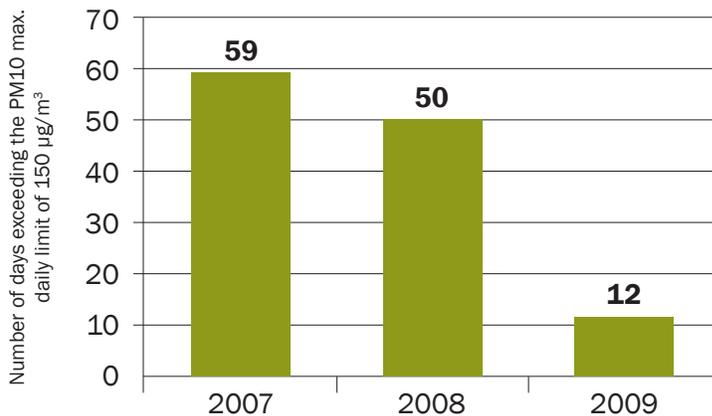
The Role of Environmental Information in Mobilizing Public Pressure for Change. The CEA's health cost estimates were taken up by a media campaign and by congressional leaders who led public protests with white blankets that were quickly soiled by air pollution. The improvement of fuel quality through the adoption of more stringent air quality regulations on sulfur content in diesel was understood to be the most urgent priority. The challenge was to ensure that compliance with the new fuel quality norms, under discussion for mobile sources, would be achieved. Over the course of 10 years prior to that, 13 attempts to pass stringent fuel quality standards had failed, mainly because of the absence of a roadmap for implementing those standards. This time, the preparation of the Fuel Quality Law in 2008, with stringent standards on sulfur content in transport fuels, was accompanied by a series of consultations with the regulated community led by the Ministry of Environment, Housing

and Territorial Development (*Ministerio de Ambiente, Vivienda y Desarrollo Territorial*, MAVDT) jointly with the Ministry of Mining and Energy (*Ministerio de Minas y Energía*, MME) and—very importantly—with the engagement of the Colombian petroleum company ECOPETROL from the very beginning.

The lowering of sulfur content in fuels appears to have helped improve air quality, however further measures are needed to sustain these gains.

Measurable improvements in Bogotá's air quality have already been observed; these have been attributed at least in part to the implementation of the Fuel Quality Law. Sulfur content in diesel fell from 1,200 ppm in January of 2008 to 500 ppm in July and further to 231 ppm in October 2009. The concentration of particulate matter in Bogotá, based on air quality monitoring data, fell by eight percent in 2008 and continued to decline further in 2009. The numbers of consecutive days with PM levels out of compliance with the norms fell from 50–59 in 2007 and 2008, respectively, to only 12 in 2009 (see Figure II.1). According to the Bogotá District Health Secretariat, no reductions in the rates of respiratory illnesses have yet been detected, but the impacts may be indirect. In-depth environmental health and monitoring studies at city level are required to ascertain these impacts. Additional regulatory changes, apart from the implementation of the stringent new sulfur limits, the strengthening of monitoring networks and the establishment of a new urban air quality information system with the latest monitoring data, are likely to result in further air quality improvements in the medium to long term. However, since motorization rates in Colombia and particularly in Bogotá continue to rapidly rise, any improvements in air quality would be reversed without effective programs and incentives to replace the old vehicle fleet, especially old buses, and improve public transport systems.

Figure II.1. Bogota's Air Quality Significantly Improved, Partly Due to Sulfur Reduction in Fuels



Note: Air quality improvements have been observed, when measured by the number of days in excess of the maximum PM₁₀ limit of 150 µg/m³, established by Resolution 601 in 2006. The District Environmental Secretariat attributes this improvement in part to the introduction of cleaner diesel in the city's fuel distribution network, and in part to greater dispersion of pollutants in 2009 compared to 2008 because of more windy conditions. The sulfur content of diesel has been reduced from 1,200 ppm to fewer than 500 ppm starting in July 2008, in compliance with ECOPEPETROL's commitment in the "Pact for Better Air Quality in Bogotá" to introduce cleaner diesel.

Source: District Environmental Secretariat, October 2009.

How Was the New Fuel Quality Law Implemented? In Colombia, ECOPEPETROL played a key role in achieving compliance with the new emissions regulations established by the Fuel Quality Law, mandating lower sulfur content in diesel. The President of ECOPEPETROL, the Minister of Environment (MAVDT), and the Mayor of Bogotá signed a voluntary pact in February 2008, whereby ECOPEPETROL would install an additional refinery process to improve diesel quality. A similar pact has been signed for Medellín. The pact stipulated that ECOPEPETROL would lower the sulfur content in diesel for Bogotá to 50 ppm by the end of 2010. This is more stringent than the levels stipulated in the 2008 Fuel Quality Law, and ECOPEPETROL is complying with this voluntary commitment. According to MAVDT, estimates of the health costs of air pollution have been instrumental for putting together the financing for the new refinery, because ECOPEPETROL's management argued that this investment would result in large savings in terms of the health costs of pollution to justify this project (Personal communication 2010).

Implementation of tight fuel quality standards is in general a formidable challenge because of the compliance costs borne by the producers and consumers, with the latter affected if an increase in

production costs of higher-quality fuel results in higher fuel prices. In Colombia, compliance with the new mandate to lower sulfur content in fuels was achieved by introducing additional refining processes in the diesel production cycle through an ECOPEPETROL investment and through a temporary increase in the imports of higher-quality diesel (subsidized by the State). ECOPEPETROL was a state-owned enterprise until 2007 when a portion of it was sold to the private sector. Thus, the Government of Colombia (GoC) has at least partially financed the investment in the additional refining capacity, enabling compliance with the new Fuel Quality Law. Fuel prices for diesel did not increase in Bogotá as a result of the new law. The costs were not passed on to consumers; retail diesel prices remained at the pre-reform level in Bogotá in order to avoid the illegal sales from cities with lower-quality diesel. The relative ease of enforcement of the new sulfur content requirements was also due to ECOPEPETROL's unique situation as a joint public-private company and its desire to improve its public image.

Negotiations with ECOPEPETROL, its involvement in the discussions that preceded the passage of the new regulations, and congressional involvement in the consultations under the framework of the

Health Forum (*Congreso de Salud*) have helped to get ECOPETROL on board with the preparation of the new regulation and to develop a strategy for compliance with the new law, which ECOPETROL's management knew was under preparation. In fact, two congressmen involved in the Health Forum's discussions later prepared and facilitated congressional approval of the new 2008 Fuel Quality Law.

Commitment to initial reforms facilitated further achievements with air quality regulations outside the transport sector. This success in tackling mobile sources has helped achieve progress in the efforts to collect data on sulfur emissions from industrial sources (also regulated by the new law), with the eventual objective of achieving compliance with the law for fixed sources. Industry representatives used to claim that the government first needed to tackle the bigger problem—sulfur content of mobile sources—before addressing fixed sources (the relatively smaller sources of sulfur emissions than those of mobile sources). The application of the new law to mobile sources and the pact with ECO-PETROL have demonstrated that the government's intentions to pass and, very importantly, to enforce compliance with the new regulations are serious. The regional environmental authorities (*Corporaciones Autónomas Regionales*, CARs), which did not previously succeed in their efforts to improve the quality of emissions from industrial sources, were now able to obtain the required information on emissions from fixed sources. This time, when industrial sources were given two months to comply with reporting requirements, they realized that the efforts to enforce compliance were serious and they provided the required data. This information is used by government agencies to define policy measures and incentives aimed at lowering emissions from fixed sources of air pollution.

The Elements of Success and the Role of the World Bank

Favorable Initial Conditions and Technical Foundation, Culminating in Strategy. The legal framework for Colombia's air quality management system dates back to the 1974 National Code for Renewable Natural Resources and Environmental Protection. Colombia has a fairly long history of air quality monitoring. More recently, the GoC has implemented a series of regulatory reforms, accompanied by the adoption of policies and strategies and by the creation of intersectoral coordination mechanisms that have built upon the 2006–2010 National Human Development Plan's (NHDP's) strategic component on air quality management and have helped achieve notable reductions in air pollution in the country's most contaminated cities.

At the time when the GoC requested World Bank assistance to help strengthen air quality management, the conditions for reforms in that area were favorable and the reforms had strong supporters in MAVDT and the National Planning Department (Departamento Nacional de Planeación, DNP). The strategy included: (i) the development and implementation of protocols to measure emissions; (ii) the creation of emission inventories; (iii) research to better understand the causal links between pollution and health; (iv) the design and approval of an action plan; and (v) the design and approval of a national policy. The benchmark achievements in this area, supported by the package of World Bank support, are the passage of the Air Pollution Prevention and Control Policy (CONPES 3344 [2005]), the passage of the Fuel Quality Law (Law 1205 [2008]), the passage of the Air Quality Law by CNA (2009) and the creation of the National Intersectoral Technical Commission on Prevention and Control of Air Pollution (CONAIRE [2006]), which was charged with the preparation of action

plans to achieve the goals of the 2005 and 2009 Air Quality Policies (see Figure II.2 and Annex Table 1). Ministries of Environment do not always have the convening power needed to coordinate powerful sectors, such as energy and transport. The CEA and Strategic Environmental Assessments (SEAs)

have helped set priorities on the policy agenda, the DPL facilitated the coordination needed to blend the work of the many different sectoral authorities, and the Sustainable Development Investment Project (SusDevInv) has provided earmarked financing to implement priority measures.

Figure II.2. Benchmark Achievements in Air Quality Management and Support by the Bank



Contribution of the World Bank Technical and Financial Assistance

- The 2005-06 Country Environmental Analysis (CEA) influenced the formulation of the urban air quality objectives in the 2006-2010 National Human Development Plan (NHDP), helping solidify the political commitment to reform
- The 2007-08 “Fuels” and “Environmental Health” Strategic Environment Assessment (SEAs) laid out priorities for an action agenda to implement the NHDP’s priorities
- The DPL program has supported the passage of benchmark policies, the Fuel Quality Law, and the formation of the National Intersectoral Technical Commission on Prevention and Control of Air Pollution (CONAIRE) as the prior actions agreed with the government for loan disbursement
- The SEAs informed the discussions of the Academic Forum with 70 stakeholders from government and other institutions and the action plans of CONAIRE; and helped establish priorities eventually addressed by the Fuel Quality Law and the Environmental Health and Air Pollution Control Policies
- The Sustainable Development Investment (SusDevInv) Project that has accompanied the Development Policy Loan (DPL) program, has financed the preparation of the SEAs, the establishment of emissions monitoring protocols, emissions inventories, environmental health studies of air quality in the most polluted sites and other specific investments in strengthening air quality management

The Role of the Country Environmental Analysis.

The CEA's Impact Evaluation has found that the topic of environmental health became pronounced in the 2006–2010 NHDP on the basis of the background studies carried out as part of the CEA (Chavarro Vásquez 2006). The CEA also provided the analytical foundation for the definition of specific policies (CONPES 3343 and the 2005 guidelines), justification for the SEAs, and justification for the conduction of a clean liquefied petroleum gas (LPG) program by ECOPETROL. It also provided the technical foundations for the public debate that ensued in the Colombian media. Congressman David Luna (the representative for the city of Bogotá), “surprisingly well versed” on the CEA's findings and the strategic actions proposed by the report and its background studies, reported that the main environmental priority was the introduction of cleaner diesel for public and heavy transport (Chavarro Vásquez 2006, p. 33). The experts in MAVDT's air quality group have reported that the CEA had made it possible to build public pressure and eventually succeed in passing the new law (personal communication 2010).

The Role of the Environmental Development Policy Loan (DPL) Series and the Sustainable Development Investment Project. The Stakeholder Workshop was held in May 2010 to solicit the participants' comments on the program's achievements.⁸ Overall, DPL support has facilitated an evidence-based policy-setting process with clear assignment of resources and commitment at high

levels and across sectors. According to the National Planning Department (*Departamento Nacional de Planeación*, DNP), the DPL series has had a very positive impact on environmental management in Colombia. The DPLs have helped lock in commitment to reform at the intersectoral level. The CEA, carried out at the start of the program, has helped focus attention on identifying priorities in each area—this is particularly true in the area of air quality management where the cause-and-effect chain is complex—and then developing concrete action plans and regulations to address those areas, and investing in specific measures to achieve progress in the areas identified as priorities. By helping to define a set of clear priorities, the Bank program has (i) helped to join the efforts of different agencies and stakeholders focusing on the priority areas, (ii) created a temporal framework for attaining these objectives, and (iii) provided financing through the SusDevInv Project for actions in these priority areas and helped to assure the fiscal space (budget allocation) to finance these actions in MAVDT and other implementing agencies. In particular, in the area of air quality management, the program owes its success to the ability to establish a clear framework from the prioritization of interventions based on integrated analysis of air quality problems in the CEA, to the establishment of the corresponding policy priorities, and to the allocation of budgets to carry out priority actions in order to achieve progress in these priority areas.

8 Participants have included key staff and technical experts of MAVDT, National Planning Department (DNP), Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), National Administrative Department of Statistics (DANE), the Bogotá Health Department, and other agencies. In a series of meetings with the teams that are in charge of implementing interventions and making the regulatory changes in each area or that are otherwise engaged in that process, the Bank team asked the participants to (i) describe the program's most significant achievements, (ii) assess the DPL's role in reaching these achievements, as well as the role of the underpinning AAA program and the associated SusDevInv technical assistance project, and (iii) respond whether in their view these achievements would have occurred in the absence of support by the DPL.

Can this Approach be Replicated and What May be the World Bank's Role?

The Need to Act at Multiple Levels and Find Customized Solutions. The successful steps toward stronger environmental regulation, with real impacts on the ground and measured air quality improvements, can be replicated in other areas of environmental management in Colombia and in other countries. The case of air quality regulation in Colombia has revealed that success is possible when the process of setting policy priorities directly translates into an action agenda, with earmarked financial resources for the implementation of priority actions. The World Bank and other donors can play a catalytic role in this process by recognizing the windows of opportunity for policy reform, providing timely analytical support to help the governments establish policy priorities, and delivering targeted technical and financial assistance. But this case has also shown that the positive outcomes were a result of the interplay of several factors, starting with the strong domestic commitment for reform and champions at different levels: in the Ministries of Environment and Energy, in Congress and in civil society. This conclusion is in agreement with the findings of the latest research on institutional economics and polycentric governance systems, which emphasize the need to act at multiple levels and find context-specific solutions. This approach calls for flexibility and adaptive management in the design of programs aimed at supporting policy reforms.

Combining Analytical Support, Policy Lending and Technical Assistance for Successful Environmental Outcomes. At a practical level, the experience of the program of environmental reforms in Colombia has shown that a combination of in-

struments—a DPL program supported by rigorous and timely analytical support and technical assistance either through a parallel investment project or linked trust fund-financed operations—can have remarkable outcomes. However, such a program needs to include all three elements. In the case of air quality reforms in Colombia, it is unlikely that the same outcomes would have been achieved if either of the elements of the program was missing. Due to technical complexities, such as the indirect links among investments, environmental quality and health outcomes, it may hold true for environmental programs more than for any other sector that a DPL program needs to be accompanied by technical assistance loans. This experience also suggests that a technical assistance loan alone would not have achieved the same outcomes because the DPL has been instrumental in mobilizing intersectoral coordination. A new lending instrument could be considered; it would automatically combine a DPL loan (normally large) with a relatively small technical assistance loan and earmarked funding for the supporting analytical studies. The proposed new instrument, P4R or Program for Results, which is currently being developed by the World Bank, may offer a much-needed integrated tool for strengthening environmental institutions and governance.

Effective Public Communication of Technical Findings and Environmental Information. This case study also reveals the importance of environmental information and effective communication of the results of technical studies to decision makers and to the public. Strengthening the communication of technical results would significantly increase the impact of the Bank's programs that aim to improve environmental governance, and would also increase these programs' chances of success.

III. Promoting Compliance Through Broader Access to Environmental Justice in Brazil's Public Prosecutors Model

Over the past 50 years, countries in LCR have developed a wide range of environmental laws and institutional frameworks aimed at protecting the environment and promoting sustainable development. However, overall compliance and enforcement of these laws and regulations remain a challenge in the region. Brazil is a notable exception: public prosecutors have played a central role in helping to promote compliance and enforcement of Brazil's environmental law and regulations. This case study describes Brazil's public prosecutors as an enforcement institution, lists key aspects contributing to their success, discusses the possibility of replication in LCR and contributes to the technical discussion on the World Bank's role in promoting environmental compliance and enforcement systems.

Natural assets decline when environmental institutions are weak. A large body of theoretical and empirical studies concludes that environmental performance is correlated with the quality of environmental institutions and the regulatory regime in place, as well as the underlying economic context. The rigor and structure of environmental regulations are two of the main factors, as is an emphasis on enforcement (Esty and Porter 2000). The World Development Report 2003, which focused on transforming institutions, growth and quality of life, stated that *"protective institutions, those that define and control the access and use of assets through norms or the threat of punishment, are es-*

sential for environmental assets to thrive [...] and contribute to growth and human well-being."

The 2001 World Bank Environment Strategy recognized the importance of effective regulatory and enforcement frameworks for improving the quality of growth in developing countries and established the goal to *"promote the introduction and enforcement of efficient environmental and natural resources management institutions, policies and regulations."* Moreover, the Regional Environmental Strategy for Latin America and the Caribbean Region considered it a priority action to *"provide targeted support to client countries for building regulatory and enforcement frameworks."*

These statements still resonate today since many Latin American countries have substantial legal frameworks for environmental protection and have introduced or reformed their laws to enable institutions such as citizen groups or public prosecutors to legally defend environmental rights (e.g., the Public Ministries of Brazil [*Ministério Público*] and Colombia [*Ministerio Público*], or MP], Argentina's and Costa Rica's "Office of the People's Advocate" [*Defensor del Pueblo*], or Mexico's Office of the Attorney General for Environmental Protection [*Procuraduría Federal de Protección al Ambiente*, PROFEPA]). In no other country in the region do public prosecutors have such a broad mandate and are so actively engaged in the mediation of environmental complaints as in Brazil. Brazil's *Ministério*

Público (MP)⁹ has been considered one of the most successful protective institutions in LCR due mostly to an unusually broad constitutional mandate, the presence of appropriate legal tools, and functional, administrative and financial independence from other agencies and political authorities.

Efforts to increase compliance with environmental regulations include a wide range of policy tools that are needed to complement more traditional enforcement instruments. Brazil's MP comprises both deterrence and normative theories,¹⁰ since these can protect environmental causes before courts but also reach cooperation-based enforcement programs; for example, when the perpetrator agrees to stop the transgression or avoid committing it altogether, while the authority agrees to a flexible enforcement process. Cooperation-based enforcement could contribute to increased compliance at a minimal cost, preventing environmental damage rather than reacting to it. This case study describes the case of the MP in Brazil, focusing on the pros and cons of this protective institution, the strategic aspects that could be applicable in the region, as well as the role of the World Bank in promoting it more broadly.

Brazil's Public Prosecutors: The Broadening of the Constitutional Mandate in the 1980s

Since its creation in 1609, the role of the MP in Brazil has developed from that of an entity prosecuting in the name of the State to an entity that can pros-

ecute the State if it breaks environmental laws and regulations. The jurisdiction was broadened three centuries later and the public prosecutor emerged as the key figure in the environmental enforcement arena. Two main legal milestones describe the rise of the MP as an environmental protection institution: (i) the Public Civil Action Law of 1985, which established a legal instrument known as the "public civil action," through which the MP could take to court any "person or entity for harm done to the environment, consumer rights, or the artistic, cultural, historical, touristic and landscape patrimony of the nation;" and (ii) the Constitutional Reform of 1988, which expanded the scope of the public civil action to *defend environmental interests and other diffuse and collective interests*.¹¹

Since then the MP has played a central role in enforcing environmental laws and regulations in Brazil. Indeed, the MP has provided a partial remedy to the "non-enforcement problem" of environmental law in Brazil by overseeing environmental agencies, enhancing accountability, and facilitating access to courts for environmental problems (McAllister 2008). In addition, the MP has worked in Brazil as a countervailing constraint that impedes policy makers from neglecting environmental protection in favor of other pressing concerns such as macroeconomic issues (Mueller 2008). Essentially, the inclusion of the mandate to protect diffuse and collective interests has broadened the MP's jurisdiction to the monitoring of all public policy; social conflicts that were previously addressed in the political and not the judicial arena can now be mediated by the MP (Mueller 2009).

9 The Ministério Público is the Brazilian body of autonomous magistrates formed by public prosecutors. It is a body of the Brazilian judicial system which includes the Procuradoria-Geral da República. The Brazilian criminal investigation police are supervised by the Ministério Público. [Source: [http://en.wikipedia.org/wiki/Public_Ministry_\(Brazil\)](http://en.wikipedia.org/wiki/Public_Ministry_(Brazil))].

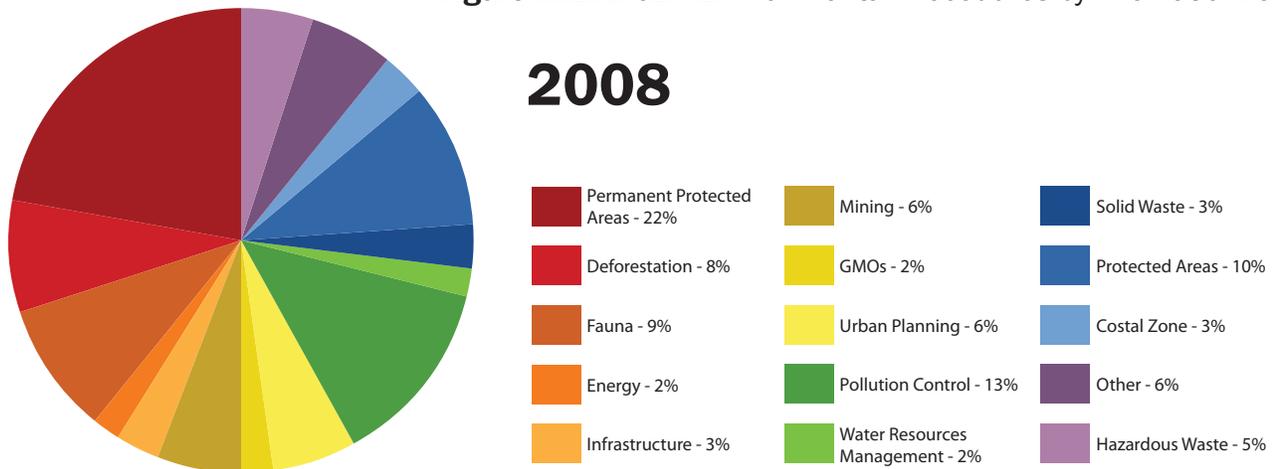
10 Deterrence Theory: Probability of detention, severity of punishments and social stigma deter illegal behavior. Normative Theory: Rewards, incentives and technical assistance promote legal behavior.

11 Diffuse rights or interests are indivisible rights held by unidentifiable persons (community) and are bounded by specific factual circumstances. A typical example is the right of undetermined and undeterminable people to have a sound and balanced environment. Collective interests are indivisible rights held by a group, a category or a class of persons linked to each other or to a certain third party by a legal relationship.

The MP has been actively engaged in cases pertaining to a wide range of environmental issues. In 2008, the majority of environmental procedures were related to Permanent Protected Areas (22 percent), pollution control (13 percent), and Natural Protected Areas (10 percent) (see Figure III.1). To what extent has the active engagement of Brazil's MP in the resolution of environmental conflicts contributed to stronger environmental management? One of the few empirical assessments of the

impact of public prosecutors on environmental outcomes in Brazil has sought to test whether states with more active MPs had a higher perception of environmental quality (Mueller 2009). The hypothesis is that more active MP involvement creates an impetus and public pressure that induce local and national level policy makers to prioritize environmental problems within the broader policy agenda and increase the allocation of resources to address those problems.¹²

Figure III.1. Brazil: Environmental Procedures by Thematic Area



Source: Ministério Público Federal 2009.

One of the MP's most unique characteristics is that in addition to taking a traditional legal approach (threatening or defending environmental causes in the courts), the MP supports environmental compliance by promoting agreement-based compliance through the use of an Environmental Commitment Adjustment Instrument (*Termo de Ajustamento de Conduta*, TAC). TACs allow for the flexible application of legal terms and conditions in exchange for

cessation of environmentally destructive practices. In the last decade, the number of environmental and cultural resources procedures, both court proceedings and TACs, has increased significantly in all regions of Brazil (Figure III.2).¹³ Some of the reasons for the overall increase in the recent rise in the number of TACs as an alternative to court proceedings are the high costs and uncertainty associated with the latter.

¹² Mueller (2009) has regressed the state-level environmental quality index, created with 105,545 data points using municipal level data on the reported perceptions of environmental quality, on several control variables: an index constructed to measure of the strength of public prosecutors in each state, as well as the quality of environmental regulation, income and average education levels in each state. The results of the cross-section regression at the state level suggest that public prosecutors contribute to making environmental regulation more effective, but these results need to be interpreted with caution because the regression includes only 26 observations by state for each of the variables.

¹³ The differences by region could be attributed to the disparity in capacities of MPs in less-developed states located in the Northern region and more developed states located in the Southern region (Mueller 2008).

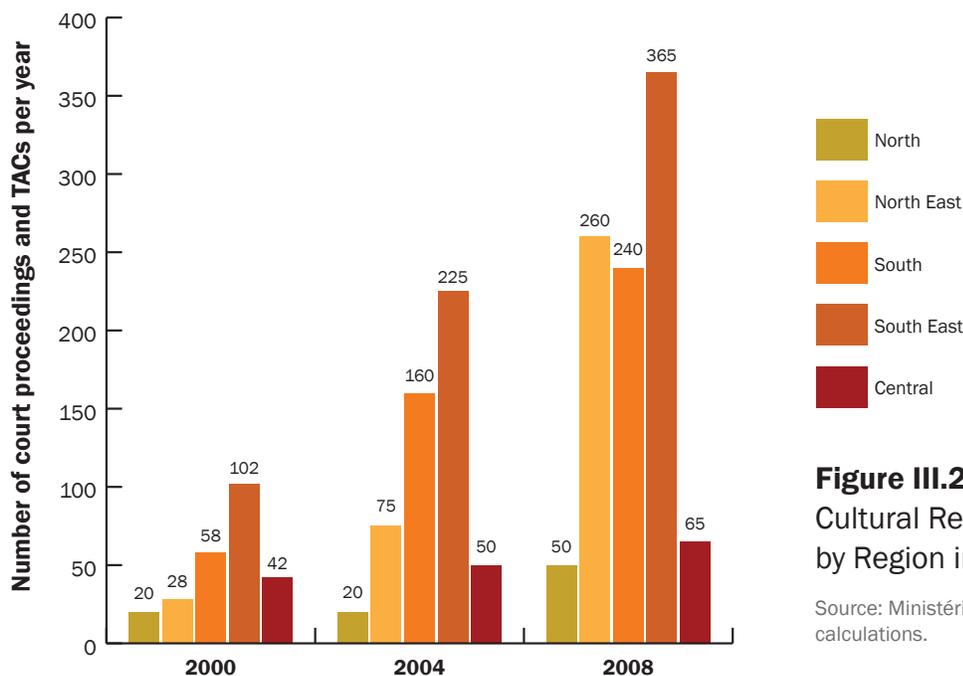


Figure III.2. Environmental and Cultural Resources Proceedings by Region in Brazil

Source: Ministério Público Federal and authors' calculations.

Success Factors and Drawbacks

The MP's success in protecting the environment is mainly due to an enabling environment for carrying out its tasks. A number of studies indicate the following aspects as key contributors to the MP's success in promoting compliance and enforcement of environmental laws and regulations:

Appropriate Legal Tools:

- (i) **Civil investigations:** The Public Civil Action Law of 1985 grants the MP the power to promote civil investigation. In practice, the MP can request free expert advice from the police and other governmental organizations such as environmental agencies in order to build a case for environmental protection (Mueller 2009);
- (ii) **Public Civil Action:** The Public Civil Action Law of 1985 grants the MP and other governmental or nongovernmental organizations the power to bring public civil actions before a court. In practice, environmental organizations often bring

complaints to the MP rather than filing legal actions themselves; they rely on the MP's expertise and capacity to investigate and manage complaints before a court (McAllister 2005);

- (iii) **Agreement-based compliance or TAC:** The TAC is an instrument through which actual or potential perpetrators of damages to the environment agree to take preventive measures to stop illegal acts or damages to public assets and enforce environmental laws and regulations. TACs are considered a faster and cheaper tool for environmental enforcement than the filing of a lawsuit, and have additional advantages such as the perpetrator's voluntary assumption of responsibility (Ninio 2010), which could simplify a later court proceeding if needed. The majority of the MP's environmental investigations result in these types of settlements being negotiated with the responsible party (McAllister 2005).

Functional, Administrative and Financial Independence:

- (iv) The MP's annual budget allocation is fixed and automatic;
- (v) Public prosecutors, working for the MP, have lifetime tenure which is accessed through a public examination open to all citizens with the necessary qualifications, (although public examinations are difficult and the number of candidates often significantly exceeds available vacancies). The 1988 Constitution stipulates that prosecutors cannot be fired, transferred or have their salaries reduced;
- (vi) Salaries are among the highest in the country for public sector jobs and, as a result, they attract highly competent people.

However, the MP's unfettered autonomy, free from hierarchical or external control, has also raised concerns. Public prosecutors' main challenges include:

- (i) Scope of action: Prosecutors have a broad mandate to influence issues that do not fall directly or explicitly under the MP's legal or technical mandate; this could constrict and delay key processes such as environmental licensing;
- (ii) Institutional coordination: The lack of information-sharing mechanisms and coordination between the MP and other environmental institutions might compromise their environmental protection efforts. The MP could place high demands for technical information and assistance on agencies with limited budget and staff resources;
- (iii) Legal certainty: There is little consistency in the response of prosecutors to similar environmental matters. Moreover, for TAC processes there is currently a lack of a standardized process

and format, criteria of uniformity, and transparency, which could hinder the use of TAC as a viable alternative for managing environmental conflicts;

- (iv) Cost-benefit assessment: There is little economic analysis comparing the pros and cons of the MP approach to environmental compliance and enforcement. Ideally, this analysis would facilitate a comparison of the benefits of increased environmental performance directly applicable to the MP's intervention with the cost of said intervention (e.g., time spent preparing and filing a lawsuit). Moreover, economic analysis of the alternative legal tools used by the MP would be desirable. There is a general understanding of the cost-effectiveness of TACs over court proceedings, but there is little analytical underpinning to support that statement.

Can the MP Approach be Replicated and What May be the World Bank's Role?

Central Role of Public Prosecutors in Environmental Regulation and Enforcement. Despite the need to assess the economic and environmental impacts of the MP, it has clearly played a defining role in promoting compliance and enforcement of environmental law and regulations in Brazil. Many Latin American and Caribbean countries are now focusing on finding innovative ways to promote environmental compliance and enforcement. Some of these countries have similar institutions for environmental protection that have been granted more or less power, independence and scope. Certain aspects of Brazil's MP could be replicated in other countries, leveraging and strengthening existing institutions where the following conditions are in place:

- Developed legal framework: Protective institutions need to be developed on the basis of a solid legal framework covering the country's main environmental challenges.
- Protective institutional framework: Protective institutions need to have financial and operational independence (e.g., through automatic and fixed budget allocations, adequate legal tools, etc.) and need to be subject to accountability in order to achieve the optimum level of enforcement.
- Receptive judiciary: The judicial system should have adequate human and budget resources as well as incentives to address cases presented by protective institutions.
- Active and engaged civil society: Although civil society does not generally play a strong role in court proceedings or rulings, it plays a fundamental role in initiating the process by drawing the attention of protective institutions to a particular case.

Technical Assistance to Strengthen Existing Protective Institutions. Increasing the capacity of public prosecutors (or a similar protective institution) to enforce environmental regulations is instrumental in enhancing environmental compliance and performance.¹⁴ One area of support is the provision of technical assistance to strengthen the existing protective institutions by improving the process of setting priorities, facilitating better targeting of enforcement efforts, and improving the cost-effectiveness of the review process. In Brazil, the World Bank is providing technical assistance to the MP in the State of Minas Gerais, with the aim of: (i) modernizing and strengthening its procedures and practices, (ii) enhancing coordination with other institutions, (iii) improving transparency

and accountability mechanisms, and (iv) developing specific tools for improving environmental performance, such as methodologies for quantification of environmental damage and compensation, targeted conflict resolution techniques applied to compliance agreements such as TACs, or performance standard mechanisms. The World Bank is well positioned to provide public prosecutors or similar protective institutions with resources and technical assistance because of its ability to promote intersectoral dialogue and create discussion forums at high levels of decision making, and because of the technical and legal expertise the Bank can offer.

Identifying Opportunities to Pilot the Public Prosecutors' Model or its Elements in Other Countries. Another area of support is to create the windows of opportunity for sharing the lessons of experience and piloting the protective institutions approach in countries where this may be an appropriate model. An in-depth review of World Bank assistance in the area of strengthening legal frameworks and enforcement would show whether or not there is a need to create a specific compliance and enforcement product line in the environment sector (e.g., a Country Environmental Compliance and Enforcement Assessment). In addition, AAA products are needed to deepen the understanding of the economic and environmental impacts of the MP program, as well as its potential replicability in other countries.

¹⁴ In addition, public prosecutors could become strategic allies in monitoring compliance with country and World Bank environmental and social safeguards in investment operations. MPs in Brazil have actively monitored hydropower investment operations and their environmental impacts.

IV. Bridging the Gap Between Science and Decision Making to Address Climate Change in the High Andes

This case study describes an innovative approach to environmental monitoring that could become part of a much broader transformation in environmental management. This transformation is beginning to occur with the impetus of climate change. Adaptation planning requires the integration of climate considerations and response strategies across sectors and government agencies. As highlighted in the 2010 World Development Report “Development and Climate Change,” the achievement of the required levels of coordination calls for a “rethinking of the role of hydrometeorological services” and the creation of a global climate service on the basis of the fledgling regional climate services.¹⁵ The report cites the Pacific Climate Information System as an example of a pioneering agency in charge of providing a regional framework to integrate ongoing and future climate observations, operational forecasting services and climate projections. Another innovative visualization and monitoring system for Mesoamerica, SERVIR, has become the largest open-access repository of environmental information. As shown in this case study, the World

Bank, together with a number of key partners, is providing support to the network of hydrometeorological agencies in the Andean countries in order to monitor and model the status of tropical glaciers, which are central to the economies of the Andean countries.

Glaciers along the tropical portion of the Andes (Venezuela, Colombia, Ecuador, Peru and Bolivia) are retreating and the length and area of all major tropical glaciers has fallen drastically in the last decades (see Table IV.1). This case study could be accompanied by a number of pictures from the beginning of the 20th century until the present, and even the most skeptical person would observe the inevitable: all those masses of ice melt from year to year. Bolivia’s Chacaltaya ski station, the world’s highest, has today become nothing but a gloomy ski lift along bare rocks. The entire glacier is gone. The shrinking ice masses serve as a visual warning, pinpointing the fact that future conditions will not be the same as current ones: some things will have to be done differently.

Table IV.1. Estimated cumulative loss for selected glaciers in the Andes

Glacier	Country	Reference period	Approximate cumulative loss over reference period (length or area)
Antisana 15A	Ecuador	1966-2005	300 m
Antisana 15B	Ecuador	1957-2005	450 m
Yanamarey	Peru	1948-2005	700 m
Broggi	Peru	1948-2005	940 m
Pastoruri	Peru	1980-2005	480 m
Uruashraju	Peru	1933-2005	850 m
Zongo	Bolivia	1948-2005	150,000 m ²
Charquini-S	Bolivia	1941-2005	360,000 m ²
Chacaltaya	Bolivia	1942-2005	195,000 m ²

Source: Based on data provided by the Institut de Recherche por le Développement (IRD).

¹⁵ World Bank, 2010: pp. 296 and 333.

Besides their undeniable aesthetic value, glaciers provide important environmental services. Runoff from glaciated basins is an important element of the regional water budget, with direct impacts on agriculture, water supply and power generation. Runoff is also essential to the integrity of mountain ecosystems. The unique regulatory capacity of glaciers is fundamental for the Andean region: glaciers accumulate fresh water in ice form during the rainy season and slowly release it during the dry season, thus providing this vital element to mountain biomes, to agriculture in nearby communities, to water supply to important urban areas at high altitudes (such as La Paz and Quito), and to hydroelectric power.

Climate change projections indicate that the situation will likely worsen. Extensive research has shown that climate is becoming warmer in high-altitude areas at higher rates than in lower areas (Bradley and others 2006). The national implications of ice-free mountains in the tropical Andes are very significant, challenging present water-use patterns and associated economic activities.

In order to try to understand these changes and their implications for countries, the Bank has engaged in a number of knowledge and on-the-ground adaptation to climate change projects in the region, such as the Integrated National Adaptation Program (INAP) in Colombia, and the Adaptation to the Impacts of Rapid Glacier Retreat in the Tropical Andes Project, which involves Ecuador, Peru, Bolivia and Colombia (World Bank 2008b).

Technology for Management Services

Scientists have developed innovative modeling tools to monitor glacier changes and to inform decision makers on the likely consequences of a warmer future. The World Bank has extensive expertise in the use and application of some of the latest,

state-of-the-art tools, through in-house capabilities and strong partnerships with cutting-edge institutions worldwide, such as the Japanese Space Agency (JAXA), the Meteorological Research Institute of Japan (MRI), the National Oceanographic and Atmospheric Administration of the US (NOAA), the French Institute of Research and Development (IRD) and the Stockholm Environment Institute (SEI). These institutions are partners in a number of Bank projects, and the Bank is now coordinating and jointly making this know-how available to the Andean countries to support them in their efforts to adapt to climate change impacts.

The First Step of This Challenge is to Understand the Evolution of Glacier Cover Over Time.

It is important to fully understand the behavior of glacier masses over the past century and relate them to temperature changes. Knowledge of the past and of variation patterns provides useful insights into future changes in glacier mass, length, melting rates and consequently runoff. To do so, the World Bank, thanks to a valuable partnership with JAXA, is providing high-definition Atmosphere and Land Observation Satellite (ALOS) images for selected mountain ranges over the selected time periods to the participating countries. The participating countries' national hydrological and meteorological services (Institute of Hydrology, Meteorology and Environmental Studies [IDEAM] in Colombia, National Meteorology and Hydrology Service [SENAMHI] in Bolivia and Peru, National Institute of Meteorology and Hydrology [INAMHI] in Ecuador) receive these images, process them, and are able to model the evolution of glacier cover.

The second step is to document actual changes in glaciers and other meteorological parameters and relate them to runoff, hydrology and ecosystems. To do so, and with support from the Government of Japan, eight high-altitude glacier monitoring stations have been acquired, and donated

to the participating countries. These stations will reinforce the national monitoring networks and collect valuable data on both glacier and associated *páramo* (high moorland) ecosystem changes at high altitude. The stations will be operated and maintained by the respective national hydrological and meteorological services, and information will be stored in national and regional databases. The data provide insights on current runoff patterns and are essential to facilitate model calibration and hydrological projections.

The third step and ultimate goal of the exercise is to predict the evolution of the glacier masses in the short, medium and long terms. To achieve this, the World Bank has partnered with the Meteorological Research Institute of Japan and relies on the projections generated by the Earth Simulator. The Earth Simulator is the largest supercomputer of its kind dedicated to climate simulations; it has the capacity to run global circulation models and provide extremely well-defined climate scenario results for the region. Meteorologists of the participating countries attended workshops in Japan, financed by the Japan–Bank partnership, have been trained in the use of the Earth Simulator’s results, and have brought unique databases about expected changes in their climate to their home institutions. These climate change simulations are now being used to create national maps of vulnerability within the participating countries, and to estimate present and future impacts of climate changes on water resources. The national meteorological services are superimposing future temperatures and rain patterns on economic activities, populated areas and development plans. Once completed, the maps will become a powerful tool to guide strategic decisions and sectoral planning in the participating countries.

In partnership with SEI, the Bank has developed a unique model that simulates the response of gla-

ciers to temperature change. The model calculates the Equilibrium Line Altitude (ELA), where glacier accumulation balances with ablation, and predicts at which altitude in the future there will be ice and where there will be water. This has the potential to become a powerful tool to support strategic decision making on matters such as irrigation infrastructure and reservoir locations; and more than 20 scientists and personnel from local institutions have been trained with Bank support to use this tool.

Critical Element of Success—Management in Support of Technology

All previous efforts would fall short of what is needed without appropriate institutional arrangements and prospective management. Closing the gap between scientific information and decision makers is key, and the Andean countries are achieving it. Through the Bank project, all the national hydrological and meteorological services have been strengthened, thus providing them with extra manpower and scientific tools. Through the project, each service has been able to hire highly skilled consultants who assist in the development of scenarios, vulnerabilities and future impact maps. The leading national and international scientists in this area have shared knowledge with other leading institutions around the globe, and have created a virtual community of knowledge in which the latest findings are shared. The joint collaboration among the services of the four participating countries is also key to mutual reinforcement, and workshops are being planned to strengthen this link.

The connection between the national services and the decision-making bodies is the key link. The focal points of the project are located in the Ministries of Environment, which decide on the modalities of supporting their respective national meteorological services and at the same time demand from them tailored information to feed into land man-

agement plans, irrigation schemes, agricultural forecasts, and urban water supply needs, among others. The Ministries of Environment of the participating countries collaborate with the Ministries of Agriculture, Planning and Energy, which are seen by the project as the ultimate clients and users of the updated, high-quality information to help them in mainstreaming climate change impacts into sectoral planning and decision-making processes.

Moreover, the Bank is supporting the strengthening and in-house capacity building of utility companies, such as metropolitan water supply and sanitation authorities. These are key stakeholders in managing national resources and need to make important management decisions based on accurate and tailored data. As an example, the Bolivian National Water and Sewerage Utility (*Empresa Pública y Social de Agua y Saneamiento*, EPSAS), servicing La Paz, has used glacier dynamics modeling and climate predictions from the country's National Meteorological Service to guide its decisions on its high-altitude reservoirs program. The utility's staff has participated in training activities to use glacier retreat models directly applied to its glaciated basins.

Can this Approach be Replicated and What May be the World Bank's Role?

Bridging the gap between scientists and decision makers by building North-South and South-South partnerships. This case study has focused on the role of environmental information and monitoring as an element for strengthening environmental institutions and governance. The Bank has a relatively long track record of supporting collaboration and partnerships among client countries at the scientific level through knowledge products and by sharing the lessons of experience. The potential for South-South cooperation to help achieve sustainable improvements in different areas of en-

vironmental management is now well recognized. The remaining challenge is to ensure that the results of technical modeling, monitoring efforts and scientific exchanges have a real impact on policy making and reach decision makers. Another challenge is to ensure that the collaboration continues beyond the life of a particular project or initiative.

Taking advantage of the focus on climate change to strengthen environmental information on old environmental issues. The impetus to integrate climate change adaptation measures in sectoral strategies has created a window of opportunity to place science at the core of decision making by Ministries of Environment and beyond. This case study shows how the meteorological agencies are becoming more closely integrated with the decision-making processes in the ministries and utility companies. The efforts to strengthen environmental monitoring can extend beyond the realm of projecting the effects of climate change, focusing mainly on deforestation and glaciers as in this case, and can benefit the traditional environmental agenda: the monitoring of air quality, water quantity and quality, and land use. The Bank is well placed to promote these initiatives and help the client countries to ensure that investments in the capacity to strengthen climate monitoring also provide much-needed information for environmental management in other areas.

V. Conclusion

The three case studies presented in this paper demonstrate successful approaches to strengthening the environmental institutions and governance along four dimensions thought to be the critical elements of successful transformation in environmental management: (i) better setting of environmental policy priorities, (ii) strengthening regulatory and enforcement frameworks, (iii) improving access to environmental information and its usefulness for decision making, and (iv) strengthening the role of civil society through providing clear forums and mechanisms for public participation in environmental decision making. Despite the lack of similarity in the context of the three cases, several recommendations are cross-cutting:

- Understanding the need to act at multiple levels to build stronger commitment to reform among different constituencies and find customized and culturally appropriate solutions,
- Supporting a process of setting clear policy priorities based on solid technical assessments, and aligning earmarked resources and technical assistance for the implementation of priority measures,
- Promoting effective public communication of academic research, technical assessments, and policy objectives through a combination of communication campaigns, discussion forums and reaching out to legislators,
- Overcoming the bottlenecks in the implementation and enforcement of environmental regulations is particularly challenging, and there is a need to scale up support for innovative and low-cost approaches to enforcement such as community monitoring and technical assistance for out of court resolution mechanisms (such as Brazil's TACs),
- Bridging a wide gap between scientists and decision makers in the government and private sector would promote the much needed evidence-based setting of policy priorities in environmental management,
- Lastly, the climate change agenda has opened a window of opportunity for the modernization of hydro-meteorological services, with successful examples in the region, and the chance to strengthen the links with decision-making should not be missed.

Annex

Table 1. Steps Toward Achieving Successful Outcomes for Air Quality in Colombian Cities, 2005–2010

Step	Description
The Initial Conditions	Colombia has a long history of air quality management and favorable initial conditions for the reforms that have occurred in the last 5 years. Establishment of first air-quality monitoring networks (1967); first emissions norm for fixed sources (1982); the 2000–2010 National Environmental Health Plan (PLANASA), etc.
The Air Pollution Prevention and Control Policy (CONPES 3344, March 2005)	The Action Plan for the implementation of this policy included two strategic directions: (i) institutional strengthening program for air quality management; and (ii) the purchase and installation of air quality monitoring equipment and conduction of training. The diagnostic study of 7 monitoring networks, carried out in 2007, revealed the need to strengthen the networks and to develop and validate an air quality monitoring protocol in order to standardize measurements.
Country Environmental Analysis (Prepared During 2005 and Published in 2006) <i>by the WB</i>	The CEA's findings on the high health costs of air pollution have informed the preparation of the 2006–2010 National Human Development Plan and are widely cited in the section on air quality management. The CEA's findings have also been taken up by the media and by politicians (especially Congressman David Luna who led a public campaign and later became an author of the draft Fuel Quality Law, which was approved by Congress).
The 2006–2010 National Human Development Plan (PNDH) <i>by the GoC</i>	The PNDH includes prevention and control of environmental degradation as one of the 6 strategic components. It foresees (i) the development of the National Environmental Health Policy (PISA) based on PLANASA; (ii) the creation of the National Intersectoral Technical Commission for the Prevention and Control of Air Pollution (CONAIRE) as the coordinating body for the design, implementation and evaluation of policies, strategies and policy instruments in the area of air pollution control; (iii) the preparation and validation of protocols for air pollution monitoring networks to ensure consistency and comparability of pollution measurements for fixed and mobile sources, with overall coordination by IDEAM; (iv) strengthening of 15 air quality monitoring networks and a diagnostic study of 7 other networks by MAVDT; (v) issuance of emissions standards for fixed and mobile sources by MAVDT; (vi) 5 pilot studies to evaluate the effects of air pollution on health; (vii) the creation of the information system on air quality (SISAIRE), to be administered by IDEAM as part of the Environmental Information System of Colombia (SIAC); (viii) development by MAVDT of economic instruments for reducing air pollution; and (ix) creation of monitoring criteria and indicators to facilitate compliance with norms.

Step	Description
<p>Programmatic Sustainable Development DPL (SusDev DPL) Series (DPL I in 2005, DPL II in 2007, and DPL III in 2009) financed by the WB</p>	<p>The Project Development Objective (PDO) of this DPL series is to support the GoC's efforts to improve the functioning of the National Environmental System (SINA) and integrate the principles of sustainable development into key sectors, with particular emphasis on protecting the most vulnerable groups. Total amount disbursed: US\$900 million (US\$150 million in 2005, US\$200 million in 2007 and US\$450 million in 2009). 3 of 18 indicators in the results framework and 5 triggers related directly to air quality management.</p>
<p>The Sustainable Development Investment project (SusDevInv) and its Additional Financing by the WB (approved in 2005 and closing 3/2015)</p>	<p>The objective of this project is to support the design and implementation of policy reforms and related investments in line with the SusDev DPL program framework. Support has been provided in the areas of (i) the incorporation of environmental considerations in sectoral policies sectors that result in a high cost of environmental degradation; (ii) the implementation of policy measures for integrated water resources management; (iii) the optimization of urban development policy instruments; and (iv) the strengthening of planning, monitoring and oversight of national, regional and local environmental management and policies. The WB provided US\$7 million in financing, with US\$1.05 million in cofinancing by the GoC. The additional financing of US\$10 million, with a 3-year extension of the closing date until 3/2015, has been approved.</p>
<p>Air Quality and Noise Level Standards by MAVDT (Decree 979 and Resolution 601 of 2006)</p>	<p>Update of standards on air quality and noise levels, in agreement with international guidelines. As a result, work on an air quality monitoring protocol, pilot studies and a protocol for emissions inventories began in 2006 (as of March 2010, final drafts of these protocols are undergoing legal review). Supported by the SusDevInv Project.</p>
<p>The Strategic Environmental Assessments (SEAs) of (i) Transportation and Fossil Fuels, and (ii) Environmental Health (financed by the SusDevInv)</p>	<p>The SEA on fuels was carried out to facilitate the preparation of an Action Plan for the implementation of the guidelines of the National Air Policy (CONPES 3344, approved in March 2005). The results of the Fuels SEA were discussed during the November 2007 session of the Academic Forum and informed the preparation of CONAIRE's 2007–2010 Action Plan.</p>

Step	Description
<p>Resolution on Fuel Quality (Resolution 180158, Followed by Resolution 182087, December 2007)</p> <p>Followed by the Fuel Quality Law (Law 1205 of 2008) that Ratified the Established Sulfur Content Limits</p>	<p>These Resolutions, later ratified by the Law, regulate diesel quality by establishing limits on sulfur content in transport fuels. Starting in January 2010, vehicles in Bogotá’s Public Mass Transit System are required to use diesel and gasoline with a maximum sulfur content of 50 ppm. In the rest of Colombia, a more gradual reduction from 3,000 ppm to 500 ppm was envisaged from July 2008 to January 2010, with an eventual introduction of 50 ppm fuels starting in January 2013 for all of Colombia.</p> <p>These Resolutions and the Law were developed by MAVDT and the Ministry of Energy and Mining, with the participation of ECOPETROL in the process, in order to ensure that clean diesel would be available and thereby facilitate compliance with the Law.</p>
<p>Policy on Energy Sources Including Liquid Fuels and their Prices (December 2007)</p>	<p>The preparation of the “Guidelines for the Policy on Energy Sources including Liquid Fuels and their Prices” was based on the inputs of the SEA on Fuels (2007).</p>
<p>The Academic Forum Organized by MAVDT in Collaboration with the University of the Andes (<i>financed by the SusDevInv</i>)</p>	<p>The Academic Forum was organized in December 2007 with the objective of disseminating the findings of the SEA on Transportation and Fossil Fuels. It included 70 stakeholders from the government, academia and the private sector who were consulted in the process of the SEA’s preparation. This forum was organized by MAVDT in collaboration with the University of the Andes, with World Bank financial support through the SusDevInv Project.</p>
<p>The National Intersectoral Technical Commission on Prevention and Control of Air Pollution (CONAIRE)</p>	<p>The main function of CONAIRE is the design and proposal of policies and national strategies in the area of air pollution management for adoption by MAVDT. The commission includes the Ministries of Transport, Mining and Energy, MAVDT, and IDEAM, as well as the National Planning Department (DNP) and ECOPETROL as permanent observers. The commission has operational guidelines and formulates 4-year Action Plans with strategic directions, timeline and performance indicators.</p>
<p>Two Regional Air Quality Round tables for Bogotá and Medellín</p>	<p>The purpose of these round tables is to obtain the information required by CONAIRE in its proposed interventions in the Action Plans and to strengthen the management of monitoring networks.</p>

Step	Description
Air Quality Monitoring Networks and Air Quality Information System, SISAIRE (financed by the SusDevInv)	A diagnostic study of 8 air quality monitoring networks, development of a monitoring protocol based on the results of this study, and purchase of air quality monitoring equipment for 16 environmental authorities (at a cost of over US\$2 million). This translates into an increase in the number of monitoring states by 30% and an increase in available monitoring equipment by 50% compared to 2005. Implementation of SISAIRE by IDEAM, which will make the data from all air quality monitoring networks in Colombia accessible on the web portal administered by IDEAM.
Emissions Inventory, Environmental Health, and Air Quality Modeling Studies and Protocols/Manuals (financed by the SusDevInv)	The following studies were supported by the SusDevInv Project: (i) Emissions Inventory: characterization of PM from point and mobile sources based on a pilot study, and development of a Protocol for Emissions Inventories and 10 manuals for future work on inventories; (ii) a pilot study in Puente Aranda in Bogotá—one of the areas with the highest air pollution in Colombia—as well as in Kennedy and Fontibon in Bogotá on the impact of air quality degradation on morbidity and mortality, particularly for children under age 5; (iii) development of a guide for air quality modeling; and (iv) air quality monitoring protocols.
The National Environmental Health Policy (CONPES 3550, November 2008)	The “Environmental Health” and “Water Quality” SEAs provided inputs in the design of the policy. Approval by CONPES was a trigger for the release of the 3 rd DPL.
The National Air Pollution and Control Policy (Approved by CNA, December 2009)	The policy was approved by CONAIRE in October 2008, and then by CNA in December 2009. Approval by CONAIRE was a trigger for the release of the 3 rd DPL.

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