Report No. _____ - PE

Republic of Peru
Environmental Sustainability: A Key To Poverty Reduction In Peru

Country Environmental Analysis

Volume 2: Full Report

May, 2006

Environmentally and Socially Sustainable Development Department
ica and the Caribbean Region

Document of the World Bank

CURRENCY
Currency Unit = S$ (Soles)
US$1 = S$

FISCAL YEAR
_____ to _____

Vice President:	Pamela Cox
Country Director:	Marcelo Giugale
Sector Director:	Laura Tuck
Sector Manager:	Abel Mejia
SectorLeader:	María Donoso Clark
Task Managers:	Ernesto Sánchez-Triana

ACKNOWLEDGEMENTS

This report was prepared by a team led by Ernesto Sánchez Triana (LCSEN) The core team included: Yewande Awe, Renan Poveda, Carolina Urrutia Vásquez, Maribel Cherres, Angie Alva (LCSEN); William Reuben (LCSEO), Marcelo Bortman (LCSHH), Marea Hatziolos and Poonam Pillai (ENV), Anil Markandya (ECSSD), David Lee (Cornell University), Bjorn Larsen, Santiago Enriquez, Elena Strukova, and Michelle Falck (Consultants).

The extended team included Abel Mejia (LCSEN), Vicente Fretes (LCC6), Maria Donoso Clark (LCSES), Douglas C. Olson (LCER); Juan David Quintero, (LCSEN); Veronica Andino (LCSEO), Alberto Ninio, Charles Di Leva (LEGEN); Michelle Falck, Lenkiza Angulo, Peter Davis, Jorge Elgegren, Juan Carlos Sueiro, Jorge Price, Jorge Villena (Consultants), Manuel Pulgar Vidal and Isabel Calle, (Sociedad Peruana de Derecho Ambiental), Manuel Glave and Rosa Morales (GRADE Consultants). The peer reviewers for the study include Maria Angelica Sotomayor (LCSFP), Dan Biller (EASES), Raul Tolmos (United Nations Development Program), Javier Cuervo and Sergio Ardila (Inter-American Development Bank), and Richard Morgenstern (Resources for the Future).

The Government of Peru, mainly through the Consejo Nacional Ambiental (CONAM), provided key feedback during the preparation of the study and participated actively in the production of diverse parts of the report. Particularly important were the contributions of the following government officials: Carlos Loret de Mola, Mariano Castro, and Gabriel Quijandria (CONAM). The team would also like to thank the following government officials for their feedback: Walter Huanami, Maria Paz Cigarán, Julio García, María Luisa del Río, Iván Lanegra (CONAM), Vilma Morales (DIGESA), Alberto Bisbal (INDECI), Rosario Acero, Manuel Cabrera Sandoval, Antonio Morisaki, Mario Aguirre, Javier Martínez (INRENA), and Héctor Talavera (OSINERG). Also, important feedback was received from members of international donor agencies, non governmental organizations, including Swiss Contact, UNDP. The team is particularly grateful to the Norwegian, and Finnish governments for their support to fund some of the studies that underpin this report through the TFESSD funds.

ACRONYMS

AAN	Agenda Ambiental Nacional
ARI	Acute Respiratory Illness
ATDR	Administraciones Técnicas de los Distritos de Riego
ATFFS	Administración Técnica Forestal y de Fauna Silvestre
BOD	Biochemical oxygen demand
BOT	Build-own-transfer
CAR	Comisión Ambiental Regional
CAT	Comisión Ambiental Transectorial
CDM	Clean Development Mechanism
CEA	Country Environmental Analysis
CEPAL	Economic Commission for Latin America and the Caribbean Comisión Económica para América Latina y el Caribe
CEPIS	Centro Panamericano de Ingeniería Sanitaria y Ciencias del Ambiente
CERs	Certified Emissions Reductions
CFCs	Chlorofluorocarbons
CFV	Certificación Forestal Voluntaria
CH4	Methane
CI	Confidence interval
CIEF	Centro de información Estratégica Forestal
CIF	Centro de Información Forestal
CMLTI	Comisión Multisectorial de Lucha contra la Tala Ilegal
CMRN	Código del Medio Ambiente y de los Recursos Naturales
CNG	Compressed natural gas
CO	Carbon monoxide
COE	Centro de Operaciones de Emergencia
CONAFOR	Consejo Nacional Consultivo de la Política Forestal
CONAM	Consejo Nacional del Ambiente
COSUDE	Agencia Suiza para el Desarrollo y la Cooperación
CTM	Comisión Técnica Multisectorial
DAF	Derecho de Aprovechamiento Forestal
DBO	Demanda Bioquímica de Oxígeno
DEEPA	Dirección Ejecutiva de Ecología y Protección del Ambiente de DIGESA
DESA	Dirección Ejecutiva de Salud Ambiental
DESO	Dirección Ejecutiva de Salud Ocupacional de DIGESA
DIA	Declaración de Impacto Ambiental
DICAPI	Dirección de Capitanías y Guardacostas
DICAREM	Dirección de Calidad Ambiental y Recursos Naturales del CONAM
DIGESA	Dirección General de Salud Ambiental
DINAMA	Dirección Nacional de Medio Ambiente de Pesquería
DINSECOVI	Dirección Nacional de Seguimiento, Control y Vigilancia
DIREPRO	Dirección Regional de Producción
DIRESA	Dirección Regional de Salud Ambiental
DIRTUECO	Dirección de Turismo y Ecología
ECA	Estándar de Calidad Ambiental
ECLAC	Economic Commission for Latin America and the Caribbean
EIA	Evaluación de Impacto Ambiental
EPS	Empresa Prestadora de Servicios de Saneamiento
FAO	Food and Agriculture Organization
FEN	Fenómeno de El Niño
FONAM	Fondo Nacional del Ambiente

FONDEBOSQUE	Fondo de Promoción del Desarrollo Forestal
GACOS	Proyecto Especial de Gestión Ambiental y Consumo Sostenible
Gcf	Giga cubic feet
GDP	Gross domestic product
GEF	Global Environment Facility
GESTA	Grupo de Estudio Técnico Ambiental
GHG	Global greenhouse gases
GNI	Gross national income
GR	Gobierno Regional
GTF	Guía de Transporte Forestal
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
H2SO4	Sulfuric acid
ha/yr	Hectares per year
HC	Hoja de Cubicación
HC	Hydrocarbon
HCA	Human capital approach
IDB	Inter-American Development Bank
IIAP	Instituto de Investigación de la Amazonía Peruana
IMARPE	Instituto del Mar del Perú
INDECI	Instituto Nacional de Defensa Civil
INIA	Instituto Nacional de Investigación Agraria
INRENA	Instituto Nacional de Recursos Naturales
IPCC	Intergovernmental Panel on Climate Change
IPPS	Industrial Pollution Projection System
IRA	Infección Respiratoria Aguda
ITDG	Intermediate Technology Development Group – Soluciones Prácticas
ITTA	Acuerdo Internacional de Comercio Internacional
ITTO	Organización Internacional de Maderas Tropicales
IUCN	World Conservation Union
JASS	Junta Administradora de Servicios de Saneamiento
JICA	Japan International Cooperation Agency
JNUDRP	Junta Nacional de Usuarios de los Distritos de Riego del Perú
JU	Juntas de Usuarios
Kg	Kilogram
km2	Square kilometers
l/s per km2	Liters per second per square kilometer
LFFS	Ley Forestal y de Fauna Silvestre
LGA	Ley General del Ambiente
LMP	Límite Máximo Permisible
LPG	Liquefied petroleum gas
m3/s	Cubic meters per second
MDGs	Millennium Development Goals
MDL	Mecanismo de Desarrollo Limpio
MEF	Ministerio de Economía y Finanzas
MEGA	Marco Estructural de Gestión Ambiental
MEM	Ministerio de Energía y Minas
MINAG	Ministerio de Agricultura
MINEDU	Ministerio de Educación
MINEM	Ministerio de Energía y Minas
MINSA	Ministerio de Salud
mm	Millimeters
MTC	Ministerio de Transportes y Comunicaciones
MVCS	Ministerio de Vivienda, Construcción y Saneamiento

MW	Megawatt
NBI	Necesidad Básica Insatisfecha
NGO	Nongovernmental Organization
NO2	Nitrogen dioxide
NOX	Nitrogen oxide
O&M	Operation and maintenance
O3	Ozone
OAD	Obstructive airways disease
ODS	Ozone-depleting substances
OECD	Organisation for Economic Co-operation and Development
OGE	Oficina General de Epidemiología del Ministerio de Salud
ONERN	Oficina Nacional de Evaluación de Recursos Naturales
ONG	Organización No Gubernamental
OPD	Organismo Público Descentralizado
OPS	Organización Panamericana de la Salud
ORT	Oral rehydration therapy
OSINFOR	Organismo Supervisor de los Recursos Forestales Maderables
OT	Odds ratio
PAHO	Pan-American Health Organization
PAMA	Programa de Adecuación y Manejo Ambiental
PBI	Producto Bruto Interno
PCBs	Polychlorinated biphenyls
PCF	Prototype Carbon Fund
PCM	Presidencia del Consejo de Ministros
PCS-1E	Programa de Ciudades Sostenibles - Primera Etapa
PETT	Proyecto de Titulación de Tierras y Catastro Rural
PGMF	Plan General de Manejo Forestal
PHRD	Japan Policy and Human Resources Development Fund
PIGARS	Plan Integral de Gestión Ambiental de Residuos Sólidos
PISA	Plan Integral de Saneamiento Atmosférico
PM	Particulate matter
PM10	Particulate matter less than 10 micros in size
PM2.5	Particulate matter less than 2.5 micros in size
PNDF	Plan Nacional de Desarrollo Forestal
PNPAD	Plan Nacional de Prevención y Atención de Desastres
PNR	Plan Nacional de Prevención y Control de la Deforestación
POA	Plan Operativo Anual
POP	Persistent organic pollutants
PPM	Parts per million
PRAL	Programa Regional de Aire Limpio
PRODUCE	Ministerio de la Producción
PRONAMCHCS	Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos
PSP	Private sector participation
PTS	Partículas Totales en Suspensión
RAD	Restricted activity days
RAMSAR	Wetlands Convention
RFF	Resources for the Future
RNSC	Civil Society Natural Reserves
RR.HH.	Recursos Hídricos.
RR.SS.	Residuos Sólidos
SDPA	Sociedad Peruana de Derecho Ambiental
SEAs	Strategic Environmental Assessments
SEDAPAL	Servicio de Agua Potable y Alcantarillado de Lima Metropolitana

SEIA	Sistema Nacional de Evaluación de Impacto Ambiental
SENAMHI	Servicio Nacional de Meteorología e Hidrología
SENASA	Servicio Nacional del Sanidad Agraria
SENREM – STEM	Proyecto de Fortalecimiento de la Gestión Ambiental - USAID
SER	Secretaría Ejecutiva Regional
SGS	Empresa SGS del Perú S.A.C. (Société Générale de Surveillance)
SINADECI	Sistema Nacional de Defensa Civil
SINANPE	Sistema Nacional de Áreas Naturales Protegidas
SINDECI	Sistema Nacional de Defensa Civil
SINIA	Sistema Nacional de Información Ambiental
SINPAD	Sistema Nacional de Información para la Prevención y Atención de Desastres
SISESAT	Sistema de Seguimiento Satelital
SNGA	Sistema Nacional de Gestión Ambiental
SNI	Sociedad Nacional de Industrias
SNIA	Sistema Nacional de Información Ambiental
SNMPE	Sociedad Nacional de Minería, Petróleo y Energía
SNP	Sociedad Nacional de Pesquería
SOB	Síndrome Obstructivo
SUNASS	Superintendencia Nacional de Servicios de Saneamiento
TOU	Technical Ozone Unit
TSP	Total suspended particles
TSS	Total suspended solids
TUO	Texto Único Ordenado
TUPA	Texto Único de Procedimientos Administrativos
UIT	Unidad Impositiva Tributaria
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VAT	Value-added tax
VIP	Ventilated improved pit latrines
VOC	Volatile organic compounds
VSL	Value of statistical life
WHO	World Health Organization
WTP	Willingness-to-pay
ZEE	Zonificación Económico Ecológica
μg/m3	Micrograms per cubic meter

VOLUME 2
TABLE OF CONTENTS

COUNTRY ENVIRONMENTAL ANALYSIS: AN OVERVIEW

1.1 Over the last five decades, Peru's environmental management framework has evolved into a large set of regulations, policies, and institutions that aim to respond to the country's environmental concerns. Recent efforts have brought encouraging results, particularly in terms of reducing deforestation, advancing towards the integrated management of water resources, and creating one of the most consolidated systems of Natural Protected Areas in the region. The establishment of agencies, including the Office of Natural Resources Evaluation (ONERN) and the National Institute for Natural Resources (INRENA), as well as the approval of legislation, such as the General Water Law of 1969 and the Law of Forestry and Wildlife (with its first version dating from 1975 and a newer version promulgated in 2000), have been instrumental. However, the country faces significant challenges in terms in controlling pollution and advancing sectoral environmental management, and most importantly, in addressing environmental health impacts, disaster prevention, and risk mitigation. More recently, Peru has taken a number of initiatives to further integrate the different elements of its environmental management framework, including the establishment of the Structural Framework for Environmental Management of 1993, the National Environmental Management System Law of 2004 and the General Environmental Law of 2005.

1.2 Environmental degradation and depletion of natural resources constitute a formidable obstacle to Peru's efforts to eradicate poverty, reduce inequality, and develop a more diversified and resilient economy. As mentioned earlier, the principal causes of environmental degradation represent more than 3.9 percent of the country's GDP, mainly due to increased morbidity and mortality and decreased productivity. Inadequate water supply, sanitation, and hygiene alone is estimated to generate a social cost of over 1 percent of GDP, with 82% of that cost attributed to health impacts that chiefly affect children under the age of five. Indoor air pollution, representing around 0.4 percent of GPD, imposes a significant burden on vulnerable groups, such as children and women of poor rural households, who must rely on solid fuels for cooking and heating, and spend prolonged periods of time in closed areas with high concentrations of pollutants resulting from the use of such fuels. As these two environmental problems illustrate, poor households are often exposed to greater environmental risks, lack the resources to mitigate those risks, and are therefore affected in a way that further reduces their chances of escaping poverty.

1.3 Some of Peru's highest costs of environmental degradation are associated with the country's growing urbanization. Greater concentrations of populations and economic activities in specific areas has led both to high concentrations of atmospheric pollutants and to a larger number of people being exposed to its negative impacts, which represent some 0.9 percent of GDP. Urban populations have also been exposed to lead pollution and are aggravated by inadequate solid wastes collection, amounting to 0.5 and 0.05 percent of GPD, respectively. Urbanization has also meant that a greater number of people are affected and the economy is most severely struck when a city is devastated by a natural disaster, a phenomenon that occurs more frequently, and kills more people, in Peru than in the rest of Latin America. Natural disasters also highlight the importance of sustainable resource management, not only as means to optimize the economic benefits of fisheries, forestry, and other activities, but as an indispensable element in controlling the anthropogenic factors that result in greater vulnerability to natural disasters.

1.4 If managed sustainably, Peru's profuse endowment of natural resources could become a pillar of an increasingly diversified and robust economy. Peru's fishing grounds and natural forests are among the most abundant in the world, while its ecosystems host a wide and highly endemic biodiversity. Each of these factors could support the development of commercially

valuable products, broaden the range of activities fueling the country's economic growth, and generate significant revenues to support the country's social agenda. However, as the analysis demonstrates, institutional and policy failures threaten the sustainability of Peru's natural resources and are largely responsible for leaving their potential fundamentally untapped. Other natural resources, such as water and cultivable lands, are under severe stress. Unless immediate actions are taken to modify the current patterns with which these resources are used, growing resource scarcity is likely to result in heightened social conflict and diminished contributions to the country's sustainable growth by the economic activities that are intensive in these factors (including agriculture).

1.5 Over the past five decades, Peru has restructured its legal and regulatory landscape, undertaken numerous policy initiatives, and dramatically expanded and strengthened its institutional capacity for protecting and managing the natural resources and environmental quality that are vital to sustainable growth and poverty reduction. While the government made significant advances, such as establishing a system of national parks and forestry reserves that covers nearly a quarter of the national territory and phasing out leaded gasoline, it still faces the serious challenge of slowing and reversing environmental degradation.

Objectives of the Country Environmental Analysis

1.6 The objective of the Country Environmental Analysis (CEA) is to present an analytical framework to support the efforts of the Government of Peru toward achieving integration of the principles of sustainable development into country policies and programs and reverse the losses of environmental resources.

1.7 Through its examination of urban environmental issues such as air pollution and untreated drinking water that affect the most vulnerable population groups, the CEA provides the analytical underpinnings to design policies aimed at achieving MDG 4, reducing child mortality, by addressing the causes of respiratory illness, diarrhea and other principal factors in morbidity and mortality for children under age five.

1.8 The findings of the CEA are specifically expected to help design and implement policies to (a) improve the effectiveness and efficiency of Peru's environmental management system, and (b) integrate principles of sustainable development into key sector policies, with an emphasis on protecting the most vulnerable groups. The main elements of the CEA include analyses of (a) the institutional capacity for environmental management in Peru; (b) the cost of environmental degradation; and (c) the effectiveness and efficiency of existing policy, and legislative and regulatory frameworks to address priority environmental concerns.

CEA Process and Linkages with other Bank Products

1.9 The CEA was initiated in October 2005 through a workshop in Paracas, Peru, involving national stakeholders and development partners. Participants included representatives from agencies from various sectors, including environment, health, and energy and mines, regional environmental authorities, the private sector, Non-Governmental Organizations, and international organizations. Workshop participants provided valuable input for the overall diagnosis of the state of the environment in Peru, helped to identify crucial information gaps that needed to be addressed by the CEA, and recounted Peru's progress in establishing a solid environmental management framework. The workshop also constituted an instance to build consensus around the importance, scope, and methodologies used to carry out the analysis.

1.10 The preliminary results of the CEA were presented during the VI Ecodialogue, which took place in Iquitos on March 22 - 24, 2006. The event counted with the participation of more than 400 representatives from public entities, indigenous peoples, professional associations, academic centers, Non-Governmental Organizations and civil society, who engaged in an open dialogue about Peru's most pressing environmental challenges.

1.11 The CEA is aligned with the Peru Country Assistance Strategy (CAS). The CAS aims to address three strategic areas: (i) competitiveness; (ii) equity and social justice; and (iii) institutionality. In terms of competitiveness, the CEA analyses and recommends responses to the main weaknesses in environmental management that have a direct, negative impact on the quality of the country's business climate and the competitiveness of the businesses. Furthermore, the CEA provides the analytical underpinnings to arrest environmental degradation, which is clearly associated with declines in productivity, mainly through negative health impacts, increased vulnerability to natural resources, and reduced yields from overexploited natural resources. Regarding equity and social justice, the CEA focuses primarily on the impacts of environmental degradation on vulnerable groups, particularly the poor and their children. The CEA builds the case for mitigating the environment-related health impacts of vulnerable groups as the GOP's first environmental priority, and includes detailed analysis of the cost-effective interventions that the GOP could undertake to that end. In terms of institutionality, the CEA proposes institutional reforms that would help to increase accountability, improve compliance with environmental standards, and foster an overall better environmental performance. If implemented, these reforms are expected to help the GOP to set environmental priorities, taking into account the voice of multiple stakeholders, and align resources and institutional efforts to address those priorities. Finally, the CEA is part of the CAS renewed focus on environmental issues.

1.12 The CEA builds on previous Bank analytical work. The report "Peru: Environmental Issues and Strategic Options" (World Bank, 2000) provided a first analysis of Peru's most serious environmental challenges and the institutional weaknesses that impeded an articulate response to those challenges. A study of wealth and sustainability in the mining sector analyzed the major environmental and social impacts associated with Peru's mining sector (World Bank, 2005). The CEA deepens the existing analytical foundation by incorporating the findings of the various studies that were commissioned to address existing data gaps, estimate the costs of environmental degradation, assess more thoroughly the impacts of environmental degradation on vulnerable groups, and propose cost-effective policy interventions.

1.13 The CEA provides new insights in areas where the Bank has long been involved. Active Bank projects support Peru's efforts in a number of topics, including: (i) expansion of water supply and sanitation in urban and rural communities, through the Lima Water Rehabilitation and Management Project and the National Rural Water Supply and Sanitation Project; (ii) improving soil and water management in the agricultural sector, through the Agricultural Research and Extension Program (currently in Phase 2) and the Peru Irrigation Subsector Project Supplemental Loan; (iii) establishing cleaner and safer mass rapid transit systems, through the Lima Transport Project; and (iv) strengthening the management of protected areas with the participation of local communities, through the Indigenous Management of Protected Areas in the Peruvian Amazon Project, the Participatory Management of Protected Areas Project, and the Vilcanota Valley Rehabilitation and Management Project. The CEA analyses the institutional frameworks in which these projects take place and recommends policy reforms that if implemented, would facilitate meeting the projects' objectives. Furthermore, such reforms would create an enabling environment in which further projects can take place.

1.14 Further research will be necessary to refine the analysis provided by the CEA on a number of topics. Basic data are missing on most of the critical environmental issues faced by the country. In many instances, including the estimates of the costs of environmental degradation, the CEA attempts to tackles this problem by transferring data from other countries and when appropriate, adjusting for income disparities. In other cases, the CEA identifies the additional analysis that should be conducted prior to deciding whether a specific policy should be implemented. This is the case for most of the policies that are expected to reduce urban air pollution and for the interventions that could be conducted to arrest soil degradation.

CEA Summary

1.15 The report has 10 chapters. *Chapter 1* presents an overview of the report. *Chapter 2* examines the evolution of Peru's environmental management framework over the last five decades. The analysis presented in this chapter finds that the country has developed a considerable institutional capacity that has been associated with important achievements in the areas of natural resource and biodiversity management, but that pollution control and environmental health problems have not been considered generally as national priorities, although the latter currently represents the country's greatest environmental challenge. The chapter also reviews Peru's achievements in the structuring of a National Environmental Management System as well as the related aspects that were being debated at the end of 2005.

1.16 *Chapter 3* analyzes the cost of environmental degradation in Peru. The analysis shows that the environment-related problems with the highest costs are, in decreasing order, inadequate water supply, sanitation, and hygiene, urban air pollution, natural disasters, lead pollution, indoor air pollution, soil degradation, inadequate municipal waste collection and deforestation. The effects of environmental degradation associated with these principal causes are estimated to cost approximately 3.9 percent of GDP, mainly due to increased mortality and morbidity and decreased productivity. The burden of these costs falls most heavily on vulnerable segments of the population, especially the poor and their children under the age of five, who are often exposed to higher environmental health risks than the non-poor and lack the resources to mitigate those risks.

1.17 *Chapter 4* focuses on the health impacts of environmental degradation on both urban and rural communities. The chapter estimates the costs and benefits of various interventions to address waterborne diseases and indoor air pollution, and urban air pollution in Peru. Waterborne diseases exert a significant economic cost, particularly on the poor, who often lack adequate sanitation and water supply. An analysis of various interventions that could address waterborne diseases concludes that the most cost-effective alternative would be the design and implementation of a safe water program that promotes hygienic behavior through hand washing and improvements in water quality at the point of use. Urban air pollution generates a significant environmental health risk for the close to 50 percent of the populations that lives in those areas. Introducing low sulfur diesel would unambiguously result in net economic benefits stemming from associated reductions in health impacts, but further assessment is needed to estimate the efficiency of additional interventions that could help to address the problem in the short run and achieve additional particulate matter emission cutbacks. Indoor air pollution is a particularly severe problem in poor rural households that must rely on solid fuels for cooking and heating. Cost-effective interventions that can reduce the impact of indoor air pollution include the adoption of improved cooking stoves and/or the use of cleaner fuels.

1.18 *Chapter 5* discusses problems associated with natural disasters, particularly floods and landslides. More than 2 million Peruvians were affected by natural disasters during 2000-2004, at

an annual cost of approximately US$ 325 million. The analysis recognizes that while some of these disasters have distinct natural sources, others –notably flooding and landslides- are increasingly influenced by human activities, such as deforestation and practices leading to soil erosion, which modify environmental conditions and create a greater predisposition to more severe effects. The poorest and most vulnerable have paid the highest costs for these disasters in terms of damages, deaths, and lost assets. A number of actions are recommended to address this issue, particularly nonstructural measures to prevent human settlements in areas that are highly vulnerable to natural disasters, as well as specific actions to incorporate risk management in the planning activities of all government levels and to establish the adequate institutional mechanisms for disaster prevention and response.

1.19 *Chapter 6* analyses the issues associated with fisheries resources management. Peru's fisheries resources support one of the country's most important economic activities and provide fundamental environmental services. The occurrence of El Niño Southern Oscillation and the steady expansion of fishing and processing capacity have been associated with an extreme resource volatility that could lead to resource depletion if urgent measures are not adopted in the short run. The sector also faces critical challenges in terms of reducing prevalent economic inefficiencies, internalizing its environmental externalities, and ensuring that the sector contributes substantial leverage to achieve the country's social and economic goals. Meeting these challenges will require conducting an open and transparent process to: i) rationalize capacity and effort in the fishing sector; ii) issue effective and efficient environmental regulations; iii) strengthen the sector's research capacity; iv) initiate a system of Marine Protected Areas; and v) rehabilitate the sector's legal and regulatory framework

1.20 *Chapter 7* discusses the main challenges associated with the sustainable use of Peru's natural resources, particularly water, forests, biodiversity, and soils. While the analysis acknowledges the country's achievements in terms of reducing deforestation, protecting biodiversity, and improving water resource management, it also identifies a series of threats and institutional weaknesses that could undermine the sustainability of Peru's efforts. The chapter includes various recommendations to enhance stakeholder participation in natural resource management, increase the effectiveness and efficiency of the agencies with a mandate for natural resource protection and management, and take advantage of the country's comparative advantage in natural resources to develop commercially valuable products.

1.21 *Chapter 8* discusses sectoral environmental management in Peru, which has been fundamentally based on the environmental impact assessment (EIA) system. The analysis finds that the effectiveness of EIA in Peru is, however, undermined by the lack of a uniform perspective regarding its objectives and usefulness. Specifically, there exists an ambiguity among government authorities as to whether its purpose is to achieve environmental planning or environmental management. The chapter highlights the need for the government to clarify the purpose of EIA and identifies the need to develop, in addition, appropriate instruments to deal specifically with environmental problems that are linked to market and policy failures.

1.22 *Chapter 9* reviews the environmental management framework in Peru and assesses the complex institutional system of checks and balances. It finds it has adequate financial resources, but that it is unable to effectively support government efforts to promote environmentally sustainable development due to lack of attention to and allocation of human and financial resources to tackle key environmental priorities linked to economic development. The chapter highlights the need for policy and institutional changes to address these factors and to target complementary investments toward areas that impose high economic costs but that have not been adequately tackled. In particular, increased efforts are needed to improve the quality of life of the

growing number of poor people living in and around urban areas in a country where more than 70 percent of the population is urban. The goal of the recommendations is to support the country's efforts to move toward more equitable and sustainable economic growth.

1.23 *Chapter 10* presents the CEA's conclusions and recommendations. The conclusions stress that while there has been considerable progress in addressing biodiversity conservation agenda in the last decades, the high urbanization rates suggest the need to increase emphasis on environmental health issues. However, the environmental management agenda has yet to catch up with this shift in priorities from biodiversity conservation to environmental health problems because mechanisms in the current institutional structure to signal these changes are not yet in place. Improved monitoring and dissemination of information on environmental outcomes, assignation of accountabilities for environmental actions and outcomes, and involvement of a broad range of stakeholders are three important mechanisms to allow these signals to be picked up.

AN EVOLVING ENVIRONMENTAL MANAGEMENT FRAMEWORK

To address the historical challenges posed by the extraction of natural resources and the resulting environmental degradation, the evolution of the framework for environmental management in Peru has focused on five core areas: (i) management and use of natural resources; (ii) use and conservation of biodiversity; (iii) pollution control and sectoral environmental management; (iv) environmental health and management; and (v) natural disasters. These areas have been determined by economic development, population trends, and global environmental priorities. The current framework has yielded significant achievements, a number of reform proposals are currently under discussion in Peru, ranging from the creation of centralized agencies for enforcement of environmental regulations and a water agency to the development of measures to mitigate impacts of large investment projects.

Introduction[1]

2.1 The evolution of the environmental management in Peru has responded primarily to economic development and global environmental issues. The extraction and exports of Peru's natural resources (minerals, agricultural products, hydrocarbons, rubber, fisheries, and wood) has been a central pillar in the history of economic development of the country and has influenced its social and economic structure. Throughout Peruvian history, however, the repetition of a pattern can be observed, through which a commodity triggers an economic boom that is shortly followed by resource depletion and collapse (Castro, 2005). Some commodities that have experienced these boom and collapse cycles include guano (between the 1850s-1870s), saltpeter (1860s – 1870s), rubber (1890s – 1910), and anchovies (1960s - 1970s). The mining sector has proven to be an exception, as it has remained a pillar of the national economy since colonial times. Nevertheless, the sector has not been exempt of problems, including a decline in mineral production during the late eighteenth century that had economy-wide implications.

2.2 Efforts to address the challenges posed by the sustainable exploitation of natural resources in Peru have been focused on five issues, historically considered to be in greatest need of regulation and enforcement. The one to receive the most attention has been the management and use of renewable natural resources. According to official data, 65% of Peru's population lived in the Sierra in 1940 (INEI, 1999). High population density in an area with scarce agricultural land contributed to a decrease in farm size and intensification of agricultural practices that eventually led to loss of soil fertility, decreased yields, erosion, and ultimately migration to other areas.

2.3 Partly as a response to these issues, the *management and use of renewable natural resources is* an area in which significant efforts have been made, such as the investments in irrigation and decentralization of water resources to Water User Boards (WUBs – Juntas de Usuarios) and the duplication of agricultural production between 2000 and 2005. Other significant achievements include the establishment of the institutional conditions for the sustainable management of the forest's resources in the legal framework of the Forestry Law of 2000 (Pulgar Vidal, 2005). The revised rate of deforestation (150,000 ha/year) is significantly lower than in neighboring countries (Brazil, Bolivia and Ecuador).

2.4 The *Conservation of Biodiversity and Natural Protected Areas* (NPA's) also has had considerable achievements, which include: (i) the enactment of the Natural Protected Areas Law

[1] This chapter draws from background documents prepared by Pulgar-Vidal (2006), D. Lee (2006), D. Olson (2006) and G. Castro (2005)

of 1997, which defines the role of the country's protected areas to conserve biological diversity and their associated cultural, landscape, and scientific values, and the establishment of the National System of NPA's which currently comprise 17.66 million hectares, or 13.74% of the country's total area; (ii) creation in 1992 of the Peruvian Trust Fund for National Parks and Protected Areas (PROFONANPE); and (iii) the increasing number of specialized non-governmental organizations which support the efforts on biodiversity conservation and protected areas.

2.5 *Pollution Control and Sectoral Environmental Management* has been fundamentally based on a framework of environmental licensing and enforcement based on environmental impact assessment (EIA) and environmental management and adaptation/compliance program (PAMAs) as its core instruments[2]. Until recently, the development of economic activities and adoption of land use patterns took place in the absence of adequate environmental safeguards. Although mineral resources have been extracted for centuries, it was only in the early 1990s that the Government of Peru (GOP) took the first steps to address the environmental and social impacts of the mining sector.[3] In this context, effluents and materials generated by mining activities were not adequately disposed of and generated significant impacts on ecosystems and public health. Unsustainable agricultural practices were associated with the most significant environmental problems during the 1940s – 1970s, when most of Peru's population was rural. Since 1992, a number of ministries established environmental units for the implementation of environmental regulations and maximum permissible levels (LMPs). Sector specific laws and regulations have been developed since 1993, particularly for some key sectors such as mining and energy[4].

2.6 A fourth core area is that of *Environmental Health*. Efforts to manage environmental health began in the 1940's through the General Directorate for Environmental Health (DIGESA) of the Ministry of Health (MINSA). DIGESA has faced numerous institutional challenges which have affected its overall capacity. Nonetheless, there have been recent milestones in environmental health such as the establishments of a program to improve personal hygiene and promote safe water programs and the phase-out of leaded fuel in 2005.

2.7 Regarding *natural disasters*, historically, the National Institute for Civil Defense (INDECI) has emphasized disaster mitigation and relief rather than disaster prevention (including the analysis of disaster risk) and adaptation. Only in the past five years have institutions begun to evolve toward designs of action plans for disaster prevention, risk assessment, and the reduction of vulnerability.

2.8 Attempts to integrate these areas have been made through the enactment of integral national legislation and the creation of a national environmental authority, the CONAM (Table 2.1). Such efforts include the incorporation of environmental considerations in the 1979 and 1993 constitutions, the enactment of framework laws such as the National Code for Environment and Natural Resources (*Código Nacional del Medio Ambiente y los Recursos Naturales*, CMARN), the Structural Framework for Environmental Management of 1993 (*Marco Estructural para la Gestión Ambiental*, MEGA), The National Environmental management System Law of 2004 (*Ley del Sistema Nacional de Gestión Ambiental*) and the General Environment Law of 2005, (*Ley General de Ambiente,* LGA).[5].

---

[2] Environmental impact studies became integral 'assessments' after the EIA Law of 2001.

[3] Since 1993, Peru has taken concrete steps to mitigate the negative social and environmental impacts of the mining sector, including: (i) creating an institutional framework to harmonize institutional responsibilities and environmental legislation; (ii) developing environmental sectoral norms; (iii) defining environmental standards for water, air, and soil quality; and (iv) elaborating an inventory of mining environmental liabilities, among others (World Bank, 2005).

[4] The Ministry of Mining and Energy, for instance, has developed at least 13 laws and rulings that directly address environmental issues pertaining to the mining sector.

[5] Table 2.1 does not provide an exhaustive list of all the environmental functions assigned by the legislation to governmental agencies, it provides a list of only the governmental agencies with a major environmental role, based on the review of relevant legislation.

Table 2.1. Landmarks in the evolution of environmental management in Peru

Year	Landmark
1962	Establishment of the ONERN
1969	Enactment of the Sanitary Code (now abolished)
1969	Enactment of the Water Law
1975	Enactment of the Forestry and Wildlife Law (now abolished)
1977	Conservation Units Regulation enacted
1979	New Peruvian Constitution Creation of the Peruvian Amazon Research Institute (established by Law in 1981)
1984	Creation of a Task Force for the development of the Environmental and Natural Resource Code (*Codigo de Medio Ambiente y Recursos Naturales* CMARN)
1989	Multisectoral Commission report for the solution of the problems at Ilo and Ite Bays
1990	Enactment of the National Code for Environment and Natural Resources CMARN (Legislative Decree Nº 613)
1991	Legal and political framework to foster incentives for private investment Framework Law for Private Investment Growth (establishes the sectorial based environmental management, Legislative Decree Nº 757)
1992	Peruvian report for the UN Conference on Sustainable Development National Conservation Strategy. PROFONANPE established
1992 - 1993	ONERN phased out INRENA established
1993	New Constitution passed
1994	CONAM established
1996 - 1997	Design and enactmentof the legal framework on natural resources • Organic Law for the Use of Natural Resources • Law for the Conservation and sustainable use of Biological Diversity • Law for Natural Protected Areas
1996 - 1997	Ecodialogues begin and National Environmental Agenda is discussed MEGA established
1998	Approval of the Environmental Quality Standards (ECA), and Maximum Permissible Levels (LMP)
2000	Design and approval of the political and fiscal policy for forestry Regional Ecodialogue
2001	Environmental Impact Assessment System and Solid Waste Laws approved
2002	Forestry Development Law established
2004	SNGA Law enacted Regional and Local Systems for Environmental Management General Environment Law Bill presented
2005	National Environmental Agenda 2005-2007 approved
2006	General Law of the Environment

(Source: Pulgar Vidal, 2005)

2.9 This chapter examines the evolution of Peru's environmental management framework which has been closely tied to the economic development of the country. The findings of this chapter are based on secondary information and interviews conducted in Peru during 2005. This chapter is organized in eight sections. Section two provides a historical perspective to natural resources management in Peru. Sections three through six respectively describe the evolution of the environmental management framework in each of the following areas: renewable natural resource management, ecosystem conservation, pollution control, and environmental health. The seventh section presents the advanced achieved in the structuring of the National Environmental Management System. Finally, the eighth section presents an outlook on the state of the debate on the framework for environmental management at the end of 2005.

Table 2.1 Main functions related with environmental management and conservation in governmental agencies in Peru

Ministry	Agency	Acronyms	Main functions
Agriculture	National Institute of Research and Agricultural Extension	INIEA	Agricultural research, innovation and technology transfer, including forestry and bio-safety
	National Institute of Natural Resources	INRENA	Design, monitor and control norms and actions related to (1) water resource management, (2) conservation areas management; (3) forest and wildlife management.
	National Program for Watershed Management and soil conservation	PRONAMACHS	Coordinate the promotion of integrated watershed management and sustainable rural development in the Andes with governmental and non governmental agencies
	National Service of Agrarian Sanitation	SENASA	Coordinate the National System of Organic Production, the National System of Grains and the National Program to Monitor Toxic Waste. Control that agricultural inputs do not exceed the maximum permitted limits (LMP).
	National System of Natural Protected Areas	SINANPE	Head of the National System of Natural Protected Areas
Defense	Directorate of Coast Guards, Port Authority	DICAPI	Enforce water contamination regulations in coastal areas Control and prevent the entrance of ships in national waters when they carry hazardous substances under risk conditions.
National Service of Meteorology and Hydrology		SENAMHI	Evaluation, study and classification of climate and water resources and their sustainable use
Education		MINEDU	Incorporate environmental education into national education programs
Energy and Mining		MINEM	Monitor air quality and atmospheric emissions, waste disposal and maximum permitted limits linked with mining activities Control the compliance with norms for the sustainable exploitation of the hydrocarbons' sector.
	Supervising Body of Energy Investments	OSINERG	Approve gas-processing systems, design and control compliance with norms for private energy companies and energy concessions Verify compliance with the Complementary Environmental Plans (PAC) in the hydrocarbon sector
Production		PRODUCE	Monitor emissions to air and water linked with the industrial and fishing sectors. Monitor implementation of approved EIA or DIA.
	Peru Sea Institute	IMARPE	Provide the scientific basis for the rational management of marine natural resources.
Health	General Direction of Environmental Health	DIGESA	Evaluate environmental risks and control compliance with environmental health standards (air, water resources and safe drinking water).
Transports and Communications		MTC	Propose LMP for emissions issued by vehicles. Regulate solid waste management in the transport sector. Coordinate with DICAPI to reduce pollution from ports and coastal activities.
Housing, Construction and Sanitation		VIVIENDA	Promote, manage and build drinking water and sewage services infrastructure. Regulate solid waste disposal in the sector. Monitor liquid domestic residue. Propose the necessary LMP to achieve the national standards on air quality.
Interior		MININTER	Control implementation of the Solid Waste and Forestry and Wildlife Laws jointly with competent authorities.
Presidency of the Ministers Council	Presidency of the Ministers Council	PCM	Approve proposals of Standards of Environmental Quality and Maximum Permitted Limits jointly with CONAM
	National Environmental Council	CONAM	Coordinate environmental management among all relevant agencies. Establish criteria for activities of monitoring policy implementation. Supervise the GESTAS for Air and Water. t. Lead the definition of Standards of Environmental Quality and Maximum Permitted Limits
	Research Institute on the Peruvian Rain Forest	IIAP	Research, inventory, evaluate and control the rainforest natural resources
National Superintendence of Sanitation Services			Supervise the compliance with the norms regulating the provision of public services of sanitation and the preservation of water resources.

A Historical Perspective

2.10 Peru's economy is highly dependent on its rich natural resource base. Extraction of natural resources has taken place from before the arrival of the Spaniards; and while there is no scientific evidence to conclude that natural resource degradation was more intense during the colonial period, , a selective extraction of key resources intensified after conquest in order for Peru to meet its mercantile needs with Spain (Castro, 2005). Once the Viceroyalty of Peru was established, silver, gold, and copper became the principal source of wealth for the crown[6]. Most of the core economic activities during the colony concentrated in the highlands, but all the wealth and resources passed through Lima (the seat of the viceroyalty and the main port). Thus, natural resources extraction became dependent upon a centralized political and economic structure based in Lima, in a pattern that persists until today. The extraction of key resources such as minerals and expansion of agricultural activities have contributed through time to degradation of soils, erosion and sedimentation of watersheds and to an accumulative pollution of soil lakes and rivers (i.e. mercury has been used since colonial times for silver extraction)[7].

2.11 For instance, by 1841 the Inca fertilizer guano and saltpetre began to be widely exploited. Guano became the most important resource in Peru during the mid-19th century, both for its use as a fertilizer and as fire-powder. By 1859 guano represented close to 75 percent of all income, but soon after, production collapsed due to lack of investments in the industry, poor policies and unfavorable prices (Castro, 2005).

2.12 Likewise, the rubber business in the Amazon basin had a rapid growth period from 1890s until it collapsed by 1910. The anchoveta industry became an emblematic example of a vast resource which was overexploited and poorly managed from 1960s until mid 1970s. The collapse of each of these commodities had specific reasons which, among others, included weak management and poor policy formulations. Furthermore, an expansion of agro-industrial activities from the beginning of the 20th also failed by 1969 when the agrarian reform was implemented and redistributed land property rights. In addition, in spite of introducing technical features (i.e. vapor-run motors for draining purposes), and creating administrative reforms, the mining sector, which has been on a continued basis the most important economic activity since colonial times, also suffered a gradual decline in production..

2.13 During the 20th century the economy began to diversify and important investments were made in irrigation in the coastal region to support the growing sugar and cotton plantations. The key resources being exploited during the 20th century included copper, sugar, gold, cotton, wool, rubber, fisheries silver, and later hydrocarbons. Each of these activities led to specific environmental impacts mainly in the highlands, and to a lesser extent in the coastal and rainforest regions. For instance, a growth of the mining sector in the 20th century led to the creation of smelters at Ilo and at La Oroya. These smelters have contributed, through time, to severe air and water pollution. In addition, a large number of mines have close during the 20th century without the adequate measures, leaving behind environmental legacies. A preliminary inventory carried out by the Ministry of Energy and Mines in 2003 identified about 610 mining environmental legacies (not including from state owned companies), from which 28 percent lacked a legal owner.

[6] Organized mining began by 1540 and covered the following key mine deposits during colonial period: Potosi (1545-1776) in Bolivia; Castrovirreyna (1590) in Huancavelica; Oruro (1608) in Bolivia; Caylloma (1608) in Arequipa; Laicacota (1619) in Puno; and Pasco in the 1700's.

[7] By the end of the XVI century, different regions had specialized on certain crops: (i) the northern coast (Piura and Tumbes) focused on cotton and goats; (ii) the central coast (Lambayeque to Lima) in sugar; (iii) southern coast (from Ica to Arica) on wineries; (iv) the northern sierra focused on cattle ranching; (v) the central Sierra focused on wheat, corn and cattle ranching; and (vi) the southern Sierra focused primarily on tubercular roots, camelids, and cattle.

2.14 After mining, industrial growth began around Lima, and fishmeal factories were established along the coastal areas. Oil and gas have been also key economic activities developed through the early 1900's. However, oil production in Peru has declined steadily over the past two decades, as the country's fields have matured and no major new discoveries have provided additional reserves. In contrast to production, Peru's oil consumption has grown over the past 20 years, reaching 161,000 bbl/d in 2004. Peru has been a net importer of oil since 1992, with most imports coming from Ecuador and other South American countries (US Department of Energy, 2005). Regarding gas, the *Camisea* Project is the most notable example in Peru, and one of great importance to the environmental sector. It comprises the exploitation one of the most important non-associated natural gas reserves in Latin America, the construction and operation of two pipelines, one for natural gas (NG) and one for natural gas liquids (NGL) and the distribution network for natural gas in Lima and Callao.

2.15 A growing rural sector compounded by weak agricultural practices also led from the 1940's to environmental impacts as pesticides and fertilizers began to be over utilized, and the agricultural frontier expanded into forested areas. Limited productivity of soils for agriculture in the highlands combined with relative and high population density led to a growing migration to urban centers in the coast. Migration also increased during the 1980's due to a growing wave of rural violence and terrorism by the Shining Path. Thus, urban centers (particularly in and around Lima) grew disproportionately since the 1950's. Urban environmental problems such as air pollution, poor water quality, solid wastes issues, intensified. During this period the fishmeal plants began to be developed along the coast, contributing to foul smell and pollution near urban centers.

Conservation and Administration of Natural Resources

2.16 In 1962, Congress established the National Office for the Assessment of Natural Resources (ONERN) was established through a supreme decree in order to systematically collect and analyze information and propose policies for the sustainable use of natural resources. The mandate of this Office was to centralize the evaluation of natural resources and to develop basic documents to inform the economic and social development plan and its sectoral programs, as well as to guide structural reforms. Thus, ONERN became the base for the administration and conservation of natural resources in Peru between 1962 and 1992. The Office gave priority to the development and promotion of the agricultural sector, which traditionally has been very important in the portfolio of state investment projects as a way to stimulate the economy in rural areas. Investments in this sector focused on integrated watershed management projects, which included reforestation, land use management, erosion control, and aquaculture. ONERN had a number of commendable achievements which include the publication of the *Guidelines on the Policy for the Conservation of the Renewable Natural Resources in Peru*, which became an important technical underpinning for the National Strategy for Conservation.

2.17 In 1992 the ONERN was transformed into the National Institute for Natural Resources (INRENA), reducing many functions, particularly those of collection and analysis of information for decision making regarding the state of natural resources and their potential. The enactment of the 1993 Constitution and the incorporation of the Chapter on Natural Resources also strengthened the regulatory framework for the conservation and management of natural resources[8]. During the development of the Constitution, the Organic Law for the Use of Sustainable Resources, enacted in 1997, defined the State's scope and the ways in which it would facilitate the access of individuals to resources for their use.

[8] The initiative to incorporate natural resource considerations in the Constitution was led by two environmental NGOs, *Sociedad Peruana de Derecho Ambiental* (SPDA) and *Pro-Naturaleza*, between 1992 and 1993. The participatory process included the conformation of a Working Group with representatives of the private and public sector that received input through workshops in the different regions.

2.18 Consequently, in 1993, INRENA became the principal agency responsible for natural resources management in Peru. Its mandate includes: (i) the management of public forests; (ii) overseeing the 61 natural protected areas; (iii) overseeing wildlife exports and for-profit captive breeding enterprises; (iv) controlling illegal trade in flora and fauna; (v) promoting sustainable management of the nation's soils and water resources; and (vi) validating environmental impact assessment of sectoral economic activities in rural areas. Being the environmental agency with the largest share of resources, INRENA has made substantial progress in a number of areas. INRENA internal organization evolved into three key departments: (i) the intendancy for Natural Protected Areas; (ii) the intendancy for Forestry and Wild Fauna; and (iii) the intendancy for Water Resources. In addition, INRENA's office of transectorial environmental management has the responsibility for validating EIA's, PAMA's and promoting inter-institutional coordination[9].

Water Resource Management

2.19 Since the 1970´s the ONERN identified the importance of the use of water for agricultural purposes. This originated not only in its sheer volume, but because it generates a significant percentage of GDP, traditionally over 10 percent. In addition, agricultural activity involves more than 30 percent of the Peruvian population. (ONERN, 1969; ONERN, 1984, Pulgar Vidal, 2005). Historically, the agricultural sector uses more than 86 percent of the water available for consumption. It is worth noting that most agricultural production comes from the coastal region, the most arid in the country, and where consequently water availability has been a major constraint. This is largely due to the considerable imbalance between the two main regions in the country: the Amazon area, one of the richest in water resources in the world, and the Pacific basin; a region characterized by the presence of the majority of the country's population, characterized by low precipitation, and numerous but often intermittent water courses. Agriculture is thus highly dependent on irrigation from these limited sources. As a result, the average per-capita water availability in the Pacific basin is only one-third of the world average (INRENA, 1995). For the above-mentioned reasons, the General Water Law of 1969 establishes the Ministry of Agriculture as the National Water Authority.

2.20 In 1992 INRENA, as a decentralized organism of the Ministry of Agriculture, assumed the management of water resources. Within INRENA, the Water Resources Intendancy (*Intendencia de Recursos Hídricos*) assumed the management of water resources, including the supervision and control of policies, plans, programs, projects and norms on its sustainable use. The General Water Law of 1969 and the CMARN have provided Peru with an adequate stock of policy tools, as evidenced by investments of about US $5 Billion between 1970 and 2005 in irrigation related hydraulic infrastructure including dams and irrigation and drainage systems.

2.21 In addition, agricultural exports have become increasingly important in Peru's economic development and growth. From 2000 to 2005, agricultural exports have more than doubled, in part due to INRENA's water resources management. Beginning in 1998, the responsibility for irrigation operation and maintenance has been transferred from the government to Water User Boards (WUBs – *Juntas de Usuarios*). Since the transfer, fees have gradually increased and collection has improved considerably. In addition, a water rights system has been initiated that includes: (i) a strict analysis of water availability and demand; and (ii) linkage to land administration policies and (iii) development of a Geographic Information System that includes land titling and water rights. By 2005, INRENA had issued more than 200,000 water user permits. This water right system along with the land titling has resulted in reduced conflicts and frustrations among the farmers, and provided legal certainty that encourages investment in on-

[9] INRENA has the mandate to review and provide technical observations of EIAs and PAMAs associated with agriculture projects and activities affecting protected areas. In addition, INRENA can issue a technical opinion on EIAs for mining and transport related projects.

farm improvements. The water rights allocation system is a regional model for water rights registry across the region.

2.22 A national strategy for water resources management was developed in 2004. Based on this strategy, between 2004 and 2005 a major effort was made to update the General Water Law. Currently a Bill establishing a National Water Resources authority and River Basin Agencies, and modernizing water resources management is awaiting congressional review. These institutional reforms are similar to Brazil's recent institutional restructuring in the water sector that have proved to have important institutional advantages for water resources management. This Bill was drafted with the participation of different entities of the central government and included significant participation from the National Water User Board (WUB). It is expected that the issuance and implementation of the proposed reforms embedded in the Bill would provide an opportunity to make major additional advancements in the agricultural sector through sustainable integrated land and water resources management (INRENA, 2005).

2.23 Compared to other developing countries, Peru is well placed to make important headway towards achieving sustainable integrated water resources management and ensuring that water availability is not a constraint to growth. In particular the water rights system once fully implemented and operational along with water availability and land use information will provide necessary elements for water resources planning at the river basin level. The WUBs provide an important basis for bringing water user participation into the planning and management mix. The institutional reform including the creation and strengthening of a National Water Resources Authority and River Basin Agencies would provide an excellent institutional framework in support of these objectives.

Forestry Resource Management

2.24 Prior to 2000, Peru's forest sector has been governed by the 1975 Forest and Wildlife Law (Law No. 21147). The law was conceived as a redistributive mechanism to alleviate rural poverty by encouraging resource-poor loggers to enter into sustainable forest activities[10]. A number of initiatives followed, including preparation of a National Forestry Strategy (1985-1996) and a national debate that extended over much of the 1990's, which eventually led to the passage of the formulated Forestry and Wildlife Law (No. 27308) in 2000. In 1993 INRENA's (through the Forestry Intendency) assumed responsibility for managing forestry related programs. The new Forestry Law is designed to promote the reform and modernization of the country's forest sector. The regulatory framework supporting the law was passed a year later in 2001. Following the enactment of the law and regulatory framework, a national debate sparked in Congress and in public fora between timber industry representatives and those with a stake in the old system, as well as local and international organizations, community leaders and other authorities. The new Forestry and Wildlife Law aims, among other things, to transform the sector into an integral part of sustainable development. The key element of the new Forestry Law is the introduction of timber concessions under the supervision of INRENA[11]. INRENA launched the forest concessions process in March 2002, after establishing the technical and administrative forestry base suitable for timber production[12]. The Law also defined a new policy

[10] While the law was a milestone for the sector, it had a number of drawbacks, including lack of recognition of the needs of indigenous populations, the granting of excessively small (1,000-ha) annual forestry contracts, and the encouragement of an exploitative relationship between small loggers and the timber industry and middlemen.

[11] The Forestry and Wildlife Law of 2000 and its 2001 Regulation permit other forms of access to timber resources: 1) permits from native communities; 2) permits from private agricultural and grazing plots; 3) extraction from local forests; 4) authorizations from Northern tropical dry forests; 5) authorization for clear cutting (e.g., for road opening); and 6) authorization for the use of trees and shrubs stranded on river banks. Other forms of access to non-timber resources include: 1) Brazil nuts concessions; 2) afforestation/reforestation concessions; 3) conservation concessions; 4) protection concessions; 5) ecotourism concessions.

[12] The total area of potential forest concessions amounts to 24.34 million ha, almost 15 million of which are in Loreto. By end of 2004, over 7.5 million hectares of forest had been awarded in the form of forest concessions to 576 concessionaires for timber production in Madre de Dios, Ucayali, Huanuco, San Martin and Loreto.

for forestry management based on consensus and sustainable use for economic development. For instance, the *Forestry Committees of Dialogue and Consensus Building (Mesas de Diálogo y Concertación Nacional*) have generated agreements on issues such as: (i) the conformation of the commission for the public bids for forestry concessions for timber products; (ii) regulations related to the price of user's rights; (iii) a timeline for the concessions; (iv) the concession contracts; (v) the regulations for local forests; (vi) the rules for he Management Committees; and, (vii) the initiative for the creation of the Multisectoral Commission for illegal logging.

2.25 The new Law also reformed the concession process, providing regulations to save valuable species such as tropical cedar (*Cedrela odorata*) and big-leafed mahogany (*Sweitenia machrophylla*) from commercial extinction. Likewise, the new Forestry Law also introduced some other innovative features, such as the definition of a new category for forest use – Forest Recuperation Areas, where concessions can be granted on bare or open land for afforestation and reforestation. Among the most important features of the law are requirements for sustainable management plans based on forest inventories and censuses, and forest resources access rights. Such access is secured by renewable forty-year forest concessions of at least 5,000 hectares granted through a public bidding process aimed to ensure transparency. In addition, the law introduced the possibility of establishing payment for environmental services schemes provided by forests for soil protection, water regulation, biodiversity conservation. In August, 2005, INRENA formed a task force to plan PES implementation.

2.26 The new Forestry Law and its regulations also allowed for the creation of new forestry agencies, such as the National Consultative Council for Forestry Policy (*Consejo Nacional Consultivo de Política Forestal,* CONAFOR), the Supervising Organism for Timber Forestry Resources (*Organismo Supervisor de los Recursos Forestales Maderables*, OSINFOR), and the Fund for the Promotion of Forestry Development (*Fondo de Promoción del Desarrollo Forestal*, FONDEBOSQUE)[13], among others. The Law also promoted the establishment of *'Local Forests'* (500-ha forest plots for use by local communities). Based on the new legal framework, and the promotion of the central government towards decentralization, INRENA has the capacity to grant forestry concessions to Regional Governments which can create ad hoc Commissions to participate in public biddings. Since 2003, the regional governments of Loreto, Ucayali and Madre de Dios have established ad hoc Commissions for this end.

2.27 As part of the implementation of the new Forestry Legal Framework, the Government developed the National Strategy Against Illegal Logging. A Commission against illegal logging (*Comisión Multisectorial de Lucha Contra la Tala Ilegal*), presided by the Minister of Agriculture was created in 2002 to develop and implement the National Strategy, which focused in the eradication of the extraction and commercialization of illegal forest products in the Peruvian Amazon (Pulgar-Vidal 2006). Though a supreme decree in 2004 the National Strategy and the "Committee" against illegal logging became effective but now under the mandate of the PCM, which has the role for the implementation of the national strategy. Amongst the achievements of the Commission (which only became operational in March 2005) are: (i) strengthening INRENA's organizational and institutional capabilities in forest control and supervision; (ii) designing and implementing a system for law enforcement, timber tracking, forest raids and timber trade transparency (including strengthening the chapter on infractions and sanctions of the under the Forestry Law); (iii) impounding wood from illegal logging (particularly in Madre de Dios and Ucayali); (iv) promotion of and support for civil society and local population participation in forest control and supervision (v) setting up control posts in

[13] The Forest Development Promotion Fund (FONDEBOSQUE) is a public-private organization (presided by the head of INRENA) and funded primarily by the donor community. Its objective is to promote investments in sustainable and competitive forest enterprises and in environmentally responsible projects generating economic opportunities and conservation of biodiversity. As of July, 2005, its portfolio amounted to US$20.4 million (82.3%, from international donors) on implementation of forest concessions (15.2% of portfolio), intermediate technology for sustainable forest use (3.7%), forestry plantation development (27.4%), sustainable communal forestry management (19.4%), and its own institutional creation and strengthening (49.6%).

Madre de Dios to control illegal logging ; and, (vi) designating an ad hoc Prosecutor for illegal logging in Ucayali. As part of the strategy, INRENA is in the process of establishing a digital database to effectively review, evaluate and manage concessions nationwide.

2.28 The annual rate of deforestation as recalculated recently by the National Capacity Strengthening Program to Manage the Impact of Climate Change and Airborne Pollution (PROCLIM), is 149,632 ha. per year.This rate is significantly lower than than previously assumed (around 261,000 ha) and also lower than in neighboring countries (D. Lee & J. Elgegren, 2005). There are concerns that illegal logging and coca production are fueling a fast deforestation rate in some regions of the Amazon basin. The government of the San Martin Region, for instance, recently declared environmental emergency due to the fast deforestation in the past years. According to Research Institute of the Peruvian Amazon (IIAP), from 5,125,003 ha of forested areas in the state of San Martin , more than 1,300,000 have been already been cut down, at a rate of 40 ha per day.

2.29 While Peru has made progress since 1975 with regards to forestry related legislation, the evolution of forestry management has been characterized by a weak institutional framework (both at ONERN and at INRENA) since it: (i) has been short in resources, adequately trained staff, and adequate reliable forestry data; (ii) has faced excessive bureaucracy, and (iii) has being unable to address simple but key issues (i.e. not working on weekends unlike illegal loggers who do).

Reforestation Efforts

2.30 While in 2005 Supreme Decree No. 003-2005-AG declared deforestation as a national priority and assigned the responsibility of preparing the *National Reforestation Plan* to INRENA and a number of other institutions (the plan has been approved in January 2006 through a supreme resolution)), there have been previous noteworthy efforts to promote reforestation activities. Some of the early reforestation programs date back to the 1960s (supported through an IADB loan), which allowed the replanting of 56,000 ha until the mid 1970's. Thereafter the Amazon Reforestation Royalty in the 1980's allowed for the reforestation of 100,000 ha. Since 1988, the National Watershed Management and Soil Conservation Program (*Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos*, PRONAMACHCS) has promoted numerous reforestation campaigns. The result of these efforts is the growth of forestry plantations from about 262,997 hectares in 1990 to 754,244 ha in 2003 (FAO and INRENA, 2005). Most of this reforestation was done in land designed for watershed protection, but not for timber production. In addition, the Fujimori administration launched the *Sierra Verde Project* (1995-96) which aimed at developing a reforestation strategy, including the reforestation of 1 million trees in different regions of the country, including the dry coastal areas.

2.31 Since its creation, in 2003, one of the key components of FONDEBOSQUE has been the promotion of forestry plantations. FONDEBOSQUE is currently supporting reforestation activities in Cajamarca, San Martin, Ancash, Junin and Madre de Dios, including the reforestation of 30,000 ha in Villa Rica, Oxapampa and Pozuzo with natie communities and small and mid-size enterprises. Reforestation is also part of the debate of the current presidential elections, as the APRA party has been promoting the *Sierra Exportadora* which seeks to reforest the highlands which have been affected by deforestation and promote the commercial timber potential of the country. ,

Conservation and Sustainable Use of Biological Diversity and Natural Protected Areas

2.32 The Peruvian government's protected areas policy started in 1961 when it created the country's first national park (Cutervo NP). Since the ONERN publication of the Policy

Guidelines for the Conservation of Natural resources in Peru in 1974, a strategy was established for the "conservation of soils, water, vegetation and animal life" (ONERN, 1974). Thereafter, the Forestry Law of 1974 and its regulations for Conservation Units led to the establishment of 7.5 million hectares, equivalent to 5.8% of the national territory, as natural protected areas. A major breakthrough was the creation of the National System for Areas Protected (*Sistema Nacional de Áreas Naturales Protegidas por el Estado*, SINANPE) in 1990 (constituted by conservation units, national forests, boundary posts, and other categories of public interest established by the agrarian sector with conservation ends). Since, the system has grown to 61 protected areas comprising 17.66 million hectares, and representing 13.74% of the country's total area.

2.33 In 1997, Congress enacted the Law for the Conservation and Sustainable Use of Biological Diversity and the Law for Natural Protected Areas (Law No. 26834). This Law established the activities permitted in each category of national protected areas and divides those that are for direct and indirect use (National Parks, National Sanctuaries, and Historical Sanctuaries) where extractive activities are not permitted. In addition, the Natural Protected Areas Law also regulates the buffer zones and establishes management committees which facilitate the participation of civil society in the co-management of protected areas. The results of this legal framework have been positive, and include the recognition of the strategic value of biodiversity, the development potential of regulations on access to genetic resources and the importance of the protection of traditional knowledge. Since the enactment of the Natural Protected Areas Law, the system assigned for conservation purposes has more than doubled in size[14].

2.34 The policy framework for biodiversity conservation became reinforced with the Environmental Code (1990), the signing of the Convention on Biological Diversity (1992) and the new National Constitution (1993). Ratifying the Convention on Biological Diversity in 1993 triggered several initiatives to meet its commitments to the international treaty including: (i) the passage of the Conservation and Sustainable Use of Biodiversity Law (1997); (ii) the Protected Areas Law (1997); (iii) The National System Plan of Protected Areas (1999); (iv) the National Biodiversity Strategy (2001); and the Law for the National System of Environmental Management (2004). All these legal instruments clearly define the need for participatory procedures in their application. Furthermore, the results of these laws have led to the recognition of the strategic value of biodiversity, the development potential of regulations on access to genetic resources and the importance of the protection of traditional knowledge. Conservation on Biodiversity has thus become one of the priority areas in the environmental agenda.

2.35 By 1992, the Peruvian Trust Fund for Protected Areas PROFONANPE was established as a private entity with the purpose to obtain and promote the financing for the conservation of protected areas. PROFONANE was established with seed funds (US$5.2 million) from the Global Environment Facility (GEF). Since its inception PROFONANPE's endowment fund has increased to US$10 million [15].. PROFONANPE has also: (i) administered a number of projects with foreign donations (i.e. GEF-Participatory Management of Protected Areas Project); (ii) has provided procurement management services for projects implemented by INRENA (i.e. GEF Indigenous Management of Protected Areas Project, the Natural Protected Areas Project by the KfW); and (iii) coordinated bi-lateral nature swaps (i.e. governments of Finland, Germany, Canada and the EU). The resources for protected areas come from a number of donations and nature swaps primarily from the GEF, the governments of Canada, Finland, Germany (GTZ and KfW), Holland, and the United States. In addition, grants from the McArthur and Moore Foundations, and international NGOs (Conservation International, The Nature Conservancy,

[14] Manuel Pulgar-Vidal (2006).

[15] Based on data provided by PROFONANPE (2005), and exchanges with Alberto Paniagua, Executive Director of PROFONANPE, Manuel Pulgar-Vidal (SPDA) February, 2006.

WWF) have been managed by PROFONANPE[16]. The financial resources for the management of protected areas are on average come from the following sources: (i) international agencies and bilateral agreements (59.9%); NGOs (17.6%); government (12.5); and multilateral agencies (10.4%) (Pulgar Vidal, 2006).

2.36 The 18 programs and projects which PROFONANPE has supported have been carried out in: (i) the Cerros de Amotape, Río Abiseo, Huascarán, Yanachaga Chemillén, Manu, and Bahuaja Sonene Natural Parks; (ii) the Machu Picchu and Manglares de Tumbes sanctuaries; (iii) the Pacaya Samiria, Lachay, Paracas, Salinas, Aguada Blanca and Titicaca reserves; (iv) the reserved zones of Tumbes, Tambopata, Candamo and Manuñ; (v) the El Angolo Boundary Post; and (vi) the Alto Mayo Protected Forest. PROFONANPE has provided a crucial technical and administrative support to the Intendancy of Protected Areas (IANP) at INRENA (established in 1993), which has the responsibility for the management of the SINANPE. The evolution of the support and financing provided by PROFONANPE has been based more on a reaction towards the specific demands of the donor community, than by a specific demand or strategy developed with INRENA (Manuel Pulgar Vidal, 2006).

2.37 The regulations for the Natural Resource Law, enacted in 2001, have significantly contributed to strengthen the conservation of biodiversity. Based on this Law, INRENA is testing innovative approaches to manage protected areas whereby local (indigenous) communities and NGOs can participate in the co-management of selected areas. By 2005, the creation of the first regional reserve, the Cordillera Escalera in San Martin, demonstrated the potential of decentralization of responsibilities for natural resources management.

2.38 Discussions have recently arisen among key stakeholders stemming from the proposal, by the National Association of Mining, Oil and Energy (SNMPE) to modify the Protected Areas Law so that National Parks and Sanctuaries, currently off limits to exploration and extraction, can be cleared for exploitation of mining and hydrocarbons. SNMPE proposes that in exchange, companies pay a fee to the Protected Areas Fund (PROFONANPE).

2.39 Given the limited technical and administrative capacity that the IANP has to efficiently manage the Natural Protected Areas System, and its low capacity to spend even the resources from donor assistance, there are proposals being discussed to reform the IANP and establish it as a stand alone national park service institute in charge of the protected areas and biodiversity issues (outside INRENA and the Ministry of Agriculture). It is believed that this autonomy would provide the new institution with the flexibility to hire qualified staff (currently INRENA has limitations on human resources) and reduce the bureaucratic processes which may turn it into a more efficient agency.

2.40 The National Environmental Fund (FONAM) was proposed by a legislator in 1995 as a means to collect and fund-raise the necessary resources to finance the programs being developed under the environmental agenda with the recent creation of CONAM (Manuel Pulgar Vidal, 2006). Consequently FONAM was created in 1997 through Law No.26793, with the purpose to promote public and private investment in programs, projects and activities destined to improve environmental quality. FONAM remained for years without any resources until 2000 when, through a World Bank-GEF operation on sustainable transport, received the necessary budget to begin operating. Since, then, FONAM has defined its areas of action which cover: (i) energy; (ii) transport; (iii) forestry, water and waste; and (iv) mining environmental legacies. The first two areas are directly linked to climate change. As for the latter, the recently approved Law for Environmental Legacies of Mining Activities (*No. 28271*), assigns the mandate for fundraising and financing for the remediation and rehabilitation of legacies to FONAM.

[16] All of the resources which PROFONANPE has either: (i) raised for the endowment fund; (ii) administered as an implementing agency; (iii) channeled through debt for nature swaps; (iv) channeled as a financial management agency for INRENA (including those funds which have long closed or which are pending disbursement) add to US$90.6 million.

FONAM has very limited technical capacity on miming related issues, and thus, its main agenda has been related to climate change related issues.

Pollution Control and Sectoral Environmental Management

2.41 Before 1990, the actions to control water, air, noise and visual pollution were traditionally managed in a fragmental manner, by different organisms including the ONERN, the Ministry of Agriculture and the Ministry of Health. To integrate these actions, Chapter XXII of the CMARN incorporated norms to regulate the evaluation, enforcement and monitoring of natural resources management. In 1991, through Legislative Act No. 757, the Framework Law for the Growth of Private Investment abolishes Chapter XXII of the CMARN and formalizes the administrative distribution of environmental management among line ministries or sectors. The Law establishes that the ministries or enforcement agencies that correspond to the activities carried out by the interested party are responsible for the environmental implications proposed. Since 1991 actions for pollution control have therefore been undertaken in the framework of a process of division of environmental management between line ministries. (Box 2.1).

2.42 Between 1993 and 1994 the regulatory framework for the promotion of investment and a technical assistance loan from the World Bank to the mining and energy sectors positioned the Ministry of Energy and Mines to lead the process of sectoral environmental legislation development by establishing environmental norms for the mining sector, and the first sectoral environmental units in the country. These norms gave priority to key environmental management prevention and control tools which include: (i) environmental impact assessments (EIAs);(ii) environmental management and adaptation/compliance programs (*Programas de Adecuación y Manejo Ambiental*, PAMAs); and (iii) maximum permissible levels (*Límites Máximos Permisibles*, LMPs) were developed to control projects and industries in the mining and energy, fishing and industrial sectors. The mining and energy sector's initiative extended to the fisheries and transport infrastructure sectors.

2.43 The legal framework left the regulations for environmental assessment and pollution control to the determination of each environmental authority in the line ministries. The regulations developed by the different sectors vary in the requirements and on the capacity to carry out an adequate enforcement. Since 1992, some ministries established environmental units for the implementation of environmental regulations and LMPs. The first units to be created were the General Directions for Environmental Issues in Mining and Energy, in the Ministry of Energy and Mines, followed by the National Environmental Directions for Fisheries and Industry in the Ministry of Production, the Direction for Social and Environmental Issues in the Ministry for Transport and Communications; and the Environment Office in the Ministry of Housing, Construction and Sanitation. Likewise, Congress created by Law a Supervising Organism for Energy Investment (*Organismo Supervisor de la Inversión en Energía*, OSINERG) in 1996. OSINERG is an autonomous entity under the PCM and subscribed to the Ministry of Energy and Minis responsible for controlling the compliance of technical and legal norms related to the protection and conservation of the environment in the electricity and hydrocarbon sub-sectors..

Box 2.1. The Roots of Sector Based Environmental Management

There are multiple roots to the current scheme of sector based environmental management. Even before the modification to the CMARN in 1991, attributed for legalizing the sectoral-based approach to environmental management, there were sector based processes and incentives already in place. The Legal Decree 757 (after the modification of the CMARN) simply ratified a sector based environmental management which was already in existence.

One of the roots for this approach is based on the decentralization and regionalization pushed from 1985-1990 led by the national government of Alan Garcia. During this period, many of the government responsibilities, including environmental ones, such as regulation of mining operations, were delegated to regional governments. This led to a number of inefficiencies and overlaps among government agencies[17]. This decentralized approach was opposed by the private sector which claimed it was inefficient. Among the reforms established by the Fujimori administration in 1992, was the re-centralization of many government functions, including the empowerment of certain sectors to carry out key enforcement functions (Pulgar Vidal, 20065).

Another source for this is within the first version of the CMARN, which established that the General Comptrollers Office (*Contraloría General de la República*) would have specialized jurisdiction to supervise the national compliance with the code. This led to an indirect environmental enforcement of certain private sector activities (particularly for the Southern Peru Mining company which was associated with environmental pollution problems, during the 1980's). The comptroller's direct involvement in environmental issues resulted in the private sector's strong rejection of this approach, Under CONFIEP's leadership. the private sector successfully lobbied for a change in the enforcement methodology in favor of one based by key sectors, to avoid this type of situations.

Finally, in the early 1990's the Peruvian Government was determined to promote investment and address key sector crisis faced at that time, particularly with regards to mining and energy (which included the paralysis of mining activities in rural areas due to terrorism, the collapse of the state-owned mining operations, and the decline of investment in public enterprises due their costly and inefficient operational structure). Thus, by 1991 the Fujimori regime, sought the support from international agencies (including the World Bank) to encourage investment in energy and mines, modernize the sector, and strengthen the environmental sectoral approach. As a result, the World Bank assisted the Government of Peru in its efforts to: (a) establish enabling conditions to attract mineral investments; (b) reform the role of the government from that of owner to regulator; and (c) shift the responsibilities for operational activities to the private sector through the implementation of first generation reforms of the mining sector carried out under the Bank-financed Energy and Mining Technical Assistance Project (EMTAL). This project, initiated in 1993, is credited with catalyzing many key regulatory and institutional changes that promoted environmental practices in the mining sector led by the Ministry of Energy and Mines. EMTAL also helped shift sector policy toward a strategic vision for the mining sector. The changes produced by the new regulations fostering private investment paved the way for today's large- scale mining projects.

It is worth noting that these processes occurred at a time when the central environmental agency was being established with a weak structure and mandate and which begun with the key coordinating role among key sectors. Acording to Manuel Pulgar Vidal (2006), no concrete model was followed for the sector based approach for environmental management. Depending on the resources, political will and commitment by key sectors (such as mining and energy) the sector-based approach has led to concrete results. However, it also resulted in an inherent conflict of interest stemming from the fact that the line ministry is supposed to be both the key promoter and the environmental regulator of a complex sector.

[17] For instance, in 1990-1991 the Ministry of Energy and Mines and the Regional Mining Directorate in Piura conflicted over environmental problems associated with the Turmalina Mine.

2.44 The main instruments for regulation used by the sectoral environmental units, EIAs and PAMAs, differ in their scope and methodology. To homogenize EIA processes, Congress approved the National Law for the Environmental Impact Assessment System (*Sistema Nacional de Evaluación de Impacto Ambiental*, SEIA) in 2001. Regulations for the Law have not been issued for a set of complex issues. After the approval of the Law, Congress set a 45.day period for the approval of the Regulations. CONAM summoned the participation of key sectors to discuss and endorse the proposed Regulations for the SEIA, but omitted the participation of NGOs, who therefore later questioned the technical soundness of the regulations. This led to the establishment of a special commission which finished the proposed regulation after 18 months and received the final endorsement from all key sectors, civil society, and the private sector (Pulgar Vidal, 2006). After the Regulations were finally submitted in 2003, a parallel process began whereby congressmen submitted proposals to modify the SEIA Law[18]. These dynamics distressed the Presidency of the Council of Ministers (PCM) which felt it would be inappropriate to endorse the regulations of a Law which was being questioned by different constituencies.

2.45 Since then, the General Law of the Environment has been approved. The new Law calls for additional modifications to the proposed Regulations, including new roles for CONAM, and the establishment of Strategic Environmental Assessment. The EIA law is therefore yet to be appropriately regulated and is currently being reviewed by the PCM, which is proposing that the law be endorsed by consensus among different constituencies, including the Afro-Peruvian, Andean, and Environmental commissions in Congress.

2.46 The environmental management and adaptation/compliance program (PAMA) was designed for polluting production activities which existed prior to the relevant environmental legislation. PAMAs are required for all activities but to date have been principally applied to the priority sectors of fishing, mining, energy and manufacturing industry.

2.47 Regarding LMPs, 1996 the Ministry of Energy and Mining determined a series of values for wastewater discharges in the hydrocarbon, miming, metallurgic and electricity sub-sectors. In 2002, the Ministry of Production established LMPs for effluents in four sub-sectors: tanneries, paper, cement and beer. These limits refer to effluents in superficial water bodies and the public sewage system. With the exception of some regulated parameters in the mining and tannery sectors, the regulated parameters refer to substances with negative aesthetic effects or to the balance of some ecosystems. Parameters such as biochemical oxygen demand (BOD), Chemical Oxygen Demand (COD), iron, oil and greases, total suspended solids, Ph, or Temperature, however, do not impair human health through water use for agriculture, cattle, industrial or recreational ends. Mining and tanneries are the only sectors to regulate substances with negative effects on human health, such as chromium for tanneries, lead in hydrocarbons, and lead, copper, arsenic and cyanide in the mining sector.

2.48 Traditionally, air pollution problems have received low attention from environmental authorities. Although in recent years CONAM has established technical committees (GESTAS) responsible for the development of ambient standards for air, water, and solid waste. Between 1965 and 2005, for example, in Ilo the main source of air pollution has been the smelter operated by the Southern Peru Copper Corporation. In 2005, the smelter emitted an average of 1400 TM of SO2 by day. It also emitted particulate matter containing arsenic and heavy metals such as copper, cadmium and lead. In 1989 (prior to the creation of PAMAs), Southern agreed with the government (through a multisectoral committee) on investments to control the pollution emissions. Southern should be complying mitigation measures by 2007.

[18] The proposed changes included calling for a different institutional arrangement in the final approval of EIAs, establishing different categories of EIAs, and changes to the standard terms of reference.

2.49 The attention of national authorities (particularly the Ministries of Energy and Mines, Industry and Transport, NGOs and the media focused on the approval of EIAs and PAMAs of large investment projects, particularly of the hydrocarbon and mining sectors. Projects such as the development of the gas pipeline of Camisea and the construction of the *Interoceanic* highway have been the focus of considerable attention.

2.50 As of December of 2005, discussions were underway about the need to reform the environmental enforcement and licensing framework, particularly among stakeholders who question whether the current system of granting environmental licenses and enforcement within line ministries is efficient, neutral and unbiased. Likewise there was a notion that there is an imbedded conflict of interest when the line ministry in charge of promoting a specific economic activity has the capacity to effectively regulate it on environmental grounds. These notions have led to two proposals being debated at the highest levels of government: (i) the creation of a centralized environmental regulatory body (*Procuraduría Ambiental*) to address the enforcement of all productive sectors (as proposed by the prime minister); or (ii) the establishment of independent environmental regulatory bodies for each sector, following the model of the already functioning OSINERG (as proposed by the Minister of Energy and Mines). The Ministry of Justice has yet to assess these proposals (Castro, 2005).

2.51 Other discussions underway by December of 2005 included proposals to update and improve environmental regulations of Mining Sector and environmental standards for water resources. In 2005, 12 years after the issuance of the first generation of environmental regulations for the sector, the Ministry of Energy and Mines was proposing that, the Environmental Quality Standards (ECAs) and the LMPs be updated for 2006, and that the environmental norms of the sector be improved. The same claims were made by key stakeholders regarding environmental standards, and there were ongoing efforts to clarify the roles and responsibilities of government agencies, including monitoring, and enforcement of environmental standards.

Environmental Health, Waste Management and Reduction of Vulnerability to Natural Disasters

2.52 Government support and commitment for environmental health management has been mixed. In 1947 the first agency to address specific environmental health related aspects in the workplace was established. The *Instituto Nacional de Salud Ocupacional* – INSO (the National Institute of Occupational Health), was set through a cooperation program between the Peruvian and the United States government. The initial purpose was to reduce the high incidence of silicosis and other occupational diseases that had been affecting Peruvian mining workers for some time. A growing public awareness of these problems influenced the government's decision to participate in this program and establish INSO. With time, the Ministry of Health widened its environmental health responsibilities to include aspects such as pollution control, food quality control, and basic sanitation.

2.53 In 1985 the National Council for Environmental Health Protection (*Consejo Nacional de Protección del Medio Ambiente para la Salud*, CONAPMAS). To widen the scope of its actions, the Health Ministry changed the name of the institution to National Institute for Environmental Health Protection (*Instituto Nacional de Protección del Medio Ambiente para la Salud*, INAPMAS). Further on, the Occupational Health institute merged with the INAPMAS by Law Nº 27657, to create the National Center for Occupational Health and Environmental Protection for Health (*Centro Nacional de Salud Ocupacional y Protección del Ambiente para la Salud*, CENSOPAS), which was integrated to the National Health Institute by means for Supreme Act N° 001-2003-SA in 2003.

2.54 Currently, the General Directorate for Environmental Health (DIGESA) at MINSA is the only government institution with a regulatory mandate for environmental health-related

issues. DIGESA's mandate includes: (i) operating national analytical laboratories; (ii) establishing and enforcing human health safety norms and standards; and (iii) inspecting and controlling environmental health matters related to water supply, sewage, solid and medical waste, air quality, and hygiene conditions in public recreational areas. In spite of its importance in national environmental agenda, DIGESA has faced numerous institutional and resource challenges which have limited its overall technical and administrative capacity.

Air pollution

2.55 Since the mid-sixties and until the beginning of the nineties, the Ministry of Health faced the responsibilities related to environmental health included air pollution control. Within the monitoring and control of air pollution, activities that should be highlighted include the establishment, operation (between 1967 and 1990) and maintenance of an air quality monitoring network in the main urban centers of Peru (*Red Panaire*). The network was dismantled at the end of the eighties and was replaced by a newer network in Lima (including a mobile station). The Ministry of Health, however, was unsuccessful in establishing the Environmental Quality Standards (ECAs). Thereafter the maximum permissible levels for mining operations were passed, and included in annex 3 the LMPs for air quality parameters (including lead, arsenic, and PM).

2.56 In 2001, the regulations for National Environmental Standards for Air Quality were issued (D.S. No. 074-2001- PCM). This regulation establishes standards for environmental quality in air, sulfur dioxide (SO2), particulate matter (PM10), carbon monoxide (CO), nitrogen dioxide (NO2), and ozone (03). To establish these standards, Technical Committees (*Grupos de Estudio Técnico Ambiental de la Calidad del Aire*, GESTAs) were created. GESTAs were responsible of formulating action plans for the improvement of air quality in Arequipa, Chiclayo, Chimbote, Cusco, Huancayo, Ilo, Iquitos, La Oroya, Lima-Callao, Pisco, Piura, Trujillo and Cerro de Pasco. The Clean Air Initiative (CAI) Management Committee was created in 1998 (with support from the CAI from the World Bank), to assume the role of the local Air Quality GESTA for Lima and Callao. An Air Quality Action Plan was developed for Lima_Callao with support from the Clean Air Initiative, providing specific recommendations for emission reductions[19]. In addition, article 118 of the General Law of the Environment (which refers to air quality) establishes that specific government agencies would adopt concrete measures (prevention, monitoring, environmental and epidemiologic control, etc.) to ensure improvements in air quality..

2.57 There have been recent efforts to launch an Inspection and Maintenance Sytem in Lima-Callao for the vehicle fleet. However, there have been legal problems involving the concession and operating rights for this system between the municipality of Lima, the municipality of Callao, the Ministry of Transport and the private company which was awarded the concession. Parallel discussions on alternatives to harmonize standards between Lima's Metropolitan region and other regions are also underway.

2.58 In addition, there are ongoing discussions (and campaigns sponsored by CONAM and NGOs) to lower the content of sulfur in the diesel fuel before the proposed timetable established by MEM in the hydrocarbons law (Nº 26221). In March 2006, Law 28694 which regulates the sulfur content in diesel fuel was published. Currently the law allows for above 5,000 ppm of sulfur in diesel fuel, and establishes that for diesel 1 and diesel 2 respectively a reduction to 50 ppm should be reached by 2010

[19] The legal framework for air quality is perhaps one of the most evolved in environmental legislation in Peru. Other benchmarks include the approval of a air quality monitoring protocol by DIGESA (2005), the promotion of the Law for bio-fuels (Pulgar-Vidal, 2006).

2.59 This section only covers air pollution from fixed and mobile sources. Indoor air pollution, which has been determined to be critical in Peru is not be covered in this chapter, given that there has been no legal or institutional set-up to address this issue. There are regulations, however, for indoor pollution from construction materials such as asbestos).

Solid Waste Management

2.60 The General Law for Solid Wastes (LGRS) was enacted in 2000 as a complement to the general framework of the CMARN, and to environmental legislation already in existence. The Law calls provides specific institutional responsibilities and provides a framework for the environmentally sound management and handling of solid wastes, minimization of waste volume, prevention of potential environmental risks, and for guarantying the health protection and wellbeing of society.

2.61 The LGRS regulates all of the activities and processes related to solid waste management throughout its lifecycle (from generation to final disposal). It also regulates the safe containment and transport requirements. The LGRS also provides a characterization of solid wastes according to the following: (i) domestic; (ii) commercial; (iii) public areas; (iv) hospital; (v) construction; (vi) agricultural; and (vii) requiring special treatment or installation. The key agencies with direct responsibility for solid wastes are: (a) CONAM; (b) Ministry of Health (and DIGESA); (c) Ministry of Transport and Communications; and (d) provincial and district municipalities (in charge of waste of domestic and commercial origin).

2.62 A year after the approval of the Law, CONAM began its mandate (under article 2.5 of the LGRS) to produce the Methodological Guidelines for the Formulation of Integrated Plans for Environmental Management of Solid Wastes (*Guía Metodológica para la Formulación de Planes Integrales de Gestión Ambiental de Residuos Sólidos-PIGARS)*. The PIGARS served as a guiding tool to promote health and environmental improvements in towns and cities with populations between 50,000 and 5,000,000 inhabitants through the sound coverage of solid waste management (Manuel Pulgar Vidal, 2006). The PIGARS establishes long term goals and objectives (10 to 15 years), mid-range programs (3 to 5 years) and short term action plans (2 years) for the efficient and sustainable management of solid wastes. The PIGARS were developed in a participatory manner with the inputs and expertise of private and public sectors linked to the solid waste management.

2.63 The PIGARS consequently served as the technical base for the development, four years later, of *National Plan of Integrated Solid Waste Management (*Plan Nacional de Gestión Integral de Residuos Sólidos – PNGIRS). Approved through a national decree (Nº 004-2005-CONAM-CD), the PNGIRS was developed in 2005 by CONAM in conformity to Law No. 27314 (General Law for Solid Waste). Since 2003, the Pan-American Health Organization (OPS) actively participated in reviewing and modifying the original draft of the PNGIRS.

2.64 The key objective of the National Plan is to reduce the generation of solid waste in the country and control its associated sanitary and environmental risks. Specifically, the PNGIRS seeks to: (i) control and reduce the per-capita generation of wastes; (ii) increase the quality and coverage of solid waste collection and disposal services; (iii) promote the selective recollection of wastes; (iv) reduce, recover, reutilize, and recycle wastes; (v) assess the economic value of treating organic matter; and (vi) dispose in a safe, sanitary and environmentally sound manner the wastes without any specific use. In conformity with the General Law for Solid Wastes, the PNGIRS supports a regional coverage for operations related to the management and handling of solid wastes from generation to final disposal. It also has specifications for handling wastes from different sources, the transport regime, and the disposal of toxic and dangerous wastes.

Pesticides and Persistent Organic Pollutants

2.65 Peru has more than 33 active norms and regulations for agricultural pesticides, and has signed all the key international conventions regarding the use and trade of chemical substances (Arika, 2005). The key conventions to which Peru is a signatory, and for which specific commitments have been assumed include: (i) Earth Summit Action Plan (Rio de Janeiro, 1992); (ii) Sustainable Development Summit Decision Plan (Johannesburg, 2002); (iii) tRotterdam Convention (1998); (iv) Basel Convention (1992); and (v) Stockholm Convention on Persistent Organic Pollutants-POPs (2004)[20].

2.66 Peru approved the Basel convention in 1993 (Decree No. 26234) and assigned the Ministry of Industry Tourism, Integration and Trade (currently the Ministry of Trade and Tourism), as the focal points to the convention.. The Rotterdam Convention, was approved by Peru in 1998. One of the first steps soon after signing this convention was to impose a prohibition on the use of pesticides developed with the active ingredient ethylic parathion, and imposing the restriction of other pesticides. The Rotterdam Convention only came into effect in 2004, and Peru ratified it in 2005 (through the decree D.S. 058-2005-RE). By the time Peru signed the Stockholm Convention in 2004, it had already prohibited the import, local production, distribution and trade of most of the 12 chemicals substances under the POPs convention.

2.67 The key institutions and government agencies that are responsible for regulating the use, transport, trade, and production of pesticides are (i) SENASA (created as a decentralized government agency of the Ministry of Agriculture); (ii) The National Commission for Pesticides (CONAP), created in 1993 under SENASA, is the maon advising agency regarrding the registry and control of agricultural pesticides; (iii) INRENA has the responsibility of preparing environmental technical reports on pesticides, as well as evaluating the environmental impacts and risks analysis; (iv) DIGESA has the onus of supervising all aspects inherent to the risks and impacts to human health, and monitoring pesticide residue in processed and industrial meals. DIGESA has the responsibility of producing toxicology reports, enforcement and regulating activities and products that may be harmful to human health (for domestic and industrial use. The health sector, however, lacks with specific norms to regulate this issue. By 1999 Peru carried out a preliminary inventory of POP pesticides considered 'stale', and by 2001 another survey revealed that there had been a decrease in the stock of certain POPs (Arica, et.al. 2005).

Climate Change and Natural Disasters

2.68 Compared to Argentina, Brazil, Mexico and Venezuela, Peru's overall contribution of green house gas (GHG) emissions to the atmosphere are low. Peru only contributes to less than 0.3 percent of overall GHG emissions(CONAM, 2003). Nonetheless, climate change has gradually taken a prominent space within the national environmental agenda. In spite of the severe impacts of el Niño (especially in 1983 and 1998) Peru's efforts in climate change have focused more on the international arena (with a significant representation in different forums), on emissions of greenhouse gases and mitigation options, rather than on vulnerability and adaptation to climate change (only until recently have taken a more prominent role). Large part of CONAM's climate change agenda has been supported through external sources (i.e. GEF, Holland, Denmark).

2.69 In 1993, resolution R.S. 359-RE established the creation of the National Commission on Climate Change (NCCC), which has the objective of coordinating the application of the framework of the convention of the United Nations on Climate Change, as well as Montreal Protocol (ozone depleting substances). Two years later, resolution R.S. 085-96-RE established that the presidency of the NCCC would be chaired by CONAM, and would be conformed by 13

[20] Peru has also adhered to Decision no. 436 of the Andean Community, and the International Code of Conduct for the Distribution and use of Pesticides by FAO.

public and non public institutions[21]. Peru ratified the convention in 1993, and produced its First National Communication on March 2, 2001. The NCCC proposed the National Strategy on Climate Change which was approved by Supreme Decree on 2003.

2.70 In 2002 a decree (N° 095-2002-PCM) provided CONAM the responsibility to implement activities linked to the clean development mechanism under the framework of the Kyoto Protocol, but delegated this responsibility to the National Environmental Fund (FONAM) which became the focal point for the prototype carbon fund in Peru.

2.71 A series of technical studies have been developed which have contributed in Peru's compliance to the requirements to the under the Intergovernmental Panel of Climate Change (IPCC), and to elaboration of its National Communication, namely: (i) an emissions inventory of GHGs (through Danish financing); (ii) mitigation of GHGs in Peru in the energy, transport and forest sectors; (iii) vulnerability and adaptation to climate change; and (iv) the climate change action plan 1994-2004. More recently the French Institute for Research and Development (IRD), has conducted the Andean Glacier Monitoring Program to analyze global climate change in South America, and its impacts in mountainous regions[22].

2.72 In addition to the proposals being submitted for Clean Development Mechanism (CDM) approval, Peru is working on several climate change issues within the framework of the National Agreement. For instance, CONAM directs the PROCLIM project (Peruvian Climate Change and Air Quality Program) supported with financing from Holland, which is responsible for implementing part of the mandate of the NCCC. The PROCLIM Project follows an integrated approach to climate change: (i) mitigation of GHG's; (ii) adaptation; and (iii) information dissemination, and is responsible for implementing the National Strategy on Climate Change, and the National Program. PROCLIM's primary objective is therefore to strengthen the country's overall national capacity via public and private sector institutions, along with over 70 partnering institutions throughout Peru's cities and regions. This program aims to enhance existing national climate change capacity.

2.73 In addition to PROCLIM, the National Institute for Civil Defense (*Instituto Nacional de Defensa Civil*, INDECI) has traditionally focused its attention on the response to natural disasters (not only to those with causes related to climate change such as el Niño), giving low priority to preventive actions for vulnerability reduction. Since 2003, attempts have been made to correct this bias though the preparation of a National Plan for Prevention and Attention to Disasters (*Plan Nacional de Prevención y Atención de Desastres*, PNPAD) approved in 2004. This plan contains guidelines, objectives, strategies and specific actions for disaster prevention. Within the plan, INDECI implements the Sustainable Cities Program, which attempts to keep population centers from being severely affected by intense natural or manmade phenomena. At the national level, 103 urban centers have participated in the Program. Of those 103, 54 urban centers have Land Use Plans and measures to mitigate disaster, and 42 municipalities have approved studies for municipal ordaining and begun their implementation.

[21] Among the institutions that conform the NCCC are: (i) association of municipalities in Peru; (ii) private sector confederation (CONFIEP); (iii) National Council of Science and Technology; (iv) Ministry of Agriculture; (v) Ministry of Economy and Finance; (vi) Ministry of Energy and Mines; (vii) Ministry of Production; (viii) Ministry of Foreign Affairs; (ix) Ministry of Transport, Communications, and Housing; (x) representative of NGOs; and (xi) representation from Academia.

[22] Peru contains roughly 71% of the globe's tropical glaciers. Since the early 1980s (PCC, 2004) Peruvian glaciers have lost about 22% of glacier surface, (500 Km2) equivalent to 7,000 million cubic meters of water (about ten years of water supply for Lima). Peru also has over 12,000 lakes and ponds that could be destabilized from glacier melt. Furthermore, the combined impacts of global warming, ENSO (El Niño Southern Oscillation), and extreme weather events on mountain hydrology are diminishing the water flow used by populations downstream (IRD 2004). and are likely to have devastating impacts on highland and associated downstream ecosystems, altering the ecology and livelihoods of millions of people, whose GHG emissions are negligible. In addition, Peru's energy sector could be affected since 80% of the energy generation comes hydropower.

Towards a National System for Environmental Management

2.74 Gradually, over the past twenty years, Peru has established the National System for Environmental Management (SNGA). In 1985 ONERN published the analytical work that set the bases for the system: "The Natural Resources of Peru". This work defined the situation and potential of natural resources in topics that included climate, soils, water, forestry resources, grasses, wildlife, water and biological resources, minerals and energy. The document proposed guidelines for natural resource management, as well as for a new legal and institutional framework.

2.75 After extensive consensus-building among stakeholders, the CMARN was approved in 1990. The Code incorporated in its Chapter XXII, the norms that regulated the SNGA. The system was integrated by all the governmental institutions dedicated to research, evaluation, command and control of natural resources and the environment, aiming to coordinate the implementation of a national environmental policy and to guarantee compliance to the functions assigned by Law to national, regional and local governmental agencies. However, through legislative Act 757, Chapter XXII of the CMARN was abolished in 1991 and environmental attributions were attributed to the line ministries, thereby establishing that each sector constituted the environmental authority for the activities at its charge. In spite of this, an interest to coordinate environmental management activities prevailed, and CONAM was created in 1994. As the national environmental authority CONAM is a coordinating agency with a directive council integrated by representatives of the national, regional and local governments, primary, secondary and tertiary economic sectors, the academic sector, NGOs and national professional associations. Box 2.2 below provides further details on the CMARN.

2.76 The legal void of an articulated environmental management system began to be filled by the establishment of the Structural Framework for Environmental Management (MEGA), aiming to guarantee intersectoral coordination. Since the creation of the MEGA, and to increase local coordination between sectors at the regional level, CONAM has established nine regional environmental commissions (*Comisiones Ambientales Regionales* - CARs) that it manages through their respective Regional Environmental Executive Secretariats. In general, CAR participants include local governments, NGOs, university and economic sectors representatives.

2.77 Also, through MEGA, CONAM has led the design of the environmental agenda, structuring four programmatic fronts: (i) the green front, relating to biodiversity conservation; (ii) the brown front for sectoral environmental management; (iii) the blue front, for water resources management; and (iv) the golden front, which respond to international conventions and legal agreements. The recent reforms to the environmental legal framework, contributed to the redefinition of CONAM's responsibilities to focus on monitoring key environmental priorities and actively participate in budget allocation based on environmental results.

2.78 CONAM has achieved steady progress in the implementation of an ambitious and comprehensive agenda of addressing environmental issues. CONAM has intended to promote consensus building for environmental management and has made major contributions to set up a coordinating process for environmental management among the most important actors at the national and regional level. Nevertheless, its lack of real power to monitor and enforce the application of environmental laws and regulations is a major handicap in the country's environmental institutional framework, particularly given the imbedded conflict of interest of enforcement carried out by sectoral units. CONAM is created within a framework already favoring the sectoral approach to environmental management, and thus, is weak in its initial design and mandate. The initial drafts tried to adopt some of the features of the Chilean model (CONAMA), which is characterized for a strong regional approach. It was assumed that the president of CONAM would have a ministerial rank and with concrete functions, and that its Board Council would be integrated by high level officials with inherence in policy making.

These suggestions were not included in the final proposal which was presented for consideration to the Environmental Director of Foreign Affairs and to the vice-minister of industry which reflected the position of the private sector (CONAM's first elected president had been active in the private sector). Thereafter Congress approved the proposed norm. Since its inception CONAM has kept a coordinating role and has taken a limited role on addressing key environmental issues (Pulgar Vidal, 2006) Limited resources and a weak capacity have also led to a implementation of instruments such as the MEGA. Thus, the nature of its initial design, compounded with limited resources, a strong sectorial based environmental approach, and ongoing pressures from the private sector have, through time, characterized CONAM as a being a frail agency with a low profile, and with lack of citizen participation (Pulgar Vidal, 2006).

Box 2.2 The National Code for Environment and Natural Resources-CMARN

The CMARN has been one of the key landmarks in the history of environmental policy in Peru. CMARN was the result of a process started in 1986 within Congress, which called for the creation of a Ministry of Environment. Since there was a lack of environmental legislation, it was opted instead to first establish an environmental code. As a result the CMARN became one of the key instruments that set in motion many the dynamics and overall structure of the current environmental policy framework in Peru. Many of the critics to the code also proposed different alternatives, including a sectorial-based environmental management approach which was later adopted[1].

One of the key elements of the CMARN, was the introduction of environmental impact assessments (EIA) and its application, which previously did not exist in Peru. Likewise, the CMARN became the first norm to recognize and legitimize the rights of citizens to have access to justice on environmental grounds, without having to proof direct environmental impact (many years later the code for civil procedures and the Law of the General Administrative Procedures recognized this right) (Pulgar Vidal, 2006).

The modification to the CMARN in 1991 through Legal Decree Nº 757, was more accidental than a planned process. The modification was a result of an initiative from the Presidency of the Environmental Commission at Congress which wanted to be known for passing a "significant" environmental norm in Peru. Consequently it proposed the creation of a review committee to which would modify the Code as a means to revamping it (Pulgar Vidal, 2006). This proposal faced many critics and resistance from groups which claimed that it could risk the existence of the norm and could represent a serious set back towards environmental legislation. Considered at the time an innocuous law (since it only proposed the creation of a review committee), the law was swiftly approved by congress. Once approved, technical groups joined the review process among other things, to prevent that key concepts and principles be taken out.

2.79 In 2004, Congress approved the Framework Law for the SNGA, which establishes the integration of all sectoral entities to the System, under CONAM's leadership. This Law reinforces inter-institutional coordination. Nonetheless, one of CONAM's biggest challenges is to resolve the overlapping and/or ambiguous environmental mandates between Peru's public institutions, and to promote further inter-institutional coordination. Institutional ambiguity associated with overlapping jurisdiction often results in delays in addressing key issues with environmental and social costs. Lack of coordination among agencies gives mixed messages to sectors and hinders the adoption of efficiency improvements.[23]

Role of the Ministry of Economy and Finance

2.80 The Ministry of Economy and Finance's (MEF) key role has been to make the planning and budgetary allocations to key environmental agencies (CONAM, INRENA, DIGESA) for their respective operations and programs. In addition, MEF has gradually contributed to a number of environmentally related initiatives, such as (i) providing matching funds from the national system if public investment (SNIP) to FONDEBOSQUE's reforestation programs; and (ii) endorsed the debt for nature swaps for which PROFONANPE has served as the implementing agency. Furthermore, the Directorate for Environmental and Macro-productive Studies has been established within MEF (under the General Directorate of Economic and Social affairs). This Directorate has the mandate of (i) analyze and provide follow-up to the productive sectors in line with the national development strategies for the country; (ii) assess

[23] For example, in 1998 a decree by initiative of the Navy required all fishmeal plants discharging into the sea to install sub-marine outfall pipes by the end of the year. This measure was contrary to MIPE policy, which was attempting to discourage the use of submarine outfall pipes, as they are expensive, result in lost revenue (in the form of raw material), and most importantly does not prevent waste (US AID, 2000).

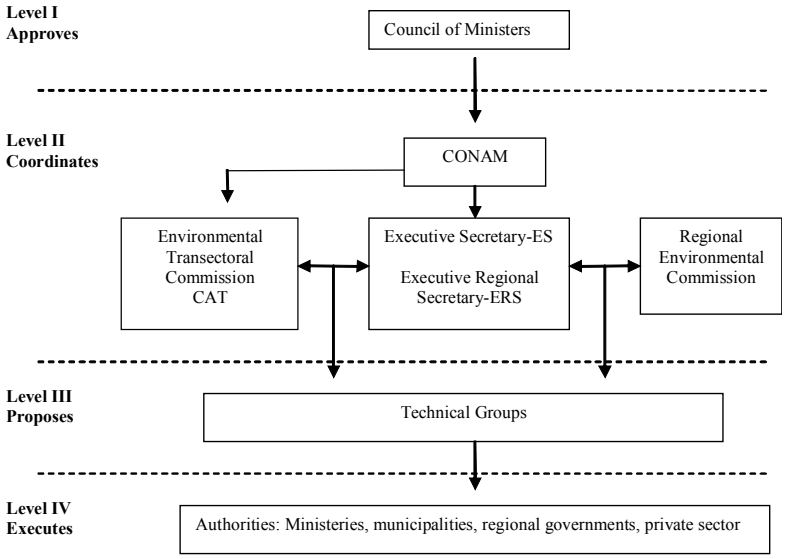
and monitoring environmental issues in the country, in accordance to the national environmental policy and the productive potential; (iii) participate in the process of formulation, implementation and evaluation of the national economic program; (iv) identify and assess a series of key indicators of the national economy; and (v) prepare research studies and analytical reports on key productive and/or environmental issues related to the economy which would serve as inputs to improve the national policies of the government[24]. This unit, however, has a limited influence over key sectoral policies and overall decisions of budget allocation.

2.81 According to Abugattas (2005), the total public spending approved by MEF's for the environmental sector, has decreased by 24% from US$170 million in 1999 to US$147 million in 2003 (0.14 percent of GDP). This amount reflects that environmental issues represent a low priority in the overall allocation of resources in the country. Furthermore, Peru is one of the few countries in the region which has not requested loans from multilateral agencies for the development of specific projects or programs destined to improve environmental conditions in the country. Rather, it has relied grants from donor agencies, foundations, NGOs, and bilateral agreements. The preliminary assessment of environmental public and private expenditure and public investment done in 2004 illustrate that the sum of investment and operational expenditures combined in 2003 equaled 0.25% of GDP (Abuggatas, 2005). While a cost efficiency assessment needs to be made on the measures which would reduce the environmental degradation, the amount required to address the key priority issues is greater than the one currently spent by government. In addition, a slightly larger share of the environmental spending goes for operational expenses rather than investments, illustrating that most likely the issues that need to be addressed are not being covered.

Box 2.3: Peru's National Environmental System (SNGA).

The 2004 Law of SNGA empowered CONAMA to coordinate environmental management among a range of public and private stakeholders. The Law defines a set of orientations, norms, activities, resources, programs and institutions that allow the implementation of general environmental principles around a model of sustainable development.

Structural Framework for Environmental Management



Source: CONAM, 2005

2.82 In October 2005, the General Law of the Environment (Ley General del Ambiente – LGA), was issued by Congress. The Law consolidates CONAM as the leading entity of the

[24] MEF's website: http://www.mef.gob.pe/propuesta/DGAES/presentaciondgaes.php

SNGA (Box 2.3). The SNGA Law assigns environmental control functions and the administration of the system to CONAM. The LGA opens the possibility to establish environmental priorities at the national and regional level. A review of the history of environmental management in Peru reveals little consideration towards priorities across environmental sectors (Pulgar, 2006, CONAM, 2005). Although plans do exist for key areas within the environment sector (such as forestry, water, natural protected areas), no systematic periodic planning exercise exists to establish priorities across environmental programs and sub-sectors such as air pollution, disaster risk management, and water sanitation. This gap has been highlighted in evaluations of planning in the SNGA (Pulgar, 2006).

Box 2.4 National Environmental Agenda 2004-2007

<table>
<tr><th colspan="2"></th><th>Structural Objectives</th><th>Green Front</th><th>Brown Front</th><th>Blue Front</th><th>Golden Front</th></tr>
<tr><td rowspan="2">National Level</td><td>Transectoral</td><td rowspan="3">Environmental Policy: Approved national environmental policy

Normative Framework: a new CMARN, laws and transectoral regulations

Environmental Institutional Development: implementation and strengthening of the National System for Environmental Management and of the environmental units at a national, regional and local government level

Decentralization of Environmental Management: push for the decentralization process in environmental matters</td><td>Implement the National Biodiversity Strategy

Strengthen public management in the managing of RRNN</td><td>Annual ECA and LMP programs

Integrated Management of Dangerous and Chemical Substances

Environmental decontaminatio n</td><td>Education: national priority

Promotion of environment al citizen stewardship

Capacity building for investigation s</td><td>FTA: defend national biodiversity interest

Integration of Commerce and Environment

Environmental services</td></tr>
<tr><td>Sectoral</td><td>National Reforestation Plan

Promote aquaculture and adequate fishing practices

Use and protection of native knowledge and technology</td><td>Regulation of Solid Waste Management

Promotion of the PML and support for the PYME

Improve the conditions for housing and urban living</td><td>Application of mechanisms for the access of information and environment al participation</td><td>Promotion of Sustainable Tourism

Promotion of Biocommerce

Development of concessions for Tourism</td></tr>
<tr><td>Regional and Local Levels</td><td></td><td>Regional biodiversity strategies

Articulation of OTA and conservation</td><td>Regional Climate Change strategies

Municipal management of solid waste</td><td>Regional assimilation of educational environment al projects</td><td>Regional and local promotion of environmental products, ecocommerce, and ecotourism</td></tr>
<tr><td colspan="2"></td><td colspan="5">Instruments for Environmental Management: complete and strengthen the instruments for the environmental management at all levels of government</td></tr>
</table>

2.83 Since 2004, the national program for decentralization of responsibilities, established contemplates in its plan the transference of functions related to natural resources and environmental protection. Actions to be decentralized include sectors such as agriculture, tourism, and energy and mining. The Ministry of Agriculture began the transference to the regions of processes of monitoring and control to guarantee the sustainable use of natural resources and to emit permits, authorizations and forestry concessions, as well as the control of the compliance to national forestry policy. The Ministry of Commerce and Tourism contemplates the transfer of functions regarding the verification of compliance to environmental

norms and regulations and natural resource preservation in tourism. The Ministry of Energy and Mines has begun the transference to regional governments of the approval and supervision functions of PAMAs and the environmental assessment for small-scale mining activities.

Box 2.5. The General Law of the Environment - LGA

The General Law of the Environment (Law no. 28611) approved in October, 2005 builds on the consensus reached by different sectors, civil society, and the private sector. The LGA which to an extent replaces the CMARN, could strengthen the trans-sectorial coordination and regional approach to environmental management. It incorporates a series of new characteristics and challenges and, to a large extent, will depend on CONAM's capacity for its final regulation and adequate implementation. The LGA had a number of controversial issues for the private sector which were extensively debated, including the precautionary principle (article VII); reparation of damage and the burden of civil responsibility (Article 147); and environmental quality standards and maximum permissible levels (articles 31-33).

Among the new features the LGA includes a fiscal framework to promote sound and responsible environmental practices and behavior (previously unknown in Peru); Likewise it establishes CONAM as the leading administrator in the EIA process, ensuring a more active role and participation, decreasing the sectorial role in the EIA process. Furthermore, there are clearer responsibilities with regards to environmental emergencies and for the establishment of transitory environmental quality norms of special character in critical environmental areas. This would allow CONAM to have presence and a mandate in addressing specific environmental problems, which previously did not get involved (i.e. air pollution in La Oroya, noise levels in Iquitos, water pollution of key watersheds such as the Rimac). Thus, among the key challenges include strengthening the role of CONAN, its new role in the enforcement process, and the establishment of an autonomous enforcement agency. There are a number of pending issues and challenges concerning the General Law of the Environment and its regulations, including: (a) the overall definition of key responsibilities among government agencies (including MEF); (b) harmonizing the system of incentives and sanctions (fines); (c) defining the methodologies and scope for environmental zoning (*ordenamiento territorial*); (d) defining environmental spending, from the agreement that CONAM and MEF would carry out the yearly accountability); and, (e) empowering CONAM with enforcement capabilities, an issue that has been linked to the discussion on the creation of an enforcement agency.

Conclusions and Outlook

2.84 From 1965 to 2005 there has been a gradual evolution in the environmental management framework. Among the significant milestones reached during 1950–1990, was the establishment of OERN, and DIGESA, and the issuance of the Code for Environment and Natural Resources in 1990, which is still the most important regulation for environmental management in the country. While Peru has greatly improved its environmental management capacity since the early 1990s when the Environment and Natural Resources code was approved, there are still challenges to be addressed.

2.85 Peru has advanced significantly in the sustainable use of natural resources. INRENA was been successful in promoting the conservation agenda, as evidenced by advances such as titling of lands belonging to indigenous peoples and establishment of protected areas. Furthermore, historical events were influential in focusing the attention of INRENA on main environmental priority areas: water and forest resources management, and conservation of biodiversity. Nonetheless, INRENA has been characterized by a weak institutional framework since it (i) has been short in resources, adequately trained staff, and adequate data (i.e. on forestry and status of biodiversity); (ii) has faced excessive bureaucracy, and (ii) has been unable to address simple but key issues (i.e. not working on weekends unlike illegal loggers who do).

2.86 Water resource management is of special importance to Peru due to the critical role it plays for economic development. Responsibilities for natural resource management have been assigned to INRENA's Intendancy for Water Resources. A national strategy for water resources has been established and efforts are currently underway for its implementation. Decentralization efforts have been highly effective, and current discussions focus on the possible creation of a national water authority to regulate water quality and quantity.

2.87 Natural resource management has been particularly effective in the forestry sector, where deforestation rates have been kept lower than in neighboring countries. This, however, should not lead to the conclusion that deforestation is under control and that it does not present a threat to biodiversity and fragile ecosystems. Current discussion among key stakeholders include questions as to whether the current framework and methodology for forestry concessions is adequate and realistic, given that serious errors have been encountered in over 90 percent of the concessions granted in the country.

2.88 The evolution of the National Protected Areas System has been successful in that close to 14 percent of the national territory has been assigned with a conservation status. Nonetheless, the development of the financial strategy has not been equaled by increased administrative and operative capabilities. In addition, a key challenge continues to be providing adequate staff, equipment, and resources to the protected areas for its efficient use and management. The difficulties for the adequate and timely process for the use of available resources have led to proposals of the decentralization of protected area management to an autonomous agency.

2.89 There are still significant challenges for pollution control and sectoral environmental management. The existing system's efficiency, neutrality and the possibility of bias have been repeatedly questioned and two alternative proposals have are currently under discussion: (i) the creation of an independent regulatory body; (ii) the establishment of independent environmental regulatory bodies within line ministries, following the model of the OSINERG.

2.90 There is an active interest and consensus in updating and improving sectoral environmental regulations, particularly in key economic sectors such as mining, transport, housing and tourism. The Regulations for the Environmental Impact Assessment Law have been prepared and are under discussion, and there is a significant need for their issuance. Regulatory gaps in this topic have led to the highly publicized controversies on large investment projects which include the extension of the PAMA for the Doe Run, adequate enforcement and compliance for the Camisea gas pipeline and the upcoming construction of the Inter-Oceanic Highway

2.91 There are a number of pending issues concerning the General Law of the Environment and its regulations, including: (a) the overall definition of key responsibilities among government agencies (including MEF); (b) harmonizing the system of incentives and sanctions (fines); (c) defining the methodologies and scope for environmental zoning (*ordenamiento territorial*); (d) defining environmental spending, from the agreement that CONAM and MEF would carry out the yearly accountability); and, (e) empowering CONAM with enforcement capabilities, an issue that has been linked to the discussion on the creation of an enforcement agency.

2.92 Environmental management in Peru continues to rapidly evolve, especially during 2005, environmental issues highlighted in national discussions focused on a number of issues ranging from proposed reforms to the institutional and legal structure, to the aforementioned potential impacts of large investment projects. In light of the 2006 presidential elections, many of these topics are taking relevance in the political debate.

CHAPTER 3 ALIGNING ENVIRONMENTAL PRIORITIES WITH THE NEEDS OF THE MOST VULNERABLE

In Peru the costs of these environmental damages are estimated at 8.2 billion Soles per year, equivalent to 3.9 percent of GDP in 2003. The highest cost is from outdoor air pollution and lead exposure in urban area,s and inadequate water supply, sanitation and hygiene, followed by natural disasters, indoor air pollution and agricultural soil degradation. The distributive analysis of environmental health impacts indicates that, relative to income, outdoor air pollution impacts in Lima-Callao are 75 percent higher for the poor even in a conservative base case scenario. From inadequate water supply, sanitation and hygiene, the health impacts on the poor are nearly 3 times higher than on the non-poor. In relation to income, the impacts are more than 10 times higher for the poor. While data are not sufficient to estimate the health impacts of indoor air pollution for the poor vs non-poor, most of the impacts occur among the poor because it is predominantly the poor that use solid fuels. The impacts for all the environmental health categories, i.e., urban air pollution, water, sanitation and hygiene, and indoor air pollution per 1000 people are nearly 20 percent higher for the poor than for the non-poor, while relative to income, the impacts on the poor are 4.5 times higher than on the non-poor population.[25]

Introduction

3.1 Environmental pollution, degradation of natural resources, natural disasters, and inadequate environmental services, such as improved water supply and sanitation, impose costs to society in the form of ill health, lost income, and increased poverty and vulnerability. In Peru the costs of these environmental damages are estimated at 8.2 billion Soles per year, equivalent to 3.9 percent of GDP in 2003 (Larsen and Strukova 2005a). The highest cost is from outdoor air pollution and lead (Pb) exposure in urban areas, and inadequate water supply, sanitation and hygiene, followed by natural disasters, indoor air pollution and agricultural soil degradation (Figure 3.1). The cost of deforestation is estimated to be somewhat less than for soil degradation, and the cost of inadequate household solid waste collection is minor in comparison to the former costs. The cost of lead pollution is declining with the phase-out of leaded gasoline.[26]

3.2 The costs of environmental damage are distributed unevenly across the population. Figure 3.2 presents estimated costs per capita based on population exposure to environmental health risks. Estimated cost of outdoor air pollution (PM) and lead exposure is for the cities with more than 100 thousand inhabitants.[27] The cost per person in these cities is estimated at 230 Soles per year. Indoor air pollution from solid fuels is predominantly a burden on the rural population, with an estimated cost of nearly 100 Soles per person per year. In contrast, hygiene practices, and to some extent inadequate potable water supply and sanitation are affecting most

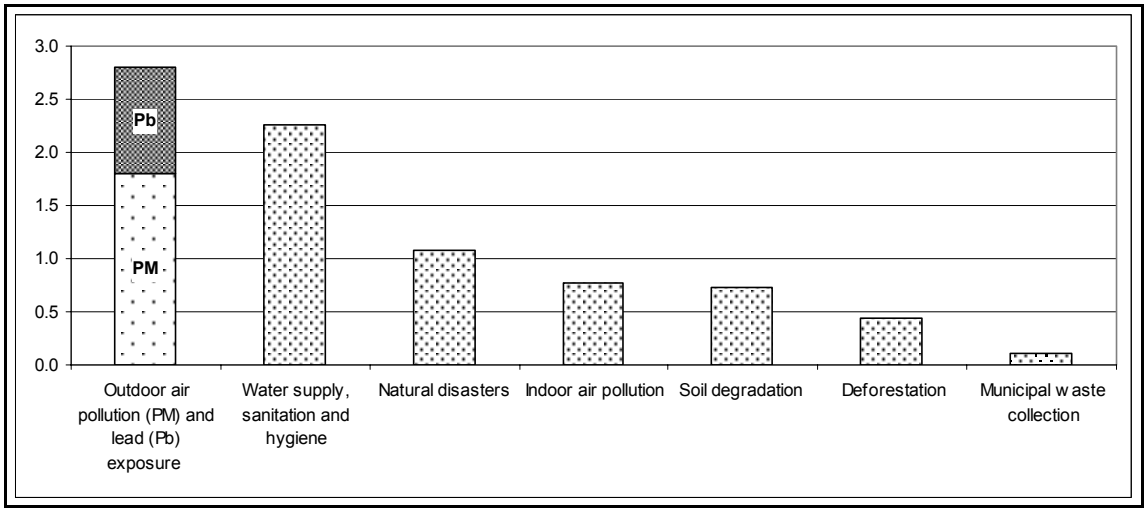
[25] This chapter draws heavily from background documents prepared by Bjorn Larsen and Elena Strukova (2005) and Bjorn Larsen and Elena Strukova (2006).

[26] Costs of rangeland degradation, coastal degradation, municipal waste disposal, and inadequate industrial and hospital waste management are not estimated due to data limitations. Other than for rangeland degradation, it is unlikely that the costs of any of these categories are anywhere close to the costs of inadequate water supply, sanitation and hygiene, outdoor air pollution, natural disasters, indoor air pollution or agricultural soil degradation. Cost of rangeland degradation however could be significant. Rangelands occupy 18 million hectares in Peru, which is more than 4 times the area of cultivated land. For fisheries, only an estimate of excess fishing fleet is provided due to uncertainties about fish stock dynamics.

[27] The cost of lead exposure is from all sources including leaded gasoline, industry, water soil, paint and food.

of the population causing unnecessary diarrheal illness and child mortality, with an annual cost of nearly 85 Soles per person.

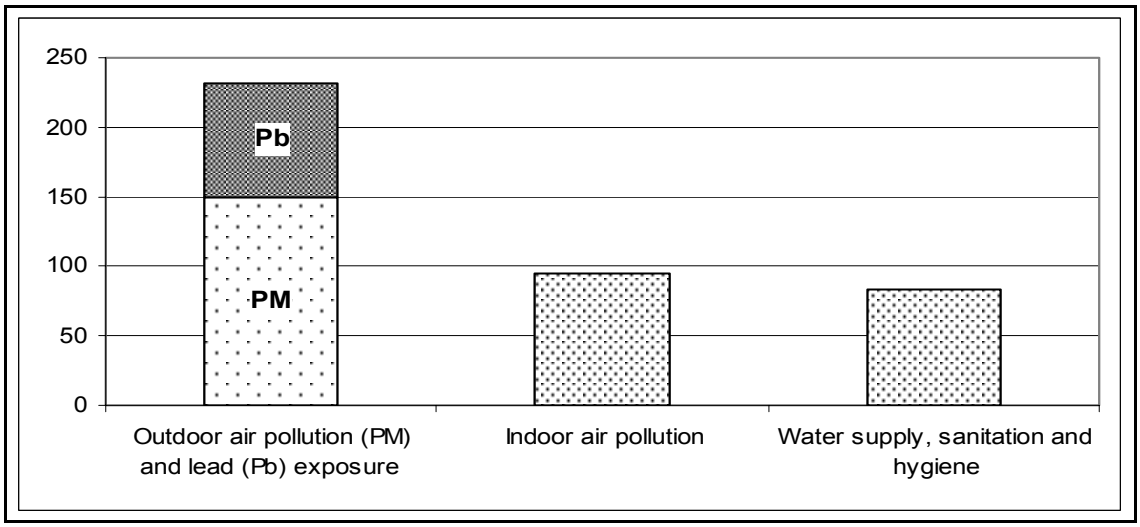
Figure 3.1: Annual Cost of Environmental Damage (Billion Soles per year)



Source: Larsen and Strukova (2005a)

3.3 Large areas of Peru are affected by natural disasters, while agricultural soil degradation is concentrated in the Sierra (erosion) and the Costa region (salinity). Data are not available to provide an estimate of costs per person, but average annual cost of agricultural soil salinity and erosion is estimated at 1200 and 1300 Soles per hectare affected, representing a substantial income loss to the agricultural population.

Figure 3.2: Estimated Cost of Environmental Damage per Capita (Soles per Year)



Source: Larsen and Strukova (2005a)

3.4 A "low" and "high" estimate of annual cost is presented in Table 3.1. This reflects uncertainties in estimated health effects, valuation of health effects, yield losses from soil degradation, cost of damages from natural disasters, and how households value solid waste collection services. The range in cost of deforestation reflects accounting of lost future forest benefits at a 3-10 percent annual discount rate.

Table 3.1: Annual Cost of Environmental Damage (Billion S/. per year)

	Billion S/. per year		
	"low"	**Mean Estimate**	"high"
Environmental Categories			
Outdoor air pollution (PM) and lead (Pb) exposure	1.71	2.81	3.91
Water supply, sanitation and hygiene	1.79	2.26	2.73
Natural disasters	1.05	1.07	1.10
Indoor air pollution	0.55	0.78	1.02
Soil degradation	0.54	0.73	0.92
Deforestation	0.28	0.44	0.59
Municipal waste collection	0.09	0.10	0.11
TOTAL ANNUAL COST	6.01	8.19	10.38

*Erosion and salinity of cultivated land (not including pasture/rangeland). Source: Larsen and Strukova (2005a)

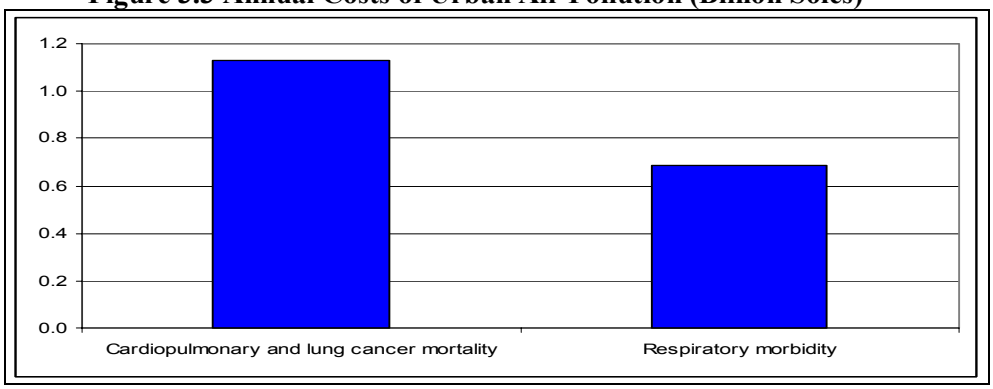
Outdoor Air Pollution and Lead Exposure

3.5 Particulate matter (PM) is the urban air pollutant that is most often found to have the strongest association with health effects, and especially particulates of less than 10 microns in diameter (PM 10) or smaller particulates such as PM2.5. The mean annual cost of PM pollution in Peru is estimated at 1.8 billion Soles, or nearly 0.9 percent of GDP in 2003. About 62 percent of the cost is from mortality, and 38 percent from morbidity (Figure 3.3). Measured in lost disability adjusted life years (DALYs), mortality represents 44 percent and morbidity 56 percent.[28] These costs are estimated based on the number of people living in cities with a population of more than 100 thousand, ambient PM concentration levels in these cities, and dose-response coefficients from worldwide studies linking PM concentrations to health effects.[29]

3.6 Nearly 75 percent of the Peruvian population lives in urban areas, with more than 12 million people in cities with a population over 100 thousand. Monitoring of PM is only available in Lima-Callao, an urban area with a population of more than 7.5 million (Table 3.2). Table 3.3 presents population figures for Arequipa, Trujillo, and "other cities" with more than 100 thousand inhabitants that do not have PM monitoring data. These cities have a total population of 4.5 million. Excluding them from estimating the health impacts of urban air pollution would therefore represent a serious omission. Annual average PM 10 levels were therefore assigned to these cities based on World Bank modeling of PM 10 concentrations.[30]

[28] DALYs combine both mortality and morbidity and is calculated from years lost to premature mortality, duration of illness, and severity of illness (using severity weights).
[29] Peruvian studies of the relationship between ambient PM concentrations and health effects are not available.
[30] www.worldbank.org/nipr/Atrium/mapping.html.url.

Figure 3.3 Annual Costs of Urban Air Pollution (Billion Soles)



Source: Larsen and Strukova (2005a).

Table 3.2: Population and PM Concentrations in Lima-Callao

Key parameters	Este	Sur	Norte	Centro	Callao
Population (million) 2002	0.97	1.60	2.64	1.57	0.79
Adult population >= 15 yrs (000)	0.69	1.14	1.90	1.17	0.57
Children population <=14 yrs (000)	0.28	0.46	0.74	0.40	0.22
Annual average PM 2.5 (ug/m^3) 2001-2004	45	39	57	84	31
Estimated annual average PM10 (ug/m^3) *	91	82	112	133	53

Source: Population figures are based on estimates by DIGESA. * PM 10 is estimated from PM2.5 and TSP monitoring data. The implicit weighted average PM2.5/PM10 ratio for Lima-Callao is 0.55.

Table 3.3: Population and Estimated Data for Cities without PM Monitoring Data

Key parameters	Arequipa	Trujillo	Other cities
Total Population (million) 2002	0.68	0.62	3.24
Adult population >= 15 yrs (000)	0.45	0.41	2.13
Children population <=14 yrs (000)	0.23	0.21	1.11
Estimated Annual average PM10 (ug/m^3)	96	55	63
Estimated Annual average PM 2.5 (ug/m^3)	38	22	25

Source: Population figures are based on city specific estimates from Peru Statistical Yearbook 2003. PM 10 figures are approximations based on World Bank modeling data (worldbank.org/nipr/Atrium/mapping.html.url). PM 2.5 is calculated using a PM 2.5/PM 10 ratio of 0.4. This is likely to be a conservative ratio for some of the cities.

3.7 Dose-response coefficients are presented in Table 3.4. The study by Pope et al (2002) of more than one million individuals over a period of 16 years in the United States is one of the best available evidence of the relationship between ambient particulate pollution (PM 2.5) and premature mortality. The dose-response coefficients from this study were applied by WHO in the World Health Report 2002, which provided a global estimate of the health effects of environmental risk factors.

3.8 Morbidity effects assessed in most worldwide studies are based on PM 10. Dose response coefficients from Ostro (1994) and Abbey et al (1995) have been applied for morbidity effects. Ostro (1994) reflects a review of worldwide studies, and Abbey et al (1995) provides estimates of chronic bronchitis associated with particulates (PM 10).

Table 3.4: Urban Air Pollution Dose-Response Coefficients

Annual Health Effect	Dose-response coefficient	Per 1 ug/m^3 annual average ambient concentration of:
Mortality (% change in cardiopulmonary and lung cancer mortality in population over 30 years of age)	0.8%	PM 2.5
Chronic bronchitis (% change in annual incidence)	0.9%	PM 10
Respiratory hospital admissions (per 100,000 population)	1.2	PM 10
Emergency room visits (per 100,000 population)	24	PM 10
Restricted activity days (per 100,000 adults)	5,750	PM 10
Lower respiratory illness in children (per 100,000 children)	169	PM 10
Respiratory symptoms (per 100,000 adults)	18,300	PM 10

Source: Pope et al (2002) for the mortality coefficient. Ostro (1994) and Abbey et al (1995) for the morbidity coefficients.

3.9 Estimated health effects are presented in Table 3.5. An estimated 3900 individuals die prematurely from air pollution each year. About 2900 of these deaths occur in Lima-Callao. The estimated number of new cases of chronic bronchitis is over 3800, while hospital admissions are estimated at more than 12 thousand and emergency room or outpatient hospital visits at more than 250 thousand. Restricted activity days are estimated at 5 days per year per adult, and one in seven children is estimated to get lower respiratory illness each year. Respiratory symptoms – such as a mild cough of throat irritation – are estimated at 16 cases per adult per year. In total, more than 65 thousand DALYs are lost each year.

3.10 Estimated cost of the health effects are presented in Table 3.6, totaling 0.9-2.7 billion Soles per year with a mean estimate of 1.8 billion. The "low" estimate for mortality is based on the human capital approach (HCA) which is the present value of future income lost to premature death. This valuation method was commonly used in the past, but has increasingly been replaced by the value of statistical life (VSL). VSL is a measure of people's willingness to pay for a reduction in their risk of death. In the absence of VSL studies in Peru, a transfer approach from studies of VSL in the United States and Europe provides a "high" cost estimate of mortality of 2 billion Soles per year.[31] The cost of morbidity is based on cost of health care services, medicines, lost work days including household work, and time spent on caring for ill family members.

Table 3.5: Estimated Annual Health Impact of Urban Air Pollution

Health end-points	**Total Cases (000)**	**Total DALYs**
Premature mortality	3.9	29,253
Chronic bronchitis	3.8	8,386
Hospital admissions	12.8	205
Emergency room visits/Outpatient hospital visits	252	1,133
Restricted activity days	43,350	13,004
Lower respiratory illness in children	533	3,467
Respiratory symptoms	137,957	10,347
TOTAL		65,796

Source: Larsen and Strukova (2005a).

[31] This is based on a VSL in United States and Europe of US $ 2 million (Mrozek and Taylor 2002), translating to 520 thousand Soles in Peru by adjusting for the income differential between these countries and Peru using an income elasticity of 1.0 at market GDP per capita. It should be noted that even this approach is considered conservative by many economists, who prefers to use PPP based GDP or a lower income elasticity.

Table 3.6: Estimated Annual Cost of Health Impacts (Billion Soles)

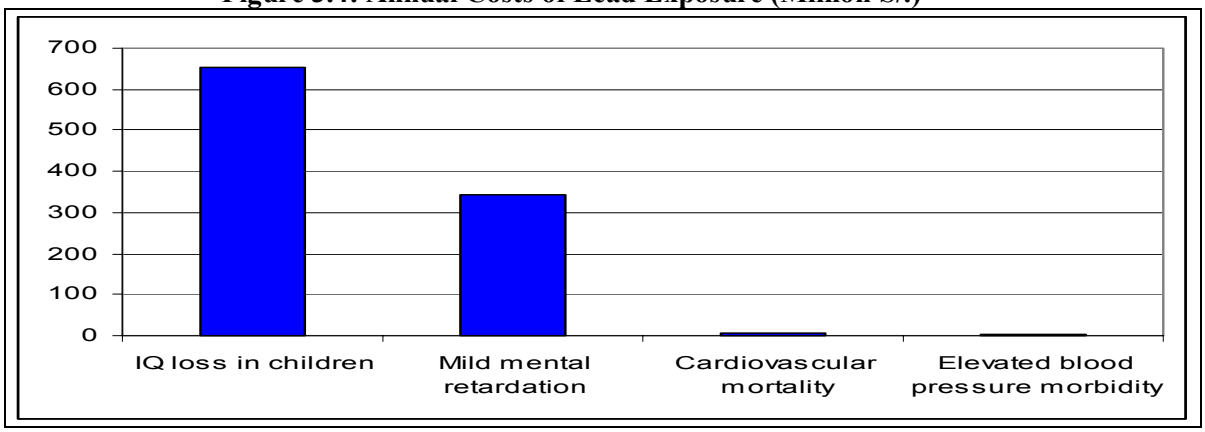
Health categories	Total Annual Cost*	Percent of Total Mean Cost
Mortality	0.23-2.02	62%
Morbidity:		
Chronic bronchitis	0.08	4%
Hospital admissions	0.03	2%
Emergency room visits/Outpatient hospital visits	0.06	3%
Restricted activity days (adults)	0.35	19%
Lower respiratory illness in children	0.09	5%
Respiratory symptoms (adults)	0.08	4%
Total cost of Morbidity	0.7	38%
TOTAL COST (Mortality and Morbidity)	0.93 – 2.72	100 %

Source: Larsen and Strukova (2005a).

3.11 Annual cost of lead (Pb) exposure is estimated at 0.8-1.2 billion Soles per year, with a mean estimate of 1.0 billion Soles, or 0.48 percent of GDP in 2003 (Figure 3.4). This estimate is based on lead exposure from all sources (leaded gasoline, industry and possible other sources such as water, soil, paint and food) for the population living in cities with more than 100 thousand inhabitants, totaling nearly 12.5 million people or about 45 percent of the Peruvian population.[32]

3.12 IQ losses (reduced intelligence) represent 65 percent of total cost, and mild mental retardation (MMR) 34 percent. Cardiovascular mortality and elevated blood pressure morbidity in adults constitute only 1 percent of total cost. In addition, lead exposure is estimated to cause 1,400-23,000 annual new cases of gastrointestinal effects in children, and 800-18,000 new cases of anemia in children.

Figure 3.4: Annual Costs of Lead Exposure (Million S/.)



Source: Larsen and Strukova (2005a).

3.13 The estimated cost of lead exposure is based on adjustments to blood lead level (BLL) measurements in children and adults from 1998. As little is known about current blood lead levels in the urban population, the cost estimates are highly uncertain.

[32] This corresponds to the population for which the cost of PM pollution was estimated.

3.14 A phase-out program of lead in gasoline initiated in the late 1990s has already brought significant benefits. Lead concentrations in the air in Lima-Callao are now quite low, averaging 0.13-0.30 ug/m^3 in five monitoring sections of the urban area during 2000-2004. But health effects of lead exposure can still be quite substantial. Lead has accumulated in soil and water, and lead exposure can come from multiple other sources. Box 3.1 discusses some lead contamination "hot spots" in Peru, and Table 3.7 presents a summary of health effects from accumulation of lead in blood.

Box 3.1. Lead Contamination "Hot Spots" in Peru

Gasoline is not the only source of lead exposure in Peru. A 2005 analysis conducted in La Oroya by a research team from St. Louis University's School of Public Health confirmed earlier findings by DIGESA. La Oroya, a town of 30,000 inhabitants, has a metal smelter producing gold, silver, lead, zinc and copper that is a major source of lead pollution. About 97 percent of children from six months to six years of age have lead concentrations in the blood (BLL) above 10 ug/dl. About 72 percent of the children have BLL of 20-44 ug/dl and 9 percent in the range of 45-69 ug/dl. Children with BLL in the latter range required urgent medical attention.

There are also other cases of elevated BLL. In 1998, Peru's Ministry of Health confirmed that 5,000 children living near the mining areas in the port city of Callao had a BLL of 20-40 ug/dl, and nearly 100 percent of the 350 students at the María Reich public school had a BLL of more than 40 ug/dl (Osava 2002).

These incidences are not characteristic of the whole urban population. BLL in most of Lima-Callao metropolitan area and other cities is much lower. Nevertheless, lead contamination "hot spots" should be analyzed and mitigation measures urgently implemented.

Sources: Salazar M.(2005). Grave Contaminación en La Oroya, 15/12/05 - La República, 20; http://www.pcusa.org/pcnews/2005/05677.htm; DIGESA, Osava M. (2002). Lead Poisoning Is Not A Child's Play, http://www.tierramerica.net/2002/0929/iarticulo.shtml.

Table 3.7: Health Effects of Lead

Outcome	Blood lead threshold[a] (µg/dl) Children	Adults	Relationship
IQ reduction[b]	5	ND	Linear relationship between 5–20 µg/dl BPb[c] (loss of 1.3 IQ points per 5 µg/dl BPb); loss of 3.5 IQ points above 20 µg/dl.
Increased systolic blood Pressure[d]	ND	5	Linear relationship assumed between 5–20 µg/dl (increase of 1.25 mmHg per increase of 5 µg/dl BPb for males, and 0.8 mmHg for females); above 20 µg/dl, an increase of 3.75 mmHg for males, and 2.4 mmHg for females.
Gastrointestinal effects	60	ND	20% of children are affected above these rates[e].
Anaemia	70	80	20% of people are affected above these rates[e].

[a] Thresholds for gastrointestinal effects and anaemia are levels "at risk", as defined by ATSDR (1999).
[b] The disease burden is always estimated for one particular year and the effects of previous exposures are not accounted for in the year of assessment. As a result, only children aged 0–1 year old were considered in the calculations, since the effects of lead on previous cohorts were considered in previous years.
[c] BPb: blood lead level (in µg/dl).
[d] Adults aged 20–79 years only.
[e] Based on Schwartz et al. (1990); see section 4.1.
ND No documented effects or insufficient evidence.

Source: Fewtrell et al (2003).

3.15 Fewtrell et al (2003) provides a practical methodology to estimate health effects of lead pollution using a Microsoft Excel model developed and distributed by the WHO department of Protection of the Human Environment (WHO 2003). The model provides an estimate of the population shares with different BLL using a log-normal distribution of average BLL and standard deviations from available studies. Health effects are then estimated by applying the relationships between BLL and health effects in Table 3.7

3.16 Blood lead level from Espinoza et al (2003) was applied in the Fewrell et al's model with two major adjustments. Although this study is the most recent large study in Peru, it dates back to 1998 and the average BLL does not reflect the recent phase-out program of lead in gasoline. While there is great uncertainty of how much BLL will decline from a lead phase-out program, international experience indicates that a program over a five-year period could lead to a 40 percent reduction in BLL. Applying this adjustment factor gives an average BLL of 4.3 ug/dl in children and 2.0 ug/dl in adults. These average levels are below the lowest threshold (i.e., 5 ug/dl) for health effects reported in Table 3.7. Nevertheless, part of the population may have a BLL well above this threshold. This is reflected in the standard deviation reported by Espinoza et al (2003). With a lower BLL today than in 1998, the standard deviation may also be lower now than in 1998. A range was therefore used, with a "low" equal to 60-100 percent of the standard deviation reported by Espinoza et al. (2003).

Table 3.8: Estimated Health Effects per 1000 People

	Rate per 1000 people					
	0 to 4		5 to 14		15+	
	Low	High	Low	High	Low	High
IQ loss of 0.65 points (5-10 ug/dl BLL)	258	184				
IQ loss of 1.95 points (10-15 ug/dl BLL)	92	87				
IQ loss of 3.25 points (15-20 ug/dl BLL)	39	50				
IQ loss of 3.5 points (>20 ug/dl BLL)	45	137				
BP +0.625 mmHg (5-10 ug/dl BLL)					1	100
BP +1.975 mmHg (10-15ug/dl BLL)					0	14
BP +3.125 mmHg (15-20 ug/dl BLL)					0	3
BP +3.75 mmHg (>20 ug/dl BLL)					0	2
Gastrointestinal effects	0.4	6.0	0.4	6.0		
Anemia	0.2	4.7	0.2	4.7	0	0
MMR for age 0-4, incidence	1.4	2.1				

Notes: IQ is in reference to intelligence; BP = blood pressure; MMR = mild mental retardation. Source: Larsen and Strukova (2005a).

3.17 The adjusted BLL and the range in standard deviation are applied in the model to estimate population BLL. The result suggests that an estimated 44-46 percent of the children and 0-11 percent of the adults have BLL > 5 ug/dl and an estimated 5-14 percent of the children and no adults have BLL > 20 ug/dl. Estimated health effects per 1000 children and per 1000 adults are presented in Table 3.8. It is assumed that IQ losses takes place during the first 5 years of a child's life, while gastrointestinal effects and anemia can occur in children under 15 years of age. In adults, the health effects are increased blood pressure (BP) and anemia.

3.18 Studies have found an average loss of 1.3 IQ points per 5 ug/dl BLL in children. Fewtrell et al (2003) apply a lower threshold of 5 ug/dl BLL below which no IQ loss occurs, and an upper threshold of 20 ug/dl BLL above which no further IQ losses are expected (i.e., a loss of about 3.5 IQ points for BLL > 20 ug/dl).[33] For some children an IQ loss will cause mild

[33] Fewtrell et al (2003) apply a linear relationship through the mid-point of each 5 ug/dl BLL interval with a maximum loss of 3.5 IQ points.

mental retardation (MMR), occurring at an IQ of 50-70 points. Thus children with an IQ of 70-73.5 points are at risk of MMR from lead exposure. Following the assumption of a normal distribution of IQ in the population, the number of children with MMR from lead exposure is estimated by applying the results in Table 3.8 to the estimated children with IQ of 70-73.5 points. Estimated annual loss of intelligence from lead exposure is presented in Table 3.9, totaling about 160-235 thousand IQ points and 1750-2670 cases of MMR.

Table 3.9: Estimated Annual IQ Losses and Cases of MMR from Lead Exposure

	"Low"	"High"
IQ Point Losses (thousands)		
IQ (1) - loss of 0.65 points per child	42	30
IQ (2) - loss of 1.95 points per child	45	43
IQ (3) - loss of 3.25 points per child	32	41
IQ (4) - loss of 3.50 points per child	40	120
Total Losses (thousands)	159	234
MMR		
Number of children with MMR	1750	2670

Source: Larsen and Strukova (2005a).

3.19 Other health effects of lead exposure are gastrointestinal effects in children, anemia in children and adults, and elevated blood pressure in adults resulting in a higher risk of cardiovascular disease and mortality. As gastrointestinal effects and anemia are found to develop at BLL exceeding 60-80 ug/dl , relatively few cases are expected in most cities in Peru.[34] For increased blood pressure, effects are only significant in the "high" case. Estimated annual cases of gastrointestinal effects, anemia and cardiovascular mortality from increased blood pressure are presented in Table 3.10.

Table 3.10: Estimated Annual Cases of "Other Health Effects"

	"Low"	**"High"**
GASTROINTESTINAL EFFECTS IN CHILDREN	**1400**	**23000**
ANEMIA IN CHILDREN	**800**	**18000**
ANEMIA IN ADULTS	**0**	**0**
CARDIOVASCULAR MORALITY	**0**	**40**

Source: Larsen and Strukova (2005a).

Cost of Health Effects

3.20 Estimated annual costs of health effects from lead exposure are presented in Table 3.11, totaling 0.8-1.2 billion Soles per year. The main costs are associated with IQ losses and mild mental retardation (MMR). Cost of IQ losses are estimated based on expected lifetime income losses, using a 1.6 percent decline in income for every one point loss in IQ from studies in the United States (Schwartz 1994 and Salkever 1995).[35] Studies of income losses from MMR are not readily available. Income losses are therefore estimated as proportional to MMR disability, using a disability weight of 0.36 provided by WHO. Also, DALYs from MMR are valued at GDP per capita in order to reflect cost of MMR not included in income losses. Cost of cardiovascular mortality is an average of the human capital value and the value of statistical life

[34] There could be additional cases of BLL > 60 ug/dl in lead contamination "hot spots" (see Box 1).

[35] This reflect a mean estimate of income losses. An annual discount rate of 3 percent and a real increase in annual income of 2 percent is applied. A 0.5 percentage point income loss attributed to a reduced likelihood of labor force participation from a decline in IQ is not included because of inadequate comparable data on factors influencing labor force participation in Peru vs the United States.

(VSL). Cost of elevated blood pressure morbidity is based on valuation of DALYs at GDP per capita in the absence of data on frequency of health care visits and medication. Costs of gastrointestinal effects and anemia are not included because of data limitations, but are in the case of Peru not likely to be significant in comparison to IQ losses and MMR.

Table 3.11: Annual Cost of Health Impacts from Lead Exposure (Million Soles)

	Total cost	Percent of mean cost
IQ loss in children	530-775	65%
Mild mental retardation (MMR)	270-415	34%
Cardiovascular mortality in adults	0-10	0.7%
Elevated blood pressure morbidity in adults	0-5	0.3%
Total annual cost	800-1205	100%

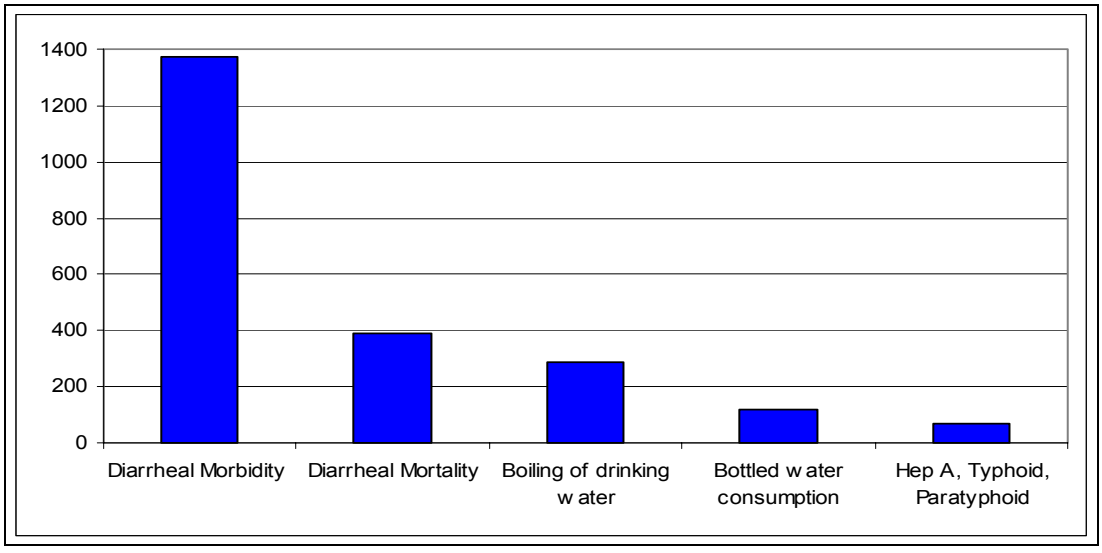
Source: Larsen and Strukova (2005a).

3.21 It should be noted again that the costs presented in Table 3.11 are only for the urban population in cities with more than 100 thousand inhabitants, and that the estimates are based on adjusted BLL measurements from 1998. As there is great uncertainty about current BLL in the urban population as a whole (and the rural population), it is necessary to undertake new studies of BLL in children and adults to provide a more accurate estimate of health effects and their costs.

Water Supply Sanitation and Hygiene

3.22 The annual cost of inadequate water supply, sanitation and hygiene is estimated at 1.8-2.7 billion Soles per year, with a mean estimate of 2.3 billion (Figure 3.5). The cost of health impacts represents an estimated 82 percent of total mean cost (1.9 billion S.), and averting expenditures about 18 percent (0.4 billion S.). Health impacts include both mortality and morbidity, and averting expenditures include bottled water consumption, and household boiling of drinking water.

Figure 3.5: Annual Costs by Category (Million S/.)



Source: Larsen and Strukova (2005a).

3.23 The major health effects of inadequate water quality and quantity, sanitation facilities and practices, and hygiene are diarrheal morbidity and mortality.[36] WHO estimates that 90 percent of diarrheal illness is attributable to these factors (WHO 2002). The Peru Demographic and Health Survey 2000 (Peru DHS 2000) provides data on diarrheal prevalence in children

[36] Hygiene refers to personal hygiene (such as handwashing), domestic hygiene and food hygiene.

under the age of five years. It reports a 2-week diarrheal prevalence rate of 15.4 percent. This rate is used to estimate annual diarrheal cases in children under-5. The DHS survey does not, and nor does any other household survey in Peru provide information on diarrheal illness in the population above 5 years of age. Estimation from Colombia was therefore applied, which indicates that diarrheal incidence in the population above 5 years of age is $1/7^{th}$ to $1/5^{th}$ of incidence in children under 5 years (Larsen 2004).

3.24 Data from Ministry of Health indicates that 4.6 percent of child mortality was due to intestinal diseases in 2000. This is used as a low bound for diarrheal mortality estimation. The Global Burden of Disease 2002 (WHO 2002) indicates that 9-13 percent of child mortality could be from diarrheal illness in Peru, which takes into account possible substantial under-reporting of mortality. This is the average of AMRO B and AMRO D WHO sub-regions, reflecting that the child mortality rate in Peru is around the average of the two sub-regions. A diarrheal mortality rate of 13 percent of under-5 child mortality is used as the high bound for diarrheal mortality estimation.

3.25 Sometimes diarrheal illness requires hospitalization. There are however no readily available centralized records in Peru that provide data on the annual number of diarrheal hospitalizations. Information from the website of the Ministry of Health of Peru on the total number of intestinal disease hospitalizations was therefore used, corresponding to 0.075 percent of diarrheal cases in children under-5 and 0.05 percent of cases in the population over 5.

3.26 Table 3.12 presents the estimated health impacts from inadequate water supply, sanitation and hygiene, and Table 3.13 presents disability adjusted life years (DALYs).

Table 3.12: Estimated Health Impacts from Inadequate Water, Sanitation and Hygiene

	Estimated Annual Cases	
	"Low"	"High"
Cases of Diarrheal illness		
Children (under the age of 5 years) – increased mortality	845	2390
Children (under the age of 5 years) – increased morbidity	8,360,000	8,360,000
Population over 5 years of age – increased morbidity	9,900,000	13,680,000
Cases of Diarrheal Hospitalization		
Children (under the age of 5 years)	6,300	6,300
Population over 5 years of age	5,900	5,900

Source: Larsen and Strukova (2005a).

Table 3.13 Estimated DALYs from Diarrheal Mortality and Morbidity

	Estimated Annual DALYs	
	"Low"	"High"
Children (under the age of 5 years) – increased mortality	28,760	81,285
Children (under the age of 5 years) – increased morbidity	2,790	3,715
Population over 5 years of age – increased morbidity	11,000	19,750
TOTAL	**42,550**	**104,750**

Source: Larsen and Strukova (2005a).

3.27 Annual cost of diarrheal illness from inadequate water, sanitation and hygiene is estimated at 1.5-2.1 billion Soles (Table 3.14). Cost of diarrheal child mortality is based on the human capital approach (HCA). The cost of morbidity includes the cost of illness (medical treatment, medicines, and value of lost time) and DALYs from morbidity valued at GDP per capita to reflect the cost of reduced well-being associated with illness.

Table 3.14: Estimated Annual Cost of Diarrheal Illness (Million Soles)

	Estimated Annual Cost	
	"Low"	**"High"**
Mortality		
Children under 5 years	205	575
Morbidity		
Children under 5 years	585	650
Population over 5 years	665	880
TOTAL ANNUAL COST	1455	2105

Source: Larsen and Strukova (2005a).

3.28 Cost-of-illness is presented in Table 3.15 for diarrheal morbidity.[37] About 25-35 percent of these costs are associated with the value of time lost to illness (including care giving), and 65-75 percent are from cost of treatment and medicines. Estimated cost of time losses is based on 75 percent of wage rates.

Table 3.15: Estimated Annual Cost-of-Illness (Morbidity)

	Estimated Annual Cost (Billion S/.)	
	"Low"	"High"
Cost of medical treatments (doctors, hospitals, clinics)	0.53	0.55
Cost of medicines	0.31	0.33
Cost of time lost to illness	0.30	0.47
TOTAL ANNUAL COST	1.14	1.35

Source: Larsen and Strukova (2005a).

3.29 Inadequate water, sanitation and hygiene is also the cause of other diseases. There were 39 thousand cases of typhoid/paratyphoid and 17 thousand cases of hepatitis A in Peru in 2000, according to data from the Ministry of Health. The cost of these illnesses is estimated at 70 million Soles (Table 3.16).

Table 3.16: Estimated Annual Cost of Typhoid/Paratyphoid and Hepatitis A

	Estimated Total Annual Cost (Million S/.)
Cost of Hospitalization	50
Cost of Medication	2
Cost of time losses	18
Total Annual Cost	70

Source: Larsen and Strukova (2005a).

3.30 Averting expenditures represent an additional cost of inadequate water supply. If people perceive there is a risk of illness from the municipal water supply, or from other sources of water supply they rely, some of them are likely to purchase bottled water for drinking purposes, boil their water, or install water purification filters. Economists usually consider these averting expenditures a cost of health risks.

3.31 Estimated averting expenditures are presented in Table 3.17, based on a total bottled water consumption of about 120 million liters per year (Ministerio de la Produccion - Oficina de Estadística Industrial) and boiling of drinking water in nearly 70 percent of households (US AID Hand Washing Survey 2004).

Table 3.17: Estimated Annual Household Cost of Averting Expenditures

[37] These costs do not include the valuation of DALYs.

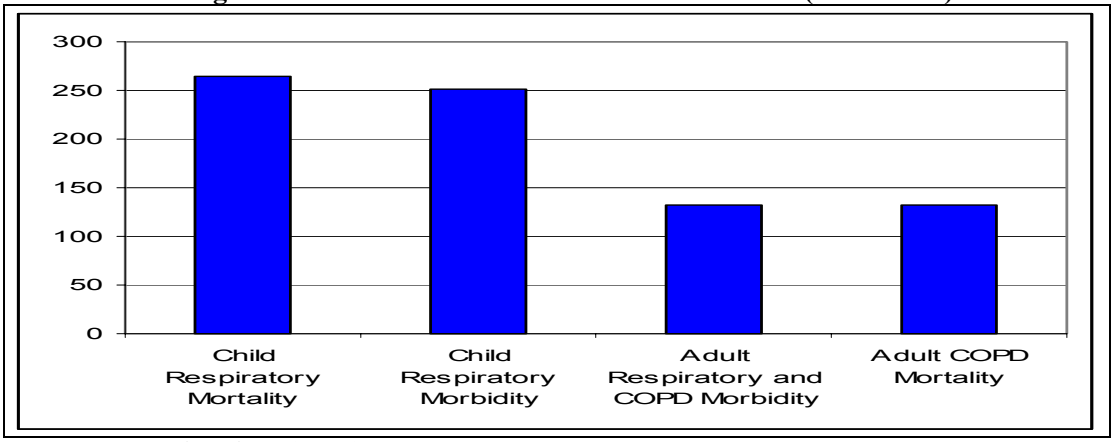
	Total Annual Cost (Million S/.)	
	"Low"	**"High"**
Cost of bottled water consumption	75	165
Cost of household boiling drinking water	190	380
Total annual cost	**265**	**545**

Source: Larsen and Strukova (2005a).

Indoor Air Pollution

3.32 The mean estimated annual cost of health impacts from indoor air pollution associated with the use of traditional fuels (mainly fuel wood) is about 0.8 billion S/. Respiratory child mortality is 34 percent of the cost, and acute respiratory illness (ARI) in children represents 32 percent. Chronic obstructive pulmonary disease (COPD) and ARI morbidity in adult females, and adult female COPD mortality each represent 17 percent of cost (Figure 3.6).

Figure 3.6: Annual Costs of Indoor Air Pollution (Million S/.)



Source: Larsen and Strukova (2005a).

3.33 According to the Peru Demographic and Health Survey 2000, around 87 percent of rural households and 11 percent of urban households used fuel wood, charcoal/coal products or dung in 2000, constituting a major source of indoor air pollution and respiratory health risk. Winrock International is currently implementing a USAID project in the high Andean district of Inkawasi in Lambayeque to reduce exposure to indoor air pollution from fuel wood used for cooking. A baseline pre-intervention monitoring of indoor air quality (PM and CO) was undertaken in the kitchens of 48 rural households in 4 communities in July-August 2005. Measurements were undertaken for 24 hours during two sessions. The first session was from 5 am to 9 pm, corresponding to the cooking period. The second session was night time from 9 pm to 5 am, corresponding to the non-cooking time. A summary of the PM results are presented in Table 3.18. The average and median level of PM 4 was alarmingly high during the cooking period, and also exceeded outdoor air quality standards during night time. PM 4 concentrations exceeded 500 ug/m^3 in 40 percent of the households, exceeded 1000 ug/m^3 in more than 20 percent of the households, and exceeded Peru's 24 hour national air quality standard for PM2.5 of 65 ug/m^3 in nearly 90 percent of the households.[38]

Table 3.18: Concentration of PM_4 (µg/m^3) in the Sample of 48 Kitchens

	COOKING PERIOD*	NON-COOKING PERIOD**	24-HOUR AVERAGE
AVERAGE ± SD.	**907 ± 1287**	**162 ± 343**	**635 ± 849**
MEDIAN	**408**	**58**	**280**
RANGE	**5 – 6312**	**ND – 2093**	**3 – 3880**

[38] Smoke from fuel wood consists of very fine particulates. The difference in the share PM4 and PM2.5 in total PM can therefore be expected to be small.

*COOKING **PERIOD: APPROXIMATELY 5 A.M. TO 9 P.M. **NON-COOKING PERIOD: APPROXIMATELY 9 P.M. TO 5 A.M. SD=STANDARD DEVIATION ND: NO READING DETECTED WITH THE METHOD UTILIZED.**

Source: Windrock International (2005). Monitoring by Swisscontact.

3.34 These monitoring results provided by Winrock International give a strong indication of the level of the problem of indoor air pollution in rural communities in Peru. PM pollution can be expected to be particularly high from the use of fuel wood with open fire or unimproved stove, with serious respiratory health effects.

3.35 Desai et al (2004) provides a review of research studies from around the world that have assessed the magnitude of health effects from indoor air pollution from solid fuels. The odds ratios for acute respiratory illness (ARI) and chronic obstructive pulmonary disease (COPD) are presented in Table 3.19. The ratios represent the risk of illness for those who are exposed to indoor air pollution compared to the risk for those who are not exposed. The range of "low" to "high" ratios reflects the review by Desai et al (2004), and have in this Chapter been applied to young children under the age of five years (for ARI) and adult females (for ARI and COPD) to estimate the increase in mortality and morbidity associated with indoor air pollution.[39] It is these population groups who suffer the most from indoor air pollution because they spend much more of their time at home, and/or more time cooking than older children and adult males.

Table 3.19: Health Risks of Indoor Air Pollution

	Odds Ratios (OR)	
	"Low"	"High"
Acute Respiratory Illness (ARI)	1.9	2.7
Chronic obstructive pulmonary disease (COPD)	2.3	4.8

Source: Desai et al (2004).

3.36 To estimate the health effects of indoor air pollution from the odds ratios in Table 3.19, baseline data for COPD and ARI are needed. Data on COPD mortality and especially morbidity incidence, according to international disease classifications, are not readily available for Peru. Regional estimates from WHO (2001) and Shibuya et al (2001) for the AMRO D region are therefore applied, i.e., a COPD incidence rate of 33 per 100 thousand females and a COPD mortality rate of 2 percent of female crude mortality.[40]

3.37 For ARI in children under-5, the two-week prevalence rate of about 20 percent from the Peru DHS 2000 is used to estimate total annual cases of ARI in children under-5. No information on ARI in adults is available in the DHS household survey or any other household survey in Peru. An analysis of a database from Colombia does however suggest that ARI incidence in the population over 5 years in Peru is about 16-18 percent of the incidence in children under-5 (Larsen 2004). This incidence differential is used to estimate annual cases of ARI in adult females. For ARI mortality in children under-5, a range of 12-18% of total estimated child mortality is applied, reflecting uncertainty over all-cause and cause specific child mortality statistics. The low bound is from the GBD 2002 for the AMRO D region of WHO, and the high bound reflects child mortality statistics in Peru.

3.38 Estimated health effects of indoor air pollution are presented in Table 3.20. They are estimated from the baseline health data discussed above, the odds ratios in Table 3.19, and the urban and rural population shares using solid fuels. Estimated cases of ARI child mortality from indoor air pollution represent 25-40 percent of total ARI child mortality in Peru. Estimated ARI morbidity in children under-5 is 20-30 percent of total ARI morbidity in this age group in the

[39] Desai et al (2004) present odd ratios for lung cancer, but this effect of pollution is not estimated in this Chapter. This is because the incidence of lung cancer among rural women is generally very low.

[40] Peru belongs to the AMRO D region of WHO, which is one of three WHO regions in the Americas.

country, and estimated ARI in adult females is 15-25 percent of total adult female ARI. Similarly, the estimated cases of COPD mortality and morbidity represent about 20-40 percent of total estimated female COPD from all causes. Table 3.21 presents the estimated health effects in disability adjusted life years (DALYs). An estimated 42-62 thousand DALYs are lost each year due to indoor air pollution.

Table 3.20: Estimated Annual Health Impacts of Indoor Air Pollution

	Estimated Annual Cases	
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	911	1291
Children (under the age of 5 years) – increased morbidity	2121400	3102200
Females (30 years and older) – increased morbidity	546200	825600
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	334	605
Adult females – increased morbidity	924	1665

Source: Larsen and Strukova (2005a).

Table 3.21: Estimated DALYs Lost to Indoor Air Pollution

	Estimated Annual DALYs (000)	
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	31	44
Children (under the age of 5 years) – increased morbidity	3.5	5
Females (30 years and older) – increased morbidity	3.8	5.8
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	2	3.6
Adult females – increased morbidity	2.1	3.7
TOTAL DALYs	42.4	62.1

Source: Larsen and Strukova (2005a).

3.39 Total annual cost of indoor air pollution is estimated at 0.55-1.0 billion Soles, with a mean estimate of 0.78 billion (Table 3.22). The cost of mortality for adults is based on the value of statistical life (VSL) as a high bound and HCA as a low bound, and on the human capital approach (HCA) for children. The cost of morbidity includes the cost of illness (medical treatment, and value of lost time for adults) and DALYs from morbidity valued at GDP per capita to reflect the cost of reduced well-being associated with illness. The value of time for adults is 75 percent of urban and rural average hourly wages, which are 3.8 S/ and 2.5 S/ respectively.

3.40 There is very little information about the frequency of doctor visits, emergency visits and hospitalization for COPD patients in any country in the world. Schulman et al (2001) and Niederman et al (1999) provide some information on this from the United States and Europe. Figures derived from these studies are applied to Peru in this Chapter. Estimated lost work days per year is based on frequency of estimated medical treatment plus an additional 7 days for each hospitalization and one extra day for each doctor and emergency visit. These days are added to reflect time needed for recovery from illness.

3.41 To estimate the cost of a new case of COPD, the medical cost and value of time losses have been discounted over a 20-year duration of illness. An annual real increase of 2 percent in medical cost and value of time has been applied to reflect an average expected increase in annual labor productivity and real wages. The costs are discounted at 3 percent per year, a rate commonly applied by WHO for health effects.

Table 3.22: Estimated Annual Cost of Indoor Air Pollution

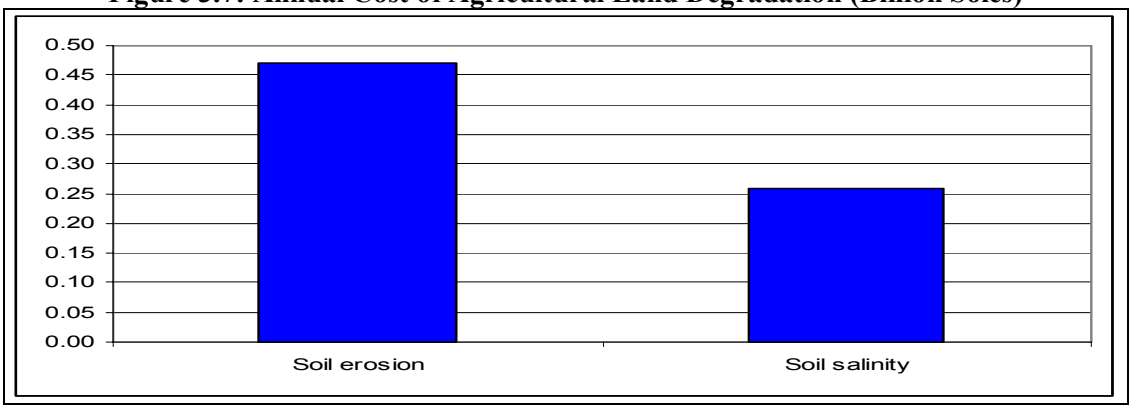
	Estimated Annual Cost (Million Soles)	
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	220	311
Children (under the age of 5 years) – increased morbidity	200	302
Adult females – increased morbidity	84	130
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	22	244
Adult females – increased morbidity	19	33
TOTAL	545	1020

Source: Larsen and Strukova (2005a).

Land Degradation

3.42 The mean estimated annual cost of agricultural land degradation is 0.7 billion Soles, of which soil erosion represents about 65 percent and soil salinity about 35 percent (Figure 3.7). These costs are the value of crop yield reductions associated with salinity and erosion. Data limitations have prevented an estimate of the cost of pasture (rangeland) degradation, and while the cost of reservoir sedimentation from soil erosion is likely to be significant, it is not estimated in this Chapter.

Figure 3.7: Annual Cost of Agricultural Land Degradation (Billion Soles)



Source: Larsen and Strukova (2005a).

3.43 An estimated 5.5 million hectares are under cultivation in Peru of which about 1.7 million hectares are irrigated. Permanent pasture constitutes nearly 18 million hectares (Peru Statistical Yearbook 2003). There is a general perception that the Sierra region is overexploited due to difficulties of agricultural production on the mountain slopes and improper land use practices, and that major salinity problems occur in the Costa region due to improper irrigation and drainage (Umali 1993). There are however very few studies of the extent of land degradation and how degradation affects agricultural productivity in Peru. No systematic and comprehensive studies have recently been undertaken of soil salinity levels in the Pacific Region. Statistics (http://www.inei.gob.pe/) indicate that about 307 thousand hectares in Peru are salt affected. The problem is particularly widespread in the departments of Piura, Lambayeque and Ica.

3.44 In the absence of precise data, it is assumed in this Chapter that 1/3 of saline lands are abandoned due to their low quality. That means 350-1000 S/ in annual income is lost per

hectare, reflecting an approximate estimate of the economic return to cultivated land. On the remaining 2/3rd of salinity affected lands it is assumed that crop yields are reduced by 10-25 percent for cotton and by 15-30 percent for rice due to salinity.[41] Of land affected by salinity, an estimated 70 percent is used for cultivation of rice and 30 percent is used for cotton cultivation. Estimated agricultural losses due to soil salinity are presented in Table 3.23, with a mean annual loss of 0.26 billion Soles.

Table 3.23: Annual Cost of Soil Salinity

		Low	High
Annual losses due to abandoned lands	Million S.	32	97
Annual loss of rice production	Thousand tons	179	357
Annual lost output value of rice	Million S./	98	196
Annual loss of cotton production	Thousand tons	10	33
Annual lost output value of cotton	Million S./	22	72
Total annual lost output	Million S./	152	365

Source: Larsen and Strukova (2005a).

3.45 As major studies indicate, the Sierra region is the most affected by soil erosion. Peru Statistical Yearbook 2004 indicates that 66 percent of severely eroded soils are in Sierra. Major reason for soil erosion is degradation and abandonment of agricultural terraces. In the absence of data on the share of land area that is eroded due to agricultural activity, it is assumed that 60 percent of agricultural crop land is eroded in Sierra (CONAM, 2001). It is also assumed that only 45 percent of cultivated land is used annually, which corresponds to the share of land under cultivation in Costa and Sierra from the Peru Statisical Yearbook 2003. The main practice to cope with erosion is construction of terraces (Valdiva 2002). Valdiva presents yield estimates for potatoes, corn and barley for the Northern (Cajamarca), Central (Lima) and Southern (Cuzco) regions of Peru with and without terraces. On average, yield gains from agricultural terraces are 5-60% for potato and corn, which are the major crops in Sierra. Based on these data, the average annual revenue loss due to agricultural terrace degradation is estimated at 392-553 million S/ per year, representing the cost of soil erosion (Table 3.24). Total estimated annual cost of land degradation is presented in Table 3.25, ranging from 0.54 to 0.92 billion Soles per year, with a mean estimate of 0.73 billion Soles (0.35% of GDP in 2003).

3.46 Clearly these estimates of agricultural land degradation suffer from data limitation. Soil salinity surveys are needed to provide more accurate estimates of crop yield effects and scale of degradation. Similarly, soil erosion surveys and studies on magnitude of crop losses are needed to better understand the costs of erosion in the Sierra and elsewhere. It is the poor who are likely to be most affected by soil erosion, and implications on income and vulnerability needs to be better understood.

[41] International experience indicates that yields of cotton start declining if soil salinity exceeds about 7.7 dS/m, and that yields of rice start declining if salinity exceeds about 3.0 dS/m (FAO (1998), Kotuby-Amacher et al (1997), and Resources Science Centre (1997)).

Table 3.24: Estimated Annual Cost of Soil Erosion in Peru (Million S/.)

REGION	LOW	MEAN	HIGH
NORTHERN	**48**	**128**	**209**
CENTRAL	**287**	**287**	**287**
SOUTHERN	**57**	**57**	**57**
TOTAL	**392**	**472**	**553**

Source: Larsen and Strukova (2005a).

Table 3.25: Estimated Annual Cost of Land Degradation

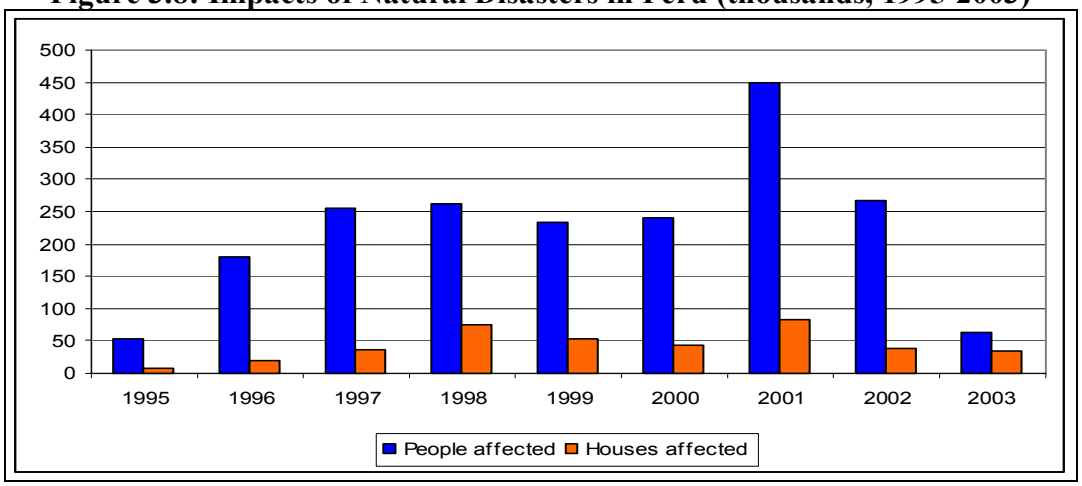
	Estimated Annual Cost (Million S/.)	
	"Low"	**"High"**
Soil erosion	392	553
Soil salinity	152	365
Total annual cost	544	918

Source: Larsen and Strukova (2005a).

Natural Disasters

3.47 Peru is annually afflicted by natural disasters such as floods, landslides, avalanches, and storms, and severe earthquakes occur periodically. The total mean annual cost of natural disasters is estimated at 1 billion Soles, or 0.5 percent of GDP. Impacts of natural disasters are presented in Figure 3.8 and Table 3.26 for the period 1995-2003. Floods, earthquakes and landslides are causing the most impact. Deaths are highest from landslides. Floods are among the leading causes of damages to houses and agricultural losses.

Figure 3.8: Impacts of Natural Disasters in Peru (thousands, 1995-2003)



Source: INDECI, 2005.

Table 3.26: Natural Disasters and Impacts in Peru, 1995-2003

	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
Total natural disasters	393	311	480	687	522	1116	1110	1376	3316	9311
Deaths	218	832	254	305	229	210	474	198	213	2933
Affected people	54507	180074	255813	261712	232614	239903	448813	266904	62347	2002687
Affected houses	7354	20537	36191	76157	53753	42489	82534	38938	34679	392632
Destroyed houses	2961	7070	6676	62693	4332	2643	27030	2801	8525	124731
Destroyed hectares	21272	32589	113658	121718	59977	13381	42873	38822	13615	457905

Source: INDECI, 2005.

3.48 There are no systematic and comprehensive estimates of the cost of damages from natural disasters in Peru. The only estimation available is from Bambaren Alatrista (2002), which was developed to evaluate damages from El Nino. This study allowed coming up with damage cost by category. Some cost categories, such as houses affected and destroyed were not presented explicitly in the study. Therefore estimations from Columbia were applied (Larsen 2004).

3.49 The cost categories presented by Bambaren Alatrista (2002) are adopted in this Chapter and applied to provide an order of magnitude of the annual cost of natural disasters. The cost of annually occurring disasters is based on annual averages for the 15-20 year period 1985/90-2003. This period was selected because of more detailed and comprehensive data were available. Total estimated annual cost of natural disasters is presented in Table 3.27. The largest cost is associated with damages to housing, infrastructure, and public buildings. In total, the annual cost is estimated at 1075 Million Soles.

Table 3.27: Estimated Annual Cost of Natural Disasters

	Million Soles
Deaths*	45
Injured	30
Missing persons	10
Houses destroyed	325
Houses affected	535
Hectares destroyed	70
Roads destroyed, affected	35
Railroads destroyed, affected	5
Bridges destroyed, affected	20
TOTAL COST	1075

* Valuation of mortality is an average of HCA and VSL. Source: Larsen and Strukova (2005a).

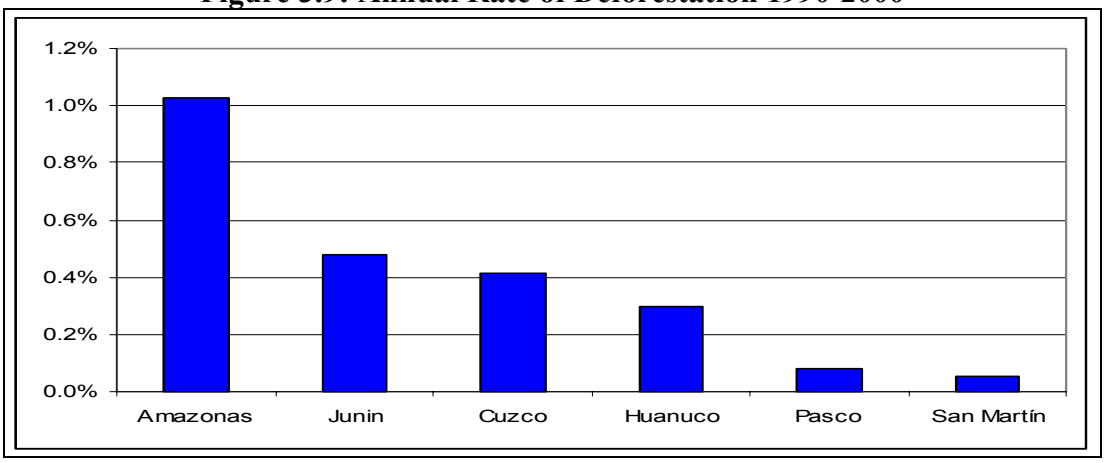
Deforestation

3.50 The estimated annual cost of deforestation is 0.3-0.6 billion Soles, with a mean estimate of 0.44 billion (0.2 percent of GDP in 2003). These costs represent the net present value of direct and indirect use forest values lost to annual deforestation in Peru.

3.51 Original forest cover in Peru is estimated to have been 59 percent of total land area. Today's forest cover is about 50 percent. While this is still above the world average of 30 percent, forest cover in Peru is distributed extremely unevenly across the country. About 80 percent of remaining forest area in Peru is located in three departments to the east of the

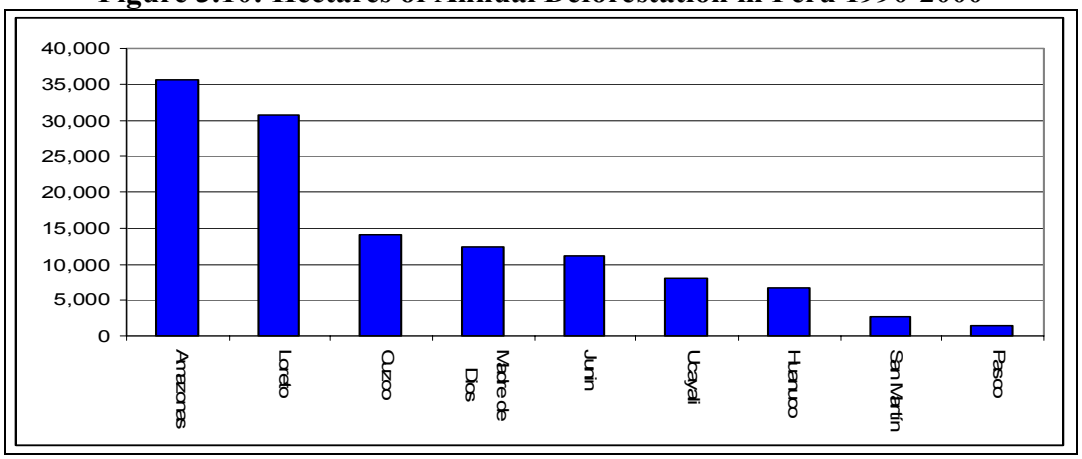
mountain chains with about 50 percent in Loreto.[42] These departments represent 43 percent of total land area in Peru, and have less than 5 percent of the total population of the country. Forest cover in these departments averages almost 96 percent. The six departments at the foot of the mountain chains, extending from North to South in Peru, with about 18 percent of the country's population, have now an average of 52 percent forest cover.[43] This represents 20 percent of Peru's forest area. Forest cover in these departments was reduced by about 25 percent in the last 10 years. Some of these departments have the highest annual rate of deforestation (Figure 3.9). Hectares of annual deforestation are presented in Figure 3.10.[44] Annual average deforestation in these nine departments totals about 123 thousand hectares.

Figure 3.9: Annual Rate of Deforestation 1990-2000



Source: Elgegren (2005).

Figure 3.10: Hectares of Annual Deforestation in Peru 1990-2000



Source: Elgegren (2005).

3.52 The cost of deforestation is very difficult to estimate. Some costs are already included in the cost of natural disasters and soil degradation to the extent that deforestation contributes to increased frequency and severity of flooding and landslides and increased agricultural land erosion. Deforestation may also have impacts on water resources quality. However, it is practically very difficult to identify and isolate these costs of deforestation at the national level, and they are not included in the estimated cost in this Chapter.

[42] Loreto, Ucayali and Madre de Dios.
[43] Amazonas, Cusco, Huanuco, Junin, Pasco, ad San Martin.
[44] Forest in the departments not presented in Figure 7.2 constitutes about 2.2 percent of total forest area in Peru.

3.53 There is a large literature that reflects different approaches to tropical forest valuation. This Chapter uses background studies by Pearce et al (1999) and Lampietti and Dixon (1994) that provide extensive literature overviews. There are several recent studies that describe deforestation costs in the Brazilian Amazon. Margulis (2004) and Seroa da Motta (2002) analyze direct forest use values of sustainable forest management for the Brazilian Amazon. A value of US $28.5 per hectare was used. Schneider et al (2002) applies about 10 US $ per hectare since the study was done at the municipal scale where higher transportation cost had a large influence on financial returns. Gram (2001) presents non-timber values for the Peruvian tropical forest. They are in the range 9-17 US $ per hectare. These values are of the magnitude of estimates in Lampietti and Dixon (1994) for non timber values in Central and South America equal to US $9-10 per hectare. Smith et al (1999) presents estimated willingness to accept compensation for forest land transformation partially into preserves with the rest into agroforestry in the Ucayali region of the Peruvian Amazon. The latter implied about US $18 per hectare of lost annual profit from direct use values, including profit from slash and burn agriculture and non timber products. This value is consistent with the sum of the two lower direct use values (US $9 and US $10) from (Schneider et al, 2002) and (Gram, 2001). Other direct use values include ecotourism. Pearce et al (1999) estimate these values in the range of US $5-10 per hectare of tropical forest and stress their local specific character. Margulis (2004) estimate these values in the order of US $9 per hectare of Brazilian Amazon forest.

3.54 Indirect use values of forest include watershed protection, nutritional and erosion/flood prevention, and water/nutrient recycling. Although there is no definite agreement in the literature about the magnitude of this forest value, Smith et al (1999) derive a willingness-to-pay (WTP) of US $4 per hectare in Peru as an indicator of the tropical service ecosystem value. Pearce et al (1999) present a higher end estimation of US $30 per hectare of tropical forest generalized from the literature review. Pierce et al also give a wide range for the option value of forest (bioprospecting, i.e. prospects of new drugs to be developed in the future using rich tropical forest biodiversity) in the range of US $0.01-21 per hectare. Existence value of forest associated with tropical forest preservation is estimated for the Brazilian Amazon in Margulis (2004). Margulis utilized the results of the recent Horton et al (2002) study WTP. After adjusting for the indirect use values, the resulting value is equal to US $31.2 per hectare of forest land. Pearce et al (1999) present US $13-27 per hectare, derived from the literature review.

3.55 The annual values of lost forest benefits per hectare in Peru are summarized in Table 3.28. The direct use values in the range of US$24-56 per hectare per year reflect the local private forest value, which includes the value from sustainable logging, non-timber products and tourism and recreation. “Low” and “high” non-use values presented in Table 3.28 differ by a factor of three, reflecting the nature of value techniques. The non-use forest values are therefore not included in the estimate of the cost of deforestation for Peru in this Chapter.

Table 3.28: Annual Values of Rainforest Benefits (US$ Per Hectare)

FOREST SERVICE	ANNUAL VALUE		
	LOW ESTIMATE	**HIGH ESTIMATE**	**MEAN ESTIMATE**
DIRECT USE VALUES	**24**	**56**	**40**
SUSTAINABLE FOREST MANAGEMENT	**10**	**29**	**19**
NON TIMBER PRODUCTS	**9**	**17**	**13**
TOURISM AND RECREATION	**5**	**10**	**8**
INDIRECT USE VALUES	**4**	**30**	**17**
NON-USE VALUES	**13**	**52**	**33**
OPTION VALUE (BIOPROSPECTING)	**0**	**21**	**11**
EXISTENCE VALUE	**13**	**31**	**22**
DIRECT+INDIRECT USE VALUE	**28**	**86**	**57**
TOTAL VALUE	**41**	**138**	**89**

Source: Pearce D. et al, 1999; Margulis, 2004; Andersen et al, 2002, Schneider R. et al, 2002; Gram, 2001; Horton et al, 2002; Seroa da Motta, 2002; Smith et al, 1999; Lampietti and Dixon, 1994.

3.56 Taking into account only the direct and indirect use values of forest, the cost of annual deforestation in Peru is estimated at about US $28-86 per hectare, with a mean value of about US $57 per hectare. The mean annual cost of 150 thousand hectares of annual deforestation per year is then US $8.5 million, or 30 million S/. Accounting for the lost sustainable future benefit flow, the present value (PV) of lost forest benefits due to annual deforestation is 280-590 million S/. with a mean estimate of 440 million S/ (0.2 % of GDP in 2003).[45] This represents the annual deforestation cost in Peru.

3.57 This Chapter refrains from including carbon storage value of forest as a cost of deforestation due to the uncertain magnitude of the carbon price at this point in time. Carbon markets are only emerging and deforestation reduction is currently not eligible for any compensation. However, the situation could change in the near future. Forest values should then be updated using carbon market prices and the eligible share of the carbon sequestration.

Municipal Waste Management

3.58 The estimated annual cost of inadequate municipal waste management is 90-110 million Soles, with a mean estimate of 100 million. This represents an estimate of the number of urban households without adequate municipal waste collection multiplied by an estimate of their willingness to pay for waste collection service.

3.59 Information from CONAM indicates that about 70 percent of municipal waste is collected in urban areas.[46] This figure is applied in this Chapter as an approximation of the percent of households with municipal waste collection. The average household size in Lima is 4.4, and 4.5 in other urban areas (Peru DHS 2000). The number of households in Lima without adequate collection is then about 530 thousand. Adjusted rate of inadequate waste collection for the other urban areas of Peru was applied. In other major cities, with a total population of nearly 6 million, there are an estimated 375 thousand households without adequate waste collection.

[45] This reflects an annual discount rate of 3-10 percent over a period of 30 years of lost benefits.

[46] Evaluación Regional de los Servicios de manejo de Residuos Sólidos Municipales. Informe Analítico de Perú - EVAL 2002 – CONAM/OPS

3.60 A commonly used technique to estimate the cost of not having waste collection services is to apply a household's willingness-to-pay (WTP) for such services. There is however no readily available information about households' WTP for municipal waste collection in Peru. A benefit transfer approach was therefore applied to Malaysian WTP in order to estimate WTP for waste collection services in Peru (Table 3.29). By adjusting for GDP per capita differentials and solid waste generation per household, the transfer approach results in a WTP in the range of 120-150 S/ per household per year in Lima and 60-75 S/ in the other cities in Peru. Multiplying these figures by the number of households without adequate solid waste collection gives cost estimate or welfare loss of 90-110 million Soles per year from inadequate solid waste collection. To provide a more reliable estimate of the cost of inadequate waste management a study of households' WTP is needed in Peruvian urban areas.

Table 3.29: WTP for Improved Municipal Waste Collection in Malaysia

		LOW ESTIMATION	HIGH ESTIMATION
WTP FOR IMPROVED SOLID WASTE COLLECTION	**MYR/HH/MONTH**	**37**	**45**
WTP FOR IMPROVED SOLID WASTE COLLECTION	**US$/HH/YEAR**	**117**	**142**
MALAYSIA GDP/CAPITA	**US$**	**3640**	**3640**
HH SIZE	**PERSONS**	**4.9**	**4.9**
AVERAGE GENERATION OF SOLID WASTE PER PERSON	**KG/PERSON/DAY**	**1**	**1**
AVERAGE GENERATION OF SOLID WASTE PER HH	**KG/HH/DAY**	**4.9**	**4.9**

Source: Othman, 2002; http://www.unescap.org/esid/psis/publications/theme1998/poptab05.htm; http://web.idrc.ca/es/ev-29989-201-1-DO_TOPIC.html.

Overfishing

3.61 Fish stock in Peru is highly uncertain and seems to be in the process of regime change, and bears significant adaptation cost to climate change (El Nino). It is therefore very difficult to estimate any impact of fishing levels on the Peruvian fish stock. Excess fishing fleet capacity does however seem to aggravate the negative impact of El Nino, further deteriorating the fishing sector's financial prospects.

3.62 Using fish catch for the last 34 years and the size of the fishing fleet it is possible to estimate maximum sustainable, economic and open access points for a "normal' year not affected by El Nino. The Gordon-Schaefer model is used for this purpose (Gordon 1953; and Schaefer 1954, 1957). The maximum sustainable point is the level of fishing fleet that gives the highest sustained fish catch. The maximum economic point is the level of fleet that gives the highest economic profit. And the open access point is the level of fleet at which economic profit is zero, i.e., profits for fishery is at levels comparable to other competitive sectors in the economy.

3.63 Table 3.30 suggests that the current fishing fleet is now, after a substantial increase in the 1990s, exceeding the maximum sustainable point by 25-40% percent. The estimates indicate that maximum sustainable fish catch could be achieved with a fishing fleet in the range 150-180 thousand MT compared to the current level of about 220 thousand MT. The estimates also indicate that the current fleet capacity in 2003-2004 is almost twice as large as the economically optimal level of 110–120 thousand MT. The current fishing fleet capacity, or any further increase in fleet, is likely to result in further hardship in the fishery sector. The current fleet is

very close to the estimated open access point of 225–240 thousand MT. The average annual predicted fishery sector profit is therefore now quite low.

Table 3.30: Fishing Fleet in Peru

	BASE CASE		BEST FIT CASE	
	PREDICTED VOLUME OF CATCH (MILLION TONS)	FISHING FLEET MT	PREDICTED VOLUME OF CATCH (MILLION TONS)	FISHING FLEET MT
MAXIMUM SUSTAINABLE POINT	**9.4**	**180000**	**9.6**	**150000**
MAXIMUM ECONOMIC POINT	**8.4**	**120000**	**8.9**	**110000**
OPEN ACCESS POINT	**8.2**	**240000**	**7.7**	**225000**
FISHING FLEET (2003-04)	**8.8**	**220000**	**7.9**	**220000**

Note: Estimated by the Gordon-Schaefer model. Source: Larsen and Strukova (2005a).

3.64 The above analysis does not provide any conclusions about over-fishing in relation to fish stock. El Nino adds further to the difficulty of estimating any impacts on fish stock of the current fishing fleet. More sophisticated modeling tools are required to take possible adaptation cost into account. A more detailed analysis should also include a separate estimation of industrial and artisan fishery. Moreover, better approximation of level of fishing effort should be used by obtaining data or estimating possible changes in fishing fleet productivity and capacity utilization over time.

Poverty and Environmental Degradation in Peru

3.65 Poverty incidence in Peru was 55 percent in 2002, ranging from 34 to 83 percent across departments (Peru Statistical Yearbook 2003). These estimates are based on the national poverty line. For international comparisons, World Bank (2005) reports that 18 percent of the population lived on less than US$ 1 per day and 38 percent lived on less than US $ 2 per day in 2000, adjusting for price differences across countries. This level of poverty is higher than in many low income countries. Environmental conditions are increasing the burden of poverty. It is therefore important to gain a better understanding of how and to what extent the poor are affected by the environment in terms of health effects, natural resources degradation and natural disasters. The cost of environmental damage in Peru is estimated at 8.2 billion Soles per year, or 3.9 percent of GDP in 2003. Of this estimate, nearly 6 billion Soles are from environmental health impacts. The focus of this section is therefore on environmental health.[47]

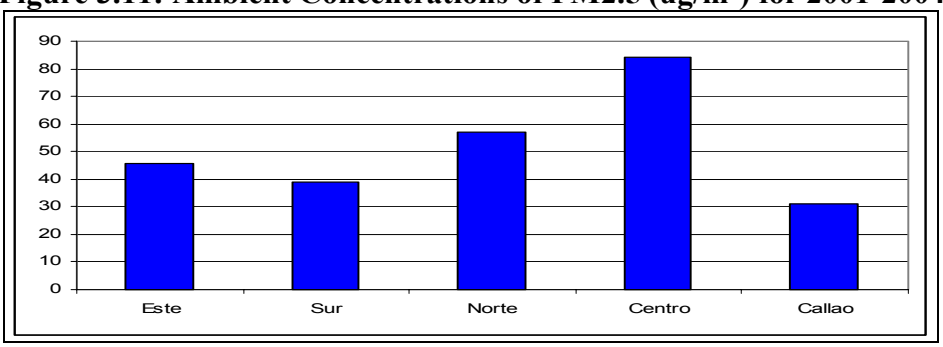
3.66 The poor, or low income households, have fewer resources to cope with environmental health effects, and a loss in income from environmental impacts is often more detrimental to their livelihood than to the livelihood of higher income groups. Often the poor are also exposed to higher levels of environmental health risk than the non-poor population. This is especially the case for risk of respiratory illness and mortality of indoor air pollution from solid fuels and risk of diarrheal illness and mortality from inadequate water supply, sanitation and hygiene. The severity of illness and fatality rate can also be higher among the poor if access to proper health services are lacking, and/or their general health condition is weak. For urban air pollution, the situation may differ from city to city and depends to a large extent on air pollution levels in

[47] Lead exposure is not included in this section because of lack of data on health effects by socio-economic group.

relation to the distribution of poverty in the city. As it is children and the elderly population that are most vulnerable to health effects of air pollution, the effects among the poor and non-poor will also depend on their respective age distribution.

3.67 The cost of health impacts of urban air particulate pollution (PM) in Peru is estimated at 1.8 billion Soles per year. Lima-Callao bears nearly 75 percent of the estimated cost and is therefore the focus of analysis of the health impacts among the poor and non-poor population. Ambient concentrations are highest in Centro and lowest in Callao (Figure 3.11). Norte has the second highest PM2.5 concentration and is the zone with the largest population. Ambient concentrations of PM10 follow a similar pattern.

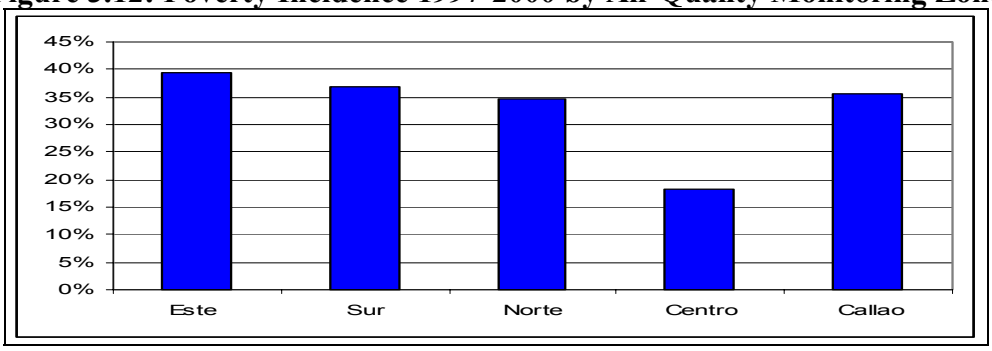
Figure 3.11: Ambient Concentrations of PM2.5 (ug/m^3) for 2001-2004



Source: DIGESA (2005).

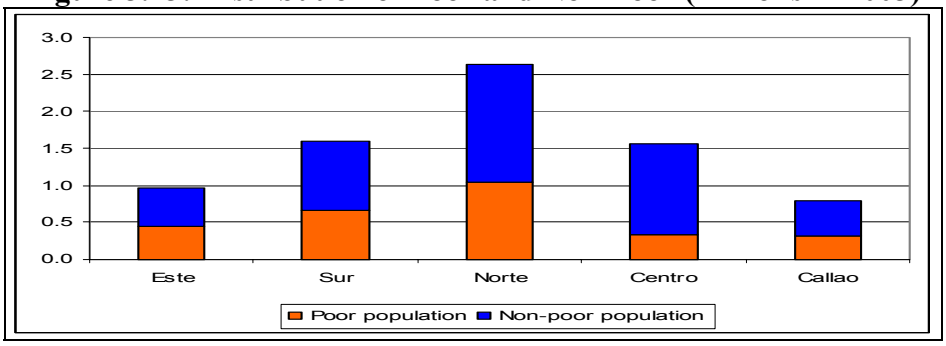
3.68 Poverty incidence is lowest in Centro and in the range of 35-40 percent in the other zones (Fgure 5.12). Very few of the poor people live in Centro and Callao, which are the zones with the highest and lowest PM2.5 ambient concentrations (Figure 3.13). In contrast, many of the non-poor live in Centro and Norte which are the zones with the highest PM2.5 ambient concentrations. The weighted concentration exposure among the non-poor is about 10 percent higher than among the poor population, suggesting that the health effects of air pollution might be higher among the non-poor population (Figure 3.14). However, age distribution and age-specific health impacts of pollution need to be taken into account in order to estimate the overall health effects among each population group.

Figure 3.12: Poverty Incidence 1997-2000 by Air Quality Monitoring Zone



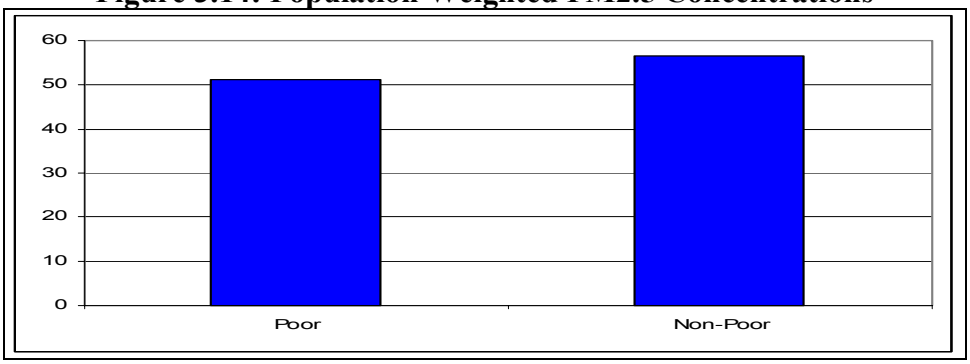
Source: Calculated from district poverty incidence data 1997-2000 by National Institute of Statistics presented in Perez and Yamasato (2002).

Figure 3.13: Distribution of Poor and Non-Poor (millions in 2003)



Source: Based on district population estimates from Peru statistical yearbook (2003) and poverty incidence from the National Institute of Statistics presented in Perez and Yamasato (2002).

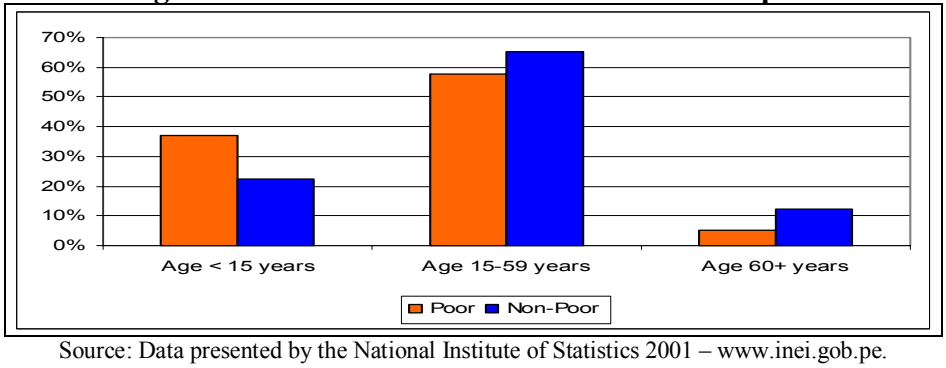
Figure 3.14: Population Weighted PM2.5 Concentrations



Source: Larsen and Strukova (2005a).

3.69 The study by Pope et al (2002) provides strong evidence that most of the premature deaths from PM2.5 in the urban environment are from an increase in cardiopulmonary mortality. The predominant share of cardiopulmonary mortality occurs among the elderly population. The age distribution among the poor and non-poor population is therefore an important factor in estimating mortality from air pollution. Age distribution of the poor and non-poor population in Lima is presented in Figure 3.15. As much as 37 percent of the poor population is children under the age of 15 years. More importantly for the mortality effect of urban air pollution, more than 12 percent of the non-poor are in the age group 60 years and up. Only 5.5 percent of the poor are in this age group.

Figure 3.15: Age Distribution of the Poor and Non-Poor Population in Lima



Source: Data presented by the National Institute of Statistics 2001 – www.inei.gob.pe.

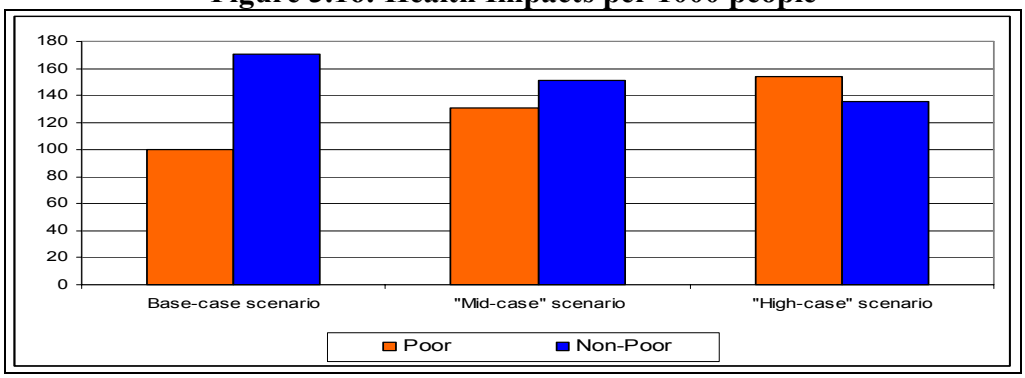
3.70 Figure 3.16 presents the estimated health impacts per 1000 people for the poor and non-poor population in Lima-Callao. In the base-case scenario the impact on the non-poor is 70

percent higher than on the poor. This outcome is mainly a result of the larger share of non-poor people in the age group 60+ years of age and that the cardiopulmonary mortality rate is substantially higher in this age group than in other age groups.

3.71 The base-case scenario assumes that the age specific cardiopulmonary death rate and incidence rate of respiratory disorders is the same among the poor and non-poor. It is however very possible that the age specific death rate and/or the respiratory incidence rate is higher among the poor. A mid-case and high-case scenario is therefore presented in Figure 3.16. The mid-case scenario is based on a 50 percent higher death and respiratory illness rate, and the high-case on a 100 percent higher rate. Only in the high-case scenario is the health impacts per 1000 people higher among the poor than the non-poor.

3.72 The incidence of health impacts among the poor and non-poor is not the only relevant indicator of the burden of environmental disease. Health impact in relation to income is also a useful indicator because illness and premature mortality result in medical treatment costs and lost income in addition to pain, suffering and activity restriction. Thus high health impact relative to income is an indication of the burden on the living standard of a household.

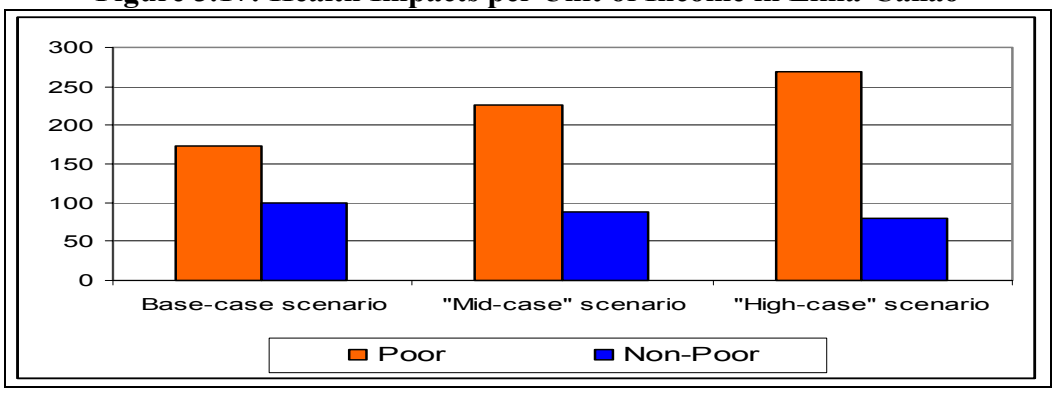
Figure 3.16: Health Impacts per 1000 people



Note: The health impacts are indexed to 100 for the poor in the base-case scenario. The impacts per 1000 people therefore show relative magnitude of impact on the poor and non-poor. Source: Larsen and Strukova (2005a).

3.73 Figure 3.17 presents the estimated health impacts per unit of income in Lima-Callao. This portrays a very different situation than simply health impacts per person. In the base-case scenario, the health impacts relative to income are nearly 75 percent higher among the poor than among the non-poor. In the high-case scenario, the impacts relative to income are more than 3 times higher among the poor than among the non-poor.

Figure 3.17: Health Impacts per Unit of Income in Lima-Callao



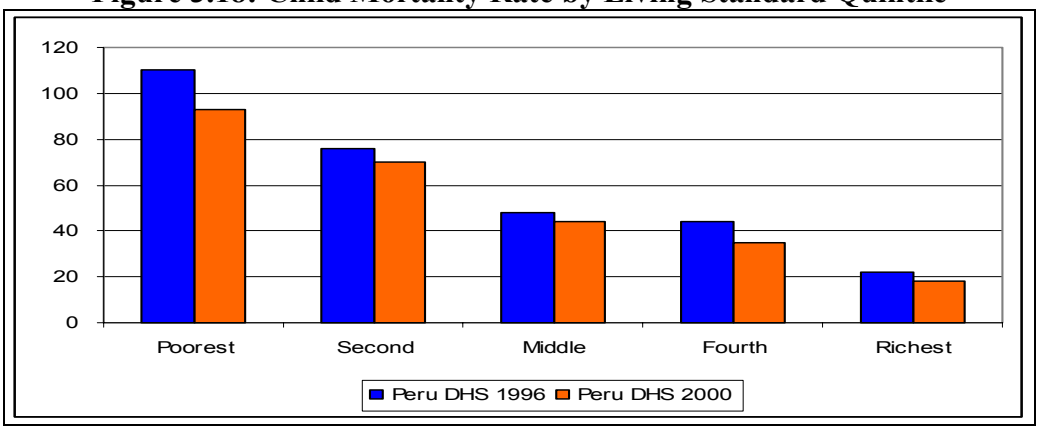
Note: The health impacts are indexed to 100 for the non-poor in the base-case scenario. It is calculated as health impact per person divided by income per person, normalized to 100. Source: Larsen and Strukova (2005a).

3.74 The cost of health impacts of inadequate water supply, sanitation and hygiene is estimated at 2.25 billion Soles per year. About 80 percent of this cost is diarrheal illness and mortality. The remainder cost is boiling of drinking water and purchase of bottled water to reduce or avoid risk of illness. The analysis in this section focuses on the distribution of the health impacts.

3.75 Diarrheal prevalence rates in children under five years from the Peru DHS 2000 were analyzed in relation to poverty incidence for each department in Peru. For every one percent increase in poverty across departments, diarrheal prevalence increases by 0.9 percent. The correlation between poverty and child mortality is even stronger. For every one percent increase in poverty across departments, child mortality increases by 1.1 percent.[48] A strong correlation between diarrheal prevalence and child mortality can also be observed.

3.76 The estimated cost of inadequate water supply, sanitation and hygiene includes in the order of 1000-2000 diarrheal deaths in children under five years of age. Figure 3.18 presents child mortality rates by living standard quintiles from the Peru DHS 1996 and 2000. The mortality rate among the poorest 20 percent of the population was about 5 times higher than among the richest 20 percent in 1996 and in 2000.

Figure 3.18: Child Mortality Rate by Living Standard Quintile

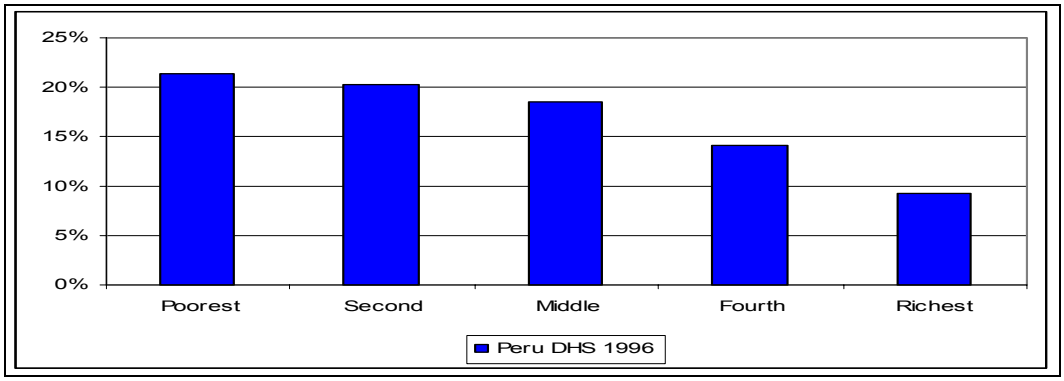


[48] The relationships are estimated by log-linear OLS regression using data from 24 departments, and are statistically significant at 99 percent. Source: Larsen and Stukova (2005a).

Source: Peru Demographic and Health Surveys 1996 and 2000. Child mortality rates are for a 10 year period prior to the survey.

3.77 Figure 3.19 presents diarrheal prevalence rate in children in 1996. The rate is more than two times higher among the poorest population compared to the richest population.[49]

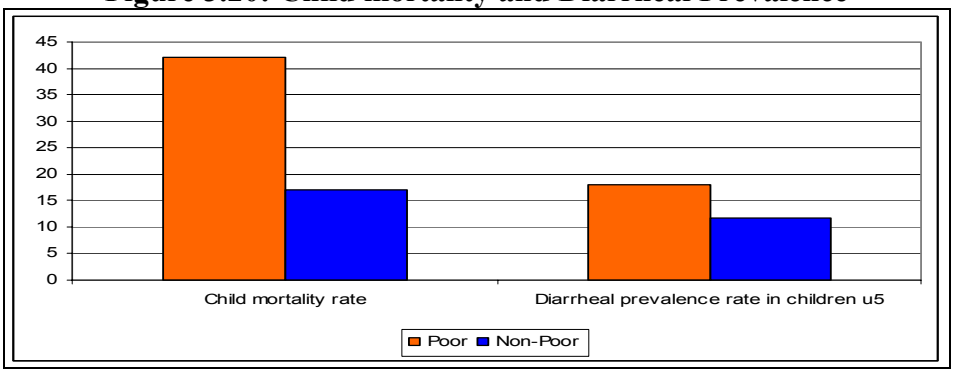
Figure 3.19: Child Diarrheal Prevalence Rate by Living Standard Quintile



Note: The diarrheal prevalence rate refers to the percentage of children with diarrheal illness at any time during a two-week period prior to the survey.

3.78 For 2003, it is estimated that the child mortality rate among the poor is around 42 per 1000 live births, compared to 17 among the non-poor. This estimate is based on a national child mortality rate of 34 in 2003 and the child mortality rates by living standard quintiles from the Peru DHS 2000. Similarly, based on an average child diarrheal prevalence rate of 15 percent in 2000 (Peru DHS 2000), the rate among the poor is estimated at 18 percent, and at 12 percent among the non-poor (Figure 3.20).

Figure 3.20: Child mortality and Diarrheal Prevalence



Source: Larsen and Strukova (2005a).

3.79 The health impacts per 1000 people are presented in Figure 3.21. The impacts are nearly three times higher in the poor population than in the non-poor population.[50] This estimate is based on the child mortality rates and the diarrheal prevalence rates in children presented in

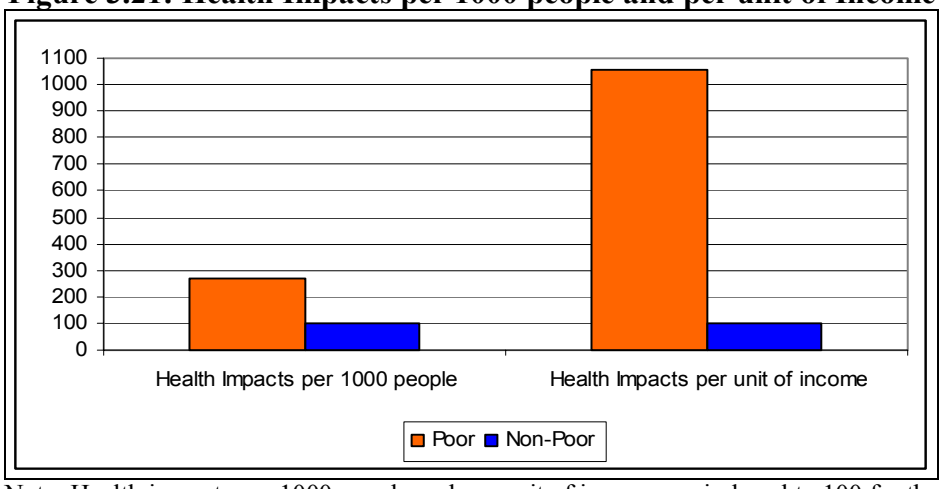
[49] Diarrheal prevalence rate by living standard quintile was not obtained for the DHS 2000 survey.

[50] This is a larger difference than the difference in child mortality and diarrheal prevalence. The main reasons for this are that the share of children in the poor population is much higher than in the non-poor population, that diarrheal mortality is largely among children, and diarrheal incidence rate is much higher in children than in adults.

Figure 3.20, and estimates of diarrheal prevalence rate in the population above the age of five years.[51] There are many reasons why the diarrheal disease burden is higher in the poor population than in the non-poor population. First of all, the poor have much lower access to improved water supply and safe sanitation. Secondly, hygiene conditions are likely to be worse.

3.80 The difference in health impacts relative to income is even larger. Health impacts are more than 10 times higher in the poor population than in the non-poor population per unit of income (Figure 3.21). This is because the income of the non-poor is nearly four times higher than the income of the poor.[52]

Figure 3.21: Health Impacts per 1000 people and per unit of Income



Note: Health impacts per 1000 people and per unit of income are indexed to 100 for the non-poor population. Source: Larsen and Strukova (2005a).

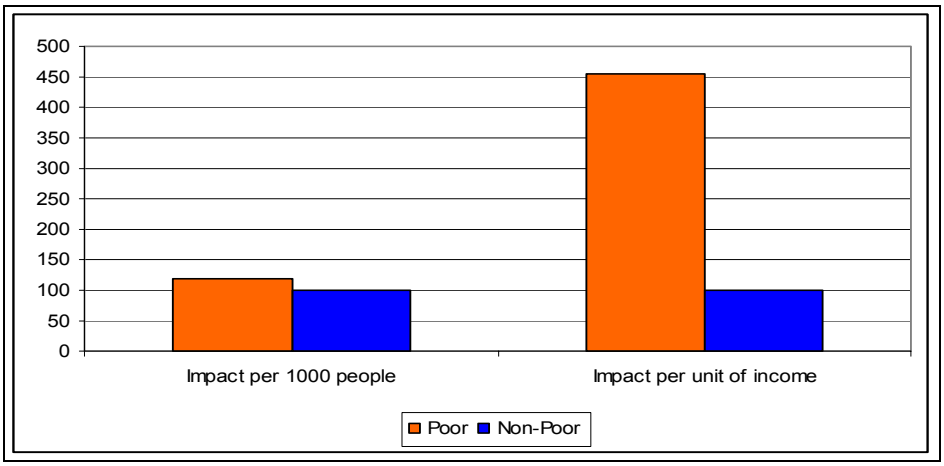
3.81 The cost of health effects of indoor air pollution from solid fuels is estimated at 0.8 billion Soles per year. Around 10 percent of the urban population and more than 85 percent of the rural population is using solid fuels in the indoor environment (Peru DHS 2000). There are however no readily available data on how many percent of the poor and non-poor population that uses fuel wood. With an urban poverty rate of about 40 percent, it is likely that almost all the 10 percent of the urban population using solid fuels are poor. The poverty rate in the rural areas exceeds 65 percent. It is therefore plausible that 20 percent of the rural population using fuel wood is non-poor while 65 percent are poor. If so, then about 43 percent of the poor population and 11 percent of the non-poor population in Peru uses solid fuels. In this case, based on the estimated of health effects from solid fuel use in urban and rural areas separately, 80-85 percent of the total health effects are among the poor population.

3.82 The share of health effects of the poor may however be larger. This depends on characteristics of wood stoves and ventilation which may be different in poor and non-poor households. It is plausible that poor households are more likely to use more polluting stoves than the non-poor households. Health effects of solid fuels can also be influenced by general health conditions of those exposed to the pollution. In this respect the poor may be more vulnerable to health effects from indoor air pollution.

3.83 The impacts for all the environmental health categories, i.e., urban air pollution, water, sanitation and hygiene, and indoor air pollution per 1000 people are nearly 20 percent higher for the poor than for the non-poor, while relative to income, the impacts on the poor are 4.5 times higher than on the non-poor population (Figure 3.22).

[51] It is assumed that the relative difference in diarrheal prevalence between the poor and non-poor population is the same for the age group 5+ years as for children under-5. Source: Larsen and Strukova (2005a).
[52] This is from the same income data used in the urban air pollution analysis.

Figure 3.22: Total Health Impacts per 1000 people and per unit of Income



Source: Larsen and Strukova (2005a).

Conclusions

5.256 Environmental pollution, degradation of natural resources, natural disasters, and inadequate environmental services are estimated at 8.2 billion Soles per year, equivalent to 3.9 percent of GDP in 2003. This represents a substantial cost to society, and particularly for the poor. While the estimates in this chapter provide an indication of the areas of the environment with the highest cost to society, an evaluation of benefits and costs of interventions are needed to identify priority actions. Such an evaluation is provided in Chapter 6 for the major environmental health issues analyzed in this chapter. For natural resource degradation and natural disasters however, benefits and costs of interventions can only be properly assessed at very localized levels requiring further data and surveys. Similarly, an analysis of benefits and costs of further reducing exposure to lead requires assessment of remaining sources of lead exposure now that lead is being eliminated from gasoline.

CHAPTER 4

REDUCING DISEASE AND DEATH CAUSED BY ENVIRONMENTAL DEGRADATION

The health impacts of environmental pollution are the largest single source of environmental damages. Interventions to reduce such damages have been evaluated for water supply and sanitation, indoor air pollution and urban air pollution. The analysis shows that water supply and sanitation improvements in rural areas can be justified on environmental-economic grounds especially when time saving is taken into account. Hand washing programs to improve hygiene have benefits substantially greater than costs, as do programs to increase drinking water disinfection. For indoor air pollution the benefits of moving from unimproved stoves to improved stoves or LPG are generally higher than the costs, while those of moving from improved stoves to LPG are less justifiable. For urban air and other pollution a range of transport related measures are recommended, including effective inspection and maintenance programs, retrofitting high use vehicles with better particulate control technology and low sulfur fuels, and action on sources of lead other than gasoline. In addition attention should be given to modernizing the bus fleet to larger, cleaner buses and possible phase out of two stroke engines in 'baby taxis'. For stationary sources introducing abatement technology may be justified for a number of industries and plants, but a more detailed assessment is needed to decide where and when[53].

Introduction

4.1 Of all the impacts of environmental degradation, those related to health are the most significant. The study of the costs of degradation carried out as part of this review estimates the annual damages from environmentally related sources at S/8.2 billion (US$2.45 billion). Over 70 percent of that (around S/5.85 billion (US$1.75 billion)) is attributable to environmental health, arising from poor quality water supply, sanitation and inadequate hygiene, outdoor and indoor air pollution, and lead (Pb) exposure (Figure 4.01).

4.2 The *prima facie* case for looking carefully at measures to reduce environmental health damages is therefore strong. What is needed before one can recommend particular interventions, however, is a comparison of the costs of the measures against the benefits, in terms of reduced damages.

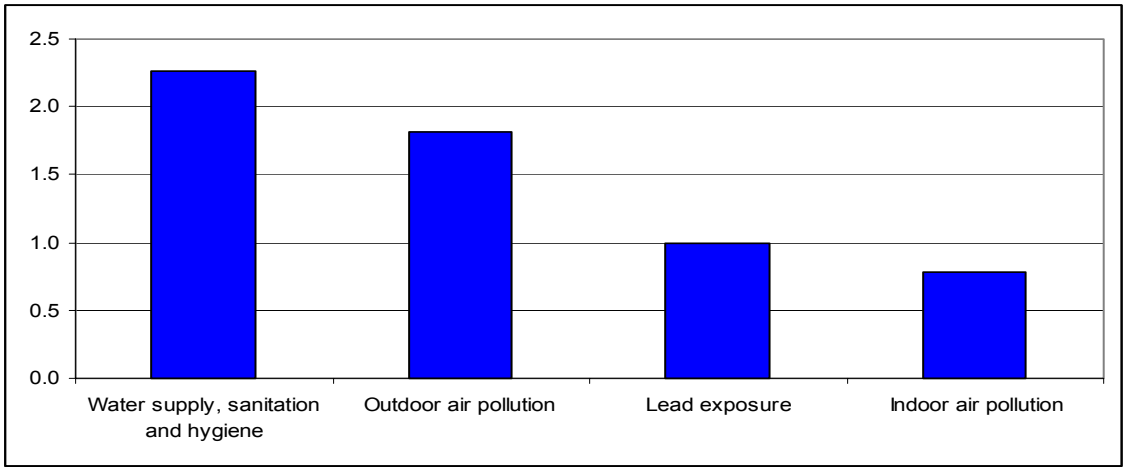
4.3 This chapter looks at the environmental health damages related to urban air pollution, indoor air pollution and water and sanitation and compares reductions in such damages from various actions relative to the costs of undertaking these actions[54]. It concludes with some recommendations for government policy reforms in this area in the short, medium and longer terms[55].

[53] This chapter draws heavily from background documents prepared by Bjorn Larsen and Elena Strukova (2006) and ECON, (2006).

[54] As lead in gasoline is phased out, further assessment of other sources of lead exposure is needed in order to evaluate the benefits and costs of mitigating measures.

[55] It is also important to take account of who bears the costs and who benefits from the actions. If the state bears the costs of providing health care, which is the case to a significant extent, then the actions will also provide financial benefits to the government. To the extent that individuals themselves bear the costs there will be financial benefit to directly to them.

Figure 4.1. Cost of Environmental Health Damage in Peru (billion S/ per year)



Source: Larsen and Strukova, 2005.

Urban Air Pollution

4.4 On account of its adverse impacts on health in the form of premature deaths and illnesses, air quality is one of the most widespread and serious environmental problems in Peru's urban centers. The major air pollutant of concern to health in Peru is particulate matter (PM) and associated small particles created from chemical reactions involving sulfates and nitrates. Lead (Pb), as an air pollutant and from other sources such as paint, water pipes, and food, is also a major health threat.

Health Effects of Lead

4.5 The case for the elimination of lead in fuels and other sources is overwhelming on health and other social grounds. It was established as long back as the 1980s for the US and has been repeatedly confirmed in studies in many countries, some of which were much poorer than the US (Barde and Pearce, 1991). Larsen and Strukova, 2005 confirmed these calculations for Peru. As a result the decision to ban lead in gasoline in Peru from January 2005 (following a long period of phase out, since the early 1990s) should be applauded. The consequence has been that lead in air is down substantially overall since the early 1990s although in Lima levels have been constant over the period 2000-2004.

4.6 The impacts of the lead ban in gasoline will take some time to be felt, as a lot of lead has accumulated in the soil and water already and the impact of these deposits is significant. The remaining problem to be addressed is that of lead from other materials such as paints, food cans and some food and water sources (including lead pipes). Action to address these sources is important and would, in most cases, pass the benefit cost test, although the analysis has not been done in Peru. The reason for taking this view is that similar actions in OECD countries have very high benefit cost ratios. Even allowing for the lower living standards in Peru it is highly unlikely that the benefits would not exceed the costs. Work to establish this, however, is warranted, to make the case in public.

Health Effects of Particulate Matter Pollution

4.7 Particulate matter that has a diameter size less than 2.5 microns (PM 2.5) has the most significant effects on health. Urban air pollution is responsible for 3,900 premature deaths annually in Peru. In addition, it accounts for the loss of approximately 65,000 disability-adjusted life years (DALYs) per year (Table 4.01).

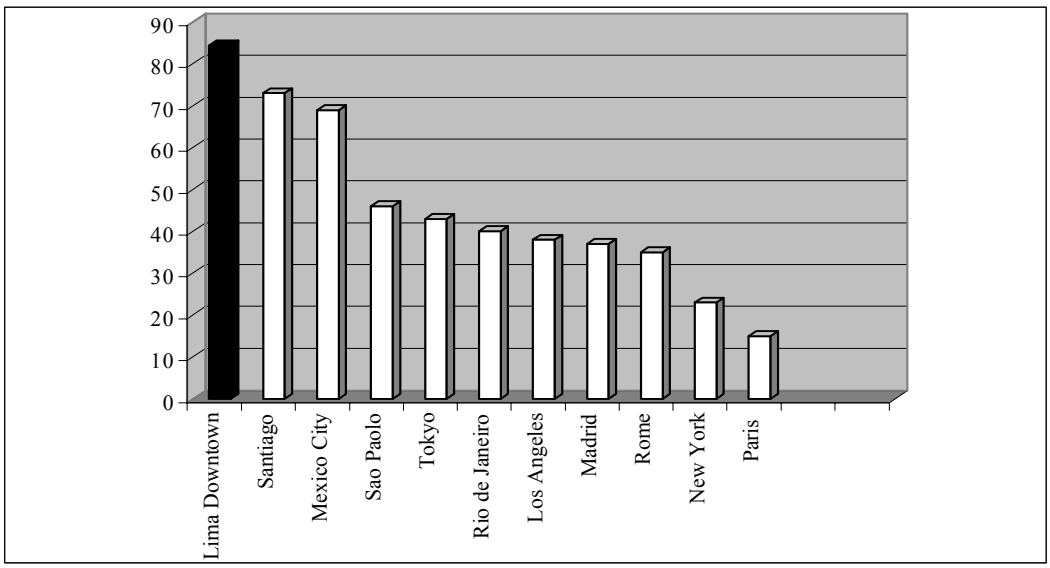
Table 4.01: Estimated Health Impacts of Urban Air Pollution from Particulate Matter

Health end-points	*Total Cases/year*	Total DALYs/year
Premature mortality	3,900	29,253
Chronic bronchitis	3,812	8,386
Hospital admissions	12,834	205
Emergency room visits/Outpatient hospital visits	251,765	1,133
Restricted activity days	43,347,360	13,004
Lower respiratory illness in children	533,457	3,467
Respiratory symptoms	137,957,686	10,347
TOTAL		65,796

Source: Larsen and Strukova (2005).

4.8 The problem of urban air pollution is most critical in the country's industrial corridors, such as Lima-Callao, which accounts for almost 75 percent of the estimated cost of health impacts of urban air pollution in Peru. Furthermore, the pollution levels in all zones exceed the concentration threshold of 7.5 ug/m^3 (annual average) set by the World Health Organization (WHO, 2002). In comparison to other countries in the region, the levels of air pollution in parts of Lima are higher than in Mexico City and Santiago, where air pollution is also severe. Air pollution levels in Lima are considerably higher than in cities such as Los Angeles, Tokyo and Rome, which have larger industrial and transportation sectors than Lima and have successfully reduced ambient concentrations of air pollutants. (Figure 4.02).

Figure 4.02: PM_{10} Average Annual Concentrations in Selected Cities (µg/m^3)
WHO **Standard is 7.5 (µg/m^3)**



Source: The World Bank, 2005b.

Valuation of Mortality Impacts of Environmental Health

4.9 A key variable in the valuation of environmental health impacts is the valuation of premature mortality. Hence it merits some discussion. The values associated with mortality are derived either from a human capital approach or a 'willingness to pay to reduce risks approach'. In the 'human capital' approach (HCA) the value of a lost life is measured in terms of the discounted earnings the person would generate over a lifetime. The second approach values a loss of life in terms of the willingness to pay to reduce the risk of death. So, if a group of, say,

100,000 persons is each willing to pay US $10 to reduce their individual risk of death by 1:100,000, then the group will collectively pay US$ 1 million and the measure, if enacted, will save one life. Consequently the value of a life saved is put at one million dollars. Such a value is also referred to as the value of a statistical life (VSL) emphasizing the fact that no specific life has been saved.

4.10 For Peru the HCA value of a life is estimated at around 240 thousand soles. At 0.31 dollars for one Sol this amounts to $74,000. The other (VSL) approach is derived from a comparison with VSL values in the United States and other high-income countries, combined with an "income elasticity" of 1.0 (implying that the VSL in a country with an income 50 percent lower than the US would also be 50 percent lower). The range of VSL values in the US and other industrialized countries is US $1.5-2.5 million (Mrozek and Taylor, 2002). Based on these values, the estimated VSL for Peru lies in the range of 390,000 to 650,000 Soles.[56] In general the HCA approach is considered as a lower bound to the value of a premature death.

Interventions to Reduce Urban Air Pollution

4.11 As part of the preparatory work for the Peru CEA, a study was commissioned on urban air pollution control, which looked at 12 options (ECON, 2006). Evaluating different options that reduce urban air pollution is difficult, as data on the responsiveness of different agents to the range of possible measures is hard to gauge. The judgments on the optimal selection of instruments will therefore rely on a combination of cost benefit analysis and experience in the application of these instruments in other countries. The following options were considered:

1. Introduce low sulfur diesel.
2. Encourage use of gasoline cars at the expense of diesel through various tax incentives.
3. Convert some gasoline/diesel cars to natural gas.
4. Convert some vehicles to ethanol or biofuel.
5. Develop a new public transport system in Lima.
6. Provide tax incentives to scrap older high-use cars (taxis etc).
7. Strengthen inspection and maintenance programs.
8. Retrofit catalytic converters on cars and particle control technology on diesel vehicles.
9. Ban imports of used cars for taxi use.
10. Ban use of diesel cars and/or 2 stroke engines as taxis.
11. Implement various city planning interventions, e.g. "green traffic light waves", bike lanes etc.
12. Introduce measures to reduce emissions from industry sources.

4.12 Most of these options are either in the process of being implemented or considered by the authorities. It is also important to note that some of them may not primarily be considered for environmental reasons, for instance option 5. More generally most policies have implications for the welfare of users of the transport and other affected sectors (e.g. an increase in the price of cars or a limitation on their use). For such options a full cost benefit analysis taking into account all benefits and costs should be carried out. This has not been done; hence the analysis presented here is only a partial input to the final decision on which instruments to deploy.

4.13 As a general guide in evaluating each of the options, the damage costs associated with a ton of emissions of PM and other particles can be compared with the abatement cost of that ton associated with the specific option. The background study conducted as part of this review estimated damages per ton from PM10 (Table 4.02). The cost ranges are wide, with the highest

[56] The lower value of mortality can misleadingly be seen as implying that a life in Peru is worth less than one in the EU or US. This is incorrect in that (a) we are not referring to a specific life and (b) it is really a willingness to pay to reduce a risk of death, which is genuinely lower in poor countries.

costs arising from mobile sources (23,000 – 85,000 Soles per ton, or US$ 7,000 – 25,000 per ton)[57]. Costs from stationary sources are around half those from waste burning about 40 percent of that. It should be noted that the estimated damage cost per ton of secondary particulates is just as high as the cost per ton of particulates from mobile sources. We should also note that these costs damages are for 2005. As the population grows and as real incomes rise, the costs will increase. This has to be taken into account when comparing benefits and abatement costs.

Table 4.02: Estimated Damages of PM10 Emissions for Various Sources in Lima –Callao

	Total Damage Cost		Damage Cost Per Ton PM10		Damage Cost Per Ton PM10	
	Mn. Soles p.a.		1000 Soles p.a.		1000 US$	
	Low	High	Low	High	Low	High
Mobile Sources	162	602	23	85	7	25
Stationary Sources	51	186	11	39	3	12
Sulfates	60	221	22	82	7	25
Nitrates	60	221	22	82	7	25
Waste Burning	2	7	10	35	3	11
Fugitive Emissions	224	394	17	29	5	9
All Sources	558	1631	17	53	6	16

Source: ECON (2005)

Low sulfur diesel

4.14 The Ministry of energy (MINEM) has determined that the sulfur content in diesel fuel in Peru should be reduced from today's 5,000 - 10,000 parts per million (ppm equivalent to 0.5 – 1 percent) to 50 ppm (equivalent to 0.005 percent) by the start of 2010. For imported diesel the sulfur limit is 2,500 ppm today. To reduce the sulfur content to 50 ppm will require substantial investments in the refineries in Peru: MINEM has indicated that the two largest refineries will have to invest around US$ 300 million. The intervention would reduce PM10 directly by about 1,425 tons and sulfates by about 715 tons. The average cost of the reductions would therefore be about US$ 18,000 (58,000 soles), which is around the same value as the mid-point of the low and high damage cost (54,000 soles – an average between 24,000 soles in the low case and 85,000 soles in the high case) (Table 4.02).

4.15 We take the view that these calculations are supportive of the program. First, the higher values, based on a VSL approach are probably more appropriate for Peru. Second, by the time the program is effective the damage costs will have increased as a result of economic and population growth. Third the damages reported are based on emissions from Lima-Callao. The measures introduced will generate benefits in other cities, raising the estimated figure for benefits by 60 percent. This would make the case much stronger. We also note that as a measure it is relatively easy to introduce and has relatively low impacts on the poor.

[57] One reason for the wide range is the problem of deriving an inventory of emissions for Peru. The data vary by source (CONAM versus PISA), resulting in very different estimates of overall emissions and hence overall damages. The figures given in Table 4.02 are the averages from the two sources. The other reason for the differences is the valuation of mortality – the HCA versus VSL approaches discussed later. This is reflected in the difference between the low and high cases in the Table.

Encourage use of gasoline cars at the expense of diesel cars through various tax incentives

4.16 The present taxation system favors diesel over gasoline while the diesel cars are more polluting as far as PM emissions are concerned. A detailed analysis of the impacts of a switch in taxes in favor of gasoline has not been carried out for Peru. The taxation of these fuels has a dynamic in industrialized countries toward reducing the previous advantage in favor of diesel; and the justification that applied in the UK and other EU countries to make this shift would also apply to some extent in Peru. A more detailed study would be needed to assess the likely benefits in terms of air quality. Against these, account would have to be taken of the fact that increases in diesel prices lead to higher expenditure increases of poor households (Kojima (2001). This would lead to the need to introduce measures to mitigate these negative distributional effects (e.g. compensating use of diesel in mass transport, agriculture etc.).

Conversion of gasoline/diesel cars to natural gas

4.17 Natural gas in the form of compressed natural gas (CNG) has been used as a vehicle fuel for years. Compared to low sulfur diesel (<50 ppm) PM emission would be virtually eliminated for smaller CNG-dedicated vehicles and reduced by more than 70 percent for dedicated heavy-duty vehicles (Cleaner Vehicles Task Force, 2000). NOx emissions would be reduced by 85-90 percent, and SO2 emissions would also be almost eliminated.

4.18 Notwithstanding these factors the conversion of gasoline vehicles to CNG is not an attractive environmental option when all factors are taken into account. Although existing gasoline vehicles could be converted to CNG using conversion kits that cost around US$ 800 – 1,500 there would be almost no direct benefits through PM emission reductions, since gasoline cars have almost no PM emissions. Also the indirect PM reductions through reduced SO2 and NOx emission reductions would be very low. Thus, converting gasoline cars to run on CNG is not an interesting PM emission reduction option.

4.19 Converting existing diesel vehicles to natural gas would practically eliminate PM emissions from these vehicles but this also not economically attractive as a rule, although it can be a viable option for high-usage vehicles, such as taxis and light duty vehicles. However, conversion is relatively costly for diesel engines and the remaining lifetime of the vehicles must be carefully considered. Since the age of the car fleet in Lima is rather high, the cost benefit ratio for this option might not be so favorable. For large buses conversion is also not likely to be an option due to high conversion costs and/or estimated short remaining lifetime of many of the buses.

4.20 CNG appears more favorable for new vehicles like taxis, light duty vehicles and large buses and other heavy-duty vehicles. CNG buses are being considered for the new public transport system in Lima. PM reductions according to the Clean Air Initiative (2005) could be 60 to 97 percent compared to the present conventional diesels with high sulfur fuel. However, when low sulfur diesel (< 50 ppm) is introduced in 2010 emissions reductions would be much less compared to that situation – see below.

4.21 A cursory assessment of the costs and benefits of introducing new dedicated CNG buses in Lima shows that the calculations are rather finely balanced and depend on which cost figures apply. Data from local sources indicate incremental investment costs of US$ 8,000 – 20,000 for the purchase of a CNG bus compared to a diesel-fuelled bus. This gives annual costs of US$ 940 – 2,345 per bus. On the other hand data from Sierra Research, 2000, indicates annual investment costs in California of around US$ 4,100 – 8,200. Given that CNG prices are likely to follow international oil (and natural gas) prices, no price advantage in fuel terms is built into the calculations.

4.22 Emission data from 2000 for Lima (Infras, 2002) show that urban buses emitted 2,985 tons of PM in 2000 in total. Assuming 20 percent of this is reduced because low sulfur diesel is introduced, and dividing this across all buses in Lima (25,000) indicates that each bus emitted around 0.096 tons PM that year. We assume that 80 percent of these emissions are removed if a bus is replaced by a CNG bus. This gives annual benefits of around US$ 1,690 per vehicle.

4.23 Benefits from reductions of and nitrates should also be accounted for. Assuming that 90 percent of NOx emissions are removed from each bus that runs on CNG compared to low sulfur diesel, and that they have the same share of the nitrates formed by the NOx emissions. This results in a benefit of around US$ 1,010/bus per year. Total benefits from using CNG instead of low sulfur diesel are thus US$ 2,700/bus per year.

4.24 We see that this is lower than the estimated total annual costs of CNG introduction from California data but slightly higher than the costs of CNG introduction provided by local sources. The latter, however, must be considered surprisingly low, as much of the equipment is internationally traded.

4.25 We also note that if low sulfur diesel is not introduced the situation changes considerably. The direct benefits from PM reduction would then be around US$ 2,100/vehicle per year plus the above nitrates reduction, giving a total of US$ 3,110/bus per year. The calculations would then also have to take into account reduced emissions of SO2 and the consequent formation of sulfates. Assuming that SO2 emissions would be eliminated, the benefit of this would be US$ 1,246/bus per year. The total benefits from running on CNG would then be around US$ 4,356 per vehicle per year, making the benefits from introducing CNG slightly larger than the lower bound of the higher cost interval above.

4.26 The above figures suggest that if low sulfur diesel is introduced the case for CNG is much weaker, although there may still be one depending on how a more detailed assessment works out. At present there is also substantial uncertainty connected to the costs of introducing and providing CNG in Peru. All this has to be cleared up before a firm decision can be made.

Conversion to ethanol or biofuel

4.27 Ethanol and biodiesel are biofuels that are used as vehicle fuels in many countries, and are expected to be used in Peru. A new law requires 7.8 percent of ethanol to be blended in the gasoline, and up to 5 percent of biodiesel to be blended in the diesel (Consejo Nacional Del Ambiente Peru, 2005). There are some investments under way for the production of ethanol, and the production of biodiesel is also considered.

4.28 For ethanol used instead of diesel, data from Sweden shows some reduction in emissions of NOx and PM (Akzo Nobel). A detailed quantitative case on these grounds for ethanol, however, is hard to make and so we do not consider ethanol as a serious option for reducing local air pollutants such as PM10. There may be a case for ethanol on cost grounds but that is a private matter on which there is considerable controversy. At present gasoline prices in Lima are around US$ 1.8/gallon, which compares with some estimated production costs of around US$ 1.6-2.5/gallon (ECON, 2005)). We also note that, since PM and SO2 emissions from gasoline cars are almost zero today, local environmental benefits from this option for such vehicles would very low.

4.29 The case for biodiesel is made up of three components: the potential private cost savings, the savings in greenhouse gas emissions and the benefits in terms of reduced particulate emissions. Of the three the last is probably the least important, although considerable effort has gone into estimating such benefits. USEPA has surveyed more than 80 prominent biodiesel emissions studies, see www.epa.gov/otaq/models/biodsl.htm and the level of such emissions compared to conventional diesel have been estimated (Table 4.03).

4.30 According to these calculations PM emissions could be almost halved when the vehicle runs entirely on biodiesel, but that the reductions are considerably smaller when biodiesel is blended 20 percent with ordinary diesel. NOx emissions tend to increase, but sulfates will be reduced at the same rate as biodiesel is blended with ordinary diesel. This shows that biodiesel has a less impressive environmental performance compared to CNG. PM emissions are not reduced as much as for CNG (70-100 percent of CNG reductions) and NOx-emissions actually increase compared to an 85-90 percent reduction for CNG. Only sulfates (SO2) show the same performance for both CNG and biodiesel. Thus, from a PM point of view CNG seems to be a better alternative than biodiesel. However, if costs of production and transportation are low enough, biodiesel could be a cost efficient option to reduce PM emissions.

Table 4.03 Average biodiesel emissions compared to conventional diesel. Percentage change compared to 100 percent petroleum diesel.

Emissions	100 percent biodiesel	20 percent biodiesel blend
PM	-47	-12
NOx	+10	+2
Sulfates	-100	-20

Source: USEPA, 2005.

4.31 The benefits of PM reductions are estimated at US$ 0.23 and US$ 0.057/gallon for the 100 percent biodiesel and 20 percent biodiesel cases, respectively. In addition, benefits from reduced SO2 and sulfates formation should be added (US$ 0.2 and 0.05 for the two cases); and the environmental costs for increased NOx and nitrates emissions should be subtracted. The latter are US$ 0.17 and $0.08 for the two cases. This yields total benefits of US$ 0.26 and 0.03 for a 100 and 20 percent blend of biodiesel into ordinary diesel. As we can see below, this may be relevant but is likely to be dwarfed by the difference in private costs of production.

4.32 The costs of producing biodiesel vary substantially between countries and regions. While cost data for total biodiesel production in Peru is not available there are estimates from the US. Radich, 2005 reports that production costs based on soybean oil were US$ 2.54/Gallon in 2004-2005, and based on yellow grease they were US$ 1.41/Gallon. These are compared to a production cost of ordinary diesel of US$ 0.67/Gallon in the US in the same period. The net diesel price in Lima in June 2005 was US$ 1.84/gallon. If these cost estimates are representative for Peru, we see that biodiesel based on yellow grease might be competitive with present oil prices, while biodiesel made of soybeans has a cost disadvantage of US$ 0.7/gallon compared to ordinary diesel.

4.33 The above figures indicate that the case for biodiesel is only marginally affected by urban pollution considerations and that private costs will dominate the decision. Only cost figures for biodiesel production from Peru can give the final answer to this.

New public transport system in Lima

4.34 There are comprehensive plans to restructure the whole public transport system in Lima. The present bus route system in Lima, which consists of a very detailed grid of small and medium sized buses, is intended to be transferred into nine new, main lines. Special corridors will be made for these lines, including new stops where passengers can change routes. This should reduce the dependence of the smaller minibuses so that these types of vehicles could be used as feeders, having the passengers then transfer onto the larger buses to enter Lima.

4.35 Fully developed, this system could lead to the scrapping of 15,000 – 20,000 small buses. The new buses could be run on natural gas.

4.36 The background for this plan is to get better quality of the public transport system and an improved environment. The fares are not supposed to be increased, but stay at a level of 0.5 – 1.5 Soles.

4.37 Total costs of the plan are estimated to be US$ 3 – 4.5 million/km, including new infrastructure, scrapping of old buses etc. There are preparations for a tendering process for one line (Blue line), which should lead to scrapping of around 4,000 old vehicles. Even if new buses run on diesel the PM emissions would be substantially reduced, because of the very high emissions from the old, existing buses. If the new buses run on natural gas, the PM emissions would be practically eliminated.

Tax incentives to scrap older high-use cars (taxis etc)

4.38 Today a large share of the high-use car fleet, i.e. taxis, small buses, lorries etc. that are frequently used within Lima-Callao consist of old, relatively high emitting vehicles. Scrapping these and replacing them with new, more energy efficient and less polluting vehicles could thus contribute substantially to improve the air quality in the city.

4.39 These vehicles could be removed by setting rather strict emission standards and imposing strict vehicle control, where those not complying would be banned from driving. (See next section for an analysis of this). Additionally, for distributional reasons, it might be useful to supplement this with some incentives for each car owner to voluntary scrap the car.

4.40 A permanent scrapping program could be designed as a deposit refund system, where the buyers of new or used imported vehicles pay a deposit, which is paid back to the owner when the vehicle is delivered to an authorized agency or company dealing with car wrecks. Such schemes have been in operation in many European countries, and are working very well. The deposit paid will be reflected in the prices of the used cars on the domestic market, and form a price floor for the used cars. Such a program would, however, only have a long-term effect, as the average age of the vehicles in Lima is over 12 years. Moreover one has to bear in mind that the costs of enforcement for such a scheme could be quite high in a country like Peru. Still, this is a scheme that is worth considering further for its positive long run environmental effects.

Inspection and maintenance programs

4.41 Periodical inspections of the existing vehicle fleet would contribute to reduced emissions and improved air quality if it results in better maintenance and eventually scrapping of old, heavy polluting vehicles. Modern vehicles remain absolutely dependent on properly functioning components to keep pollution levels low. Minor malfunctions in the air and fuel or spark management systems can increase emissions significantly. Major malfunctions can cause emissions to skyrocket. According to OECD, 1999 and the Clean Air Initiative, 2005 a relatively small number of vehicles with serious malfunctions frequently cause the majority of the vehicle-related pollution problem. Effective inspection and maintenance (I&M) programs are essential to identify these problem vehicles and ensure their repair or scrapping. Unfortunately so far such controls have been lacking in Peru. Although there were emissions regulations for vehicles on paper, the number of checks carried out were very few. Only 12,000 vehicles have been inspected since 2001 and there have been no cases of fines.

4.42 The need for a more rigorous enforcement regime is clear and Peru has decided to implement a new vehicle inspection and maintenance program for the whole Peruvian vehicle fleet, starting with Lima in April 2006 and becoming country–wide by 2007. (See Consejo Nacional Del Ambiente Peru, 2005).

4.43 The Clean Air Committee, 2004 has estimated that the new program will result in emission reductions from buses and heavy duty vehicles of almost 2,900 tons of PM10 in Lima in 2010, increasing almost to 4,600 tons in 2020 and 5,900 tons in 2025 in Lima-Callao. This is a considerable reduction, taking into account that total emissions from mobile sources today is estimated to a little more than 7,000 tons. The emission reduction is high because many vehicles have not been tuned or repaired for years. The effects of other measures like introduction of low-sulfur diesel are likely not accounted for in the Committee's estimate. As we understand it the Lima program is having some difficulty in the startup, so the effectiveness will have to be seen. Anyway, it is obvious that there is a great potential for substantial emissions reductions from this program.

4.44 The Clean Air Committee, 2004 estimates the specific abatement costs at US$ 4,096/ton ofPM10. These cost estimates is significantly lower than the costs from similar programs in Europe have. The estimate is lower than the estimated range of the benefits of emissions reductions at US$ 6,000 – 28,000 per ton PM10, indicating that this intervention is socially profitable for the society.

Retrofit catalytic converters on cars and/or retrofit particle control technology for diesel vehicles

4.45 Buses and trucks operating on diesel are responsible for a large part of the PM emissions from mobile sources in Lima. New vehicles emit less than old buses but scrapping them is a costly alternative. Instead of removing these vehicles from the fleet through various means, retrofitting old trucks and buses with particulate control technology could be an option.

4.46 The technology for retrofitting is really only effective with low sulfur fuel. Hence this measure will have to wait until low sulfur diesel is introduced in Peru in 2010.

4.47 As far as the costs and benefits are concerned, the figures look quite encouraging. Costs were around US$ 5,000 – 17,000 per vehicle in 2000 (Cleaner Vehicles Task Force, 2000) but estimates are that they have fallen significantly by 2005 (to US$ 2,500 – 3,500). On the benefit side it is difficult to predict how the vehicle fleet will develop by 2010. As a rough guide we have taken emissions from buses in 2000 and assumed their PM emissions in 2010 will be reduced by 20 percent anyway (the effect of low sulfur diesel). On this basis emissions per vehicle will be approximately 0.1 ton/year. Reducing these by maximum 90 percent (which the retrofitting would provide) gives an emissions reduction of 0.09 ton and a benefit of US$ 1,980 per vehicle per year. If device cost has dropped to US$ 3,000, the annual costs are around US$ 350, which is far below estimated benefits. The investment cost would have to be more than US$ 17,000 for this option to have a negative benefit cost ratio, which is highly unlikely.

4.48 These benefit cost calculations are based on average emissions per vehicle, and if the most polluted vehicles are removed from the fleet through other measures (for instance an I&M program), benefits from retrofit technology may be substantially lower. Even allowing for this, however, the simple calculation presented shows that retrofitting PM control technology after 2010 should have a positive benefit cost ratio.

Ban on imports of used cars for taxi use

4.49 According to the statistics more than 85 percent of all imported passenger cars and station wagons in Peru in 2003 were used vehicles. This has been encouraged by the authorities, who have reduced the import duties for used cars compared to the duties for new ones. This was done for social reasons, enabling average income families to have their own car.

4.50 The imported cars have often been old, with high mileage and high emissions of pollution. Today the import diesel passenger cars that are more than two years old is not allowed, while gasoline cars can be up to five years old. Still, the imported cars have a high

mileage and thus catalytic converters etc. that are not functioning properly, resulting in relatively high emissions of PM10 and other harmful substances. The municipality of Lima-Callao is therefore considering a ban on the use of imported, used cars as taxis. This could result in lower PM10 emissions, since most of these cars have diesel engines.

4.51 Bans are a more drastic alternative to adopting stringent I&M requirements on all imported vehicles to ensure they have a functioning catalyst, as was done in Poland . Another alternative is to impose higher taxes on such vehicles – Romania and Hungary are examples. OECD, 1999 argues that all the three primary approaches stringent emissions requirements, ban on imports or heavy taxation on imported, used vehicles can be successful if designed properly.

4.52 In Peru it seems difficult for the authorities to impose special taxes on the import of used cars for taxi use or other purposes for social reasons. The I&M program currently being introduced could pay special attention to the imported, used vehicles to ensure compliance with the new emission standards. If the I&M program is not effective, a ban on imports of used vehicles for taxi use could be an effective solution. Taxis are high usage vehicles, so measures targeted towards them could be efficient. We have not been able to estimate the emission reduction that could be achieved through this measure.

Ban on use of diesel cars and/or 2 stroke engines as taxis

4.53 Most passenger cars employed as taxis are diesel fuelled. In poorer areas of Lima-Callao the use of 3-wheeled, 2 (and 4) stroke gasoline motorbikes as taxis are also common. These vehicles are heavy emitters of PM, both because of the high emissions per kilometer driven and their high annual mileage. To remove these vehicles from the traffic could therefore yield substantial environmental benefits.

4.54 In Dhaka, Bangladesh, similar measures have been considered and in Delhi, India a progressive replacement of two-stroke motorbike taxis with gas fuelled ones has been very effective. These types of vehicles (the so-called "baby-taxis") are a major source of PM partly because of incorrect use of lubricant and use of excess lubricant of the wrong type, called straight mineral oil. Because of their significant contribution to particulate emissions, the ESMAP program in Dhaka, "Reducing Emissions from Baby-Taxis in Dhaka," included the education of commercial two-stroke engine three-wheel vehicle drivers and owners through mechanics training, a baby-taxi "auto clinic," meetings, dissemination of information, and informational meetings with auto mechanics and gasoline station owners who come in contact with vehicle drivers on a regular basis. The activity also sought to restructure the market for lubricants through both private voluntary action and government policy reform.

4.55 An outright ban of diesel cars and/or 2 stroke engines as taxis would be a rather dramatic action, as these vehicles would be forced out of traffic in a relatively short time. Implementing the program gradually over a 3 to 5 year period, however, following the example in Delhi is a real option and should be considered seriously, along with the education program of the kind introduced in Bangladesh.

Various city planning interventions

4.56 Various steps to promote the use of bicycle instead of driving a car could contribute to reducing emissions and indeed there are several plans for promoting bicycle use in Lima. Several positive experiences with such measures can be cited from around the world. For example, the experiences of some local communities in California are encouraging (Cal/EPA, 2005). In some communities up to 20 percent go to work by bicycle, and 41 percent consider the bicycle their primary mode of transportation.

4.57 Cal/EPA, 2005 claims that promoting bicycling has been a cost efficient measure to reduce emissions of PM10 and other harmful substances. For each percent replacement of light duty vehicle trips with bicycle trips emissions of PM10 are reduce by a total of 0.65 tons/day in all the communities in California that have promoted bicycling. People choosing to pedal rather than drive usually replace short automobile trips that are disproportionately high in pollutant emissions.

4.58 Experiences from California and other areas show that on-street bike lanes along principal roads raise bicycle usage by providing official accommodation for the needs of cyclists and addressing concerns about their safety. Nationally, US cities with at least one mile of bike lane for every three miles of arterial roadway have 3 to 10 times higher average bicycle commuting rates than cities with lesser ratios (Cal/EPA, 2005).

4.59 Thus, various measures to promote bicycle use in Lima, notably construction of bike lanes, should be considered to see if this could be a cost efficient measure to reduce PM emissions, although they not be as successful there due to the high level of outdoor pollution. An assessment should be made of the impact of various factors, including studying commuting patterns of various segments of the population, lengths of average trips, areas or routes where bike lanes could be efficient to promote bicycling, what kind of transport mode that increased biking would replace, the costs of establishing bike lanes and related measures etc.

Measures towards emissions from industry sources

4.60 There are several industry and non-industry sources that emit PM. We do not have data for emissions and abatement costs for the industry plants in Lima. According to Rabl, 2000 international studies show that PM abatement costs tend to be highly site specific, and are generally not known with precision until an installation is complete. However, international abatement cost data may give some indications as to what extent actions, mostly end-of pipe measures, may be cost efficient (Table 4.04).

4.61 Most of the industries for which costs have bee estimated internationally are represented in the Lima-Callao area. All these abatement costs fall within the range of our estimates for the damage costs for stationary sources (US$ 7,000 – 16,000/ton). When considering these one should bear in mind that PM (and SO2) controls sometimes yield mercury (Hg) control as a co-benefit (Sobin, 2004)) (Table 4.04).

4.62 One industry not represented in the international estimates of abatement costs is cement, which is by far the largest stationary source for PM emissions in Lima-Callao. This generates emissions of PM, NOx and SO2 among other substances (Portland Cement Association, 2005). Rabl, 2000 estimates abatement costs for retrofits of existing kilns to between US$ 27,000 and 213,000 per ton PM reduced based on experiences from various retrofits in Belgium and France. The large cost interval is partly due to different abatement levels. The larger emissions reductions that are achieved, the lower are the costs per ton. However, Rabl, 2000 also cites to some Dutch reference values of US$ 3,000 per ton PM reduced, which is based only on a limited number of existing Dutch industrial operations and thus may not be representative.

4.63 These estimates show that actions to curb PM emissions from cement production may be cost efficient but a more detailed investigation is needed to find out where the measures should be introduced and at what level of abatement.

Table 4.04 Average abatement costs for PM in some industries. US$/ton PM reduction.

Power production	13,005
Stone/Glass	2,747
Petroleum Refining	6,745
Paper production	7,725
Chemicals	1,627
Metals	1,202
Mining	2,747

Source: WWS, 1999.

Ranking of Urban Air Pollution Control Options

4.64 A ranking of the options along a cost effectiveness curve, showing how much reduction each option can make and at what cost per ton provides the policy-maker with a clear description of the complex analysis that is needed to evaluate the different alternatives (Figure 4.06). Unfortunately it cannot be carried out for all options; of the 12 measures reviewed in this section five can be analyzed in this way: (a) introduction of low sulfur diesel, (b) inspection and maintenance programs, (c) retrofit particle control technology, (d) shift in due course from low sulfur diesel to CNG, and (e) the reduction of emissions from industry sources.

4.65 Estimates have been made of what annual reductions in emissions can be expected after 2010 from each of these sources. To avoid double counting each action has been adjusted for the effects of the others. The reductions they estimate and a best estimate of the cost per ton for that reduction are reported below (Table 4.05). The resulting cost effectiveness curve has then been estimated (Figure 4.03). On the same curve we also give an average damage estimate over all mobile sources of PM emissions of US$16,000, which is the average of the low and high estimates for mobile sources (Table 4.04). A much lower figure of US$8,000 applies for stationary sources and this should be taken into account for when looking at industry reductions.

4.66 The data show that of the options considered, the retrofit for particle control, the I&M program and reductions in industry sources are well below their respective damage cost estimates. The adoption of low sulfur diesel is not below the average damage costs but, as we argued earlier it is probably justified because (a) the higher estimate of damages is US$25,000 and is more likely to be the right figure and (b) increases in damage costs between now and 2010 will in any case bring the damages up to the estimates costs. The further shift to CNG is not justified on PM reduction grounds.

4.67 This analysis, while useful has important limitations that should not be ignored. First, it leaves out those options that can only be assessed qualitatively. Second, there are considerable simplifications involved. The costs are dynamic – they vary over time – and so are the benefits and what is shown is a rough picture somewhere in the future. Nevertheless it is useful in eliminating some of the more seriously wrong options and in showing the scope for reductions that each alternative can make.

Recommendations for Actions on Urban Air Pollution

4.68 Although the analysis reported here is often unclear about the potential benefits of different measures and indicates that most options need some further work in terms of detailed design, there are a number of directions for policy. First, as far as lead is concerned, action

should be taken to examine the outstanding sources of such pollution, including lead in paint and lead in water and food and based on that a plan should be prepared for the phase out of all such emissions where justified. Second, as far other air pollutants are concerned the focus should be on PM, and particularly on PM2.5, which is most associated with health effects. Peru urgently needs to establish ambient standards for PM in priority urban areas and, based on those, establish technology specific standards for PM and its precursors. Related to that it needs to implement a PM and ozone monitoring program in priority urban areas. In addition the following actions are justified based on present knowledge:

a) The government should devote enough resources to ensure that the new I&M program really is effective. The record in the past has not been good and this is an area where cost effective reductions in emissions can be made.

b) The retrofitting of buses to control particles is a low cost option and a program to implement it should be designed for introduction in the near future.

c) The low sulfur diesel program, to which the government is committed, should be kept on track for introduction in 2010. Although it is marginally justifiable at present, it will be so by 2010.

4.69 Other options on urban air pollution where further evaluation is needed are:

- The use of CNG for buses and taxis
- Changes in the bus fleet to larger cleaner buses
- A phase out of two stroke engines in baby taxis, or replacement by four stroke engines
- Introducing abatement technology may be justified for a range of industries and plants.

Table 4.05: Amounts of PM Reduction Feasible and Cost Per Ton for Selected Options

Option	Reduction Feasible Tons	Cost US$/Ton
Retrofit Particle Control Technology	360	3888
Inspection & Maintenance Programs	2900	4096
Reductions in Industry Sources	1750	5114
Adoption of Low Sulfur Diesel	3400	18000
Shift from Low Sulfur Diesel to CNG	500	80000

Notes:

1. Costs of retrofitting are based on annual costs per car of US$350 and emissions reductions of 0.09 tons.
2. The I&M program cost estimates are taken from the Clean Air Committee study. They give a central estimate of US$4096/ton.
3. Reductions in industry sources are taken from Table 4.04, as a simple average of the costs.
4. The 'adoption of low sulfur diesel' estimates are from MINEM data on costs and ECON's estimates of reductions in emissions.
5. The shift to low sulfur diesel estimates are based on average costs of conversion of US$6,200 per vehicle and a reduction in PM per bus of 0.0768 tons per year.

Environmental Damages Related to Water and Sanitation

Water and Sanitation Infrastructure Programs

4.70 Based on studies from several countries, estimates of the benefits associated with different measures to reduce damages arising from inadequate water and sanitation have been

developed. These international studies estimate the percentage reductions in the incidence of diarrheal morbidity and mortality following interventions to improve the infrastructure that provides drinking water or basic sanitation, or interventions that improve personal hygiene. The results are applied to Peruvian health data and to Peruvian estimates of the costs of providing improvements in the areas described above. Each intervention is considered independently of other possible interventions, with the aim of providing benefit-cost ratios for each intervention that the Government of Peru might consider implementing.

4.71 The aim of the infrastructure interventions is to improve water supply and sanitation, largely in rural areas. Two programs are investigated: one that provides 3.6 million people with improved sanitation and 3 million with improved water supply.[58] Local data indicate that annualized *per capita* costs amount to 28 soles for improved sanitation (improved latrines) and 25 soles for improved water supply (protected well or bore hole)[59].

4.72 The benefits are derived from a range of studies and are calculated separately for different categories of individuals in rural Peru[60] (Table 4.06). The key assumptions in deriving the benefits relate to the costs of morbidity and mortality and to the value of time saved. The morbidity costs, based on the costs of treatment and value of lost time, are 50 soles per case of diarrhea. The mortality costs are calculated based on the 'Human Capital Approach' (HCA) as presented in the previous section. There are strong reasons, however, to believe that the HCA approach provides an underestimate of the value of a lost life and hence the figures reported here should be taken as lower bounds. Finally the programs generate savings in time, which is an important ingredient in the calculations. It is based on data for households who are more than 15 minutes walk from a water source (approximately 210,000 households are in this category). Time saved is valued at 75 percent of the average rural wage (20 soles/day, or 2 soles/hour).

4.73 The data reveal that programs to improve water supply have a benefit to cost ratio marginally greater than one when the time savings of improved water are excluded but the ratio increases to over 2 when such time savings are taken into account. A similar conclusion holds for the sanitation program (Table 4.06).

Table 4.06: Benefits of Reductions in Diarrheal Morbidity and Mortality in Rural Peru

	Improved Sanitation Facilities	Improved Water Supply
Population (million) Receiving Improved Sanitation*	3.6	
Population (million) Receiving Improved Water Supply**		3.0
Percent reduction in diarrheal illness per person (from Fewtrell and Colford 2004)	32%	25%
Diarrheal Cases (million) Averted per Year	1.3	1.0
Deaths in Children Averted per Year	180	135
Annual Health Benefits of Improved Services (Million Soles)	110	82
Annual Value of Time Savings from Improved Services (Million Soles)	116	112
Annualized Cost of Service Provision (Million Soles)	100	72
Benefit-Cost Ratio (Health Benefits Only)	1.10	1.14
Benefit-Cost Ratio (Health Benefits and Time Savings)	2.26	2.69

* 51 percent of the rural population. ** 42 percent of the rural population (households using surface water (40%), tanker truck (1%) and "other" water sources (1%)). This is likely to be conservative, as some water wells and pit latrines may not be considered improved water supply and sanitation. Source: Larsen and Strukova (2006).

[58] This is the population in rural areas that lack improved sanitation and water supply according to the Peru DHS 2000.

[59] Per capita investment costs represent average costs in South America (WHO/UNICEF 2000). O&M is operations and maintenance based on local data.

[60] Preliminary data suggest that the majority of benefits are to be derived from improved rural provision.

4.74 Care should be taken in interpreting these results. First and foremost, the benefits are averages for all of rural Peru. There will be circumstances where the benefits will be substantially greater (and conversely where they will be much less) than these averages. More detailed assessments need to be carried out to determine where the programs are most needed and effective. Second, the estimated benefits are probably low. The low value attached to the loss of a child's life has already been mentioned. Account should also be taken in a social choice context of the fact that the benefits of such programs would be preponderantly for the poor. Improving the living standards of the poor is itself a goal of social policy. These two factors would suggest that a large number of programs for improving the water supply and sanitation facilities in rural Peru would be amply justified.

Hygiene Programs

4.75 The single most effective hygiene intervention is found to be hand washing after defecation, before preparing meals, and before eating. Peru initiated a hand-washing program in 2005 (Box 4.1), which looks promising although the impacts of this are not yet available.

Box 1: The Handwashing Program in Peru

The Handwashing Public Private Partnership was established in Peru in 2003 to promote and institutionalize handwashing among low income families so as to significantly reduce children diarrhea incidence in the country. With financing from the Japan Social Development Fund, USAID, the private sector and local and regional government, the program started with the training of field personnel and measurement of a baseline against which the impacts of the program would be judged. In the first phase 3,500 health professionals will be trained and they in turn will reach a target audience of 117,000 mothers and 57,000 children in the first phase (2005 – 2006). So far, this component is being implemented in five regions of the country. Funding is being sought to extend it to another six regions.

The program includes a media campaign (a 'soap' opera in which the benefits of the use of soap feature prominently, radio and newspaper advertisements, poster contests, etc.). A door-to-door sales force representing a private company also is promoting handwashing.

This initiative is to be welcomed and holds much promise in reducing diarrheal disease in rural areas. It needs, however, to be extended to more areas, and to include *in situ* disinfection.

4.76 In view of that, estimates of possible benefits are reported based on studies elsewhere. Curtis and Cairncross (2003) provide a meta-analysis of about 20 hand-washing studies and report a mean reduction in diarrheal illness of about 47 percent. Fewtrell and Colford (2004), in their meta-analysis, report a mean reduction in diarrheal illness of about 45 percent from hand-washing interventions. Based on these studies a reduction of 45 percent in diarrheal illness is applied to all age groups.

The analysis of hand-washing programs is based on a number of data requirements and assumptions about effectiveness. These are:

a. The percentage of the targeted population that change behavior as result of the program. This has been found to range from 10 to 18 percent in previous studies in Guatemala, Thailand and Burkino Faso.

b. The cost per targeted household. There is a wide range for this variable based on previous studies – from US$0.4 to as much as US$5. Clearly the benefit cost ratio will depend on which cost figures apply.

4.77 Private costs will be incurred as a result of the program. More water will be used, along with soap and other hygiene products. Estimates of these costs have been made from Peruvian data and surveys and are estimated at 38 Soles per mother or caretaker.

4.78 A summary of the benefits and costs of a rural and an urban hand-washing program has been calculated (Tables 4.07 and 4.08). The assessment is made for a program targeted only at children under 5 but one that, additionally benefits those over 5 at no incremental cost. For children under 5 three levels of effectiveness are evaluated: 10 percent, 15 percent and 20 percent. These are combined with three program costs: the lowest effectiveness rate assumes a unit cost of 1.5 Soles, the middle effectiveness program a unit cost of 4 Soles and the highest effectiveness program a cost of 18 Soles per targeted household. The benefits are based on the reductions in diarrheal morbidity and mortality.

Table 4.07: Benefits and Costs of a Rural Hand-Washing Program

	Rural Households with Children Under 5 Years		
	"Low"	"Medium"	"High"
Program Effectiveness			
Program Target (million households)*	1	1	1
Program Response (% of households with Behavioral Change)	10%	15%	20%
Percent reduction in diarrheal illness per child (Fewtrell and Colford 2004)	45%	45%	45%
Program Cost			
Program Cost per Household (Soles)	1.5	4	18
Total Program cost (Million Soles)	1.5	4	18
Private Costs per Household**			
Cost of water per mother or caretaker per year (Soles)	1.6	1.6	1.6
Cost of hygiene products per mother or caretaker per year (Soles)	36	36	36
Program Benefits			
Cases of diarrheal illness averted per year (thousands)	165	250	330
Deaths in children averted per year	45	70	90
Benefit-Cost Ratios***			
LOW: If Behavioral change lasts 1 year	3.8	3.0	1.6
MEDIUM: If Behavioral change lasts 2 years****	4.4	**3.7**	2.3
HIGH: If Behavioral change lasts 3 years****	4.6	4.1	2.8

* There are about 1 million rural children under the age of five years in Peru. It is assumed there is one child under 5 in each household (thus the program target is 1 million households). However, the estimated benefit-cost ratio is higher for households with more than one child under 5. ** Private Costs per Household are estimated to be equal in the three scenarios, but total private costs would increase as the response rate increases. The private total costs under the "high" scenario would be twice those under the "low" scenario, since the "high" scenario assumes a percentage of households with behavioral change that is twice that of the "low" scenario. Private costs per household on water and hygiene products are estimated to be the same across all scenarios because it is assumed that households' spending on these items is independent of response rates. ***The Benefit-Cost Ratios only consider the costs and benefits of households with behavioral change. **** Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

4.79 The data show benefit-cost ratios significantly greater than one in all cases. They also show how the benefit-cost ratios change with changes in the period over which behavior changes as a result of the program. Naturally, the longer people maintain the better habits, the higher are the benefits[61]. Finally, urban programs are uniformly lower than rural ones because diarrheal incidence per person and mortality rates are generally lower in urban areas.[62]

[61] One might expect some attrition over time, but behavior changes should continue over more than one year. Programs that last longer may also have a higher cost that is not analyzed here.

[62] Disease and hygiene conditions in poor peri-urban areas bear similarities to rural areas as indicated by the hand washing study by Prisma (2004). The benefits of a hand-washing program in these areas are therefore likely to be higher than in other urban areas.

4.80 Lastly the benefits of the same program to households without young children are evaluated (Table 4.09). The costs of the program are allocated to the main program, so these benefits are 'additional' to the ones given in Tables 4.07 and 4.08. However, even allowing for that the benefits are less than the private costs because diarrheal incidence is so much lower in these households[63].

Table 4.08: Benefits and Costs of an Urban Hand-Washing Program

	Urban Households with Children Under 5 Years		
	"Low"	"Medium"	"High"
Program Target (million households)*	1.9	1.9	1.9
Cases of diarrheal illness averted per year (thousands)	240	360	480
Deaths in children averted per year	40	60	80
Benefit-Cost Ratios**			
LOW: If Behavioral change lasts 1 year	2.8	2.2	1.2
MEDIUM: If Behavioral change lasts 2 years***	3.3	**2.8**	1.8
HIGH: If Behavioral change lasts 3 years***	3.4	3.1	2.1

* There are about 1.9 million urban children under the age of five years in Peru.
Source: Larsen and Strukova (2006).). ** The Benefit-Cost Ratios only consider the costs and benefits of households with behavioral change. *** Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

Table 4.09: Benefits and Costs of a Hand-Washing Program: Households Without Children

	Rural	Urban
Program Effectiveness		
Program Target (million households)	1.2	3.6
Program Response (% of Individuals with Behavioral Change)	10-20%	10-20%
Percent reduction in diarrheal illness per individual	45%	45%
Private Costs		
Cost of water per person per year (Soles)	1.6	1.6
Cost of hygiene products per person per year (Soles)	36	36
Program Benefits		
Cases of diarrheal illness averted per year (thousands)	170-340	390-780
Benefit-Cost Ratios		
Benefit-cost ratio*	0.4	0.4

* Private costs per household on water and hygiene products are estimated to be independent of response rates in both urban and rural programs. **The benefit-cost ratio is independent of duration of sustained hand washing improvement because the upfront hand washing program cost is allocated to the primary target of the program, i.e. to household with young children. Source: Larsen and Strukova (2006).

Drinking Water Disinfection

4.81 The US AID Handwashing Survey (2004) reports that about 70 percent of households disinfect their drinking water (point-of-use disinfection). According to the survey the most common method of disinfection is boiling water and is therefore the method considered in the benefit-cost analysis analyzed here (Table 4.10). Fewtrell and Colford (2004) report from their meta-analysis that disinfection of drinking water at point-of-use reduces diarrheal illness by 47 percent in rural areas and 23 percent in urban areas.

[63] The fact that the benefit-cost ratio is less than one here is not particularly important because it is a comparison of private benefits and costs. If the private benefits are less than the costs individual swill not adopt the program (or not for long).

4.82 There are no estimates of program costs to promote drinking water disinfection at point-of-use. The same program costs and behavioral change rates as for hand-washing programs are therefore applied. The private cost of boiling drinking water is estimated at 75 Soles per year for households using commercial fuels and 35 Soles for households using fuel wood. In rural areas the program is estimated to avert 160-320 thousand cases of diarrhea and 20-40 deaths in children per year (Table 4.10). The benefit-cost ratio for the central estimate is 5.4, corresponding to a 15 percent program response rate with drinking water disinfection sustained for two years. Even for the "high" program cost, and with improved hand washing only sustained for one year, the benefit-cost ratio is 2.4.

Table 4.10: Benefits and Costs of a Rural Drinking Water Disinfection Program

	"Low"	"Medium"	"High"
Program Effectiveness			
Target population – rural population not practicing disinfection (millions)	2.2	2.2	2.2
Target Households (millions)	0.44	0.44	0.44
Program Response (% of households with Behavioral Change)	10%	15%	20%
Percent reduction in diarrheal illness per person (Fewtrell and Colford 2004)	47%	47%	47%
Program Cost			
Program Cost per Household (Soles)	1.5	4	18
Program Cost per Household with Behavioral Change (Soles)	15	25	90
Total Program cost (Million Soles)	0.6	1.8	7.6
Private Costs*			
Cost of boiling drinking water per household per year (Soles)**			
- households using commercial fuels	75	75	75
- households using fuel wood	35	35	35
Program Benefits			
Cases of diarrheal illness averted per year (thousands)	160	240	320
Deaths in children averted per year	20	30	40
Benefit-Cost Ratios			
LOW: If Behavioral change lasts 1 year	5.5	4.4	2.4
MEDIUM: If Behavioral change lasts 2 years***	6.2	**5.4**	3.5
HIGH: If Behavioral change lasts 3 years***	6.5	5.9	4.1

*Private Costs per Household are estimated to be equal in the three scenarios, but total private costs would increase as the response rate increases. The private total costs under the "high" scenario would be twice those under the "low" scenario, since the "high" scenario assumes a percentage of households with behavioral change that is twice that of the "low" scenario. Private costs per household on water and hygiene products are estimated to be the same across all scenarios because it is assumed that households' spending on these items is independent of response rates. ** The Benefit-Cost Ratios only consider the costs and benefits of households with behavioral change. *** Estimated based on efficiency of LPG and wood stoves, cost of LPG, fuel wood collection time of 30 min per day and 10% of fuel wood is used for water boiling, and per person water consumption of 0.75 liter per day. ** Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

Table 4.11: Benefits and Costs of an Urban Drinking Water Disinfection Program

	"Low"	"Medium"	"High"
Target Households – urban population not practicing disinfection (millions)	1.24	1.24	1.24
Percent reduction in diarrheal illness per person (Fewtrell and Colford 2004)	23%	23%	23%
Cases of diarrheal illness averted per year (thousands)	120	180	240
Deaths in children averted per year	<10	<15	<20
Benefit-Cost Ratios			
LOW: If Behavioral change lasts 1 year	1.0	0.8	0.5
MEDIUM: If Behavioral change lasts 2 years*	1.1	**1.0**	0.7
HIGH: If Behavioral change lasts 3 years*	1.2	1.1	0.8

* Benefits and costs in the second and third years are discounted at an annual rate of 10 percent.

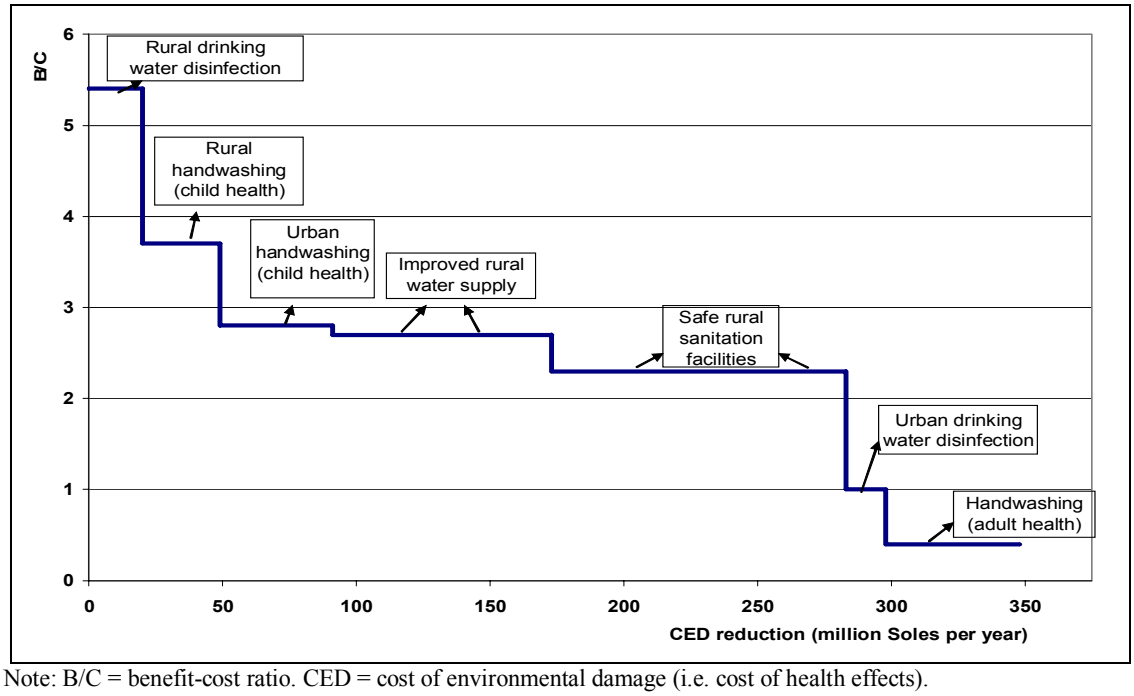
4.83 The benefit-cost ratio for urban areas is only above one for the "low" program cost, or for "medium" program cost if disinfection is sustained for at least two years (Table 4.11). The benefits are so much lower in urban areas because of the substantially lower percent reduction

in diarrhea expected from disinfection and the lower diarrheal incidence per person in such areas.

Summary Assessment of Interventions Related to Water and Sanitation

4.84 The different interventions discussed above can be summarized in terms of their contribution to reduced environmental damages and the ratio of benefits to costs (Figure 4.04). This is unlike the earlier conventional cost effectiveness rankings for urban air pollution but serves a similar purpose. Figure 4.04 shows the amount of reduction of environmental damage on the horizontal axis (in millions of soles) and the benefit to cost ratio on the vertical axis. The graph then plots the relative values of these two pieces of information for a number of interventions. Rural drinking water disinfection (i.e., household boiling of drinking water) has the highest ratio of benefits to costs but makes a relatively small reduction in environmental damages. It is followed by rural hand washing by mothers or caretakers of young children with a slightly higher reduction in damages. Next is urban hand washing, and then provision of improved water supply and safe sanitation facilities in rural areas. Both of the latter make the largest reductions in damages. Urban drinking water disinfection at point-of-use is also estimated to provide higher benefits than costs but to contribute only a small reduction in damages. Finally the benefits of hand washing among adults, unless caring for young children, are estimated to be significantly lower than the cost.[64] In total the measures with a positive benefit to cost ration could reduce the cost of health effects by 350 million Soles per year.[65]

Figure 4.04: Water Supply, Sanitation and Hygiene Interventions



Note: B/C = benefit-cost ratio. CED = cost of environmental damage (i.e. cost of health effects).

Recommendations for Actions on Water Supply and Sanitation

[64] The benefit-cost ratios for hand washing and drinking water disinfection are based on behavioral change being sustained for two years. The ratios would be higher (lower) if, as a result of promotion programs, households sustain improved behavior for longer (shorter) than two years.

[65] This figure does not consider the possible interaction effects between different interventions (i.e. how the impacts of a first intervention affect those of a second intervention) because data constrains preclude a sound analysis of such effects.

4.85 From the analysis presented here it is clear that most of the measures that make improvements in water supply and sanitation facilities in rural areas yield benefits in excess of costs under most assumptions. The programs are also justified on the grounds that the benefits are concentrated primarily among the poor. These include drinking water disinfection, handwashing, improved rural water supply and safe rural sanitation. The highest priority should be given to the drinking water disinfection and handwashing programs.

Indoor Air Pollution

4.86 It is well documented from studies around the world that air pollution from solid fuels used for cooking and heating the indoor environment has substantial respiratory health effects. Women and young children appear to bear the largest of these because they tend to spend more time indoors and/or closer to the cooking areas.

4.87 Smith et al (2004) and Desai et al (2004) report results of health effects from biomass smoke (fuel wood, etc.) and coal smoke based on a meta-analysis of available studies (Table 4.12). The relative risks (RRs) represent the risk of health effect or illness relative to the use of clean fuels such as LPG. The RR for households using LPG is therefore 1.0. The strongest evidence of health effects is for acute lower respiratory illness (ALRI) in children under 5 years, COPD in adult females, and lung cancer in adult females from coal smoke.

Table 4.12: Relative Risks for Strong and Moderate Health Outcomes

Evidence	Health Outcome	Group	RR	CI
Strong	ALRI	Children <5 yrs	2.3	1.9-2.7
	COPD	Women >30 yrs	3.2	2.3-4.8
	Lung Cancer (from coal smoke)	Women > 30 yrs	1.9	1.1-3.5
Moderate-I	COPD	Men > 30 yrs	1.8	1.0-3.2
	Lung Cancer (from coal smoke)	Men > 30 yrs	1.5	1.0-2.5
Moderate-II	Lung Cancer (from biomass smoke)	Women > 30 yrs	1.5	1.0-2.1
	Asthma	Children 5-14 yrs	1.6	1.0-2.5
	Asthma	All > 15 yrs	1.2	1.0-1.5
	Cataracts	All > 15 yrs	1.3	1.0-1.7
	Tuberculosis	All > 15 yrs	1.5	1.0-2.4

Source: Desai et al (2004). Notations: RR= relative risk. CI= confidence interval. ALRI=acute lower respiratory infection. COPD=chronic obstructive pulmonary disease.

4.88 For the purpose of this report, five scenarios were selected that represent five stylized situations commonly found in most developing countries (Table 4.13). These stylized situations reasonably well represent the pollution loads from solid fuel use. Actual pollution exposure, however, can vary substantially in each scenario, and depend on additional factors such as household ventilation practices, housing characteristics, and household behavior. As data on these factors are not readily available at a national level, a sensitivity analysis of relative risk will need to be undertaken in order to assess the likely influence of these factors on the benefit-cost ratios of interventions.

Benefit-Cost Analysis for Indoor Air Pollution Interventions (IAP)

4.89 A benefit-cost analysis is undertaken for four household interventions and two community kitchen interventions for rural areas of Peru. They are based on the stylized situations described in Table 4.13. The estimated benefits of these interventions are presented in the paper (Tables 4.14-4.15). Avoided cases of ARI and COPD are estimated from the relative risk ratios for ARI and COPD in women as estimated across a number of studies in Latin

America and elsewhere, combined with baseline estimates of annual cases of ARI and COPD. More details are provided in Chapter 3 of this report and in Larsen and Strukova (2006). The monetary benefits of avoided cases are calculated from the estimated unit costs of ARI and COPD morbidity and mortality. Unit costs of morbidity include medical treatment cost, value of time losses (at 75 percent of rural wages), and the value of a 'disability adjusted life year' (DALY), valued at GDP per capita as a proxy for the cost of reduced well-being.[66]

4.90 As far as the valuation of loss of life is concerned, child mortality is valued using the human capital approach (HCA) of discounted life earnings losses as described earlier. For adult loss of life, however, both approaches to the valuation of mortality have been included. As a lower bound HCA based value has been used but an upper bound has been derived based on the willingness to pay approach which provides an estimated value of statistical life (VSL). As reported earlier this value lies between 390,000 to 650,000 Soles. The total health benefits of the interventions are only influenced by 20 percent from the choice of valuation technique for adult mortality.

Table 4.13: Fuels, Stove Technology and Pollution Scenarios

Stylized Situation	Stylized Description	Relative Risk
I. Unimproved Wood Stoves or Open Fire	Low energy efficiency. No chimney or ventilation device. Very high indoor pollution load.	Very High
II. Improved Wood Stoves	Relatively low energy efficiency. Chimney (or other ventilation device) taking much of the smoke outdoors. Still relatively high indoor pollution load if stove/chimney is not well maintained.	High
III. Unimproved Wood Stoves and LPG (or other clean fuel)	Pollution load reduced in proportion to the use of LPG (relative to situation I.).	Medium
IV. Improved Wood Stoves and LPG (or other clean fuel)	Pollution load reduced in proportion to the use of LPG (relative to situation II.).	Medium to Low
V. LPG or other clean fuel	Absence of smoke from solid fuels.	Low

4.91 An estimate of the value of time-savings from reduced fuel wood collection is also included for each intervention (Tables 4.14-4.15). As a base case, it is assumed that a household using an unimproved wood stove spends on average 30 minutes per day on fuel wood collection. It is assumed that household substitution from unimproved to improved stove provides a 33 percent time savings because of the higher energy efficiency of improved stoves. A substitution from improved stove to LPG would then provide a 67 percent time saving. Time is valued (as before) at 75 percent of average rural wages. In total, the estimated benefits of time savings are 35-70 percent of health benefits, or 25-40 percent of total benefits. The estimated time benefits of community kitchens with LPG are larger than the health benefits because of time savings in cooking in addition to avoided fuel wood collection.

[66] DALYs are an alternative measure of loss of well-being resulting from illness. As an approximation that has been used in other studies they have been valued at GDP per capita (see Larsen and Strukova (2005)).

Table 4.14: Benefits and Costs of Rural Indoor Air Pollution Control

	Improved Stove (from Unimproved Stove)	**LPG** (from Improved Stove)	**LPG** (from mix of Unimproved Stove and LPG)	**LPG** (from mix of Improved Stove and LPG)
Population receiving intervention (millions)	2.8	2.8	0.35	0.35
ARI cases averted per year (millions)	0.7	0.7	0.1	0.05
Deaths in children averted per year	300	300	40	20
COPD cases averted per year	220	220	30	15
COPD deaths averted per year	80	80	10	5
Annual health benefits (Million Soles)*	185**	185**	23	12
Annual value of time savings (Million Soles)	65	130	12	8
Program cost (Million Soles)	20	20	2	2
Annualized stove cost (Million Soles)	17	17	-	-
Annual cost of LPG (Million Soles)	-	380	25	25
Benefit-Cost Ratio (health benefits only)	5.1	0.4	0.9	0.4
Benefit-Cost Ratio (health and time benefits)	6.8	0.7	1.3	0.7

This is from using VSL for COPD adult mortality. Using the HCA approach gives 20% lower health benefits. ** Substitution from unimproved to improved stoves is assumed to reduce health effects by 50 percent, and substitution from improved stoves to LPG is assumed to avert the remaining 50 percent of health effects from IAP.

Table 4.15: Benefits and Costs of Rural Community Kitchens

	LPG (from Unimproved Stove)	**LPG** (from Improved Stove)
Population receiving intervention (millions)	0.5	0.5
ARI cases averted per year (millions)	0.26	0.13
Deaths in children averted per year	100	50
COPD cases averted per year	80	40
COPD deaths averted per year	30	15
Annual health benefits (Million Soles)*	65	33
Annual value of time savings (Million Soles)	83	72
Program cost (Million Soles)	3.5	3.5
Annualized stove cost (Million Soles)	0.5	0.5
Annual cost of LPG (Million Soles)	37	37
Benefit-Cost Ratio (health benefits only)	1.6	0.8
Benefit-Cost Ratio (health and time benefits)	3.6	2.5

* This is from using VSL for COPD adult mortality. Using the HCA approach gives 20% lower health benefits.

4.92 The estimated annual costs of interventions have also been estimated (Tables 4.14 and 4.15). A tentative estimate of the program cost of promoting, implementing improved stoves and LPG fuel switching, and sustaining a stove inspection and maintenance program is included in the table. Annualized stove costs (improved stove or LPG stove) are about the same as the program cost. For the LPG fuel switching interventions, the fuel (LPG) represents around 90 percent of total cost in interventions.

4.93 Eight benefit-cost ratios are estimated for the household interventions. Four ratios include only the health benefits and four ratios include both health benefits and benefits of time saving from reduced fuel wood collection, i.e., total benefits. The estimated benefit-cost ratios of adoption of improved stoves by far exceed unity even without the value of time saving. The benefit-cost ratio for switching to LPG from unimproved stove, or from a mix of unimproved stove and LPG, is higher than unity when time savings are included in the benefits, but less than unity if only health benefits are included.[67] The ratios for the intervention to switch from improved stoves to LPG, or from a mix of LPG and improved stove to LPG alone are lower than unity (Table 4.14).

4.94 Substitution from unimproved and improved stoves in individual households to community kitchens with LPG is found to have substantially higher benefits than costs (Table 4.15). The benefit-cost ratio is estimated at 3.6 for substitution from unimproved stove to LPG, and 2.5 for substitution from improved stoves to LPG when time benefits are included. The reasons for the high benefit-cost ratios are substantial LPG efficiency gains from larger pots used for cooking in community kitchens compared to pots used in individual households, and substantial time savings of one kitchen cooking for many households. For households with improved stoves, the health benefits alone are however not large enough to outweigh the cost of switching to community kitchen with LPG.

4.95 While promotion of improved stoves is a very attractive intervention, the merits of promoting LPG in individual rural households are uncertain. LPG prices would have to be reduced by as much as 25-30 percent in order for the estimated benefits to exceed costs. Moreover, the benefits include both health improvements and time saving from reduced fuel wood collection. Time savings are valued at 75 percent of rural wages. If, however, rural households only value their time at 50 percent of rural wages then LPG prices would need to be reduced by 40 percent for benefits to exceed costs. It therefore seems that LPG will only have a chance of success in better-off households and community kitchens.

Summary Assessment of IAP Interventions

4.96 The different interventions discussed above can be summarized in terms of their contribution to reduced environmental damages and the ratio of benefits to costs as was done for the water and sanitation programs (Figure 4.05). The benefit-cost ratios reflect both health benefits and the value of time savings. Household substitution from unimproved to improved stove has the highest ratio of benefits to costs and the largest reduction in damages. This is followed by switching to community kitchens with LPG from use of unimproved or improved stoves in individual households, and household switching to LPG alone from a mix of unimproved stove and LPG. [68] Each of these measures contributes an increasingly smaller amount of reduction in environmental damages and in total they reduce the cost of health effects by 250 million Soles per year. This reflects a substitution to improved stoves in 33 percent of rural households, use of LPG in community kitchens for 15 percent of rural households, and switching to LPG alone from a mix of unimproved stoves and LPG in 5 percent of rural households.

Recommendations for Actions on Air Pollution

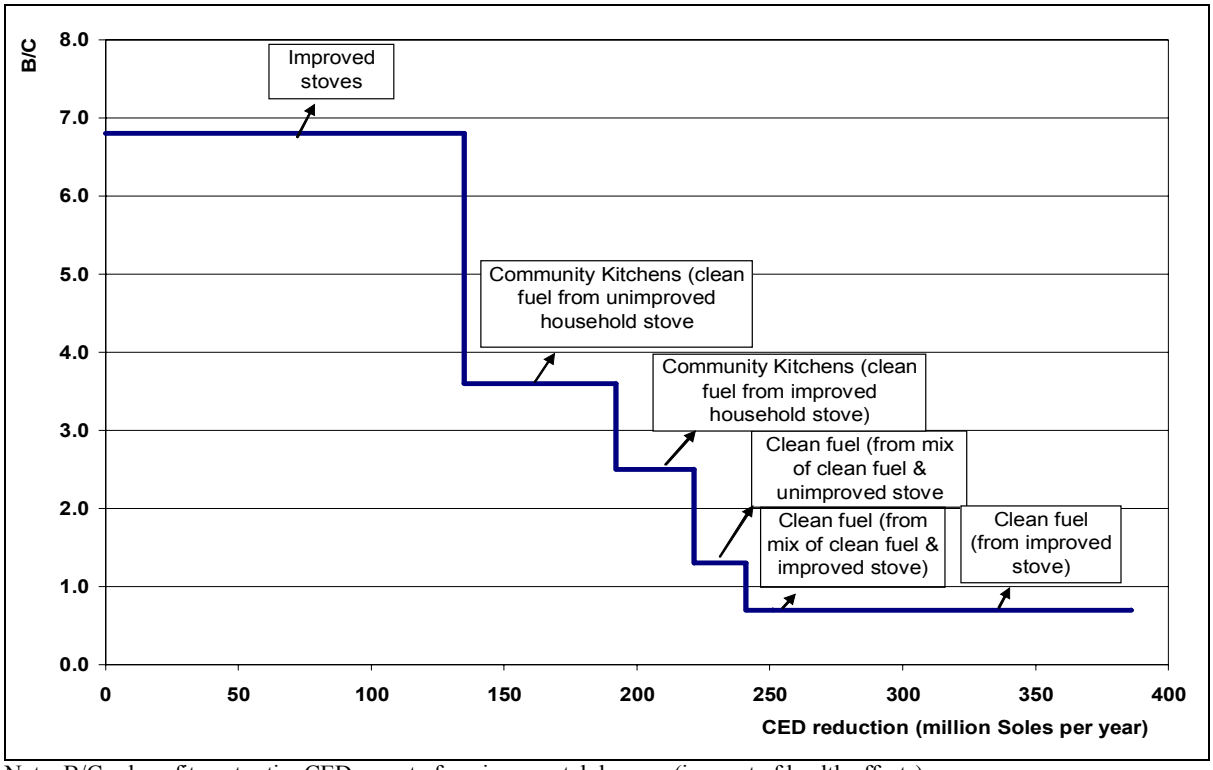
4.97 Based on the analysis presented one can make an unqualified recommendation to shift households who have unimproved stoves to improved ones. The results of other improvements – from unimproved stoves to LPG or from improved stoves to LPG are dependent on which cost

[67] The benefit-cost ratios for switching to LPG from unimproved stove are not presented in Table 4.14.

[68] A substitution from unimproved stoves to LPG is not included in the graph. This would represent a double counting of reductions in health effects from indoor air pollution because substitution from unimproved stoves is already reflected in the substitution to improved stoves.

figures and which benefit figures one takes. Hence a more detailed analysis needs to be carried out for such changes, looking at specific cases and including other benefits.

Figure 4.05: Indoor Air Pollution Interventions



Note: B/C = benefit-cost ratio. CED = cost of environmental damage (i.e. cost of health effects).

Overall Short Term Recommendations

4.98 Overall recommendations for actions relating to environmental heath are summarized below (Table 4.16). For air pollution urgent attention is needed to establish national ambient standards for PM and to implement an air quality monitoring program. These are both low cost actions. Action to determine the sources of lead pollution and preparation of an action plan to deal with them is also urgent and low cost. Other actions that have been identified have modest to high costs and include strengthened I&M programs, retrofitting of diesel operated buses and reduced sulfur content of diesel. On water supply and sanitation both the priority short term actions of hand washing for children and disinfection of water are low cost. Finally for indoor air pollution, promotion of LPG and other cleaner fuels to those predominantly dependent on fuelwood and implementation of a program to promote improved stoves to those who do not have them are priority actions with modest costs.

Table 4.16: Recommended Short-term actions for Environmental Health

Objective	Recommended Short-term Actions
Reduce health risks associated with ambient air pollution	• Establish national ambient standards for $PM_{2.5}$ and PM_{10} in priority urban areas and strengthen technology-specific emission standards for PM and its precursors (particularly sulfur and nitrogen oxides) (Cost: Low) • Implement an air quality monitoring program to monitor $PM_{2.5}$, PM_{10}, and ozone in priority urban areas (Cost: Modest) • Prepare an action plan to reduce lead pollution from sources other than gasoline. • Implement air pollution control interventions, including: (a) promoting retrofitting of diesel-powered vehicles, (b) implementing a program of testing vehicle exhausts, (c) reducing sulfur content in diesel to less than 500 parts per million, including increasing clean imports of diesel with low-sulfur content. (Cost: Modest to high)
Reduce health risks associated with inadequate water supply, sanitation and hygiene **Reduce cost of environmental degradation associated with Indoor air pollution**	• Promote handwashing programs that target children under the age of 5. (Cost: Low) • Promote safewater programs that includes disinfection of drinking water at point-of-use. (Cost: Low) • Promote the use of LPG and other cleaner fuels in areas that predominantly use fuelwood, and implement actions to improve availability and access to fuelwood users in a safe and cost-effective manner (Cost: Modest) • Implement a program to promote improved stoves (Cost: Modest)

CHAPTER 5

REDUCING VULNERABILITY TO NATURAL DISASTERS

Peru is one of the Latin American countries most highly prone to natural disasters – earthquakes, floods, landslides, drought, the periodic impacts of El Niño, and other events. The impacts in terms of human lives, homes destroyed and damaged, and destruction of the social and economic infrastructure have been severe. Aside from natural causes, the effects of these disasters have been exacerbated by man-made influences; including deforestation, soil erosion, and poor land use practices. Historically, the country's civil defense institutions, notably the National Institute for Civil Defense (INDECI), have emphasized disaster mitigation and relief rather than disaster prevention and the analysis of disaster risk. Only in the past five years have these institutions begun to evolve toward a set of integrated policies and practices that emphasize disaster prevention, risk assessment, and the reduction of vulnerability. Significant strides have yet to be made before these policies and practices are fully integrated in the plans and budgets of national, regional and local institutions.[69]

Introduction

5.1 Over its long history, Peru has suffered profoundly from natural disasters. Located on a continent which is one of the most disaster-prone regions on earth (IADB, 2000), Peru is characterized by its proximity to major earthquake faults, a highly mountainous topography, and increasingly urbanized development, which has concentrated a growing proportion of the population. A review of disaster exposure indicators in Latin America shows that Peru's incidence of natural disasters is nearly twice that for Latin America as a whole, while its rate of fatalities is the highest on the entire continent (Charvériat, 2000). The causes of these disasters have been many: earthquakes, tsunamis, floods, landslides, volcanic eruptions, and others. Periodic occurrences of the El Niño phenomenon, most recently in 1997-98, have caused major flooding, landslides and associated devastation, especially in the northern parts of the country. Together, these conditions have generated a high vulnerability of the Peruvian population to natural disasters. Although some of these disasters have distinct natural sources, the effects of others – notably, flooding and landslides – are greatly exacerbated by human activities that modify environmental conditions and create a greater predisposition to more severe effects, particularly in response to heavy rains, including El Niño. This suggests that strategic interventions to assess sources of risk, ameliorate the effects of natural disasters, and target public investments to reduce human vulnerability hold the potential for significant payoffs for the Peruvian population.

Current Situation

5.2 Statistics show that the incidence of natural disasters increased in Peru over the 2000-2004 period, according the National Civil Defense Institute (Instituto Nacional de Defensa Civil, INDECI). Although the frequency of specific types of disasters varies annually, in most years as well as the five-year period as a whole, the three most prevalent types of natural disasters were strong winds, floods and heavy rains. Together, these accounted for nearly two-thirds of the total number of natural disasters over this period. It should be emphasized however, that sheer incidence of natural disasters is not necessarily correlated with impact (see discussion below). Other common disasters include landslides, 'huaycos' (a

[69] This chapter was prepared by David Lee, based in part on a background document prepared by Lenkiza Angulo (2006) for this study.

local term for gully-type landslides), and frost. Over the period 2000-2004, the incidence of natural disasters has increased more than threefold.

Table 5.1. Types of Natural Disasters in Peru, 2000-2004

Type of Disaster	*Year*						*Percent of Total*
	Total	*2004*	*2003*	*2002*	*2001*	*2000*	
Volcanic activity	1	1	-	-	-	-	0.01%
Aluvium	10	6	2	1	-	1	0.01%
Avalanches	5	2	3	-	-	-	0.01%
Landslides	496	118	191	35	77	75	7.19%
Hail	120	41	50	11	15	3	1.74%
Frost	556	438	73	12	4	29	8.06%
"Huaycos"	244	50	72	28	39	55	3.54%
Floods	1,328	254	490	137	239	208	19.26%
Heavy rains	1,241	426	388	122	146	159	18.00%
Ocean swells	14	2	6	1	1	4	0.20%
Show	367	95	16	251	2	3	5.32%
Drought	221	215	5	1	-	-	3.20%
Earthquakes	229	11	35	9	174	-	3.32%
Thunderstorms	45	14	11	7	11	2	0.65%
Strong winds	1,806	595	615	291	128	177	26.19%
Other	213	89	64	13	17	30	3.09%
Total	**6,896**	**2,357**	**2,021**	**919**	**853**	**746**	**100.00%**

Source: Regional Offices, National Operations Office, INDECI, 2005.

5.3 The increasing trend in natural disasters seen during 2000-2004 (Table 5.1) is also evident over the lengthier time period of 1990-2004 (Table 5.2) (Angulo, 2005). Flooding, by these measures, increased from 521 events in 1970-80 to 840 events in 1990-2000, more than 60%. Huaycos increased in frequency from 172 events in 1970-80 to 682 events in 1990-2000, nearly fourfold. This increased frequency of natural disasters in 1970-2000 in fact represents a continuation of a longer-term trend over the second half of the 20th century in Peru, and is independent of the fact that the registry of natural disaster events is increasing in coverage and quality (Angulo, 2005). Moreover, this trend is characteristic of Latin America as a whole, as it is globally (Charvériat, 2000). As discussed below, there are several reasons for this, including increasing deforestation in the Andean highlands and increasing degradation of many of Peru's river basins.

5.4 Care must be taken in interpreting trends over the longer term, since INDECI data currently include several categories of natural disasters that were excluded from official statistics in the 1990's and before: volcanic activity, avalanches, thunderstorms, strong winds, and drought. Even accounting for these changes in the official statistics, however, the measured incidence of natural disasters has increased significantly in recent years. The situation in Peru is similar to that in other nations. In the decade preceding 2004, the Secretariat of the International Strategy for Disaster Reduction (ISDR) estimates that natural disasters resulted in 2.5 billion people affected and $690 billion (U.S.) in economic losses, the vast majority stemming from hydro-meteorological hazards (UNEP, 2005).

5.5 Although this chapter focuses principally on human-induced natural disasters, it is important to emphasize that many of Peru's most catastrophic disasters have been due to natural phenomena like

Table 5.2: Incidence of Earthquakes, Floods and *Huaycos*, by Department and by Decade, 1970-2000

Department	*Earthquakes*			*Floods*			*"Huaycos"*		
	1970-1980	*1980-1990*	*1990-2000*	*1970-1980*	*1980-1990*	*1990-2000*	*1970-1980*	*1980-1990*	*1990-2000*
Amazonas	3	4	10	13	5	15	2	0	18
Ancash	72	46	20	46	58	57	24	56	127
Apurímac	2	2	8	3	2	4	7	2	9
Arequipa	47	28	65	49	43	62	11	33	43
Ayacucho	5	24	11	5	4	17	7	8	31
Cajamarca	4	3	2	27	5	32	2	7	34
Callao	5	3	4	8	13	8	0	0	0
Cusco	10	7	17	48	41	72	16	14	33
Huancavelica	4	3	3	3	5	12	7	13	25
Huanuco	7	5	4	18	5	35	3	5	28
Ica	20	69	64	17	26	39	11	6	18
Junín	15	11	17	40	55	94	21	29	104
La Libertad	24	9	11	27	30	49	9	13	27
Lambayeque	6	6	7	12	10	31	2	1	7
Lima	79	77	47	42	107	95	40	120	115
Loreto	2	3	1	38	15	39	0	0	0
Madre De Dios	0	0	0	1	2	12	0	0	3
Moquegua	4	2	5	4	1	6	0	2	3
Pasco	4	2	5	7	9	20	4	13	23
Piura	16	4	5	36	54	28	1	11	10
Puno	1	2	0	28	14	16	2	4	7
San Martín	7	6	17	17	14	27	1	4	2
Tacna	3	4	4	1	0	8	0	5	7
Tumbes	10	3	4	24	38	39	0	3	6
Ucayali	0	4	6	7	11	23	2	1	2
TOTAL	**350**	**327**	**337**	**521**	**567**	**840**	**172**	**350**	**682**

Source: DESINVENTAR Natural Disaster Data Base, ITDG Network

earthquakes and El Niño. Peru is in one of the most seismically active areas of the planet and the cities and populations of the coast and neighboring Andean areas are particularly vulnerable. Earthquakes often occur in the southern Coastal region, particularly in the area near the Peru-Chile border and in the Arequipa area between Atico and Camaná. Recent earthquakes that have proven to be particularly devastating were those in Huaraz in 1970, which caused 70,000 deaths, more than 150,000 injuries, and total damages exceeding $ 500 million dollars (U.S.); the earthquakes of Lima in 1966 and 1974; and the earthquake and tsunami in southern Peru in June, 2001. Estimates from the President's Cabinet (PCM) are that 62 provinces in Peru, located all over the country, have a high or very high seismic danger, in which live 71.3% of the national population (Angulo, 2005).

5.6 Not only is Peru highly prone to natural disasters – earthquakes, floods, landslides, drought, El Niño, and other events – but the impacts in terms of human lives, homes destroyed and damaged, and destruction of the social and economic infrastructure have also been severe. Aside from natural causes, the effects of these disasters have been exacerbated by man-made influences, including deforestation, soil erosion, and poor land use practices. Historically, the country's civil defense institutions, notably the National Institute for Civil Defense (INDECI) have emphasized disaster mitigation and relief – often following periodic disasters like earthquates or flooding caused by El Niño – rather than disaster prevention and the analysis of disaster risk. Only in the past five years have these institutions begun to evolve toward a set of integrated policies and practices that emphasize disaster prevention, risk assessment, and the reduction of vulnerability. Significant strides have yet to be made before these policies and practices are fully integrated in the plans and budgets of national, regional and local institutions.

5.7 Even beyond the periodic El Niño events, the damage to the human population, houses, public infrastructure, and productive agricultural land stemming from natural disasters has been considerable. Official estimates of these impacts over just the recent 2000-2004 period include 635 deaths, 9,840 injuries, 40,941 houses destroyed, and 187,385 cultivated hectares lost to disasters (Table 5.3). The greatest effects of natural disasters in terms of deaths, disappeared persons, houses destroyed and houses damaged were reported in 2001, the year of the major earthquake and tsunami in southern Peru. In 2002 and 2004, adverse climatic phenomena produced significant damage to agricultural production.

Table 5.3: Damage Caused by Natural Disasters, Peru, 2000 - 2004

Year	Total Number of Disasters	Deaths	Injuries	Disappeared Persons	Victims*	Houses Affected	Houses Destroyed	Cultivated Hectares Lost
Total	**6,893**	**635**	**9,840**	**219**	**2,168,612**	**237,251**	**40,941**	**187,385**
2004	2,357	50	95	28	936,086	30,880	4,255	90,240
2003	2,021	137	189	30	291,703	33,333	6,672	13,615
2002	919	124	6,532	39	261,245	48,778	1,306	37,736
2001	853	169	2,930	97	445,107	82,463	26,529	41,834
2000	743	155	94	25	234,471	41,797	2,179	3,960

*Includes deaths, persons directly injured and persons affected.
Source: Regional Civil Defense Offices, National Operations Center, INDECI, 2005.

5.8 Collectively, between 1985/90 and 2005, it is estimated that natural disasters generated an annual average cost of 1.075 billion Soles in Peru, or about $ 325 million (U.S.) (Chapter 3 and Table 5.4). These estimates were generated by estimating the annual values of agricultural, housing and infrastructure losses, the costs of injuries to humans (including medical treatment costs and the values of lost work time and time caring for ill family members), and the average values of human mortality calculated using two different approaches: a lower value, stemming from the Human Capital Approach (HCA), which estimates the present value of future income lost to premature death, and the value of statistical life (VSL) methodology which estimates willingness to pay for a reduction in the risk of death (Chapter 3 and Larsen and Strukova, 2005a). By far the two largest categories of annual economic costs due to natural disasters, accounting for 80 percent of the total cost, are those associated with damage to and destruction of housing. The effects on agriculture and human life are the next most important. These estimates likely underestimate the full effects of natural disasters due to several factors: the conservative estimates stemming from the HCA methodology; the lack of incorporation of broader dynamic multiplier effects on

regional and national economic development stemming from natural disasters; and the fact that using 1985/90 - 2003 averages neglects the increasing trend of natural disasters and their resultant effects over this period. Nonetheless, these estimates clearly demonstrate the order of magnitude of total losses as well as the relative contributions. To put the Peruvian losses in context, total natural disaster impacts in Latin America and the Caribbean during 1990-1998 have been estimated at $ 24.2 billion (U.S.) (OFDA/CRED, 1999).

Table 5.4: Annual Cost of Natural Disasters[1]	
	Million Soles
Deaths[2]	45
Injured	30
Missing persons	10
Houses destroyed	325
Houses affected	535
Hectares destroyed	70
Roads destroyed, affected	35
Railroads destroyed, affected	5
Bridges destroyed, affected	20
TOTAL COST	1075

[1]Estimates based on period 1985-90 to 2003.
[2]Valuation of mortality is an average of HCA and VSL (Larsen and Strukova, 2005a).

Table 5.5: Effects of Natural Disasters, Peru, 2000 - 2004

Year	Total Number of Disasters	Deaths	Injuries	Disappeared Persons	Victims*	Houses Affected	Houses Destroyed	Cultivated Hectares Lost
Total	**6,896**	**635**	**9,840**	**219**	**2,168,612**	**237,251**	**40,941**	**187,385**
Volcanic activity	1	0	0	0	0	0	0	0
Aluvium	11	6	5	21	691	215	54	80
Avalanches	4	8	1	12	137	0	0	0
Landslides	496	144	105	27	26,896	3,467	1,537	2,490
Hail	120	5	2	0	37,827	3,608	219	4,863
Frost	556	62	0	0	396,781	4,542	74	30,881
"Huaycos"	244	55	44	25	18,633	2,896	698	777
Floods	1,328	60	71	20	591,379	98,301	10,213	62,383
Heavy rains	1,241	25	46	2	143,255	25,814	2,406	5,979
Ocean swells	14	4	2	6	1,634	122	382	0
Snow	367	83	6,457	0	301,256	36,829	120	27,588
Drought	221	0	0	0	296,297	0	0	46,662
Earthquakes	229	89	2,867	66	230,607	40,257	22,714	1,800
Thunderstorms	45	18	28	0	1,171	94	33	0
Strong winds	1,806	18	51	9	108,906	19,605	2,175	2,112
Others	213	58	161	31	13,142	1,501	316	1,770

*Includes deaths, persons directly injured and persons affected.
Source: Regional Offices and National Operations Office, INDECI

These effects on Peru's population were caused by numerous different types of natural disasters in Peru during 2000-2004 (Table 5.5). The events with the greatest effects on victims were floods, earthquakes, frost and snow, and drought. The damage produced by flooding was distributed throughout the period, but especially heavy in 2003. The damage caused by earthquakes took place largely during the 2001 earthquake in southern Peru. Damage caused by snow and frost took place mainly in 2002 and 2004, with extreme temperature drops and snow that affected poor communities in southern Peru at high altitudes above 3,500 masl.

5.9 The effects of natural disasters in Peru vary widely by geographic location (Table 5.6), making it difficult to generalize about causes and effects for the nation as a whole. As one would expect, the frequency of specific types of disasters differs markedly by location in the country. Heavy winds are particularly severe in the Oriente (Loreto, San Martín, Amazonas), two Departments in the Sierra (Puno and Cajamarca) and on the northern Coast (Piura). Heavy rains are severe both in the Sierra (Apurimac, Cajamarca, Huancavelica, and Puno) and in lower elevations both in the Oriente (Amazonas) and on the Coast (Arequipa). The flooding caused by those heavy rains has been particularly severe in both highland areas (Cuzco and Puno) as well as the lowland regions fed by those rains: Madre de Dios, Loreto, and San Martín. Predictably, landslides are especially problematic in the Sierra and Oriente regions which are also characterized by heavy rains and/or flooding: Cuzco, Amazonas, Cajamarca, Huancavelica and Apurimac. Other natural disasters are more geographically specific. Overall, INDICE's national disaster plan estimates that nearly half (46.2%) of the natural disasters occurring between 1993-2002 were accounted for by floods (INDICE, 2004). Importantly, a PCM study has identified 89 provinces with a high or very high vulnerability to multiple natural disasters, in which live more than 17.65 million people, representing more than 76% of Peru's population (Angulo, 2005). These include areas in several Departments – Ancash, Junín, Huancayo, Cuzco, Cajamarca, Lima, and Arequipa – which have exhibit high vulnerability to landslides, huaycos, floods, and avalanches due to earthquakes and/or heavy rains associated with El Niño.

Causes of Natural Disasters

5.10 While the underlying causes of many natural disasters stem from natural forces, the effects on human populations are frequently exacerbated by human actions. Natural causes include the periodic recurrence of El Niño, earthquakes, and heavy winds. But the incidence and severity of the impacts of some natural disasters – including flooding, landslides and huaycos – are all exacerbated by human interventions affecting the environment. Two causes in particular stand out: soil erosion and deforestation. As discussed in Chapter 7, soil erosion is a widespread problem in Peru, affecting at least 128 million hectares nationally, particularly in the Sierra and Oriente. Erosion exacerbates the effects of heavy rainfall by reducing the absorptive capacity of the soil, worsening flooding and sedimentation problems downstream during periods of heavy rain. Soil erosion, in turn, stems from a variety of factors, many of which are influenced by human action: deforestation and removal of ground cover; poor cropping and irrigation management practices; the frequent lack of use of basic soil conservation practices; widespread overgrazing of cattle, particularly in the Sierra; and poor watershed management practices in general.

5.11 In addition to its indirect effects vis-à-vis soil erosion, deforestation also directly contributes to the severity of runoff by altering the hydrological regime, decreasing the capacity for humidity retention in dry years and decreasing the vegetative cover of the land, particularly in higher altitude areas of watersheds, making them more vulnerable to intensive rainfall and erosive processes. As noted in Chapter 7, deforestation in Peru has recently been estimated at about 150,000 hectares annually, although this is primarily a problem in Peru's Oriente region, where it is of course not linked to the flooding and landslides in the Sierra and Coast. Deforestation and associated loss of ground cover fostering soil erosion have occurred over many years. It should also be noted that a recent international report from the Food

Table 5.6. Location of Natural Disasters in Peru by Department, 2000 - 2004

Type of Natural Disaster	*Department*																								
	Total	Amazonas	Ancash	Apurimac	Arequipa	Ayacucho	Cajamarca	Callao	Cusco	Huancavelica	Huánuco	Ica	Junín	La Libertad	Lambayeque	Lima	Loreto	Madre de Dios	Moquegua	Pasco	Piura	Puno	San Martín	Tacna	Tumbes	Ucayali
Volcanic activity	**1**						1																			
Aluvium	**11**		1			2	3		2	1			2													
Avalanches	**4**		2			1							2										1			
Landslides	**496**	56	22	31	13	30	43	0	69	38	14	3	23	8	2	35	21	3	6	24	17	20	11	2	0	5
Hail	**120**	1	4	3	8	17	11	0	5	13	1	0	11	0	0	0	0	0	5	2	0	39	0	0	0	0
Frost	**556**	28	15	72	42	48	60	0	29	38	12	1	5	8	3	0	0	0	20	18	9	124	0	24	0	0
Huaycos	**244**	21	10	16	6	8	17	0	28	29	18	4	18	14	1	29	0	0	3	11	2	1	2	5	0	1
Floods	**1328**	43	10	30	23	55	57	3	146	29	31	4	60	16	12	53	143	163	6	10	30	185	105	25	15	74
Heavy rains	**1241**	124	18	140	121	48	143	0	27	115	55	6	52	18	4	11	12	8	39	20	4	147	68	36	12	13
Ocean swells	**14**	0	1	0	3	0	0	4	0	0	0	4	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Snow	**367**	0	0	57	55	17	0	0	68	47	0	0	1	0	0	0	0	0	28	0	0	72	0	22	0	0
Drought	**221**	3	0	5	5	91	0	0	0	42	1	0	1	0	22	0	0	0	0	0	21	0	0	18	12	0
Earthquake	**229**	0	0	20	118	12	0	0	7	0	0	1	2	0	1	0	0	0	27	0	0	5	1	35	0	0
Thunderstorms	**45**	0	2	2	13	3	1	0	1	5	3	0	1	2	0	0	1	0	0	0	1	6	0	1	0	3
Strong winds	**1806**	194	15	67	51	46	213	0	25	82	46	4	34	21	12	2	386	10	20	19	125	108	219	7	8	92
Others	**213**	4	2	2	1	3	5	2	4	0	2	8	2	1	3	23	93	3	1	1	1	0	4	1	2	45
Total	**6,896**	**474**	**102**	**445**	**459**	**381**	**554**	**9**	**411**	**439**	**183**	**35**	**212**	**89**	**60**	**153**	**656**	**187**	**156**	**105**	**210**	**707**	**411**	**176**	**49**	**233**

Source: Regional Offices and National Operations Office, INDECI, 2005.

and Agricultural Organization of the United Nations and the Center for International Forestry Research, while acknowledging the link between deforestation and flooding at small geographic scales, has questioned the link at larger scales (FAO-CIFOR, 2005).

5.12 Whether caused by soil erosion, deforestation, or other factors, increased runoff and accompanying sedimentation often have severe downstream effects, increasing river volume and flood risk in exposed and low-lying areas. Deforestation and erosion also allow rainwater infiltration and supersaturation of the soil, which in turn, create conditions for mass soil movement resulting in landslides and huaycos. On the Coast, intense rains associated with El Niño on barren or deforested soils cause periodic heavy runoff, gully erosion, and huaycos. If rivers are not properly channeled and river banks not reinforced in critical areas, or if vegetation and building construction have interfered with or occupy natural channels, the effects downstream can be critical, causing damage to agriculture, water and power sources, transportation, and human health. The devastating effects of El Niño in 1997-98 in the area surrounding Piura, for example, resulted from this type of interlinked series of events. As shown above (Table 5.4), the economic impacts on the housing stock are particularly devastating.

5.13 Another key factor contributing both directly and indirectly to the impacts of natural disasters in Peru is climate change. Some of these processes are well understood; others are not. One of the direct

links is through increased glacial melt. Peru contains roughly 71% of the globe's tropical glaciers. Since the early 1980s (PCC, 2004) Peruvian glaciers have lost about 22% of their glacial surface (500 km^2), equivalent to 7,000 million m^3 of water (about ten years of water supplies for Lima). Peru also has over 12,000 lakes and ponds that could be destabilized from glacier melt. Furthermore, the combined impacts of global warming, ENSO (El Niño Southern Oscillation), and extreme weather events on mountain hydrology are diminishing the water flow used by populations downstream (IRD, 2004), and are likely to have devastating impacts on highland and associated downstream ecosystems, altering the ecology and livelihoods of millions of people, whose greenhouse gas emissions are negligible. In addition, Peru's energy sector could be affected since 80% of the energy generation comes from hydropower.

5.14 While the above effects are relatively direct, the underlying connections between greenhouse gas (GHG) emissions, global warming and ENSO are less clear. There is some evidence that increases in GHG emissions caused by human actions are possibly linked to the increased frequency and severity of ENSO events (Trenberth and Hoar, 1996). If confirmed in future research, this would establish a direct linkage between human actions affecting the global environment and one of the largest sources of disaster risk in Peru. But these hypothesized relationships are based on simulation analyses which exhibit a high degree of variability and unpredictability, making it difficult to establish clear linkages (AchutaRao, et al.; Toniazzo, 2006). Regardless, as discussed in Chapter 2, Peru's contributions to overall GHG emissions are very modest (estimated at 0.3 percent (CONAM, 2003)), and various governmental agencies and projects – CONAM, the National Environmental Fund (FONAM), the Intergovernmental Panel on Climate Change, INDECI, and the PROCLIM Project – are working toward supporting Peru's compliance with the U.N. Convention on Climate Change and the Kyoto Protocol.

5.15 UNDP's recent global report on Reducing Disaster Risk (2004) emphasizes the close relationship between economic development, urbanization and disaster risk globally. In Peru, the urban population grew from 2.2 million in 1940, 26% of the national population, to about 19 million, or 72.6% of the population, in 2004 (Angulo, 2005). The Lima-Callao metropolitan area alone accounts for an estimated 45% of the Peru's GDP, 59% of its public budget, and 84% of its national tax base (Galarza, 2001). The potential effects of natural disasters are intensified by this progressive urbanization and associated factors: the concentration of people and housing in urban centers; a concomitant concentration of private business assets and public infrastructure investments; and a rise of economic interdependence which inflates the costs of disaster-related business interruption. Together, these increase the human and economic exposure to potential disasters in specific areas.

5.16 Conditions of poverty and marginality of the population further worsen the situation. The National Statistics and Information Institute (INEI, 2004) estimates that in 2004, more than half (51.6%) of Peru's population lived in poverty, and 19.2% of the population was under conditions of extreme poverty. Poverty increases vulnerability to disasters in many ways (IDB, 2000): construction of housing where land is cheap, frequently on flood plains, river banks, steep hillsides, or reclaimed land; the lack of land use controls in these areas; poor quality construction; lack of basic mitigation measures, such as retention walls and adequate surface drainage; and the marginal livelihoods and limited capacity for economic resilience of many of the extreme poor. This vulnerability has been demonstrated many times in the past, such as in the two Lima earthquakes of 1966 and 1974, and the flooding in Ica in 1963 and 1998.

5.17 As this discussion shows, the causes of natural disasters in Peru are many, the relationships between causes and effects are complex, and the solutions are diverse. There are at least two common elements that surface throughout this discussion. One is the role that human actions have in helping cause some natural disasters and contributing to worsening the impacts of others. The second is the important role of risk assessment and disaster prevention in helping to avoid, or at least lessen the impacts of natural disasters on people, homes, agriculture and infrastructure. To date, the government's approach to natural disasters has been largely focused on mitigating the effects of disasters once they have occurred, rather

than assessing *ex ante* the sources of greatest risk, preventing disasters, and establishing priorities for disaster prevention and mitigation through a consistent assessment of past effects. Although there has been some movement toward moving in the latter direction, especially over the past five years, the progress has been slow and intermittent.

Institutional and Policy Framework

5.18 The first two parts of this section discuss the policy framework and institutional network, respectively, which comprise Peru's national system of disaster mitigation, prevention and response. This system is evaluated in the final section.

Policy Framework

5.19 The **National Plan for Prevention and Attention to Disasters** (*Plan Nacional de Prevención y Atención de Desastres*), approved in 2004, defines the national strategies, objectives, and governmental programs on disaster prevention and risk reduction, disaster preparations to reduce long-term vulnerability to natural disasters, and for reconstruction and rehabilitation when they occur. The Plan incorporates six specific strategies relating to 1) risk estimation, 2) preventive activities, 3) the incorporation of disaster prevention in public planning; 4) institutional strengthening; 5) community participation; and 6) optimizing the response to disasters. For each of these strategies, the plan defines programs, indicators, and responsible institutions. However, it fails to define terms, specific operational roles and responsibilities of individual institutions, implementing mechanisms, or monitoring plans and protocols. All of these operational details are needed in order to successfully translate the National Plan into action. The Plan also provides for the approval of sectoral disaster plans at the national level within 30 days and regional plans by each regional government within 60 days, an unduly ambitious schedule. **Law No. 28551** (May, 2005) requires the preparation of sectoral and governmental Contingency Plans consistent with the National Plan.

5.20 National disaster planning is also a key part of the July 2002 **National Agreement** (*Acuerdo Nacional*), a broad-based participatory reform agenda among key political and civil society groups that identifies national and regional development priorities. Policy No. 10 of the National Agreement covering poverty reduction includes a specific policy to "develop a culture of prevention and control of risks and vulnerability to natural disasters, assigning resources to prevention, assistance and reconstruction." Specific goals include, by 2006, to have 1) the National System of Civil Defense (SINADECI), responsible for coordinating the national response to (and prevention of) disasters, functioning at 100%; 2) 100% of public infrastructure projects incorporating risk control and prevention mechanisms; 3) 80% of Civil Defense Committees and offices of regional and local governments and public and private institutions to be fully organized and trained (by 2011, 100%); and 4) for risk control and prevention curricula to be incorporated in 100% of public education. Most of these goals appear unrealistically ambitious in view of actual operations as of December, 2005. In addition, Policy No. 15 of the National Agreement on food security contains a concrete goal of taking measures to confront threats to national food security, including drought, desertification and disease.

5.21 With the purpose of formulating a national strategy for risk reduction, the government in 2000 created a **Multisectoral Commission for Risk Reduction in Development**, presided over by a representative of the President's Cabinet (PCM) and composed of scientific experts and public sector representatives. The Commission proposed a national effort to identify the main disaster threats in the country, sources of social and economic vulnerability, ways to institutionalize risk assessment and control, and the production and use of scientific risk information as a basis for the national strategy. It stimulated similar regional efforts in Piura and Arequipa, which have proceeded with support from the

German government, and initiated a study of the incorporation of risk analysis into public investment projects. However, before the Commission was able to complete its work, it was deactivated in October, 2004, (reportedly to prevent turf battles with INDECI) with its functions to be assumed by a yet-to-be-created National Center of Strategic Planning (*Centro de Planeamiento Estratégico Nacional*, CEPLAN).

5.22 Following the deactivation of the Multisectoral Commission, the **Ministry of Economy and Finance** has assumed leadership in the process of incorporating risk analysis in the formulation of public investment projects, and there has been some progress. A recent General Directive (Resolution 012-2002 EF 6801) of the **National System of Public Investment** (SNIP), establishes the minimum requirements for feasibility studies for public investments. Methodological guidelines have been developed to incorporate risk analysis. Workshops to train public officials on guidelines for public investment projects have been carried out in the Departments of Piura, Arequipa, Lambayeque and San Martín. Guidelines for public investment projects in the health and education sectors, incorporating risk reduction criteria, have been developed.

5.23 The Andean Community's Program on **Promoting Prevention in Andean Country Development** (*Promoción de la Prevención en los Procesos de Desarrollo de los Países Andinos*, PREANDINO), supported by the Andean Development Corporation (CAF), has charged the CAF with incorporating risk assessment and prevention broadly in the development projects and processes of the Community. This effort stemmed from its earlier regional evaluation of the impacts of the El Niño disaster of 1997-98 and, given the ineffective prevention of major impacts from the 1997-98 El Niño (not just in Peru), a major emphasis on risk prevention (CAF, 2000). The PREANDINO strategy prioritizes risk reduction in development planning, and seeks to have risk assessment methodologies incorporated by institutions like the PCM, Ministry of Economics and Finance (MEF), the National Environmental Council (CONAM), and INDECI. The past activities of this program are currently in a hiatus, with progress continuing to be monitored from its central office in Caracas, emphasizing promotion, transfer of methodologies, information exchange, and facilitating events in conjunction with the Andean Committee for Prevention and Attention to Disasters (CAPRADE), the Andean regional project on Support for the Prevention of Disasters in the Andean Community (PREDECAN), and with MEF, with its focus on risk analysis in public investment projects.

5.24 The **Sustainable Cities Program** (*Programa Ciudades Sostenibles*), executed by INDECI with support from the U.N. Environment Program, is focused on improving urban environmental planning and management in over 30 countries through strengthening local capacities and participatory stakeholder involvement (UNHSP, 2005). In Peru, a major emphasis has been on the prevention and mitigation of natural disasters in urban areas that have experienced unplanned growth. Activities include the mapping of urban land uses and soils, the development of disaster mitigation measures, and the translation of these plans into local approval through municipal ordinances. Given Peru's rapid urbanization in recent years, the activities of the Sustainable Cities Program have been particularly important. Through October, 2005, the program had activities in 18 regions and 104 cities in Peru; 93 of those cities have urban hazard maps and 59 also have completed land use and disaster mitigation plans. Of these, 50 municipalities have approved them with formal decrees.

5.25 Other major ongoing programs dealing with risk assessment and disaster mitigation have also arisen in recent years. The Ministry of Education and INDECI's **Learning Prevention Program** (*Aprendiendo a Prevenir*), operating since 2004, is trying to introduce a "culture of prevention" in primary, secondary, and adult educational programs. The Andean Community's **Andean Strategic Plan for the Prevention and Attention to Disasters 2005-2010** (*Plan Estratégico para la Prevención y Atención de Desastres 2005-2010*), approved in April 2005, has the goal of incorporating themes of risk assessment and monitoring and disaster prevention into national and regional development plans, civil society programs, and educational and training programs throughout the region, including Peru. Since

1999, the European Commission-supported **DIPECHO Program** has supported training, the development of early warning systems, and disaster preparation and mitigation plans in 12 areas of high risk in Peru. The European Commission has also supported the **Prevention of Disasters in the Andean Community Project** (*Proyecto Apoyo a la Prevención de Desastres en la Comunidad Andina*, PREDECAN) which recently began (2005) with the objectives of promoting risk assessment and disaster prevention through institutional strengthening and coordination, improved policies for disaster planning, development of an information system, and developing methods and guidelines to incorporate risk analysis in regional land use planning and development planning.

Institutions

5.26 The **National System of Civil Defense** (Sistema Nacional de Defensa Civil, SINADECI), created in 1972, provides the institutional framework for natural disaster planning and response in Peru. The functions of this system are to protect the population, prevent damage, and to provide timely response and rehabilitative assistance in the event of natural disaster. SINADECI is constituted by both public and non-governmental entities, including the **National Institute of Civil Defense** (INDECI), and its regional offices; regional systems of civil defense; and offices of civil defense associated with individual sectors, institutions and public agencies. Regional civil defense systems are, in turn, composed of Civil Defense Committees at regional, provincial and district levels, and offices at the levels of regional and local governments. Many of these offices, particularly at the local level, exist mostly "on paper."

5.27 **INDECI** is the central coordinating mechanism of the national civil defense system. It is in charge of the planning, organization, direction and coordination of the activities of SINADECI and supervising and coordinating the activities of all organizations that receive public funds for civil defense purposes. Its leadership has historically come from the military, and it has had the reputation of being a hierarchical institution. Its functions are evolving, though, in the current environment of governmental decentralization. The Ministries also participate in Civil Defense activities under SINADECI and the National Plan of Prevention and Attention to Disasters, which obliges them to develop sectoral plans of prevention of and attention to disasters, including emergency plans, and plans for rehabilitation and reconstruction activities.

5.28 The **National Environmental Council** (*Consejo Nacional del Ambiente*, CONAM), according to Decree No. 048-97-PCM, has overall responsibility for coordinating national environmental management, including land use planning studies and management. Environmental studies and management plans constitute an important first step towards disaster prevention because they include analysis of the environmental conditions that exacerbate the impacts of natural disasters. CONAM is in charge of approving the National Environmental Action Plan, regional environmental action plans, the National Report on the State of the Environment, and the National Plan for Environmental Management.

5.29 The GOP **Ministries** are responsible for developing operational plans for dealing with natural disasters affecting their specific spheres of interest. The **Ministry of Agriculture** has the greatest expertise when it comes to the management of the natural resources and river basins. According to the Law No. 25902, this sector is obliged to promote agricultural development within a watershed management framework emphasizing socio-economic and environmental sustainability. The Ministry's 2006 Strategic Plan prioritizes the objective of institutional strengthening and "implementing a system of prevention and attention to to natural phenomena to lessen their effects on agricultural activity". Within this sector are, among others, the National Food Safety Service (SENASA), the National Institute of Natural Resource (INRENA), the National Institute of Agricultural Research (INIA), and the National Program of Watershed Management and Soil Conservation (PRONAMACHCS). **INRENA** is the governmental authority responsible for environmental and natural resource management, including areas relevant to natural disaster protection: regional watershed planning and land use mapping (through its

OGATEIRN office); proposing measures for ecosystem conservation and recuperation, and through its PERPEC program, river channeling and water storage structures.

5.30 The **Ministry of Housing, Construction and Sanitation**, according to Decree No.002-2002-VIVIENDA is responsible for housing and urban development. Included in its mandate are the formulation, proposal and execution of policies and plans for risk prevention against natural disasters and coordinating regional and municipal government efforts for urban housing and environmental management. As related above, the two most important economic effects caused by natural disasters in Peru are housing damage and destruction. Accordingly, this Ministry has a key role to play in planning and policymaking to prevent and mitigate disaster risk.

5.31 The **National Meteorological and Hydrological Service (SENAMHI)**, through its 13 regional offices, provides meteorological, hydrological, and other environmental and climatic data, information and forecasting to regional governments and civil defense systems.

5.32 **Non-governmental institutions** (NGO's) play an important role in natural disaster planning and response. They continue to fill many of the gaps existing in GOP efforts, interact closely and directly with regional and local governments, and have played a major leadership role in recent years to put disaster prevention and risk assessment on the national agenda. Major NGO efforts include those of PREDES, Red Cross-Peru, OXFAM, GTZ (Germany), Save the Children, World Vision, ITDG, and CARE.

Evaluation of Policies and Institutions

5.33 Numerous international venues – from the June, 1999, Hemispheric Meeting of the International Decade for Natural Disaster Reduction in Costa Rica, to the January, 2005, International Conference on Disaster Reduction in Japan – have emphasized that national governments must give greater priority to disaster prevention, the reduction of vulnerability and *ex ante* disaster risk assessment. A fundamental reason for this policy recommendation is that government support for risk assessment and disaster prevention can be viewed as an investment, an investment in a country's economic development (Clarke, 2000), without which the resultant costs of natural disasters could, and have, set back a country's path toward economic progress. Viewed thus as an investment, it appropriate to consider where the greatest payoffs from public funding exist in reducing risk and vulnerability and the destructive effects of natural disasters, and what should the priority areas be for GOP focus and attention.

5.34 In Peru, as discussed previously, multiple public initiatives exist, begun mostly over the past five years, which are addressing these priorities. But the organization and integration of these concerns at the operational and budgeting levels in national, regional and local governments is still far from adequate. The lack of a functioning National Center for Strategic Planning to articulate and help organize an effective long-term strategy for incorporating disaster prevention and risk assessment in national and regional development planning and management is a major weakness; accomplishing these objectives awaits the planned imminent formation of CEPLAN.

5.35 Poverty and environmental degradation are primary factors in generating conditions of vulnerability to natural disasters. The effects run in both directions (UNDP, 2004). But the interrelationships between these three elements are not adequately understood or acted upon. Environmental deterioration, including soil erosion and deforestation, contributes to the increased likelihood of natural disasters (especially floods, landslides and huaycos) and to amplifying the severity of these and others. Poverty, by itself and in conjunction with uncontrolled land uses, greatly increases human vulnerability to natural disasters. Thus reinforcing efforts to address both the environmental causes of disasters (see Chapter 7) and the problems of poverty which exacerbate them, is key to improving the effectiveness of risk management and mitigating the impacts of disasters.

5.36 Addressing the root causes of natural disasters must mean dealing effectively with soil erosion and deforestation. Although agricultural sector is the one with the greatest availability of resources to deal with river basin and natural resource management, the treatment is diffuse, partial, and not integrated. The Ministry highlights some aspects (e.g., irrigation management), but neglects others such as soil erosion and land use management. The Ministry of Education's recently initiated 'Learning to Prevent' educational program represents only a start in integrating issues of prevention and risk into the educational culture, and requires monitoring of its progress and impacts.

5.37 The National Plan of Prevention and Attention to Disasters has several key limitations. First and most importantly, it fails to adequately define terms, implementing mechanisms, and monitoring plans and protocols for dealing with natural disasters. Operational and logistical plans for dealing with natural disasters have yet to be developed at many regional, provincial and local levels of government. Law No. 28551 (May, 2005) defines the requirements for disaster contingency plans so broadly that it has created widespread confusion. The provision for the development of sectoral disaster prevention plans has only partially been complied with. As of October, 2005, only eight sectoral plans had been formulated and approved (Ministries of Commerce, Economy and Finance; Justice; Production; Health; Energy and Mines; Transport and Communications; and Housing, Construction and Public Health); four were finished and three were in the preparation process. At the regional level, as of the same date, only four regional plans had been approved (Amazon, Tacna, Arequipa and Moquegua), three were finished, four were in revision, and 15 were in formulation.

5.38 The National Plan should be reviewed and revised with broader participation of the institutions, both public and civil society, involved in its execution, to better define the terms, mechanisms, and resource allocations necessary for its implementation and monitoring. This is important because civil society groups were not involved in the development of the original plans. Simply issuing directives from INDECI and approving sectoral and regional disaster plans – both for prevention and response – does not guarantee that the institutions involved will actually incorporate these plans in their strategic and operational plans, nor that they will include budgetary requirements in their annual budget programming. The Sustainable Cities Program has made some progress in this regard, but has been limited by lack of management capacity of many local governments, lack of commitment by many municipal authorities, and insufficient citizen participation.

5.39 Regarding disaster and emergency preparation, many serious weaknesses exist, in particular, emergency operating plans and protocols are widely lacking. PREDES estimates that only 50-60% of Peru's 194 provinces have technical secretaries for civil defense, and that at most 5% of 1,821 districts have effectively functioning civil defense systems (PREDES, personal communication). Local Committees of Civil Defense have many limitations of staff, resources, organization, management and training. The impacts of these limitations have been demonstrated recently in emergencies such as the earthquake in southern Peru in June, 2001, and the earthquake in San Martín in September, 2005. Even worse, cities such as Lima and Arequipa, with enormous risks of natural disaster, do not have operational plans for disaster preparation and emergency action.

5.40 In Peru, national, regional, and provincial levels of government typically approve plans, laws and regulations with little attention to those existing at other levels of government. The result is significant overlaps, gaps, and inconsistencies. During the 1990's, a sectoral emphasis existed; in terms of risk management, most changes centered on the central organization of SINADECI. This model is being significantly modified in the context of decentralization. Nevertheless it is occurring without clear plans and orderly adjustment. The sectors (Ministries) count on specific mandates in the area of prevention and others only indirectly, but in both cases it is possible to improve mandates and directives that allow a clearer integration of reduction of risk and vulnerability in the context of national and regional policy. Given its legal and historic responsibilities, INDECI has the task of generating instruments and

regulations to try to better promote and monitor the changing functions of the different elements of the national civil defense system.

5.41 Completion of the goals of the National Agreement has been mixed. Some progress has been made in incorporating risk analysis and prevention in public infrastructure projects (Measure 2) and in building awareness of risk and disaster mitigation into the educational curricula (Measure 4). Progress toward Measure 1 (incorporating a focus of risk prevention and control throughout SINADECI) has been limited by the traditional lack of focus on risk and protection (versus that of response to natural disasters) in SINADECI (notably, INDECI), and the lack of specified indicators. This is confirmed by the small proportion of INDECI's total budget in 2003-2005 that is accounted for by prevention and risk analysis-related expenditures (Table 5.7). Note that although the percentage of the budget devoted to "risk analysis" declined sharply in 2005, this was due to a transfer of these responsibilities – although not associated budgetary increases – to the local and regional levels. Well over half of INDECI's budget continues to be spent on emergency and disaster response. Table 5.7 also shows, notwithstanding this devolution of responsibilities, that INDECI's staff expanded significantly between 2004-2005.

Table 5.7: Annual Budget and Staff of INDECI, 2003-2005

	2003	2004	2005
Total Budget (soles)	**59,804,851**	**85,315,955**	**86,432,560**
Risk Analysis (%)	2,905,949 (5%)	3,462,573 (4%)	542,594 (1%)
Prevention (%)	8,162,479 (14%)	11,488,613 (13%)	11,961,225 (14%)
Total Staff	**443**	**442**	**603**
Permanent staff	103	102	102
Contracted by SNP	340	340	501

5.42 There has been progress reported in the training of civil defense committees, particularly at the regional and provincial levels, but there are no statistics or indicators to confirm this. In 2004, INDECI transferred its training functions to the regional governments, but without the financial resources to achieve it. The goals set out in the National Agreement do not relate necessarily to the reduction of the vulnerability to the disasters for the poor, as one would hope. Many have argued that the State should have an explicit policy, recognizing the prevention of disaster and reducing disaster risk as a national priority. This would conform to the objectives set forth at the 2005 International Conference on Disaster Reduction and other venues which have proposed to increase the priority and political commitment given to disaster reduction and mitigation globally.

5.43 The process of decentralization provides an opportunity for a new vision and emphasis on disaster prevention and risk assessment throughout Peru. Decentralization places more responsibility on regional, provincial and local governments to plan and to manage economic development jointly with the reduction of vulnerability and risk. However, INDECI remains a hierarchical institution in many ways, and much confusion exists regarding the assignment of roles and responsibilities under decentralization. The lower levels of government can positively influence the vulnerability of their populations to risk and natural disaster through a variety of legally instituted measures: regional and local development plans (*Planes de Desarrollo Concertados*), participatory budgets (*Prespuestos participativos*), and land use planning (*Planes de Ordenamiento Territorial*). However, the organizational, technical and management abilities of regional and local governments fall far short of the responsibilities assigned to them by law, and they have yet to build their new responsibilities into their budget planning. The NGO sector fills in the gaps in many cases, working with regional and local governments. But financial resources, technical support,

training, and improved management capacity are urgently needed for local governments to comply with their mandated new responsibilities. Local and regional governments have yet to build into their operating budgets the expanded authority now given them in natural disaster prevention and response.

5.44 Land use planning is an important instrument for the prevention of the natural disasters. But the national framework for land use planning – Decree No. 087-2004-PCM covering *Zonificación Económica y Ecológica* – is subject to various interpretations and types of planning processes. As a simultaneous responsibility at all levels of government, this demands a much improved level of integration and consistency. The statutory laws of the sectors, regional governments and municipalities, have thus far not adequately generated this outcome.

5.45 Although risk assessment methodologies have been incorporated into public investment projects, there are both political and technical aspects which make this a slow process. The introduction of greater technical requirements in the National System of Public Investments (SNIP) will also require more and better information on threats and vulnerabilities, as well as dissemination of information to building inspectors who provide the critical link to contractors. Incorporating risk reduction in regional and local development plans in a coordinated way requires a concerted effort by an organization like the incipient CEPLAN.

Recommendations

5.46 There has been a positive, if slow, movement in the recognition of the importance of disaster risk, vulnerability and prevention on the part of governmental and nongovernmental organizations in Peru. This is clear from the incorporation of these concepts in major documents and efforts such as the National Agreement and the National Plan for Prevention and Attention to Disasters. Yet, as a matter of practice, the focus is still often one of attention to emergency events and dealing with their immediate impacts, without a sufficiently integrated response that emphasizes prevention, vulnerability analysis and risk assessment. Suggested recommendations address needed changes in policy, technical assistance and public investments:

<u>Policy</u>

1. **Highlight disaster prevention and the reduction of disaster risk and vulnerability as a national priority**. The prevention of disasters and the reduction of disaster risks and vulnerability should be highlighted as a national priority, within the National Agreement, the National Plan, and public sector entities and development planning at all levels. In the longer run, disaster risk reduction and prevention should also be promoted not just within government, but at all levels of civil society, from NGO's and the private sector. It is important to strengthen technical and organizational capacities, especially at the regional and local levels, to manage risk reduction and organize the response to natural disasters.

2. **Create an Office for Reduction of Vulnerability to Natural Disasters** as part of the establishment and funding of the new National Center for Strategic Planning (CEPLAN), as has been planned since 2004. This could be done in the short term, and might be complemented by establishment of a parallel office in the Ministry of Housing, Construction and Sanitation, given the major impact of natural disasters on housing. Such a move would also help in promoting a consistent unification of disaster prevention and risk assessment policies across the various Ministries and functional areas, from development planning to watershed management to public works projects.

3. **Support for disaster planning (prevention and emergencies) and incorporation of checks and balances in the context of decentralization.** SINADECI is organized better than most areas of government to adjust to the new decentralization framework law, but much needs to be done. A clear articulation and structure of specific operational roles and responsibilities for disaster prevention and planning at each level of government is needed. In the short term, the National Plan can be much more fully articulated with clear guidelines specifying the allocation of roles and responsibilities among levels of government and specific offices within government, clear budgetary allocations, and mechanisms and indicators for evaluating performance. The leadership role of INDECI in this new structure should be clearly defined, perhaps in terms of the organization of disaster prevention and response, establishing methods and indicators for risk assessment and monitoring, training, and education. Changes to INDECI will not come easy given its traditional resistance to change. Regulations governing the preparation of contingency plans should be articulated and enforced. Training is needed in disaster assessment and planning, risk analysis, public infrastructure project planning, public health, and other areas. Also needed are better communications, and the development of early alert systems.

4. **Better budgetary planning, greater financial resources, and greater accountability in disaster prevention and planning.** Although responsibilities for disaster planning are being devolved to the regional and local level, financial resources are not. Technical expertise, staff, and budget resources at provincial and local levels, are woefully inadequate to handle the increased responsibilities brought on by decentralization. Regional and local governments are in the early phases of incorporating disaster planning in their budgets. A long-term commitment to better budgetary planning, both at national and regional levels, can be better used to assure that disaster prevention and risk assessment are included in operational plans of governments and Ministries. The use of regional government revolving funds should be considered for dealing with natural disasters, much like that of INDECI at the national level.

5. **Greater participation in developing disaster plans**. The National Plan for Prevention and Attention to Disasters of SINADECI should be revised with the participation and agreement of the actors and institutions involved in its execution, to better define roles, resources and specific mechanisms for its implementation and monitoring. These reviews and revisions should be conducted in a transparent, inclusive and participatory fashion. It is critical that sectoral and regional plans be incorporated in the strategic plans of the sectors, regional and local governments and, importantly, in their institutional operating plans, in order to incorporate the financing of activities and projects in their annual budgetary programming.

6. **Establish a national framework for integrated watershed management.** The institutionalization of watershed management should be redefined. The Independent Watershed Authorities (*Autoridades Autónomas de Cuencas*) have structural problems originating from their design, in that they ignore the need of regional and municipal governments to elaborate land use and development plans. In addition, lack of representation and inadequate financing are commonplace. Especially in the context of decentralization, it is important to give regional and municipal authorities a legal and management authority in river basin management, as well as adequate financial resources. Part of this effort should be the establishment of early warning systems and monitoring systems in the main river basins. This will help identify the processes that are generating environmental degradation in the first place and leading to greater vulnerability to natural disasters, for example: poor land use management; soil erosion; deforestation; mining; sources of surface water contamination; the construction of human settlements in risky areas; and other developments that increase the vulnerability to natural disasters. In organizations like PRONAMACHCS, indicators of environmental deterioration and increased risk vulnerability to disaster in watersheds should be considered an additional criterion

for its targeting of critical watersheds, one that would complement its existing focus on poverty. An effort should be made to identify and systematize the lessons and successful experiences in watershed management and soil conservation, not only by PRONAMACHS but NGO efforts.

7. **Establish a policy on land use planning.** Land use planning is a key tool for risk reduction, because it identifies spatial uses for different human activities – housing, infrastructure, and productive activities like agriculture – but it also identifies critical constraints, risks and limitations arising from both human activity and the environment. While "Economic and Ecological Zoning" is a widespread requirement across Ministries and different levels of government, its interpretation and requirements are diffuse and ambiguous. This needs better articulation and consistency with a priority given to disaster prevention and mitigation; this could be a role for both CONAM and CEPLAN. Land use planning should be better coordinated between central, regional and provincial governments This could be enhanced through a general law of land use planning, a revision of Decree No. 087-2004-PCM, that clarifies the roles and functions of land use planning at the three levels of government, specifies the processes of civil society participation, and serves as a guide to assigning resources.

Technical Assistance:

1. **Promote disaster prevention and risk assessment through comprehensive incorporation of planning and management tools at all levels of government.** Indicators of vulnerability and risk should be incorporated in risk management and planning at regional and local levels, in budgeting, in project design and management, and in the formulation of development and land use plans. This requires the development and application of risk and prevention methodologies, indicators and instruments to assess vulnerability and risk, including early warning systems, as well as their use in establishing baselines, measuring trends in key indicators, proposing goals for risk and vulnerability reduction at regional and local levels, and monitoring policies, programs, plans and outcomes. This will necessitate a much greater effort at training and building human capital in these areas, especially at regional and local levels.

2. **Incorporating risk analysis in public investment projects.** The efforts of the Multisectoral Commission and, more recently, the MEF should be strengthened to incorporate risk analysis and disaster prevention in the formulation of public infrastructure and investment projects, beginning with the SNIP. This will necessitate greater attention to building standards as well as strengthening capacities at regional and local levels, especially for project managers, public works inspectors, and quality control specialists. All this will require a much greater effort in training and technical assistance.

3. **Management of risks in urban planning and development.** It is also necessary to better incorporate risk and vulnerability assessment in the formulation of urban plans. In the case of the Sustainable Cities Program, it is necessary to evaluate the manner and extent to which the participant municipalities have actually controlled urban growth and managed urban development plans on the basis of the completed studies and plans. On this basis, technical assistance programs could be improved and framed appropriately, given the actual conditions facing municipal officials. It is also necessary to strengthen the processes of citizen participation and buy-in of local authorities in the design and execution of these studies.

4. **Diffusion of appropriate and safe construction technologies**. To reduce the risks in housing construction will require, especially in poor urban sectors located in risky locations, taking advantage of known construction technologies and devising mechanisms for improved technical assistance in the case of self-built housing. In rural areas, the improvement of traditional

construction systems (e.g., adobe) will require direct and efficient mechanisms to advise the rural population of safe construction practices and standards.

Investments

1. **Evaluate alternative mechanisms for financing disaster response and transferring risk.** The decentralization of the national framework for dealing with disasters, as well as the highly variable incidence of disasters over time and space (see Tables 5.1 - 5.6) suggests that new funding mechanisms to enable regional and local governments to access the necessary financial resources to deal with disaster mitigation are necessary. One possible mechanism would be a national fund for co-financing disaster mitigation investments in local infrastructure. Regional and local governments are hard-pressed to finance these investments solely from local/regional funds. Through co-financing, the national government could exert some influence in assessing critical needs throughout the country and directly resources to the areas of greatest need and potential payoff. The proposed fund would build on the current fund available to INDECI in times of disaster, but would direct funds to help meet local needs, where local funds are also available, and would be spent on disaster prevention, not just emergencies.

2. **Consideration should also be given to alternative mechanisms for transferring risk**. Disaster insurance is seldom used in developing countries for a variety of reasons (Freeman, et al., 2003): the high probability of extreme weather events, the difficulty of spreading risk in small economies (relative to the magnitude of risk), the adverse selection problem, and thin markets for insuring risk. However, a number of potential risk transfer mechanisms could be considered for Peru: catastrophe insurance or bonds; access to an international insurance fund (such as that proposed by the United National Framework Convention on Climate Change); private-public partnerships (such as the Turkish Catastrophe Insurance Pool); and parametric earthquake insurance. Some initial investigations into the potential for using broad-based catastrophe insurance in Peru have been made by the Peruvian Association of Insurance Companies (APES). The company Cooper Gay Perú Corredores de Reaseguros S.A. has recently presented a proposal for catastrophe insurance to INDECI. These and similar initiatives should be considered further.

Summary of Policy Recommendations

Objective	Recommended Short-Term Actions	Recommended Medium and Long-Term Actions
Emphasize disaster prevention and the reduction of disaster risk and vulnerability as national priorities.	• Establish and fund Vulnerability Reduction Office in CEPLAN (Cost: low) • Establish Vulnerability Reduction office in Ministry of Housing (Cost: low) • Develop and apply risk assessment and prevention methodologies, indicators and instruments to assess and monitor vulnerability and risk in national and regional plans, program and project planning, infrastructure design, etc. (Cost: moderate) • Strengthen MEF efforts to incorporate risk analysis in public infrastructure projects, and building design standards (Cost: moderate to high) • Invest in early alert systems in targeted areas (Cost: moderate to high).	• Incorporate disaster prevention and risk reduction across all levels of government, NGOs, education, private sector, etc. (Cost: moderate to high) • Incorporate risk and vulnerability assessment in urban plans (Cost: moderate to high). • Establish a national framework for integrated watershed management to help avoid natural disasters (Cost: moderate)
Strengthen institutions involved in disaster planning and management, especially in the context of decentralization	• National Plan needs to identify roles, responsibilities, budgetary allocation guidelines, and performance indicators for national (INDECI), regional and local entities (Cost: moderate). • Increase financial resources spent on disaster prevention and planning, especially at regional and local levels given decentralization framework (Cost: high) • Improve training, at all levels of SINADECI (especially at regional and local levels), in disaster planning, risk analysis, public infrastructure planning, etc. (Cost: moderate to high) • Diffuse information on safe construction technologies (Cost: low to moderate)	• Foster better budgetary planning, and greater accountability in disaster prevention and planning (Cost: low to moderate). • Foster greater civil society participation and greater transparency in disaster prevention and planning (Cost: low) • Establish national and regional policies on land use planning, and roles of different levels of government, as part of disaster prevention effort (Cost: moderate)
Evaluate alternative mechanisms for financing public and private responses to natural disasters	• Establish national fund to facilitate co-financing of local and regional infrastructure and disaster prevention projects (Cost: high)	• Evaluate feasibility of catastrophe insurance and other risk transfer mechanisms (Cost: low to moderate)

CHAPTER 6

SUSTAINABLE FISHERIES THROUGH IMPROVED MANAGEMENT AND POLICIES

Peru's fisheries resources support one of the country's most important economic activities and provide fundamental environmental services. The Peruvian anchoveta remains the largest single stock fishery in the world. The occurrence of El Niño Southern Oscillation drives extreme fishery resource volatility. Combined with the expansion of fishing and processing capacity and weak sector governance, this volatility has resulted in resource depletion, extensive marine ecosystem change, widespread environmental degradation and dissipation of resource rents, and loss of socials and economic benefits. Meeting these challenges will require an open and transparent participatory process to: i) substantially increase net benefits from the sector by reducing capacity and effort in the fishing sector in line with natural productivity and maximum economic yield; ii) improve sector governance and equitable benefit distribution; iii) issue effective environmental regulations with independent oversight of enforcement; iv) strengthen the sector's research capacity to support an ecosystem approach to management of fisheries and coastal resources; v) establish a system of Marine Protected Areas; and vi) revise and modernize the sector's regulatory framework.[70]

Introduction

6.1 About fifty years ago, Peru started to develop an industrial fisheries sector, based on its rich anchoveta and sardine resources. These resources account for nearly 10% of the global marine catch and are not only a major natural resource for Peru, but are key constituents of the the Humboldt Current Large Marine Ecosystem, one of the most productive in the world. Except for the privatization, however, no major policy innovations have been introduced to the sector, even when technological innovations and an expanding fleet caused the resources to pass from a situation of abundance to one of scarcity. Successive governments have shied away from tackling critical issues, because of the perceived complexity and political sensitivity of the problems and because of strong and articulate commercial lobbies pursuing narrowly focused interests. As a result, many fish resources are over-exploited, or in a precarious recovery phase, the sector's capital investments are used inefficiently, the sector is a major source of pollution due to handling and processing inefficiencies, and the contribution of the industry to social welfare, nutrition and employment remains very modest. Moreover, while medium term market prospects for fishmeal and -oil remain promising, biotechnology may enable the development of alternatives to these products, and long- term buoyant and remunerative export markets for fish meal and oil cannot be taken for granted. It is therefore now of major importance to take a critical look at the entire policy and institutional framework governing the fisheries sector in order to ensure a sustained and enhanced contribution to national welfare. While the focus of this chapter is primarily on the anchoveta fishery, the economic and social importance of the other fisheries, and in particular the artisanal fisheries, must not be forgotten.

Background

[70] This chapter and draws significant information from the background report prepared by Patricia Majluf, Alberto Barandiarán, and Juan Carlos Sueiro

6.2 Peru's fishing grounds are the richest in the world, and anchoveta remains the largest single stock fishery in the world. Over 300 million MT of fish have been harvested from Peruvian waters during the almost 50 years of industrial fishing (from 1960). The average yearly catch is 6.56 million MT since 1960. During the last 7 years, since the last El Niño in 1998, the average yearly catch is 8.65 million MT (Table 6.1 and 6.2).

Table 6.1 Landings of Maritime and Inland Resources According to Use: January - December 2 005

Thousands Metric Tones Live Weight

TYPE OF USE	January – December		Variation% 2 004 / 2 005
	2004	2005	
TOTAL	**9 618.5**	**9 285.4**	**- 3.5**
DIRECT HUMAN CONSUMTION	**807.9**	**754.7**	**- 6.6**
Canned	82.9	87.6	5.7
Frozen	307.7	305.2	- 0.8
Cured	50.0	51.6	3.2
Fresh	367.3	310.3	- 15.5
INDIRECT HUMAN CONSUMTION	**8 810.6**	**8 530.7**	**- 3.2**
ANCHOVETA	8 797.1	8 530.6	- 3.0
Other species	13.5	0.1	- 99.3

Table 6.2 Landings of Resources by use according to species: January - December 2005

Thousands Metric Tones Live Weight (TMB)

Species	Total	Fishmeal	Canned	Frozen	Cured	Fresh
TOTAL	**9 285 365**	**8 530 657**	**87 554**	**305 213**	**51 599**	**310 342**
Anchoveta	8 555 630	8 530 551	14 156	498	10 425	-
Tuna	10 902	-	9 861	1 008	-	33
Mackerel (Caballa)	44 992	-	25 256	3 345	2 913	13 478
Horse mackerel (Jurel)	83 469	-	19 723	2 253	2 603	58 890
Squid (Calamar)	8 783	-	169	6 165	-	2 449
Flying Squid (Pota)	276 144	-	2 875	226 925	40	46 304
Shell (Caracol)	2 730	-	497	1 651	-	582
Shell (Concha de Abanico)	11 290	-	-	10 656	-	634
Shellfish (Langostino)	9 226	-	13	8 410	-	803
Mullet (Lisa)	6 403	-	-	-	465	5 938
Hake (Merluza)	28 671	-	-	21 737	158	6 776
Smelt (Pejerrey)	8 957	-	-	299	-	8 658
Other species	238 168	106	15 004	22 266	34 995	165 797

6.3 The *industrial purse seine fisheries for small pelagics* mostly targets anchoveta (*Engraulis ringens*). The other major pelagic fisheries target sardine, horse mackerel and chub mackerel. Historically, annual recorded landings of anchoveta have varied from 1.2 to 12 million MT, and are currently in the 8-10 million MT range, or approximately 10 percent of the global annual marine catch. Other major pelagic fisheries target sardine, horse mackerel and chub mackerel. Almost the entire catch of anchoveta and sardine is reduced to fish meal and oil for export, primarily to Europe and China, to supply a growing livestock and aquaculture industry with essential animal feed ingredients. Only a small fraction (2 to 7 percent) of the total marine catch, including the artisanal catch, is used for direct human consumption.

6.4 *Other industrial fisheries* target hake (Merluza, or *Merluccius gayi*), squid and other demersal (bottom) species. Hake is a popular domestic food fish, with a strong export market. Average annual catches have been on the order of 70,000 MT over the last nine years, but fishing activities have caused substantial variations – from less than 8,000 MT to over 100,000 MT in recent years. In 2003, overfishing led to the collapse of the fishery (with a catch of less than 8,000 MT) and the temporary closure of the fishery until stocks could rebound. The fishery was reopened in 2004, when recorded catches reached 35,000 MT. Recorded squid catches have also varied considerably from less than 10,000 MT in the 1990s to over 200,000 MT in 2004 and 2005.

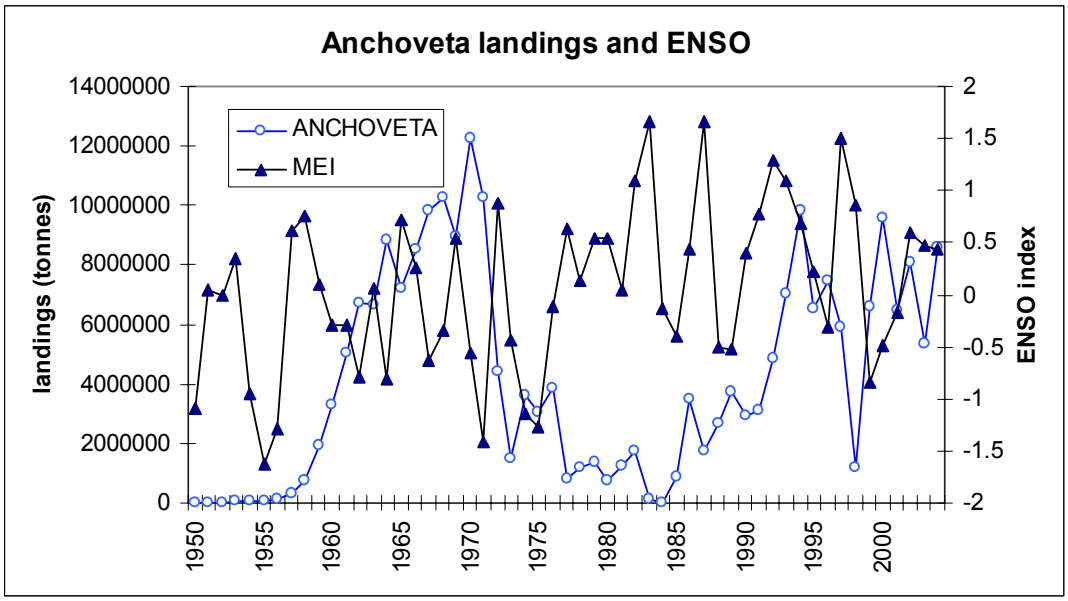
6.5 The *artisanal fisheries* target a wide variety of species, mainly for human food. The total catch varies from around 100,000 to 200,000 MT per year. Official estimates indicate more than 40,000 people are employed, with informal estimates putting the figure at 100,000 persons. The resources targeted by these fisheries are diverse, with fish accounting for about 80 percent, invertebrates for 17 percent, algae for two per cent and other resources for one percent.

6.6 The *inland fisheries* of the Amazon and Highland areas have landings estimated at between 30,000 and 80,000 MT per year, mostly for subsistence use. The fisheries in the Highlands focus mostly on the lakes, and in particular Lake Titicaca, targeting indigenous species, in particular the "ispi", but also introduced species, such as trout.

6.7 *Aquaculture* is a rather recent industry, with little diversification. The shrimp industry, mostly in the Extreme North of the country has suffered from "White spot" disease in the late nineties, but with improved farm practices and disease control measures, production has recovered to about 5,000 MT (2004). Culture of Peruvian scallops has also shown strong growth, with a production of 10,000 MT in 2004.

6.8 Peru's extraordinarily rich marine fisheries resources are the result of an exceptional upwelling of cold, deep water nutrients brought to the surface by the Humboldt Current, the driving force of the Humboldt Large Marine Ecosystem (LME). However, the LME is subject to major periodic disturbances in the form of El Niño Southern Oscillations (ENSO). Warm westerly winds drive the nutrient rich Humboldt Current further south and offshore, replacing it with warm water from the Southern Equatorial Current. During El Niño years plankton levels decline and changing ocean temperatures contract and distend the habitats of different species. The nutritional base of the food chain radically contracts altering the complex cascade of predator-prey relationships with far reaching impacts on the marine ecology, the fisheries and the economy (see Figure 6.1).

Figure 6.1. Relationship between anchoveta landings and mean Enso Index, demonstrating the inverse relationship between the two.



Importance of the sector

6.9 The fisheries sector remains a significant contributor to the Peruvian economy. It is the second largest earner of foreign exchange after mining, accounting for between US$ 1 and 1.7 billion annually in exports (Peru Statistical Yearbook, 2003), or 11-16 percent of total export earnings. It generates about 4 percent of the rural employment, and comprises approximately 1 percent of GDP. However, the sector is currently a minor source of revenue for the public sector. Finally, one-fifth of the animal protein intake of the average Peruvian are derived from fish. The poor are even more dependent on fish as a source of protein and nutrition.

6.10 In addition to their economic and social value as a fishery, anchoveta and small pelagic stocks sustain a large and diverse food web, including a large variety of marine mammals and bird species. These, in turn, generate an array of ecosystem goods and services which are essential to maintaining marine biodiversity and productivity, but whose ecological, economic and social value are only now beginning to be recognized. For example, the marine birds and mammals which rely on anchoveta as a major food source, support a growing marine eco-tourism industry in the Pisco-Paracas area, valued at some US$7-9 million/year. The guano[71] reserve system, a chain of islands and peninsulas protected for the exploitation of guano, generated from the droppings of these fish eating birds, have been identified as a marine biodiversity hot spot, and a proposal to designate the entire system of islands as a Marine Protected Area network is pending within INRENA. Furthermore, the guano from these islands supports a growing niche market for organic fertilizer in Europe and the U.S. Exports could generate alternative livelihoods for coastal fishers and help pay for the maintenance of the guano reserve system. Thus, anchoveta stocks have the potential to support not only a robust industrial fishery, but artisanal livelihoods based on secondary markets for the goods and services they produce. Figure 6.2 and 6.3 provide

[71] Guano is the generic name for the fertilizer produced from the droppings of seabirds, mainly cormorants, boobies and pelecans

a simplified illustration of the complex trophic relationships showing the pivotal role of the anchoveta in the Humboldt Current LME.

Figure 6.2. Main trophic interactions in the pelagic ecosystem off Peru (from Muck, P. 1989)

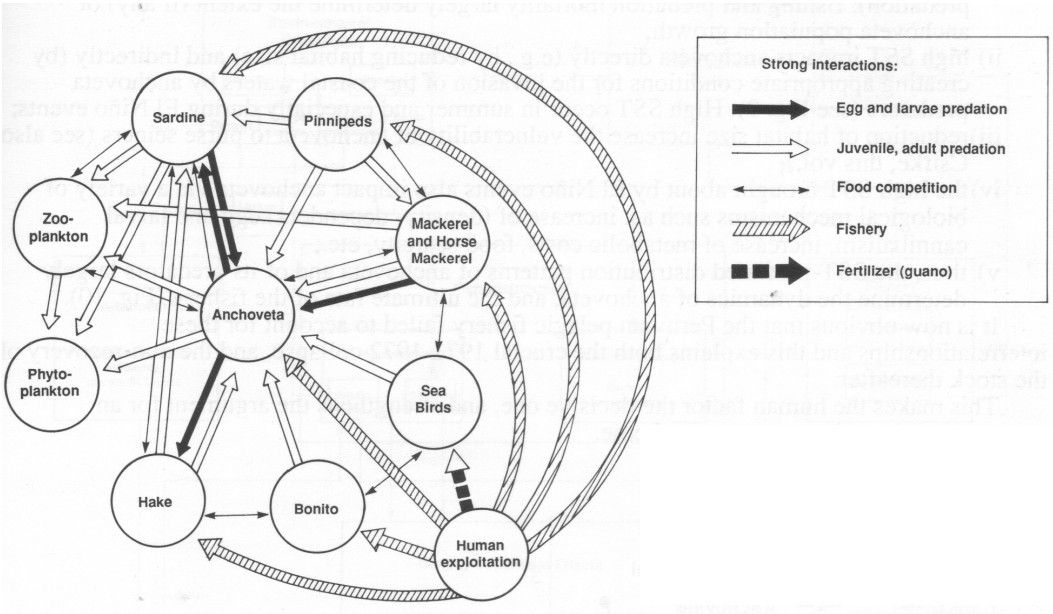
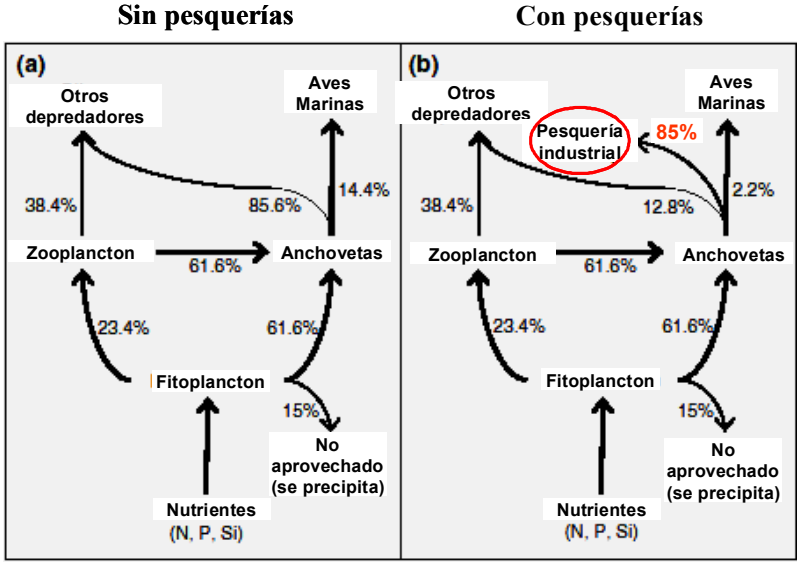


Figure 6.3. Schematic of trophic interactions in the Peruvian Upwelling System with and without fisheries.



6.11 There have been numerous studies on the fisheries sector, including a Fisheries Sector Note, prepared with support of the World Bank (World Bank, 2003) and more recently, a detailed environmental assessment of the fisheries sector by Majluf *et al* 2005, which formed a central

background piece to this chapter. All studies emphasize the need to strengthen governance, transparency and objectivity in decision making.

Specific Issues

6.12 The tremendous potential productivity of the Peruvian fisheries sector can be much more efficiently and sustainably exploited, its negative environmental and social impacts reduced, and its contribution to the Peruvian society enhanced. Key issues, which must be addressed in synergy to achieve these goals are; (a) overcapacity in the fishing and processing sectors; (b) negative environmental, and ecosystem impacts; (c) weak governance and a deficient environmental oversight and regulatory framework; (d) inadequate institutional arrangements and role of civil society; and (e) the unrealized contribution to Peruvian society. These issues are further examined below.

6.13 Peru is not alone in facing these problems. Over-fishing and overcapacity problems beset many fisheries. However the sheer scale of the anchoveta fishery – landings can be well in excess of 100,000 MT in a single day – the extreme volatility of the changes in the fish stocks caused by the El Niño events, and lack of a broad consensus roadmap in a volatile political climate have all contributed to making the problems appear intractable.

Overcapacity

6.14 Perhaps the greatest single factor threatening the fisheries sector at this time is fleet and processing overcapacity, fueled by continuous growth in the fish hold storage capacity of the fleet and characterized by an excessive number of economically inefficient fish meal processing plants.

6.15 The industrial anchoveta fleet is comprised of steel purse seiner vessels of more than 110 MT of hull capacity, and the "Viking Fleet", wooden vessels with a storage capacity of 32-110 MT. The steel vessels include 655 vessels with a total fish hold capacity of a little more than 183 thousand MT. The wooden fleet includes 604 vessels has a combined fish hold capacity of 35 thousand MT. The latter fish the anchoveta stocks in the north-central part of their distribution and, in violation of existing regulation, frequently enter into the restricted 5-mile coastal zone reserved for artisanal fishing,. The recent fleet expansion has taken place almost entirely in the wooden Viking fleet and has effectively doubled the number of vessels in operation.

6.16 This overcapacity is demonstrated in several ways. The anchoveta fleet is permitted to fish for only 120 days, although a 200-day fishing season would be possible, and still provide adequate protection of the juvenile anchoveta. The fish-hold capacity of individual vessels is, on average, 3-4 times that required for an average day's landings. It is estimated that, in 2005, the steel purse seiners used, on average, only 31.5 percent of fish hold capacity and the wooden fleet only 25.4 percent.

6.17 The fishmeal industry consists of 127 processing plants with an installed capacity of nearly 9,000 MT/hour. Forty three large plants account for over 50% of the processing capacity. However, only 35 percent of the installed capacity is capable of producing the finest quality fish meal (ACP), i.e., that with the highest protein content, which requires fresh fish for processing. The greater portion of the capacity (65 percent) and the largest number of processing plants (80) are geared toward production of conventional fishmeal, which permits use of lower quality raw material in the processing, adversely affecting product quality and price. In 2003 the total fish meal processing capacity was estimated to be 9000 MT/hour, equivalent to about 170.000 MT per

day in three shifts, or 30 million MT per year (based on a 200 day fishing year), thus exceeding the available fish supply by more than 200 percent (World Bank 2003)

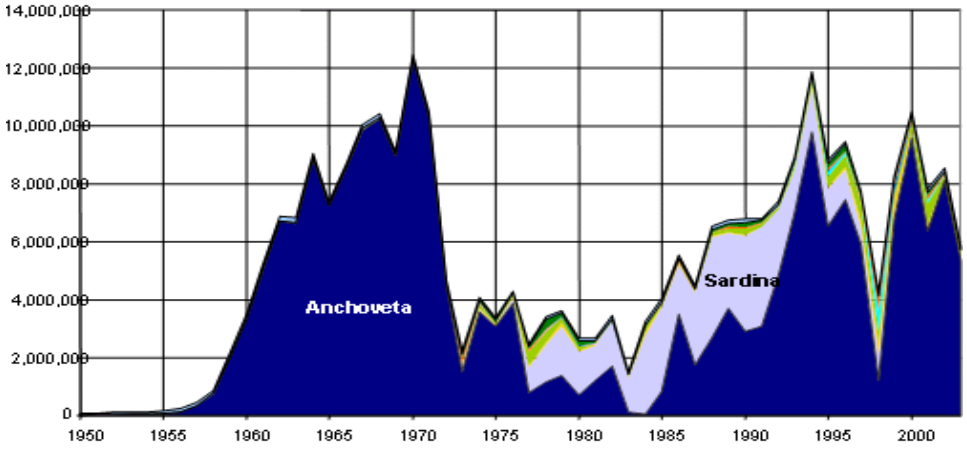
6.18 Overcapacity has two distinct effects: (i) depletion of the fish resources and marine ecosystem imbalance; and (ii) dissipation, or loss of economic benefits from the sector.

Depletion of fish resources and marine eco-system imbalance

6.19 The indicators of over fishing are clear in the hake fisheries. The average length of the hake fish caught has declined from 45 cm in 1971 to 25 cm in 2001. Stocks have collapsed twice in the last 25 years, most recently in 2003, when catches registered less than 8,000MT, a decline from nearly 120,000 MT in 2001. The fishery was closed temporarily in 2003, in recognition of its over-fished status, but re-opened shortly thereafter and stocks are now recovering.

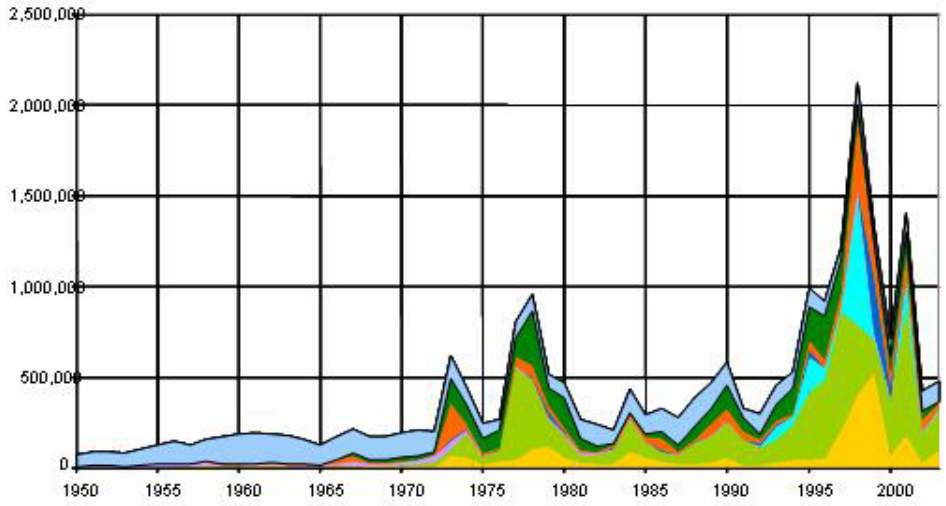
6.20 In the anchoveta and small pelagics fisheries, the picture is more complex. Over-fishing has clearly been one of the key factors contributing to the periodic collapses of the fishery. But there is also a strong effect of El Niño, as during El Niño years, catches have periodically declined to less than 2 million MT or a quarter of the yield in normal years. However, the relative importance of these two factors is not clear. Partly as a result of fishing restrictions during the last (1998) El Niño, the fishery has rebuilt rapidly since then, with landings in the order of 8 million MT, (Figure 6.4) but the fleet overcapacity constitutes a constant threat of overfishing and ecosystem imbalance.

Figure 6.4 Variations in historic catch of marine fish along the Peruvian coast 1950-2004.
Total catch – Scale 0 to 14 million MT



Source: FAO fisheries statistics (2005)

Total catch excluding anchoveta (engraulis ringens) and sardines
Scale 0 to 2.5 million MT



- Anchoveta
- Horse mackerel
- Flying Squid
- Sardines
- Menhaden
- Bony fish
- Mackrel
- Anchoveta (other)
- Hake
- Other species

6.21 The development of the anchoveta fishing industry has caused the anchoveta biomass available to birds to drop from about 14 percent to only 2 percent now (Figure 6.2). As a result the population of seabirds in the coastal areas of Peru has declined from about 15 million in the fifties and sixties to about 2 million. Similar declines in marine mammal populations are evident, demonstrating that the marine ecosystem has altered radically from its state several decades ago. There has also been a marked decline in fish stocks in the inland fisheries, where a combination of habitat destruction and pollution by extractive industry (mining and oil) and over-fishing has led to declining catches.

Economic inefficiency

6.22 Based on estimates of fleet overcapacity indicated above, the capital invested in the fleet may be as much as 4-5 times higher than necessary. This overcapacity means crew employment is reduced to about 120 days per year and there is political pressure to expand the fishing season to the detriment of resource recovery[72]. This overcapacity combined with resource fluctuations has led to a reported major indebtedness of the sector and absorbs capital which could have been used to diversify the economy. A more in depth understanding of the debt structure in the sector is necessary. Tax-relief for the industry resulting from the debt burden means that the contribution of the sector to national welfare is disproportional low. While exact data are not available, and the favorable market conditions for fish meal and oil has reportedly reduced the debt from US $ 1.8 billion in 2000 to less than US $ 1 billion in 2003, the highly volatile nature of the pivotal anchoveta fishery makes the restructuring of the industry critical for the long-term sustainability of the sector. However, this capital is currently 'locked' into the vessels and cannot readily be converted to economic alternatives. Similarly in the case of the processing overcapacity, many plants are old and relatively inefficient and can neither meet high end market demands nor modern environmental standards for fish meal plants. As mentioned before, Peru is not alone in facing these problems. A number of international comparisons can be used to demonstrate how these problems of overcapacity can be addressed.[73] The following Box indicates how Norway overcame these problems.

Box 6.1
Example from Norway on reduction of capacity of the fleet and processing plants

Relevant experience in methods for reducing both fleet and processing plant capacity comes from Norway, where reductions of 80% and 88%, were achieved, respectively, for the purse seine fleet and fishmeal processing plants over the course of about 35 years. This was achieved through comprehensive structural adjustment programs, that included industry-financed buyouts, industry consolidation, mothballing of plants, comprehensive price agreements between vessels and plants (mandated by specific legislation), government subsidies; incentives for fleet reduction through the individual quota system, and subsidized sales of excess capacity, both to Peru and elsewhere. .

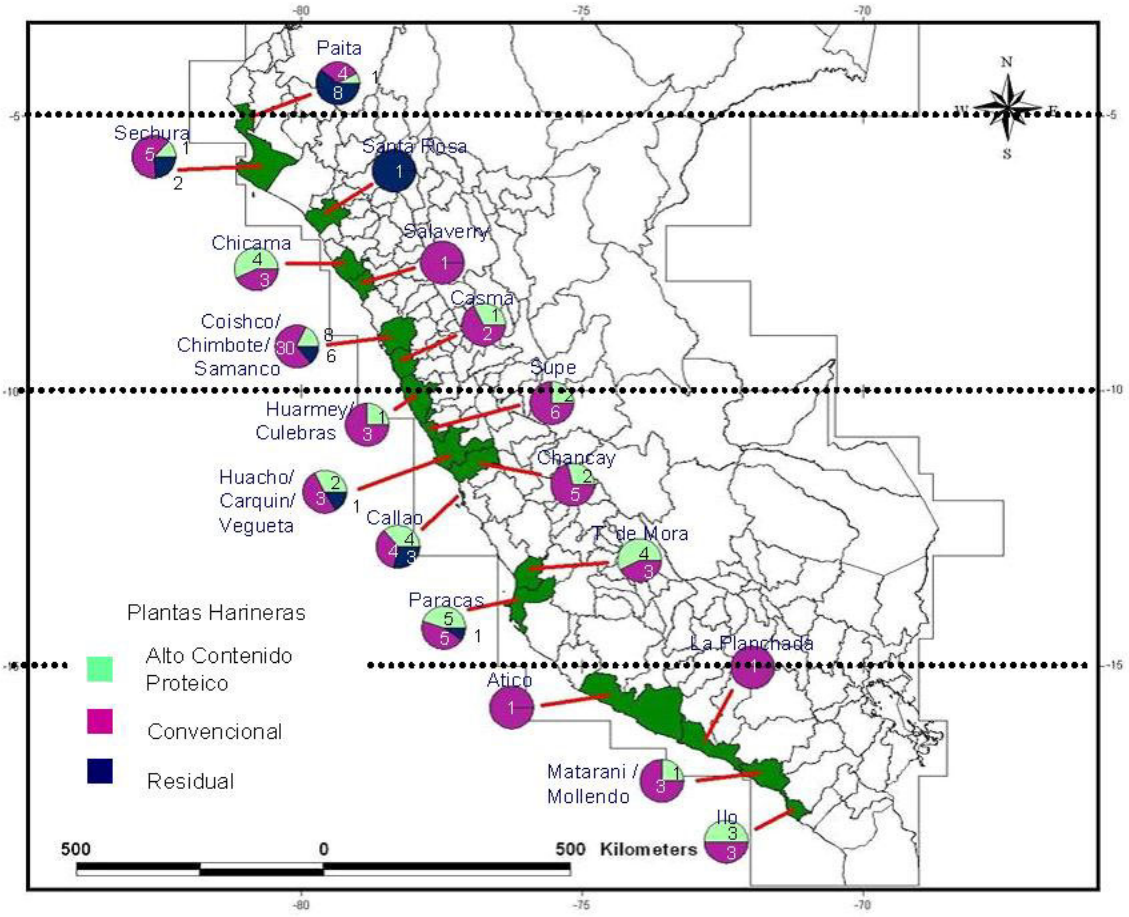
[72] Although awareness of Peruvian policy makers seems to increase, for example, in 2005 the Vice Minister for Fisheries, commenting on the overcapacity in the sector, noted in a recent interview the paradox that today the anchoveta fleet operates a little more than 120 days/yr, but in that time period the fleet is capable of catching more than 8 million MT of anchoveta—its entire year's quota (Majluf, 2006).

[73] See for example OECD documents:
AGR/FI(2004)4/REV1: FURTHER EXAMINATION OF ECONOMIC ASPECTS RELATING TO THE TRANSITION TO SUSTAINABLE FISHERIES. REVIEW OF THE USE OF MANAGEMENT SYSTEMS.
AGR/FI(2004)5/PART3: ICELAND CASE STUDY by professor R. Arnason.

Environmental/ecosystem and public health impacts

6.23 In addition to the direct impacts on anchoveta, hake and other stocks, substantial ecosystem wide impacts arise from capture and processing activities. These include significant by-catch of non-target species and impacts to other species adversely affected by the catching of millions of MT of anchoveta each year (Figure 6.2 and 6.3). Anchoveta production is also responsible for environmental impacts related to water and air pollution, thus undermining social and economic contribution of the sector. The introduction of currently available improved processing technologies appear to have strong win-win potential, as more efficient waste recovery could lead to recouping at least part of the discharged fish meal and oil. Similarly, overall emissions can be reduced by using steam dryers for processing fishmeal instead of direct heat, and would augment the amount and quality of protein in the final product, and generate a price differential of US $ 30-80 per MT above that for standard fishmeal.

Fig. 6.5. Industrial Fishing Landing and Processing Facilities Showing Processing Quality



Weak governance and inadequate oversight

6.24 The increase in fisheries production capacity witnessed over the last 15 years has come about in spite of the 1992 General Fisheries Law, which expressly prohibits expansion of fleet

and processing capacity. In spite of the intent of the General Fishery Law to manage Peru's fisheries on the basis of biological, economic and social considerations and in compliance with the FAO Code of Conduct for Responsible Fisheries the institutional framework for effective governance remains deficient. This is largely a result of difficulties in enforcement and loopholes in the law with respect to limits on fleet size and class of vessel (i.e., whether fishing for direct or indirect human consumption, and whether targeting under-exploited or fully fished stocks, or whether vessels are classified as industrial or artisanal). Some specific examples follow.

6.25 Many of the loans for vessel construction were granted against provisions of the Fisheries Law, others were approved initially to target "under-exploited stocks" (e.g., chub and horse mackerel), only to have the license request changed to fish anchoveta when it became clear shortly thereafter that a fishery for these species was not economically viable.

6.26 In 1998 the Viking Class fleet vessels were legitimized as part of the anchoveta fleet. Classed as artisanal vessels, the Vikings were exempt from regulations limiting the size of the industrial fleet, despite recognition by authorities that the sector suffered from overcapacity. This act precipitated the rapid construction and growth of Viking Class vessels in the fleet, with the addition of 380 wooden vessels since 2001. The Viking fleet currently captures around 1 million MT annually, with far less variability in catch than the fleet of steel purse seiners.

6.27 When substituting newer vessels for older ones, the 1:1 replacement ratio of vessel fish hold capacity has been retained, although better equipped, newer vessels have much greater efficiency and power[74] than the older vessels they are replacing. Other "exceptions" to ordinances limiting capacity, include *ad hoc* adjustments to regulations on fishing licenses and permits for operating processing plants.

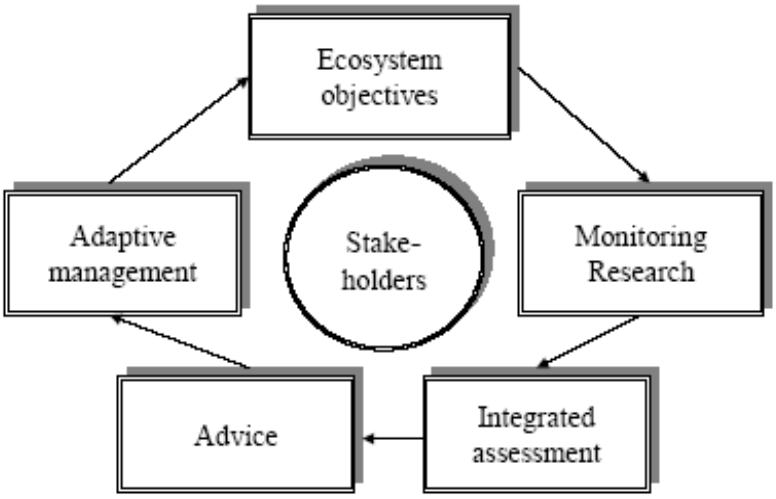
6.28 Finally, despite a Vessel Tracking System (SISESAT) and independent inspection of catch at landing facilities by a external private company (SGS) along the coast, fragmented responsibilities for Monitoring, Control and Surveillance (MCS) and restricted access to information have led to allegations of violations and fraud. For example, the percentage of juvenile anchoveta is legally set at 10 percent of landings, and percentages of up to 96 percent of juveniles are reported in landings, sometimes for periods of several weeks. These weaknesses in the MCS system would affect the successful introduction of more market based fishing rights systems, as will be proposed later.

Institutional arrangements and public participation

6.29 The huge overcapacity in the Peruvian fishing industry is a sign of the fundamental weakness in the governance of the fisheries sector. It is of fundamental importance to strengthen the governance of the sector taking due account of ecosystem considerations through an Ecosystem Approach to Fisheries and Ocean management (EAF). IMARPE (Instituto del Mar de Peru), the biological research arm of the Division of Fisheries within the Ministry of Production, issues its recommendations on the TAC for different stocks each year based on its assessment of their condition and recruitment potential, oceanographic and other factors. At times IMARPES's advice is not reflected in ministerial management decisions showing weak linkages between research, policy making and implementation at the level of the Ministry (Figure 6.6).

[74] Perú Pesquero No 9 1992

Figure 6.6
Framework for an Ecosystem Approach to Ocean Management



The illustration describes the interactive management decision cycle. All stakeholders – both from the fishery sector and from civil society - must be included in the process to promote openness and transparency.

6.30 The central environmental institutions, such as CONAM (Consejo Nacional del Ambiente), INRENA, and DIGESA have been sidelined with respect to environmental oversight of the fisheries sector, and civil society in the form of NGOs, academic and research institutions, has historically had little voice in independent reviews or demands for public accountability. A recent positive sign has been the initiation of discussions on overcapacity, the future sustainability of the anchoveta fishery and the need to reduce fishing effort. The discussion have been facilitated by bilateral assistance, the private sector and NGOs, reflecting international market concerns regarding sustainable sources of supply and product quality.

Contribution to economic and social welfare

6.31 The sustainability of Peru's anchoveta fishery is not only dependent on the ecological and economic viability of production, but on the extent to which benefits from this public good accrue to society. As noted above, the vast majority of the catch is destined for conversion into fishmeal and fish oil for livestock and aquaculture production in China and Europe, with only 2-7 percent used for direct human consumption, mostly for export. Only 1 percent of the production is used for domestic consumption. With meat and the higher value fish unaffordable to the poorer classes in Peru, small pelagics represent an important, but largely untapped, potential source of protein for the poor in Peru and elsewhere. Despite food security and nutrition issues in Peru and the government's efforts, very little progress has been made in developing a domestic market for direct consumption of anchoveta.

6.32 No comprehensive analysis has been made to estimate the economic losses (or foregone benefits) caused by fleet and plant overcapacity and sub-optimal fish stocks. Further analysis is also required to estimate the environmental and social costs of marine and coastal degradation

caused by the industry. Some indicative studies suggest that the sector is probably loosing several hundred million dollars annually in net benefits:

- Aguero (1987) concluded that elimination of fleet overcapacity could have increased net benefits by over 60 million US$. This was based on a 37 percent fleet overcapacity compared to the current overcapacity of more than 100%;
- The poor utilization of investment and infrastructure was conservatively estimated in a 2002 study (PRODUCE, 2002) as causing losses of US$ 50 – 70 million per year. A similar order of magnitude was estimated by Rizopatrón (2000), according to which a fleet reduction by only 50,000 MT hold capacity would save US$ 6 fishing cost per ton of anchoveta landed;
- The eco-systems change because of the high catch of anchoveta threatens incomes from alternative livelihoods of some US $ 20 million per year (Majluf, 2005).
- The reported heavy indebtedness of the sector enables the industry to obtain significant tax exemption, with the result that the sector contributes a disproportionately small fraction of its earnings to the national treasury. Annual aggregate taxes paid to the state in recent years range between US $ 22 and US$ 60 million, or less than 1 percent of total government revenues. If taxes were levied at rates equivalent to other productive sectors, or to the contribution of the sector to GDP, public revenues could increase up to US $ 100 million per year;
- License fee levels are low, as currently vessels pay only US$0.72/ton of catch or a total revenue of about US $ 7 million. In comparison, for a smaller fishery, the Chilean treasury receives US $20 million in revenue;
- Inefficiencies in the production, and low grade of the fish meal (in particular regarding protein quality) leads to foregone benefits. Recovering these benefits would require significant changes in management of catch on board and at the landing sites to prevent spoilage and investments in more efficient recovery sytems for fish oil and protein, now available.

6.33 The dissipation and drain of resource rents and net benefits which the government and Peruvian economy should otherwise realize from the anchoveta fishery has significant social consequences. These include lost income to finance Peru's anti-poverty and food security agenda and marine resources management in general, lost job opportunities from diversified and value added industries related to anchoveta, including marine tourism associated with seabirds and marine mammals dependent on anchoveta in the food chain, and contamination of air, water and food.

The Future

6.34 Two major external factors are likely to shape Peruvian fisheries in the future: (1) the growth of aquaculture and livestock production, particularly in China, and its dependency on fish meal and fish oil; and (2) climate change, or more specifically, the frequency and intensity of ENSO events. The degree, to which these factors will affect on the economic, environmental and social performance of the sector, will depend to a large extent on creating a more economically viable and biologically robust sector through reforms in fisheries management and governance.

6.35 Future prospects for fish meal and in particular for fish oil look promising, The price of fish meal, and particularly fish oil, is expected to increase further over the next 5 years based on anticipated demand in China and worldwide from expanding aquaculture operations. Consumer concern about the sustainability and safety of feed stocks is also an issue in Europe, where certification and labeling are in increasing demand by quality-wary consumers. In China, efforts

to substitute imported fishmeal with soy and cheaper sources of protein in livestock feeds are advancing. However fish oil remains an essential source of Omega 3 fatty acids in the diet of carnivorous farmed fish. Until alternative supplies of these fatty acids are sourced through advances in biotechnology and genetic engineering, demand for fish oil supplied largely by Peru will continue. This will put a premium on improved processing and fish oil extraction techniques and could be an incentive for recovery of fish oils from fish waste currently discharged along with pump water and responsible for pollution near the processing plants.

6.36 With climate change models predicting more frequent El Niño events, climate-driven change in anchoveta biomass is expected to become more volatile. Managing this volatility to maximize resilience and recovery of anchoveta stocks will require improved oceanographic information on the estimated onset and severity of an ENSO event, accurate monitoring of the condition of standing stocks and recruitment potential, and improved capacity to monitor stock behavior during an El Niño event to determine factors influencing recovery. Better assessment of the interactive effects of El Niño and fishing pressure on stock recovery potential will also be required to manage stocks for optimal yields. These studies should be extended to other species in the food-webs of economically important fish stocks within the Humboldt Current Large Marine Ecosystem. As the climate-induced changes in the anchoveta biomass and resulting economic impacts are likely be recurrent, consideration may be given to establishing economic stabilization mechanisms to provide insurance, or compensation to vessel operators and crews which may have to stop fishing in El Nino years.

6.37 Business as usual on the management and governance side is not an option. Leaving the current system of weak governance with major regulatory gaps in place is likely to lead to further increase in vessel and processing capacity, and hence further increasing inefficiency of utilization in fishing and processing investments, further stress on the ecosystem, and continued poor economic returns to Peru from the sector. Strengthening the governance of the sector, as recommended in the policy recommendations described below, could at least recuperate some of the losses and capture some of the foregone benefits, estimated to be on the order of several hundred millions per year

Policy Recommendations

6.38 Policy recommendations center around three **major objectives, to improve sector governance**:

1. Substantially increase the net benefits from the fisheries.

2. Ensure an equitable distribution of these benefits (social and economic) from the fisheries.

3. Sustainably exploit the fisheries resources through an ecosystem approach to management which internalizes environmental and social costs in determining optimal economic yields for the fisheries.

6.39 The following recommendations support these objectives and identify those policy actions which can be undertaken in the short term and the medium to longer term with potential high returns on investment.

I. Substantially increase the net benefit from the fisheries and ensure equitable benefit distribution

a. **Limit access and allocate fishing rights**. Institute a general framework for the allocation of rights; paying particular attention to (i) equity in the allocation (ii) distribution of social benefits and (iii) human welfare issues;

b. **Reduce the capacity of the fleet and fish plants** to a level which maximizes the net economic returns during normal years through a structural adjustment program. Develop a timeline for decision-making and implementation of effort reduction in the whole fishing industry, including a period for public vetting and securing financing.
Options to consider are:

- Institute a vessel buy-back and decommissioning scheme, providing adequate safeguards to the moral hazards involved.
- Institute a general system of quotas, to be gradually developed for the different fisheries. For hake fishery a system of individually transferable quotas (ITQ) might be considered and, if proven successful, expanded to cover other demersal and pelagic fisheries.
- Enforce a freeze on the capacity of Viking fleet until a comprehensive fishing capacity reduction plan is under implementation.
- Provide a financial incentive to reduce excess vessel capacity, through increased licensing fees - which reflect the true value of the resource being harvested - or by other methods.
- Eliminate excess capacity in processing plants through closure by using market mechanisms, ensuring, as a matter of public policy, that all subsidies are eliminated, and that all costs for the mitigation of pollution are charged to the industry. This can be expected to eliminate the least efficient factories.
- Increase revenue capture from industry to support development of alternative economic opportunities and the anti-poverty agenda.
- Restructure the industry debt through a dialogue with industry stakeholders and key donors.

c. Explore market and regulatory mechanisms to 'automatically' adjust fleet activity and plant capacity during El Niño to: (a) retain a high level of net economic benefit and (b) facilitate a rapid recovery of the anchoveta and other stocks following El Niño events. Consider establishing a stabilization fund to address the economic impacts of the regulatory measures required by the climate-driven volatility of the stocks and landings.

II. Ensure equitable benefit distribution and improved sector management

a. Create a system of co-management with participation by industry, civil society and other legitimate stakeholders in decisions affecting management of the fisheries sector.

b. Ensure open public access to key information about the fishery sector (biological, economic, fiscal and social).

c. Strengthen monitoring and enforcement of fishery regulations, including the vessel monitoring, surveillance and control (MCS) system.

d. Ensure that the institutional arrangements for drafting, adoption, monitoring and enforcement of environmental standards and safeguards maintains a transparent independence from industry.

III. Adopt an ecosystem-approach to management of the fisheries

a. Strengthen the fisheries and oceans research capacity of IMARPE for science-based management of marine resources.

b. Pursue a precautionary approach in fisheries management.

c. Establishing, where necessary, a revised system of fishery regulations to ensure the rational and sustainable harvest of fish stocks; such as minimum fish size, seasonal closures, and gear restrictions.

d. **Internalize environmental costs of the fisheries sector**. Reduce and/ or internalize the negative externalities of the fishing industry on the coastal population, the coastal environment and the ecosystem.

e. **Establish system of marine reserves**. Finalize the incorporation of the Guano Reserve System (Sistema de Islas, Islotes y Puntas Guaneras) into the National system of Natural Protected Areas (SINANPE) to launch a system of Marine Protected Areas to protect critical breeding and nursery habitats for threatened marine species and areas of high productivity for artisanal fisheries and aquaculture.

Summary of Policy Recommendations: Actions for the Fisheries Sector

Objective	Recommended Short-Term Actions	Recommended Medium to Long-Term Actions
Substantially increase the net benefits from the fisheries, and ensure equitable distribution of these benefits (social and economic) from the fisheries.	• Limit access and allocate fishing rights. Instituting a general framework for the allocation of rights; paying particular attention to (i) equity in the allocation (ii) distribution of social benefits and (iii) human welfare issues; (Cost: low) • Develop a timeline for decision-making and implementation of effort reduction in the whole fishing industry, including a period for public vetting and securing financing (Cost: low) • Increase revenue capture from industry. (Cost: low) • Restructure the industry debt through opening a dialogue with industry stakeholders and key donors. (Cost: high) • Explore market and regulatory mechanisms to 'automatically' adjust fleet activity and plant capacity during El Niño to: (a) retain a high level of net economic benefit and (b) facilitate a rapid recovery of the anchoveta and other stocks following El Niño events. (Cost: moderate to high) • Consider establishing an industry driven stabilizing fund to address the volatility of the stocks and landings. (Cost: moderate)	• Reduce the capacity of the fleet and fish plants to a level which maximizes the net economic returns during normal years through a structural adjustment program. (Cost: high – but can be moderate, by use of potential mechanisms for financing by the industry)
Improve sector governance.	• Ensure open public access to key information about the fishery sector (biological, economic, fiscal and social) (Cost: low) • Strengthen monitoring and enforcement of fishery regulations. Strengthen the vessel monitoring, surveillance and control (MCS) system. (Cost: moderate to high) • Freeze any expansion of the Viking Fleet and implement a vessel registry system to monitor the fleet. (Cost: low) • Establish a multi-stakeholder working group to examine the trade-offs and viability of instituting a general framework for the allocation	• Create a system of co-management with participation by industry, civil society and other legitimate stakeholders in decisions affecting management of the fisheries sector. (Cost: low)

	of fishing rights paying particular attention to (i) biological carrying capacity; (ii) social equity in the allocation and (iii) financing issues; (Cost: low) • Transfer to CONAM, DIGESA and INRENA decisions related to the drafting and adoption of environmental standards for industry emissions, and the monitoring and enforcement within an integrated framework of these standards and of environmental safeguards. (Cost: moderate)	
Sustainably exploit the fisheries resources through adoption of an ecosystem approach to management of the fisheries sector.	• Strengthen the fisheries and oceans research capacity of IMARPE for science-based management of marine resources. (Cost: high) • Establishing a revised system of fishery regulations to ensure the rational and sustainable harvest of fish stocks; such as minimum fish size, seasonal closures, and gear restrictions. (Cost: moderate) • Finalize the incorporation of the Guano Reserve System (Sistema de Islas, Islotes y Puntas Guaneras) into the National system of Natural Protected Areas (SINANPE) (Cost: low)	• Internalize environmental costs of the fisheries sector. Reduce and/ or eliminate the negative externalities of the fishing industry on the coastal population, the coastal environment and the ecosystem. (Cost: moderate) • Establish system of Marine Protected Areas to protect critical breeding and nursery habitats for threatened marine species and areas of high productivity for artisanal fisheries and aquaculture. (Cost: moderate)

CHAPTER 7

CONSERVATION OF NATURAL ASSETS: SOILS, FORESTS, AND BIODIVERSITY

Much of Peru's economy depends on the effective utilization of its natural resource base. Peru has the world's eighth largest forest cove and a unique array of diverse biological resources, but scarce soils to sustain its agriculture. The sustainable use of these resources is under threat from many sources, both natural and human-induced. The latter include migration to the Oriente, illegal logging, road and infrastructure development, threats to many endangered species, increasing soil erosion and soil salinity problems on the Coast. Improving the management of Peru's diverse natural resource base will require an improved policy and regulatory framework, a higher level of resources to its management and protection, and a renewed national commitment to sustainable natural resource management.[75]

Introduction

7.1 Peru possesses a vast natural resource base that serves as the foundation of much of its economy. Agriculture, fisheries, petroleum, natural gas, and forestry are among the most important economic sectors. Increasingly, though, the productive use of these and other natural resources is under threat from many sources, both natural and human-induced. Estimates of total annual environmental damage in Peru, ranging from 6.0 to 10.4 billion Soles, include an estimated 820 million to 1.51 billion Soles due to soil degradation (erosion and salinity) and deforestation (Chapter 3). This chapter addresses the conservation of natural assets in Peru, specifically as regards soils, forests and biodiversity. This chapter treats these three areas in turn, in each case examining the current situation, causes contributing to resource degradation, the institutional and policy framework, and recommendations for institutional and policy changes to reduce environmental degradation and promote their sustainable use in the future.

Soil Degradation

Current Situation – Soil Erosion and Soil Salinity

7.2 Soil erosion and soil salinity have long presented formidable constraints to improving the productivity of Peruvian agriculture. To begin, cultivable land is scarce in Peru; the country's 4.2 million hectares of land in annual and perennial crops represent only about 3.3% of the country's total area and amount to only about 0.160 hectare per capita, one of lowest among developing nations. This makes soil erosion, which affects all three regions of the country (Coast, Sierra, Oriente), all the more serious a problem. Of the various types of soil erosive processes in Peru, sheet erosion is the most frequent, accounting for an estimated 49.19 million ha (Table 7.1). Sheet erosion is not highly visible, occurring as rainfall falls on steep slopes, slowly dragging soil particles downhill, not producing noticeable rills or gullies, but nonetheless causing loss of soil fertility. The second important erosive process is concentrated surface runoff that produces furrows (rills) of various depths, some eventually becoming deep ditches

[75] This chapter draws on background documents prepared by Jorge Elgegren (2005, 2006) and Juan Guerrero Barrantes (2006).

(>1m) or gullies. This accounts for another 24,100 million ha. Mass soil movement, sometimes resulting in mudflows and landslides, accounts for another 18.8 million has of eroded soils.

7.3 Based on the most recently available statistics – which stem from the 1970's and are severely out-of-date – approximately 18.9 million has in Peru are affected by moderate to severe erosion (including nonarable land), and on another 109.9 million ha, the erosion is light to moderate (Table 7.2). Moderate to severe erosion is most serious in the mountainous topography of the Sierra, where it is estimated to characterize 50% or more of the region's soils, while another 40% of the region's soils are affected by light to moderate erosion. Light soil erosion is more prevalent in the soils of the Coast and Oriente.

Table 7.1. Dominant Types of Soil Erosion in Peru by Region (million hectares)

Type of Erosion	*Coast*	*Sierra*	*Oriente*	*Total*
Mudflow	0.39	1.52	39.98	41.89
Sheet erosion	1.30	4.92	1.08	7.30
Non-concentrated surface runoff	**1.69**	**4.92**	**41.06**	**49.19**
Rill erosion	0.75	15.75		16.50
Rill and gully erosion		7.60		7.60
Concentrated surface runoff	**0.75**	**23.35**		**24.10**
Mass movement (mudflow, seasonal soil creep, intensive sheet erosion, landslides)			18.80	18.80
Mass movement and surface runoff due to torrential events	3.50			3.50
Fluvial deposition			17.30	17.30
TOTAL WATER EROSION	**5.94**	**29.79**	**77.16**	**112.89**
TOTAL WIND EROSION	**5.60**			**5.60**
Glacial processes and wind erosion		3.80		3.80
Landslides and wind erosion	5.70	3.80		9.50
TOTAL EROSION	**17.24**	**37.39**	**77.16**	**131.79**

Source: ONERN, 1985.

Table 7.2: Intensity of Soil Erosion in Peru (1,000 hectares)

Degree of Erosion	*Coast*	*Sierra*	*Oriente*	*Total*
Very light	1,292	1,842	51,959	55,093
Light	7,350	14,150	12,400	33,900
Light to moderate	2,878	9,522	7,700	20,100
Moderate	320	5,780	4,800	10,900
Moderate to severe	1,900	4,400	300	6,600
Severe	-	1,400		1,400
Total	**13,740**	**37,094**	**77,150**	**127,984**

Source: ONERN, 1985.

7.4 Several studies have estimated the aggregate soil loss arising from soil erosion in Peru. Early on, Gamarra (1945) estimated annual sedimentation in Peru's Coastal rivers at 63.2 million m^3, representing a loss of 316,000 hectares of arable land. Reyes and Portocarrero (cited in Alfaro Moreno, 1984) also estimated annual soil loss equivalent to 200,000-300,000 ha annually. Low (1967) estimated that 1,500

metric tons per km^2 annually were lost. The National Soil and Water Conservation Program (1986) estimated soil loss in 44 river basins on the western slopes of Andes equivalent to 318,000 ha/year. So these estimates, however old, are roughly consistent.

7.5 Soil salinity is not only a serious problem in Peru, but is a global problem, affecting an estimated 1 billion ha of the world's soils, representing 10% of global arable lands (Szabolcs, 1989). "Soil salinity"[76] indicates the total amount of soluble salt in the soil. Salts, especially nitrates and potassium, are necessary components of soil, but when present at high levels will adversely affect plant growth by inhibiting water uptake by plants from the soil, aggravating water stress, and causing nutrient imbalances, reduced water infiltration, and the accumulation of toxic elements. High soil salinity can lead to plant stunting, leaf burn and defoliation, resulting in yield decreases and reduced forage quality. In principle, soil salinity is not difficult to manage. Saline and sodic (sodium-containing) soils exist in at least 100 countries, where an estimated 10 million ha of irrigated land are abandoned annually because of salinization, sodification, and waterlogging (Szabolcs, 1989).

7.6 The main requisite for managing soil salinity is adequate drainage, either natural or man-made. Soil salinity first must determined by measuring the electrical conductivity of a sample solution extracted from a water-saturated soil paste. Soil salinity is typically measured the electrical conductivity of the extract, in units of deciSiemens per meter (dS/m) or millimhos per centimeter (mmhos/cm). Below this level has been defined as 'incipient salinity' for Peru (Table 7.3). 'Evident salinity' is that in excess of 4 mmhos/cm); this is further divided into "light" salinity (4-8 mmhos/cm) – the level at which most plants are adversely affected – and "heavy" salinity (>8 mmhos/cm) (also Table 7.3).

7.7 Based on these criteria, more than 306,000 ha – 40% of cultivated land in Peru's Coastal Valleys – were affected by soil salinity in the 1970's. About 25% (roughly 190,000 ha) was characterized by light to extreme salinity (above 4 mmhos/cm), enough to negatively affect crop productivity. The extensive nature of the salinity problem is demonstrated by the fact that in 18 of these Coastal valleys, over 60 percent of cultivated land was characterized by some level of soil salinity, and in another eight valleys, this figure was between 40-60% of cultivated land. The severity of the problem is confirmed by the results from evaluations of soil salinity in 16 selected Coastal areas (also in the 1970's), showing that salinity affected fully 69% of the soils evaluated (Table 7.4).

7.8 Together, soil erosion and soil salinity are estimated in Chapter 3 to result in S/544 to S/918 million Soles worth in annual losses resulting from reduced crop yields and abandoned lands. It is likely that these figures are conservative and significantly underestimate the severity of the actual current economic losses resulting from soil degradation. Soil erosion and salinity data, though reported (still) by INRENA, are based on data assembled by its predecessor organization, the National Office of Evaluation of Natural Resources (ONERN), in the 1970's and 1980's. At this point, they are of questionable utility due to their age (20-30 years or more); the fact that soil salinity problems have likely worsened in the intervening years; and the subjective criteria that were (and are) used often in reporting salinity problems. Lack of monitoring makes it impossible to confirm the magnitude of the current problem, but it is widely reported to have become worse in key areas of the Coast such as the Chira-Piura region.

Causes of Soil Degradation

7.9 The causes of erosion in Peru are many. Peru's Sierra region, accounting for nearly 30% of the total national area of 1.29 million km^2, is a mountainous area of great topographic variation with mountain valleys ranging from 1,500-3,000+ masl and widely characterized by steep slopes (FAO, 2002). This makes much of the country's soils highly vulnerable to erosion. Reinforcing this problem are

[76] The discussion of soil salinity draws from Kotuby-Amacher, et al., 1997.

Table 7.3: Area Affected by Salinity in Peru's Coastal Valleys

	Estimated	*Incipient*		*Evident Salinity*				*Total Area Affected*	
	Cultivated	*Salinity*		*Light-Moderate*		*Heavy-Extreme*		*Ha.*	*%*
Valley	*Area- Ha*	*Ha.*	*%*	*Ha.*	*%*	*Ha*	*%*		
Acari	5,042					964	10	964	10
Asia, Omas	2,610	100	4	1,300	50			1,400	54
Atíco	140			6	4			6	4
Camaná	6,033	300	5	300	5	4,578	66	5,178	86
Cañete	26,373	10,261	39	2,993	11	2,462	10	15,716	60
Caplina (Tacna)	7,963	832	10	4,195	53	2,296	37	7,953	100
Caraveli	564	48	9					48	9
Cascajal-Olmos-Motupe	6,400					650	10	650	10
Casma	9,257					2,237	24	2,237	24
Chala	468	268	41			161	25	429	66
Chancay-Huaral	26,000					4,207	16	4,207	16
Chao	7,288	1.960	27			3,285	45	5,245	72
Chaparra	1,062	33	3	77	7			110	10
Chicama	71,592	4,820	7	8,879	12	12,473	18	26,172	37
Chilca	1,880	248	13			871	47	1,119	60
Chili	10,116			1,094	11	515	5	1,609	16
Chillón	12,030	210	2	893	7			1,103	9
Chira	33,344	9,103	27	189	1	7,550	23	16,842	50
Culebras	1,332	170	13			45	3	215	16
Fortaleza-Pativilca- Supe	24,265	3,079	13	1,770	7	2,715	11	7,564	31
Huarmey	3,175			633	20	638	20	1,271	40
Huaura	34,080	3,790	11			2,380	7	6,170	18
Ilo	378	170	45			208	55	378	100
Jequetepeque	46,996	15,049	32	4,238	9	4,190	9	23,477	50
La Leche-Chancay	106,299	26,911	25	13,546	13	11,292	10	51,749	48
Locumba	3,210	31	1	738	23	2,441	76	3,210	100
Lurin	4,566	1,003	22	775	17	1,006	22	2,724	61
Majes	62,889	595	9			3,018	48	3,613	57
Mala	5,334	885	17	1,947	37	1,840	34	4,672	88
Moche	10,447	419	4			419	4	838	8
Moquegua	2,211	135	6			81	4	216	10
Nepeña	11,425			503	5	3,562	31	4,065	36
Ocoña	782	62	8	521	66	19	3	601	77
Pescadores	40	25	63			15	37	40	100
Pisco	33,166	4,898	15			2,468	7	7,366	22
Piura-San Lorenzo	94,700	15,000	16			22,000	23	37,000	39
Quilca	302	135	44	48	17			183	61
Rimac	9,280	2,180	23	2,405	26	465	5	5,050	54
Rio Grande	17,599					1,688	10	1,688	10
Sama	2,896			60	2	2,836	98	2,896	100
San Juan (Chinche)	27,660	3,166	14			10,831	48	13,997	62
Santa y Lacramarca	14,985			1,729	11	1,607	11	3,336	22
Siguas	2,633	50	2	103	4	410	16	563	21
Tambo	10,404	1,468	14	1,071	10	3,846	37	6,385	61
Topará	493								
Tumbes	12,226	1,339	11			7,201	59	8,540	70
Viru	11,119	131	2	895	8	635	5	1,661	15
Vitor	5,562	740	13	685	12	353	7	1,778	32
Yauca	1,529	559	36	71	5	338	22	968	63
Zaña	18,250	4,520	25	1,696	9	1,262	7	7,478	41
Zarumilla	950					100	10	100	10
TOTAL	**775,431**	**115,493**	**15**	**53,360**	**7**	**137,448**	**18**	**306,701**	**40**

Source: Ministry of Agriculture Portal, 2005, based on data from ONERN, 1973.

Table 7.4: Area Affected by Soil Salinity at Sites Evaluated by ONERN, 1973

Area Evaluated	*Number of Sites Evaluated*	*Area Evaluated (ha)*	*Area Affected (ha)*	*% Affected*
Chicaza	9	50,620	1,000	2
Moche, Viru and Chao	19	99,400	17,900	18
Santa, Lacramarca, Nepeña, Casma, Culebras and Huarmey	31	104,700	34,625	33
Fortaleza, Pativilca and Supe	16	35,000	18,190	52
Chancay Huaraz	4	6,420	3,480	53
Chillon, Lurin and Chilca	7	13,440	13,005	97
Cañete	7	31,300	30,100	95
Topara and San Juan (Chincha)	2	24,720	24,720	100
Pisco	5	106,800	60,300	56
Ica	5	111,400	69,800	68
Rio Grande	7	49,850	42,150	85
Acari, Yauca, Indio Muerto and Cháparra	24	117,595	99,475	85
Atico, Caravelí, Pescadores and Ocoña	6	18,655	18,655	100
Majes and Camaná	17	126,990	107,450	85
Quilca and Tambo	15	335,700	297,100	89
Osmore, Locumba, Sama and Caplina	26	258,000	189,000	78
TOTAL	**200**	**1,490,660**	**1,026,980**	**69**

Source: ONERN, 1973.

seasonal rains in many areas, exacerbated by periodic occurrences of El Niño, most recently in 1997-98, which have caused significant soil erosion and downstream sedimentation, as well as severe impacts on the human population. The lack of protective measures – both natural and man-made – on stream banks makes the impacts of flooding even more severe. Wind erosion is a major source of soil erosion on the Coast.

7.10 Exacerbating these natural causes of erosion are numerous human-induced influences. Overgrazing, particularly in the Sierra, which includes 90% of the nation's cattle, is a common problem. Widespread deforestation (see next section), currently in the Oriente and earlier in the Sierra, has further exacerbated this problem. Poor crop cultivation practices also contribute to erosion. Data from the Andean region (Peru and Ecuador) show a close association of cultivation practices and soil erosion (Table 7.5). Both choice of crop and the use or non-use of soil conservation practices – contour plowing, crop rotations, and fallow management, for example – have had significant impacts on the degree of soil erosion. The magnitude of the erosion problem is illustrated by the Poechos Reservoir in northern Peru which had an initial capacity of 1 billion m^3 when constructed in 1977, but which sedimentation, due in part to poor soil management practices, has reduced to an effective capacity of 400,000 m^3 today.

7.11 The problem of soil salinity in Peru's Coastal valleys also has diverse causes. Heavily eroded desertic soils, low in moisture and organic material and high in mineral salts due to their marine origins, have left Peru's Coastal valleys with soils containing a high soluble salts content. Salinity is further

affected by a variety of environmental and management factors, including climate and irrigation practices. As soil dries in hot, dry conditions, such as those on Peru's Coast, salts become concentrated, increasing salt stress. Salinity problems are consequently most severe in these areas, but this is often accompanied by increasing irrigation frequency.

Table 7.5: Estimated Rates of Soil Erosion for Peru and Ecuador

Authors	*Conditions (rainfall, slope)*	*Experiment*	*Treatment*	*Erosion (mg/ha/yr)*
Felipe-Morales, 1993	500-750 mm Slope: 25%	Runoff plots, 40 m^2	Maize-potato-oats, mulching	3.7
			Maize-potato-oats, contour plowing;	6.9
			Maize-potato-oats, up-down plowing;	14.2
			Maize, up-down plowing	20.0
Low, 1967		Simulation, USLE	Peru	0 - 70
			Southern Andes	10 - 30
Pastor, 1992	1,050 mm Slope: 30-60%	Runoff plots, 40 m^2	Natural vegetation	0.4 - 1.1
			Sweet potato, contour plowing	0.6 - 1.4
			Sweet potato, up-down plowing	1.8 - 4.0
			Clean fallow (bare land)	3.1 - 14.9
Torre, 1985	2,000 mm Slope: 20%		Maize-pea rotation	4 - 45
			Pea-cassava rotation	12 - 70
Alegre & Rao, 1996	2,200 mm Slope: 15-20%	Runoff plots, 150 m^2	Contour hedgerow cropping	6
			Annual crops (rice - cowpeas)	79
			Bare soil	141
Byers, 1990		Rainfall simulations	Maize	82
Harden, 1988	800-1,400 mm Slope: >50%	Rainfall simulations	Thin dusty soils	20
			High-altitude, rich organic matter soils	40
			Intermed. altitude, dark Andean soils	80

Source: Authors listed above, cited in Posthumus, 2005.

7.12 The over-application of water in excess of plant demand often occurs during hot, dry periods to minimize salinity stress. This leads to a highly inefficient system and high groundwater levels in the absence of an adequate drainage system. Due to high evaporation, irrigation water is of poor quality. Overplanting of rice uses a great deal of water, up to 30,000 m^3/ha or more, worsening pre-existing salinity and drainage problems. In major irrigation projects such as Chira-Piura, irrigation and drainage systems are poorly maintained, and in many cases have fallen into total disrepair. More efficient irrigation technologies than gravity irrigation, such as sprinkler and drip irrigation, are rarely used. Soil and water contamination further exacerbates the problem. Finally, low water costs, typically well below the cost of water delivery, mean that little economic incentive exists for farmers to economize on water use.

Soil Conservation Measures

7.13 The primary means by which farmers can arrest soil erosion is through the use of soil conservation measures. Ideally, avoiding the deforesting and cultivation of land inappropriate for agriculture would render these measures unnecessary. But for land which is already highly eroded, such as much of the Peruvian Sierra, explicit measures are typically required to prevent further soil loss. The use of these measures entails benefits – lower erosion, greater soil moisture retention, higher crop productivity – as well as costs, principally in terms of labor inputs. Some soil conservation measures are ancient; estimates of the extent of remaining Incan and pre-Incan stepped terraces range from 200,000 ha to ten times that amount (Inbar and Llerena, 2000), most of which are abandoned or in disrepair.

7.14 The crop productivity effects of soil conservation measures are well documented, although most applied research in the case of Peru is somewhat dated. Three studies, all from the late 1980's, compare crop yields from unterraced land to that under two types of agricultural terraces, among the most commonly promoted soil conservation measures in Peru (Table 7.6). The results from the La Encañada study, using 'slow formation' terraces in which the soil is slowly built up over time, show a 17.6% increase in yields (simple average across six crops). The other two studies, using bench-type 'water absorption' terraces which require greater construction costs, demonstrate a 52.4% average yield increase[77] in the Cajamarca study and a 48.6% yield increase in the Colca Valley study. A recent study (FCPS, 2003) in three Sierra sub-watersheds in which soil conservation measures where introduced along with small-scale irrigation demonstrated yield increases ranging from 33% (beans, onions, wheat) to 200% (potatoes) and even 700% (alfalfa). Most crops achieved 50-100% yield gains.

Table 7.6: Crop Productivity Effects of Soil Conservation Measures

Crop	*Yield without Soil Conservation Measures (kg/ha)*	*Yield with Terraces* (kg/ha)*	*Estimated increase in yields (%)*
La Encañada study, 1988[1]			
Potato	3,800	4,300	13.1
Maize	794	951	19.7
Barley	726	798	9.8
Andean tubers	6,331	6,709	5.9
Dry beans	640	755	17.9
Peas	596	830	39.2
PRONAMACHCS study, Cajamarca region, 1988[2]			
Potato	4,581	11,091	142.1
Maize	482	490	1.7
Barley	740	993	34.2
Oats (for forage)	5,625	7,675	36.4
Wheat	723	1,113	53.9
Quinua	8,500	11,550	35.8
Oca**	5,433	9,300	71.2
Olluco**	2,700	5,000	85.2
Alfalfa	567	6,345	1019
Apples	1,500	1,666	11.1
Colca Valley study, 1989[3]			
Potatoes (fertilized)	12,206	17,206	41.0
Maize (fertilized)	1,807	2,982	65.0
Barley (fertilized)	1,333	1,910	43.3
Barley, forage (fert.)	15,865	23,000	45.0

[1]Ganoza, 1988, cited in PIDAE, 1995.
[2]PRONAMACHCS, 1988.
[3]Treacy, 1989.
*Terraces in La Encañada study are slow formation terraces; those in the other two studies are water absorption terraces. **Andean tuber crops

7.15 To achieve these gains requires labor and material inputs ranging from modest to substantial. The primary input is labor, either paid or unpaid. Estimated costs78 for the four most widely promoted soil conservation measures in Peru are available from previous studies, although these studies range over a wide time period, making the comparability of economic and financial estimates difficult (Table 7.7). The four measures include: slow formation and water absorption terraces, described above; the

[77] The yield increase for alfalfa appears to be an outlier, and is excluded from this calculation.
[78] Where possible, costs were updated to 2005. In two studies, the underlying data were not sufficiently disaggregated to enable this updating, thus costs are reported in 1994 and 1996 U.S. dollars.

reconstruction of traditional Andean terraces (Andenes), and water infiltration ditches. For all four measures, cost estimates vary widely depending factors such as location and date of the study, soil type, soil moisture level, and cost of local materials.

Table 7.7: Construction Costs for Selected Soil Conservation Practices

Soil Conservation Measure	*Labor Investment*	*Estimated Cost ($/ha)*
Reconstruction of traditional Andean terraces (*Andenes*)	1,013 days/ha	$1,993 - $3,985 (1996)[1]
	600 days/ha	$1,764 - 2,472 (labor only, 2005)[2]
Water absorption terraces (*terrazas de absorción*)	1,250 days/ha	$3,675 - $5,150 (2005)[3]
	1,000 days/ha	$2,940 - $4,120 (labor only, 2005)[3]
		$3,323 (1994)[4]
Slow formation terraces (*terrazas de formación lenta*)	500 days/ha	$1,470 - $2,060 (labor only, 2005)[2]
		$ 807 (1994)[4]
Infiltration ditches (*zanjas de infiltración)*	85-380 days/km, depending on soil type and soil moisture	$250 - $ 1,566/km (2005)[5]
	210 days/ha	$617 - $865 (labor only, 2005)[2]
		$ 1,649 - $2,311/ha (2005)[6]

[1]Olarte and Trivelli, 1999 (based on calculations made in 1989 and 1996). Excludes additional irrigation costs of $1,150/ha.
[2]World Food Programme, Promoción de Desarrollo Sustentable de Microcuencas Altoandinas, WFP/EB.2/2000/6-A/2/Add.1, Lima, Peru, May, 2000. Labor costs updated to 2005.
[3]P. Romero, Instituto de Desarrollo y Medio Ambiente, Lima, 2005.
[4]Fondo de Contravalor PERU-SUIZA, 1994.
[5]Sánchez Cevallos, 1986, with labor costs updated to 2005.
[6]Fondo de Contravalor, PERU-SUIZA, 1994, with labor costs updated to 2005.

For Andean terrace reconstruction, Treacy (1989) reports an even wider range of labor costs – from 350 to 3,750 days per ha – which at 2005 labor cost levels[79] would entail labor costs ranging from $1,029 to $15,442 (U.S.) per ha. Given these exceedingly wide ranges of estimated costs and yield levels stemming from soil conservation measures, as well as the outdated nature of most cost estimates, it is difficult to conclude whether investing in these measures represents an economic use of resources for most farm households at present.

Institutional and Policy Framework

7.15 The **National Institute of Natural Resources** (*Instituto Nacional de Recursos Naturales*, INRENA) is the authority in charge of promoting the sustainable management soil, water and forestry resources in Peru. INRENA was created in 1992 as a successor institution to the National Office of Natural Resource Evaluation (*Oficina National de Evaluación de Recursos Naturales,* ONERN*)* which had been in place since the 1960's. Currently, INRENA's Water Resources Superintendency (*Intendencia*

[79] 2005 labor costs are estimated at 10-14 soles per 6-hour work day (*jornal*), depending on location.

de Recursos Hídricos) is the office directly responsible for administering the laws and regulations governing soil and water management. This includes oversight of 68 Irrigation Districts, of which 63 are implemented jointly with local watershed management authorities (*Administradores Técnicos de Distritos de Riego,* ATDR). The ATDR's are directly in charge of local water and irrigation management in the Coastal valleys. The Autonomous Watershed Authorities (*Autoridades Autónomas de la Cuencas Hidrográficas*, AACH), created between 1992-94, are the ultimate decision-making authorities in terms of the use of irrigation water and soil management in the irrigated coastal zones, working in concert with INRENA representatives and waters users associations.

7.16 INRENA and other agencies working in irrigation management are greatly hampered by the **1969 Water Law (No. 17752)** which states that water is state property, and that there are no "private property nor acquired rights" to water. Water use is prioritized, in order, by: human, animal, agricultural, energy, industrial and mining, and other uses. Although the legal framework for water use was revised by subsequent regulations in 1989 (D.S. No. 037-89-AG) and 1990 (D.S. No. 003-90-AG), there is still a widespread view among users that water rights are inalienable and that water use, except in irrigation projects (where water charges are typically well below cost), should be free. This has led, among other things, to highly inefficient use of water on the Coast, and has stimulated the widespread cultivation of crops like rice that, without below-cost charges for water use, would not be economically viable. More generally, the multiple demands on scarce water resources, especially on the Coast, as well as the lack of price-based or other rationing mechanisms, has led to inefficiencies and inequities in water use that could be addressed by more integrated and economically-oriented allocation mechanisms.

7.17 The principal authority in charge of dealing with soil degradation issues is the **National Program of Watershed Management and Soil Conservation** (*Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos*, PRONAMACHCS). It dates only from 2002, although predecessor organizations with similar names and related responsibilities extend back to 1981. Over time, the focus of this program has changed from a technical emphasis on soil conservation to a broader focus on sustainable natural resource management. In the 1990's, PRONAMACHCS became highly politicized and lost much of its technical focus. Its current strategy focuses on enhancing livelihoods and strengthening production-marketing chains in a target population which includes 5,000 communities in 850 watersheds, containing an estimated 170,000 families living in poverty and extreme poverty. Specific program activities include small-scale irrigation infrastructure, technology transfer, reforestation, rural community organization and agricultural marketing. Although the institution has 125 regional offices serving 18 Departments, continuing budgetary cutbacks have reduced the professional staff in each office from five to as few as one or two (each office having a target population averaging 40 communities and 1,300-1,400 families). Much activity focuses specifically eight selected 'model' sub-watershed areas.

7.18 Financing for PRONAMACHCS activities has been heavily dependent on external donors. The Japan Bank for International Cooperation (JBIC) has financed over $155 million worth of support over many years. The World Bank has supported a project on *Intensive Management of High Altitude Watersheds* (MIMA) in three sub-watersheds of the Sierra (in Cajamarca, Hunin and Cuzco Departments). A $51 million Bank loan complemented by $14.3 in GOP support and $27.9 million of in-kind community labor together supported the "Natural Resource Management for Poverty Alleviation in the Sierra" Project in 1997-2002. PRONAMACHCS' total budget has declined from about $93 million (U.S.) in 2000 to $84 million in 2001 and $42 million on 2004. The current (2005) budget totals roughly $38.34 million, which is distributed across five major categories (Table 7.8). The project's past focus on soil conservation now accounts for only a small proportion of the total portfolio, while production, irrigation infrastructure, and marketing assistance to agricultural producers and reforestation have assumed much larger shares. Among specific soil conservation measures, expenditure allocations for 2005 were as follows: rehabilitation of *Andenes* (traditional Andean terraces) - 9.2%; terrace construction - 77.7%; infiltration ditches - 11.8%; and gully erosion control - 1.3%. Nearly 80% of the soil

conservation budget is spent on general coordination of watershed management activities, training, and other costs (A. Toscano, personal communication, 2005).

Table 7.8: PRONAMACHCS Budget Allocations, 2005

Budget component	*Budget (1,000 soles)*	*% of budget*
Irrigation infrastructure	30,121,505	23.1
Soil conservation	27,023,183	20.7
Reforestation	28,795,253	22.1
Support to agricultural sector	41,912,245	32.2
Watershed management	2,510,453	1.9
TOTAL	**130,362,639**	**100.0**

*At 3.4 soles/$1 U.S., this equals an annual program budget of approximately $38.34 million in 2005.
Source: PRONAMACHCS, Cumulative Budget Summary, 2005.

7.19 As in the case of erosion, GOP attention to the salinity problems of Coastal valleys began in the 1960's and 1970s. The MAG addressed this problem by creating the Land Recuperation Center (*Centro de Recuperación de Tierras*, CENDRET, 1967-1974) and later the Sub-Direction for Land Rehabilitation (SUDRET, 1970-1974). The salinity data reported above stem from these early efforts. This was followed by the National Plan for the Rehabilitation of Coastal Lands (*Plan Nacional de Rehabilitation de Tierras Costeras* (REHATIC), 1977-1990), and by the National Program for Land Drainage and Recuperation (PRONADRET, 1991-95). This institutional legacy disappeared during the 1990's under the Fujimori administration (1990-2000), during which time the General Direction for Water and Soils was transferred to INRENA. INRENA's current Water Resources Office has little technical expertise and its efforts to address soil salinity and drainage problems are greatly reduced compared to earlier years.

7.20 Another agency, the **National Institute for Development** (*Instituto Nacional de Desarrollo,* INADE), despite its broad title, was created in the 1990's with a specific focus: management of large-scale irrigation projects in 10 Coastal watersheds, serving multiple uses: water storage for domestic and industrial use, energy generation, and irrigation. Together, nine of these projects total more than 570,544 hectares in improved, new, and rehabilitated Coastal lands (plus 3.11 million hectares "involved" in the Chavimochic Project in the Chao-Viru-Moche-Chicama region). Principal projects include the binational (with Ecuador) Puyango-Tumbes Project (126,000 hectares in both countries), the Chira-Piura Project (83,356 hectares in three areas), and the Tinajones Project, covering 200,000 hectares. Total investment in these projects through 2000 was $3.367 billion (U.S.), with total projected costs of $11.283 billion.

7.21 INRENA's **General Direction of Rural Environment (***Dirección General de Medio Ambiente Rural*, DGMAR) is responsible for coordinating the national response to problems of desertification, which is highly related to problems of soil salinity on the Coast. In 1994, Peru's Congress approved the U.N. Convention to Combat Desertification; in July, 2001, Peru's National Action Plan to Combat Desertification (PAN-PERU) was authorized; and just recently, in June, 2005, the National Committee to Combat Desertification was authorized. Peru's national effort is very modest, comprising only two staff members. This office engages in a variety of mostly coordinating activities with researchers, NGO's and university collaborators, including efforts to evaluate soil salinity problems in selected Coastal valleys (including Chancay, Lambayeque, Chao, Tambo and Sama), the early stages of a monitoring and evaluation effort, and the elaboration of a data base on salinity problems on the Coast.

7.22 Also within INRENA, the **Special Land Titling and Rural Cadaster Project** (PETT, *Proyecto Especial Titulación de Tierras y Catastro Rural*) has, since 1992, had responsibility for land titling and cadastral registry of expropriated and state-owned land, as well as the promotion of private sector and cooperative investment in the rural sector. Beginning in 1996, with support from the Inter-American Development Bank and the collaboration of the National Superintendency of Public Registry (SUNARP), the Land Titling and Registry Project (PTRT) has devoted significant resources to cadastral surveys and

land titling of farms and rural landholdings in Peru. By the end of the project's first phase in 2001, more than 900,000 farms had been titled under the project (IDB, 2001). Land titling is widely recognized as a valuable mechanism to encourage long-term investment in land improvements and farm productivity.

7.23 There are a number of other governmental and non-government-based efforts that attempt to improve land management. The National Network for Watershed Management (REDNAMAC) is composed of public, private and NGO sector participants and has the objective of coordination, promotion and diffusion of work in watershed management. Its Coordinator is the Director of INRENA's Direction of Waters and Soils and its national technical committee is composed of public sector and NGO representatives. Among NGO-led projects, that of SESA (*Servicio Silvo Agropecuario*) at the National University in Cajamarca, is perhaps the best known, especially for its work in reforestation and soil and water conservation.

Recommendations

7.24 The recommendations below in large part stem from a common origin – namely, the progressive disinvestment of the Peruvian government in mechanisms to address soil degradation issues over the past 30 years. Given the scarcity of Peru's arable soils, this disinvestment has come at a price: high levels of eroded land and increasing salinity problems in many areas of the Coast. A number of changes in policy, technical assistance and investments would help redress this situation, both in the short and long terms.

Policy

1. **Revise the 1969 Water Law to authorize broad-based fees for water use.** The restrictions of the 1969 law were only partially addressed in 1989 and 1990 legislation and the inalienable "right to water" continues to be a powerful impediment to the use of water charges. Allowing for water pricing where it doesn't yet exist, and for higher charges where it does, will help address massive water use inefficiencies in the Coastal valleys, and will lead to more rational resource management. Where they do already exist, in Coastal irrigation projects, water use fees are typically far below cost; thus, in the short run, increasing water use fees and the longer-run improved land management patterns that result can be expected to address soil salinization as a result of less overuse, especially for rice. Moreover, funds can be generated to invest in maintaining irrigation systems. Soil conservation research has demonstrated significant payoffs from improved water use in the Sierra.

2. **Create a new Water Resources Agency.** Water is a critical resource in Peru, with strict competition for multiple uses, especially on the Coast and in the Sierra. Peru has several institutions with a role in water management, but none which has broad-based responsibilities for the integrated management of Peru's water resources. INRENA's Water Resources Superintendency has general responsibility for administering laws and regulations regarding soil and water management. As a practical matter, much of INRENA's attention is focused on the irrigated areas of the Coast where it jointly administers the irrigation districts with the ATDRs; ultimate authority for water storage release rests with the AACHs. INADE focuses on construction and engineering issues in the large-scale Coastal irrigation projects. By pulling water management responsibilities out of INRENA and assigning this global task to a new Water Resources Agency, a measure that could be accomplished in the short run and with relatively low investment, this could strengthen the general management of this critical resource and better insulate the government from short-term demands of water users. The Agency could continue to work with the local ATDRs and AACHs, much as at present. INADE could continue its largely technical role. But the new agency would have overall an overall coordinating role as well as responsibility for assuring sustainable long-term availability of water resources, including reconciling short-term demands with long-term best interests. To assure its success, greater budget support would be required that exists at present.

Technical Assistance

1. **Strengthen institutional technical capacity to address soil degradation.** Peru's institutional capacity to deal with problems of soil erosion and soil salinity has diminished greatly since the 1970's. Even in only to monitor and assess the nature of these problems – and certainly if greater level of public sector intervention is sought – the ability of INRENA to address soil degradation should be strengthened over the medium to long run. This includes the Water Resources Office, OGATEIRN, PRONAMACHCS, INADE, and other offices. If a new independent Water Resources Agency were to be created, this would enable INRENA to focus more narrowly on soil degradation issues.

2. **Conduct comprehensive feasibility analysis of soil conservation investments.** Many millions of dollars of both donor and government funds have been spent on soil conservation investments over the years. However, the evidence on the costs versus benefits of these investments is inconsistent and out-of-date. PRONAMACHCS has emphasized the building of terraces (among other interventions), but some estimates show the reconstruction of traditional Andean terraces to be less expensive. Overall, however, it is not at all clear which of these conservation investments are cost-effective given current labor costs. There is likely to be considerable payoff to conducting, as early as possible, comprehensive feasibility analyses of alternative conservation investments before expending further funds. This could be accomplished in the short to medium run, with returns from improved public investment strategies generated over the long run, as funding is increasingly directed toward high-payoff investments and away from those with low economic rates of return.

Investments

1. **Conduct new national inventories of soil erosion and soil salinity**. The last comprehensive inventories were conducted in the 1970's (soil erosion) and 1980's (soil salinity), and are now severely out of date, especially given the rate at which soils can degrade. New comprehensive soils inventories should be conducted, focusing nationally in the case of soil erosion and on the Coastal valleys in the case of soil salinity. They should be based on up-to-date soil monitoring techniques, equipment and extensive ground-truthing. Various government entities, including INRENA, are involved in the Ecological and Economic Zoning ("*Zonificación Ecológica y Económica*") process, but these efforts are typically inconsistent across levels and agencies of government, and do not include conducting inventories of soil and water resources. Without an adequate and up-to-date data base to assess the magnitude and nature of soil erosion and salinity problems, other public policy alternatives are premature. Conducting these inventories should be part of a long-term strategy to use improved information on Peru's soils to focus future public investments in the most cost-effective manner.

Deforestation

Current Situation

7.25 Based on the most recent data, Peru is estimated to harbor 68.74 million hectares of natural forests (FAO and INRENA, 2005), the world's eighth most extensive forest cover and second to Brazil in Latin America. Data from Peru's Report to the FAO's Forest Resources Assessment (Table 7.9) show that forest cover accounts for roughly 53.5% of the total national territory of 1.29 million ha. However, Peru's forests are distributed highly unevenly across the country, with virtually all (99.4%) of the country's forests located in the eastern (Oriente) part of the country. The Coastal region has been depleted almost entirely of its forest cover of mangroves and dry and sub-humid forests. In the Andean

highlands, somewhat over 300,000 hectares of forests remain, including small extensions of original *Polylepis* forest.

Table 7.9: Peru: Total Forest Cover and by Regions, 1975-2005 (hectares)

	1975	*1990*	*1995*	*2000*	*2005*
Coast	1,667,973	3,215,456	3,731,283	350,891	87,475
Sierra	450,189	421,547	412,000	332,996	309,557
Oriente	69,451,058	65,183,110	63,760,461	68,529,369	68,345,031
Total Forest Cover	71,569,219	68,820,113	67,903,744	69,213,256	68,742,064
Method	Aerial Photo & SLAR	Interpolation 1975-1995	LandSat-MSS (1988) (1/1M)	LandSat TM (1/250K)	Extrapolation 1975-2000
Source: FAO and INRENA, 2005.					

7.26 At the outset, one must note that time trend data on forest cover and deforestation in Peru are not highly conclusive because they come from different sources and use diverse and non-comparable methods of data collection and estimation (Elgegren, 2005). Forest cover estimates for Peru's Amazonian region have been recently revised in a recent study conducted by Peru's National Environmental Council (CONAM) and INRENA.

7.27 The property rights regime governing forests in Peru is composed of two major categories: private ownership and public (state-owned) property. Each is composed of four major categories (Table 7.10), although there are little reliable data on forest cover for most private property. State-owned forest land is comprised of: Permanent Production Forests, available for timber production through public bidding or competition; Conservation Concessions, non-timber forest concessions used for biodiversity conservation projects and other non-consumptive activities such as ecotourism, research and education; Natural Protected Areas, also used for biodiversity conservation as well as cultural, landscape and scientific uses; and State Reserves, available for subsistence purposes by indigenous groups. There are currently over 25 million hectares of permanent (sustainable) timber production, and over 14 million hectares of forests under protected area status.

7.28 Although Peru has extensive forest resources, it is not a leading country in the production of timber and forest products. Of a total $186 billion (U.S.) of forest products traded internationally in 2002 (Seneca Creek Associates and Wood Resources International, 2004), Peru's forest products exports accounted for roughly $136 million that year, representing less than 0.01% of world sales (INRENA-CIF, 2003). Nonetheless, Peru ran an annual average $116,280 trade account deficit of its forest sector for the 1994-2003 period (INRENA, 2005). This suggests that great scope exists for further commercial development of Peru's forestry resources.

Table 7.10: Forest Property Rights Regimes, 1990 – 2004

Property Rights Regime	*Land Under Property Rights Regimes (1,000 ha)*		
	1990	*2000*	*2004*
Private Property			
Amazonian Indigenous Communities	n.a.	10,517.93	12,616.89
Andean Peasant Communities	n.a.	n.a.	n.a.
Private Conservation Areas	n.a.	n.a.	n.a.
Private Agricultural Plots	n.a.	n.a.	n.a.
Public Property			
Permanent Production Forests	39,877.39	39,877.39	25,174.97[1]

Conservation Concessions	-	-	135.83[2]
Natural Protected Areas	7,228.48	16,041.13	14,169.89
State Reserves	1,573.55	1,573.55	2,860.16
Other type of property			
Other areas[3]	20,140.69	1,203.26	13,784.31
TOTAL	**68,820.11**	**69,213.26**	**68,742.06**
[1]Of this land, some 7.5 million hectares are under concession contracts as of October 2005.			
[2]As of October 2005, conservation concessions had increased to a total of 199,623 ha and ecotourism concessions cover 43,190 ha. The total area of these categories now amounts to 242,812 ha.			
[3]Defined as the difference between total forest and the two other categories.			
Source: FAO and INRENA, 2005.			

7.29 Past analyses of deforestation in Peru have shown dramatically different results. The most widely cited estimate – based on data through 2000 provided by Peru's National Institute of Natural Resources (INRENA) – has been an annual rate of deforestation of 261,000 ha (Reátegui, 1996; CIFOR, 2003), with cumulative forest loss of 9.6 million ha over the last 25 years. However, a recent comprehensive study jointly undertaken by CONAM and INRENA – the National Capacity Strengthening Program to Manage the Impact of Climate Change and Airborne Pollution (PROCLIM) – has recalculated deforestation for the period 1990-2000 for the Peruvian Amazon based on Landsat imagery (scale of 1:100,000), extensive ground-truthing, and forestry inventories on 120 forest plots in the Peruvian Amazon.

7.30 Overall, the PROCLIM study estimates the deforestation rate between 1990 and 2000 at 149,632 ha per year. This figure is roughly consistent with a recent study conducted by the Universidad Nacional–La Molina's Conservation Data Center (CDC) and the World Wildlife Fund (WWF) of three areas in the Peruvian Amazon, which projected annual deforestation for 1996-2001 at 136,000 ha[80]. By comparison, estimates of annual deforestation in neighboring countries are as follows: Bolivia –168,000 ha[2] (1975-1993); Brazil – 1,850,600 ha[2] (1990-2004), increasing to 2,612,900 ha[2] in 2004; and Ecuador – 189,000 ha[2] to 300,000 ha[2] (Butler, 2004; Mecham, 2001). Cumulative deforested areas in Peru's Oriente Region show that San Martín, Amazonas and Loreto are the regions most severely affected by deforestation, followed by Junín, Ucayali and Huánuco (Table 7.11). Most of this forest loss is due to land conversion to agriculture and grazing, but other drivers include road opening and maintenance, coca cultivation and illegal logging (discussed in next section).

Table 7.11: Cumulative Deforested Area through Year 2000 by Department

Department	*Deforested Area (ha)*	*% of total deforested area*
San Martín	1,327,736	18.5
Amazonas	1,001,540	14.0
Loreto	945,642	13.2
Junín	734,304	10.2
Ucayali	627,097	8.7
Huanuco	600,655	8.4
Cusco	537,632	7.5
Cajamarca	520,062	7.3
Pasco	302,021	4.2
Madre de Dios	203,892	2.8

[80] The USAID-sponsored CDC-WWF study is based on three regions covering about 7.87 million hectares, or roughly 10.2% of the Peruvian Amazon.

Puno	146,041	2.0
Ayacucho	135,373	1.9
Huancavelica	51,991	0.7
Piura	31,737	0.4
La Libertad	7,232	0.1
Total	**7,172,954**	**100.0**
Source: PROCLIM, 2005.		

Table 7.12: Cumulative Deforestation in the Peruvian Amazon: Annual Average and Percentage Increase, 1990-2000

Department	Adjusted Deforestation, 1990*(ha)	Deforesta-tion, 2000** (ha)	Estimated Increase in Deforestation, 1990-2000 (ha)	Mean Annual Deforestation 1990-2000 (ha)	% Increase in Deforestation, 1990-2000
Amazonas	645,582	1,001,467	355,885	35 588,52	23.78
Loreto	638,071	945,591	307,520	30 751,97	20.55
Cajamarca	366,618	520,030	153,413	15 341,29	10.25
Cusco	395,850	537,601	141,752	14 175,16	9.47
Madre de Dios	79,268	203,879	124,611	12 461,10	8.33
Junin	622,859	734,273	111,414	11 141,36	7.45
Ucayali	547,750	627,064	79,315	7 931,48	5.30
Huanuco	532,457	600,620	68,163	6 816,30	4.56
Puno	101,358	146,033	44,676	4 467,55	2.99
Piura	287	31,735	31,448	3 144,81	2.10
Huantavelica	23,561	51,987	28,426	2 842,61	1.90
San Martin	1,300,014	1,327,669	27,655	2 765,47	1.85
Pasco	287,353	302,008	14,655	1 465,51	0.98
Ayacucho	128,642	135,366	6,725	672,47	0.45
La Libertad	6,570	7,231	662	66,17	0.04
Total	5,676,236	7,172,554	1,496,3186	149,631,76	100.0
*INRENA, Natural Resources and Infrastructure Data Base, 2000.					
**PROCLIM					
Source: PROCLIM, 2005.					

7.31 It is important to note that the recent estimate of Peruvian deforestation of roughly 150,000 ha annually should not be interpreted as a decline in the rate of deforestation from earlier years, but rather an improved estimate[81]. As discussed in Chapter 3, the estimated annual cost of deforestation which occurred during the decade 1990-2000 is S/280-590 million. This includes the estimated value of the sustainable flow of future forestry benefits. From Table 7.12, it is clear that Amazonas is the Department with the largest increase in deforestation during this period, followed by Loreto and Cajamarca, while the Departments with the smallest increase in deforestation for the same period are La Libertad, Ayacucho and Pasco.

7.32 Forestry plantations are of increasing importance in Peru. Reforestation programs date the 1960s, when they were supported by an IADB loan – which permitted the reforestation of 56,000 ha through 1974 – followed by an Amazon Reforestation Royalty in the 1980's (100,000 ha), and since 1988, promotion of reforestation in the Sierra by the National Watershed Management and Soil Conservation

[81] The earlier estimate of 261,000 ha annually beginning in the mid-1970's through the end of the 1990's was based on alternative methodologies which are not directly comparable with the improved estimates obtained from the PROCLIM study (see Table 7.9).

Program (PRONAMACHS). The result of these efforts is the growth of forestry plantations from about 262,997 hectares in 1990 to 754,244 ha in 2003 (FAO and INRENA, 2005). Most of this land is designed for watershed protection, however, not timber production.

Causes of Deforestation

7.33 The causes of deforestation in Peru are varied and complex. The proximate causes of deforestation typically receive greatest attention, though a recent study by Alcalde (2002) also addresses the enabling conditions behind deforestation in Peru. As is true throughout much of the world, small subsistence migrants from the Sierra and some parts of the Coast use slash-and-burn agriculture to open their small agricultural plots. Rowe et al. (1992) estimate that smallholder agriculturalists account for as much as two-thirds of deforestation globally. Large-scale commercial agriculture and plantations convert forested land to agricultural use for commercial crops such as oil palm, sugar cane, rubber, coffee, cacao and tropical fruit. This sometimes pushes small subsistence migrants even further into the forest. Narcotics traffickers clear forests to grow coca and to build illegal runways to transport illegal drugs, mainly coca base paste and cocaine. Garnica estimates that coca plantations have deforested 2.3 million hectares in Peru, about half of which is in San Martín (800,000 ha) and Huánuco (450,000 ha); if accurate, this would account for nearly one-third the total deforestation in the Peruvian Amazon.

7.34 Cattle ranching, typically in areas from 30 to 50 ha (unlike the extensive cattle ranches in the Brazilian Amazon), sometimes also pushes small subsistence migrants further into the forest. Loggers build forest roads to transport commercial timber from the harvest area to the main roads; these secondary roads then allow migrants into the forest. Petroleum, natural gas and mining all involve geographically focused direct impacts on forests due to exploration and exploitation activities, including the construction of roads and facilities, as well as indirect impacts associated with increased colonization and agricultural land uses due to those activities. Rural colonization programs have promoted the relocation of colonists into forested land. Infrastructure development, particularly the opening of roads, has promoted forest clearing and has made millions of hectares of tropical forests more accessible to colonization by settlers. Although it is not intrinsically destructive of forests if conducted in a sustainable fashion, firewood gathering and charcoal production tends to significantly affect the forest and forest fauna to the extent it is highly selective of commercial timber species and closer to urban areas.

7.35 Illegal logging, and illegal trade in timber more generally, is also an important cause of deforestation. Since forest concessionaires must pay harvest fees and produce according to costly sustainable forest management plans, illegal loggers have a competitive advantage in avoiding these costs. Illegal harvesting is highly selective: 80% of mahogany is reported to be illegally extracted and sold. The worldwide economic loss from illegal logging has been estimated in the range of $10-15 billion annually (Contreras-Hermosilla, 2002) to $23 billion (Seneca Creek Associates and Wood Resources International, 2004). In Peru, conservative estimates value the economic cost of illegal logging associated to mahogany alone at $40-70 million/year (M. Romero, WWF-Peru, personal communications, 2005). It should be emphasized that without a market in the illegal timber trade, illegal logging would not be a remunerative activity.

7.36 Some idea of the magnitudes of the different factors leading to deforestation can be gained from recent PROCLIM data on the current land uses of deforested land in Peru. The data show that agriculture – including cultivated land, fallowed land and newly opened agricultural plots – covers approximately 609,515 hectares of the Peruvian Amazon. This includes annual crops such as maize, cassava and rice, and perennial crops such as citrus, sugar cane, banana, oil palm, and peach palm. About 440,000 ha (63.8% of total deforested agricultural land) is in three Departments: Amazonas, San Martín, and Loreto. Grazing and pasture use account for nearly twice as much land (1,179, 983 ha), with four Departments (Amazonas, Cusco, Ucayali, and Cajamarca) accounting for 63.4% of the total. Secondary forests cover

2,067,765 ha, of which 76.5% is in the Departments of San Martín, Loreto, Cusco, Huanaco, Amazonas, and Ucayali. A mixed category of secondary forests and agriculture occupies an estimated 3,166,728 ha, by far the largest in the Peruvian Amazon, more than half (52%) of which is in San Martín, Loreto and Junin. Finally, a 'bare land' category of 65,565 ha includes areas occupied by energy and mining infrastructure; more than half of this is in San Martín and Loreto.

7.37 Underlying these factors are more basic enabling causes of deforestation (Alcalde, 2002; Roger and Roberts, 1999). Peru´s annual population growth is approximately 400,000 habitants on a base of roughly 26,749,000 total inhabitants (INEI, 2002), leading to increasing demand for land and resources. As previously discussed, poverty in Peru is extensive, with over half (51.6%) of the population in conditions of poverty, and the extreme poor accounting for nearly 25% of the population (INEI, 2004). As much as 70% of the rural population is estimated to live in poverty. Malnutrition and food insecurity are highly correlated with poverty. Having few economic opportunities, it is logical for the rural poor to regard the country's forested areas as an attractive solution to their economic problems.

7.38 Other causes of deforestation relate to policy failures or unforeseen impacts. The use of tax exemptions on imported equipment and machinery and government-supported infrastructure projects have promoted regional development at the expense of impacts on forests. The Belaúnde administration in the 1960's and 1980's promoted agriculture in the Amazon basin, misconceiving this region as the nation’s food pantry. Land title in Peru is still granted only on deforested land, so that land suitable for forestry purposes is converted to agriculture or cattle ranching. Most recently, the CDC has released a report (2004) correlating deforestation rates in Huallga, Pachitea-Aguaytía, and Aprurímac valleys with road rehabilitation sponsored by USAID and Peru's Ministry of Transport and Communication. They find one additional kilometer of road opening and maintenance is associated with 1,000 hectares of forest loss. There is concern among many that the opening of the Inter-Oceanic Highway connecting Brazil with Peru's Pacific ports may greatly stimulate in-migration and deforestation if left uncontrolled.

7.39 It is important to note that, although a lack of comparable data and analytical methods used in past studies limit the ability to accurately estimate changes in deforestation over time, a good deal of anecdotal evidence suggests that many of the factors that underlay deforestation in the 1980's, and that may have retrenched in the 1990's, may resume their roles in the current decade. Weak economic growth that characterized much of the 1990's has reversed course, and, on both supply and demand sides, a stronger national economy would be expected to contribute to pressures on forest resources. Peru's internal security situation that was so precarious in the 1990's and that led to significant migration from rural to urban areas helping relieve the demand for forest products, has improved markedly. Migration to areas in the Oriente especially from the Coast continues, and pressure on forest resources continues due to land encroachment, lack of adequate titling, and poor enforcement capability. The exploitation of forest land for coca plantations continues, although the inherent nature of this activity makes estimates of its magnitude difficult. Finally, following a decade or more of little government investment in infrastructure projects, the construction of the Inter-Oceanic Highway has the potential to greatly exacerbate deforestation in the affected areas. In sum, the combination of factors which, by some accounts, may have lessened the pressures on Peru's forest resources in the 1990's, together have the potential to exacerbate deforestation in the current decade if not addressed.

7.40 A final underlying cause of deforestation is the lack of understanding and undervaluation of the economic value of the environmental services provided by the forest, which discounts their incorporation in private and public decision-making. A variety of studies are starting to provide insights into these economic values. FONDEBOSQUE (E. Toledo, personal communication, 2005), has recently estimated the economic loss due to slash-and-burn agriculture in Peru's Amazon basin – including timber and non-

timber products – at $1.6 to $2.0 billion/year (U.S.)[82]. Chambi (2002) estimates the carbon sequestration value of forestland covering 2.26 million ha in Madre de Dios, Puno and Cuzco at $1.26 billion in the year 2000, projected to $2.47 billion in 2010. He also estimates the total economic value of biodiversity as US$ 1.851 billion in 2000, including both direct (fishing, Brazil nuts, timber, etc.), indirect (e.g., carbon sequestration), option and existence values. Portilla (2002) estimated the total economic value of the 86,673 ha Cerro Escalera Protected Forest in San Martín at $496.5 million in the year 2000, including both direct and indirect (environmental service) values. Malca (2002) estimates willingness-to-accept in compensation for changing the actual land use from shifting cultivation to conservation ($67/ha/year) and agroforestry ($45.50/ha/year). Three willingness-to-pay studies of entrance fees to national parks and protected areas find that average WTP is 50-100% higher than current entrance fees (Buendía, 1999; Diez, 2002; Vigo, 2005), suggesting considerable scope for recovering higher economic surpluses.

Institutional and Policy Framework

7.41 Prior to the year 2000, Peru's forest sector was governed by the 1975 Forest and Wildlife Law (Law No. 21147). The law was conceived of as a redistributive mechanism to encourage resource-poor loggers to enter the forest activity and alleviate rural poverty. In addition to this questionable premise, the law had a number of serious flaws in execution. Annual forest contracts were overly small (1,000 ha) and not economically viable; this was compounded by the problematic role of middlemen (*habilitadores*), and led to a great deal of unauthorized timber harvesting and trade, especially in mahogany. Very little recognition was given to the needs of indigenous populations. The existence of an exploitative relationship – described as a "feudal" relationship (Bedoya and Bedoya, 2005) – between the timber industry and middlemen and resource-poor small loggers made it difficult for the latter to effectively operate. Overall, the law left considerable scope for ambiguity and corruption in the management of forestry contracts.

7.42 A number of initiatives, including preparation of a National Forestry Strategy covering 1985-1996 and a national debate extending over much of the 1990's, eventually led to the passage of the new **Forestry and Wildlife Law** (No. 27308) in 2000, designed to promote the reform and modernization of the country's forest sector. In 2001, the regulatory framework supporting the law was also passed. Enactment of both the law and regulatory framework followed intense national debate in Congress and public fora among timber industry representatives and those with a stake in the old system, as well as local and international organizations, community leaders and other authorities.

7.43 The new Forestry Law and its centerpiece, the introduction of timber concessions under the supervision of INRENA, represent a significant improvement over the old legal framework, although implementation problems continue to exist. The new framework for timber concessions[83] has following main features: 1) access to timber resources through transparent public bidding; 2) concessions may become tradable; 3) concessions are granted for 40 years (versus annual contracts under the old law), renewable upon five-year compliance evaluations; 4) concessions cover from 5,000 to 50,000 hectares (versus 1,000-hectare contracts previously); 5) a General Forest Management Plan (PGMF), containing financial projections for the 40-year contract period, is required immediately after signing the contract; 6) a specific Annual Logging Plan (POA), mapping the trees to be harvested each year, is required prior to

[82] This figure is based on an estimated deforestation rate of 250,000 ha/yr, and thus should be revisited in view of the results of the PROCLIM Project which estimated annual deforestation in Peru's Amazon amounts at roughly 150,000 ha/yr.

[83] The Forestry and Wildlife Law of 2000 and its 2001 Regulation permit other forms of access to timber resources: 1) permits from native communities; 2) permits from private agricultural and grazing plots; 3) extraction from local forests; 4) authorizations from Northern tropical dry forests; 5) authorization for clear cutting (e.g., for road opening); and 6) authorization for the use of trees and shrubs stranded on river banks. Other forms of access to non-timber resources include: 1) Brazil nuts concessions; 2) afforestation/reforestation concessions; 3) conservation concessions; 4) protection concessions; 5) ecotourism concessions.

the authorization of harvesting[84]; 7) concessions may be used as collateral for accessing bank financing; and 8) incentives are introduced for i) voluntary forest certification to promote access to international markets for certified wood products (a 25% discount on annual harvest fees); and ii) processing of timber locally, to promote increased value added and the generation of employment at the local level (an additional 25% discount on the harvest fee).

7.44 INRENA launched the forest concessions process in March 2002, after establishing the forestry base suitable for timber production (column two in Table 7.13). The total area of potential forest concessions amounts to 24.34 million ha, almost 15 million of which are in Loreto. By end of 2004, over 7.5 million hectares of forest had been awarded in the form of forest concessions to 576 concessionaires for timber production in Madre de Dios, Ucayali, Huanuco, San Martin and Loreto.

Table 7.13: Permanent Production Forests and Forest Concessions, October 2005

Department	*Permanent Production Forests (1,000 hectares)*	*Forests under Concessions (1,000 hectares)*	*%*
Madre de Dios	2,522	1,034	51.7
Ucayali	4,090	2,877	70.3
Loreto	14,782	2,539	17.2
Huánuco	881	286	32.5
San Martín	1,501	498	33.2
Pasco	180	0	0.0
Ayacucho	146	0	0.0
Cusco	172	0	0.0
Puno	68	0	0.0
Total	24,342	7,504	30.8
Source: M. Romero, 2005.			

7.45 The new Forestry Law introduced some other innovative features. A new forest use category – Forest Recuperation Areas – was defined, where concessions can be granted on bare or open land for afforestation and reforestation. The Law created Forest Management Committees to involve local stakeholders in monitoring sustainable forest use to help assure compliance with the Law, the PGMF's and the POA's. The Law also created so-called 'Local Forests', 500-ha forest plots for use by local communities. Finally, the law introduced the possibility of financing environmental services provided by forests for soil protection, water regulation, biodiversity conservation, and other purposes. In August, 2005, INRENA formed a task force to plan PES implementation.

7.46 **INRENA's Forestry Superintendency** is responsible for managing forestry concessions and related programs. The **Multi-Sectoral Commission to Fight Illegal Logging**, created in 2002 with representation from several ministries and SUNAT (the national tax agency), released the National Strategy to Fight Illegal Logging in November, 2004. It was succeeded by another commission of the same name, which became operational in March 2005, whose mandate is to implement the Strategy to combat illegal logging by: a) strengthening INRENA's organizational and institutional capabilities in forest control and supervision; b) designing and implementing a system for law enforcement, timber tracking, forest raids and timber trade transparency; and c) promotion of and support for civil society and local population participation in forest control and supervision. As part of the strategy, INRENA is developing a computer system and database to effectively review, evaluate and manage concessions nationwide.

[84] Failure to submit the General Plan or the Logging Plan to INRENA for approval or not getting approval is a cause for nullifying the concession contract.

7.47 Other agencies and organizations are also important in the forestry sector. **The Supervisory Agency for Forest Resources (OSINFOR)**, which was absorbed into INRENA in 2004, is charged with enforcing the forestry law, including the GOP's quota on mahogany exports, now set at 23,621 metric tons. The concentration of both management and enforcement responsibilities in INRENA has resulted in ambiguity and inconsistency in the execution of governmental management functions. The **National Forestry Consensus-Building Roundtable (***Mesa Nacional de Diálogo y Concertación Forestal*, MNDCF) – like similar institutions in Brazil, Paraguay, and elsewhere – is composed of numerous prominent governmental agencies and NGO's, and played a key role in facilitating the implementation of the new forestry law. It continues to be a locus of consensus-building in the forestry sector, and is being replicated in several regions of the country, including Ucayali, San Martín, Tingo María, and Loreto. The **National Protected Areas System (SINANPE)** includes 25 NPA's, protecting over 14 million ha of Peruvian Amazon ecosystems, approximately 20% of the region. The NPA Law of 1997 allows for the creation of Private and Regional Conservation Areas outside of SINANPE and some of them may be located within the Amazon. **Supreme Decree No. 037-99-AG** requires INRENA's technical input regarding overlaps of proposed private agricultural plots and NPAs with forest resources prior to issuing land titles in the Amazon. **Supreme Decree No. 003-2005-AG** declares deforestation as a priority of national interest and assigns the responsibility of preparing the **National Reforestation Plan** to INRENA and a number of other institutions. The Plan is pending approval as of December, 2005.

7.48 Non-governmental programs play an important role in Peru's forestry sector. The Netherlands-funded Project "**Institutional Support to INRENA with a Focus on the Forest Sector" Project**, was a $ 2.1 million (U.S.) effort to implement sustainable forest management in the Amazon through institutional strengthening of INRENA, including support for a decentralized forestry administration system, improved communications and training, and leveraging donor funding. The project supported the launching of the concession process and helped INRENA sign 338 forest concession contracts through July, 2004.

7.49 The "**Certification and Development of Peru's Forest Sector" (CEDEFOR) Project**, is an on-going USAID-funded project, originally for $16 million (U.S.), to help reform, modernize, and promote sustainable management of the forest sector, through institutional strengthening in forest management, implementation of sustainable forest management and forest certification, and strengthening business management capacities and improved market access, especially for certified markets. Project results include providing technical assistance to 132 (23%) of 576 existing forest concessions; helping INRENA in the review and approval of 86 Forest General Management Plans (representing 1.53 million ha), and 62 Annual Logging Plans; advising in the creation and operation of 21 Forest Management Committees; assisting in the certification of roughly 63,000 ha of forests; helping in the generation of 615,734 temporary jobs; and generating almost $ 10 million in timber sales through June of 2005 (WWF-Peru Program Office, 2005)

7.50 The **Forest Development Promotion Fund (FONDEBOSQUE)** is a public-private organization (presided by the head of INRENA) and mostly funded by the donor community. Its objective is to promote investment in sustainable and competitive forest enterprises and in environmentally responsible projects generating economic opportunities and conservation of biodiversity. As of July, 2005, its portfolio amounted to $20.4 million (U.S.) – $16.8 million, or 82.3%, from international donors – with a focus on implementation of forest concessions (15.2% of portfolio), intermediate technology for sustainable forest use (3.7%), forestry plantation development (27.4%), sustainable communal forestry management (19.4%), and its own institutional creation and strengthening (49.6%). Specific projects have included technical assistance to 31 forest concessionaires, including timber processing; 2) support to Brazil nuts harvesters (394,106 ha); 3) support for construction of the first industrial timber products factory in Madre de Dios; 4) creation of a Forest Development Center in Oxapampa, with an estimated production of 730,000 seedlings, and 5) creation of a forest business information center.

Evaluation of Forest Concessions

7.51 The introduction of the forest concessions process is an important improvement in the effort to introduce effective sustainable forest management to a sector that in the past has been plagued by inefficiency, informality and corruption. However, issues pertaining to implementation of the new legal and institutional framework will continue to require GOP attention. The concessioning process has thus far been implemented on largely an *ad hoc* basis and a great deal should yet be done to make the process more effective and credible. Criticisms to date include: inadequate planning and scheduling of the initial public bidding process; poor mapping of the concessions, in turn creating access difficulties to concessions and concessionaire complaints that they didn't get what they bid for; lengthy delays in the review and approval of PGMF's and POA's, making timely (e.g. dry season) harvesting difficult; inadequate monitoring of illegal timber trade; and so forth.

7.52 Concessionaires often do not have adequate capital, access to credit, or sufficient technical and business and forest management experience to make their concessions economically viable enterprises. Two separate and independent surveys (WWF – 47 concessions, and Universidad del Pacífico – 4 concessions) have determined that the concessions are economically feasible and that the primary limitation for most concessionaires lies in the lack of operating capital. The rate of delinquency in the payment of harvest fees is high so far. To date, only 36 concessionaires of the 343 concessions granted in the first and second public bidding (2002 and 2003) have paid their harvest fee; the remainder (92%) should have their contracts nullified, per the Forestry Law.

7.53 Illegal logging, and the illegal trade in timber more generally, continue to be a major problem, challenging existing government institutions. There are inadequate surveillance and control systems to combat illegal logging, particularly in issuing harvest and transport authorizations (which permit the laundering of timber from private land and indigenous communities). Part of the problem is although infractions are specified in the Forestry Law (Article 363), accompanying sanctions are not (Glave and Morales, 2006). In November, 2004, INRENA began random concession inspections in Madre de Dios to verify compliance with the PGMFs and POAs, and to monitor mahogany extraction as required by CITES commitments. Of 23 inspections conducted, INRENA detected violations in five concessions, involving the laundering of $2 million worth of mahogany. By law, OSINFOR should nullify these concessions and the areas returned to public control. Violators should be prosecuted as required by law. Until June of 2005, however, no legal action had been concluded against the violators, illustrating the GOP's weak capacity to enforce the law.

7.54 Thus far, the GOP has lacked institutional capacity to accomplish the desired reform and modernization of Peru's forest sector. INRENA's institutional weaknesses arise from lack of prioritization of forestry policy, insufficient funding, inadequately trained staff, lack of adequate forestry information and intelligence, excessive bureaucracy (corruption has been alleged at some INRENA offices), and even simple things like not working weekends (unlike illegal loggers, who do). The increasing transfer of jurisdiction from the central to regional governments as part of the Decentralization Framework is needed, but thus far, there has been only limited participation by local stakeholders, including NGO's, in the concessioning process. Effective decentralization will require time and technical and administrative support. There is greater needed involvement of civil society, including local and indigenous populations, in the concessioning process, through such mechanisms as the National Forestry Consensus-building Roundtable and the regional roundtables. Land tenure problems continue to exist, including overlaps of land claims (native community territories, protected areas, private plots, etc.), inadequate mapping of concessions, and conflicts between concessionaires and newly arrived migrants.

Policy Recommendations

7.55 The new Forestry law and institutional framework represents a significant improvement over the 1975 Law; however, forestry institutions and administrative processes need significant strengthening. Among the recommended changes in policy, technical assistance and investment strategies are the following:

Policy

1. **Better position Forest Concessions for success.** The forest concessions are at the heart of Peru's new forestry policy and are key to its eventual success. In the short run, the GOP should consider temporarily suspending bidding and the issuance of new timber concessions until needed changes are made. It is preferable to focus first on the consolidation of existing concessions and assuring their economic feasibility. In the future, efforts should be made to attract larger investors to invest in the remaining forest concessions, approximately 9 million hectares. Consideration should be given to creation of a secondary market, where forest concessions could be traded and thus attract private investment, the forging of alliances with international buyers focusing on certified markets, and strengthening of the concessionaires' capacity to become part of a chain of production and hence secure a demand for their timber.

   The criteria for concessionaire profiles need to be revised for future bidding. Future criteria should pay more attention to such elements as higher capital requirements and adequate equipment furnished by bidders. The economic proposal should receive more weight relative to the technical one[85]. Promoting the formation of bidding consortia seems to be a sensible solution, but consortia should provide complementary proposals, and strict criteria should be used in forming consortia: minimum areas, minimum capital requirements, etc. Technical assistance (in forest and business management and administration) should be directed to a limited number of concessionaires that have shown the commitment and potential to getting certified and have actual or potential links with foreign markets.

2. **Institutional strengthening of INRENA.** INRENA's limited funding and staffing, along with the limitations of the newly created OSINFOR, are major constraints to GOP capacity to manage, monitor and enforce compliance with forest management regulations. Even with the technical assistance provided by donor-supported projects (U.S. and Dutch governments) and FONDEBOSQUE, significantly greater efforts are required in many areas, including: systematic inspections of concessions to ensure compliance with forestry regulations; better monitoring and enforcing of harvesting and transportation authorizations; building, equipping and staffing forest check points; consolidation of a national information network to control fraudulent trafficking of timber; closer coordination with Peru's Tax Service (SUNAT); more active participation of local and indigenous populations through the Forest Management Committees and Local Forests; work with NGO's and private sector in providing technical assistance to concessionaires; and communication and education activities. This effort will only succeed with long-term GOP commitment.

3. **Better control of illegal logging and timber trade.** Existing gaps in the legal framework should be addressed to better attack illegal logging and trade in timber. Short term, iIllegal logging should be clearly defined as a criminal act and specific sanctions should be established for specific infractions, with offenders prosecuted and penalties assessed without other concurrent crimes having to be committed to allow this. Longer term, greater support should be given to SUNAT, OSINFOR and INRENA in their ability to enforce compliance, impose fines and collect them. The ambiguous relationship between INRENA and OSINFOR (which surfaced as recently as December, 2005) limits

[85] In the first bidding competition of 2002, the weight distribution was 70% for the technical proposal and 30% for the economic one. In the last process (Loreto, 2004) the distribution was modified to 90% for the technical and 10% for the economic proposal. Neither have given adequate weight to economic and financial criteria.

the effectiveness of both. The GOP should consider placing OSINFOR in the PCM to enhance its stature and likely effectiveness. The effectiveness of the Multi-Sectoral Commission should be evaluated. INRENA's data base could be expanded into a "forestry intelligence center" as a clearinghouse of timely, accurate information on timber concessions and illegal logging.

4. **More active participation of stakeholders in forest management** should be promoted. Over the medium and longer term, this should include the expansion and strengthening of the local Forest Management Committees and providing them technical support. The National Forestry Roundable (MNDCF) is important locus for stakeholder involvement at the national level. This model should be replicated at the local/regional levels through *Mesas Regionales de Concertación y Diálogo Forestal* wherever possible; these already exist in several departments.

5. **Promote alternative sources of revenue generation in forest management** to supplement GOP and external funding. Once the concessions are on a firm financial footing, harvest fees might be increased and the proportion of fees received by OSINFOR could be increased to support enforcement efforts (care would have to be taken to avoid conflicts with INRENA on this score). A strengthened focus on sustainable forest management practices throughout the industry would highlight the importance of financial viability, which has been a chronic problem in the past. In the future, transferring responsibility of monitoring and enforcement schemes to the logging industry itself should be considered, such as in the case of Guatemala's system of forest auditors (*regentes forestales*).

6. **Addressing land tenure and titling problems in forestry concessions and surrounding areas**. INRENA needs to review its concessioning procedures to avoid titling conflicts. The law requiring the cutting of forests to get private land title should be revised. This will entail a closer coordination with the Special Land Titling Program (PETT), the Ministry of Energy and Mines, and other GOP agencies.

7. **Strengthen international markets**. Many of the above constraints result in a lack of international competitiveness in forest product markets. Peru has much to gain from a greater involvement in international markets, if properly managed. This could include market development activities, business feasibility analysis, identification of critical constraints to the Peruvian industry (such as transportation constraints), etc. Trade agreements and operations in the emerging market of responsible forest products should be promoted, including collaboration with the WWF-led Global Forest Trade Network.

8. **Strengthen the participation of indigenous populations in forestry management** to mitigate problems with the concessioning process and to minimize conflicts over land tenure. There is handful of key native communities that may benefit from the support given to the existing concessions. This should be coordinated closely with representative indigenous populations associations and bodies, such as the Inter-ethnic Association for the Development of the Peruvian Jungle (AIDESEP), the Peruvian Indigenous and Peasant Agroforestry Coordinating Body (COICAP), the National Institute of Peruvian Andean, Amazonian and African Peoples (INDEPA) and individual native communities at the local level. More of an effort should be made to also involve indigenous groups in the local Forest Management Committees wherever possible.

<u>Technical Assistance</u>

1. **Support for decentralization of forest management.** INRENA's current initiative to delegate functions from its central office to its regional branches (ATF's) and regional governments should be supported and reinforced. The movement toward decentralization of INRENA's functions is

underway and needs greater long-term support. However, regional governments currently lack the administrative and technical capacity, funding, and staffing to do this adequately, and these needs should begin to be addressed in the short term. Checks and balances need to be built into forest management at the regional level; independent third-party involvement in forest management should be considered. INRENA's commitment to Permanent Production Forests should be continued even as its functions are increasingly transferred to the local and regional levels. Greater transparency in the concessioning process will be needed if local stakeholders and regional governments are to be effectively involved. Bidding processes and procedures, in particular, need to be fully disclosed. The creation of Forest Management Committees and Local Forests, but this as yet inadequate for effective forest control and surveillance, and should be reinforced.

2. **Strengthen technical assistance to the forestry sector,** through FONDEBOSQUE and other institutions, including: promoting forest certification and sustainable logging practices; technical support for tree plantations, reforestation and agroforestry; introducing technical innovations to reduce wood product waste; and promoting improved technologies for forest product processing.

3. **Promote greater attention to Reduced Impact Logging (RIL)** to moderate its environmental effects. The extensive experience with RIL in Brazil should be considered in light of similar conditions in Peru. RIL includes management practices such as: pre-harvest inventory and mapping of trees, vine-cutting, and planning of roads and skidtrails; directional felling; cutting stumps low to the ground; constructing roads and skid trails of optimum width; winching of logs to skid trails; constructing landings of optimal size; and minimizing ground disturbance and slash management (Holmes, et al.). Widespread use of these practices not only mitigates the environmental impacts of logging but can result in higher profitability. CONAM and/or the Ministry of Transportation should be involved in this dialogue given their national-level authority. The construction of the Inter-Oceanic Highway provides an important opportunity for the use of these practices and other means to moderate the impacts of road construction and logging.

Investments

1. **Improved mapping, zoning and forest inventories** of Permanent Production Forests should precede the launching of new bidding processes in order to more clearly define land use patterns in the areas where concessions will be granted. This will address two major problems associated with the current bidding process: 1) conflicts over property rights, stemming from multiple claims on forest concession lands, and 2) providing better information on accessibility (roads and rivers) species composition, and the economic potential of the plots that are bid upon.

Biodiversity Conservation

Current Situation

7.56 Peru is recognized as one of the twelve "mega-diverse" countries of the world. It hosts 70% of the world´s biological diversity, and contains some 25,000 plant species; 460 mammal species, third in the world; over 340 amphibian species, fourth in the world; 1,811 bird species, second in the world, to Colombia; 365 reptile species (fifth in the world); and almost 2,000 marine and freshwater fish species, first in the world (Brack; Portilla, 2002; Sanchez, et al. 2005). Peru's species endemism is also very high, with at least 6,288 endemic species, 5,528 species of flora and 760 species of fauna (Sanchez, et al., 2005). Peru also has a long list of endangered species, however, including 301 fauna species, of which 23 are considered "critically endangered", 332 orchid species, and 375 other species of flora (INRENA, 2005).

7.57 There have been numerous collaborative efforts to establish baseline data, assess and monitor biological diversity in different biodiverse or biologically fragile sites (Table 7.14). The Conservation International-Birdlife International ongoing effort in the Tropical Andes region has identified 128 Important Bird Areas, covering 19,120,000 ha, in which have been identified 1,642 bird species, including 87 threatened species (Boyla and Estrada, 2005). Conservation International has led Rapid Assessment Programs in at least six biologically important areas (Table 7.14), in each case identifying new species of plants, mammals, reptiles, frogs, and birds not previously known to science. Some of these efforts were initiated as part of the large Camisea natural gas project during 1996-1999. The Field Museum of Chicago has sponsored Rapid Biological Inventories in two areas. The National Agrarian University–La Molina's Center for Data Conservation (CDC) in collaboration with the Frankfurt Zoological Society and INRENA have undertaken a number of exercises to standardize environmental monitoring for the National Protected Areas System (SINANPE). The World Wildlife Fund also tried to produce a national monitoring system to measure SINANPE's managerial capacity and biological diversity conservation.

7.58 These efforts have been mostly implemented by local and international NGOs, and by projects funded by the international donor community. A consistent long-term, national-level monitoring system to gauge the progress of biodiversity conservation does not exist. CONAM is currently leading an effort to establish regional guidelines which can be applied in regional monitoring efforts, beginning in 2006 in Loreto in conjunction with the Peruvian Amazon Research Institute (IIAP), INRENA's Protected Areas agency (SINANPE) and Biodiversity Conservation Directorate, and other organizations.

7.59 A variety of different methodologies have been employed in these biodiversity monitoring efforts. Some of the most notable include those of The Nature Conservancy's (TNC), including: Conservation Action Plans (CAPs), identifying conservation objectives, threats, causes, and losses; TNC's biodiversity "scorecard", applied to management capacity – and often biological monitoring – at a conservation site; and Threats Monitoring, conducted by TNC's local local partner, the Conservation Data Center at Universidad Nacional La Molina. At two major sites, Pacaya Samiria and Central Selva, the TNC-CDC effort has employed satellite imagery from 1997, 2001 and 2003 to monitor changes in forest cover as an indicator of illegal logging, with site visits and overflights to ground-truth the data. Conservation International's approach to biodiversity conservation, which includes Rapid Assessment Programs and biological assessments, highly coincides with TNC's, and focuses primarily on the National Protected Areas System. The biodiversity information and monitoring system employed in the Camisea project is based on the Shannon Index, employed widely in community ecology.

Table 7.14: Major Biodiversity Monitoring and Assessment Projects in Peru

Sponsoring Institution	*Project*
Conservation International & Birdlife International	Important Bird Areas (IBAs) of the Tropical Andes
Conservation International	Rapid Assessment Programs
Field Museum of Natural History	Rapid Biological Inventories in Cordillera Azul National Park and in Yavarí region (Loreto)
Universidad Nacional La Molina Conservation Data Center, /Frankfurt Zoological Society/INRENA	Environmental monitoring in National Protected Areas System: Bahuaja Sonene National Park, Tambopata National Reserve, Amarakaeri Communal Reserve, Manu National Park, and Alto Purús Reserved Zone
World Wildlife Fund	National monitoring system for SINANPE
Conservation International	Biological Assessment of Tampobata Candamo Reserved Zone, southeastern Peru

Conservation International	Biological Assessment of Cordillera del Cóndor Region in Peru and Ecuador
Conservation International & Smithsonian Institution	Biological and Social Assessments of the Cordillera de Vilcabamba, Peru
Conservation International	Biological Assessment in Zona Reservada Tambopata Camdamo (Madre de Dios and Puno)
Duke University Center for Tropical Conservation	Alto Purús region (covering parts of the Ucayali and Madre de Dios
Universidad Nacional La Molina	Biodiversity loss in three coca-growing areas of the Peruvian
Conservation Data Center and WWF	Amazon
The Nature Conservancy (TNC)	Conservation Action Plans; Biodiversity monitoring in Pacaya Samiria National Reserve (Loreto) and Central Selva Compound (in Yanachaga-Chemillén National Park, San Matías-San Carlos Protected Forest, and Yanesha Communal Reserve)
Peruvian Association for the Conservation of Nature (APECO)	PIMA Project – biological monitoring in Amazon
Peruvian Amazon Research Institute (IIAP) and Government of Finland	BIODAMZ Project in northern Peruvian Amazon

Source: Assembled from data in Elgegren, 2005.

7.60 Many of the areas of high biological diversity in Peru lie within or proximate to the 61 natural protected areas in the country. The Natural Protected Areas Law of 1997 defines the purpose of the country's protected areas as to conserve biological diversity and their associated cultural, landscape, and scientific values, as well as to secure their contribution to the sustainable development of the country. Together the various categories of protected areas in Peru comprise 17.66 million hectares, representing 13.74% of the country's total area (Table 7.15). Each category has a distinct objective and associated level of protection, the highest for National Parks and National and Historic Sanctuaries (for further details, see Pulgar-Vidal and Calle, 2003). Most of these areas are located in the Oriente, with smaller areas in the Sierra, and to a lesser extent, the Coast. These parks and protected areas represent a potential source of future economic growth if Peruvian protected area managers and private sector entrepreneurs are able to use these resources in stimulating growth in Peru's ecotourism industry.

7.61 Beginning in 1997, an effort has been made by INRENA, with technical assistance from the CDC, WWF and USAID to conduct an assessment of the management capacity of the Protected Areas System, SINANPE, using the so-called Management Monitoring Matrix (M3) approach. This assessment has focused on management criteria including: registration of the PA in the public registry to avoid/minimize land tenure conflicts; the establishment of Protected Area Management Committees to secure open and transparent participation of all those with a stake in protecting the area; financial sustainability; the approval of Master

Table 7.15: Peru's Protected Area System

Protected Area (date estab.)	*Area (ha)*	*Protected Area (date estab.)*	*Area (ha)*
NATIONAL PARKS (11)			**7,812,667**
Cutervo (1961): 2,500	2,500	Yanachaga-Chemillen (1986)	122,000
Tingo Maria (1965)	4,777	Bahuaja-Sonene (2000)	1,091,416
Manu (1973)	1,716,295	Cordillera Azul (2001)	1,353,191
Huascaran (1975)	340,000	Otishi (2003)	305,973
Cerros de Amotape (1975)	91,300	Alto Purus (2004)	2,510,694
Rio Abiseo (1983)	274,520	Yanachaga-Chemillen (1986)	122,000
NATIONAL SANCTUARIES (7)			**263,983**
Huayllay (1974)	6,815	Manglares de Tumbes (1988)	2,972

Calipuy (1981)	4,500	Tabaconas-Namballe (1988)	29,500
Lagunas de Mejia (1984)	691	Megantoni (2004)	215,869
Ampay (1987)	3,636		
HISTORIC SANCTUARIES (4)			**41,279**
Chacamarca (1974)	2,500	Machupicchu (1981)	32,592
Pampa de Ayacucho (1980)	300	Bosque de Pomac (2001)	5,887
NATIONAL RESERVES (10)			**3,279,445**
Pampa Galeras Barbara D'Achille (1967)	6,500	Salinas and Aguada Blanca (1979)	366,936
Junin (1974)	53,000	Calipuy (1981)	64,000
Paracas (1975)	335,000	Pacaya Samiria (1982)	2,080,000
Lachay (1977)	5,070	Tambopata (2000)	274,690
Titicaca (1978)	36,180	Allpahuayo-Mishana (2004)	58,069
LANDSCAPE RESERVES (2)			**651,818**
Nor Yauyos-Cochas (2001)	221,268	Cotahuasi Watershed (2005)	430,550
COMMUNAL RESERVES (6)			**1,658,901**
Yanesha (1988)	34,745	Machiguenga (2003)	218,906
El Sira (2001)	616,413	Ashaninka (2003)	184,468
Amarakaeri (2002)	402,336	Purus (2004)	202,033
PROTECTED FORESTS (6)			**389,987**
A.B. Canal Nuevo Imperial (1980)	18	San Matias-San Carlos (1987)	145,818
Puquio Santa Rosa (1982)	73	Pagaibamba (1987)	2,078
Pui Pui (1985)	60,000	Alto Mayo (1987)	182,000
HUNTING ZONES (2)			**124,735**
El Angolo (1975)	65,000	Sunchubamba (1977)	59,735
RESERVED ZONES (13)			**3,437,397**
Laquipampa (1982)	11,347	Rio Rimac	28 km strip
Pantanos de Villa (1989)	264	Santiago-Comaina	1,642,567
Tumbes (1994)	75,102	Cordillera de Colan	64,115
Algarrobal el Moro (1995)	321	Cordillera Huayhuash	67,590
Chancaybaños (1996)	2,628	Pampa Hermosa	9,575
Aymara Lupaca (1996)	300,000	Pucacuro	637,919
Gueppi	625,971		
TOTAL AREA OF 61 NATURAL PROTECTED AREAS (ha)			**17,660,212**

Source: IANP

Plans to provide management guidelines; and the approval of Annual Work Plans. The M3 tool does not include monitoring and evaluation of the status of biological diversity itself. The fact, however, remains that no standardized monitoring system is in place in Peru, even in the protected areas system, unlike neighboring countries like Colombia, to assess the status of or changes in biological diversity.

7.62 In addition to its wild biodiversity, Peru is also one of the most ancient sites for species domestication, dating to over 6,000 years ago. The country hosts a genetic diversity of over 128 cultivated species, including the highest global diversity of potato varieties, one of the four most important food crops of the planet, along with wheat, rice and maize. At least nine species of domesticated potato are known with almost 3,000 ecotypes and an estimated 150 wild species with high genetic value. (Peru's potato production had a farm-level value of about $425 million in 2003).

7.63 The annual global market for biodiversity-derived products – comprising agricultural products, functional foods, pharmaceuticals, biopharmaceuticals, herbal medicines and neutraceuticals, seeds and personal care and cosmetic products – has recently been estimated at over $230 billion (U.S.) (Roca, et al., 2004). As noted above, estimates by Chambi (2002) and others suggest that there is considerable economic

value to Peru's biodiversity. If properly managed, this value – of both wild and agro-biodiversity – could be translated into a source increased national income and employment. In addition to conventional agriculture and growth of industries such as ecotourism, Peru has considerable potential for the improved commercial management of many types of species of fauna and flora. Roca, et al. (2004) identify more than 40 sources of wild and cultivated biodiversity in Latin America with current or potential commercial use. In Peru, species that have been identified for commercial potential include: the alpaca and vicuña, brazil nuts, tropical fish, the peccary (for meat and hide), orchids, natural colors derived from the *cochanilla* bug, medicinal plants with international market demand such as 'cat's claw' (*Uncaria tomentosa*) and '*sangre de grado*' (*Croton lechleri*), foods such as the vitamin C-rich '*camu camu*' (*Mycaria dubia*), and others. Individually, these species may not have the same commercial potential as potato or maize, however, together they represent a prospective means for Peru to take better advantage of its competitive advantage in biological diversity.

Causes of and Threats to Biodiversity Conservation

7.64 Deforestation is without doubt a key driver of biodiversity loss since it deprives living species of their habitats. As indicated in the previous section, forest cover loss is significant in Peru, amounting to around 150,000 ha annually. An interesting recent effort to link deforestation to biological diversity loss is represented by a landscape analysis done by the CDC of three coca-growing areas of the Peruvian Amazon, Huallaga, Pachitea-Aguaytía, and Apurímac (CDC-UNALM (2004). One of the major findings of the study is that of the 7.87 million ha in the study area, 31.4% (roughly 2.47 million ha) were estimated to be of "high conservation value" based on a set of biodiversity and landscape criteria.

7.65 A recent study sponsored by CONAM and the National Biological Diversity Commission (1998) identifies three categories of threats to biodiversity. The first category – "conceptual" threats – consists of misconceptions of biodiversity, and lack of knowledge and awareness about ecosystem functioning, the role of biodiversity, and its economic potential. The second category of political and economic threats consist of policy gaps and failures such as perverse incentives for slash and burn cultivation in areas not suitable for agriculture, lack of policies to facilitate the preservation of genetic resources, and economic instability and widespread poverty. A third category of "direct threats" consists of human activities that can lead to the degradation of species habitat and/or species extinction: migration to the Oriente; deforestation; urban and industrial pollution; over-fishing and over-hunting; genetic erosion; road opening; exploration and exploitation of mineral and hydrocarbon resources; and the extinction of native populations and cultures, which can lead to loss of traditional knowledge about biodiversity. These direct threats also include large-scale projects such as Camisea and the Inter-Oceanic Highway, of which 1,100 km is being built in Peru, potentially disrupting landscapes, ecosystems and conservation corridors.

Institutional and Policy Framework[86]

7.66 Biodiversity has long been recognized as having many of the qualities of a public good – nonexcludability, non-rivalrous in consumption, etc. Markets have a tendency to underinvest in public goods – and private sector control accordingly may be suboptimal – because of the tendency to free-ride and expect others to pay for the benefits provided, and because private provision is often limited to the immediate capturable private benefits (FAO, 2002; Zilberman, 2002). As explained above, even though there is great scope for greater private investment in and private capture of the economic benefits rooted in Peru's biodiversity, the public goods rationale and the need for Peru to comply with its international treaty obligations, among other factors, provide justification for public sector investments in helping conserve these diverse resources.

[86] This section and the next draw in part from Sanchez, et al., 2005.

7.67 Peru has a comprehensive legal and policy framework governing biodiversity conservation and management. These include a national sectoral policy and programs to deal with its diverse ecosystems. Likewise, Peru has a number of broad set of public institutions that have a biodiversity conservation mandate (CONAM, INRENA, IMARPE, INIA) as well as a large number of local and international NGOs working in biodiversity management. The central regulatory umbrella governing biological diversity worldwide, including Peru, is the 1992 **Convention on Biological Diversity (CBD)**, which Peru ratified in April, 1993. In Peru, the response to the CBD was to create the **National Biological Diversity Commission (CONADIB)**. This Commission has been fundamental in facilitating the implementation of the CBD and defining national positions and policies regarding biodiversity, notably through formulation of the National Biological Diversity Strategy (ENDB) which provides regulations, priorities and actions to operationalize the CBD's principles in Peru.

7.68 A recent report by the U.N. Development Program and CONAM (Sanchez, et al., 2005) suggests that CONADIB has a mixed record in galvanizing efforts regarding biodiversity conservation in Peru. A first phase of CONADIB's effort (1996-1998) was highly proactive and the passing of the Conservation and Sustainable Use of Biological Diversity Law (1997), the Protected Areas Law (also 1997), the approval of the **National Biological Diversity Strategy (ENDB)** in 2001, and the creation of thematic working groups, such as those in agro-biodiversity, biotechnology, access to genetic resources, and economic valuation of biodiversity. In recent years, the efforts have been less visible but have focused on consolidating national policies and negotiations in international fora regarding biodiversity, approval of regulations governing the operation of the Conservation and Sustainable Use of Biological Diversity and Protected Areas Laws, and approval of the law protecting the biodiversity-related knowledge of indigenous populations (2002). Technical assistance from UNEP has helped strengthen CONADIB and make its operation more efficient, though it is still as weak entity for several reasons, including lack of financial support. Making CONADIB more effective will require greater political visibility, a strategic plan with concrete and measurable targeted impacts, and additional funding from the donor community.

7.69 **CONAM** is the national agency that is responsible for national policy and guidelines governing the conservation and sustainable use of biological diversity, and is the lead agency for administering the ENDB. Its **Biodiversity and Biosafety Directorate**, established in 2003, focuses its work in three main areas: 1) institutional coordination with other GOP Ministries, agencies and Regional Governments, including implementing CONADIB; 2) sustainable use of biodiversity, dealing with biotrade, agrobiodiversity, and access to genetic resources; and 3) biosafety, dealing with biotechnology and transgenic organisms. CONAM is not an implementing agency unlike INRENA or IMARPE (Peru's Oceanic Institute), but acts largely in a coordinating role, conducts training programs and acts as an information clearinghouse. Its regional coordinating function rests on the Regional Environmental Commissions (CARs), which in turn provide assistance to the Regional Governments in the design and implementation of their Regional Biodiversity Strategies, as mandated by the Decentralization Framework Law of 2003. The Biodiversity and Biosafety Directorate is a minimally staffed office (four people), which creates major challenges in executing its wide mandate.

7.70 **INRENA** is the primary implementing agency for biodiversity management in Peru, through its Biodiversity Conservation Directorate. This office has primary responsibility for national programs which assure Peru's compliance with three international conventions: the CDB; the Convention on International Trade in Endangered Species (CITES); and the Convention on Migratory Species. This includes major responsibility under ENDB for biodiversity monitoring, including monitoring Peru's mahogany export quota, a politically sensitive task. The existing monitoring effort is very modest; an inherent conflict in moving aggressively toward a national system of biodiversity monitoring is that such a system could well confirm the weaknesses of current GOP policies and procedures in dealing with biodiversity conservation and deforestation. The Directorate is also active in the National Biotrade Commission (over which CONAM presides), in environmental education – important given the lack of

knowledge about biodiversity and its importance – and in conservation training at the regional and provincial levels.

7.71 Numerous other institutions work on biodiversity conservation in Peru. Since 1992, the **Peruvian National Trust Fund for Parks and Protected Areas (PROFONANPE)** has been managed by the private sector to provide funding for Peru's main protected areas. By 2003, it had generated an estimated $38 million in assistance from the Peruvian government, national and international non-governmental organizations, the World Bank Global Environment facility, and the United Nations Environment Program, in support of protected area management in Peru (Global Environment Facility, 2003). The **Peruvian Amazon Research Institute (IIAP)** has an active program of biodiversity research management focusing on Peru's Amazon region, including projects with commercial applications. The **National Agricultural Research Institute (INIA)**, with its four regional stations, has a small gene bank collection and research effort. A number of *in situ* and *ex situ* agrobiodiversity conservation efforts are underway in Peru, with involvement of INIA, the **International Potato Center (CIP)** and several national universities, and with funding from the GEF, the McKnight Foundation and the Swiss government, among others. These include innovative projects such as the "Potato Park" project in southern Peru, developed with indigenous communities and international donors; a CIP and INIA-led effort to restore native potato varieties in 35 villages in the Sierra; and the "Condor Route" network of *in situ* Andean conservation sites planned to extend from southern Venezuela to Bolivia.

7.72 7.72 Finally, efforts funded by the **Global Environment Facility (GEF)** on conservation and biodiversity in Peru focus primarily on biodiversity conservation and protected area management through public participation, particularly through enhancing the capability of indigenous people to actively participate in protected area management. By mid-2006, there were six active biodiversity projects funded by the GEF through the United Nations Development Programme and the World Bank, totaling almost $33 million (U.S.). In addition, the GEF also funds enabling activities for around US$500k on biodiversity-related issues. There area also nine GEF-funded active climate change projects totaling over $27 million (U.S.), and one POPs (persistent organic pollutants) project for $500,000 (U.S.). Under the new Resource Allocation Framework, Peru will greatly benefit from the GEF, and is eligible to receive roughly $30 million in grant funding for biodiversity, $5 - 10 million for climate change and adaptation, plus additional GEF funds for land degradation, persistent organic pollutants, and international waters.

7.73 Having at least two major actors working toward biodiversity conservation fosters a lack of clarity about which has highest authority. This in turn impedes communication and creates conflict with other sectors of the Government including relationships with other Ministries. The recently approved General Environmental Law (2005) will help better define CONAM's role as the country's highest environmental authority, but the problem will likely persist under the current structure. Even though some of the Regional Environmental Commissions (CONAM´s regional branches) are quite active, CONAM has little field-level expertise and implementation capacity (Sanchez, et al., 2005), which will continue to hamper it. INRENA is widely perceived as the agency that has the most hands-on experience and its current leadership is well respected. However, excessive bureaucracy, understaffing, and a chronic lack of resources leave it difficult for INRENA to adequately fulfill its many mandated functions.

7.74 Even though Peru has a comprehensive policy and regulatory framework covering biodiversity, the application of this body of regulations and policies leaves much to be desired. This is in part because jurisdictional and enforcement institutions are weak, chronically short of resources, and traditionally too dependent on individual initiative rather than institutional strength. CONADIB seems to have lost momentum (Sanchez, et al., 2005). This may be reversed by strengthening the strategic planning capacities of the agencies and institutions within CONADIB so as to establish baseline information and tangible targets and goals. There are also overlaps and inconsistencies, which is a common problem at the

regional level in Latin America. The problem may be greater in Peru than in other Andean countries where a Ministry of the Environment exists (Colombia, Ecuador, Venezuela; in Bolivia, the Ministry of Sustainable Development). This effort has been complemented in the past by donor community contributions, which have created numerous benefits but have fostered a project-based approach to dealing with biodiversity, rather one built on strong institutions.

7.75 Perhaps inevitably, another limitation stemming from the current institutional configuration are difficulties in intra- and inter-institional coordination. The government has a highly sectoral approach to biodiversity: INRENA deals with forests, CONAM deals with biodiversity policy, IMARPE deals with marine biodiversity, INIA deals with agro-biodiversity, and so on. International coordination can also be difficult, such as, within INRENA, coordination between the National Protected Areas Superintendency (IANP) and the Forest and Wildlife Superintendency (IFFS). Coordination is often not a problem rooted in lack of willingness to coordinate, but in time constraints and shortage of personnel. The multi-institutional framework also leads to duplication of efforts across projects, and therefore a need for coordination among donor agencies.

7.76 Despite Peru's enormous biological diversity, GOP efforts, and those of donors, NGOs, universities and civil society, there is as yet no comprehensive and consistent biodiversity monitoring system in place in Peru. As reviewed above, many monitoring systems have been employed in one-off donor-funded projects, but these efforts are typically intermittent, unsustained, and narrow in geographic scope. Even in the Protected Areas system, there is no ongoing monitoring system. The Protected Areas Superintendency (IANP) does not have an information specialist and has only one person handling monitoring for the whole Protected Areas System. A 2004 report on the previously mentioned M3 evaluation of the Protected Areas system found, for example, that only 28 of 56 Protected Areas were registered in the public registry as state-owned land; of the 28 Management Committees, 18 had a Work Plan; only 4 PA's had a financial sustainability plan; only 18 PA's had an approved Master Plan, of which only 13 were used as a management tool, and only three had a monitoring and evaluation plan. For the past three years, IANP has focused on strengthening management capacity and achieving the Protected Areas Master Plan targets. Information gathering and systematization has not been a priority, though.

7.77 Finally, there is very limited capacity to properly manage biodiversity at the regional and local levels. This is a critical constraint because, under Peru's decentralization laws (Nos. 27680 and 27783, both in 2002) INRENA is gradually devolving responsibility for the management of forestry and wildlife biodiversity to the regional governments, which are demanding a role and participation in an area which they foresee as a future source of economic growth. Several Departments (Loreto, Madre de Dios, Ucayali, San Martín, Amazonas, Ica and Junin) have already developed their biodiversity strategies as provided for by law. But the regional governments do not currently have the technically trained staff nor the resources to assume these responsibilities, which has a target date of 2007. They reportedly still frequently contact INRENA in Lima for guidance and support on key biodiversity management issues. Overall, only about 0.15% of the GOP budget is currently allocated to dealing with the environment and natural resources, including biodiversity (Sanchez, et al., 2005). The Departments which are most advanced in their biodiversity management capacity include Ayacucho, Piura, Tumbes and Loreto.

Recommendations

7.78 Despite progress in complying with national commitments to international treaties such as the CBD, there severe constraints. The most challenging problem seems to be the lack of integration and consistency of biodiversity management at the highest political level. Biodiversity, not to mention environmental issues as a whole, is not prioritized in the agenda of the PCM. Some ministries do not have a clear view that in being responsible for biodiversity, they are the stewards of the nation's storehouse of genes, species and ecosystems. It may be unrealistic to think that Peru will soon approach the

commitment of a country like Costa Rica, but the country can go much further in taking advantage of its unique biodiversity resources, including in a commercial and developmental context. Important recommendations for changes in policy, technical assistance and public investment include the following:

Policy

1. **Strengthen institutional capacities of key actors** in biodiversity conservation both at the national and regional level. This long-term goal includes increasing staffing and budget at CONAM's Biodiversity and Biosafety Directorate, INRENA´s Directorate of Biological Diversity Conservation and Natural Protected Areas Superintendency, IMARPE, and the regional governments. This strengthened capacity is especially needed in view of the decentralization framework. Although in the specialized area of biodiversity management, the central offices of INRENA and CONAM can be expected to serve as national resources, there is great need to build institutional capability over the longer term at the local and regional levels as responsibilities are increasingly devolved to these institutions.

2. **Build on Peru's 'comparative advantage' in biological diversity, including agrobiodiversity.** Over the longer term, Peru should make better use of its strengths in agrobiodiversity and in developing commercial uses of its unique wild biodiversity. This should begin by building on current efforts, such as those underway in institutions like CONSITEC (with co-funding from IDB and GOP) and the National Competitiveness Council (*Consejo Nacional de Competitividad*). But these efforts should be reinforced and given new focus and vision.

3. **Speed up the process of review and approval of CONAM roles and functions,** which will clarify and strengthen its Biodiversity and Biosafety Directorate. In view of the National Biological Diversity Strategy and Peru's new Environmental Law (2005), CONAM's regional offices (CAR's) may also need strengthening in view of the increasing importance of decentralized efforts in biodiversity management. These objectives can be accomplished in the short to medium run.

4. Given the important role of external donor agencies working in biodiversity, there is a **need for refining the coordination mechanisms among donor agencies** to avoid duplication of efforts, improve information sharing, and to promote interventions in areas that have received little external support. Although this is a long-term goal, it could have significant payoff given the level of donor resources that have supported biodiversity conservation in Peru.

Technical Assistance

1. **Strengthen GOP efforts to disseminate biological technical knowledge and training.** This should include the regional governments, CAR's, INRENA regional offices, as well as more specialized opportunities for private sector participation, such as in agrobiodiversity and promising biotrade opportunities. This effort is consistent with, and necessary to reinforce, the decentralization framework.

2. **Support national efforts to value biological diversity and environmental services**. A Payment for Environmental Services working group has recently been formed with initial funding from GTZ. This initiative should receive more attention in view of decreasing funding resources from the donor community. This effort is important, among reasons, in generating incentive-compatible solutions to biodiversity and natural resource conservation, thus potentially reducing the reliance on central GOP financing.

Investments

1. **Increase resources (financial support and technical assistance) to create an adequate biodiversity monitoring system, including agrobiodiversity,** and to evaluate and assess progress of its status in Peru. Peru's commitments with international treaties will not be fulfilled if no consistent and reliable data are available regarding the state of biological diversity, nor will the national vision and objectives stated in the National Biological Diversity Strategy be achievable. A consistent, ongoing, long-term national monitoring effort, using modern, science-based methodologies, is needed to improve past monitoring efforts which have been inadequate, inconsistent, and which have generated non-comparable results. Also, it is advisable to strengthen Peru's Biodiversity Clearinghouse Mechanism, placed in CONAM. Information sharing is vital in consolidating these efforts, as there is abundant information that has not been systematized.

Summary of Policy Recommendations to Address Soil Degradation, Forestry, and Biodiversity

Objective	Recommended Short-Term Actions	Recommended Medium and Long-Term Actions
I. Soil Degradation		
Foster more efficient public planning and private resource allocation through improved information	• Conduct/update new national inventories of 1) soil erosion and 2) soil salinity (none completed since 1980's). (Cost: Low to moderate)	• Use updated information for improved planning of public and private interventions in soil salinization, water and irrigation use, land use planning, soil erosion and soil conservation. (Cost: Low)
More efficient use of water resources, and associated land uses.	• Revise the 1969, 1989 and 1990 Water Laws to authorize higher, broad-based fees for water use. (Cost: Low) • End preferential treatment for rice in water allocation in Coastal irrigation projects (Cost: Low)	• Increase water use fees to cover provision costs and generate more efficient water use and associated land uses. (Cost: Low)
Strengthen institutional capacity to address water use and soil conservation	• Consider establishment of a new independent Water Resources Agency with a mandate for integrated water use management. (Cost: Low) • Refocus mandate of INRENA on soil conservation (Cost: Low)	• Improve technical capacity of personnel working in soil conservation, and improve staffing resources (INRENA, PRONAMACHCS, etc.) (Cost: moderate) • Improve inter-institutional coordination (PRONAMACHCS, non-governmental organizations, donors) through REDNAMAC and other venues in guiding investments in soil conservation (Cost: Low)
More efficient allocation of government and external resources in soil conservation	• Conduct comprehensive feasibility analysis of soil conservation investments (Cost: Low)	• Use feasibility analysis, improved information, and estimated economic costs and returns to guide public investments in soil conservation (Cost: Low)

Objective	Recommended Short-Term Actions	Recommended Medium and Long-Term Actions
II. Deforestation **Improve functioning of new 2000 Forestry Law, especially forest concessions**	• **Suspend concessioning process until further reforms are made (Cost: Low)** • Improve mapping, zoning, and forest inventories prior to further concessioning (Cost: Low) • Create secondary market in forest concessions (Cost: Low) • Revise concessionaire criteria, esp. higher capital requirements, and promote bidding consortia (Cost: Low) • Assign greater weight to economic vs. technical criteria in evaluating concessaire proposals (Cost: Low) • Improve stakeholder involvement in forest concessioning process through National Forestry Roundtable, local Forest Management Committees, etc. (Cost: Low) • Strengthen the participation of indigenous populations in forestry management through AIDESEP, COICAP, INDEPA, etc. (Cost: Low)	• Provide ongoing targeted technical assistance to bidders and concession holders through INRENA, FONDEBOSQUE, NGO's and other institutions to assure success of forest concessions (Cost: Moderate) • Provide more intensive ongoing institutional support (INRENA, OSINFOR, etc.) for forest concessioning process. (Cost: Moderate to high). • Strengthen alliances with international buyers, esp. in certified markets (Cost: Low) • Promote Reduced Impact Logging (RIL) practices through increased technical assistance and incentives (Cost: Low) • Promote alternative sources of revenue generation, including increased harvest fees, transfer of monitoring and enforcement to industry, etc. (Cost: Low) • Expand national information network and data base to assist monitoring and enforcement of Forestry Law. (Cost: low to moderate)
Strengthen institutions involved in forestry resource management	• Devote increased resources to inspections and compliance; monitoring and enforcement of harvest and transport authorizations; closer coordination with SUNAT, OSINFOR, PETT, etc.; (Cost: moderate). • Clarify division of responsibilities between INRENA and OSINFOR (Cost: low)	• Consider making OSINFOR an independent agency, reporting to PCM (Cost: low). • Address land tenure and titling problems in forestry concessions through better coordination with PETT, MEM, etc. (Cost: low to moderate).

Objective	Recommended Short-Term Actions	Recommended Medium and Long-Term Actions
Support decentralization of forest management and institutions	• Continue national support of Permanent Production Forests (Cost: low). • Support/strengthen devolution of administrative and technical functions to Departments and regional INRENA offices (Cost: moderate) • Increase funding, staffing, technical (monitoring and evaluation), and enforcement capabilities at regional level (Cost: moderate to high)	• Promote greater role of Forest Management Committees in local monitoring of forest resources (Cost: low to moderate). • Promote greater participation and stakeholder involvement in local forest management through regional forestry roundtables, etc. (Cost: low).
Better control of illegal logging and trade	• Devote greater resources to inspections, compliance, monitoring and enforcement of harvest and transport authorizations; closer coordination with SUNAT, OSINFOR, PETT, etc.; (Cost: moderate). • Clarify role of Multi-Sectoral Commission to Control Illegal Logging (Cost: low)	• Expand INRENA data base to create National Intelligence Center to support monitoring and enforcement activities (Cost: low).
III. Biodiversity Management **Provide improved information to foster better planning, including complying with international treaties and agreements, and improved private resource allocation**	• Increase resources –financial support and technical assistance – to create an adequate national biodiversity monitoring system, including agrobiodiversity (Cost: moderate) • Strengthen Biodiversity Clearinghouse Mechanism, in CONAM (Cost: low).	• Support national efforts to value biological diversity and environmental services (Cost: moderate).
Strengthen institutional capacity in biodiversity management	• Clarify responsibilities of different public institutions in biodiversity management, including CONAM, INRENA, IMPARPE, and Ministries (Cost: low). • Speed up review and clarification of CONAM's functions in biodiversity management (Cost: low) • Strengthen GOP efforts to disseminate biological technical knowledge and	• Refine coordination mechanisms among donor agencies (Cost: low)

Objective	Recommended Short-Term Actions	Recommended Medium and Long-Term Actions
	training, especially at regional level, given decentralization framework (Cost: moderate)	
Foster greater economic returns from Peru's 'comparative advantage' in biological diversity, including agrobiodiversity.	• Register all protected areas as state-owned land in public registries (Cost: low) • Assure that all Protected Areas have Management Committees (Cost: low) • For all Protected Areas, develop: 1) Work Plan, 2) Financial Sustainability Plan, 3) Master Plan, and 4) monitoring plan, as provided in existing national legislation and regulations (Cost: low to moderate)	• Foster public-private linkages to promote Peru's ecotourism sector (Cost: low) • Promote commercial uses of wild biodiversity through CONSITEC, National Competitiveness Council, and foster private sector initiatives (Cost: low) • Provide adequate financial and staffing resources to enable INRENA and Protected Areas to carry out Plans #1-4, once they are developed (Cost: moderate)

CHAPTER 8
ENHANCING COMPETITIVENESS TO IMPROVE DESIGN AND IMPLEMENTATION OF ENVIRONMENTAL POLICY

EIA is the main tool for environmental planning in Peru. However, its effectiveness is undermined by the lack of a uniform perspective regarding its objectives and usefulness. Specifically, there exists an ambiguity among government authorities as to whether its purpose is to achieve environmental planning or environmental management. This ambiguity has led to a situation where neither environmental planning nor environmental management is satisfactory and as a result environmental problems continue to persist. There is a clear need for the government to clarify the purpose of EIA. In doing so, it is crucial to recognize that as a planning tool, there is a need for strengthening screening and scoping procedures and improving mechanisms for public participation that allow for representative participation of the public including indigenous communities. If on the other hand, EIA is to be used as an environmental management tool, it is important to recognize its limitation, particularly where market and policy failures are strongly linked to environmental problems. A variety of mechanisms exist for controlling environmental degradation, including (i) direct regulation by government or "command-and-control" measures; (ii) economic and market-based instruments; and (iii) others including administrative procedures; legal actions; and formal negotiation. Economic instruments and command and control measures are far more efficient and effective to tackle Peru's priority environmental problems.

Introduction

8.1 A growing body of regulations has been passed in response to Peru's environmental problems[87]. The main environmental policy instruments for environmental planning and management include environmental assessment procedures (environmental impact assessments—EIAs—and environmental compliance and management program—PAMAs—) and environmental emission standards (*límites máximos permisibles* LMP*s*).

8.2 Concerns are routinely expressed by the private sector that the lack of overall coordination and clarity of the environmental approvals process leads to uncertainty and affects overall investor confidence. This concern is reflected in the environmental performance indexes of the Global Competitiveness Report 2005-2006 in which Peru is placed in the bottom quarter among 117 countries (Table 8-1). Poor management of environmental problems lies at cross-purposes to the achievement of sustainable economic growth and the protection and improvement of the welfare of Peruvians. A growing body of evidence from the experience of businesses in the most competitive countries (Japan, Germany, Denmark, and Ireland) in the past two decades shows that environmental performance is directly related to the quality of the country's business climate and the competitiveness of the businesses (Hammond, 2005; IADB, 2005).

8.3 Adopting strict and stable environmental requirements, and enforcing them in a clear and transparent manner, has improved the business climate in the most competitive countries. The 2005-2006 Global Competitiveness Report indicates that complying with environmental standards improves long-term competitiveness (Lopez-Claros and others, 2005). The business climate of a country is crucial to enable businesses to operate optimally and increase their productivity. Consequently, and particularly in an economy based on natural resources, the successful incorporation of environmental factors in the competitiveness structure of a country facilitates a business climate that is attractive to foreign investors,

[87] This chapter draws heavily from a background document prepared by Miles Scott-Brown (2005) for this study.

orients agriculture and industrial sectors toward higher value markets, reduces the pressure of productive sectors on the natural resources base, and offers new business opportunities in global markets (Lopez-Claros and others, 2005; Porter, 2005).

8.4 Consistent with the above, experience from the most competitive developing countries – such as Malaysia and South Africa – shows that environmental quality is a key factor that affects the growth and competitiveness of important economic sectors. In this context, failure to adequately address or respond to pollution problems has the effect of undermining the growth potential of the country and the competitiveness of its business sectors. In the same vein, failure to reduce the potential health risks that are presented to the public, by exposure to hazardous wastes and substances, has detrimental implications for the health and productivity of the population.

8.5 Therefore, the establishment of efficient and transparent environmental legislation in Peru, and increasing the enforcement capacity, is a dire need for Peru. Increasing the efficiency and effectiveness of an environmental regulatory framework, particularly of the EIA, PAMAs and LMPs system, correspond to an urgent need in Peru.

Table 8.1 Peru: Environment and Competitiveness (117 countries in total)

Indicator	Position of Peru	Position of Chile	Position of Colombia	World Leader	Position of Leader in Latin America
Stringency of environmental regulations	70	35	41	Germany	Brazil (25)
Clarity and stability of environmental regulations	78	38	50	Denmark	Chile (38)
Protection of ecosystems by business	83	23	45	Iceland	Chile (23)
Extent of government-mandated environmental reporting	87	45	58	Denmark	Panama (44)
Effects of compliance on business	88	37	78	Denmark	Chile (37)
Prevalence of corporate environmental reporting	88	36	59	Denmark	Brazil (32)
Prioritization of energy efficiency	60	30	44	Denmark	Brazil (25)
Importance of environment in business planning	96	67	66	Japan	Panama (28)

8.6 While EIA is still a relatively new process in Peru, it is being applied to a variety of sectors and investment projects. Previous studies have discussed ways in which environmental licensing procedures operate as a barrier to development, particularly in dynamic and growing sectors such as energy and mining (IADB, 1997; IADB, 2001; World Bank, 2000; Garcia, 2005; World Bank, 2005). Much less is known, however, about the influence of EIA and environmental licensing on Peru's environmental quality and the effectiveness and efficiency of EIA tools. There has been little comparative review of EIA practices across all sectors, relative to existing and proposed legislation and international EIA standards. There also has been little comparative analysis of EIA effectiveness, particularly in regard to monitoring, follow-up and compliance with EIA commitments. In order to address these gaps, this chapter analyzes the existing environmental policy framework for sectoral environmental management in Peru, particularly its environmental impact assessment system. Section 4.2 describes the evolution of Peru's environmental impact assessment system. Section 4.3 discusses the effectiveness of the EIA system as the main environmental planning tool in Peru. Section 4.4 analyzes the effectiveness of EIA for environmental management in Peru. Section 4.5 analyzes the application of EIA to three projects in the mining, electricity and oil sectors. Section 4.6 discusses the limitations of EIA. Finally, section 4.7 presents

conclusions and discusses options to improve the design and implementation of environmental assessment.

Peru's Environmental Impact Assessment System

8.7 The institutional and legal framework governing environmental assessment and licensing in Peru has evolved from 1990 when the Code of the Environment and Natural Resources established it as an environmental planning tool (CONAM, 1999). A series of laws and regulations constitute Peru's environmental impact assessment (Table 8-2). Legislative Decree 757 establishes that the legal authority for environmental approvals and compliance is regulated at the ministerial level. Legislative Decree 757 also identifies the responsible ministry for specific industrial and other regulated activities. This has been done through the enactment of various sectoral regulations and guidelines. Each ministry is responsible for defining the EIA process and the terms of reference for the content of environmental impact studies.

8.8 Environmental assessment systems are not uniform across all ministries in Peru. The ministry with the strongest EIA system is the Ministry of Energy and Mines, followed by the Ministries of Transport and Communications and the Ministry of Production. INRENA has a dual mandate in the EIA process. It acts as a review agency to other ministries where natural resources may be affected and also is the sectoral authority for the EIA review of agricultural projects. The devolution of responsibility to the ministerial level has created a diversity of approaches to EIA from a legal, organizational and institutional perspective. A variety of regulations specify different types of EIA documents, terms of reference for EIA scope and content, timing for review and approval, and means of public consultation. While the proposed regulations to the SEIA attempt to unify the EIA process with respect to categorization, content, process and timing, they still have yet to be promulgated. As a result, there is currently no unified approach to EIA in Peru, and each ministry is conducting EIA according to their specific regulations and institutional practices. Not only do EIA practices differ significantly between ministries, they also differ within ministries, for example within the Ministries of Energy and Mines and within the Ministry of Production. Furthermore, not all Peruvian ministries conduct EIA of projects and activities.

Table 8.2 Peruvian environmental legislation pertinent to environmental impact assessment

Law	Relevance to EIA
Code of the Environment and Natural Resources Legislative Decree No. 613 of 1990 (CAM)	First law to establish need for EIA. Indicated list of activities subject to EIA. Provision superseded by Law 757.
Framework Law for Increasing Private Investment – Legislative Decree No. 757 of 1991	Delegated responsibility for EIA and environmental management to sectoral authorities (ministries).
Law for Environmental Impact Assessment of Projects and Activities. Law No. 26786 of 1997	Establishes CONAM's oversight role in EIA process but Ministries responsible for EIA.
Law of the National System for Environmental Impact Assessment. Law 27446 of 2001	Establishes a true "one-window" system for EIA. Establishes uniform procedures to identify requirements, steps and scope of EIA. Establishes three categories for EIA: I Environmental Impact Declaration (DIA) II Semi-detailed EIA III Detailed EIA Establishes mechanisms for public participation. By December 2005, this Law was not in force, as regulations have not been enacted.
General Law of the Environment. Law No. 28611 of 2005	Article 24 states all project, plans, programs and policies that could cause significant environmental impacts are subject to requirements of SEIA.

8.9 The current ministries that undertake EIA in Peru include: Energy and Mines, Production, Transport and Communications, and Agriculture. As of December 2005, the status of EIA in other government ministries is as follows:

> **Foreign trade and tourism** – Currently, Tourism does not have a legal framework for EIA. The sector has been working with CONAM to define an EIA guide for the tourism sector. Some EIAs have been done on tourism projects, mostly on ecotourism concessions offered by the government;
>
> **Communications** (done for Transport) – Investment projects in this subsector are associated almost exclusively with the installation of transmission towers and cable. An environmental protection regulation states that technical environmental studies are required which are similar in format and content to an Environmental Impact Declaration (DIA);
>
> **Defense** – There is no legal framework for EIA established. The draft SEIA regulations include a series of projects which will require EIA in future;
>
> **Housing, Construction and Sanitation** – In 2006, the Environmental Directorate of the Ministry will develop EIA regulations for the sector. Consultants have been hired to prepare a proposal for environmental management.

8.10 At the regional and local level, EIA is mostly non-existent. Regional Authorities have limited capacity in EIA and focus their attention towards construction and operating licenses, which require the approval of DIAs or EIAs in order to be made effective. In practice, little is done towards this.[88]

8.11 Overall, the EIA capacity within Peruvian government ministries is very weak. Staff is largely inexperienced in environmental impact analysis and continuity is complicated by a significant staff turnover and significant lack of financial resources. The review of environmental impacts assessment studies focus more on technical aspects, rather than issues of impact analysis and environmental management. Staff has little experience in the EIA approval, monitoring and follow-up process, and training in EIA within ministries is generally lacking. Finally there is a vacuum between the EIA process and land use zoning, and pollution control.

8.12 Law No. 27446, passed in April 2001, establishes a new environmental assessment process, the National System for Environmental Impact Assessment (SEIA), which establishes a one-window system for environmental impact assessment and establishes a process for environmental approvals. Law No. 27446 and its regulations have yet to come into force.

8.13 The Law of the National System for Environmental Impact Assessment, Law 27446, establishes several objectives for Peru's EIA system. At one side of the spectrum, the Law adopts the EIA goal of the first EIA system enacted in the United States in 1969 (NEPA, 1969). According to this view, EIA is a planning tool aimed at opening up decision making to public scrutiny and providing citizens the opportunity to better understand impacts and alternatives of an investment project (NEPA, 1969; Ortolano, 1998). This goal can be attained by including regulations that point out clear procedures for EIA screening, public participation, scoping, analysis of alternatives, information disclosure and accountability. On the other side of the spectrum, the Law also allows for the design of an EIA system that is the base of an environmental protection statute. In this case, a portfolio of environmental regulations might be designed and implemented to include regulations for: (i) land use zoning, (ii) pollution control, (iii) conservation of biodiversity, (iv) management of forest, water and other natural resources, and (v) technical environmental specifications for sectoral environmental management. In this

[88] An exception to this is the Municipality of Lima, which has undertaken EIAs, but only in the historic center of the city.

latter case also the EIA system would include requirements for the design of environmental management plans based on detailed mitigation measures.

8.14 Currently, at a conceptual level, clear conflicts exist with respect to normative understanding of the EIA in Peru. At the project level, different stakeholders (public and private) in the development assessment process have very different expectations of the EIA process. EIA is characterized by most as an information gathering exercise, by environmentalists as environmental advocacy, for academics as a mechanism for integrated analysis, for the private sector as a compliance tool, a risk management (safeguarding) framework, a mechanism for public deliberation, and as an awareness raising instrument. According to the draft regulation for the Peruvian National System of Environmental Impact Assessment (SEIA), EIA is defined as:

> The orderly, coherent and reproducible set of analyses for the adoption of decisions and measures that permit the project proponent, government authorities and civil society to understand in an integral manner, at the earliest stage possible, the potential positive and negative impacts generated by the Project proposal, as well as the Environmental Management Strategy to be adopted, following approval of the environmental impact assessment, to prevent, control, mitigate, recuperate or compensate those negative impacts, while promoting the positives. (CONAM, 2005:43)[89]

8.15 This definition incorporates the different objectives of EIA (NEPA, 1969; IAIA, 1999) including:

- To open up decision making to public scrutiny by providing citizens the opportunity to better understand impacts and alternatives of an investment project;
- To ensure that environmental considerations are explicitly addressed and incorporated into the decision-making process of projects;
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals;
- To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
- To promote development that is sustainable and optimizes resource use and management opportunities.

8.16 Delays in issuance of regulations for the SEIA have contributed to confusing objectives for EIA systems currently in place in Peru. There is an inconsistency in the approach, content, timing and requirements of the EIA legal and regulatory process developed by sectoral ministries to achieve the objective of opening up governmental decision making to public scrutiny. This inconsistency is blatant in EIA procedural components such as: (i) timing of public consultation procedures from the onset of the project through approval and implementation; (ii) mechanisms for incorporating the results of public consultation into the decision-making process; (iii) public disclosure of project information and accessibility of information (location, language, etc.); and (iv) feedback to participants of the results of the consultative process. At the other end of the spectrum, EIA has become de facto a substitute for pollution control regulations and effective land use planning, but should instead form part of the land-use planning process. EIA goals associated with avoiding, minimizing or mitigating environmental impacts to third parties could only be attained with the design and implementation of regulations for: (i) land use zoning, (ii) pollution control, (iii) conservation of biodiversity, (iv) management of forest, water and other natural resources, and (v) technical environmental specifications for sectoral environmental management.

[89] Translated by Scout-Brown (2005). Page 43: Reglamento de la ley del sistema nacional de evaluación ambiental

Environmental Assessment as a Planning Tool

8.17 An analysis of EIA practices in the ministries of Energy and Mines, Transport, and Agriculture, shows that the lack of a consistent and efficient screening process has led to an excessive number of EIAs completed that are not necessary. The resources of environmental units in these ministries are mostly spent in reviewing reports. The analysis also shows significant differences in (1) screening, (2) scoping, (3) evaluation criteria, (4) public consultation, (5) timing of EIA approval among the different ministries, (6) monitoring and (7) follow-up procedures (Table 8.3).

Screening

8.18 The purpose of screening is "to determine whether or not a proposal should be subject to EIA and, if so, at what level of detail" (IAIA, 2005).[90] In Peru the responsible ministerial authority determines screening of projects and activities and thus screening is not consistent between ministries and sectors. This leads to an overall lack of clarity in regard to assessing the significance of project impacts. In some cases projects with significant impacts are not subject to EIA. For example, in the transport sector a case in point is the construction of the InterOceanic highway, launched in 2005, which will complete a connection with Brazil and provide a direct commercial link between Peru's Pacific ports and the Atlantic Ocean. In other cases, many projects are subject to EIA, but this is often unnecessary as the prevention or mitigation of project impacts could be addressed through technical environmental specifications, environmental management plans, a land-use zoning bylaws or a pollution control regulation.

8.19 In order to address this deficiency, Article 4 of the Law of the National System of Environmental Impact Assessment (Law 27446) aims to assess project proposals based on their environmental risk in three categories:

> Category I: Environmental Impact Declaration – no negative significant impacts expected;
>
> Category II: Semi-detailed Environmental Impact Assessment (EIA-sd) – those Projects which could result in moderate impacts that can be minimization through the adoption of mitigation measures; and
>
> Category III: Detailed Impact Assessment – those projects whose characteristics and location can result in significant negative quantitative or qualitative impacts requiring a detailed analysis of project impacts and the development of environmental mitigation strategy (EIA-d).

8.20 Contents of the EIA for Categories II and III are specified in Annexes of the proposed regulation of the Law 27446. As neither the SEIA law nor the regulations are in force, consistent screening and focus of EIA scrutiny in Peru is highly inconsistent and ineffective.

[90] See www.iaia.org for description of best EIA practices

Table 8.3 Summary of Findings of Survey of EIA Practice in Peru by Ministry and Sector

Ministry/Sector	Organization	Training	Screening	EIA Preparation	EIA Timing	Compliance Monitoring	Public Participation
DGAAM. Ministry of Energy and Mines. Environmental Issues-Mining	14 professionals in 3 areas. Technical - 1 director + 6 professionals. Legal - 1 director + 3 assistants Community Relations - 1 director + 2 CR staff	Limited formal EIA training apparent. Regular participation in issues within MEM. No specific mention of courses.	3 categories described. Legal declaration, Environmental evaluation, EIA plus PAMA and closure plans	TOR for EIA preparation on website - 1997. Focus on environmental issues, no mention of public consultation	45 days	Done by inspection and auditing companies	Community relations guide provide state of the art guidance on procedures but this content is not included in existing regulation R.M. 596-2002.
DGAAE. Ministry of Energy and Mines. Environmental Issues - Energy	22 professionals in 4 areas; environmental management, legal, community relations, GIS	Limited formal EIA training apparent. Regular participation in issues within MEM. No specific mention of courses.	2 categories. Preliminary EIA and EIA, plus PAMA	TOR for EIA available on website (no date). More emphasis on social considerations, mention of consultation, no cumulative effects assesment	210 days for exporation and production activities (DS-003-2000-EM)	OSINERG, reports to Council of Ministers	Governed by R.M. 535-20004-MEM-DM. Largely through information workshops. Public hearing to be held. No specific guideline available.
DGASA. Ministry of Transport and Communications. Transport subsector	4 staff in general directorate; 12 staff in socio-environmental evaluation; 11 staff in expopriation and resettlement	DGASA implements training courses. No further details given.	2 categories DIA - Declaration Environmental Impact (no risk) and EIA	Preparing TOR	6-7 months	DGASA has no role in compliance and follow-up. Done by independent companies to monitor compliance by contractor	Regulated by R.D. 006-2004-MTC/16.01. 10-20% of projects conclude without consultation

Scoping

8.21 The purpose of scoping in EIA is: "to identify the issues and impacts that are likely to be important and to establish terms of reference for EIA" (IAIA, 2005).[91] The legislation governing the Peruvian EIA process does not include a formal requirement for the scoping of issues; the EIA terms of reference for proposed projects within different industrial sectors are defined by the responsible ministerial authority. Generic EIA terms of reference are available for the mining, oil and gas, electrical, agricultural and industrial sectors. Within the various EIA terms of reference examined as part of this review, only those of the Sub-directorate of Hydrocarbons contain any reference to scoping. Even then, there is little elaboration on methods for scoping of both environmental and social issues. Similarly, in most EIA processes, public participation is absent in the scoping for identifying key issues for analysis.

8.22 Significant differences are observed in the treatment of key components of what is considered as best practice for EIA. These components include (i) EIA scoping based on public consultation process at the earliest stage of the project to help define major environmental and social issues; (ii) determination of spatial and temporal boundaries; (iii) consistent process for analysis of alternatives; (iv) data collection consistent with the scoping process and identification of data gaps; (v) determination, analysis and prediction of impacts, including impact significance and quantification of impacts, where possible; (vi) consideration of cumulative effects, including suggested procedures for their determination and assessment; (vii) consistency in content and scope of environmental management plans in relation to predicted impacts; (viii) detailed monitoring and follow-up plans to confirm the effectiveness of project mitigation measures and the accuracy of impact predictions; (ix) consideration of all project phases (life cycle approach), including decommissioning and abandonment; and (x) public participation in governmental decision making.

8.23 The EIA terms of references reviewed as part of this study do not refer explicitly to the establishment of spatial, temporal, technical and administrative boundaries at the onset of the EIA scoping process (Beanlands and Duinker, 1983). This leads to a lack of definition in EIA scope largely to direct project impacts, often at the expense of not addressing more regional and induced impacts that are more significant and widespread in their consequence.

8.24 An unbiased analysis of alternatives is a critical part of EIA and should be done early on in the planning stage before project design decisions are taken. Analysis of alternatives is mentioned in some terms of reference (e.g. Hydrocarbon Sector) but the process is not fully described. Ideally, the analysis of alternatives should be presented as a stand-alone chapter and be used as part of project justification.

8.25 As of December 2005, the EIA process in Peru does not explicitly nor effectively address the assessment of cumulative effects of all other past, present and pending developments in association with the impacts of the proposed project. The existing EIA TORs for each sector do not explicitly refer to how such an assessment should be considered and conducted (Hegmann and others, 1999).

8.26 In Peru, EIA terms of reference contain information on what impacts should be assessed, but lack specific details regarding how impacts should be assessed and, more importantly, how their importance or significance should be determined. In order to be effectively used as a decision-making tool, the EIA should determine the importance of environmental and social impacts, based on information collected as part of a baseline and also considering the effectiveness of mitigation methods to remove or reduce the impact to an "acceptable" level.

[91] See www.iaia.org for description of best EIA practices.

8.27 To be effective, EIA terms of reference should consider the following in regard to the assessment of project impacts:

- Impacts should be quantified to the best extent possible, based on the best information available to the EIA consultant at the time of preparation; and
- The determination of impacts should also be defensible, in that it involves a clear and transparent process, the adequacy of which can be independently verified by the public or third party reviewers.

8.28 While there are a number of procedures, models, and matrices available for the determination of impacts, the following variables should be referenced at a minimum: magnitude, scale and extent, duration, frequency, uncertainty and scientific probability. Only the TOR for Hydrocarbons of the Ministry of Energy and Mines makes mention of these variables. Other TORs should also consider their use.

8.29 In terms of the quality of EIAs in Peru, the focus of environmental assessment is geared toward approval of the project EIA rather than toward ensuring long-term environmental management and sustainability (De la Puente, 2005).[92] Scoping of EIAs without public participation correlates with the low quality of EIAs. Environmental Impact Assessment studies in Peru are a largely descriptive exercise with an "academic" focus on baseline data collection. There is lesser emphasis given to the determination, prediction and analysis of project impacts. There is no formal requirement to assess the cumulative effects of single projects, nor an established methodological process.

8.30 EIA preparation is the responsibility of the project proponent. According to Peruvian law, only approved consultants or institutions can prepare EIAs within each sector. With the exception of the Vice-Ministry of Fish Production, all Ministries surveyed maintain consultant registries and a qualification process for completing environmental impact assessments. The maintenance of these consultant registries is largely a bureaucratic exercise and in practice does little to improve the standards and quality of EIAs or to ensure the competence of EIA practitioners. Moreover, the registry is subject to lack of transparency with regard to contract awards to competent companies.

8.31 As is common worldwide, the cost of EIA preparation in Peru is borne by the project proponent. There are no published standards or guidelines as to what EIA should cost in Peru; the wealth of the sector often dictates the cost of EIA preparation. Typically in Peru, EIAs in the oil and gas sector are the most costly and elaborated, followed by those of the mining, electrical and transport sectors. EIAs in sectors that have low economic returns, such as the fish processing sector, are not highly elaborate and are done at low cost. Large international consulting companies therefore focus their efforts on those sectors with the highest return and number of projects, namely the mining and oil and gas sectors. Mining EIAs dominate in number, as there are few large oil and gas projects currently under development in Peru (Furst, 2005).[93]

Public Participation

8.32 Public involvement is the term used for a spectrum of approaches that can help mitigate misunderstandings or disagreements with stakeholders. It gives stakeholders the opportunity to participate in and possibly have increasing levels of influence over business activities that may affect them (Canadian Association of Petroleum Producers, 2005). Public participation in the

[92] In a review of EIA for mining and hydrocarbon projects in Peru, de la Puente (2005) states that EIA is an administrative procedure for obtaining environmental approval rather than a tool for environmental management.
[93] Personal communication to Miles Scott-Brown with Dr. Thomas Furst. Environmental Scientist. Vector Peru S.A.C. Lima, Peru.

EIA process has been initiated in Peru and both formal and informal processes are in operation. Although guidelines for public participation exist in most ministries, there is no standardized public consultation process across the anticipated life of a project. Public participation, while initiated early in some cases, is only usually conducted to the time of the public hearing, usually held within 30 days of an approval decision. Consultative processes and mechanisms thus vary substantially between ministries.

8.33 Public participation in the EIA process in Peru is largely informative in nature: to inform the public about coming projects and their legal rights, and to inform them about the project and its potential impacts and management. Formal public hearings are geared more towards dissemination of project information rather than providing a mechanism whereby public comment and input can enter the decision-making process and affect the outcome of approval decisions. As stated recently by Manuel Pulgar Vidal, "…public participation implies, among other rights, involvement at the true level of the decision-making process, to have the right to reject a project, to participate in an effective manner in the benefits arising from the project and to demand from government objectiveness and representation in project decisions…" (in Brunke, 2005). Holden and others (2005) comment on the shortcomings of the public participation process due to the fact that most consultation is conducted in Lima and that rarely the affected community is involved.

8.34 The lack of consistency in the approach to and scope of public participation in Peru have made it difficult or impossible for the opinions of indigenous people to be taken into account in the EIA process. Opinions expressed by indigenous people from the Peruvian Amazon at the recent ECODIALOGO held in Iquitos in February 2006 indicated that indigenous people consider the development of projects, such as infrastructure expansion, in the Amazon as infringements upon their habitat that threaten their home and indeed their source of livelihood as clear regulations that provide for their protection do not exist.[94]

Monitoring and Follow-Up

8.35 EIA follow-up is defined as "*the monitoring and evaluation of the impacts of a project or plan…for management of, and communication about, the environmental performance of that project or plan*."…[95] Recently, academic groups have proposed a shift in EIA follow-up and monitoring from monitoring and evaluating impact predictions towards establishing links with environmental management, sustainability assurance and communication with project affected stakeholders.[96]

8.36 As in most countries with EIA systems, in Peru, the EIA follow-up and monitoring process is poorly developed and largely ineffective.[97] The responsible authority at the ministry level grants the approval of the environmental impact assessment study. However the responsible authority is not necessarily accountable for the supervision and compliance of the Project. This responsibility is turned over to another agency (either within the Ministry, or independent of it) that is responsible for monitoring, compliance and enforcement. Within the Vice-Ministry of Energy, this responsibility is assumed by OSINERG, a separate organization responsible to the Presidency of the Council of Ministries. Within the Vice-Ministry of Mines,

[94] Opinions expressed by participants from AIDESEP, CONAIE and CIDOB at the ECODIALOGO held in February 2006.
[95] Morrison-Saunders, A. and J. Arts. 2004 (Eds.) Introduction to EIA follow-up. p. 1-21. In: Assessing Impact: Handbook of EIA and SEA Follow-up. Earthscan, London.
[96] Morrison-Saunders, A. and J. Arts. 2005. Editorial: Learning from experience: emerging trends in environmental impact assessment follow-up. Impact Assessment and Project Appraisal. Vol. 23 (3):170-174.
[97] The official word in Spanish is *fiscalización* which has no direct translation in English. Compliance monitoring and enforcement is the closest translation available. Fiscalización is more concerned with legal and financial aspects of compliance than follow-up of environmental and social commitments contained within the EIA and its related environmental management plan.

Ministry of Transport and Communication and Agriculture, the monitoring function is assumed by another agency within the same Ministry.

8.37 Compliance monitoring is largely concerned with administrative procedures, and far less with ensuring commitments made in the EIA are upheld. In addition, financial constraints often impede the ability for effective compliance monitoring in the field. Finally, monitoring reports are not available to the public for review and the public has no role in the EIA follow-up process.

8.38 There are currently three forms of *fiscalización*, or compliance monitoring, being done at the present time in the Peruvian EIA system:

- Completed within the Ministry itself, e.g. Compliance Monitoring Directorate, General Directorate of Mining.[98];
- Completed by independent government agency – e.g. OSINERG which reports to the Council of Ministers; and
- Completed by a third partner private sector consulting company that is officially registered for this type of work within the specific ministry e.g. MTC.

8.39 At the time of EIA preparation, only preliminary engineering details are usually available. Environmental management plans presented in EIA therefore are largely conceptual in nature and are intended to be a guideline as to how they will be implemented once detailed engineering design is finalized. The compliance monitoring entity is also directed by legal requirements that are more concerned with formal compliance than actual commitments made in the EIA. The overall result is a weakened and largely ineffective EIA follow-up process.

8.40 A number of other observations and concerns exist about how compliance monitoring (*fiscalización*) is actually implemented in the field:

- Random inspections can not be made unless there is a fatal accident or emergency situation (CED, IDB, 2002);
- Since the compliance monitoring agency or consultant is not based permanently in the field, but rather visits the project on a scheduled basis, there are concerns about number of visits and the level of detail that can be garnered, compared to a full-time compliance monitoring presence;
- Although companies are registered to conduct compliance monitoring and guidelines exist for some ministries, there are concerns about their qualifications and the amount of budget available compared to EIA preparation;
- There are questions about the technical competence of third party companies and how they are contracted;
- There are questions as to how the compliance monitoring budgets are determined relative to the needs of compliance;
- The focus of compliance monitoring is aimed more at financial and legal compliance than the actual implementation of EIA commitments;
- There are concerns about the capacity to monitor discharges and evaluate actual compliance; and
- There are concerns about penalties and the implementation of fines.[99]

8.41 Realizing the complexities associated with the follow-up and monitoring of complex mega projects, the Peruvian Government established the Inter institutional Technical

[98] Dirección General de Minería – Dirección de Fiscalización

[99] According to a September 25, 2005 article in the Peruvian newspaper, El Commercio, OSINERG fined 17 petroleum companies in 2005 for environmental infractions, none of which have been paid.

Coordinating Group (GTCI) for the Camisea gas project. It was established under D.S. No. 120-2002-PCM to coordinate and strengthen the supervision, follow-up and compliance monitoring of environmental and social aspects arising from execution of the Camisea Gas Project.

Analysis of Case Studies

8.42 In order to support the findings of this review, three EIAs, considered by governmental officers as best practice, were reviewed as case studies to assess the EIA preparation, review and approval process against established best international EIA practice Case studies were selected from the mining, electricity and oil and gas sectors (Tables 4.4 - 4.6). The mining project is the Antamina copper-zinc mine located in the Department of Ancash. The project consists of three components: an open pit mine, processing facilities, and infrastructure (port, pipeline, roads and power transmission). The Kallpa project involves the construction of 380 MW thermal generation plant in the district of Chilca, in the Lima Department. The plant will consist of two 190 MW turbines and a 220V electrical substation. The Lote IX project involves the oil drilling of two development wells in Lote IX, Piura.

Case Study 1: ANTAMINA

8.43 The following is an analysis of the Antamina Mine operated by Compañía Minera Antamina S.A. (CMA).

Table 8.4: Case Study Analysis – Antamina

EIA Component	Analysis
Project Description	Antamina is the world's third largest mine and the leading combined copper-zinc mine with a capital cost of US $2.3 billion. It is located in the Department of Ancash in the Peruvian Andes approximately 473 Km north of Lima. The project consists of three components: an open pit mine, processing facilities, and infrastructure (port, pipeline, roads and power transmission). The mine began production in 2001 and has an expected operating life of 20 years.
Timeline of EIA Activities	March 1998 – EIA submitted for approval April 1998, public hearing (Lima) took place May 1998, MEM and INRENA presented observations to the EIA June 1998, CMA answered all the observations July 1998, CMA filed the Road Addendum July 15, 1998 – EIA approved January 1999 – Concentrate pipeline EIA addendum submitted for approval January 1999 – public meetings at Huallanca, Chiquian, Chavín, San Marcos, Huaraz, Aquia, Chasquitambo, Huarmey and Public Hearing (Lima) took place. February 1999 - INRENA presented observations March 1999 – MEM presented observations March 1999 – CMA answered all observations March 1999 – MEM approves the addendum
Screening	According to regulations of the Ministry of Energy and Mines, Environmental Issues, Mining an EIA was required.

EIA Component	Analysis
Scoping	Scoping of issues was done using a simplified failure modes and effects analysis (FMEA) and workshop. Workshop consisted of experts only and did not involve general public or affected stakeholders.
EIA Preparation	In October 1996, CMA retained Klohn Crippen SVS S. A. (KC-SVS) to prepare an Environmental Impact Study (EIA) for the Antamina Project. The EIA was filed with MEM in March 1998. Addendums were submitted for a new access road (1998) and concentrate pipeline (1999). The EIA was prepared considering Peruvian government EIA requirements, CMA environmental and socio-economic policies and World Bank guidelines developed for mining projects.
EIA Content	EIA approach for the most part consistent with World Bank standards and consisted of a three-part process – Issue scoping, Impact assessment analysis, implementation. Detailed assessment of project boundaries and impacts were assessed using a matrix approach as either significant or non-significant. Variables considered included magnitude, duration, geographical extent and probable frequency of occurrence of expected interactions. No analysis of cumulative effects or regional effects. No formal alternatives analysis including impact evaluation presented. An analysis of alternatives for the concentrate transportation route was completed.
Analysis of Alternatives	The EIA refers to an analysis of alternatives but no formal analysis appears in the EIA document. An analysis of alternatives consistent with the requirements of O.P. 4.01 environmental assessment was not done.
Major Impacts	Environmental: – impacts on surface water quality, loss of habitat, heavy metal release, local impacts on air quality, reclamation and long-term liability issues associated with closure, impacts on cultural resources. Socio-economic: resettlement, immigration, increased housing demand . There are anticipated improvements in educational and health facilities, increased employment opportunities, new housing development and improved infrastructure and social services.
EIA Evaluation and Decision	Peruvian legislation in force in 1998 provided that MEM and INRENA were involved in EIA approval. It is likely that today interventions of other ministries such as MTC would be involved.

EIA Component	Analysis
Mitigation and Monitoring	According to the EIA, CMA will adopt environmental standards for the project based on company policy, legal regulatory limits in Peru, and World Bank Guidelines as well as the limits, objectives and guidelines used in North America. The project will employ a Best Management Practices approach, as used by the mining industry world wide, to control emission sources and prevent accidental releases during operations. During construction, control measures to minimize disturbance and prevent and control erosion and spills were developed for each project element (mine, port, roads, power line) to limit environmental effects, protect watercourses and sensitive habitats. These measures were described conceptually in the EIA and further elaborated by CMA as part of comprehensive project environmental management plan. During construction, operations and closure CMA will monitor the quality of discharges to the environment as well as the ambient condition of surface water, groundwater, air and soil that may be affected by such discharges to verify compliance with Peruvian regulatory requirements. In addition to direct monitoring of water and air, CMA will implement Environmental Effects Monitoring (EEM) to document the health of biological communities. A resettlement policy and community development plan were prepared. The community development program builds on the principles of respect for the local communities, to engage them in planning for change, to emphasize self-sustaining and community driven initiatives, and to secure benefit to the community from project development.
EIA Follow-up and Compliance	EIA follow-up and compliance involves the following: MEM performs periodic audits (usually 3 times a year) to the mine and port sites. It also reviews the quarterly environmental monitoring information submitted by CMA. DIGESA performs a periodic surveillance of the ambient air and water adjacent to the mine and port sites. Monitoring results are also reported to local environmental monitoring committees.
EIA Cost	A total of US$$5-10 million was spent on EIA costs and permits. The Annual Environmental Budget is between US$3-4 Million.
Public Participation	Public participation for the project followed Peruvian guidelines and included the following: public meetings in the project area, open house in Lima and formal public hearing in Lima. The EIA was widely distributed and made available in Spanish and English. Following project approval, local environmental committees were set up in communities across the Project. Current public consultation efforts include: • Public meetings to discuss environmental issues • Distribution of quarterly reports on CMA´s environmental monitoring program • Delivery of the Environmental Impact Assessment (EIA) and annual Sustainability Reports • Joint monitoring work with the participation of the community, local entities, government authorities, NGOs and other stakeholders • Resolution of environmental grievances and claims • Guided visits by stakeholders to CMA´s operations • Involvement by CMA in regional environmental work groups, sponsoring the participation of the environmental committees and assisting in the development of local environmental policies.

EIA Component	Analysis
EIA improvements and recommendations for follow-up	Suggested improvements to the EIA process are as follows: • The EIA only considered the impacts of each mine component separately and should have assessed the combined effects of the Project. • A stand-alone alternatives analysis should have been completed compliant with O.P. 4.01 requirements • The EMP was conceptual in nature and more details should have been provided. • A cumulative effects and regional assessment should have been done. • Although public consultation and disclosure complied with Peruvian requirements, efforts could have been initiated earlier on the EIA process. Since project approval, CMA has adopted a comprehensive environmental management program to implement project environmental controls. This has overcome a weakness of the EIA whereby details on environmental management plans were not fully available at the time of preparation. Long-term liability issues are being addressed in response to new government legislation on mine closure. CMA is actively monitoring the implementation of EIA commitments and success of project mitigation. A third party company also conducts independent audits. Government monitoring and compliance review focus on compliance of project air and water discharges, solid waste management and tailings impoundment stability. On the social side, public consultation and involvement processes could have been initiated earlier during the project approval process. Since project approval, CMA has taken a more proactive approach to public involvement forming environmental committees across the Project. CMA is initiating the efforts without being directed by regulatory demands or requirements. CMA has also formed the Ancash Association to help foster sustainable development across the Project. A fund of US$1.5 Million was established for this purpose. The EIA for the Antamina project demonstrates that EIA is a tool to be used in a comprehensive environmental management process over the life of the project. The EIA forms the basis for corporate commitments, which are then developed during Project operations. An adaptive management approach is a key part of the successful environmental management program.

Case Study 2: Kallpa Thermoelectric Plant, Chilca, Peru

8.44 The second case study is an EIA of the 380 MW Kallpa thermoelectric generating station, that was submitted to the Ministry of Energy and Mines in September 2005. The Project EIA was downloaded from the MEM website and reviewed.

Table 8.5: Case Study Analysis: Kallpa

EIA Component	Analysis
Project Description	Globeleq Peru (S.A.), a division of Globeleq is proposing to construct and operate a 380 MW thermal generation plant in the district of Chilca, Canete Province, Lima Department. The plant will consist of two 190 MW turbines and a 220V electrical substation. The plant will use gas from the Camisea Project as an energy source and connect to the national grid. No information is provided on project costs.
Timeline of EIA Activities	September 2005: Submission of EIA
Screening	According to regulations of the Ministry of Energy and Mines, Environmental Issues, Energy an EIA was required.
Scoping	There is no indication in the EIA as to whether scoping was conducted.
EIA Preparation	The EIA was prepared by Walsh Peru S.A. The EIA complies with Law 757 and 27446 and was prepared in accordance with the Guide for Environmental Impact Studies for electrical activities, the Environmental Protection Reglation for Electrical Activities D.S. No. 029-94-EM (06-08-94) and World Bank Thermal Power Guidelines for New Plants (1998). Globeleq's corporate policy is to comply with the most stringent of either Peruvian or World Bank emission standards.
EIA Content	The EIA process consisted of three phases: Background review/field work, impact analysis and report preparation. The impact evaluation methodology follows World Bank and best EA practice procedures. A cause-effect matrix was used to evaluate project impacts considering the following: duration, intensity, frequency, magnitude and probability of occurrence. A positive or negative impact value was determined and an impact significance value was assigned. No analysis of cumulative effects or regional effects was conducted.
Analysis of Alternatives	There was no analysis of alternatives described in the EIA document.
Major Impacts	Impacts were described for both the construction and operations phase. A summary of major impacts follows: Environmental: impacts to air quality, noise, visual quality, changes in land use, and faunal disturbance. Social: impacts on traffic flow, expectations for employment, increase in land prices and living costs, potential for social conflicts. Positive impacts include provision of employment and improved availability of services.
EIA Evaluation and Decision	Under evaluation by MEM

EIA Component	Analysis
Mitigation and Monitoring	Monitoring will be done during both construction and operation phases. Monitoring during construction will focus on contractor compliance with the project environmental management plan. A community relations plan will also be put in place to manage construction and operations impacts on local communities and residents. Monitoring during operations will be done for stack emissions, air quality, noise and vibration. Compliance monitoring on behalf of the government will be done by OSINERG.
EIA Follow-up and Compliance	Globeleq will implement an environmental management plan during construction and operations including the following: • Impact prevention • Solid waste management • Monitoring • Occupation health and safety • Community relations • Management of social conflict A Contingency Plan and an Abandonment Plan are also provided.
EIA Cost	No figures available in the EIA.
Public Participation	Four participatory workshops and four focus groups were conducted assess the perception of the local population about the project and to gain baseline information. Additionally, in accordance with the Regulation for Public Participation, two information and consultative workshops were done prior to the EIA and two others during preparation of the EIA.
EIA improvements and recommendations for follow-up	Suggested improvements to the EIA process include: • A stand-alone alternatives analysis should have been completed compliant with O.P. 4.01 requirements • The EMP was conceptual in nature and more details should have been provided. • A cumulative effects and regional assessment should have been done considering other electrical generation projects and other industries The level of effort expended in the EIA appears to be sufficient, but no details are provided on project or EIA costs. Public participation appears to be sufficient relative to the extent of the Project but no information is provided as to how information collected in the EIA was used in the decision making process.

Case Study 3: EIA for the drilling of two development wells in Lote IX, Piura, Peru. Company: Empresa Petrolera Unipetro ABC SAC

Table 8.6: Case Study Analysis – Lote IX, Piura

EIA Component	Analysis
Project Description	The project involves the drilling of two development wells in Lote IX, Piura. Lote IX is an existing field
Timeline of EIA Activities	EIA was submitted in July 2005. No further information on the status of the EIA is provided on the MEM website.
Screening	According to regulations of the Ministry of Energy and Mines, Environmental Issues, Energy an EIA was required.
Scoping	There is no indication in the EIA document that scoping was conducted.
EIA Preparation	The EIA was prepared by ECOLAB SRL, Lima, Peru. No information is available on EIA cost.
EIA Content	EIA approach for the most part consistent with World Bank standards and involved the following – project description, description of natural and human environment, impact evaluation using a matrix approach and preparation of an environmental management plan. No analysis of cumulative effects or regional effects. No formal alternatives analysis, including impact evaluation presented.
Analysis of Alternatives	An analysis of alternatives consistent with the requirements of O.P. 4.01 environmental assessment was not done.
Major Impacts	Environmental: – impacts to air quality and noise associated with drilling activities, impacts on soil quality from construction, spills and improper disposal of drilling waste, loss of vegetation and landscape alteration, disturbance to wildlife due to noise and air quality impacts Socio-economic: visual impacts of drilling rig, potential impacts on health due to operations and improper waste disposal, risk of accidents due to increased traffic. No archaeological resources were encountered.
EIA Evaluation and Decision	No information is available on the MEM website regarding a decision on the EIA.
Mitigation and Monitoring	Monitoring of air quality, water quality in runoff and noise will be conducted. The environmental management plan outlines typical best management practices to minimize the impacts of drilling activities.
EIA Follow-up and Compliance	No information on follow-up and compliance provided. According to established practice, OSINERG will be responsible.
EIA Cost	No information is provided on EIA costs.
Public Participation	The status of public consultation efforts is not clear. The EIA refers to participatory workshops but the respective annex is not provided on the MEM website with the EIA.
EIA Improvements and Recommendations for Follow-Up	The EIA follows a typical approach to evaluation of oil and gas activities with most effort expended on the analysis of baseline information. Suggested improvements to the EIA process include: • A stand-alone alternatives analysis should have been completed compliant with O.P. 4.01 requirements. • The EIA provides an extensive qualitative evaluation of project impacts using a matrix approach, but more efforts should have been expended to quantify project impacts as much as possible. • The EMP was conceptual in nature and more details should have been provided. • Cumulative effects should have been addressed. Public participation does not appear to be adequate based on the information provided in the EIA

8.45 Major findings of the case study analysis which substantiate the conclusions of this review are:

- There is little effort dedicated to scoping of impacts and early public consultation to discuss potential project impacts;
- There is no formal analysis of project alternatives;
- There is no discussion of cumulative effects or analysis of regional impacts;
- The environmental management plans are for the most part conceptual in nature, but do address important concerns identified in the impact evaluation process;
- While the level and intensity of public consultation efforts varies between the three projects and does appear to be consistent with Peruvian regulatory requirements, there was little attention paid to early public consultation,
- Only the Antamina project has an extensive environmental monitoring program that is undertaken by the Proponent, but this is also related to the size and scale of the project and established company practices; and
- Environmental Impact Assessment was useful for environmental planning but largely ineffective for environmental management.

Table 8.7: Analysis of Case Studies compared to best international EIA practice

EIA Component	Antamina	Chilca	Lote 64
Was EIA Scoping conducted?	Partial	No	No
Was public participation involved in EIA Scoping?	Low	No	No
Was EIA screening conducted?	Yes	Yes	Yes
Was an analysis of alternatives conducted?	Partial	No	No
Was baseline data sufficient for prediction of environmental impacts?	Partial	Yes	Yes
Were data gaps identified?	No	No	No
Was a quantitative evaluation of project impacts conducted?	3	No	No
Was consideration given to the assessment of cumulative effects or indirect project impacts?	Yes	Yes	Yes
Was an environmental management plan developed based on assessed project impacts?	Yes	Yes	Yes
Was there implementation of the environmental management plan and development of an environmental management system?	Yes	Partial	No
Was public consultation started at the earliest stage of the project and continued throughout the life of the project?	Partial	Partial	No
Was there a feedback in the consultation process to involve project-affected stakeholders in the EIA process?	Partial	Partial	No
Were broad public hearings held?	Partial	No	No
Was an EIA monitoring and follow-up program developed by the company to assess the effectiveness of environmental and social management activities.	Yes	Partial	Partial

Designing Effective Instruments of Environmental Policy

Understanding the limitations of Environmental Assessment

8.46 Environmental problems in Peru are as diverse as their causes. Without solid environmental regulations and interventions that are targeted to redress specific problems, it is impossible for EIA to deliver on the promise wrongly ascribed to it as an environmental

management tool. As discussed in other chapters of this report, the main environmental challenges in Peru consist of reducing the incidence of waterborne diseases and illnesses caused by urban and indoor air pollution, as well as minimizing vulnerability to natural disasters. These are not problems that EIA can address. It is important to recall that EIA is a planning tool for opening up governmental decision making to public scrutiny by providing citizens the opportunity to better understand impacts and alternatives of new projects that have potential significant environmental impacts.

8.47 The above discussions shed light on the deficiencies in environmental planning and monitoring of compliance and enforcement in the EIA process. Coupled with these deficiencies, is the incipient development of environmental regulations aimed at addressing environmental problems that are strongly linked to market and/or policy failures. The existing situation contributes to the creation of an implicit and flawed expectation regarding the role of EIA whereby it is expected to perform, in addition to its intended function of being a planning tool, as an instrument for management of environmental problems and preservation of environmental quality. For instance, EIA has become *de facto* a substitute for pollution control regulations and effective land use planning, whereas it should form part of the land-use planning process. In countries with established EIA systems, management of environmental problems linked to market failures is done using environmental policy instruments that are different from EIA. Indeed, the management and solution of such problems is only achievable with the design and implementation of economic instruments or command and control regulations that address specific problems and cover: (i) pollution control,, (ii) technical environmental specifications for sectoral environmental management, (iii) protection of endangered species and conservation of biodiversity, (iv) land use zoning, and (v) conservation of forest, water and other natural resources.

8.48 As explained, EIA is foremost a tool for environmental planning and not for environmental regulation or environmental management. Furthermore, EIA is a tool for identifying potential adverse environmental impacts prior to the implementation of a project and proposing measures to mitigate environmental impacts from a specific project. However, its usefulness may very well be undermined by market and policy deficiencies that act at cross purposes to the objective of promoting environmental management. Currently EIA is perhaps the only point of contact between the environment and productive sectors. Furthermore, other instruments such as emission standards and land use zoning are at best incipient in Peru.

8.49 The ambiguity on the purpose of EIA in Peru, has led to a situation where neither environmental planning nor environmental regulation or management is satisfactory and as a result environmental problems persist. Clearly, if EIA is to be used as an environmental management tool, it will be important to develop additional instruments and regulations that are targeted to the specific environmental problems that Peru faces. In other words, it is futile to look to EIA alone as a tool for redressing the existing market and policy failures in Peru and translating them to improved environmental outcomes. A variety of mechanisms exist for controlling environmental degradation, including (i) direct regulation by government or "command-and-control" measures; (ii) economic and market-based instruments; and (iii) others including administrative procedures; legal actions; and formal negotiation (Sanchez-Triana, 1992; 1998; 2001). These mechanisms are discussed in more detail in the following paragraphs.

Outdoor and Indoor Air Pollution

8.50 In Peru, outdoor and indoor air pollution are the results of market and policy failures. EIA is not a tool which lends itself to application for controlling air pollution since it is unsuitable for redressing market and policy failures. Experience in other countries indicates that economic instruments and command and control regulations are far more efficient and effective than EIA in controlling air pollution.

8.51 Economic instruments or market based instruments aim at modifying the behavior of economic agents by providing incentives for them to internalize the externalities that they may be producing. Economic instruments include: tax differentiation, pollution charges, and tradable permits, (Stavins, 2001). In some countries, tax differentiation has been used to reduce vehicle-related emissions by encouraging motorists to switch from leaded to unleaded gasoline, high sulfur to low sulfur diesel, and by encouraging clean car sales (Panayotou, 1998). Many European countries assess differentiated taxes and fees on vehicles according to cylinder capacity, age, fuel efficiency, and other environmentally relevant aspects (Speck, 1998). A strong system of enforcement and monitoring investments are key to enhancing the effectiveness of tax differentiation systems.

8.52 Fuel types vary in their potential to produce atmospheric emissions that pollute the environment (Table 8.8). In Peru, fuel taxes could be designed to promote a shift from using dirty fuels such as fuelwood and diesel to clean fuels such as gas. The Government might consider the timing of implementation of such taxes according to fuel prices. If for example, fuel prices decline, the government could withhold reducing pump prices immediately. This approach might incur less resistance than instituting a new tax. In addition fuel tax revenues can help to subsidize gas consumption by households in rural areas. Furthermore, increased fuel revenues would provide additional resources that could be used to finance the investments required for the state-owned refineries to shift to production of cleaner fuel.

Table 8.8: Fuel Type by Level of Atmospheric Emissions.

Fuel Type	PM 2.5	SOx	NOx	VOCs
Propane	-	M	L	M
Natural gas	L	M	H	M
Methanol	-	M	L	M
Ethanol	L	L	H	H
Gasoline	L	M	M	H
Kerosene	M	H	M	M
Diesel (low Sulfur)	M	M	H	M
Diesel (high Sulfur)	H	H	H	M
Fuel oil	H	H	H	M
Crude oil	H	H	H	M
Coal (low Sulfur)	H	M	M	L
Coal (high Sulfur)	H	H	M	L
Fuelwood	H	H	H	H

Legend – L = low concentration of atmospheric emissions; M = medium concentration of atmospheric emissions; H = high concentration of atmospheric emissions; Blanks indicate no atmospheric emission. PM2.5 Particulate matter; SOx, Sulfur oxides, NOx, Nitrogen oxides, VOC, Volatile

8.53 Command and control measures include ambient standards, emission standards, and technology- and performance-based standards. In Perú, the environmental regulatory framework includes requirements for ambient standards (ECAs), and emission standards (LMPs). Since PM 2.5 and lead are priority air pollutants, the government might consider adjusting ECAs and LMPs to control air concentration of these pollutants. For example, findings from scientific research suggest setting ambient air primary standards for particulate matter (PM2.5) at 14.0 µg/m3 (Annual average) and 35 ug/m3 (24-hour average). Recommendations for technological standards include reducing the sulfur content in diesel to 500 ppm in the short term, and to 15

ppm, in the medium term. Other technological standards might include requiring retrofit particle control technology for diesel vehicles, and banning used cars imports.

8.54 To control indoor air pollution the Government might consider the use of a gas pricing policy aim at fostering the use of compressed natural gas and liquefied petroleum gas. This gas pricing policy would promote available and affordable options for the poor to use as substitutes to fuelwood. Another economic instrument to control indoor air pollution includes the implementation of subsidies for improved stoves targeted to poor families and people most affected by adverse health impacts of exposure to such kind of pollution.

Inadequate Water Supply, Sanitation and Hygiene

8.55 The reduction of the incidence of waterborne diseases, for instance, could be achieved through measures such as - (i) reducing regulatory barriers to construction of water supply and sanitation projects; (ii) increasing subsidies to education campaigns for hand washing and household disinfection of water; (iii) setting and enforcing strict standards for drinking water quality particularly of substances that have adverse health impacts such as most probable number of fecal coliform; and (iv) setting water standards for uses that could impair human health including irrigation, and recreation. In Peru, for agricultural uses the Government might consider prohibiting irrigation of vegetables with wastewater containing more than 2000 NMP of fecal coliform/100 ml

8.56 Public disclosure of water quality parameters has been very effective in fostering continuous improvements in drinking water quality. Reporting requirements include, for example, the Drinking Water Consumer Confidence Reports required by USEPA since 1999. Under this program, all suppliers of drinking water in the country should provide households with information on the quality of their drinking water, including specified information regarding water sources and actual and potential contamination. In Peru, the government might consider implementing similar regulations requiring water utilities to publicly disclose environmental-health related parameters on monthly consumer water bills such as pathogenic quality and data on morbidity and mortality associated with water borne diseases by area served.

Regulation requiring public disclosure of environmental-health related water quality parameters for beaches and other recreational activities has also been used very effectively in Mexico. A similar program could be consider by GoP to disclose publicly environmental-health related water quality parameters for water based recreational and tourism activities.

Natural Disasters

8.57 Design and implementation of regulations relating to land use plans; and identification of areas prone to risk of natural disasters are more relevant and effective measures for minimizing vulnerability to natural disasters than EIA. The government could implement policies on land use planning for risk reduction that identify spatial uses for different human activities – housing, infrastructure, and productive activities like agriculture. The approach to zoning should emphasize disaster prevention and mitigation; and take into account critical constraints, risks and limitations arising from both human activity and the environment.

8.58 In developed countries, the most frequent market-based instrument used to reduce vulnerability to natural disasters is disaster insurance. Unfortunately, disaster insurance is seldom used in developing countries for a variety of reasons (Freeman, et al., 2003): the high probability of extreme weather events, the difficulty of spreading risk in small economies (relative to the magnitude of risk), the adverse selection problem, and thin markets for insuring risk. However, a number of potential risk transfer mechanisms could be considered for Peru: catastrophe insurance or bonds; access to an international insurance fund (such as that proposed by the United National Framework Convention on Climate Change); private-public partnerships

(such as the Turkish Catastrophe Insurance Pool); and parametric earthquake insurance. These and similar initiatives should be considered further.

Deforestation and Biodiversity Loss

8.59 Market and policy failures are important causes of deforestation and degradation of ecosystems in Peru. In Peru, many markets simply do not exist for many environmental services. Very high transaction costs, for instance, prevent the development of markets for valuing the ecological functions provided by the upper portions of watersheds. Polluters and loggers have few incentives to avoid downstream impacts associated with their wastewater discharges or harvesting practices since these social costs rarely translate into private ones. Another example of a market failure is the situation where private property rights are ill-defined or unprotected This provides the opportunity for overexploitation of natural resources and biodiversity as it is difficult to assess and distribute the costs and benefits of mitigating environmental degradation or abating pollution to individual polluters and parties affected by pollution or environmental degradation. Market based instruments such as payments for environmental services could be considered by GOP to overcome these market failures.

8.60 The forest concessions are at the heart of Peru's new forestry policy and are key to its eventual success. Existing gaps in the legal framework should be addressed to better attack illegal logging and trade in timber. Short term, illegal logging should be clearly defined as a criminal act and specific sanctions should be established for specific infractions, with offenders prosecuted and penalties assessed without other concurrent crimes having to be committed to allow this. In the future, efforts should be made to attract larger investors to invest in the remaining forest concessions, approximately 9 million hectares. Consideration should be given to creation of a secondary market, where forest concessions could be traded and thus attract private investment, the forging of alliances with international buyers focusing on certified markets, and strengthening of the concessionaires' capacity to become part of a chain of production and hence secure a demand for their timber.

Water Pollution

8.61 Market failures in water pollution are pervasive in Peru. Despite persistent water pollution associated with municipal wastewater discharges and agricultural non-point sources, the attention of environmental agencies has been restricted to few activities namely mining, energy, fishmeal, tanneries, breweries, cement, and pulp and paper. Effluent standards are the instruments in place for water pollution control. Typically, parameters for which limits (LMPs) have been established and regulated include primary pollutants such as Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids, PH, temperature, odor, color and taste. These limits are primarily of aesthetic and ecological significance and have a bearing on water use for recreational purposes or water use for productive purposes such as in agriculture and industry.

8.62 Efforts to regulate water pollution have been few and isolated, with mining and tannery being the only sectors that regulate substances that have potential adverse health impacts such as lead, copper, arsenic, cyanide and chromium. In some cases these regulations are not effective. Case in point is in the mining sector where, for example, increases in the price of gold on the international market could present incentives to foster environmental degradation within the country. Such price increases provide incentives for behaviors by small-scale miners that maximize production at the expense of environmental sustainability. Furthermore, control of such degradation is particularly difficult because such mining activities are informal. In this case, appropriate options for mitigating pollution could include, among others, increasing the taxes on polluting inputs such as cyanide and mercury used in gold mining.

Solid Waste Disposal

8.63 Inadequate waste disposal is also an environmental problem where EIA can prove ineffective without clear command and control regulations. There also is a blatant lack of environmental regulations for the disposal of solid wastes and for the management of hazardous wastes. Of the 13000 tons of municipal solid waste generated, less than 20 percent is disposed of in sanitary landfills while 65 percent are placed in unsafe, open dump sites, in rivers and on beaches. The remaining 15 percent is recycled, typically under conditions unsafe for human health, usually during collection and at the site of final disposal. Poor coverage of waste management services and lack of landfills, which has contributed to the proliferation of unsafe disposal methods and sites, are important factors contributing to the existing situation of waste management in the country. Only eight sanitary landfills are in operation in Peru, most of them in the province of Lima. Typically, the most highly populated, low-income districts have the poorest coverage and regularity of waste management services. For example, in San Juan de Lurigancho, Peru's most highly populated district, waste management service coverage is 47 percent with an average frequency of two times per week; final disposal coverage is 42 percent; recycling is 12 percent and coverage for other disposal services (to beaches and rivers) is 46 percent. An explanatory variable in the existing situation with collection and final disposal of municipal solid waste in Peru is the lack of precise regulations that address the technical aspects of design and construction of waste disposal facilities, typically landfill. Decree No. 057 of 2004 provides regulations to implement the General Solid Waste Law No. 27314 of 2002. However, the decree does not provide specific regulations in sufficient detail to ensure that landfills are adequately designed.

8.64 Undoubtedly there is a need for detailed regulations that clearly address technical criteria – including among others, siting of landfills, treatment of leachates, gas collection and management, management of surface or storm runoff in the event of flash flood or *huayco* events – and that provide technical specifications for the design, construction and operation of landfills. The above paragraphs show that without clear regulations and instruments - that address (i) technical specifications for design, construction and operation of landfills; (ii) incentives for compliance of waste generators and government officials responsible for waste management, through appropriate sanctions – it would be unrealistic to expect EIAs prepared by project proponents prior to project implementation to suffice for waste management.

Hazardous Wastes

8.65 Adequate hazardous waste management requires an environmental regulatory framework far beyond EIA. It is estimated that 4,700 tons of industrial waste are generated daily in the country. Of this amount, 81 percent or 3,807 tons are hazardous wastes. The main sources of industrial hazardous wastes are reported to be metallurgy, metallic manufacture, printing presses, oil refineries and tanneries (DIGESA, 1998; Price, 2005). Approximately 65.5 tons of hazardous wastes are generated from healthcare facilities (Price, 2005). One of the challenges to adequate management and disposal of hazardous wastes in Peru is lack of adequate infrastructure to manage hazardous wastes. In Lima, there were only three autoclaves for treatment of infectious healthcare wastes, each located within the premises of the healthcare establishment which owns it. It was reported that only 2 percent of hazardous wastes receive any type of treatment or reach a secure disposal facility (Price, 2005).

8.66 GOP is preparing regulations relating to Law No. 28256 of 2004 on Transportation of Hazardous Substances and Wastes. Among the topics to develop in the hazardous waste regulations, the GOP might consider focused and unambiguous regulations that provide sufficient detail to ensure adequate management and treatment of hazardous wastes; allocate clear roles and functions to environmental authorities; ensure segregating hazardous and non-hazardous wastes, and define liabilities associated with compliance with hazardous wastes

management and treatment. Clearly, each type of waste (hazardous and non hazardous) should be dealt with by a separate piece of regulation. Furthermore, in order to ensure compliance, regulations should promote accountability by attributing specific responsibilities for specific, identifiable waste management functions – such as waste collection and disposal – to specific positions in the municipal governments, and using sanctions in the event of non-compliance by the officers that occupy such positions. Clearly, in Peru hazardous waste management is beyond the realm of EIA.

8.67 Policy failure is also one of the main causes of hazardous waste pollution. Explicit subsidies favor wasteful and/or overuse of hazardous waste precursors. For instance, agrochemical subsidies contribute to the overuse of chemical inputs in agricultural production leading to contamination of water, soil, and produce. Addressing the contamination impacts from agricultural projects through EIA could be highly inefficient and also ineffective since the existing policies do not provide incentives for polluters to reduce the use of chemical inputs or to seek alternative less polluting inputs. Furthermore, if the cost of abating pollution exceeds the value of agricultural output, this provides a disincentive for polluters to invest in operation and maintenance of pollution abatement devices. Again, without first addressing the policy deficiencies that stimulate environmental degradation, it is not possible to achieve far reaching improvements in environmental quality outcomes. In effect, in addition to EIA, Peru needs specific regulations and instruments that address among other aspects appropriate pricing of inputs precursors of pollution and environmental degradation; and appropriate pricing of natural resources such as water.

Water Resources Management

8.68 In the water sector, an example of a policy failure is evident in water subsidies that encourage inefficient water distribution and over-consumption of water among those with first access, while depriving the "tail-enders." In Peru, the Ministry of Agriculture sets water fees in irrigation schemes. Fees are priced far below the economic cost of water and even below the operation and maintenance costs of the irrigation scheme infrastructure. As a result of the low cost of water, together with low water tariff collection rates, water is wasted and used inefficiently. Government interventions that subsidize operation and maintenance costs of irrigation districts contribute to environmental problems such as soil salinization in the northern Pacific basin valleys of Peru. In this context, EIA may prove useless as a solution with far reaching and sustained results in terms of environmental quality improvements as it can provide neither incentives for such ongoing operations to reduce waste of water nor for improved agriculture and irrigation practices to control soil salinity. In effect, in addition to EIA, Peru needs specific regulations and instruments that address among other aspects appropriate pricing of water; efficient allocation of water rights; and improved collection of water tariffs.

8.69 The restrictions of the 1969 law were only partially addressed in 1989 and 1990 legislation and the inalienable "right to water" continues to be a powerful impediment to the use of water charges. In order to promote more efficient use of water resources, and associated land uses, the government could revise the 1969, 1989 and 1990 Water Laws, to authorize higher, broad-based fees for water use. Through the regulatory reforms, allowing for water pricing where it doesn't yet exist, and for higher charges where it does, will help address massive water use inefficiencies in the Coastal valleys, and will lead to more rational resource management. Where they do already exist, in Coastal irrigation projects, water use fees are typically far below cost; thus, in the short run, increasing water use fees and the longer-run improved land management patterns that result can be expected to address soil salinization as a result of less overuse, especially for rice. Moreover, funds can be generated to invest in maintaining irrigation systems.

Fisheries Overexploitation

8.70 An example of environmental policy failure is the current fishery management system based on fishing licenses. Fish catch is regulated by general permits that specify seasonal, but not volume, limits on a fishery. This policy creates an incentive to catch the maximum volume of fish in the shortest time possible. As a result, the fleet has become over-dimensioned in both numbers and technology. Similarly, factories are geared to service a high throughput in a very short period of time. Fleet and equipment remain idle during the off-seasons, creating economic inefficiencies. In addition to these inefficiencies, the system encourages overexploitation of fisheries and waste. Fishermen sometimes use dynamite and other non-sustainable fishing practices to maximize harvesting rates. Where catch exceeds space in the hold, the surplus is thrown back (mostly dead or dying).

8.71 Economic Instruments are far more efficient and effective than EIA to control overexploitation of fisheries. Experience in other countries indicates that where individual tradable fishing quotas (which allow catching of a given percentage of the available catch) are introduced, there are fewer incentives to overexploit fisheries and the industry is more efficient. In Peru tradable fishing quotas could be far more effective in promoting the sustainability of fish stock, and mitigating pollution of water bodies from activities in the fishery industry.

Sectoral Environmental Management

8.72 Since EIA is foremost a tool for environmental planning and not for environmental regulation or environmental regulation, alternative environmental policy instruments should be considered to address consequences of policy failure in infrastructure construction and maintenance that are evident in weak environmental planning and management. A case in point is the above mentioned construction of the InterOceanic highway. In addition to a badly needed EIA, Peru requires (i) precise, unambiguous command and control regulations in the form of technical specifications for construction, operation and maintenance of roads and highways; (ii) regulations for land use zoning; (iii) regulations for disposal of waste and dirt from movement during road construction; and (iv) pollution control regulations for camps and all potential urban and regional development activities induced by highway construction.

Conclusions and Recommendations

8.73 EIA is the main tool for environmental planning in Peru. However, its effectiveness is undermined by the lack of a uniform perspective, by governmental authorities, of its purpose. Specifically, there exists an ambiguity among government authorities as to whether its purpose is to achieve environmental planning or environmental management. This ambiguity has led to a situation where neither environmental planning nor environmental management is satisfactory and as a result environmental problems continue to persist. There is a clear need for the government to clarify the purpose of EIA. In doing so, it is crucial to recognize that as a planning tool, there is a need for strengthening screening and scoping procedures and improving mechanisms for public participation that allow for representative participation of the public including indigenous communities.

8.74 Given the existing inconsistency in the approach, content, timing and requirements of the EIA legal and regulatory process in Peru, which creates a lack of standardization and uniformity in the project planning and approval process, CONAM is designing regulations for a unified EIA process – including screening and scoping criteria, for all ministries and sectoral authorities – that is consistent with the existing legal framework and incorporates aspects of best EIA practice. This will ensure consistency with the proposed SEIA regulations and also avoid the proliferation of different standards between sectors for EIA. To enhance the effectiveness of the EIA, it is suggested to minimize the need for carrying out EIAs for projects that pose no environmental threat or risk. Carrying out fewer EIAs by concentrating on significant projects with regional, precedent setting impacts would greatly improve the quality of EIAs and increase the opportunities for meaningful public consultation and community participation.

8.75 Given that EIA in Peru is currently used primarily for administrative purposes rather than mitigating complex environmental and social issues, there is a need to clarify the objective of the EIA system. Furthermore, the design of the new regulations represents a potential opportunity to set uniform screening criteria for the identification of projects with significant impacts. These criteria could be aligned with national environmental and social priorities such as: protected areas and protected forests, indigenous peoples, vulnerable segments of the population, health issues, and vulnerability to natural disasters. Furthermore, the screening process could explicitly require an official statement from the National Geographic Institute of Peru as to the location of the proposed project in relation to sensitive areas. This service should have a cost for the project proponent. Significant projects that involve significant biodiversity issues or protected areas might be referred to INRENA.

8.76 The new EIA regulations could also serve to promote adopting environmental standards for the design, construction sand operation of infrastructure projects in each sector. These standards might be officially adopted and ensuring compliance with them should be the responsibility of the sectoral units. By adapting and enforcing such standards, localized, direct impacts would be managed through the engineering process (design, construction, operation) rather than through the EIA process, thus minimizing the need for EIAs. Furthermore, minimum environmental performance standards that each sector would need to meet in order to conduct EIA should be developed. These minimum standards would include staffing and equipping of environmental units in each sector, procedures, environmental technical standards, enforcement capacity, and quality control systems. CONAM could conduct annual performance audits of selected sectors. Non-compliance with these standards would trigger the need for improvement plans or ultimately for an EIA process that would involve national agencies such as INRENA.

8.77 With a view to attaining financial sustainability for environmental units, the design of the EIA regulations might consider raising the cost of environmental approvals, which presently is only a token amount, with the exception of the Ministry of Health. An alternative is to raise the costs of environmental approvals to a percentage of the project capital cost. If control over receipt of these funds were possible, it would greatly increase the financial resources available to each Ministry to administer the EIA review and approval process. Additional financial resources are required for the optimal functioning and staffing of the various sectoral environmental authorities.

8.78 Some form of public consultation exists in those Peruvian ministries that currently conduct environmental impact assessments, but the requirements and processes for consultation differ significantly and are not consistent. The new EIA regulations might develop a unified terms of reference and procedures for public consultation that are applicable to all ministries and sectoral authorities and consistent with best EIA practice and public consultation procedures. Standardized procedures for public consultation in Peru could be developed to include the following:

- Timing of public consultation procedures from the onset of the project through approval and implementation;
- Procedures for incorporating the results of public consultation into the decision-making process;
- Consistent disclosure processes for dissemination of information and accessibility of information (location, language, etc.) to all stakeholders including indigenous peoples; and
- Feedback to participants of the results of the consultative process.

8.79 In order to address delays in public consultation in the EIA process, early public consultation should be institutionalized. The existing process, whereby public hearings are held on average 30 days prior to a decision on project approval when for all intents and purposes a

decision has been made, should be reviewed. In addition, mechanisms should be established to allow the public to effectively contribute to the project decision-making process. To facilitate stakeholder participation, mechanisms could be established for reimbursing stakeholder costs for attending public consultation sessions and public hearings in centralized locations rather than in project affected areas.

8.80 If EIA is to be used as an environmental management tool, it is important to recognize the limitations of EIA for environmental management particularly where market and policy failures are strongly linked to environmental problems. Consequently, clear and specific regulations that are targeted to specific environmental problems need to be developed. A variety of mechanisms exist for controlling environmental degradation, including (i) direct regulation by government or "command-and-control" measures; (ii) economic and market-based instruments; and (iii) others including administrative procedures; legal actions; and formal negotiation. Economic instruments such as fuels taxes or a gas pricing policy could be more effective in tool for redressing the existing market and policy failures in Peru and translating them to improved environmental outcomes. Command and control measures including environmental standards – such as for air pollution, PM2.5, drinking water quality standards should be promoted and aligned with the country context and conditions.

CHAPTER 9

OPPORTUNITIES AND CHALLENGES FOR EFFECTIVE ENVIRONMENTAL MANAGEMENT

Since 1990, Peru has developed a National System for Environmental Management (Sistema Nacional de Gestión Ambiental, SNGA) coordinated by the National Environmental Commission (Comisón Nacional Ambiental, CONAM). The system has several responsibilities including natural resources management, sectoral environmental planning and management, environmental health protection, and conservation of natural protected areas. Based on an analysis of the existing organizational framework, strategic options proposed to strengthen SNGA's capacity to address environmental problems include: (i) implementing a priority setting mechanism to tackle environmental problems that affect the most vulnerable groups; (ii) increasing accountability and transparency in environmental decision making; (iii) developing a social learning system aimed at continuous improvements in environmental policy design and implementation; and (iv) fostering investments in sustainable development programs. [100]

Introduction

3.1 For the purpose of managing renewable natural resources, protecting the environment and mitigating environmental impacts associated with projects in key productive sectors, the Peruvian Government has made efforts to consolidate an organizational structure for environmental planning and management. Among these efforts the GoP has: (i) established an institutional system (*Sistema Nacional de Gestión Ambiental*, SNGA) to harmonize environmental legislation and institutional responsibilities; (ii) created a national coordinating agency (CONAM) under the President of the Council of Ministers; (iii) developed sectoral-based environmental units in the Ministries of Mines and Energy, Transport, Production, and Housing; (iv) established an agency responsible for managing water, forestry, and biodiversity resources (*Instituto Nacional de Recursos Naturales*, INRENA); (v) established a unit within the Ministry of Health, DIGESA, to manage environmental health programs, (vi) consolidated a natural protected areas system, (vii) decentralized oversight of environmental management plans and management of forests and water resources, and (viii) given responsibilities to the Comptroller's Office and the Ombudsman to enhance accountability, transparency, and public participation.

3.2 The organizational structure in place for natural resources management and environmental protection has been effective in establishing a system of national parks and forestry reserves, encompassing more than 12% of the national territory, and lowering deforestation rates in comparison to neighboring countries (INRENA 2005). There has also been significant progress in watershed management.

3.3 However, as discussed in previous chapters of this report, the greatest challenges faced by Peru are associated with urban air pollution and lead exposure; inadequate water supply, sanitation and hygiene, indoor air pollution, natural disasters, and land degradation The Peruvian model has evidenced significant weaknesses to address priority environmental problems. Environmental planning has not been incorporated at the highest policy-making level, despite the economy's evident reliance on natural resources and the negative impacts of environmental degradation on economic growth and social development.

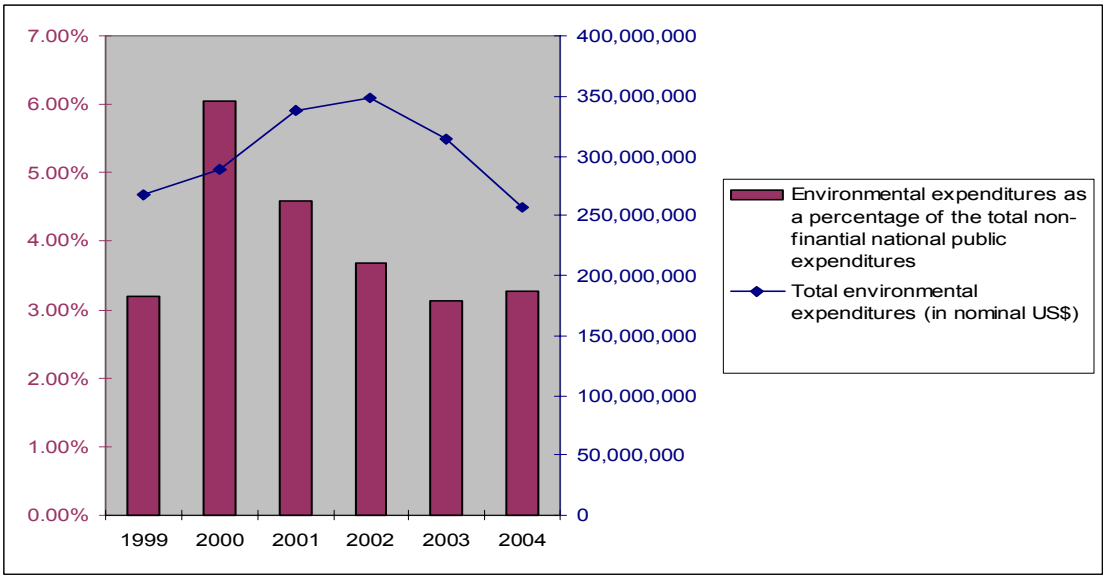
[100] This chapter draws from background documents prepared by Manuel Glave and Rosa Morales (2006), Nelson Shack (2006) and Manuel Pulgar-Vidal (2006).

3.4 This chapter reviews the organizational framework in place to address environmental priority issues, and suggests strategic options for government actions. The chapter has seven sections. Section two presents the findings of an environmental expenditure review and examines mechanisms for environmental priority setting. Section three analyzes the management capacity of the environmental agencies including financial sustainability, human resource management, and institutional alignment and cooperation. Section four discusses accountability, transparency, and checks and balances within and among environmental agencies at various levels. Section five examines alternatives for aligning policy options that tackle priority environmental problems with an organizational reform. Section six describes proposals for restructuring the governmental agencies that are responsible for water and forestry resources management as well as those in charge of managing natural protected areas. Section seven provides recommendations.

Planning and priority setting

3.5 The Peruvian system for environmental planning and environmental priority setting has improved since the creation of the National Environmental Comission (CONAM) in 1994, although there exist severe shortcomings in its ability for identifying and addressing environmental priority problems An illustration of these shortcomings is shown in a decrease in the total environmental expenditure of the national government from 2001 to 2005 (Figure 9.1). This expenditure has also decreased as a percentage of the total non-financial national public expenditure of the national government since 2000, although 2004 shows a slight increase. The only environmental expenditures that show positive rates in the period 2001 to 2005 are those related to emergency response systems to natural disasters and relief; and biodiversity conservation (Figure 9.2). The former can be explained by the damages caused by the *El Niño* phenomenon, while the latter shows a shift of preferences of the government towards the enhancement of the conservation agenda.

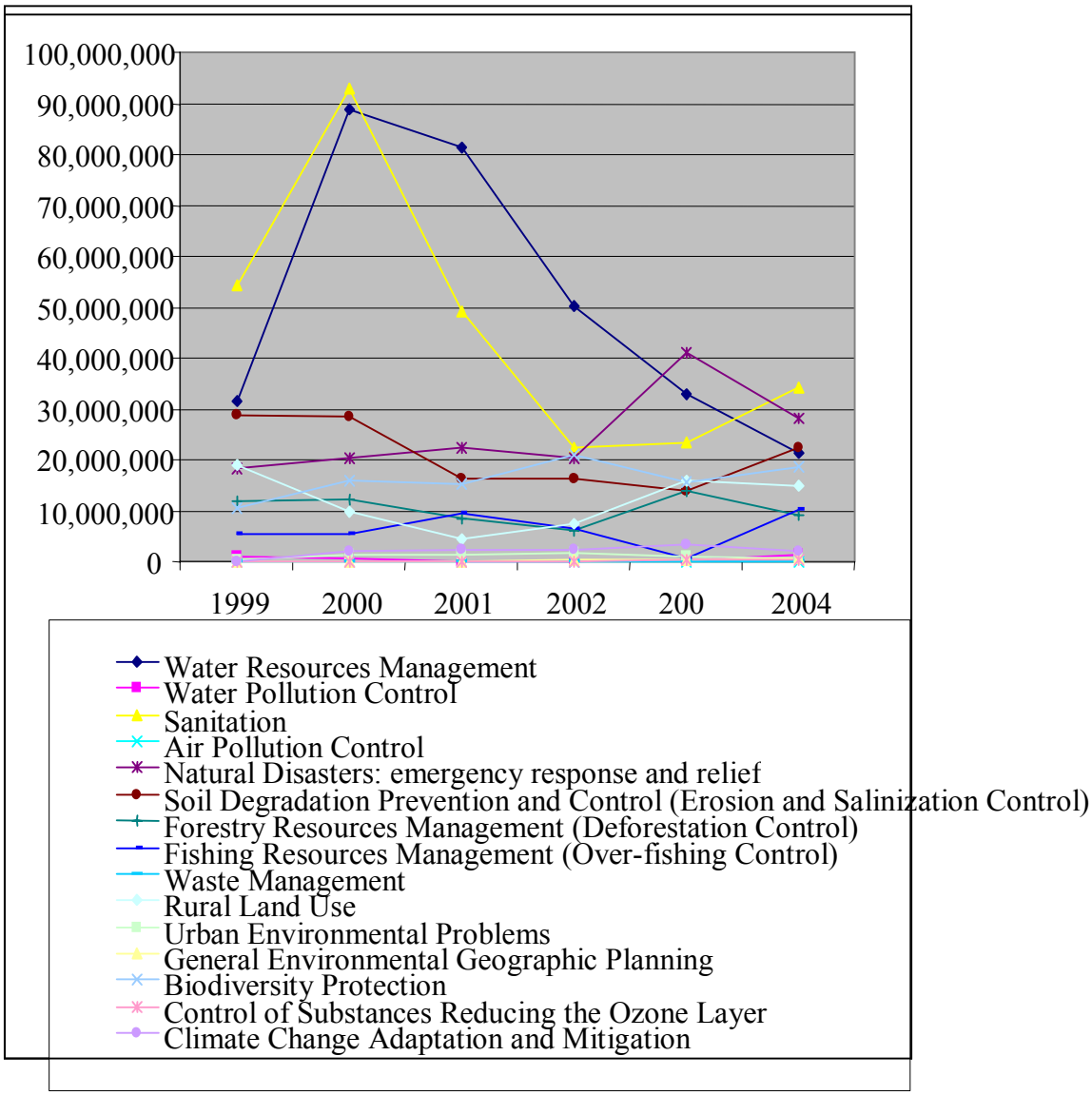
Figure 9.1: Evolution of national environmental expenditures in Peru



Source: Shack, (2006)

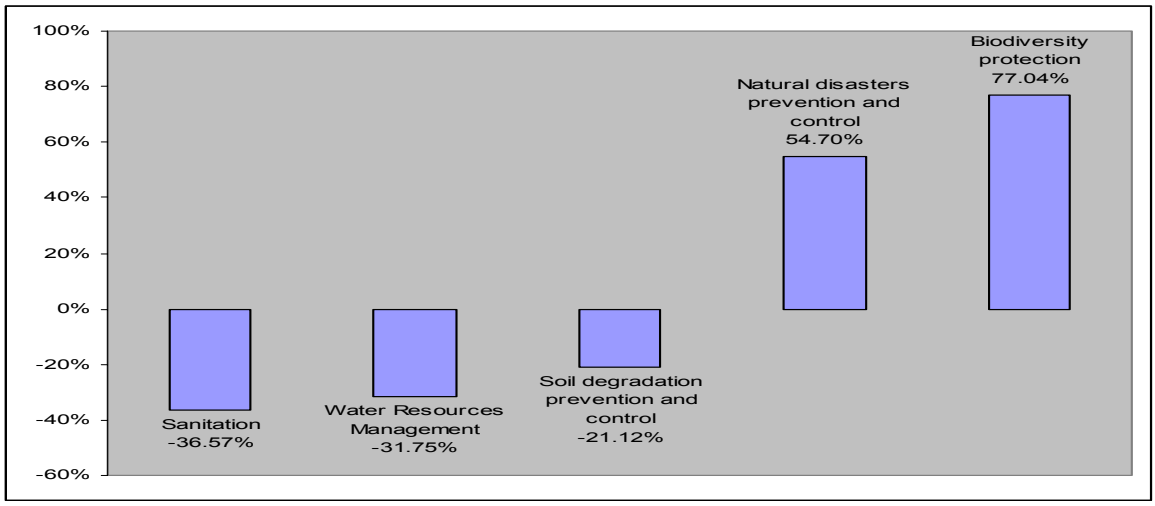
3.6 An analysis of expenditures of the national government found that priority environmental problems such as air pollution control, lead exposure, reduction of waterborne diseases, indoor air pollution control, or reduction of vulnerability to natural disasters received very low or no budgetary allocations (Figure 9.3).

Figure 9.2: Evolution of Peruvian Environmental Spending from 1999 to 2004



3.7 There is a striking divergence between the issues perceived as a priority by the Peruvian population and the current allocation of environmental resources. Indeed, a study conducted by *Instituto Cuanto* in 1998 showed that air and water pollution were identified among the greatest environmental concerns of the Peruvian population (1998). These findings were confirmed in 2004 by a survey conducted by GEA which identified air pollution as the main priority for the population in the Lima-Callao area (GEA, 2004).

Figure 9.3: Rate of growth of selected national environmental expenditures from 1999 to 2004



Source: Shack, (2006)

3.8 There are several characteristics of Peru's planning and decision-making mechanisms that contributed to the observed disconnect in priority setting. The first of these is the lack of analytical work to support the governmental decision-making process. This is further aggravated by the lack of representation of certain sectors and stakeholders in the venues where decisions are made, resulting in a particularly apparent absence of the voices and concerns of the most vulnerable groups. Another missing key element is a formal mechanism for the allocation of financial and human resources according to key environmental priorities linked to poverty alleviation and social priorities. Besides increasing the effectiveness of environmental policies and management for poverty alleviation, the incorporation of these three elements would allow for increased accountability in decision making and in policy design and implementation.

3.9 An international comparison of environmental institutional arrangements suggests that those countries in which biodiversity conservation, natural resource management, and environmental health functions are assigned to specialized governmental agencies lead to more effective work and more balanced resource allocation (Table 9.2). This may be due to the fact that allocating these diverse responsibilities to a single agency may lead to unequal attention and budget allocation to priority environmental problems. Evidence from studies conducted in different countries (World Bank, 2005, 2006) indicates that international assistance is more often available to support projects and programs related to global environmental issues – such as biodiversity conservation and climate change mitigation – rather than to local environmental programs that benefit the most vulnerable groups. The same appears to be true in the Peruvian case (Figure 9.4). Placing responsibility for to many functions under one agency may lead to competition for resources for activities that otherwise require more balanced attention and resources allocation.

3.10 Another reason in support for specialized agencies to attend to biodiversity conservation, natural resource management, environmental health protection, and reduction of vulnerability to natural disasters may be the different coordination schemes required for effective policy design and implementation. Attending to environmental health problems requires significant collaboration between the health and environmental agencies, while effective conservation efforts and natural resource management depend on the cooperation between the agricultural and environmental sectors.

3.11 Institutional arrangements documented as successful such as in the United States, have set in place a sectoral model for environmental impact assessment. When complemented by overall strict and stable environmental requirements and clear and transparent enforcement, this model appears to increase the possibility of effective incorporation of environmental considerations into other sectors. Models in which environmental impact assessment is centralized under one institution's mandate have not been documented as successful (Ortolano and Abracosa, 1986, Ortolano and Sinkule, 1996; Ortolano, 1997, Sanchez and Morillo, 1998, BID, 2002).

Table 9.1. Institutional Arrangements for Environmental Management in Peru , 2006

	Agency								
Responsibility	**CONAM**	**INRENA**	**DIGESA**	**Mining and Energy**	**Production**	**Other Sectors**	**CARs**	**Regions**	**Municipalities**
Design of national environmental policy	✔	✔	✔	✔	✔				
Enforcement of environmental policies		✔	✔	✔	✔	✔	✔		
Coordination of national environmental policy	✔	✔	✔	✔					
Design of pollution control measures s	✔	✔	✔	✔	✔			✔	✔
Enforcement of pollution control measures			✔	✔	✔	✔			
Enforcement of natural resources management Allocation of water rights and forestry concessions		✔		✔	✔	✔			
Environmental Permitting		✔	✔	✔	✔	✔			
EIA		✔	✔	✔	✔	✔			
Reduction of vulnerability to natural disasters									
Conservation and protected areas		✔							

Table 9.2. Institutional Arrangements for the Environmental Sector in Bangladesh, Colombia, Hong Kong, Mexico and the United States

Responsibilities	**Institutions***						
	National Environment Agency/ Ministry	Independent Enforcement Agency	Agriculture or Specialized Resources Agencies .	National Health Agency	States/ regions	Municipalities	Sectors
Environmental Health Regulations and Enforcement	Mexico Bangladesh Hong Kong Colombia	**Mexico** **USA**		**Hong Kong** **Mexico**	Colombia		
Urban Environmental Issues	Mexico Bangladesh Hong Kong Colombia				Colombia	**Colombia** **USA** **Hong Kong**	
Environmental Impact Assessment	Mexico Bangladesh Colombia **Hong Kong**		**USA**		Colombia **USA**		**USA**
Natural Resource Management Regulations and Enforcement	Bangladesh Colombia Mexico	**Mexico** **USA**	USA Hong Kong	Hong Kong**	Colombia		
Conservation Protected Areas and Biodiversity	Bangladesh Colombia Mexico		**USA** **Hong Kong**	Hong Kong**	Colombia USA		
Infrastructure Investment	Bangladesh Hong Kong Colombia Mexico		**Mexico** USA		Colombia USA		
Reduction of Vulnerability to Natural Disasters	Hong Kong USA		Mexico USA		USA	**USA**	

* Practices documented as successful are highlighted in bold

**Although the Hong Kong Agriculture, Fisheries and Conservation Department is under the Secretary for Health, Welfare and Food, it is also responsible to the Secretary for the Environment, Transport and Works

3.12 According to the Annual Budget Law, the National Public Budget Office (*Dirección Nacional de Presupuesto Público*–DNPP) is responsible for linking the allocation of financial resources to multi-annual strategic sectoral plans (PESEM), Concerted Regional Development Plans (PDRC), Concerted Local Development Plans (PDLC), and Institutional Strategic Plans (PEI). In practice, however, the allocation of resources follows an institutional rationale that aims to finance each institution's planned activities, rather than to establish and maintain cross-sectoral programs which do not respond to specific institutional priorities. As a result, budget formulation becomes a rather inert process of resource allocation according to the agencies' expenditure levels in different categories and their expected increase for the next year. This budgeting system leads to allocations that are considerable misaligned with national environmental priorities. Indeed, the ultimate decision with respect to the amount allocated to each agency is a discretional process guided by the specific negotiation power held by each governmental agency. The current allocation of environmental resources is therefore, in part, a reflection of the difference in negotiation capacities between Congress and MEF and the different environmental agencies and stakeholders - such as DIGESA and INRENA and NGOs that represent other interests.

3.13 Nevertheless, other plausible explanations for the way in which resources have been allocated include the lack of reliable and complete data available to public institutions to support an informed priority-setting process. Peru's current data collection infrastructure—including

environmental laboratories, measuring stations, documentation centers, and basic cartography—is inadequate by many accounts. Companies are not required to monitor or report on their effluent discharges and the National System of Environmental Information (*Sistema Nacional de Información Ambiental*–SINIA) often faces problems in generating information on a timely basis. The generation of information is frequently compromised by the unavailability of financial resources. The GOP also faces important challenges in terms of the implementation of environmental regulations and plans, since most environmental agencies lack the sufficient management capacity to perform their functions in a sustainable manner. Major problems associated with management capacity are: (1) insufficient and insecure funding; (2) lack of a human-resource system based on merit and skills development; (3) lack of incentives to implement a results-based management system, and mechanisms of organizational learning; and (4) limited capacity and incentives to coordinate with other agencies.

Management capacity of the environmental agencies

3.14 Capacities in terms of human resource management vary from agency to agency. INRENA is an agency with highly qualified personnel. The large number of experts in areas such as irrigation, water resources management, forestry, and biodiversity conservation has resulted in a continued emphasis on conservation, national parks, forest and water resources management. Although this has resulted in Peru's considerable success in these issues, it is also a contributing factor to the absence of an active assessment of what Peru's highest environmental priorities are. In comparison, between 1992 and 2005, the human resource capacities of DIGESA and other environmental agencies decreased as a result of the downsizing of the public sector [101] (Hanrahan, M., et al. 1995; and Figueroa, E., et al. 1996; World Bank 2000; World Bank 2005)[102].

Table 9.3. Institutional Capacity: Budget and staff, 2006

	CONAM	INRENA*	DIGESA
Budget	$13,197,290.00	$90,029,671.00	$16,000,000.00
Staff total	91	196	109
Officials	17	68	6
Proffessionals	29	58	39
Technical	32	60	34
Auxiliary	13	10	30

*Data includes permanent staff, a significant amount of INRENA's work is conducted by consultants and contractors

**For comparative purposes, DIGESA's consultants and contractors are not included, if included total staff would add up to 293

*Source: www.conam.gov.pe, I*NRENA and DIGESA sources

3.15 Environmental agencies are facing two main problems in terms of financial sustainability. Some of them lack the minimum funding to perform their functions in a sustainable manner. Others are highly dependent on resources from the donor community. For example, the air and water GESTAs have not been given a specific budgetary allocation (*partida presupuestaria*) to ensure the funding of their operations. According to national regulations GESTAs must be funded on an annual basis. However, in practice the GESTAs have not been successful in securing funding for air pollution control programs and currently lack access to any source of funding. This situation is causing the capacity and motivation of

101 Several officials of environmental agencies have expressed their concern about the wave of early retirement of the most experienced personnel stemming from the downsizing of the public sector.

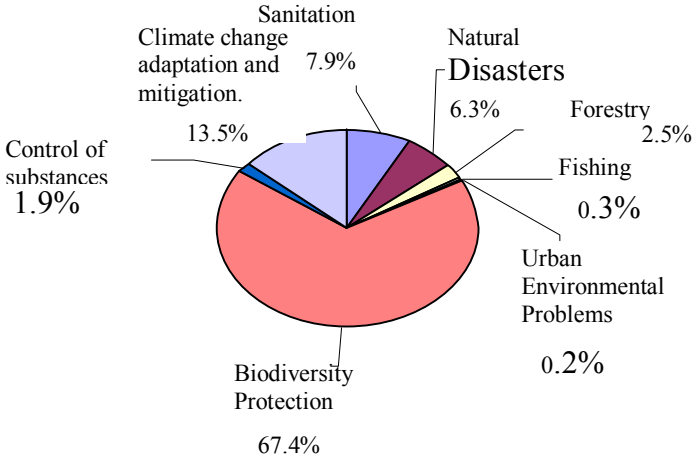
102 A forthcoming analysis of the human capacities within environmental agencies, performed by the IADB, should be able to detaul the opportunities and challendes in terms of human resource management for the different environmental agencies.

GESTA's members to deteriorate. Evidence of this situation is that the most successful GESTA functioning in Arequipa fully depends on international cooperation.[103]

3.16 In other cases, the resource allocation system in place does not provide incentives to make the best choices in terms of environmental projects. For example, funds for addressing natural disasters are only allocated after earthquakes, floods, or landslides have impacted communities. Therefore, this financial mechanism may be providing a perverse incentive that encourages competent agencies to concentrate their efforts on problem solving rather than to act proactively on prevention.

3.17 In the late nineties, environmental and natural resource projects (or environmental components of projects) funded by nonrefundable international cooperation in Peru amounted to an estimated US$411 million, supporting 211 environmental projects in the country, while concessional loans supported additional 10 projects, totaling US$735 million (Guinand and Chávez 1997). Funding by international donors has continued in different areas. By 2005, the most important bilateral sources of aid were Japan, the United States, the Netherlands, Germany, Canada, and Switzerland. Also in 2005, the most important sources of multilateral aid are the World Bank, IADB, EU, WFP, UNDP, ITTO, FAO, and GEF. A major problem identified by GoP with respect external funding is that it is not a stable[104] source of revenue. From 2000 to 2005, donors have given greater attention to programs such as biodiversity protection and climate change mitigation (Figure 9.4). Coordination mechanisms between donors and Peruvian public environmental agencies exist but need to be strengthened.

Figure 9.4: Donations and transfers by environmental category



Source: Shack, 20006

103 Arequipa's GESTA-Air receives support from the Swiss Agency for Development and Cooperation (COSUDE).

104 Guinand and Chavez (1997) show that recent initiatives to prepare investment projects (e.g., through sector work) on the environment were never converted into loans (e.g., Institutional Environmental Strengthening II, Mantaro Valley II, and Environmental Management of the Rio Rimac Watershed II).

Interinstitutional Coordination

3.18 Important efforts have been made to ensure coordination for the implementation of plans and regulations across sectors and different territorial units and between the sectoral and territorial dimension of environmental management. However, the challenge remains significant for two reasons: (1) Peru's great geographic diversity requires that the coordination system possesses sufficient flexibility to address the regions' different environment issues; and (2) due to the sectoral division of environmental agencies, rivalries exist and there are few incentives for agencies to cooperate.

3.19 CONAM has focused its efforts on designing a cross-sectoral and decentralized management system known as the National Environmental Management System (*Sistema Nacional de Gestión Ambiental*–SNGA). Specific coordination structures have also been created for the management of different environmental problems and natural resources requiring intersectoral and geographical coordination. However, the results of these initiatives vary widely according to the complexity of managing specific natural resources. This is the case of the Air and Water GESTAs which were created in order to involve private and public stakeholders in the definition of a management plan for the protection and use of natural resources. Despite the fact that the GESTAs include participation from key stakeholders, their management plans have not been successfully implemented. Thirteen GESTA-Air, for example, were established in 2001. Of these, two have produced air quality management plans that have been approved; and three are in different stages of approval. The remaining seven are still colleting the necessary data to draft the plans (Glave, Morales, 2006). The GESTA-Water, on the other hand, was established in 1999 by Presidential Decree and is divided into five working groups. Their proposals for ECA and LMP have not yet been approved internally or by DIGESA and INRENA.

3.20 There are still major environmental issues that continue to lack the minimum coordination structure for the definition of priorities and action plans. This is the case of environmental problems such as indoor air pollution, vulnerability to natural disasters, or overexploitation of fisheries. The delay in initiating coordination activities related to these environmental issues might be due to the lack of representation, of groups affected by these problems, on CONAM's Board of Directors.

3.21 CONAM has promoted the decentralization of coordination responsibilities through the creation of eight Regional Executive Secretariats (*Secretarías Ejecutivas Regionales*-SER) and nine interinstitutional coordination agencies called Regional Environmental Commissions (CAR), which include local governments, NGOs, universities, and economic sectors interested in the region's environmental sustainability. However, there is still a lack of clarity about the functions and responsibilities of organizations at the sub-national level. For example, there is a lack of clarity about whether CAR or the environmental units within local governments are the entities responsible for GESTA implementation. In some cases, the regional government has assumed the presidency of the GESTA and thus became highly involved in the implementation of action plans. However, in other cases the lack of clarity about the specific roles of CAR and the environmental units of local governments has been the cause of rivalries and lack of interest of some regional governments in implementing these action plans.

3.22 Such uncertainties, in addition to lack of political will and accountability, have reduced the effectiveness of these decentralization initiatives. The absence of a roadmap - that defines what, when and how environmental policy is going to be decentralized - is affecting local implementation of environmental initiatives. The Peruvian environmental sector could learn from the decentralization process that the social sectors are already experiencing in order to avoid the duplication of roles and functions, the increase of transaction costs, and the ambiguity of accountability responsibilities among decentralized agencies

Organizational Learning

3.23 Management practices in Peru have not yet incorporated the concept of results-based management, nor have they adopted formal mechanisms that promote organizational learning. Transparency with respect to results-based performance is important, but so is transparency with respect to the effectiveness of environmental expenditures to address environmental priorities and administrative practices. Administrative performance indicators allow organizations to set measurable goals, to periodically evaluate their achievements, and to engage in processes of reforming and improving their practices. Over the past decades, the absence of such mechanisms in Peru may have prevented environmental agencies from adapting their priorities and actions in order to provide a response to changing environmental needs.

3.24 A significant weakness in the environmental management framework in Peru is the absence of systematic processes of learning from experiences that can help guide actions in the present and the future. Peru's environmental system lacks a consistent evaluation system. Baselines are not created at the beginning of interventions and government institutions do not systematically conduct performance and impact evaluations. Without evaluation, the learning process is weak and institutional adjustment, and adaptation, do not build on experience. Learning, in the context of Peru, is particularly important in three respects:

1. Learning to adapt and adjust specific policies and institutions: One example of this as discussed extensively in this chapter is lack of government capacity to reevaluate environmental priorities periodically and adjust environmental expenditures accordingly. Another is to adjust to new developments in science and technology, as is the case with developing understanding of causes of health problems linked with air pollution or lead exposure. A third is to assess and learn on an ongoing basis underlying institutional weaknesses (e.g. lack of effective accountability mechanisms) to make environmental management more effective.
2. Learning from past experiences of weak implementation. The experience with difficulties in air quality monitoring systems is an example of this. Experiences such as these are extremely valuable in identifying what works and does not work in terms of monitoring and implementation.
3. Learning from good practices of environmental revenue generation at the local government level. An interesting issue with respect to environmental management in Peru is the greater allocation of revenue for environmental management at the local levels compared to the national level.

Decentralization process and results

3.25 There have been several initiatives to promote the decentralization of environmental responsibilities in Peru. According to the Decentralization Law, environmental decentralization has the purpose of improving territorial zoning plans, sustainable management of natural resources and environmental quality through the promotion of inter-institutional coordination and citizens' participation. In practice, however, only a few functions have been effectively decentralized and most of them involve regional rather than municipal or district governments (some functions concerning forestry and natural-disaster management have been decentralized to municipal governments (Table 9.4).

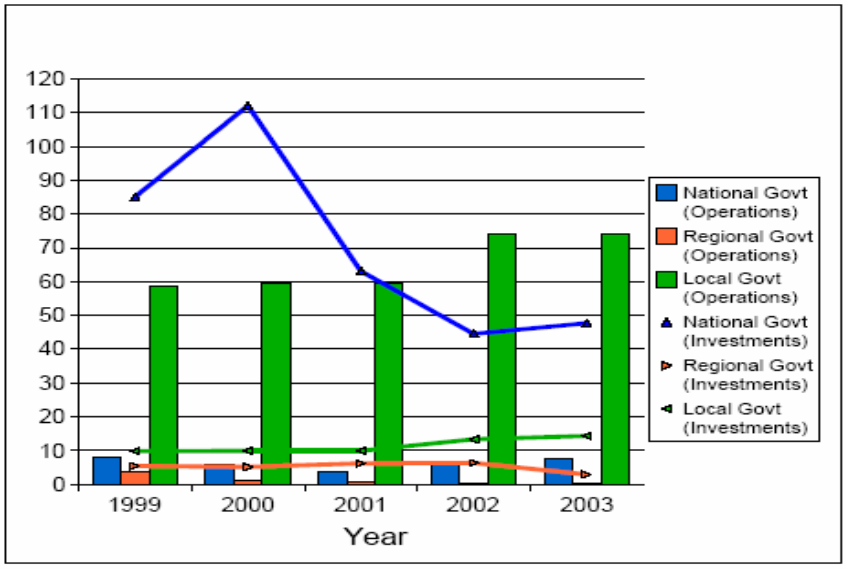
Table 9.4: Environmental functions decentralized to regional governments

Sector	Decentralized functions
Fishing	Research and information on technological services to preserve the environment. Control of the application of fishing norms and enforcement of sanctions for non-compliance.
Mining	Approve and supervise EIA and its adaptation to small and traditional mining. Control of the application of norms for small and traditional mining and enforcement of sanctions for non-compliance.
Energy	Evaluate and approve EIA for activities related with electricity at a small scale Evaluate and approve the EIA of gas providers.
Tourism	Verify the application of norms for the preservation of natural resources linked to tourist activities
Health	Disseminate, adapt and ensure the compliance with national norms on environmental health and health at the workplace. Disseminate, control and evaluate the application of norms related with the management of public health services at the regional level. Identify, prioritize and evaluate, in coordination with local governments, issues concerning environmental health and health at the workplace.

Source: Aldana, (2006)

3.26 Despite the modest progress in decentralizing environmental functions, local governments have been increasingly involved in the implementation of environmental plans. In 2003, the total amount of environmental expenditures was higher at the local level than at the national level. However, it is important to note that the high amount of local governments' operational expenditures is largely due to the inclusion of expenditures related to solid waste management activities in this category (Figure 9.6). Waste-management systems have a positive impact on improving the living conditions of the population; the value of urban real estate; and business opportunities, like tourism.

Figure 9.5: Environmental Expenditures by National, Regional, and Local Governments, 1999–2004 (US$ million in current dollars)



Source: Abugattas, (2005)

Accountability, monitoring, and enforcement capacity

Accountability mechanisms

3.27 There is evidence of a systemic bias, in the attention from environmental agencies, away from the needs of the groups most affected by environmental degradation. As has been shown in the previous sections, priority setting has not included social and poverty impact criteria as a decisive parameter and budget allocations follow an inertia responding to particular bureaucratic and economic interests. This bias contributes to perpetuating the historical inequality between different segments of the population. This situation contrasts with the fact that Peru, unlike many other countries in the region, already has important elements in place in its legal framework to support a more equitable use of natural resources and a fair distribution of the impacts of environmental degradation. These include the rights to a clean environment, enacted in the Constitution, and the guarantee of community participation in decisions that may affect community members. The Constitution also allows for legal recourse to prevent the violation of fundamental rights. An appropriate accountability system would help create the conditions to address the above-mentioned inequality through the use of constitutional rights and available legal resources. However, as analyzed below, the accountability framework of Peru's environmental system is faulty and requires urgent improvement.

3.28 In terms of horizontal accountability, Peru has established an accountability framework which includes three main institutions: the Congress, the Office of the Comptroller General, and the Ombudsman's Office. The Congress does not have a specialized commission to deal with environmental policies and issues in a consistent manner. Environmental policy debate and monitoring are spread out among different specialized commissions of the Congress, such as Agriculture; Energy and Mining; Housing; Health; Andean-Amazonian Peoples, Afro-Peruvians, and Ecology. Likewise, the Ombudsman Office does not possess a technical unit that specializes in environmental issues; and a specific reporting capacity that deals with compliance, with citizens' rights linked to the environment, is lacking.

3.29 Since 1998, the Office of the Comptroller General has been conducting environmental audits in specific projects or programs with a potentially high environmental impact. The methodology for environmental audits currently applied has been built through an ongoing learning process, including pilot audits with the collaboration of international experts. In 1999 the Office of the Comptroller General performed 17 environmental audits and used this experience to publish the Methodological Guide to Environmental Management Audits. In 2002, the Office of the Comptroller General created a specific unit in charge of environmental protection and the preservation of cultural assets (*Gerencia de Medio Ambiente y Patrimonio Cultural–MAC*). This unit has two responsibilities: (1) planning, organizing, implementing, and evaluating the enforcement actions conducted by decentralized public institutions, decentralized agencies, project management units, etc; and (2) conducting audits of environmental and cultural assets in vulnerable geographic areas (i.e., watersheds). Despite this progress, it is important to recognize that the Comptroller's Office faces financial and technical limitations in fulfilling its responsibilities, forcing the agency to limit its role to highly critical areas.

3.30 The absence of clear responsibilities and capacities among agencies, to hold environmental institutions accountable, and the implementation of environmental policy dilute public accountability. Likewise, the lack of apparent channels for citizens to voice their concerns and complaints, regarding the fulfillment of their rights, hampers accountability on environmental issues between the state and citizens.

3.31 Information and transparency concerning environmental management have improved over the past five years. Furthermore, the Access to Information Law, approved in 2002, requires all public institutions to publish their information including that related to environmental issues. Currently all ministries and public institutions related to the environment have their own portals, which make available timely and useful information. The policies, approaches, and programs of all the ministries and public institutions are made available

through those portals and in most cases they offer interactive devices to receive and respond to queries and complaints from the public. There have also been initiatives to use public information as an enforcement mechanism to comply with environmental standards.

3.32 Mechanisms to disseminate information in a manner that is easily interpretable can allow communities to play a role as informal regulators, but also promotes accountability on the part of those being regulated. An example is the pioneering public disclosure scheme in Indonesia (PROPER) that encouraged small firms to improve their performance with respect to environmental pollution (World Bank 2005). Interestingly, in a second phase of the same program, the government has moved to make such a disclosure plan compulsory, rather than voluntary (Leitmann and Dore 2005). Arguably, a compulsory plan forces greater social accountability than a voluntary program.

3.33 The 2005 General Environmental Law requires CONAM to establish and publicly disclose a "Registry of Environmental Good Practices and Offenders." This registry will indicate entities that comply and do not comply with their environmental obligation. Nevertheless, there remain many problems in disclosing and accessing environmental information. There are many sectors in which requirements for disclosing information exist but are not implemented. For example, in the case of air quality enforcement, the different sectors, having established maximum allowed limits (LMPs), are required to make publicly available a table specifying the sanctions associated with noncompliance (Glave and Morales, 2006). Currently, only the Ministry of Mining and Energy has made this information available through the Internet. In addition, the information made available through these portals usually lacks a clear indication of the environmental rights and the minimum standards that every citizen is entitled to expect from environmental services, expressed in a simple and measurable way, allowing any citizen to monitor performance and to demand the fulfillment of his rights. Finally, it is clear that most Peruvians lack access to the Internet or do not know how to use it to channel their views and voice. Peru's large network of community radios (ANC) and local media has not been adequately used to create and disseminate information, promote policy debate, and support accountability.

3.34 In the past decade efforts were undertaken to include public participation in environmental management spaces. These efforts range from participation in the design of environmental regulations to the involvement of a diversity of actors in the implementation of environmental programs. The regulation of national standards for ambient air quality, for example, was the result of a two-year consultation process with civil society and the private sector. On the other hand, the Program for Sustainable Cities implemented by the National Civil Defense Institute in urban settlements, has involved the participation of several stakeholders including civil society, local and regional governments, academic institutions, relevant ministries and institutions in the promotion of sustainable urban development. Another example is the decentralized Forest Management Committees (*Comités de Gestión de Bosques*) responsible for ensuring the participation of civil society and the private sector in monitoring and controlling deforestation. INRENA has approved only 17 of the 35 Forest Management Committees to date. However, the implementation of public participation initiatives has not yet been fully satisfactory. Institutional mechanisms, particularly resources, to adequately manage and incorporate public participation mechanisms into decision making are not fully operational yet.

3.35 From the demand side, the Peruvian conservation movement is very strong, and emerges primarily from the well established training programs at the Universidad Agraria (UNALM). There have been numerous priority-setting exercises for protected areas since the late 1980s, and there is a strong and active local NGO movement organized in two very active networks of environmental NGOs: the National Environmental Society (SNA)[105] and the

105 http://www.sna.org.pe

Peruvian Environmental Network (RAP). Moreover, two organizations represent Peruvian indigenous communities: the Inter-ethnic Association for Peruvian Rainforest Development (*Asociación Inter-étnica de Desarrollo de la Selva Peruana*–AIDESEP) and the Peruvian Agroforestry Coordination Office for Indigenous Peoples and Small Farmers (*Coordinadora Agroforestal Indígena y Campesina del Peru*– COICAP).

3.36 SNA includes more than 50 civil society organizations working on environmental issues. Within SNA these civil society organizations are classified in three categories: (1) nongovernmental organizations (NGOs) including large nationally based organizations with presence in at least two of Peru's three regions; (2) regional networks formed by NGOs acting within a specific geographical area; and (3) national networks, including organizations regrouped by specific areas of intervention such as radios, environmental education, sustainable urban development, water, forestry, and sustainable agriculture. The Peruvian Environmental Network is formed by 38 NGOs working on environmental issues across the country. These networks have played an important role in the dissemination of good practices in environmental management and in the creation of spaces for discussion, learning, and designing proposals on specific issues of environmental management. Examples of these discussion platforms are: the National Commission of Biological Diversity (CONADIB), the Discussion Group on Hydrocarbons and Natural Protected Areas, Management Committees of Natural Protected Areas, and the National Health Air Network.

3.37 At the national level, CONAM has conducted six Eco-dialogues involving diverse stakeholders. These Eco-dialogues have provided important opportunities for voicing concerns of different environmental stakeholders. However, at the regional and local levels, the numerous spaces for institutionalized public participation in Peru have not provided a systematic forum to address environmental issues. Environmental issues do not consistently constitute a cross-cutting element of the agendas of recently created decentralized participatory mechanisms such as the Local and Regional Coordination Committees, the local *Mesas de Concertación para la Lucha Contra la Pobreza*, and relevant participatory processes such as the formulation of Joint Development Plans (*Planes Concertados de Desarrollo*) and the Participatory Budget (Reuben, W. and Belsky, 2006).

Monitoring capacity

3.38 A major problem in terms of monitoring is the lack of reliable time series data on the state of the environment and natural resources. An example of this is the sporadic history of air quality monitoring networks in Peru. PAHO and the Ministry of Health established these networks in the late 1960s in several cities, including Lima, to monitor TSP and sulfur dioxide levels. These networks lasted until the late 1980s, when they were dismantled. Despite the existence of stations belonging to these networks, there is no reference to the delivery and use of data generated by them as an input to air pollution control strategies before 1990. In the late 1990s, DIGESA installed and operated two monitoring stations in Lima and purchased a mobile station to carry out air quality monitoring in urban centers other than Lima. However, the functioning of this newest network has been interrupted several times, due to weaknesses in equipment calibration, and has resulted in information gaps.

3.39 Second, a system of homogeneous, results-focused indicators of environmental quality is not available. Moreover, it is crucial that evaluation systems not be static but instead able to adjust to new developments in science, technology, and other fields. For example, in the 1970s, the conventional wisdom was that high ambient concentrations of total suspended particles (TSP) represented a serious health problem. More recently, with improvements in measurement technologies and analytical techniques, fine particles with diameters of 2.5 microns or less (PM2.5) appear to be the real culprits. This finding, in turn, has led to significant changes in developed and developing countries' strategies for controlling air pollution. Recently in Peru, the importance of PM2.5 on health impacts is being recognized. The government of Lima is

considering efforts to move ahead with the installation of a PM2.5 monitoring system to obtain better information for decision-making on strategies to control air pollution.

3.40 Systems for monitoring and evaluation that are publicly available seem especially crucial, not only for technical learning but also for purposes of democratic legitimacy and public confidence. This involves the use of both ex-post evaluations and ex-ante assessments of policymaking and impacts built on broadly shared sustainable development goals. Efforts by communities of participation in the valuation of experiences are also crucial to avoid learning traps.

Enforcement capacity

3.41 The lack of real power to monitor and enforce the application of environmental laws and regulations is a major deficiency in the country's environmental institutional framework. Although the 2005 Law increases CONAM's responsibility in the enforcement of environmental policies, CONAM currently has no enforcement capacity. While it has the right to request implementation of administrative, civil, and/or penal sanctions when existing policies, norms, and/or directives are not complied with, in fact the real enforcement power remains with the ministerial environmental units which are politically stronger than CONAM but far weaker than the economic development units in their respective ministry.

3.42 At the ministerial level, there are many cases in which quality standards have not been defined and thus enforcement has been impossible. This is the case for most of the GESTA-Air which have already completed action plans to clean the air and prevent further deterioration but lack any enforcement capacity since the different ministries have not yet completed the definition of LMPs required to carry out audits and levy sanctions for lack of compliance. In fact, the ministries have little incentive to complete this task, as CONAM and the sectoral environmental units have little negotiating power within and amongst the sectors.

Policy options and organizational structure

3.43 As explained in previous chapters, Peru faces several environmental challenges including, among others, poor outdoor air quality as a result of pollution from particulate matter and lead, inadequate water supply, sanitation and hygiene; natural disasters; indoor air pollution; soil degradation, overexploitation of fisheries; deforestation and loss of biodiversity; and inadequate disposal of wastes. The institutional framework in place has not been effective in reducing the cost of environmental degradation associated with these challenges.

3.44 The analysis of the organizational structure of the environmental sector in Peru points to the need to undertake several reforms in order to improve its performance. There is a clear need to give to each agency clear duties and functions, avoid overlaps and conflicts of interest, build their capacities to deliver and be responsive to environmental needs, and provide them with the incentives and mechanisms to coordinate with other agencies within and outside the sector. It is suggested that an independent task force be formed to look into alternative structural reforms. The Task Force could be formed by Congress representatives, MEF, CONAM, the Ministries of Agriculture and Health and representatives of those groups most affected by environmental degradation. Options to choose such representatives are parent's associations, particularly considering that children under five are the group most affected by air pollution and waterborne diseases. Among the options for the Task Force to consider are the ones described below.

3.45 Addressing Environmental Health Problems

The results of the study of the costs of environmental degradation in Peru lend support to the need for Peru to address environmental health problems in a concerted manner through the design and implementation of policies and the strengthening of the

governmental structure. Environmental health problems and their solutions are cross-sectoral by nature. In this context, it would be advisable building capacity in MEF, CONAM, the Ministry of Energy and Mines, the Ministry of Housing, and the Ministry of Health for the design and implementation of policies to address environmental health problems.

3.46 **Bolster and streamline the regulatory and enforcement role to properly address environmental health challenges**: Given the priority of environmental health issues and the social and economic costs linked with it, the analysis suggests that an urgent and priority task is to strengthen DIGESA design and implement environmental health policies including those related to the quality of drinking water. Strengthening DIGESA, by increasing its allocation of financial and human resources, would allow this Directorate to implement safe water programs, including hand washing campaigns and other awareness campaigns for personal hygiene; and to coordinate programs to control air pollution and phase out lead exposure.

3.47 Concurrently with strengthening DIGESA, it would be important to strengthen the Agency for Environmental Health (*Instituto de Salud Ambiental*). This Agency could be given responsibility for monitoring and enforcement of air pollution control regulations, lead exposure and hazardous waste management particularly for those pollutants that affect human health including, among others, PM2.5, heavy metals and hazardous wastes. It is advisable to provide autonomy and independent sources of funding for the Agency for Environmental Health. The sources of funding could be provided by environmental fees imposed on fuels and precursors of pollutants hazardous to human health.

3.48 **Designing and implementing air pollution control policies requires a concerted effort accompanied with organizational strengthening**. To tackle air pollution, it would be advisable that inter-institutional coordination is strengthened - between CONAM and the Ministries of Economy and Finance; and Mines and Energy - on fuel pricing. Similarly, under the leadership of DIGESA and CONAM, the government could design and implement PM 2.5 emission standards for mobile, diffuse and stationary sources. A restructured Agency for Environmental Health could assume responsibility for monitoring and enforcing regulations to control ambient air quality standards and air pollution emissions from mobile, stationary and diffuse sources.

3.49 **The Ministries of Health, Housing, and CONAM could design and implement a strategy to reduce the cost of environmental degradation associated with inadequate water supply, sanitation and hygiene**. Jointly, MEF, CONAM and DIGESA could work together in the design and implementation of policies aimed at reducing the burden of water borne diseases. The Ministry of Housing and DIGESA could be responsible for scaling up ongoing pilot projects on safe water and hand washing. The Ministry of Housing could strengthen ongoing programs to extend the coverage of water supply and sanitation services.

3.50 **A restructured Agency for Environmental Health could assume responsibility for monitoring and enforcing regulations to control pathogenic and toxic pollutants affecting water quality**. The agency would be responsible for monitoring and disclosure of data of environmental-health related water quality parameters for drinking water, irrigation or recreational purposes. On a regular basis the agency would disclose data on concentration of most probable number of coliforms in drinking water supplied by water utilities, water provided in irrigation districts, and data on concentrations of pathogens in water bodies used for recreational activities such as beaches or lakes. Dissemination of data on morbidity and mortality associated with water borne diseases by city and department could also help raising public awareness on these environmental health problems. Among other responsibilities this

agency would enforce compliance with primary water quality standards, and would impose penalties for administrators or owners of water utilities, irrigation districts, or recreational sites that do not comply with these standards.

3.51 **Efficient fuel pricing and promotion of efficient stoves, particularly in community kitchens could become the core of a strategy for indoor air pollution control.** The design and implementation of a strategy to control indoor air pollution needs a joint effort of the Ministries of Economy and Finance, Health, Mines and Energy, and CONAM. In addition, to designing and implementing a program to promote efficient stoves at community kitchens, and at the household level, the Ministries of Energy, Health and Housing and CONAM could collaborate in establishing a technical unit to certify improved stoves marketed in the country, for both fuel efficiency and reduced pollution.

Reducing the Vulnerability to Natural Disasters

3.52 **Establish an Agency aimed at reducing vulnerability to natural disasters**: Due to the significant impact of natural disasters on Peru, the government might consider the creation of an autonomous agency, under the Ministry of Housing, Construction and Sanitation, in charge of nonstructural measures to *reduce vulnerability to* natural disasters. INDECI should continue to be responsible for emergency relief and reaction, making use of its already demonstrated strengths to organize relief interventions. The PROFONANPE model could be followed in order to create a fund to reduce vulnerability by financing the disaster prevention plans proposed by regional and local governments. The fund would become an important incentive for local governments to move forward on the preparation of local prevention plans and their implementation.

3.53 Creation of an office for reduction of vulnerability to natural disasters as part of the establishment and funding of the new National Center for Strategic Planning (CEPLAN) could be carried out in the short term. This could be complemented with establishment of a parallel office in the Minister of Housing, given the major impact of natural disasters on housing. This approach would also help in promoting of disaster prevention and risk assessment policies across the various Ministries and functional areas, from development planning to watershed management to public works projects.

3.54 The proposed agency would have to work in close coordination with local and regional governments, the CCL/R, and the *Mesas de Concertación para la Lucha Contra la Pobreza* in order to make the disaster prevention plans a part of the local and regional *Planes Concertados de Desarrollo,* emulating the successful experience of the Sustainable Cities Program (*Programa de Ciudades Sostenibles*).

Proposals to restructure the organizational framework for natural resources management and conservation

3.55 **Clear separation of regulatory and investment functions in forestry management**: Longer term, greater support should be given to SUNAT, OSINFOR and INRENA to strengthen their ability to enforce compliance; and impose and collect fines. The ambiguous relationship between INRENA and OSINFOR (which surfaced as recently as December, 2005) limits the effectiveness of both. The GOP should consider placing OSINFOR in the PCM to enhance its stature and likely effectiveness. This was initially the intention with the creation of OSINFOR by the Forestry Law of 2000 (*Ley Forestal y de Fauna Silvestre*). However, OSINFOR was never developed as an autonomous agency and finally was absorbed by INRENA, thus creating a potential conflict of interest as the regulatory and investments responsibilities are within the responsibility of the same agency.

3.56 A report submitted by Apoyo Consultoría in 2003 opened a menu of options to address some of the problems summarized above. These options included: (i) the creation of an autonomous agency concentrating natural resource management and directly reporting to PCM; (ii) the creation of two new agencies to complement INRENA's responsibilities: a special committee within PROINVERSION to manage forestry concessions, and an autonomous entity responsible for land management; and (iii) maintenance of the current institutional framework, strengthening INRENA, developing OSINFOR, clearly defining their responsibilities, and making them accountable for their fulfillment.

3.57 **Build up soil conservation capacity**: Soil conservation also needs reforms in legislation and institutional strengthening. The 1995 Land Law provided important legal instruments to promote public investment in land conservation and monitoring capacity. Analytical work to be developed by the Ministry of Agriculture could include the identification of incentives for private investment in soil conservation and management. In similar terms, the centralized and decentralized institutions with soil management responsibilities require reliable and updated data on the state of soil degradation and the natural and social process of increasing soil salinization and erosion. Since the disappearance of ONERN in 1992, monitoring and evaluation of soil conservation has not been undertaken systematically, and adequate information for decision making is not available. The Ministry of Agriculture should be given a mandate –and the necessary resources – to carry out these monitoring and evaluation tasks, which are needed particularly for agriculture production.

3.58 **Integrate and further decentralize water management**: Much of INRENA's attention is focused on the irrigated areas of the Coast where it jointly administers the irrigation districts with the ATDRs; ultimate authority for water storage release rests with the AACHs. INADE focuses on construction and engineering issues in the large-scale Coastal irrigation projects. The Government and several stakeholders have drafted a Bill for water resources management that would address various institutional gaps and overlaps that presently affect the effectiveness of water management in Peru. By pulling water management responsibilities out of INRENA and assigning this global task to a new Water Resources Agency, the Bill proposes to insulate the government from short-term demands of water users. According to the Bill, the new agency would have an overall coordinating role in addition to responsibility for assuring sustainable long-term availability of water resources, including reconciling short-term demands with long-term best interests.

3.59 Under the proposed Bill, water management will require an institutional set-up that conveniently addresses the directive to decentralize management of water resources and the need to encourage management of river basins and irrigation districts by local councils and committees. According to the Bill, the proposed water agency would be responsible for regulating of decentralized councils and committees that operate at the local level, with the involvement of a wide range of stakeholders. Thus, it would have to build the capacity to develop a reliable information system; a monitoring mechanism provided with a sound set of goals; the legal and financial resources to enforce regulations; and a communication and participatory framework to raise awareness about water challenges; and involve citizens and civil society organizations in demand side management.

3.60 **Provide greater autonomy to the administration of natural protected areas**: Peru is one of the most successful countries in Latin America in terms of the creation of protected areas, and PROFONANPE is a model for sustainable financial management in the region. Nevertheless, problems faced by the system include dependence on resources from the donor community and the need to administer resources in a more timely and effective manner. In order to achieve financial stability, the Government might consider establishing mechanisms to generate its own financial resources, including the development of fees for access to protected areas and the establishment of a concession system for park and service management.

3.61 In order to effectively decentralize protected areas, co-management programs might be established to fully integrate indigenous communities in the management of protected areas, particularly in the Amazon Region. In areas with little or no indigenous population, similar programs might be established with departments and municipalities. In both cases, management plans might also be modified to create an explicit role for local communities in the drafting and implementation of management plans and the sharing of benefits derived from the protected area, even if a full co-management regime is not immediately established. The programs could lead in the future to the complete decentralization of protected area management to regional and local governments and councils, helping ensure that these areas are managed in concordance with local customs, needs, and priorities. Similarly, conservation efforts would significantly benefit from the implementation, by the Ministries of Agriculture and Social Development or regional and provincial governments, of rural development programs in buffer areas, sustainable productive projects as permitted within other areas of the park, and of other activities designed to increase the positive benefit accrued to local economies from the presence of the protected area.

3.62 **Strengthen fisheries resource management**: Fisheries resource management in Peru still has an incomplete legal and institutional framework. In spite of significant achievements, by DINAMA and DINSECOVI, environmental regulations (*Reglamento de Gestión Ambiental para las Actividades Pesqueras*) have not yet been approved for this sector. DINAMA and DINSECOVI could improve their management effectiveness if they would encourage and enable public participation, and take the decentralization process forward. Currently, only responsibilities concerning environmental impact statements have been decentralized to the regions. The GoP might consider efforts aimed at establishing participatory mechanisms to involve key stakeholders in consensus building regarding a sustainable fisheries policy; and restructuring the sector's legal and regulatory framework by closing loopholes and eliminating exceptions in existing laws and regulations.

Recommendations for Institutional Strengthening

3.63 Although Peru has made progress in its environmental management framework, many challenges remain. This section suggests ways to address some of the issues mentioned above. The following sets of institutional challenges have been identified as the most important: (i) setting environmental priorities, (ii) aligning environmental expenditure with priorities and improving the financial sustainability of environmental agencies, (iii) fostering decentralization, (iv) promoting enforcement and accountability, and (v) ensuring participation and social accountability.

Setting Environmental Priorities

3.64 **Priority-setting Role of MEF**: As illustrated in the previous sections, vulnerable populations and the overall society would benefit from the implementation of a priority-setting mechanism that considers (a) the impacts of environmental degradation over the poor and most vulnerable groups; (b) the most urgent needs as perceived by the population; (c) the costs that environmental degradation infringes to society, and (d) a cost-benefit analysis of environmental measures. Satisfactory implementation of this mechanism requires a dual strategy that includes influence in political processes and technical capacity that involves the establishment of a strong working alliance between MEF and CONAM. The creation of a group within MEF to conduct, in close collaboration with CONAM, the analytical work for priority identification would provide analytically sound foundations for environmental priorities across sectors and budget allocation in response to those priorities. On the other hand,

Criteria for Setting Environmental Priorities

- The impacts of environmental degradation over the poor and most vulnerable groups;
- The most urgent needs as perceived by the population;
- The major risks and costs that environmental degradation infringes to the overall society
- The cost-benefit rate of environmental measures.

CONAM would benefit from this influence and focus on the coordination of environmental policy design and implementation among the sectors.

3.65 **Strengthen CONAM's consensus-building role:** In order to incorporate the population's perception about the most urgent environmental issues, CONAM would benefit from having the mandate to systematically conduct public opinion polls on the urgency of environmental issues. These surveys would provide a forum for the most vulnerable segments of the population to voice their concerns, while providing CONAM with negotiating tools before Congress, donors, and other stakeholders. For additional effectiveness, this process would benefit from formal participation from the private sector and civil society. .

3.66 **Development of Information and Analytical Work**: Development of research and analytical work by specialized governmental agencies can complement CONAM and MEF's monitoring and priority setting functions. As such, capacity-development of the SINIA, and its close coordination with INEI and Peru's relatively strong academic institutions and think-tanks to generate, collect and disseminate environmental information, should be supported. It is necessary to strengthen SINIA's equipment and the skill of its staffing in order that it may fulfill its role. More importantly, however, SINIA requires the necessary authority to get a responsive feedback, from agencies, line ministers and sub-national governments, to its requests for information. This authority is generally built up through technical assistance and a set of incentives that CONAM could provide to responsive agencies. An example worth examining is the Instituto Nacional de Ecología (INE) in Mexico. INE is the main environmental research institute in Mexico, and its work is specifically developed to carry out analytical work to support environmental policy design and decision making across sectors. This work is developed under close coordination with private and public institutions, and has significant credibility among the private sector, and national and international stakeholders.

3.67 **Information Disclosure** It is crucial that a more systematic effort be made to raise awareness of environmental issues. The publication of data in support of key environmental indicators (including health statistics or pollution loads); wider use of public fora to air development initiatives; broader and more detailed review and discussion of environmental management tools are examples of ways to improve public information, and promote transparency, accountability and awareness. In Colombia and Indonesia, among other countries, the publication of key environmental performance indicators has been instrumental to raise environmental awareness and place environmental issues in the national agenda. Mechanisms to disseminate information in a manner that is easily interpretable can allow communities to play a role as informal regulators, and also promotes accountability on the part of those being regulated (World Bank, 2005)

3.68 **Strengthen monitoring and Priority Setting Role of the Regions***:* To address environmental areas at the regional level, each region should be responsible for the incorporation of the region's specific priorities into the national environmental agenda. The lack of accountability for the identification of these priorities leads to top-down priority setting and lack of representation. For instance, on the country's Pacific Coast, currently the major environmental priorities (other than the national priorities of air pollution and vulnerability to natural disasters) may be found in urban environmental management problems such as water and noise pollution. In coastal zones and in the Sierra, massive soil erosion and salinization hinder agricultural productivity. The Selva, with a constant influx of highland colonists, represents the "next frontier" and, in the absence of safeguards, this influx places forest and biodiversity resources at risk.

3.69 **Create the capacity to evaluate results and impacts and learn from experience***:* All the institutions of Peru's environmental system would benefit from incorporating result and impact evaluation as part of their management routine. Without the capacity to evaluate, they will not be able to learn and build-in institutional change. For this, they would need to

systematically create baselines and entrust evaluations to independent consultants or organizations. Peru has an excellent set of researchers, think tanks and academic institutions that could be contracted to conduct these evaluations. The creation of a competitive evaluation-fund managed by MEF and CONAM could be a good way of encouraging an evaluation and learning culture in the system. The fund could also support the organization of learning activities, such as retreats to discuss evaluation results and workshops for cross-learning and analyzing international best practices. These learning activities should try to involve a broad audience of the institutions' staff, and participants from partner organizations, like NGOs, research institutions and universities.

Aligning environmental expenditure with priorities and improving the financial sustainability of environmental agencies

3.70 **A Planning Process to Align Environmental Expenditures with Priorities***:* Public resources allocated to support environmental sustainability are scarce and have been decreasing in absolute and relative terms since 2000. In absolute terms, they decreased from S/. 964 to 558 million; and in per capita terms from S/.37 in 2000 to S/.20 in 2004 (Shack, 2006)**.** Therefore, the effectiveness of environmental expenditure will increasingly depend on the GoP's capacity to allocate resources according to environmental priorities. As discussed above, mechanisms to align resources and priorities are not in place. Therefore, it is suggested that CONAM, with the support of the Presidency of the Council of Ministers (PCM)**,** and MEF, establish a planning process to align the sector's multi-annual strategic plan ((PESM) with the environmental priorities identified through the priority-setting process. A similar strategic planning process could be undertaken with the Regional Governments. Additionally, given the number of environmental activities supported by donors, or implemented by regional and local governments, the GOP might consider efforts aimed at planning environmental roundtables involving public institutions, donor agencies**,** and civil society to discuss priorities, coordinate actions, and develop a joint strategy. At the decentralized level it would be advisable to systematically include key environmental aspects in the agendas of the Joint Development Plans (*Planes Concertados de Desarrollo*) and the Participatory Budget. The Poverty Reduction Roundtables (*Mesas de Concertación para la Lucha Contra la Pobreza*) and the more recently established Regional and Local Coordination Councils could play a pivotal role in these regional and local processes.

3.71 **Create Capacity in MEF to Monitor Environmental Expenditure***:* An adequate assessment of policy implementation requires reliable monitoring and evaluation of environmental expenditure according to results and impacts, which could be carried out in MEF The proposed environmental policy team in MEF could carry out this periodic monitoring. As an alternative, the unit that currently monitors social expenditure could also track the effectiveness of environmental expenditure. To do so, it could develop results and impact indicators for each of the priority issues, and incorporate data delivered by participatory monitoring mechanisms into the M&E system. The reports of the unit would help MEF and CONAM to identify expenditure gaps and biases and propose corrective measures. It is important to note that in order for environmental expenditures to be adequately monitored, CONAM should be responsible for defining the expenditures that are eligible under this category.

3.72 **Improve Self-Financing of Environmental Agencies:** Because current fiscal public resources are shrinking, it is also important to establish incentives and mechanisms to improve the capacity of public environmental agencies to generate their own resources. In the case of the *Intendencia de Áreas Naturales Protegidas*, for example, some alternatives include the development of ecotourism services and the collection of fees for access to protected areas. These initiatives could involve the participation of indigenous peoples, NGOs, and local communities of the surrounding areas. Improvement in the collection of permits and concession fees by the environmental agencies could also be encouraged. Reliable databases and cadastre

systems would be essential to improve fee collection and accountability. This capacity also needs to be transferred to regional and local governments to improve their finances and properly fund environmental priorities.

Strengthening Interagency Coordination

3.73 CONAM and MEF to play a joint coordination role*:* The MEF and CONAM might explore new strategies for improving coordination among environmental authorities and building their management capacity. A necessary condition is to establish a system for collecting credible data on the institutional performance of environmental agencies. These data are needed for planning coordinated activities, monitoring compliance with such plans, and monitoring overall institutional performance. Actively disseminating such data and publicly disclosing it can create strong incentives for compliance with coordinated plans and for improved institutional performance. The *Ecodiálogo Nacional,* an annual meeting - of environmental authorities, environmental units of ministries, and CARs - that is fully open to the public should be maintained as a mechanism to foster coordination, learning, accountability and transparency. MEF and CONAM could also explore new strategies for improving coordination between them and other ministries, DIGESA, INRENA, and sub national environmental units. A number of more specific coordination mechanisms are available which fall into two categories: incentives for cooperative behavior; and control to sanction non-cooperative behavior.

3.74 **Result-based agreements to improve control**: Regarding control, an effective mechanism that has been used by MEF to ensure compliance with sectoral policies, is the signing of results-based agreements with national agencies and subnational governments. The MEF and the leading sectoral agency—CONAM in this case—monitor compliance of the agreement based on a clear, small set of critical standards indicators and milestones, which are part of the agreement. Budgetary disbursements are subject to a given degree of compliance, and allocations in the following budget cycle are decided according to the results achieved in the previous cycle.

3.75 **Setting coordination incentives**: Possible coordination incentives with subnational environmental units include enhancing the MEF's ability to cofinance investment projects at the regional level, linked to results agreements. In countries with a decentralized environmental structure, cofinancing is often the most important tool national authorities have to ensure national–regional coordination. A mechanism similar to the one described for budget allocation and disbursement could be applied to monitor compliance with results agreements. Conventional control mechanisms would be used to ensure that project funds are well spent. These mechanisms would help to bolster MEF and CONAM's ability to monitor environmental performance.

3.76 **Setting quantifiable goals**: The process of developing environmental performance could be closely tied to efforts to require environmental units to set specific quantifiable goals in their action plans, and to systematically monitor their progress toward achieving these goals. Ideally, this performance evaluation system would measure direct impacts on environmental quality, such as reduction in waterborne diseases or in outdoor and indoor concentrations of particulate matter less than 2.5 microns in size ($PM_{2.5}$)

Fostering Decentralization

3.77 Peru has made important progress in its decentralization process. As discussed in previous sections of this chapter, decentralization of environmental competences is limited and in most of the cases only covers the regional level.

3.78 **Determining what to decentralize**. International experience shows that decentralization is particularly convenient when participation in decision making, implementation and monitoring of local stakeholders play a crucial role to ensure quality outputs and effective results. The Government could consider decentralizing - to regions, departments and municipalities - responsibilities such as enforcement of secondary water quality standards such as biochemical oxygen demand, total suspended solids, phosphorous, potassium, and total dissolved solids. Enforcement of wildlife, forestry, and waste management regulations as well as forestry concessions could also be considered among those responsibilities to decentralize.

3.79 **Defining a decentralization scheme**: It is important that, in close coordination with the National Decentralization Council and with regional governments, CONAM and other environmental agencies define a decentralization scheme for those environmental functions which are set for decentralization. This scheme should define the result agreements that are going to determine the rules of engagement between the different levels of government involved, as well as the monitoring mechanisms, incentives and set of indicators that will control their performance. It is advisable that civil society play a role in this process making use of the already rich participatory setup that has been created with the process of decentralization in Peru, which includes mechanisms for local planning (*Mesas de Concertacion para la Lucha contra la Pobreza*), budgeting (*Presupuesto Participativo*), coordination (*CCLs*) and monitoring (*Comites de Vigilancia Ciudadana*).

Promoting Enforcement and Accountability

3.80 **Enforcement mechanisms should be strengthened**. One of the major limitations in the existing institutional framework is the absence of clarity regarding the enforcement of environmental laws and regulations, particularly in terms of transparency in the environmental planning and management process. As of 2005, discussions were underway on the need to reform the environmental enforcement and licensing framework, particularly among stakeholders who question whether the current system of granting environmental licenses and enforcement within line ministries is efficient, neutral, and unbiased. Likewise, there is a notion that there is an embedded conflict of interest when the line ministry in charge of promoting a specific economic activity has the capacity to effectively regulate it on environmental grounds. These notions have led to two proposals being debated at the highest levels of government: (i) the creation of a centralized environmental regulatory body (*Procuraduría Ambiental*) to address the enforcement of all productive sectors (as proposed by the prime minister); or (ii) the establishment of independent environmental regulatory bodies for each sector, following the model of the already functioning OSINERG (as proposed by the Minister of Energy and Mines). The Ministry of Justice has yet to assess these proposals. In this assessment the Ministry would have to taking into account the options that provide more legitimacy to the environmental management process and are most cost-effective.

3.81 Lessons from international experience suggest that it would be advisable to create a centralized environmental regulatory body, such as the Mexican *Procuraduria Federal de Protección al Ambiente* (PROFEPA). The creation of such an agency grants legitimacy to the environmental sector as a whole by providing efficient, neutral, and unbiased enforcement while eliminating potential conflicts of interests within sectors. This agency can also implement interesting incentives for public-private partnerships for improved environmental management systems and environmental performance indicators disclosure programs of to promote demand-driven environmental improvement in the private sector. In the case of Peru, this environmental regulatory body could focus its responsibilities on environmental priority problems, namely those associated with environmental health issues such as outdoor and indoor air pollution, and hazardous waste management.

3.82 **Support to accountability agencies**: As shown in the analysis, accountability mechanisms also need to be strengthened. The Comptroller's Office has established a specialized unit to monitor the integrity and performance of environmental agencies. However, due to financial and technical constraints, the unit limits itself to strategic interventions in critical areas. This unit has a great potential to enhance the accountability of the environmental system. It is therefore suggested that this unit be supported with the necessary financial and technical capacity to expand its coverage and role. The Ombudsperson's Office also has a significant potential to improve the accountability framework of the public environmental system. However, as indicated above, it does not have a technical unit that specializes in environmental issues; and a specific reporting capacity to deal with the fulfillment of citizens' rights linked to the environment is lacking. The Ombudsperson's Office, in coordination with CONAM and civil society organizations, could put in place a simple but effective accountability mechanism that consists of identifying a simple set of standards to measure the fulfillment of basic environmental rights, such as the right to clean air and water. Using simple language, these standards could be broadly disseminated among the population with the help of civil society organizations, making use of national and local media. Every six months the Ombudsperson's Office could produce report cards measuring the degree of fulfillment of those standards in each region or province, and could promote townhall meetings to discuss the inability to comply with authorities and civil society, and jointly find remedies and solutions

Ensuring Participation and Social Accountability

3.83 **The need to increase public support for change**: Participation and social accountability should be strengthened in order to mainstream the environmental agenda. A major constraint to effectively addressing environmental issues is the lack of public awareness of the extent, severity, and significance of key problems and environmental priorities. In the absence of public pressure, there appears to be little likelihood that the government will assign the environmental sector the priority it warrants. Likewise, it is important to have legitimate representation by the most affected groups in the design and formulation of environmental policy. It is clear that greater public awareness needs to be fostered among decision makers and the public at large to promote a significant change in public policy on the environment. The publication of data in support of key environmental indicators (including pollution loads, concentration of priority pollutants, and health statistics); wider use of public forums to air development initiatives, broader and more detailed review and discussion of EIAs, and other environmental management tools are illustrative examples of ways to improve public information and promote transparency, accountability, and awareness.

3.84 **Strengthen the demand side of accountability**: The analysis described in previous sections of this chapter reveals that Peru has active civil society organizations which play a crucial role in implementing projects, delivering services to poor sectors of the population, and those established in Lima participating in policy debates. However the capacity of civil society to participate in monitoring policy implementation and holding environmental institutions accountable is limited. International experience indicates that civil society can play a crucial role when citizens' organizations demand accountability from public institutions. International NGOs and donors could support the development of the technical capacity of civil society organizations to promote social accountability initiatives that could be independently implemented or in association with environmental agencies or with horizontal accountability institutions, such as that suggested for the Ombudsperson's Office in the previous section of this chapter.

3.85 **Creating an enabling environment for social accountability**: The public sector needs to meet two conditions in order to create an enabling environment for social accountability: (i) the production, disclosure, and dissemination of reliable, timely, and relevant information; and (ii) the establishment of inclusive channels of voice. Peru has a wide range of participatory channels at the national level, such as the Acuerdo Nacional, the Mesa Nacional de

Concertación para la Lucha Contra la Pobreza, the Ecodiálogo; and at the subnational level, the Local and Regional Coordination Committees (CCL/R), the Participatory Budget and the local *Mesas de Concertación*, all of which could become excellent conduits for voice and social accountability.

Table 9.5. Summary of Main Institutional Recommendations

Responsibility	Recommendation
Analytical work and environmental policy design	Establishment of a small group in MEF
Coordinating environmental policy design and implementation as well as negotiating with sectors and stakeholders	Strengthening CONAM
Enforcement of primary standards and environmental health regulations	Strengthening the Environmental Health Institute to act as a *Procuraduría* (fiscalización, vigilancia y control)
Environmental Impact Assessment (EIA) for large scale projects	National Ministries with EMS certification
EIA for local projects	Regions, Departments and Municipalities
Reduction of Vulnerability to Natural Disasters	Separation from INDECI and incorporation in the Housing Ministry of a specialized group
Management of National Protected Areas	Strengthening and granting budgetary independence to National Protected Areas Department (*Intendencia*)
Management of local Protected Areas	Departments, Municipalities, Indigenous comunities
Enforcement, monitoring and evaluation of secondary standards regulations, economic instruments for water pollution control, charges and fees.	Regions and Departments
Enforcement of wildlife, forestry and waste management regulations	Regions and Departments
Forestry concessions	Regions and Municipalities
Analytical work and policy design for fisheries sector	Strengthening IMARPE

Table 9.6 Institutional Arrangements for Environmental Management, 2006

	Agency								
Responsibility	**CONAM**	**INRENA**	**DIGESA**	**Mining and Energy**	**Production**	**Other Sectors**	**CARs**	**Regions**	**Municipalities**
Design of national environmental policy	✔	✔	✔	✔	✔				
Enforcement of environmental policies		✔	✔	✔	✔	✔	✔		
Coordination of national environmental policy	✔	✔	✔	✔					
Design of pollution control measures s	✔	✔	✔	✔	✔			✔	✔
Enforcement of pollution control measures			✔	✔	✔	✔			
Enforcement of natural resources management Allocation of water rights and forestry concessions		✔		✔	✔	✔			
Environmental Permitting		✔	✔	✔	✔	✔			
EIA		✔	✔	✔	✔	✔			
Reduction of vulnerability to natural disasters									
Conservation and protected areas		✔							

Table 9.7, Proposed Institutional Arrangements

Responsibility	CONAM	INRENA	DIGESA	Mining and Energy	Production	Other Sectors	Nattonal Water Agency	National Health Agency	Vulnerability reduction Agency	Regions	Municipalities
Coordination, design and implementation of environmental policy	✔	✔	✔							✔	✔
Enforcement of environmental policies		✔				✔				✔	✔
Enforcement of pollution control measures			✔					✔		✔	✔
Enforcement of natural resources management regulations							✔	✔		✔	✔
Environmental permitting		✔					✔	✔		✔	✔
EIA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Reduction of vulnerability to natural disasters	✔	✔				✔	✔	✔	✔		
Conservation and protected areas		✔								✔	✔
Water and forestry rights allocation		✔					✔			✔	✔

CHAPTER 10

A WAY FORWARD

10.1 Over the past two decades, Peru has carried out numerous activities aiming to protect its environment. These include restructuring its legal and regulatory frameworks, undertaking numerous policy initiatives, and expanding and strengthening its institutional capacity for protecting and managing the natural resources and environmental quality vital to sustainable growth and poverty reduction. The government has made significant advances, such as establishing a system of national parks, among other advances. Significant milestones in the Evolution of Peru's Environmental Management Framework include the passing of the Environment and Natural Resources Law (Código del Medio Ambiente y los Recursos Naturales) in 1990, the development of sectoral environmental authorities, which was spearheaded by the mining and energy sector in 1993, the establishment of a national environmental authority, the National Environment Council (Consejo Nacional Ambiental, CONAM) in 1994, and more recently, the enactment of the Environment Law in October 2005. However, Peru still faces the serious challenge of slowing and reversing environmental degradation.

10.2 This chapter summarizes the conclusions of the country environmental analysis and provides recommendations to assist the Government of Peru in the revision of policies to address the priority environmental problems. It also outlines a program of policy and institutional reform and complementary investment directed toward areas that impose a high cost on the economy, but which have not yet been tackled (Table 1). An increased focus is needed on improving the quality of life for the growing number of poor people living in urban and rural areas. The goal of the recommendations presented in this chapter is to support the country's efforts to move toward more equitable and sustainable economic growth.

10.3 The analysis of the cost of environmental degradation done as part of this analysis, shows that the most costly problems associated with environmental degradation are, in decreasing order, inadequate water supply, sanitation, and hygiene; urban air pollution; natural disasters; lead exposure; indoor air pollution; soil degradation; inadequate municipal waste collection; and deforestation. The burden of these costs falls most heavily on vulnerable segments of the population, especially the poor, who are often exposed to higher environmental health risks than the non-poor and lack the resources to mitigate those risks. It is estimated that the impact of environmental degradation for the poor relative to the non-poor is 20% higher in terms of impact per 1,000 people, while it is 4.5 times higher in terms of impact per unit of income. Children under the age of 5 bear a large percentage of the total cost of environmental health damages, most of these costs are borne by children from poor families, highlighting the importance of environmental degradation as a barrier to inequality reduction. The effects of environmental degradation associated with these principal causes are estimated to cost more than 3.9 percent of GDP, mainly due to increased mortality and morbidity and decreased productivity. To identify alternatives aimed at abating the cost of environmental degradation, this CEA examines institutional and policy issues in the functioning of the country's environmental management system and suggests some cost-effective interventions.

10.4 The cost of environmental degradation in Peru is higher than in other countries that have similar income levels. Studies of the cost of environmental degradation conducted in Colombia, an upper middle income country in Latin America, and several lower middle income countries in North Africa and the Middle East show that the monetary value of increased morbidity and mortality typically lies below 2 percent of GDP in these countries, in comparison to a value of 2.8 percent of GDP in Peru.

10.5 The results of the analysis of the cost of environmental degradation are roughly consistent with those of a 1997 national survey on environmental awareness (Instituto Cuanto, 1998), where 85% of the population considered that environmental problems should be promptly solved, and survey respondents identified water and air pollution as the most pressing concerns, followed by urban management of wastes and public areas.

Revisiting Environmental Priorities for the Most Vulnerable Groups

A study was conducted as part of the CEA to identify the environmental problems that are associated with the most significant economic costs (Larsen and Strukova, 2005). The study estimated that the economic costs of environmental degradation, depletion of natural resources, natural disasters, and inadequate environmental services (such as inadequate sanitation) amount to 8.2 billion Soles, equivalent to 3.9 percent of GDP in 2003. The analysis shows that the most costly problems associated with environmental degradation are, in decreasing order, inadequate water supply, sanitation, and hygiene; urban air pollution; natural disasters; lead pollution; indoor air pollution; and agricultural soil degradation. The costs of inadequate household solid waste collection and deforestation are minor in comparison to the former categories.

10.6 The cost of environmental degradation in Peru is higher than in other countries that have similar income levels. Studies of the cost of environmental degradation conducted in Colombia, an upper middle income country in Latin America, and several lower middle income countries in North Africa and the Middle East show that the monetary value of increased morbidity and mortality typically lies below 2 percent of GDP in these countries, in comparison to a value of 2.8 percent of GDP in Peru.

10.7 The burden of these costs falls most heavily on vulnerable groups. The poor, or low income households, are often exposed to higher environmental risks than higher income groups and lack the resources to mitigate those risks. Environmental health impacts often have more severe repercussions on the poor than on the non-poor because the latter tend to have more resources to cope with such events, better access to health services, and a better general health condition. Environmental impacts and natural disasters can also result in a loss of income or assets that is more detrimental for the livelihoods of the poor than for those of the non-poor. In general terms, it is estimated that the impact of environmental degradation for the poor relative to the non-poor is 20 percent higher in terms of impact per 1,000 people, while it is 4.5 times higher in terms of impact per unit of income.

10.8 The impacts of urban air pollution relative to income are more severe for the poor than for the non-poor. It is difficult to ascertain whether health impacts from urban air pollution have a higher incidence on the poor or the non-poor. The non-poor may have a higher incidence of health impacts per 1000 people because a relatively larger share of this population is in the age group of 60 year or more and cardiopulmonary mortality predominantly occurs among the elderly population. However, it is possible that the age specific death rate and/or respiratory incidence rate are higher among the poor and these factors could result in health impacts being higher among the poor. Health impacts relative to income are also considered a useful indicator because illness and premature mortality result in medical treatment costs and lost income, in addition to pain, suffering, and activity restriction. Based on this indicator, health impacts are between 75 and 300 percent higher among the poor.

10.9 The impacts of waterborne diseases are several times higher for the poor than for the noon poor. Both child mortality and child diarrheal prevalence have a strong correlation with poverty. Official data indicate that child mortality rate among the poorest 20 percent of the population was 5 times higher than among the richest 20 percent, while child diarrheal prevalence among the first group was two times higher than among the second group. Based on this data and on the higher relative share of children in the poor population, it is estimated that health impacts per 1000 people are three times higher in the poor population than in the non-

poor population. The difference is even higher in terms of impacts relative to income, with impacts in the poor population estimated to be 10 times higher than for the non-poor.

10.10 The impacts of indoor air pollution are highly concentrated among the poor. Around 10 percent of urban population and more than 85 percent of rural population use solid fuels for cooking and heating. Although there is no available data on the percentage of poor and non-poor population that use solid fuels, it is reasonable to assume, based on urban and rural poverty rates of 40 and 65 percent, respectively, that almost the entire 10 percent of the urban population and around 65 percent of the rural population that use solid fuels are poor. Under these assumptions, an estimated 80 – 85 percent of the total health effects would be among the poor. This share could be even higher in the plausible cases that poor households use more polluting stoves and have worse general health conditions.

10.11 The priorities identified by the analysis of the cost of environmental degradation are roughly consistent with public perceptions. Water contamination and air pollution were identified as the environmental issues of greatest concern in a national survey on environmental awareness conducted in 1997. At that time, 85 percent of survey respondents considered that environmental problems must be promptly solved. (Instituto Cuanto, 1998). In a different survey conducted in 2004 in the Lima-Callao region, 80 percent of respondents identified air pollution as the principal environmental problem in the area (GEO, 2004).

Environmental Health

10.12 Negative health impacts represent more than 70 percent of the costs of environmental degradation. Increases in morbidity and mortality resulting from urban air pollution and lead exposure; inadequate water supply, sanitation, and hygiene; and indoor air pollution have an estimated cost of 5.85 billion Soles.

10.13 In spite of the important reductions that Peru has achieved in child mortality from diarrheal illnesses, diarrheal prevalence in both adults and children remains high. Poor households are most severely affected, as their relatively low income and education interact with lack of access to basic services to generate a very high risk to diarrheal illness. An analysis conducted as part of the CEA estimated the costs and benefits of interventions for environmental health improvements including: (i) hand washing by mothers or caretakers of young children; (ii) improved rural water supply; (iii) safe sanitation facilities in rural areas; and (iv) drinking water disinfection at point-of-use. The analysis concluded that benefits would exceed the costs of each of these interventions and that, if implemented they could reduce the cost of environmental health effects by more than 360 million Soles per year.

10.14 Indoor air pollution (IAP), associated with the use of solid fuels for cooking and heating, has a well-documented relationship with negative health effects, particularly with acute lower respiratory illness (ALRI) in children under age 5, and chronic obstructive pulmonary disease (COPD) and lung cancer in adult females. IAP is most severe in poor rural communities and predominantly affects women and children, who spend more time in closed areas with high concentrations of pollutants associated with the use of solid fuels. The analysis conducted as part of the CEA evaluated various interventions to eliminate indoor air pollution from solid fuels, including the installation of improved wood stoves with chimneys and substitution to clean fuels in both individual households and in community kitchens. Benefits accruing from the substitution in households of unimproved to improved stoves were found to be almost seven times larger than the costs. The substitution to liquefied petroleum gas (LPG) from unimproved stoves or from a combination of unimproved stoves and LPG was also estimated to have higher benefits than costs. Conversely, the benefits of substitution from improved stoves to clean fuel (LPG) were found to be slightly smaller than the costs of LPG at current market prices. Implementation of household substitution from unimproved to improved stoves and from a mix

of unimproved stoves and clean fuel to clean fuel alone, and the use of clean fuel in community kitchens could reduce the cost of environmental health effects by 250 million Soles per year

10.15 Urban air pollution is one of the most widespread and serious problems in Peru's cities and is responsible for an estimated 3,900 premature deaths per year. There are two major air pollutants of concern to health in Peru, namely particulate matter (PM) and associated small particles created from chemical reactions involving sulfates and nitrates; and lead. Both of these originate principally from transport and industrial activities. Peru is already undertaking substantive measures to eliminate lead in fuels, and thus, the CEA discusses more thoroughly the risks associated with exposure to PM, particularly those with less than 2.5 micros (PM_{25}), which have a strong documented relationship with negative health effects. The problem of air pollution is most critical in the country's industrial corridors, such as Lima-Callao, which bears almost 75 percent of the estimated cost of associated health impacts. Pollutant concentrations in downtown Lima are higher than in other Latin American cities with severe air pollution, such as Mexico City and Santiago, and are considerably higher than cities outside the region, including Los Angeles, Tokyo, and Rome, which have successfully reduced their ambient concentrations of air pollutants, despite having larger industrial and transportation sectors.

10.16 As part of the preparatory work for the CEA, a study evaluated several interventions aimed to reduce urban air pollution, including the introduction of low sulfur diesel, the use of compressed natural gas in buses and taxis, changes in the bus fleet to larger cleaner buses, improved inspection and maintenance programs for vehicles, retrofitting particulate control technology for vehicles, a phase out of two stroke engines in "baby taxis", better facilities for the use of bicycles, and the introduction of industrial abatement technologies. The three most efficient interventions correspond to; (i) the retrofitting of diesel powered trucks and buses, (ii) introducing a vehicle inspection and maintenance program with a rigorous vehicle emissions testing, and (iii) introduction of low sulfur diesel (planned to be introduced in 2010) which would unambiguously result in net economic benefits stemming from associated reductions in health impacts. Additional actions that the GOP might consider implementing in the short run include the establishment of national ambient standards for PM10 and PM2.5 in priority urban areas and strengthening technology-specific emission standards for PM and its precursors, particularly sulfur and nitrogen oxides. An air quality monitoring program might be implemented to ensure the effective application of such norms. Medium to long term actions that the GOP might also consider include: (i) establishing a plan to upgrade the vehicle fleet; and (ii) adopting integrated land-use and sustainable transport policies to promote sound mobility systems and reduce the average fuel consumption per trip.

10.17 Environmental health issues should be Peru's first priority in the short run. Based on the severity of the health impacts of environmental degradation, as well as their higher incidence on vulnerable groups, Peru should focus its efforts in conducting interventions aimed at reducing urban atmospheric concentrations of particulate matter (PM25); mitigating the impacts of indoor air pollution stemming from the use of solid fuels for cooking and heating; and reducing the incidence of waterborne diseases.

10.18 Environmental health problems could be more effectively addressed by an independent entity with clearly defined responsibilities for environmental health management. A decentralized entity should be created within the Ministry of Health to regulate emission of PM2.5, lead, toxic pollutants and fuel quality to tackle air quality, and enforcing bacteriological quality, POPs, VOVCs, and heavy metals, among others, to deal with water contaminants that affect human health. The urgency of controlling water pollution to protect and improve public health cannot be overemphasized. Most of the sectorial agencies that are responsible for regulating water pollution control have focused on a limited range of activities and have established legal limits on a reduced number of parameters, most of which have aesthetic or ecological significance, but minimal importance for human health. The dearth of relevant regulations in this area is a problem that should be urgently solved, considering that waterborne

diseases are a significant cause of morbidity and mortality in Peru. In this context, the GOP should consider developing specific regulations and enforcement mechanisms in the short run to control water quality parameters that have health implications, such as pathogens, volatile organic compounds, and persistent organics. It is further recommended that an autonomous Environmental Health Agency is created with responsibilities for enforcement of health-related parameters, while parameters of aesthetic, ecological or productivity relevance should be regulated separately by INRENA or the proposed National Water Authority.

Natural Disasters

10.19 Peru's incidence of natural disasters is nearly twice that for Latin America as a whole (Charvériat, 2000). Peru's geographical location partly explains such high incidence, as the country is located in one of the most seismically active areas of the planet and is recurrently affected by the atmospheric and oceanic conditions caused by El Niño. The most prevalent types of disasters during the 2000 – 2004 period have been strong winds, floods, and heavy rains, but floods, earthquakes, frost and snow, and drought have affected a larger number of victims. Different data series show an increasing frequency of natural disasters over both the short and long term. Although some of these disasters have distinct natural sources, others – notably flooding and landslides- are increasingly influenced by human activities that modify environmental conditions and create a greater predisposition to more severe effects. Soil erosion and deforestation have contributed to higher flood risk in exposed and low-lying areas, and also contribute to create the conditions for mass soil movement resulting in landslides and *huaycos*. Urbanization and greater demographic density have led to higher exposure to potential disasters in specific areas that concentrate socio-economic activities.

10.20 Reducing vulnerability to natural disasters should constitute the GOP's second short-term priority. These events have resulted in a significant cost to the country's human and physical capital. It is estimated that more than 2 million people were affected by natural disasters during 2000–2004, at an annual cost of approximately US$325 million (Larsen and Strukova, 2005). The poorest and most susceptible have paid the highest costs for these disasters in damages, deaths, and lost assets. These groups tend to be more vulnerable to natural disasters for a variety of reasons, including the construction of housing where land is cheap, frequently near river bottoms and on steep hillsides; the lack of land use control in these areas; poor quality construction; lack of basic mitigation measures; and their marginal livelihoods and limited capacity for economic resilience.

10.21 To address this problem, it is necessary to develop an integrated response to natural disasters that emphasizes prevention, vulnerability analysis, and risk assessment. In this regard, the GOP should consider establishing an autonomous agency in charge of non-structural measures to prevent natural disasters. This new agency could function independently of existing entities focusing on emergency relief and reaction. A crucial element of the strategy would be the creation of a fund to provide incentives for local governments to advance in the preparation and implementation of prevention plans. Additional non-structural and structural measures that the GOP should consider include the establishment of reduction of disaster risk and vulnerability as a national priority, adoption of disaster prevention and risk assessment tools at all levels of government, managing risks in land use and urban planning, and diffusion of appropriate and safe construction technologies.

Natural Resource Management

Fisheries

10.22 Peru's fishing grounds are the richest in the world. Over 274 million MT of fish were harvested from Peruvian waters between 1950 -2001, with anchovies constituting over 75% of total harvest during that period and currently representing approximately 10 percent of the

global annual marine catch. The importance of the anchovies lies not only in its social and economic value as a fishery, but also in its role in sustaining a large and diverse food web that supports a wide array of ecosystem goods and services that are essential to maintain marine biodiversity and productivity. Fisheries also target additional pelagic species, such as sardine, horse mackerel and chub mackerel, as well as coastal species that include the hake (merluza). Inland fisheries in the Amazon and Highland areas yield an annual 30 – 80,000 MT. The fisheries sector is a significant contributor to the Peruvian economy, generating around 6% of the employment, 1% of GDP, and accounting for 11-16% of total exports earnings (which makes it the second largest earner of foreign exchange after mining).

10.23 The sustainability of Peru's fisheries is critically threatened by several factors. The overcapacity of the fishing fleet and the occurrence of El Niño has resulted in extreme resource volatility and overexploitation of fisheries of various species, including anchovies and hake. Economic inefficiencies plague the sector, with vessels remaining idle for most part of the year and the sector absorbing a substantial amount of capital to service its heavy debts. Additional issues that should be tackled to ensure the sustainability of Peru's fisheries include: i) negative environmental/ecosystem impacts; ii) weak governance and inadequate oversight, manifested in the existence of legal loopholes and the granting of "exceptions" that have allowed the sector's capacity to grow in spite of existing regulations limiting such growth; iii) weak accountability and lack of transparency resulting from the influence of a powerful lobby and the conflict of interests that stems from PRODUCE's dual role in environmental oversight and production; and iv) social and equity issues, including the need to develop a domestic market for direct consumption of species that represent a potential protein source for the poor and the dissipation and drain of resource rents that the government might collect from the sector to support other socially desirable goals, such as poverty reduction.

10.24 Continuation of the existing situation will most likely result in severe overexploitation of fisheries and the waste of scarce economic resources that could be used as a platform to develop a more diversified and resilient economy. Recommendations to address the sector's challenges include: i) inemdiately exploring options to reduce capacity and effort in the fishcing sector; ii)establishing the participatory mechanisms to involve key stakeholders in consensus building regarding a sustainable fisheries policy; iii) strengthening the sector's research capacity to support an ecosystems approach to management, including assessing the onset and impact of El Niño on the anchoveta fishery; iv) establishing a system of marine protected areas to protect critical nursery habitats for threatened species and areas of high productivity for artisanal fisheries and aquaculture; and v) rehabilitating the sector's legal and regulatory framework by closing loopholes and eliminating exceptions in existing laws and regulations, as well as transferring environmental oversight and monitoring of environmental safeguards to an independent agency with authority to issue sanctions.

Soil Degradation

10.25 Cultivable land is a scarce commodity in Peru: arable land amounts to only about 0.155 hectare per capita, one of the lowest among developing nations. This makes soil erosion, which affects the whole country, a significant challenge. Lack of updated statistics precludes a robust assessment of the severity of the problem, but data from the 1970's indicated that 18.9 million has. in Peru were affected with moderate to severe erosion and light to moderate erosion affected another 109.9 million has. Different estimates (of which the most recent date from 1986) consistently conclude a soil loss arising from erosion of over 300,000 has/year. Soil salinity is also known to affect a significant share of Peru's cultivated land. Again, lack of monitoring makes it impossible to confirm the magnitude of the current problem, but studies conducted in the 1970's found that salinity affected 69% of the soils evaluated and qualitative evidence suggests that the situation has worsened over time. Larson and Strukova (2005) recently estimated that revenue loss to farmers caused by soil erosion and salinization amounted to S/$544 – 918 million Soles. While problems associated with land degradation, particularly

soil erosion, have exacerbated with time, they are still low compared to other countries where a similar analyses has been done

10.26 Natural factors, including topographic variations and seasonal rains exacerbated by the periodic occurrences of El Niño, make the country's soils vulnerable to erosion. However, these natural causes are aggravated by man-made influences such as overgrazing, deforestation, and poor cultivation practices. Similarly, soil salinity problems are created by a combination of natural factors, such as the soil's natural high mineral salts levels, and human activities, such as inefficient irrigation. Concerns regarding soil degradation are deepened by the evident and progressive disinvestment of the Peruvian government in mechanisms to address the problem over the past 30 years. Policy and public management reforms that would help to redress this situation include: conducting a new national inventory of soil erosion and salinity, modify water regulations that fix resource prices below its economic cost and thus contribute to its inefficient use, and carry out feasibility analysis of soil conservation investments as a basis for the adoption of cost-effective conservation measures.

Water Resources Management

10.27 Peru is endowed with abundant water resources. It has a national average freshwater supply of almost 60,000 cubic meters per capita, a figure that is several orders of magnitude larger than that of other Latin American countries such as Mexico and Argentina. However, water resources are unevenly distributed throughout the territory, and the largest share of the population and economic activities are located in the dry coastal region, generating considerable stress on the resource. The agricultural sector consumes the vast majority (86%) of available water at the national level, a pattern that is emulated in the coastal region, where 58% of the country's irrigation infrastructure is located. The use of gravity and flooding irrigation methods, as well as setting of very low irrigation fees that are barely collected largely explain a low water efficiency of 35%. These factors have also contributed to drainage and salinization problems in the coastal valleys. Historically, water resources management has been mainly focused on sectoral users, in particular irrigation[106], and water supply infrastructure. Recommendations to address the water sector's challenges include: continued implementation and strengthening of a comprehensive water rights system; continued improvements in irrigation practices and effectiveness; promotion of integrated land and water management; and strengthening river basin organizations.

Deforestation

10.28 With an estimated 68.74 million hectares of natural forests covering roughly 35.5% of its territory, Peru forest cover is the eighth largest in the world and second only to Brazil in Latin America. 99.4% of the forests are located in the eastern (Oriente) part of the country, while the Coastal region has been depleted almost entirely from its forest cover of mangroves and dry and sub-humid forests, and some 300,000 hectares of forests remain in the Andean highlands. Recent estimates suggest that Peru's deforestation rate between 1990 and 2000 was roughly 150,000 hectares per year, representing an annual cost of approximately US$130 million (INRENA, 2005; Elgegren, 2005; Larsen and Strukova, 2005). Proximate factors leading to deforestation in Peru include: slash and burn agriculture, large scale agriculture and forest plantations, narcotics traffickers who clear forests to grow coca and to build illegal runways, cattle ranching, and the development of roads and infrastructure, among others. Yet, increasing demand for land and resources driven by demographic growth, rural poverty rates of as much as 70%, undervaluation of the environmental services provided by forests, and policy failures represent some of the ultimate factors of the causes of deforestation.

[106] An Irrigation Strategy was discussed and approved underlining the importance of the subsector among the authorities. This strategy was used as a basis for the Water Resources Strategy discussions.

10.29 The 1975 Forest and Wildlife Law that governed the forest sector until the year 2000 had serious flaws including the lack of recognition of the needs of indigenous populations, the granting of excessively small (1,000 hectares) annual forestry contracts, and the encouragement of an exploitative relationship between small loggers and the timber industry and middlemen. The new Forestry and Wildlife Law of 2000 strengthened the sector's institutional framework, by introducing 40 year timber concessions for 5,000 to 50,000 hectares, allocated through transparent public bidding. Among the most important features of the law are requirements for sustainable management plans based on forest inventories and census, and forest resources access rights. However, implementation of the new Law has been characterized by inadequate planning and scheduling of the initial public bidding process; poor mapping of the concessions, in turn creating access difficulties to concessions and conflicts with concessionaires who argue that they received something different from what they bid for; lengthy delays in administrative processes that make timely harvesting difficult, and inadequate monitoring of illegal timber trade. One major factor limiting the sector's development has been the concessionaires' general lack of adequate capital, access to credit, or sufficient technical and business and forest management experience. Recommendations to address the sector's challenges include: revising the criteria for concession awarding to increase the probability of successful forestry enterprise development; strengthening institutional capacity, particularly in terms of monitoring and enforcement capabilities; and fostering the participation in forest management of sub-national governments, indigenous groups, and other stakeholders.

Biodiversity

10.30 Peru is recognized as one of the world's twelve mega-diverse countries, hosting 70% of the world's biological diversity and a very large number of endemic species. Peru's biological diversity represents a source of comparative advantage for the development of commercial species, including the alpaca and vicuña, brazil nuts, tropical fish, the peccary (for meat and hide), orchids, and medicinal plants among others. Although these species may not have the same commercial potential of crops such as potato or maize, they constitute the basis for a more diversified agricultural activity that can contribute to the country's sustained economic growth. Among other conservation efforts, Peru has established 61 natural protected areas that cover 13.74% of its total territory, a relative high figure when compared with other biologically diverse countries in Latin America and other regions. Peru's biological wealth has attracted much attention from international organizations and Non-Governmental Organizations (NGOs), which have supported numerous efforts to establish baseline data and monitor biological diversity in different biodiverse or biologically fragile sites.

10.31 While progress has been achieved in the use and conservation of biodiversity, Peru faces the challenge of integrating a consistent biodiversity management framework supported at the highest political level. Specifically, there is a need to guarantee the sustainability of existing conservation efforts, particularly as current legislation does not assign clear responsibilities to different entities with mandates on biological conservation and neither does it foster inter-agency coordination; the application of the existing body of regulations and policies is chronically deficient; there is limited capacity to properly manage biodiversity at the regional and local levels; and the country lacks a standardized monitoring system to assess the status of or changes in biological diversity. To that end, the CEA recommends strengthening the institutional capacity of key actors, clearly defining the roles and functions of CONAM, supporting national efforts to value biological diversity and environmental services, building on Peru's comparative advantage in biological diversity, and refining the coordination mechanisms among donor agencies.

10.32 The GOP is considering addressing the institutional weaknesses that affect the management of water, and biodiversity by establishing two independent and financially sustainable agencies. First, a national water authority as been included in a Water Resources Management Bill. This agency would have a mandate for overseeing the allocation of water

rights by Water User Boards and enforcing secondary water quality standards for parameters such as biological oxygen demand, chemical oxygen demand, PH, iron, manganese, and salts, among others. The Bill proposes a series of instruments to financially support the national water authority including water fees, based on the quantity and quality of water assigned to users, as well as pollution charges on parameters regulated by secondary water quality standards. A second agency would be in charge of the conservation and use of biodiversity, including the management of national parks. Resources to fund the functioning of this agency would come from PROFONANPE and would also be collected through fees charged for entrance to national parks and for the use of biodiversity. If these reforms come to fruition, INRENA would be redefined as a specialized agency with responsibilities for management of forests and soils. Under this scheme, INRENA would carry out its activities through watershed councils and be funded through stumpage fees and taxes on forests or soil degradation.

Environmental Assessment

10.33 The analysis of existing institutions, policies, and programs suggests that current environmental protection efforts can be better aligned with the priorities of the population or with the most pressing problems associated with the cost of environmental degradation. The negative impacts of environmental degradation on human health and decreased productivity now represent the most significant environment-related burden for vulnerable groups and constitute the most significant obstacle for sustainable economic growth. Yet, most institutional efforts have left environmental health programs in a second place, a situation that highlights the predominant influence of the international environmental agenda and tradition in Peru's environmental priority-setting, as well as the need for the development of more robust accountability and social learning mechanisms within the environment sector.

10.34 Peru's institutional framework assigns the main regulatory responsibilities of pollution control and environmental management to the environmental units created within each sector's authority. The Energy and Mining sector spearheaded these efforts by developing sectoral norms based on the use of Environmental Impact Assessments (EIA), Environmental Adaptation and Management Plans (PAMAs), and Maximum Permitted Limits (LMSs), and by establishing an independent entity to enforce environmental norms in the electricity and hydrocarbon subsectors. The Ministries of Production, Transport and Communications, and Housing, Construction, and Sanitation followed suit in terms of establishing specialized environmental units.

10.35 Peru's sectorized approach to environmental management and pollution control has resulted in a wide variation across sectors in terms of the development of appropriate regulations to safeguard the environment and limited institutional capacity to apply those regulations effectively. Currently, each sectoral ministry is responsible for defining the EIA process and terms of reference for the environmental impact studies. The result has been a lack of consistency in the approach, content, timing, and requirements of the EIA legal and regulatory process, which creates a lack of standardization and uniformity in the project planning and approval process. Ministerial staff are largely inexperienced in EIA and significant turnover and lack of financial resources for training have inhibited a response to this situation. Public participation has not played a significant role in project approval, as most consultations are held when most relevant decisions have already been made and usually take place in centralized locations where local interveners cannot participate. Responsibilities for EIA approval and monitoring and compliance are segregated among different entities, while consultants that participate in the former are legally impeded to continue with the latter, resulting in a disruption in the environmental management process and a lack of enforcement of EIA commitments and legal standards. As a consequence, EIAs have become a bureaucratic obstacle for projects with minimal environmental impacts, while failing to serve as a decision-making tool for managing and resolving complex environmental and social issues.

10.36 Peru has taken an important step to strengthen the use of EIA with the approval in April 2001 of the National System for Environmental Impact Assessment, but in order to significantly enhance the efficiency of EIAs, it should follow up with the development of the appropriate regulations and institutional efforts. Specific recommendations in this area include: i) developing uniform standards and terms of reference for EIA in Peru that are consistent both with respect to Peruvian Law and international best practice; ii) conducting an analysis of the links between the EIA and the land planning process; iii) developing an EIA guide that incorporates a life-cycle approach to project development with sustainability assessment considerations and long-term public engagement; iv) revising the current monitoring and follow-up process and broadening enforcement responsibilities to ensure compliance with EIA commitments; and v) strengthening public participation by developing standardized procedures for: timing of public consultation from the onset of the project through approval and implementation, incorporation of the results of public consultations into the decision-making process, dissemination and accessibility of information, feedback to participants of the result of the consultative process, and reimbursement of stakeholder costs for attending consultations in centralized locations.

Institutional Analysis

10.37 The set of environmental and natural resource laws and regulations that have been issued since the 1960's have given place to a complex and unique institutional framework for environmental and natural resource management in Peru. The Constitution of 1993 established the Peruvians' right to a safe environment and assigned the property of all natural resources to the State. Other institutional milestones include the 1990 Code of Environment and Natural Resources, the establishment in 1994 of the National Environmental Council (CONAM), the establishment in 1996 of the Structural Framework for Environmental Management, and the 2004 approval of the Law of the National System of Environmental Management.

10.38 Peru's model for environmental management is based on CONAM's role as a coordination body with the capacity to propose, manage, and evaluate the national environmental policy, which is implemented by environmental units within sectoral ministries. To this date, the Peruvian model has evidenced significant weaknesses including its lack of capacity to function as an integrated system, with the level of development of environmental regulatory frameworks and institutional capacity ranging widely from one sector to another. Environmental planning has not been incorporated at the highest policy-making level, despite the economy's evident reliance on natural resources and the negative impacts of environmental degradation on economic growth and reduction of inequality. Although Peru has considerable environmental regulations, they are inadequate for a number of reasons. First, in many cases, urgently needed regulations do not exist. Second, some regulations are incomplete and lacking in critical details. Third, some regulations are overly prescriptive and potentially inappropriate to local economic and social circumstances.

10.39 Other institutional constraints include: inadequate data on environmental quality and institutional performance; limited and uneven technical capacity in the environmental agencies of some sectors as well as interest groups that exert excessive influence on environmental authorities; and substandard enforcement, mainly due to the fact that the sectors themselves are responsible for enforcing environmental regulations and there is no independent control. There is also a weak legal and institutional framework to enforce regulations endowed with appropriate incentives and controls. This framework is even more fragile because of the existence of a scant system of accountability. Accountability institutions like the General Comptroller and the Ombudsperson lack the technical and financial capacity to oversee the performance of environmental institutions; and gaps and potential conflict of interests affect report lines of public environmental agencies. Additionally, the absence of timely and reliable information flows, and institutionalized spaces of dialogue hamper the ability of civil society to provided oversight and channel voice.

10.40 Sound environmental management and sustainable use of natural resources are indispensable for Peru's sustainable economic growth. Unless these conditions are met, the heavy burden of environmental degradation will continue to represent a constraint for the country's economic take-off. Addressing these serious issues requires the systematic incorporation of environmental priorities at the highest policy-making levels, which will require the establishment of strategic and systematic tools for priority-setting; establishing a set of indicators to monitor the interaction between the environment and the economy, progress to meeting environmental goals, and the change in natural assets and their impact on the wealth of Peru; and strengthening institutions' capacity to address environmental priorities. Institutionalizing systematic evaluations of policy impacts and institutional performance could foster the capacity of the Peru environmental system to learn from experience and could create feedback loops promoting institutional improvement and change.

Conclusions

10.41 The highest costs of environmental degradation in Peru are, in decreasing order of magnitude, inadequate water supply, sanitation, and hygiene, urban air pollution, natural disasters, lead exposure, indoor air pollution, land degradation, deforestation, and municipal waste. Combined, these environmental problems cost 8.2 billion soles, or 3.9 percent of Peru's GDP. The poor and vulnerable populations bear a disproportionately high amount of this cost. To address these problems, this report identifies a number of cost-effective policy interventions that could be adopted in the short and medium term to support sustainable development goals.

10.42 In recent decades, there has been considerable progress in addressing biodiversity conservation agenda. The high mortality and morbidity rates suggest the need to increase emphasis on environmental health interventions. However, the environmental management agenda has yet to catch up with this shift in priorities to strengthen environmental health programs because mechanisms in the current institutional structure to signal these changes are not yet in place. Improved monitoring and dissemination of information on environmental outcomes, assignation of accountabilities for environmental actions and outcomes, and involvement of a broad range of stakeholders are three important mechanisms to allow these signals to be picked up.

The main recommendations of the report are summarized in Table 10.1.

Table 10.1. Main Recommendations of the Report

Key Issue	Main Recommendations
Need for strategic and systematic tools for priority setting	• Design and implement a policy (through laws and regulations), to set environmental priorities in the national, regional, and local levels based on learning mechanisms to periodically review and learn from the experiences of implementation of environmental policies.
	• Install and implement systems to monitor and evaluate environmental management and the extent to which the objectives of environmental priorities are efficiently met.
	• Periodic evaluations of progress on the implementation of policies to tackle environmental priorities with the support of the accumulation of data, results, and experiences achieved through intersectoral coordination and learning.
Strengthening the Environmental Institutions	• Establishing the leadership and institutional arrangements and capacities to set priorities in environmental policy design and implementation • Aligning environmental expenditure with priorities and improving the financial sustainability of environmental agencies • Realigning and streamlining the institutional setup by filling in institutional gaps, avoiding overlaps, and creating regulatory and enforcement frameworks and capacities; • Improving interagency coordination; and planning and building capacity to adequately harness decentralization of key environmental competencies • Strengthening institutional learning and building the necessary feedback loops to mainstream improvements and change • Supporting the technical and financial capacity of accountability agencies to oversight environmental performance and creating an enabling environment for voice, public participation and social accountability. • Modify laws and regulations on parameters of effluent standards so that pathogens, and toxic and hazardous substances are regulated.
Restructuring Environmental Assessment	• Developing uniform standards and terms of reference for EIA • Conducting an analysis of the links between the EIA and the land planning process; • Securing the necessary resources to provide training courses and capacity building in EIA; • Developing an EIA guide that incorporates a life-cycle approach to project development with sustainability assessment considerations and long-term public engagement; • Revising the current environmental monitoring and follow-up process and broadening enforcement responsibilities • Strengthening public participation • Introduce more rigorous approaches to vehicle emissions testing.
High costs of environmental degradation associated with lead pollution	• Control air pollutant emissions with lead concentrations from stationary sources. • Identify other sources of lead pollution

Reduce health risks associated with ambient air pollution	• Establish national ambient standards for $PM_{2.5}$ and PM_{10} in priority urban areas and strengthen technology-specific emission standards for PM and its precursors (particularly sulfur and nitrogen oxides) (Cost: Low) • Implement an air quality monitoring program to monitor $PM_{2.5}$, PM_{10}, and ozone in priority urban areas (Cost: Modest) • Implement air pollution control interventions, including: (a) promoting retrofitting of diesel-powered vehicles, (b) implementing a program of testing vehicle exhausts, (c) reducing sulfur content in diesel to less than 500 parts per million, including increasing clean imports of diesel with low-sulfur content; and (d) emissions control from stationary, mobile, and non-point sources (Cost: Modest to high)
Reduce health risks associated with inadequate water supply, sanitation and hygiene	• Promote handwashing programs that target children under the age of 5. (Cost: Low) • Promote safewater programs that includes disinfection of drinking water at point-of-use. (Cost: Low)
Morbidity and premature deaths associated with indoor air pollution	• Promote the use of cleaner fuels in areas that predominantly use fuelwood in an accessible, safe, and cost-effective manner. • Implement a program to promote improved stoves. • Extend the coverage of rural electrification programs. • Include, in housing subsidy programs for rural low-income housing, requirements for building codes and housing design in poor communities to allow for improved ventilation and optimal chimney design.
Vulnerability to natural disasters	• Establish the reduction of disaster risk and vulnerability as a national priority. • Promote disaster prevention and risk assessment through comprehensive incorporation of tools at all levels of government. • Support disaster planning in the context of decentralization. • Improve budgetary planning and devote greater financial resources for disaster prevention and planning. • Incorporate risk analysis in public investment projects. • Foster greater participation in developing disaster plans. • Establish and national framework for integrated watershed management. • Establish a policy on land use planning. • Management of risks in urban planning and development. • Diffusion of appropriate and safe construction technologies.
Need for improved water resource management	• Support the Bill of Water Resources Management • Continued implementation and strengthening of a comprehensive water rights system. • Undertake a benefit cost analysis of an alternative wastewater discharge control system. • Design and implement a water pollution control policy • Promote integrated land and water management. • Set water fees equal to opportunity cost of water • Set water pollution fees to saline discharges • Strengthen river basin organizations. • Strengthen water users associations • Strengthen inter-institutional coordination of water resources management • Develop more secure infrastructure and disaster management systems. • Strengthen the decentralization process. • Promote stakeholder participation.
Deforestation	• Better position forest concessions for success. • Institutional strengthening of INRENA • Improve mapping, zoning, and forest inventories. • Better control of illegal logging. • Support for decentralization of forest management. • More active participation of stakeholders in forest management. • Strengthen technical assistance to the forestry sector. • Strengthen international markets. • Address land tenure and titling problems in forestry concessions and surrounding areas. • Stronger participation of indigenous populations.
Biodiversity conservation	• Strengthen institutional capacity of key actors. • Increase resources (financial support and technical assistance) to create an adequate biodiversity monitoring system, including agrobiodiversity. • Build on Peru's 'comparative advantage' in biological diversity, including agrobiodiversity. • Speed up the process of review and approval of CONAM roles and functions. • Strengthen GOP efforts to disseminate biological technical knowledge and training.

REFERENCES

Abbey, D. et al (1995). Long-Term Ambient Concentrations of Particulates and Oxidants and Development of Chronic Disease in a Cohort of Nonsmoking California Residents. Inhalation Toxicology, Vol 7: 19-34

Abbugatas Javier (2004). El Gasto Medio Ambiental en Perú: Exploración Inicial. Serie Medioambiente y Desarrollo no. 103. Proyecto CEPAL-PNUD. Santiago de Chile.

AchutaRao, K., K.R. Sperber and the CMIP Modelling Groups (no date). " Simulation of the El Niño Southern Oscillation: Results from the Coupled Model Intercomparison Project," Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, Livermore CA.

Aguero, M. 1987. A bioeconomic model of the anchoveta fishery. In Pauly, D. and Tsukayama, I. (Eds.). The Peruvian Anchoveta and its Upwelling Ecosystem: Three Decades of Change. IMARPE, Peru.

Ahmed K, Awe Y, Barnes, D, Cropper M, and Kojima M. (2005). Environmental Health and Traditional Fuels Use in Guatemala. Directions in Development. ESMAP. World Bank.

Albalak, R., Bruce, N., McCracken, J., Smith, K., and De Gallard, T. (2001). Indoor Respirable Particulate Matter Concentrations from an Open Fire, Improved Cook Stove, and LPG/Open Fire Combination in a Rural Guatemalan Community. Environmental Sciences and Technology. Vol. 35, No. 13.

Albalak, R., Frisancho, AR., and Keeler, GJ. (1999). Domestic biomass fuel combustion and chronic bronchitis in two rural Bolivian villages. Thorax. Vol. 54.

Alcalde, M. "Diagnóstico de la Deforestación en el Perú." (2002) Working Paper, USAID-INRENA- BIOFOR Activity. Lima, Peru.

Alfaro Moreno, J. *Conservación de Suelos y Desarrolla Rural en los Andes Peruanos (*1984). Lima, Peru.

Alonso, L., A. Alonson, T. Schulenberg and F. Dallmeier eds. (2001) *Biological and Social Assessments of the Cordillera Vilcabamba, Perú.* RAP Working Papers 12 and SI/MAB Series 6. Washington, D.C.: Conservation Internacional.

Andersen, L., Granger, C., Reis, E., Weinhold, D., Wunder, S. (2002) The Dynamics of Deforestation and Economic Growth in the Brazilian Amazon. Cambridge University Press.

Angulo, L. "Reducción de la Vulnerabilidad a los Desastres en Peru." (2005) Background paper prepared for World Bank Country Environmental Analysis, World Bank, Lima, Peru, December, 2005

Aprovechamiento Y Comercio Ilicito De Productos Forestales Maderables En El Peru, (2005). Working paper. Lima. Peru.

Arica, Yanggen, Kroschel, Forbes & Saint Pere (2005) (Centro International de la Papa)

Plaguicidas Orgánicos Persistentes y Altamente Tóxicos en Perú.

Bambaren Alatrista, C. V. (2002) Valuation of the El Nino damage. Universidad Nacional de Ingenieria-CISMID. Lima. Peru.

Baquero Haeberlin, I. et al (2003). Cuentas Ambientales del Suelo. Draft Paper. Corpoica.

Baranzini, A. and Goldenberg, J. (1996). Desertification, energy consumption, and liquefied petroleum gas use, with an emphasis on Africa. Energy for Sustainable Development. Vol. II, No. 5. January 1996.

Barde, J-P and D.W. Pearce (eds.) (1991). Benefits Estimates and Environmental Decision-Making, Earthscan, London.

Bedoya, E., and A. Bedoya, (2005) *El Trabajo Forzoso en la Extracción de la Madera en la Amazonía Peruana* International Labor Organization, Geneva, Switzerland, March,.

Begazo, A. (2004). Estimación De La Valoración Económica de los Impactos de la Contaminación Atmosférica por Pts y Pm10 en la salud de la Población De Lima Metropolitana. Final report

Borghi, J., Guinness, L, Ouedraogo, J., and Curtis, V. (2002). Is Hygiene Promotion Cost-Effective? A Case Study in Burkina Faso. Tropical Medicine and International Health, Vol 7 No11. November 2002.

Boy, E., Bruce, N., Smith, K., and Hernandez, R. (2000). Fuel efficiency of an improved wood-burning stove in rural Guatemala: Implications for health, environment and development. Energy for Sustainable Development. Vol. IV, No. 2. August 2000.

Boyla, K. and A. Estrada. (2005) *Áreas Importantes para la Conservación de las Aves en los Andes Tropicales. Sitios Prioritarios para la conservación de la biodiversidad.* Birdlife Conservation Series Nº 14. Quito: Birdlife International and Conservation International..

Brack Egg, A (sd). "*Economía y Conservación de la Diversidad Biológica*." Mimeo.

Brack Egg, A. (1997) "Comunidades Nativas como Centros de Conocimientos Tradicionales". In: GEF/PNUD/UNOPS. *Amazonia Peruana. Comunidades Indígenas, Conocimientos y Tierras Tituladas. Atlas y Base de Datos*.

Buenía, B. (1999) *Valoración Económica del Parque Nacional Tingo María – Cueva de las Lechuzas a partir del Mérodo de Valoración Contingente.* Thesis, Master of Science in Conservation and Sustainable Development. Lima: Universidad Agraria La Molina..

Butler, R. "Deforestation in the Amazon", http://www.mongabay.com/brazil.html ; http://www.mongabay.com/20ecuador.htm

Cal/EPA (2005): ARB bicycle awareness program 2005: Bicycle Fact Sheet

Castro, Mariano (2005) *Gasto e Inversion Ambiental en Peru*, presented at Seminar for Fiscal Policy, CEPAL, Santiago de Chile, February, 2005

Chambi, P. (2002) "Valoración Económica de la Captura de Carbono mediante Simulación Aplicado a la zona boscosa del río Inambari y Madre de Dios". In: M. Glave and R. Pizarro (eds).

Valoración Económica de la Diversidad Biológica y Servicios Ambientales en el Perú. Lima: Instituto Nacional de Recursos Naturales, International Resources Group and USAID.

Chervériat, C. (2000) *Natural Disasters in Latin America and the Caribbean: An Overview of Risk,* Inter-American Development Bank, Washington, D.C. October, I

CIFOR (2003) (International Forestry Research Center). *Review of Forest Rehabilitation Initiatives: Lessons from the Past: Peru Brief.* December 5,.

Clean Air Initiative (2005): Clean Air Initiative in Latin American Cities. Clean Technologies Information Pool. www.cleanairnet.org

Cleaner Vehicles Task Force (2000): The Report of the Alternative Fuels Group of the Cleaner Vehicles Task Force. An assessment of the Emissions Performance of Alternative and Conventional Fuels. DTI Automotive Directorate, London.

Comunicación Nacional del PERÚ a la Convención de Naciones Unidas sobre Cambio Climático, (2001). Lima. Peru.

CONAM (2001) Estado del Ambiente 2001. Lima. Peru.

CONAM and National Biological Diversity Commission. (1998) *Diversidad Biológica y Desarrollo en el Perú.* Mimeo.

CONAM-INRENA (2005a) (National Environmental Council and Program on National Capacity Strengthening for Managing the Impact of Climate Change and Air Contamination, National Institute of Natural Resources, Office for Transectoral Environmental Management and Natural Resources Evaluation and Information) ("PROCLIM") *Mapa de Deforestación de la Amazonía Peruana – 2000. Memoria Descriptiva. IM-03-02. Volumen I – Texto.* Lima: CONAM and INRENA.

CONAM (2005b): Legislación Ambiental del Recurso Aire. Serie Normas Ambientales, Septiembre 2005.

Conservation Data Center, (2004) Universidad Nacional Agraria, La Molina. *Análisis y Modelación Espacio-Temporal del Paisaje en las Áreas de Intervención del PDA*. Report submitted to the USAID World Wildlife Fund Project on "Environmental Management and Sustainable Use of Forest and Natural Resources in the Alternative Development Program (ADP) Intervention Areas", Lima, Peru.

Conservation International (1997) The Cordillera del Cóndor Region of Ecuador and Peru: A Biological Assessment. *RAP Working Papers* 7..

Conservation Internacional (2004) The Tambopata-Candamo Reserved Zone of Southeastern Perú: A Biological Assessment. *RAP Working Papers* 6.

Contreras-Hermosilla, A. (2002) *Law Compliance in the Forestry Sector. An Overview.* Washington D.C.: The World Bank Institute..

Corporación Andino de Fomento (CAF, 2000). *Las Lecciones de El Niño: Peru,* Caracas, Venezuela. October.

Cropper, M. and Oates, W. (1992). Environmental Economics: A Survey. Journal of Economic Literature. Vol. XXX, pp. 675-740.

Csirke J. (2005). B15. Southeast Pacific. Review of the State of the World Fishery Resources. FAO Fishery Technical Paper N 457. Rome

Curtis, V. and Cairncross, S. (2003). Effect of Washing Hands with Soap on Diarrhoea Risk in the Community: A Systematic Review. Lancet Infectious Diseases. Vol 3.

Dennis, R., Maldonado, D., Norman, S., Baena, E., and Martinez, G. (1996). Woodsmoke Exposure and Risk for Obstructive Airway Disease Among Women. Chest 109: 115-119. 1996.

Desai MA, Mehta S, and Smith K. (2004). Indoor Smoke from Solid Fuels: Assessing the Environmental Burden of Disease at National and Local Levels. Environmental Burden of Disease Series, No. 4. World Health Organization.

Diez, C. (2002) "Aproximación a la Valoración Económica de la Reserva Nacional Pacaya Samiria". In: M. Glave and R. Pizarro (eds). *Valoración Económica de la Diversidad Biológica y Servicios Ambientales en el Perú.* Lima: Instituto Nacional de Recursos Naturales, International Resources Group and USAID..

DIGESA (2005). Information on Air Quality in Lima-Callao for PISA-2005-2010, Comité de Gestión de la Iniciativa de Aire Limpio para Lima y Callao.

DIGESA (2001) Informe de monitoreo de 18 puntos de muestreo.Lima Peru 2001

Dockery D.W., Pope C.A. III, Xu X, et al (1993). An association between air pollution and mortality in six US cities. New England Journal of Medicine, 329: 1753-1759.

ECLAC/IDB (2000) "*Una cuestión de desarrollo: La reducción de la vulnerabilidad estructural frente a los desastres naturales*." Paper presented at the Conference "Confronting Natural Disasters: A Matter of Development" New Orleans, U.S. March,.

ECON Analysis (2005). Urban Air Pollution Control in Perú, Draft Report to the World Bank.

Elgegren J. (2005). Deforestation in Peru. Working Paper.

Espinoza R., et al, (2003). Determinants of blood-lead levels in children in Callao and Lima metropolitan area. Salud Publica de Mexico, Vol. 45, Suppl. 2., S209-S219.

Esrey, Potash, Roberts, and Shiff (1991). Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma. Bulletin of the World Health Organization, 69(5):609-621.

Esrey, S.A. (1996). Water, Waste and Well-being: A Multicountry Study. American Journal of Epidemiology, Vol. 143, No. 6.

Esrey, S.A., and Habicht, J-P. (1988). Maternal literacy modifies the effect of toilets and piped water on infant survival in Malaysia. American Journal of Epidemiology, 127(5): 1079-1087.

Esrey, S.A., Potash, J.B., Roberts, L., and Shiff, C. (1991). Effects of Improved Water Supply and

Sanitation on Ascariasis, Diarrhoea, Dracunculiasis, Hookworm infection, Schistosomiasis, and Trachoma. WHO Bulletin, Vol. 69, No. 5.

Ezzati, M. and Kammen, D. (2002). The Health Impacts of Exposure to Indoor Air Pollution from Solid Fuels in Developing Countries: Knowledge, Gaps, and Data Needs. Discussion Paper No. 02-24. Resources For the Future. Washington DC.

FAO (1998). FAO Irrigation and Drainage Paper 56. Prepared by Allen, R. et al.

FAO (2003). Fishery country profile. Republic of Peru.

FAO (2005). AQUASTAT data.

FAO (Food and Agricultural Organization of the U.N.) and INRENA. (2005). Actualización de la Evaluación de los Recursos Forestales Mundiales a 2005. Perú. Informe Final. Lima: INRENA.

FAO (2005) Information Portal. www.fao.org/ag/agl/swlwpnr/reports/y_lm/z_pe/pe.htm. December, 2005

Fewtrell F., Prüss A, Kaufmann R. (2003). Guide for assessment of EBD at national and local level: Lead. WHO, Geneva

Fewtrell, L. and J. Colford Jr. (2004). Water, Sanitation and Hygiene: Interventions and Diarrhea – A systematic review and meta-analysis. HNP Discussion Paper. World Bank

World Bank, (2003) Fishery Strategy Sector Note, Republic of Peru.

Fjeldså, J., and M. Kessler. (1996) *Conserving the Biological Diversity of Polylepis Woodlands of Peru and Bolivia: A Contribution to Sustainable Natural Resource Management in the Andes.* Copenhagen: Nordic Foundation for Development and Ecology..

Florez, R. (2005). Peru Handwashing Public Private Initiative – 2005 Highlights. Water and Sanitation Program. World Bank.

Fondo de Contravalor Peru-Switzerland (FCPS, 2003). *Sistematización de Manejo de Recursos Naturales agua suelo y cobertura vegetal.* Edit. Termil. Lima, Perú.

Food and Agricultural Organization of the U.N. (FAO, 2002).*The State of Food and Agriculture*, *2002*. Rome, Italy.

Food and Agriculture Organization of the U.N. (FAO, 2005) and the Center for International Forestry Research (CIFOR). *Forests and Floods: Drowning in Fiction or Thriving on Facts?*

Freeman, P.K., M. Keen, and M. Mani. (2003)"Being Prepared: Natural disasters are becoming more frequent, more destructive, and deadlier, and poor countries are being hit the hardest."*Finance and Development* 40(2003): 42-45.

Galarza, L. (2001) *Descentralización, Organización Económica del Territorio y Potencial de Recursos.* Report prepared for United Nations Development Program. Lima, Peru.

Gamarra, L. (1945)"La Erosión de Suelos – un Problema Nacional." *Revista Agronomía* Vol. 47: 5-12.

Garnica Gonzales, (2001). L. *La Deforestación por la Actividad de Coca en el Perú.* CONTRADROGAS, Unidad de Monitoreo y Evaluación. Lima, Peru.

United Nations Environment Program (2004), Global Environment Outlook Year Book 2004-5, New York.

Glave, M. and R. Morales (2006). "Análisis Institucional Ambiental en el Peru", Background Paper for Peru Country Environmental Analysis, Lima, Peru,.

Global Environment Facility (2003) *Peru: Participatory Management of Protected Areas.* Project Appraisal Document, GEF-World Bank, January 30.

Gonzáles Olarte, E., and C. Trivelli (1999) *Andenes y desarrollo sustentable*. Instituto de Estudios Peruanos (IEP) and Consorcio para el Desarrollo sostenible de la Ecoregion Andina (CONDESAN). 219. Lima, Perú.

González Del Valle Begazo, A. M. (2004) Estimación De La Valoración Económica De Los Impáctos De La Contaminación Atmosférica Por Pts Y Pm10 En La Salud De La Población De Lima Metropolitana. Lima. Peru.

Gordon, H. (1953). The Economic Theory of Common Property Resource: The Fishery. Journal of Political Economy. Vol. 62, pp. 124-142.

Gram, S. (2001) Economic Valuation of Special Forest Products: An Assessment of Methodological Shortcomings, Ecological Economics, 36, 109-117.

Hannesson R. (2002). The Development of Economic Institutions in the World Fishery.WDR 2003. Background Paper.

Hartwick, J., Olewiler, N. (1998). The Economics of Natural Resource Use. Addison-Wesley Educational Publishers.

Holmes, T.P., G.M. Blate, J.C. Zweede, R. Pereira, Jr., P. Barreto, F. Boltz and R. Bauch (no date). "Financial Costs and Benefits of Reduced-Impact Logging Relative to Conventional Logging in the Eastern Amazon". Southern Research Station, USDA Forest Service, Research Triangle Park, No. Carolina.

Horton B., et al. (2002). Evaluating Non-Users Willingness to Pay for the Implementation of a proponed National Parks Program in Amazonia. A UK/Italian Contingent Valuation Study by CSERGE WP ECM 02-01

http://www.indeci.gob.pe

Huttly, S., Morris, S. and Pisani, V. (1997). Prevention of Diarrhoea in Young Children in Developing Countries. WHO Bulletin. Vol. 75, No. 2.

IFH (2001). Recommendations for Selection of Suitable Hygiene Procedures for the Use in the Domestic Environment. International Scientific Forum on Home Hygiene.

Inbar, M., and C.A. Llerena (2000). "Erosion Processes in High Altitude Mountain Terraces in Peru", *Mountain Research and Development*, Vol. 20, 72-79.

INDECI. *Impacto Socio-Económico de los Desastres en el Perú.* Lima, Peru. 1989.

INDECI. *Plan Nacional de Prevención y Atención de Desastres*. Lima, Peru. 2004.

Infras (2002): PISA Lima/Callao: EMOD/CMAP. Assumptions and Results. Working paper, Lima/Berne 31. July 2002.

INRENA (2005) General Directorate of Biodiversity Conservation: http://www.inrena.gob.pe/iffs/biodiv/catego_fauna_amenazada.pdf; and p://www.inrena.gob.pe/iffs/iffs_biodiv_catego_flora_silv.htm

INRENA. (1996). Monitoreo de la Deforestación en la Amazonía Peruana. Lima, Peru

INRENA-CIF, 2004. *Perú Forestal en Números Año 2003*. http://www.inrena.gob.pe/iffs/cif/inf_estad/ANUARIO_PERU_FORESTAL_2003.pdf

Instituto Nacional de Estadística y Información (INEI, 2004). *Condiciones de Vida en los Departamentos del Perú*. Lima, Peru.

Inter-American Development Bank (IADB, 2000), *Facing the Challenge of Natural Disasters in Latin America and the Caribbean: An IDB Action Plan*, Washington, D.C. March, 2000.

Inter-American Development Bank (2001). *Programa de Titulación y Registro de Tierras – Segunda Etapa (PTRT2)*. IDB-Peru. February 7, 2001.

Israel, D., Banzon C. (1995) Over fishing in the Philippine Marine Fisheries Sector. The International Development Research Center. Canada. Document 66.

Jacoby E. (1998). Environmental Lead Is a Problem in Lima, Peru. Environmental Health Perspectives 1998, Vol.106, No 4, p A170-171.

Jordan: METAP (2000). Note:

Kojima (2001): Breathing Clean. Considering the Switch to Natural Gas Buses. World Bank Technical Paper No. 516, Washington D.C.

Kotuby-Amacher, J. et al (1997). Salinity and Plant Tolerance. Utah Sate University. United States.

Kotuby-Amacher, J., R. Koenig, and B. Kitchen, *Salt and Plant Tolerance,* Utah State University, Logan, Utah, Publication AG-SO-03, July, 1997.

Lampietti, J., Dixon J. (1994). To See the Forest for the Trees: A Guide to Non-Timber Forest Benefits. World Bank.

Larsen, B and Strukova, E (2006). A Cost-Benefit Analysis of Environmental Protection in Peru. Report prepared as a background document for the Peru Country Environmental Analysis. World Bank.

Larsen, B. (2003). Hygiene and Health in Developing Countries: Defining Priorities through Cost-Benefit Assessments. International Journal of Environmental Health Research. Vol 13: S37-S46

Larsen, B. (2004a). Cost of Environmental Degradation: A Socio-Economic and Environmental Health Assessment in Damietta, Egypt. Prepared for SEAM II, Cairo, Egypt.

Larsen, B. (2004b). Cost of Environmental Damage in Colombia: A Socio-Economic and Environmental Health Risk Assessment. Prepared for the Ministry of Environment, Housing and Land Development of Republic of Colombia.

Larsen, B. (2005a). Cost-Benefit Analysis of Environmental Protection in Colombia: Socio-Economic and Environmental Health Benefits of Interventions. Prepared for MAVDT, Colombia.

Larsen, B. (2005b). Cost of Environmental Damage: Analysis by Department. Prepared for MAVDT, Colombia.

Larsen, B., and E. Strukova (2006). *Peru: Cost of Environmental Damage: A Socio-Economic and Environmental Health Risk Assessment.* Background Report for Country Environmental Assessment, World Bank, Washington, D.C. October, 2005.

Lery, J., Prado, J., Tietze, U. (1999). Economic Viability of Marine Capture Fisheries - Findings of a Global Study and an Interregional Workshop. FAO. Fisheries technical paper 377. Rome.

Lovei M. (1998). Phasing out lead from gasoline. Worldwide experience and Policy implications. World Bank Technical Paper No 397. The World Bank. Washington DC.

Low, F. (1966). "Estimating Potential Erosion in Developing Countries." *Water Conservation* 22: 147 – 148.

Luo, Z. and Hulscher, W. (1999). Woodfuel Emissions. RWEDP, Bangkok. May 1999.

Majluf, P., Barandearán, A., and Sueiro, J.C. (2005). Evaluacion Ambiental del Sector Pesquero en el Peru. in World Bank Country Environmental Análisis for Peru.

Malca, G. (2002). "Estimación de la Capacidad de Captura de CO2 en Bosques Secundarios del Trópico Amazónico como Indicador de Valoración Económica. Loreto, Perú." In: M. Glave and R. Pizarro (eds). *Valoración Económica de la Diversidad Biológica y Servicios Ambientales en el Perú.* Lima: Instituto Nacional de Recursos Naturales, International Resources Group and USAID.

Margulis S. (2004). Causes of Deforestation of the Brazilian Amazon. World Bank working paper No 22. The World Bank. Washington D.C.

McCracken, J. and Smith, K. (1998). Emissions and Efficiency of Improved Woodburning Cookstoves in Highland Guatemala. Environment International. Vol. 24, No. 7.

Mead, P. et al (1999). Food-Related Illness and Death in the United States. Emerg Infect Dis. Vol. 5, No. 5.

Mecham, J. *Causes and consequences of deforestation in Ecuador* (2001). Centro de

Investigacion de los Bosques Tropicales (CIBT), Ecuador, May 2001.

Ministry of Sustainable Development and Environment (Bolivia). *Memoria explicativa, Mapa Forestal.* La Paz, Bolivia: Secretaría de Medio Ambiente, 1995.

Mrozek, J. and Taylor, L. (2002). What Determines the Value of Life? A Meta Analysis Journal of Policy Analysis and Management. Vol 21 (2): 253-270

National Program for Soil Conservation and Watershed Management (PRONAMACHCS, 1988). *5 Años de Conservación de Suelos con los Campesinos de los Andes Peruanos.* Ministry of Agriculture, Lima, Peru.

Naeher LP, Leaderer BP, Smith KR. (2000). Particulate matter and carbon monoxide in highland Guatemala: indoor and outdoor levels from traditional and improved wood stoves and gas stoves. Indoor Air. Vol. 10, No. 3.

Nepstad, D., Moreira, A., Alencar, A. (1999). Flames in the rain forest: origins, impacts and alternatives to Amazonian fire. The Pilot Program to Conserbe the Brazilian Rain Forest. Brazilia. Brazil.

Niederman, M. et al. (1999). Treatment Cost of Acute Exacerbations of Chronic Bronchitis Clinical Therapy, 21(3): 576-91.

OFDA/CRED. (1999). *EM-DAT: International Disaster Database.* Université Catholique de Louvain, Brussels, Belgium. www.md.ucl.ac.be/CRED

ONERN (1973). *Inventario, Evaluación y Uso Racional de los Recursos Naturales de la Costa: Cuencas de los Ríos Viru y Chao*. 1973.

ONERN (1985) . *La erosión en el Perú.* Presentation by C. Robles at IV International Conference on Soil Conservation, Maracay, Venezuela.

Ostro, B. (1994). Estimating the Health Effects of Air Pollution: A Method with an Application to Jakarta. Policy Research Working Paper, World Bank.

Othman, J.(2002) Household Preferences for Solid Waste Management in Malaysia, Economy and Environment Program for Southeast Asia(EEPSEA) Research Report No. 2002-RR8, International Development Research Centre.

Padilla, P. (2004) *Resultados de la Aplicación de la Matriz de Monitoreo de la Gestión de las Areas Naturales Protegidas del SINANPE (2001 – 2003)*. Mimeo. May, 2004.

PAHO (2002). Situación de Salud en Peru. Organización Panamericano de la Salud http://www.per.ops-oms.org.

Pearce, D., Putz F., Vanclay J. (1999). A Sustainable Forest Future? CSERGE Working Paper GEC 99-15. London.

Perez D. and Yamasato E. (2002). Aproximación a la pobreza de la ciudad de Lima. Informe de consultoria Banco Mundial.

Perez-Padilla, R. et al (1996). Exposure to biomass smoke and chronic airway disease in Mexican

women: A case-control study. Am. J. Respir. Crit. Care Med. Vol. 154, No. 3.

Peru Demographic and Health Survey (DHS, 2000). www.measuredhs.com

Instituto Cuanto (2003) *Peru en numeros*, *Anuario Estadístico*, Lima, Peru, http://www.cuanto.org

Proyecto Integral de Desarrollo Agropecuario de la Encañada (PIDAE, 1995). *La Encañada: Caminos hacia la sostenibilidad*. Lima, Peru. 1995.

Pinfold, J. and Horan, N. (1996). Measuring the Effect of a Hygiene Behaviour Intervention by Indicators of Behaviour and Diarrhoeal Disease. Transactions of the Royal Society of Tropical Medicine and Hygiene, Vol 90.

PISA-2005-2010. (2004). El Comité de Gestión de la Iniciativa de Aire Limpio para Lima y Callao. DIGESA. Peru

Pope CA III, Burnett RT, Thun MJ, et al (2002). Lung cancer, Cardiopulmonary mortality, and Long-term exposure to Fine particulate air pollution. Journal of the American Medical Association, 287: 1132-1141.

Pope CA III, Burnett RT, Thun MJ, et al (2002): Lung cancer, Cardiopulmonary mortality, and Long-term exposure to Fine particulate air pollution. Journal of the American Medical Association, 287: 1132-1141.

Pope CA III, Thun MJ, Nambudiri MM, et al (1995). Particulate air pollution as a predictor of mortality in a prospective study of US adults. American Journal of Respiratory and Critical Care Medicine, 151: 669-674.

Porter, G. (2005). Report to the IDB on Fisheries Issues in Latin America

Portilla, A. "Amenazas a la diversidad biológica." (1998). In Alegre, M. et al. *El Medio Ambiente en el Perú. Año 2001*. Lima: Instituto Cuánto and USAID, 2001; or Consejo Nacional del Ambiente, Comisión Nacional de Biodiversidad. Biodiversidad y Desarrollo.

Portilla, A. (2002). "Valoración Económica del Bosque de Protección Cordillera Escalera – San Martín". In: M. Glave and R. Pizarro (eds). *Valoración Económica de la Diversidad Biológica y Servicios Ambientales en el Perú.* Lima: Instituto Nacional de Recursos Naturales, International Resources Group and USAID.

Portland Cement Association (2005): Environment and Energy: Clean Air. www.bipac.net

Posthumus, H.(2005) *Adoption of Terraces in the Peruvian Andes.* Tropical Resource Management Paper No. 72, Wageningen University, The Netherlands, November 2005.

Prisma (2004) Behavioral Study of Handwashing with Soap in Peri-urban and Rural Areas of Peru. Environmental Health Project. USAID. Washington DC.

Pruss, A., Kay, D., Fewtrell, L., and Bartram, J. (2002). Estimating the Burden of Disease from Water, Sanitation and Hygiene at the Global Level. Environmental Health Perspectives. Vol 110, No. 5.

Pruss, A., Kay, D., Fewtrell, L., and Bartram, J. (2002). Estimating the Burden of Disease from

Water, Sanitation and Hygiene at the Global Level. Environmental Health Perspectives. Vol 110, No. 5.

Pruss-Ustin , A., Fewtrell F., Landrigan P. (2004). Lead Exposure. In "Comparative quantification of health risks" ed. by Ezzati et al. WHO. Geneva.

Pulgar-Vidal, M., and I. Calle (2003, 2004) . *Manual de Legislación Ambiental.* Peruvian Society for Environmental RIghts, Commision of the Environment and Ecology (Peruvian Congress), and USAID. 2003, 2004.

Pulgar-Vidal, M., and I. Calle (2006) *¿Quién Manda a Quién? Historia de la Gestión Ambiental en el Perú de 1990 a 2005* Background paper prepared for the World Bank Country Environmental Analysis, World Bank, Lima, Peru, January, 2006

Quick, R.E. et al (1999). Diarrhoea Prevention in Bolivia through Point-of-use Treatment and Safe Storage: A Promising New Strategy. Epidemiol Infect. Vol. 122.

Rabl, A. (2000): Criteria for limits on the emission of dust from cement kilns that burn waste as fuel. Centre D'Energetique, Paris.

Radich (2005): Article 15 - Biodiesel production methods, costs and available capacity. Anthony Radich, EIA.

Ramírez, A., Paucar J., and Medina J.(1997). Blood lead levels in the inhabitants of four Peruvian localities. Pan Am J Public Health, 1(5):344-348

Reatégui, F.(1996) *Monitoreo continuo de los procesos de deforestación en la Amazonía Peruana*. Lima: Universidad Nacional Agraria, La Molina. Mimeo. 1996.

Resources Science Centre (1997). Irrigation water quality – Salinity and soil structure stability, Prepared by R. DeHayr, N. Diatloff, and I. Gordon. ISSN 1327-5364. Australia

Roca, W., C. Espinoza, and A. Panta (2004). "Agricultural Applications of Biotechnology and the Potential for Biodiversity Valorization in Latin America and the Caribbean", *AgBioForum* 7(1-2): 13-22.

Rockhill B, Newman B, Weinberg C. (1998). Use And Misuse Of Population Attributable Fractions. Am J Public Health 88: 15-19.

Roger, J. and R. Roberts (1999). *Deforestación: Bosques Tropicales en disminución.* Red de Asesores Forestales de la ACDI (RAFA). Mimeo.

Romero, M. (2005). *Análisis del Proceso de Concesiones Forestales Maderables para lograr su Consolidación en el Departamento de Loreto.* Consulting Report of FOCAL-Bosque Project. Mimeo.

Rowe, R., N. Sharma and J. Browder (1992). "Deforestation: Problems, Causes and Concerns." In: N.P. Sharma, (ed.). *Managing the World's Forests: Looking for Balance between Conservation and Development*. Iowa: Kendall/Hunt Publishing Co..

Rutstein, S.O. (2000). Factors Associated with Trends in Infant and Child Mortality in Developing

Countries during the 1990s. Bulletin of the World Health Organization. Vol. 78(10): 1256-1270.

Saade, C., Bateman, M., and Bendahmane, D. (2001). The Story of A Successful Public-Private Partnership in Central America: Handwashing for Diarrheal Disease Prevention. Published by BASICS II, EHP, Unicef, USAID, and World Bank.

Saatkamp, B., Masera, O., and Kammen, D. (2000). Energy and health transitions in development: Fuel use, stove technology, and morbidity in Jaracuaro, Mexico. Energy for Sustainable Development. Vol. IV, No 2. August 2000.

Salkever DS. (1995). Updated estimates of earnings benefits from reduced exposure of children to environmental lead. Environmental Research. 70: 1-6

Sánchez Huamán, S., I. Lapeña, C. Ipenza Peralta, and M. Ruíz Muller (2005). *Perfil Sobre Diversidad Bológica. Informe Final. Proyecto Autoevaluación de Capcidades Nacionales para el Cumplimiento de Acuerdos Globales*. Lima: PNUD and CONAM. 2005.

Sanchez-Triana, E. and Yewande A. (2005). Environmental Degradation, Disease and Death: A Plea for a Strengthened Environmental Health Policy in Perú, World Bank Draft.

Scarborough J, Clinton N, Gong P (2002). Creating a Statewide Spatially and Temporally Allocated Agricultural Burning Emissions Inventory Using Consistent Emission Factors. Prepared for the Air Resources Board, California EPA

Schaefer, M.B. (1954). Some Aspects of the Dynamics of Populations Important to the Management of the Commercial Marine Fisheries. Inter. Amer. Trop. Tuna Comm. Bull. 1 (2), pp. 27-56.

Schaefer, M.B. (1957). Some Considerations of Population Dynamics and Economics in Relation to the Management of Commercial Marine Fisheries. Journal of Fisheries Research Board of Canada, 14 (5), pp. 669-681.

Schneider , R., Arima E., Verissimo A., Souza Jr. C., Barreto. P. (2002). Sustainable Amazon. Limitations and Opportunities for Rural Development. World Bank technical Paper No. 515. Environmental series. Washington DC.

Schulman, Ronca and Bucuvalas, Inc. (2001). Confronting COPD in North America and Europe: A Survey of Patients and Doctors in Eight Countries.

Schwartz J. (1994). Societal benefits of reducing lead exposure. Environmental Research 66:105-12

Seneca Creek Associates and Wood Resources International. *Illegal Logging and Global Wood Markets: The Competitive Impacts of the U.S. Wood Products Industry*. Report prepared for American Forest and Paper Association, November, 2004. www.afandpa.org/Content/NavigationMenu/News_Room/Papers_Reports1/AFPAIllegalLoggingReportFINAL2.pdf

Seroa da Motto, R.S. (2002). Estimativa do Custo Economico do Desmatamento na Amazonia. Working paper. www.bankomundial.org.br

Shi, A. (1999). The Impact of Access to Urban Potable Water and Sewerage Connection on Child Mortality: City Level Evidence, 1993. Economists' Forum, Vol. 1, World Bank 1999

Shibuya, K., Mathers, C., and Lopez, A. (2001). Chronic Obstructive Pulmonary Disease (COPD): Consistent Estimates of Incidence, Prevalence, and Mortality by WHO Region. Global Programme on Evidence for Health Policy. World Health Organization. November 2001

Sierra Research (2000): A Comparative Analysis of the Feasibility and Cost of Compliance with Potential Future Emission Standards for Heavy-Duty Vehicles Using Diesel or Natural Gas. Sierra Research Inc., Sacramento, California.

Smith K, Mehta S, and Feuz M. (2004). Indoor Air Pollution from Household Use of Solid Fuels. In: Ezzati M, Rodgers AD, Lopez AD, and Murray CJL (eds): Comparative Quantification of Health Risks: Global and Regional Burden of Disease due to Selected Major Risk Factors. World Health Organization, Vol.2.

Smith, J., et al. (1999). Willingness to Pay for Environmental Services among Slash and Burn Farmers in the Peruvian Amazon: Implications for Deforestation and Global Environmental Markets. CSERGE. London. Mimeo.

Sobin, R. (2004): Fact Sheet on Power Plant Emissions of Mercury in Virginia. Office of Air Permit Programs, Virginia DEQ.

Strukova, E. (2004). Opportunity Cost Of Deforestation In The Brazilian Amazon: Aggregated Estimate Per Ton Of Avoided Carbon Emission. Working Paper. Washington DC.

Sueiro, J. (2005). The Status of Peruvian Fisheries. Working Paper.

Szabolcs, I. *Salt-Affected Soils.* Boca Raton, Fla.: CRC Press. 1989.

Toniazzo, T. (2006). "A Study of the Sensitivity of ENSO to the Mean Climate," *Advances in Geosciences*, Vol. 6, pp. 111-118.

Torras M. (2000). The total economic value of Amazonian deforestation, 1978-1993. Ecological Economics 33, pp. 283-297

Treacy, J. (1989) M. *The Fields of Coporaque: Agricultural Terracing and Water Management in the Colca Valley, Arequipa, Peru.* Ann Arbor: University Microfilms. 1989.

Trenberth, K.E., and T.J. Hoar (1996). "The 1990-1995 El Niño Southern Oscillation Event: Longest on Record," Geophysical Research Letters, Vo. 23(1): 57-60.

Umali, D.(1993). Irrigation-induced salinity: a growing problem for development and the environment. World Bank. Working paper N. 215.

United Nations Development Program (UNDP, 2004). *Reducing Disaster Risk: A Challenge for Development*. New York. 2004.

United Nations Environment Program (UNEP, 2005). "Environmental Management and Disaster Reduction", Session Concept Paper for World Conference on Disaster Reduction, Kobe, Japan, January 2005.

US Department of Energy (2005), Peru: Country Analysis Brief. Energy Information Administration.

Valdiva, R. (2002). The economics of terraces in the Peruvian Andes: An application of sensitivity analysis in an integrated assessment model. Montana State University.

Varley, Tarvid and Chao. 1998. *A reassessment of the cost-effectiveness of water and sanitation interventions in programmes for controlling childhood diarrhoea.* Bulletin of the World Health Organization, 76(6):617-631.

Vigo, V.(2005) "Valoración Económica para la Gestión del Parque Turístico Nacional Quistococha (PTNQ): Zona Reservada Allpahuayo-Mishana". In: Loyola, R. and E. Gargía. Valoración 2005.

Viscusi, W.K. and Aldi, J.E. (2002). The Value of a Statistical Life: A critical review of market estimates throughout the world. Discussion Paper No. 392. Harvard Law School. Cambridge, MA. United States.

WHO (2001). Global Burden of Disease 2001. The World Health Organization.

WHO (2002a). Global Burden of Disease 2002. The World Health Organization.

WHO (2002b). The World Health Report 2002. The World Health Organization.

WHO/Unicef. (2000). Global Water Supply and Sanitation Assessment 2000 Report.

Willink, P., B. Chernoff, and J. McCullough (2005). A Rapid Biological Assessment of the Aquatic Ecosystems of the Pastaza River Basin, Ecuador and Peru. RAP Bulletin of Biological Assessments 33. Washington D.C.: Conservation International. 2005.

Winrock International (2005). Reduction in Exposure to Indoor Air Pollution through Improvements in Household Energy and Behavior in Families from the High-Andean District of Inkawasi, Peru. Summary of Monitoring Results by Swisscontact.

World Bank (1995). Peru. A User-Based Approach to Water Management and Irrigation Development. Report No. 13642-PE

World Bank (2001). *Peru Institutions and Governance Review.*
http://www.worldbank.org/wbi/governance/peru/pdf/peru_gov_corr_econ.pdf

World Bank (2002a). Egypt Cost Assessment of Environmental Degradation. Report No. 25175-EGT. Washington DC.

World Bank (2002). Country Assistance Strategy for the Republic of Peru. Latin America and the Caribbean Region.

World Bank (2003). Peru Fishery Strategy Sector Note.

World Bank (2004a) Saving Fish and Fishers, Towards Sustainable and Equitable Governance of the Global Fishing Sector. Report 29090 GLB

World Bank (2004b). World Development Indicators 2004. Washington DC.

World Bank (2005). World Development Indicators 2005. Washington D.C.

World Bank (2000). *Peru: Environmental Issues and Strategic Options*. Environment and Social Sustainable Development, Latin America and the Caribbean Region.

World Bank (2004c). Study on the Environmental and Social Dimensions of the Mining Sector in Peru

World Bank (2005a), Republic of Colombia: Mitigating Environmental Degradation to Foster Growth and Reduce Inequality. Washington D.C.

World Bank (2005b), Integrating Environmental Considerations in Policy Formulation: Lessons from policy-Based SEA Experience, Report no. 32783, World Bank, Washington D.C.

WWS (1999): Particulate Matter. Section 4: Economic Analysis. Woodrow Wilson School of Public and International Affairs. www.wws.princeton.edu/step/ch4.pdf

www.who.int/evidence/nbd

Zilberman, D. "Biodiversity, Biotechnology and Intellectual Property Rights", Department of Agricultural and Resource Economics, University of California-Berkeley, 2002.