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The Philippines:

Country Environmental Analysis

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Abbreviations and Acronyms

ADB	Asian Development Bank
AF	attributable fraction
ALRI	acute lower respiratory infection
BCA	benefit-cost analysis
BCR	benefit-cost ratio
BOD	biochemical oxygen demand
CAS	Country Assistance Strategy
CBA	cost-benefit analysis
CBFM	Community-based Forest Management
CDM	Clean Development Mechanism
CEA	Country Environmental Analysis; also cost-effectiveness analysis
CMR	coastal and marine resources
CO	carbon monoxide
CO_2	carbon dioxide
COI	cost-of-illness
COPD	chronic obstructive pulmonary disease
CRU	Climate Research Unit, World Wildlife Fund
DA	Department of Agriculture
DALY	disability-adjusted life year
DBM	Department of Budget and Management
DENR	Department of Environment and Natural Resources
DHS	Demographic and Health Survey
DILG	Department of Interior and Local Government
DOC	diesel oxidation catalyst
DOH	Department of Health
DOLE	Department of Labor and Employment
DOST	Department of Science and Technology
DPF	diesel particulate filter
DTI	Department of Trade and Industry
EA	environmental assessment
EIA	environmental impact assessment
EMB	Environmental Management Bureau
ENR	environment and natural resources
EO	Executive Order
EUFS	Environmental User Fee System
FHSIS	Field Health Surveillance Information System
FMB	Forest Management Bureau
GDP	gross domestic product
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	greenhouse gas
GNI	gross national income
GNP	gross national product
GOCC	government-owned and controlled corporations

GS	Good Shepherd
HCA	human capital approach
HCV	human capital value
HECS	Household Energy Consumption Survey
IACCC	Inter-Agency Committee on Climate Change
IAP	indoor air pollution
I/M	inspection and maintenance
IRA	internal revenue allocation
ISDR	U.N. International Strategy for Disaster Reduction
KCCC	Klima Climate Change Center
LGC	Local Government Code
LGU	local government unit
LISCOP	Laguna de Bay Institutional Strengthening and Community Participation
LPG	liquefied petroleum gas
LTO	Land Transportation Office
MDGs	Millennium Development Goals
MPA	marine protected area
MTPDP	Medium Term Philippine Development Plan
MVIS	Motor Vehicle Inspection System
NAMRIA	National Mapping and Resource Information Authority
NSCC	Nueva Segovia Consortium of Cooperatives
NDCC	National Disaster Coordinating Council
NEDA	National Economic and Development Authority
NIPAS	National Integrated Protected Areas System
NG	national government
NGO	nongovernmental organization
NO	nitrogen oxide
NP	net price
NPV	net present value
NRE	new and renewable energy
NTFP	non-timber forest products
OAP	outdoor air pollution
OCD	Office of Civil Defense
PA21	*Philippine Agenda 21*
PAB	Pollution Adjudication Board
PACC	Presidential Adviser on Climate Change
PAFASA	Philippine Atmospheric, Geophysical, and Astronomical Services Agency
PAWB	Protected Areas and Wildlife Bureau
PCSD	Philippine Council for Sustainable Development
PEP	Philippine Environmental Policy
PES	payments for ecosystem services
PETC	private emission testing center
PHS	*Philippine Health Statistics*
PM	particulate matter
PTFCC	Presidential Task Force on Climate Change
RR	relative risk

SD	standard deviation
SO_x	sulfur oxide
TEV	total economic value
TFH	tricycles for hire
TSS	total suspended solids
UNFCCC	United Nations Framework Convention on Climate Change
VF	ventilation factor
VSL	value of statistical life
WA	weight-for-age
WAZ	weight-for-age z-score
WHO	World Health Organization
WSH	water, sanitation, and hygiene
WTP	willingness to pay

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The main "building blocks" in the process, and the chapters or text they formed the basis of, were the following papers commissioned for the CEA:

- Antonio La Viña: *Re-thinking Philippine Environmental Institutions: Do We Need to Reallocate Mandates, Powers, and Functions?* (Chapter 1)
- Agustin Arcenas: *Environmental Health: Economic Costs of Environmental Damage and Suggested Priority Interventions* (Chapters 2–4)
- Bjørn Larsen: *Cost-Benefit Analysis of Selected Environmental Health Interventions International Evidence and Applications to the Philippines* and *The Philippines Malnutrition Related Mortality from Water, Sanitation and Hygiene Accounting for the Effect of Diarrheal Infections on Child Malnutrition* (Chapters 2–4)
- Jose Padilla: *Analysis of Coastal and Marine Resources* (Chapter 5)
- Roehlano Briones: *The Philippines Country Environmental Analysis: Land Degradation and Rehabilitation* (Chapter 6)
- Antonio Carandang: *The Forestry Sector: Costs of Environmental Damage and Net Benefits of Priority Interventions* (Chapter 7)
- Maria-Fernanda Garcia-Rincon and Felizardo Virtucio: *Climate Change in the Philippines* (Chapter 8)
- Elmer Mercado: *Preserving Cultural Heritage through Good Environmental Management in Vigan City, Ilocos Sur*; *A Case Study of Ubay, Bohol on Sustainable Coastal and Fishery Resource Management*; *A Case Study of Bayawan City, Negros Oriental on Controlling the Effects of Lowland Flooding and Siltation through Sustainable Forest Land Use Planning and Management*; *A Case Study of the Municipality of Infanta, Quezon Province Community-based Disaster Preparedness and Management (CBDPM): Surviving and Recovering from a Natural Catastrophe*; *Using Market-based Instruments to Save Laguna de Bay*; and *A Case Study of Nabunturan, Compostela Valley on the Rehabilitation of its Degraded Uplands through Sustainable Management* (six case studies underpinning boxes throughout the CEA)

With minor exceptions, these papers were processed through two broad-based consultative workshops in the Philippines: June 16–17, 2008, and November 18–19, 2008. About 100 participants from government, academia, donors, and nongovernmental organizations contributed to the first workshop, while about half that number contributed to the second. The second workshop was arranged in collaboration with the Asian Development Bank. The draft CEA was presented to the World Bank's Decision Meeting in April 2009. After revisions, it was officially conveyed to the Government of the Philippines in May 2009. This version—which is final—reflects adjustments made in response to comments received from the Government since then. It should be recognized that it was not possible to accommodate all comments that came in at this late stage, as some suggested major restructuring of the document and the launch of new

analysis. The CEA does not aim to completely cover all environmental issues but instead selects a few that are judged to be of most significance.

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Executive Summary

The **objective**s of this Country Environmental Analysis (CEA) were to assess the environmental quality in the Philippines with a focus on how this affects human welfare and sustainability, measure and analyze the biophysical significance and monetary cost of environmental degradation and derive priority areas of action, assess the Philippines government's capacity to manage the environmental challenges identified, and identify opportunities for reform and interventions.

The **selection of issues** for inclusion in the CEA was determined on the basis of literature review, expert judgment, and an existing public perception survey. On that basis, the following topics were chosen: environmental policy, legislation, and institutions; environmental health (including water pollution, sanitation, and hygiene (WSH) and outdoor and indoor air pollution); and natural resources (coastal and marine resources (CMR), land, forestry, and climate change).

The CEA has been written in a very **consultative process**. The foundation is a large number of reports produced by local consultants, as identified in the acknowledgments. These have been processed through two major consultative workshops with wide stakeholder representation, additional peer review, and public access on the World Bank's Web site. On that basis, this document has been distilled and refined through a team vetting process, also involving international peer reviewers. The CEA team has also been actively involved in contributing to the World Bank Group's Country Assistance Strategy (CAS), which evolved in parallel with the current document.

The **methodology** applied gives great weight to economic analysis, including sectoral contributions to national income, damage costs inflicted by environmental degradation, and cost-effectiveness and net benefits of proposed interventions. The database for such calculations has been quite uneven across sectors, which inevitably will strike the reader as a lack of comparability. Nevertheless, a certain panorama can be sketched, and top priorities emerge. The broad sectoral analyses are complemented by six case studies of successful environmental management, reflected as boxes in the main text. Unless otherwise noted, costs are stated in 2007 prices, and using the annual average exchange rate of PhP46 per U.S. dollar. Biophysical and health impacts refer to different years, as stated in the respective chapters and consultant reports. More detailed recommendations beyond the following general summary are given in the main text.

Environmental legislation, regulation, and institutions: The Philippines has sound and comprehensive environmental laws and policies. However, it suffers from weak implementation because of inadequate capacity and financial constraints both at the national and local levels. A shift in strategy toward more devolution to local levels of government, enhanced resource mobilization for environmental management, better prioritization, and retooling of human resources are urgently needed to accommodate new priorities. The CEA also recommends improvements in environmental information systems and public access to such information.
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The Philippine environmental impact assessment system has all the elements of a sound system, such as the presence of screening, scoping, independent review, public participation, disclosure,

and monitoring. However, it has limited use as a planning tool because in most cases it is applied downstream of key feasibility decisions. Its implementation suffers from a highly regulatory and control-oriented approach that emphasizes compliance with rigid bureaucratic procedures, from overlap with many laws, from more attention being given to procedural compliance rather than technical contents, and from a complex and poor system of follow-up and monitoring.

Outdoor air pollution (OAP): We estimate that more than 1 million people get sick every year due to outdoor air pollution in urban areas. About 15,000 people die prematurely due to OAP. As explained in the main text and in detail in Annex A, the economic costs of this depend very much on what method is being used but are in all cases significant.

The cost of disease linked to OAP is estimated at more than $20 million per year. When only the income loss from mortality is valued (the human capital approach, or HCA), the cost is more than $120 million per year. However, valuing mortality in terms of the willingness to pay for risk reductions of premature mortality (the value of statistical life, or VSL), the cost is more than $1.6 billion per year. This is more than 1% of the gross national product (GNP) in the Philippines. Although international comparisons are difficult because of differences in methodology, similar results from 11 other countries are available. These show a span of about 0.2–2.5% of gross domestic product (GDP) (Guatemala and China respectively).

In view of these costs, the CEA discusses several options for cost-effective interventions. A well-functioning inspection and maintenance program is one of the most cost-effective interventions in abating outdoor air pollution. Switching from two-stroke to four-stroke tricycles will reduce PM emissions from these vehicles by 80%. The successful engine conversion program in Vigan City is an inspiring example. A cost-benefit analysis (CBA) of low-sulfur diesel and vehicle emissions control technology also shows promising results. Investments in mass rapid transit systems are also important.

Indoor air pollution (IAP): About half the population of the Philippines uses fuelwood or charcoal for cooking. Indoor air pollution is conclusively linked to several types of respiratory disease and premature death. Our estimates show that almost half a million annual cases of illness are caused by IAP, which is also linked to almost 6,000 deaths per year.

The economic cost of illness in terms of income losses and health care costs amount to more than $30 million per year. We estimate that premature deaths from IAP cost about $100 million, using the HCA approach. Using the VSL approach, the figure becomes more than $600 million per year. The relationship between the two cost estimates is not the same as in the case of OAP. IAP causes many premature deaths at a younger age, so people's remaining life-time income is higher, which increases the HCA estimate relative to the VSL. Adding both morbidity and mortality costs, the total IAP-related costs are equivalent to about 0.1–0.4% of GNP in 2007. This is less than the costs associated with OAP, but because poor people use polluting fuel to cook, the impacts of IAP on the poorest households are much higher. The international comparison shows a span of costs related to OAP of 0.1–1.7% of GDP across 11 countries (Tunisia and Nigeria, respectively).

The CEA also analyzes promising interventions to cost-effectively mitigate this burden of disease, such as improved ventilation, better stoves, and switching to cleaner fuels. Our CBA shows that the introduction of improved stoves has high economic returns in a range of household cooking environments. Likewise, switching to liquefied petroleum gas is also found to provide higher benefits than costs in households cooking indoors in poorly ventilated conditions.

Water pollution, sanitation, and hygiene: Our calculations show that a total of about 34 million cases of WSH-related illnesses occurred nationally in 2003. While we consider seven relevant diseases, diarrhea is by far the most important factor. It is estimated that more than 14,000 Filipinos died directly from WSH-related illnesses in 2003, most of them from diarrhea in children under 5 years old. This CEA adds a novel element by estimating the indirect mortality caused by diarrhea-induced malnutrition in young children. These indirect costs are shown to be quite significant and are borne primarily by the very poor.

Our calculations indicate that total annual cost of WSH-related morbidity and direct and indirect mortality is about $1.4–2.8 billion, depending on the use of HCA or VSL for valuing premature mortality. In either case, these costs are quite significant and disproportionately borne by the poor. This is in the order of nearly 1–2% of national income per annum. In contrast to the cost of IAP and OAP health effects, the cost of WSH-related morbidity is quite significant in comparison to the cost of mortality. The international comparison shows a span of costs related to WSH of 0.1–2.2% of GDP (China and Iran respectively).

The CEA analyzes priority interventions to mitigate this damage. A CBA was undertaken for the Philippines of the two interventions that international evidence indicates provides the largest reduction in diarrheal disease, namely hand washing with soap and household point-of-use drinking water treatment. A CBA was also done for improved water supply and toilet facilities to rural households. The results show very high returns to boiling of water and hand washing, but also encouraging returns for improved water supply and toilets.

Coastal and marine resources: A rich and interlinked set of ecosystems, CMR include coastal lands, mangrove forests, seagrass beds, coral reefs, and fish stocks. These resources are an important part of the Philippine economy, generating net economic benefits of more than $500 million per year both directly through marketed goods and services as well as indirectly through the flow of ecosystem services. The annual cost from degradation of CMR is estimated at more than $120 million in 2006 prices. By far the largest source of this is overfishing, which means that potential rents from more sustainable fisheries management are being lost.

From an international perspective, the Philippines harbors coastal and marine resources of major international significance. Well managed, they could also contribute much more to sustainable income through nature-based tourism. The results presented in the CMR chapter highlight the large and diverse potential economic benefits provided by marine protected areas (MPAs). It is proposed that 10% of each major ecosystem be included in MPAs. Registration and licensing of national and local fisheries is another priority intervention, although it was not possible to do a CBA on this. The case study from Ubay shows that progress can be made toward sustainable CMR management. One way of addressing overfishing is to provide fishers with alternative sources of income that reduce their dependence on capture fishing. An attractive option is the development of environmentally sensitive aquaculture. Collectively, the three interventions

proposed here are mutually reinforcing by protecting and conserving habitats through MPAs, providing real alternatives through pro-poor aquaculture, and instituting a licensing scheme with the long-term objective of limiting entry to the open access fishery.

Forests: Forests have seen a long-term decline in the Philippines. Changes in definitions over time obscure the trend, but the overall loss in forest area has probably been reversed. The volume of secondary forests is recovering, while old-growth forests are still losing ground. Forests are estimated to produce net benefits of more than $100 million per year, almost equally divided between timber and non-timber benefits. This underlines the value of forests not only for timber but also for biodiversity. Future agreements on payments for carbon sequestration could potentially alter this calculation considerably.

When overall extraction exceeds the growth of forests, the forest capital is depleted and costs can be calculated. This measure of depletion is not directly comparable to, for example, the cost of air pollution; rather it is a measure of the liquidation of forest capital. Our analysis focuses on the latest phase of forest management (from 1992) and ends in 2003 due to the limitation of statistics. For this period, overextraction of forestry products and conversion to other uses—which lead to losses of non-timber forest products—are estimated to have cost the Philippines about $60 million a year.

Selected interventions to remedy this situation show promise in helping to maintain the sustainable flow of goods and services from forests. Several concrete actions are proposed, including the following: improvement of forest statistics and consistent application of definitions over time; long-term tenure arrangements to give forest users the proper incentives to make long-term investments; stepped up enforcement of logging regulations, including both logging techniques and reforestation and land management; and promotion of community forestry.

Land management: The major crops in the Philippines are rice, maize, and coconuts. All have shown a healthy annual growth in productivity of 1–5% per annum in the 1970–2006 period. The main drivers are more fertilizers, new seeds, and better management. These have masked the influence of land degradation.

The cost of land degradation is highly site-specific. Extrapolating to nationwide figures is therefore a highly uncertain exercise. Nevertheless, our results point to an annual cost of approximately $150 million per year in lost productivity due to soil erosion. This is equivalent to about 0.6% of gross value added in agriculture. The best “guesstimates” of the off-site costs of soil erosion are considerably larger: almost $600 million per year. This number is not firmly based in empirical measurements, but it does highlight that the off-site costs of land degradation may well be considerably larger than the on-site costs.

The results from CBAs of soil conservation measures reported in this CEA confirm the intuition that farmers would have an incentive to invest in such technologies only if they have long planning horizons and a low discount rate. Security of land tenure is not believed to be important in influencing the planning horizon, but high private interest rates imply that less soil conservation is undertaken than economically optimal. Added to this is the fact that off-site impacts will not be included in land managers’ decisions. Correction of this major market failure can be achieved by a system of payments for ecological services. These have high transactions

cost but could be used selectively in watersheds that show major downstream impacts from upland land degradation.

Climate change: The Philippines makes a very minor contribution to global greenhouse gases (GHGs). But the country is significantly at risk due to extreme weather events that are expected to be exacerbated by climate change. About half of its total area and more than 80% of its population are considered vulnerable to natural disasters. Disaster risk management is therefore a natural point of entry in extending the planning horizon and incorporating gradually improved understanding of the impacts that climate change will bring to the Philippines.

There has been an active legislative and institutional response to climate change from the government. However, there is a lack of clear strategic guidance on the management of climate change, and the existing government strategy is not operational. The institutional mandates have changed drastically with recent Executive Orders, but implementation rules and regulations are still to be worked out. There is a need to further mainstream climate change risk management in national, local, and sector decision-making processes. The enabling environment for climate risk management would benefit from improvements in awareness raising and advocacy, financing, technology transfer, and coordination. Although the Philippines is a minor GHG emitter, it should nevertheless fully exploit the available technical and financial global facilities that address mitigation. New financial instruments, including the Clean Technology Fund and the Carbon Partnership Facility have recently become available and should be pursued. The recently approved World Bank Group CAS gives significant attention to the topic of climate change and provides a mandate for strengthening work in both mitigation and adaptation.

In summary, much of the cost of environmental degradation is due to lack of development, particularly IAP and WSH-related diseases. However, standard economic development will not be enough to cure all problems, as other costs tend to rise: OAP and overexploitation of fisheries, land, and forests being prime national examples, and climate change being the major global one. Prudent stewardship of natural resources and pollution control must be brought together in an efficient environmental management regime. By giving the environment its true economic value and putting a price on degradation and its human impacts, the road to sustainable development becomes clearer.

Chapter 1: Environmental Policy, Legislation, and Institutions

The Philippines has been a forerunner in passing environment and natural resources (ENR) policies and legislation. Through the years, the government has issued a plethora of laws and created institutions to manage, protect, and preserve the country's environment and natural resources.

This chapter provides an overview of the country's comprehensive ENR policies and legislation, covering all the subsectors of the environment and the roles of various institutions involved in ENR management at both the national and local levels. It also examines the roles of citizens, the private sector, and civil society organizations in terms of ENR management. The chapter also provides a glimpse of the effectiveness of the institutions, identifies the various issues hindering effective implementation, and proposes recommendations moving forward.

1.1 Policy Framework for Environmental Management

The direction of ENR management in the country has been set by the 1987 Philippine Constitution, which expressly recognized the right of people "to a balanced and healthful ecology in accord with the rhythm and harmony of nature" (Article II, section 16). Reading this provision, together with other provisions calling for equitable distribution of wealth and expanding productivity as a key to raising the quality of life for all,[1] it can be concluded that the goal of ENR management in the Philippines is threefold: environmental protection, economic development and poverty alleviation, and the promotion of social justice and equity.

As early as the 1970s, and even before the concept became internationally recognized, sustainable development was already institutionalized in the Philippines as a policy. This can be gathered from the Presidential Decree No. 1151 (1977), otherwise known as the Philippine Environmental Policy (PEP),[2] which encouraged the widest exploitation of natural resources, subject to the condition that it shall not degrade the same or endanger human life, health, and safety and shall not create conditions adverse to agriculture, commerce, and industry.

The pronouncement under the PEP was followed by the 1989 Philippine National Strategy for Sustainable Development and the 1996 Action Plan for Sustainable Development, also known as *Philippine Agenda 21*. The 1989 strategy sought to achieve economic growth with adequate protection to the country's biological diversity, vital ecosystem functions, and overall environmental quality. *Philippine Agenda 21* set guidelines for sustainable national development. It placed integrity of nature at the center of development initiatives and, in a sense, improved on

[1] See 1987 Constitution Article II, sections 9-10; Article XII, sections 1-5; Article XIII, sections 1, 4-8.
[2] Presidential Decree 1151 made it a policy of the State "to (a) create, develop, maintain, and improve conditions under which man and for succeeding generations; (b) preserving important historic and cultural aspects of the Philippine heritage; (c) attaining a rational and orderly balance between population and resource use; and (d) improving the utilization of renewable and non-renewable resources."

the PEP by moving the focus away from maximum productivity to "appropriate productivity" within the limits of the natural environment's carrying capacity (Oposa 2002). At present, it continues to serve as the guiding document for the country's strategy for sustainable development.

The sustainable development agenda was further strengthened by the formulation of the Mid-Term Philippine Development Plan (MTPDP) 2004–2010[3] and the country's adherence to the Millennium Development Goals. The MTPDP identified five goals relating to the environment and natural resources sector:

- Sustainable and more productive utilization of natural resources to promote investments and entrepreneurship
- Promotion of responsible mining that adheres to the principles of sustainable development: economic growth, environmental protection, and social equity
- Strengthening the protection given to vulnerable and ecologically fragile areas
- Creating a healthier environment for the population
- Mitigating the occurrence of natural disasters to prevent the loss of lives and properties.

1.2 Environmental Legislation

The country's environmental policy is backed up by a comprehensive body of laws covering almost every aspect of the ENR sector. (See Box 1.1.) These laws are divided into natural resources laws and environmental laws. Noticeably absent, however, is a comprehensive land use law.

Box 1.1. Major Legal Instruments in the ENR Sector

Natural Resources Laws

- Revised Forestry Code (Presidential Decree 705)
- Exploration, Exploitation, Utilization and Conservation of Corals (Presidential Decree 1219)
- Water Code (Presidential Decree 1067)
- People's Small-Scale Mining Act (Republic Act 7076)
- National Integrated Protected Areas System (NIPAS) Act (Republic Act 7586)
- Philippine Mining Act (Republic Act 7942)
- Agriculture and Fisheries Modernization Act (Republic Act 8345)
- Philippine Fisheries Code (Republic Act 8550)
- Wildlife Resources Conservation and Protection Act (Republic Act 9147)
- Management and Protection of Caves and Cave Resources (Republic Act 9072)

[3] The MTPDP identified five goals relating to the environment and natural resources sector: (a) sustainable and more productive utilization of natural resources to promote investments and entrepreneurship; (b) promotion of responsible mining that adheres to the principles of sustainable development: economic growth, environmental protection and social equity; (c) strengthening the protection given to vulnerable and ecologically fragile areas; (d) creating a healthier environment for the population; and (e) mitigating the occurrence of natural disasters to prevent the loss of lives and properties.

Environmental Laws

- Code on Sanitation of the Philippines (Presidential Decree 856)
- Marine Pollution Decree (Presidential Decree 979)
- Philippine Environmental Code (Presidential Decree 1152)
- Philippine Environmental Impact Statement System (Presidential Decree 1586)
- Toxic Substances and Hazardous and Nuclear Wastes Control Act (Republic Act 6969)
- Clean Air Act (Republic Act 8749)
- Ecological Solid Waste Management Act (Republic Act 9003)
- Clean Water Act (Republic Act 9275)

Historical Perspective of ENR Policies and Laws

The attention given to balancing utilization and conservation of natural resources, as seen in policy pronouncements, is a relatively recent development. For a long time the government implemented a policy that emphasized economic development, with little regard for conservation. Natural resource exploitation was heavily encouraged since the American and Philippine Commonwealth periods. In fact, from the 1940s to the 1970s the Philippines was one of the world's leading exporter of logs. This bias toward extraction and utilization led to the degradation of Philippine forests and marine resources. Sad to say, the country as a whole gained little from this policy, which benefited only a small, privileged segment of society.

The policy shift from exploitation to management occurred in the 1990s, when Executive Order No. 263 was promulgated in 1995, which pronounced Community-based Forest Management (CBFM) as a strategy for sustainable forest management. The CBFM strategy addressed the concern on sustainable forest management, and also allowed more equitable access to forest resources. Other instruments that served these ends include the National Integrated Protected Areas System Act and the Indigenous Peoples Rights Act, which respectively gave local communities and those of indigenous peoples the opportunity to participate formally in forest management (de Rueda 2007). In the fisheries sector, the passage of the Fisheries Code gave impetus to fisheries resources conservation and community-based management (Israel 2003).

Environmental laws have a relatively shorter history. Before the 1970s, little importance was placed on environmental concerns, which were not viewed as critical (Israel 2003). As the population grew rapidly, however, followed by urbanization and industrialization that put serious pressure on the country's natural resources and gave rise to pollution problems and its attendant woes (such as environmental health concerns), it became obvious that there was a need to address the problem. In response, the government came up a succession of laws that have been hailed as landmark legislation, including the Clean Air Act (1999), the Ecological Solid Waste Management Act (2000), and the Clean Water Act (2004). These have been lauded for laying down a comprehensive framework for environmental management in the place of the piecemeal legislation that previously governed these matters.

1.3 Institutions for Environment and Natural Resources Management

The three branches of government—Executive, Legislative, and Judiciary—have distinct roles in formulating, executing, and interpreting the ENR laws of the land. Their roles are crucial in ensuring the successful implementation of the laws and meeting their intended outcomes. The Legislative branch, composed of the House of Representatives and the Senate, legislates and appropriates resources for the implementation of the laws it passes, with the Executive branch headed by the President mandated to implement the laws. The role of the Judiciary is to interpret the provisions of the laws and rule whether these are in accordance with the Philippine Constitution.

Executive Branch: National and Local Government

The Executive Branch has two levels of governance. At the top is the national government (NG), operating through more than 20 executive departments and specialized agencies. The other level is the local government, which has been empowered to implement devolved functions provided for under the Local Government Code (LGC) of 1991 (Republic Act 7160). There are at least three levels of local government units (LGUs): provincial; city and municipal; and barangay or village. There are currently 80 provinces, 61 chartered cities, 56 component cities, some 1,500 municipalities, and about 40,000 barangays in the Philippines (World Bank and ADB 2007).

The NG maintains executive departments and specialized agencies to deliver basic services and implement national policies, programs, and projects. Traditionally, it was the NG that provided most of the social and economic services down to the household levels, until some of the functions, including ENR management, were devolved to the LGUs under the LGC of 1991. To perform devolved functions, most LGUs rely on financial transfers from the NG, as most of them have limited revenue-generating powers and capacities.

Department of Environment and Natural Resources

The country's lead environment agency is the Department of Environment and Natural Resources (DENR), created in 1987 by Executive Order (EO) No. 192, which consolidated several government agencies performing ENR functions.[4]

The DENR is primarily responsible for the conservation, management, development, and proper use of the country's environment and natural resources, specifically forest and grazing lands, mineral resources, and lands of the public domain, as well as the licensing and regulation of all natural resources. Its powers and functions are prescribed by EO 192 and basically revolve around the following major final outputs: development, implementation, monitoring, and evaluation of ENR policies and plans; development, protection, conservation, and enhancement of ecosystems and natural resources and rehabilitation of degraded ones; and development,

[4] These include the Bureau of Forest Development, Wood Industry Development Authority, Bureau of Lands, Bureau of Mines and Geosciences, Mineral Reservations Development Board, Gold Mining Industry Development Board, National Environmental Protection Council, National Pollution Control Commission, Environmental Center of the Philippines, Forest Research Institute, and National Mangrove Committee.

implementation, monitoring, and enforcement of ENR standards and regulations (World Bank and ADB 2007). In addition to the powers and functions provided for under EO 192, others are found in the specific ENR laws listed in Box 1.1.

The DENR is headed by a Secretary, who is appointed by the President and in whom the authority and responsibility for exercising the department's mandate is vested. It consists of the Department Proper, the staff offices, the staff bureaus, and the regional/provincial/community natural resources office. The Department Proper consists of the Office of the Secretary, Offices of Undersecretaries, Offices of Assistant Secretaries, the Public Affairs Office, the Special Concerns Office, and the Pollution Adjudication Board (PAB). The staff bureaus consist of the Forest Management Bureau (FMB), Lands Management Bureau, Protected Areas and Wildlife Bureau (PAWB), and Ecosystems Research and Development Bureau. Two former staff bureaus, the Mines and Geosciences Bureau and the Environmental Management Bureau (EMB), have been converted into line bureaus by the Mining Act and the Clean Air Act. A line bureau operates as a suborganization in the department with direct line of command, usually with its own representative offices, down to the regional and field offices of the department. The functions of these bureaus and the PAB under Executive Order No. 192 and other laws are summarized La Viña (2008).

For field operations, the DENR maintains 16 regional offices,[5] 73 provincial offices, and 171 community offices (World Bank and ADB 2007). The DENR's Regional Environment and Natural Resources Office is headed by a Regional Executive Director, who is assisted by four Regional Technical Directors, one each for forestry, land management, protected areas and wildlife, and ecosystems research. The DENR exercises its line functions through these field offices.

Other Agencies with ENR Functions

There are other agencies with ENR and related functions outside of the DENR. These include the DENR-attached agencies such as the National Mapping and Resource Information Authority, the Natural Resources Development Corporation, the Laguna Lake Development Authority,[6] and the National Water Resources Board. The other major agencies with ENR management functions include the Department of Agriculture (DA) and its Bureau of Fisheries and Aquatic Resources (BFAR), the Department of Energy; the Department of Health, the National Commission on Indigenous Peoples (NCIP),[7] the National Power Corporation, and the Philippine National Oil Company. Moreover, even agencies not traditionally associated with ENR functions, such as the

[5] Note that the Autonomous Region in Muslim Mindanao has its own autonomous DENR.
[6] The Laguna Lake Development Authority is mandated to assess the development potentials of the lake and its watershed and to review and approve plans and programs within the region (e.g., LGUs, business enterprises), including issuing permits and collecting fees for the use of the lake and its river systems for supply and disposal of wastes, among other tasks, and using these funds for environmental management.
[7] The Indigenous Peoples Rights Act of 1997 created the National Commission of Indigenous Peoples, which is the primary government agency responsible for the formulation and implementation of policies, plans, and programs to recognize, protect, and promote the rights of indigenous peoples. The law states that all the rights of indigenous peoples, including ancestral domain areas, shall be recognized, promoted, and protected by the state.

Department of Trade and Industry, the Department of Transportation and Communication, and the Department of Public Works and Highways, have been given ENR management roles under the Clean Air Act and the Clean Water Act. The mandates of these agencies are summarized in La Viña (2008).

A couple of other government-owned and controlled corporations (GOCCs) participate in ENR management, such as the Philippine Forest and the National Resources Mining and Development Corporation. In addition, there are special multijurisdictional and coordinative bodies with ENR functions. These include the Palawan Council for Sustainable Development, for the province of Palawan, which was created by the Strategic Environmental Plan (SEP) for Palawan Act (Republic Act No. 7611) to implement the SEP for Palawan. In addition, newer laws created multisectoral bodies to govern various ENR sectors, such as the Protected Area Management Board under the NIPAS Act, the Fisheries and Aquatic Resources Management Councils under the Fisheries Code, the Airshed Governing Board under the Clean Air Act, the National Solid Waste Management Commission under the Solid Waste Management Act, and the Water Quality Management Board under the Clean Water Act.

Local Governments

At the local level are the LGUs, which pursuant to the policy of decentralization under the LGC of 1991 have numerous devolved functions, including ENR management. (See Box 1.2.)

Box 1.2. Environment and Natural Resources Functions Devolved to LGUs

- Regulation of environmental impacts of small and medium-scale enterprises under *Kalakalan* 20 Law (Republic Act 6810)
- Establishment of greenbelts and tree parks under the Local Government Code (Republic Act 7160)
- Management of communal forests and watersheds (Republic Act 7160)
- Integrated social forestry projects (Republic Act 7160)
- Community-based forestry projects (Republic Act 7160)
- Regulation of fishing in municipal waters (Republic Act 7160 and Republic Act 8550)
- Regulation of minor mineral extraction like small-scale mining and certain scales of quarrying and sand and gravel gathering (Republic Act 7160)
- Regulation of nuisance and pollution under the Clean Air Act (Republic Act 8749)
- Solid waste management under the Ecological Solid Waste Management Act (Republic Act 9003)
- Anti-smoke belching program (Republic Act 8749)

Source: League of Municipalities of the Philippines 2005.

Two laws have been passed recently to help LGUs enforce devolved functions more efficiently: EO 444, “Strategic review on the continuing decentralization and devolution of services and functions to LGUs” (2005), and EO 366, “Rationalization of the Executive branch” (2004). These laws coincided with the passing of lean national budgets to make room for higher internal revenue allocations (IRAs).

In DENR, devolved ENR functions are supported by the deconcentration of powers to lower offices. Unlike other government agencies, DENR is well placed to mobilize its provincial environment and natural resources offices and community environment and natural resources offices to assist LGUs build capacity and mobilize local resources to improve local governance and ensure sustainability in local development. However, this takes time and resources, as new skills and processes are being developed. Likewise, disincentives (e.g., distorted IRAs and disproportionate congressional funds) need to be resolved to further stimulate sustainable development in the countryside. Nevertheless, there are a growing number of LGUs that are successfully implementing devolved ENR functions and reaping the fruits of their labor. (See Box 1.3.)

Box 1.3. Successful LGU Implementation of Devolved Functions

Quezon City, Metro Manila

In a dumpsite where more than 300 people were buried when a mountain of garbage collapsed, the Quezon City LGU in 2004 started converting the open dumpsite into a controlled waste disposal facility. With the cooperation of nongovernmental organizations (NGOs) and the private sector, more than 1,000 waste picker families were provided with housing, health care, non-formal education, and livelihood opportunities. In February 2007, the Biogas Emission Reduction project—an offshoot of the Gas to Power generation project—was approved and registered as a Clean Development Mechanism project under the Kyoto Protocol. Its proceeds will go to the resettled community for their development.

Sanito, Ipil, Zamboanga Sibugay

After rebels set the coastal barangay of Sanito, Ipil, Zamboanga Sibugay on fire, it virtually became a destitute wasteland. Wanting to revive their prosperous past, and with the strong support of its constituents, barangay officials passed the Sanito Barangay Government Code of 2004 and 2005, which adopts a Barangay environmental protection and coastal management framework. It called for strengthening intergovernmental linkages and the participation of the private sector. It mandated the imposition of fees for public works, water development, and coastal resource development. The Sanito Agro ecotourism park was established, and various programs on environmental protection and coastal resource management were implemented, such as aquasilviculture, seaweeds processing, construction of farm-to-market roads, a fish market and storage plant, and a barangay-wide recycling and composting system. Peoples' organizations were established, such as the Pag-asa Women, the Sanito Responsible Women Association, Mini Kibbutz for women, the Women Agar-agar Crackers Producers, and the Sanito Mudcrab and Livelihood Association. The multisectoral participatory process created a sense of ownership, responsibility, and belonging among the stakeholders, which led to the improvement of its infrastructure, sustaining a flourishing economy and restoring peace and order.

San Carlos City, Negros Occidental

When the San Carlos City LGU decided to convert its declining sugar-based economy to an ecologically oriented commerce and industry economy, it adopted a sustainable development strategy and called it the Sustainable City Project. It established a San Carlos Development Board, Inc., an independent non-profit private organization mandated to coordinate the

implementation of its local development initiatives with the active participation of NGOs and peoples' organizations. It included the establishment of a sustainable land use plan and promotion of energy-efficient infrastructure, ecotourism, reforestation, coastal resource management, a solid waste management program, and communal sanitation facilities. A consortium of four multisectoral organizations jointly manage and implement a watershed development and rehabilitation project that oversees nursery planting and maintenance, capacity building on agro-forestry and livelihood programs, and community organizing. Since 2005, more than 200,000 trees have been planted in the city, which includes a total of 140.8 hectares of private lands that have been voluntarily set aside by landowners and corporations. Communities living in the watershed areas were provided with livelihood opportunities (livestock and agricultural production, planting operations, and nursery maintenance). This project has now escalated to a region-wide watershed protection project in which 11 LGUs agree to share resources and strategies.

Source: Galing Pook Foundation 2008.

Legislative Branch

The legislature participates in ENR management in two significant ways: through the enactment of ENR legislation and the enactment of appropriation laws. Specific functions were also imposed under certain ENR laws. A legislative enactment is necessary to establish a protected area under the NIPAS Act. Congressional oversight committees were created under the Clean Air Act, the Ecological Solid Waste Management Act, and the Clean Water Act.

Judiciary and Quasi-Judicial Agencies

The judiciary influences ENR management through its power of judicial review.[8] Trial courts have jurisdiction over criminal cases for offenses defined under ENR laws. Meanwhile, in pollution and mining cases the DENR's Pollution Adjudication Board and Mines Adjudication Board have exclusive original jurisdiction, and courts only have appellate jurisdiction. Early in 2008, the Supreme Court designated 84 branches of first-level courts and 31 branches of second-level courts as special Environmental Courts, with jurisdiction to try and decide violations of environmental laws.[9] This was done based on an inventory and assessment of pending environmental cases whose objective is to improve efficiency in the administration of justice, and to provide greater access to environmental justice, by having these courts in places where environmental violations were shown to be most frequent and by providing judges with specialized skills and knowledge relevant to the cases prevalent in their area.

[8] Judicial review is defined as the power to settle actual controversies involving rights which are legally demandable and enforceable, and to determine whether or not there has been a grave abuse of discretion amounting to lack or excess of jurisdiction on the part of any branch or instrumentality of the government (Constitution, Article VIII, section 1). Specifically, courts (i) adjudicate "conflicts and violations that arise out of the implementation or enforcement of laws dealing with the use of natural resources and impact of human activities on public health and the ecosystem" (Ynares-Santiago 2007); and decide on the just apportionment of limited resources (Davide 2004).

[9] All single first- and second-level courts are considered special courts for this purpose.

Citizens, Citizens' Organizations, and the Private Sector

Participation by citizens and citizens' organizations in ENR management can either be through participation in decision making and policy making or through participation in the direct management of the resource. Between environmental management and natural resources utilization, participation by the private sector has traditionally been more vigorous in the latter. At present, the private sector can participate in natural resources utilization through three methods: production sharing, joint venture, and co-production agreements. Recent environmental laws, however, have expanded the role of business through multisectoral bodies.

1.4 Indicators of Environmental Management

"We have more than enough laws, but we cannot seem to enforce them" is a commonly heard complaint among Filipinos (ADB 2004). Despite the myriad of laws, ENR degradation continues. The country's rich biological resources are under threat because the ecosystems that support them have been severely degraded (see Table 1.1). The subsequent chapters in this report provide further details.

Table 1.1. The State of the Philippine Environment

Problem	Extent of the Problem	Main Causes
Poor air quality in urban centers, particularly in Metro Manila	Estimates of PM_{10} and $PM_{2.5}$ levels in Metro Manila at weighted average of 72 and 48 micrograms/m^3, respectively, are significantly above the World Health Organization guidelines of 15 and 7.5 micrograms/m^3	Mainly vehicular emissions
Poor water quality	11 of 88 rivers are biologically dead while 34 had high or slight pollution level	Mainly from domestic waste (48%), followed by agriculture (37%) and industry (15%)
Declining forest cover and watershed degradation	Only 7.2 million of the 17.1 million hectares of forest remain	Population pressure; slash-and-burn cultivation; illegal logging
Loss of natural habitats and land degradation	3,659 hectares converted each year; 284 species considered endangered; 2 million hectares of upland cultivated for agriculture	Population pressure; encroachments; slash-and-burn cultivation; poaching and illegal wildlife trade
Declining coastal and marine resources	Only 0.24% of the coral reefs are reported to be in excellent conditions; only 5% of the mangrove cover are old-growth	Population pressure; overfishing and use of destructive methods; mangrove conversion

Sources: Philippine Environment Monitor 2000-2005; Arcenas 2008; Carandang 2008.

If the current state of the Philippine environment is to be the basis, it is apparent that ENR laws and institutions have failed to address environmental degradation effectively. Some of the reasons cited for ineffective environmental management in the last decade are: the lack of explicit environmental objectives/programs, inadequate leadership, and weak enforcement of policies and laws; inadequate financial and human capital, unclear distinction between responsibilities, and conflicts of interest among ENR agencies and local governments; the absence of land use planning and zoning and unclear property rights; and the lack of routine environmental monitoring and poor use and dissemination of environmental information (World Bank 2004).

Not even the country's long history of implementing its environmental impact assessment law (see Box 1.4) has helped. The sad state of the environment is attributed to overexploitation of natural resources, conversion of natural ecosystems to other uses, development of urban and industrial infrastructure, and pollution and sedimentation from urban and industrial centers and agricultural expansion (World Bank 2003). Furthermore, the rapid population growth, urbanization, and industrialization that have taken place in the last several decades have led to deteriorating environmental quality, especially in urban areas. Air pollution in major cities and urban centers has worsened as a result of vehicular emissions and greater industrial activity. Population growth and rising living standards have contributed to the accumulation of wastes and, with industrial and agricultural activities, have caused extensive pollution of water bodies. The adverse impacts of environmental degradation and natural resource depletion on the economy and the health of the populace have been significant. For example, the economic costs of indoor and outdoor pollution and sanitation-related illnesses are estimated at $3.4 billion per annum (Arcenas 2008).

Box 1.4. Philippine Environmental Impact Statement System: Framework, Implementation, Performance, and Challenges

A joint 2007 World Bank-Asian Development Bank review on the legal and institutional frameworks of the Philippine environmental impact assessment (EIA) as well as its effectiveness and efficiency indicated that the legal and institutional frameworks were sound and robust and that the country's EIA has all the basic elements of a good environmental assessment (EA) system, as identified by the International Association of Impact Assessment, such as the presence of screening, scoping, independent review, public participation, disclosure, and monitoring.

The EIA, while able to compel proponents to disclose the environmental impacts of their projects, has limited use as a planning tool because in most cases it is applied downstream of key feasibility decisions. Its implementation suffers from centralized administration that is disconnected from the real local environmental issues on the ground, from a highly regulatory and control-oriented approach that emphasizes compliance to rigid bureaucratic procedures, from overlap with many laws, from more attention being given to procedural compliance rather than technical contents, and from a complex and poor system of follow-up and monitoring, with virtually no evaluation study. Because of these constraints, the EIA's contribution to achieving sustainable development is difficult to pin down.

The study put forward the following recommendations:

1. Maximize the contribution of the EIA to local planning and decision making through decentralization and deconcentration of the EA functions to, respectively, the Local Governments Units and Regional Offices of the DENR
2. Improve the quality of the EA process, the focus and depth of assessment, and the overall quality of the EA reports
3. Streamline and simplify requirements to make it more cost-effective for the project proponent, the DENR, and the economy in general
4. Focus EA resources on environmentally critical projects and give priority to the mapping of environmentally critical areas
5. Move toward strategic EA
6. Subject proposed environmental regulations to cost-benefit analysis or impact studies

Source: World Bank and ADB 2007.

1.5 Challenges and Issues

There are a number of challenges cited for the ineffectiveness of ENR institutions both at the national and local levels. These range from financial, technical, and human resources to political, corruption, and procedural issues. It is important to note that while much of the attention here, as in the underlying report by La Viña (2008), is on DENR, many players and stakeholders arev active in environmental management in the Philippines.

Lack of Financial, Human, and Technical Resources

DENR's Declining Budget

There appears to be a disparity between the government's strong policy pronouncements in favor of ENR management and the resources that it has committed to carry out what needs to be done. ENR management receives a very small share of the national budget, with the DENR's allocation steadily declining over the years—from about 1.2% in the late 1990s to about 0.7% in 2005 (World Bank 2007), though it increased in 2008. Moreover, the steady erosion of budgetary appropriation in real terms was observed from 2003 to 2008 (Abuyuan 2008). Compared with the rural development departments, the DENR appears to be receiving the smallest appropriation, with a budget that is less than half that of the DA and less than one-third of the DAR. Considering that the scope of the DENR's mandate is broader and deeper, this implies that the DENR's budget may not be commensurate to its responsibilities and to the problems faced by the ENR sector (Abuyuan 2008).[10] The low budget ceiling leaves too little room to offer salaries that can effectively compete with the private sector. The result is high turnover of staff and frequent changes in leadership.

[10] Abuyuan, however, acknowledges that there are other agencies (such as the DA and LGUs) performing ENR management functions. Hence, resources devoted to ENR management are actually more than what had been allocated to the DENR.

DENR's Internal Budget Allocation

Within DENR, the allocation appears to be high on expenditure for personal services, claiming 62% of the total budget, at the expense of its programmable/developmental budget consisting of the maintenance and other operating expenses and capital outlays, which only claim 27% and 10% of the total DENR budget, respectively (World Bank 2007). As a consequence, the DENR has little to spend on development expenditures. Also, the sectoral allocation within DENR reflects old mandates and priorities, which has been historically focused on forestry, with FMB getting 27% of the total budget, despite the emergence of newer mandates and more pressing concerns, such as those of EMB, which is tasked to carry out the new laws such as the Clean Air Act, Ecological Solid Waste Management Act, and Clean Water Act, which received only 5%. The PAWB, on the other hand, received only 4% (World Bank 2007).

Fragmentation of Programs and Projects

In addition, budget allocations are fragmented across too many programs and projects, with priority programs changing from year to year with each new DENR secretary. This has limited the effectiveness of these programs (World Bank 2003).

Human and Technical Resources

The DENR has one of the highest staff complements in the public sector, with more than 20,000 permanent employees in its bureaucracy. Notwithstanding this, there are many complaints that the department is severely undermanned. The problem appears to lie not in the number of existing personnel but in the way they are distributed and in their level of skills. The department's staffing pattern reflects that of an agency whose main thrust is resource extraction rather than resource management. A great number of DENR personnel are involved in forest management (ADB 2004). In contrast, the EMB, which is saddled with numerous functions mandated under recent laws, had only about 743 staff as of 2008, making it difficult to fulfill its mandates.

Fragmented and Overlapping Responsibilities

There are numerous government agencies involved in ENR management, causing inevitable overlaps and conflicts. Thus, for example, the management of a specific resource can be divided among several agencies, the management of two or more resources can be lodged with two or more agencies whose policies and programs conflict when applied to a specific locality where these resources concur, the line separating the responsibilities of NG agencies and special, multijurisdictional bodies can be unclear, and the line separating the responsibilities of NGAs and local agencies or of two or more local agencies can be unclear.

Contradictory DENR Roles

The DENR is tasked both with protecting the environment and conserving natural resources and with promoting the utilization of natural resources—functions that some see as conflicting. In

fact, some have concluded that the great bulk of the inefficiency attributed to the DENR is due to this setup (Shih 2004).

Politicization of and Instability in the ENR Bureaucracy

Civil society points to the politicization of the ENR bureaucracy as one of the causes of ineffective management. Specifically, they note that in recent years top officials of the DENR have been appointed not on the basis of their qualifications and track record in governance, in general, or ENR management, in particular, but in view of the appointees' perceived closeness to the appointing power. Furthermore, the quick succession of DENR secretaries (five in the last seven years) not only lent the impression that appointments were being extended as a form of political accommodation to whomever was close to the appointing power, but also contributed to disjointed policy making and implementation.

Corruption

According to Transparency International, corruption is perceived as quite high in the Philippines. Ranked 131 on the Transparency International 2007 index, in 2008 the Philippines slipped 10 places and is now ranked 141 globally out of 179 countries (Transparency International 2008). Needless to say, to strengthen the accountability and credibility of environmental institutions, there is room for increased access to environmental information and justice and for enhanced transparency in decision making in order to minimize rent-seeking (Transparency International 2006).

It has been observed internationally that natural resources offer a rich opportunity for corruption. Environmental crimes, such as illegal logging, and other forms of illegal appropriation of natural resources have been facilitated by corruption (WRI 2003). The Philippines is not exempt from this problem. In terms of processes, the issuance of environmental compliance certificates, title or tenure, and user rights are among the most vulnerable to corruption. In terms of environmental sector, the forestry and coastal sectors are among the most prone to corruption.

Most governance indicators (voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, control of corruption) have fallen substantially in the Philippines over the last decade due to several factors, including corruption (WBI 2008). Even with a proliferation of environmental laws and regulations, causes of corruption in the ENR sector are typically sources attributed to any other sectors in society, including insufficient legislation, lack of respect for the rule of law, lack of access to information and justice, wide discretion given to public officials, minimal accountability and transparency, poor enforcement, low levels of professionalism, and perverse incentives (Winbourne 2002). A report of the Asian Institute of Management cites the findings of a survey conducted by the Social Weather Station[11] in 1999 in which respondents view corruption occurring in DENR at the following levels of position: 18% at lower level, 35% at middle level, 73% at high level (AIM 2004).

[11] The Social Weather Station is a private, nonprofit research institution founded in 1985.

Even as the environmental institutions are well organized in the country, corruption may occur across a number of transactions, both on the regulator and regulatee side, starting from bribery and cronyism in developing national policy and misuse of funds in implementing environmental programs to bribery in securing or issuing permits and licenses, collecting "rents," undercharging fees, and selectively applying the law (Winbourne 2002).

While corruption is perceived as a widespread ill of society, very few cases have been filed, adjudicated, or resolved. In a documented example in a report from the Philippine Center for Investigative Journalism, a DENR secretary was quietly issued an environmental license for his processing plant by a regional official whom he had promoted less than two weeks before (Servino 1998). Another example is the pending cases of the Marcopper Mining Corporation in Marinduque, considered as the country's worst industrial pollution disaster. On March 24, 1996, a siltation dam owned by Marcopper collapsed, contaminating the Boac River. The case is still pending in court at the Regional Trial Court in Marinduque. This came after a series of continuous pollution episodes from the same company from November 2, 1975, to June 30, 1991, which created an 80-squarekilometer tailings dump and the collapse of another siltation dam on December 6, 1993, contaminating the Mogpog River, which remains biologically dead (Transparency International 2006, 2007, 2008).

Among national government agencies, based on the 2008 survey of enterprises on corruption conducted by the Social Weather Station, the DENR is among the agencies rated poorly, with a net score of fighting corruption placed at –25, the same category as the Commission on Election (–27), the Department of Transportation and Communication (–27), and the Office of the President (–27) (SWS 2008).[12]

Constraints in Local ENR Management

As discussed earlier, LGUs are mandated to carry out a large number of ENR management functions under the LGC and various ENR laws. However, their discharge of these functions has been hampered by a number of factors, ranging from attitudes and misconceptions to legal ambiguities and a lack of resources.

Low Priority Given to ENR Management

Many LGUs have not fully internalized the major role given to them under various laws and have shown a lukewarm attitude toward ENR management. Consequently, they are unwilling to invest sufficient effort and resources in this area. This attitude can be traced to a number of factors, namely a lack of awareness of the value of good ENR management and its potentially significant contribution to the local economy, disaster mitigation, and public health; the slow rate of return of ENR investments, whose results are not immediately manifested; blurred lines of responsibility between government agencies, especially with the DENR; and a low sense of accountability for poor ENR management.

Lack of Financial, Human, and Technical Resources

[12] The survey was based on face-to-face interviews with more than 400 managers. A score of 50 and above is a "very good" rating, while a score of minus is considered "very bad."

The same problems experienced by the DENR at the national level hound LGUs: lack of financial, human, and technical resources.

Unclear Institutional Arrangements

At the local level, there are numerous agencies involved in various aspects of ENR management—including DENR's regional, provincial, and community-level offices, the LGU's own Environment and Natural Resources Officer, and local legislative councils and local-level offices of national government agencies (such as DA-BFAR, NCIP)—with responsibilities often unclear and overlapping.

Incomplete Devolution

According to Manasan (2002), local autonomy in ENR management is actually limited despite the seemingly categorical language of the LGC. A lot of devolved functions remain subject to the control and supervision of the DENR, such as in forestry and small-scale mining.

Backlog in Legislation

Certain ENR laws have been found to be outdated, and newer, more responsive laws are needed, specifically: a Sustainable Forestry Act, to replace the 1970s-era Revised Forestry Code, and a new Public Land Act to replace Commonwealth Act No. 141. Also much needed are a National Comprehensive Land Use Law and a Land Administration Authority Law.

Improving Citizens' Participation

The Philippines has a vibrant citizens' organization movement, with about 60,000 nongovernmental institutions. Participation by citizens and citizens' organizations is backed by a strong legal framework. However, a number of factors hinder participatory mechanisms from being wholly effective. These factors include poor access to environmental information, lack of mechanisms for transparency in local decision making, lack of mechanism for feedback and/or integration of inputs, and overlapping jurisdictions.

Improvements in forest management were observed where community groups acting as resource manager received adequate funding and technical support from the national and local governments and funding agencies. However, many areas set aside for community forestry are not under effective management due to budgetary and technical constraints.

Increasing Private Sector Participation

The private sector can be a valuable partner in ENR management, as shown by the moderate success of privately managed forestlands (under instruments like Industrial Forestry Management Agreements). The private sector has also initiated various ENR projects under their corporate social responsibility programs. Beyond these voluntary activities, however, more

substantial private sector participation and investment in ENR management should be encouraged (such as the operation of sanitary landfills).

Improving Access to Justice

The Philippines has a comprehensive regulatory framework. However, this appears to have been a poor deterrent to acts harmful to the environment. (See Box 1.5.) This is mainly because of poor enforcement, which means that the probability of apprehension and punishment remains low. Studies conducted by NGOs disclose a low number of cases being filed in court, despite the high number of violations. Furthermore, the assessment conducted by The Access Initiative–Philippines reveals that extensive delays in proceedings and the costs associated with bringing a case in court constitute substantial barriers to access to justice.

Box 1.5. A Long Road to Justice

The Regional Trial Court of Cebu Judge Geraldine Econg issued five search warrants to seize almost 2.5 tons of blasting powder—enough to make nearly 40,000 homemade dynamite sticks—used for fishing in the Visayas Seas. In February 2007, law enforcement officers raided the home of an elected councilor of the Municipality of Medellin. Charges for illegal possession of explosives and as well as administrative charges of gross misconduct, corrupt practices, and violation of the Code of Conduct of Public Officers were filed.

While the office found probable cause to charge him in court and a warrant of arrest was about to be issued, a dilatory petition was filed by the suspect at the Office of the Secretary of the Department of Justice, which is now pending. Since more than 60 days have lapsed since the petition was filed with the department and since by law the court can act on its discretion to issue a warrant of arrest, concerned lawyers are now appealing to the court to act on its discretion and order the suspect's arrest.

Source: Oposa 2009.

1.6 Recommendations

On Financial, Human, and Technical Constraints

Addressing Financial Constraints

Given the country's poor fiscal position, the limit on financial resources is a problem that the DENR and other agencies with ENR management functions share with the rest of the bureaucracy. To address the ENR sector's financial needs despite this constraint, reforms are necessary on both demand and supply. On the demand side, the government may seriously pursue the streamlining of the bureaucracy to free up a portion of the budget devoted to personnel services, which can instead be used for needed capital outlays and development expenditures. The government may also consider dispensing with some functions and processes that add little value to ENR management. An example of this is the continued conduct of EIA for projects whose environmental impacts are already well known and to which routine control

measures can simply be applied (World Bank and ADB 2007). The government may also choose to focus on selected priority programs or priority areas to ensure impact, or tasks that can be completed despite limited resources (World Bank 2003), or those that are environmentally critical in the case of enforcement and compliance monitoring functions.

Planning and budgeting processes should also be aligned, so that newer mandates and priorities can be reflected in budgetary allocations instead of just following historical allocations.

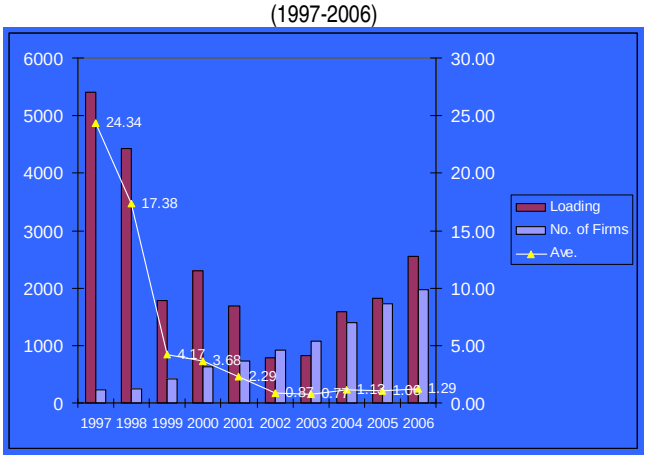
On the supply side, there is a need to adopt innovative ways to generate more financial resources. This may include increasing the use of environmental user fees to complement regulations and to generate revenues, encouraging private sector investments in ENR management, and tapping GOCCs and government financial institutions. International development agencies should be engaged with and encouraged to invest in longer-term, strategically programmed undertakings. Finally, to ensure that allocations went to the intended purposes, there should be results-based monitoring and evaluation (Abuyuan 2008).

Box 1.6. Using Market-based Instruments to Save Laguna Lake, Philippines

Launched in January 1997 by the Laguna Lake Development Authority, the Environmental User Fee System (EUFS) represents a pioneering water pollution charge system in the Philippines and in the Laguna lake region in particular. The EUFS, as an economic instrument, was to complement the regulatory approaches to environment management in the lake to encourage industrial firms to invest in and operate pollution prevention and abatement systems. It includes a fixed fee for administrative costs and a variable fee that is calculated based on the biochemical oxygen demand (BOD) level and the volume of wastewater discharged into the lake. It is integrated in the payment of the discharge permit, which is only issued if the discharge complies with the BOD effluent standard.

The introduction of the EUFS was mainly influenced by the need to abate direct discharge of liquid wastes into the lake through its tributaries by about 5 million out of the 8 million people residing in the Laguna lake region when the system was introduced. Estimates at that time showed that the major sources of BOD loads in the lake were industries (40%), domestic sources (30%), and agriculture (30%). During the first year of implementation, BOD loading was reduced by 88% (about 2,800 metric tons). When it was expanded in 1998 to cover 100% of wastewater discharges from the top five polluting industries, the BOD reduction reached to a total of 3,014.83 tons. Based on the initial success of the EUFS in the Laguna lake region, in the 2004 Philippine Clean Water Act the government required nationwide implementation of EUFS.

Total BOD Loading vs. Number of Firms and Ave BOD Loading Per Firm (1997-2006)



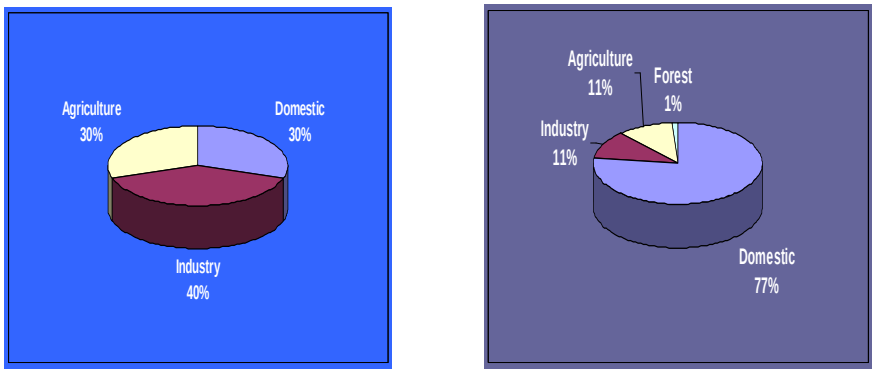
In 2004, the EUFS was expanded under the Laguna de Bay Institutional Strengthening and Community Participation (LISCOP) project financed by the World Bank and the Netherlands Government to increase coverage from 728 firms to 2,124 and to cover additional parameters such as total suspended solids (TSS). Industries with high inorganic effluents, previously charged for BOD, are assessed against TSS. By 2006, average BOD loading was an average of 1.29 tons per firm, compared with 24.34 tons in 1997. Ten years after the introduction of the EUFS, the contribution of industrial sources to pollution loading has been

drastically reduced from 40% to 11%.

The revenue derived from the EUFS increased 54% by October 2008 (PhP 84 million from PhP 55 million in 2003), a portion of which (PhP 18 million) is used to finance environmental projects implemented by the local government units. Complementary to the EUFS, the Public Disclosure Program—a system to rate industries according to their compliance to standards and environmental performance, now on its third cycle—has also been implemented.

Challenges remain in implementing the EUFS among households, which now contribute 77% of pollution load, up from 30% 10 years ago. This is largely due to the lack of investments in treatment facilities and the continuing increase in population, which is now estimated at 13.2 million, a 64% increase from the pre-EUFS implementation level. The expansion of the EUFS into this area is being actively pursued.

Distribution of Pollution from Different Sources, 1996 and 2006



1996 *2006*

Source: Adapted from Elmer S. Mercado, *Using Market-based Instruments to Save Laguna de Bay: A Contribution to the Philippines Country Environmental Analysis* (Washington, DC: World Bank, November 2008) and from LISCOP Project.

Capacity Building, Retooling, and Redefining the Role of the DENR

The DENR needs to realign its staffing so as to reflect current priorities and mandates and to build the capacity of its staff in areas where gaps have been identified. For DENR, the main issue was lack of expertise in critical areas. There should be a serious review and inventory of the competencies available in the DENR. Following the results of this review, DENR personnel should be retooled and their skills upgraded so that they can provide technical assistance to LGUs and other partners (Abuyuan 2008). The role of the DENR also needs to be redefined. This can be done in two significant ways: taking out utilization promotion functions and shifting from being "doer" to "enabler." The enhanced role of LGUs and the movement toward integrated, spatially based management require a corresponding shift in the role of the DENR. Under this setup, the DENR's main role would be as catalyst, coordinator, and convenor. The department would continue, however, to perform regulatory functions for activities that have not been devolved to the local level.

Formulating Environmental Policy

It would be highly effective for DENR to ensure that environmental policies are formulated based on the following:

- Priority setting, within and across environmental media, rooted in transparent criteria analysis and political considerations
- Participation of major stakeholders to build political and public support for agreed actions
- Cost-effective and financially feasible implementation plans that establish a realistic objective and quantitative targets and that involve an appropriate mix of policy, institutional, and investment actions
- Realistic strategies to mobilize financial resources to implement institutional and investment action
- Active monitoring to track the relations between policy implementation and changes in environmental quality for periodic policy reviews and updates (OECD 2008).

It is also important that DENR is able to set policy interventions limiting the environmental externalities that stem from markets' failures to capture costs of pollution and unsustainable use of natural resources. This contributes to protecting the integrity of ecosystems and human health, to ensuring the sustainable use of natural resources, and to guaranteeing fair competition. Revenues may be an ancillary benefit associated with some of the methods used to address externalities, but if this becomes a self-sufficient objective, it could seriously undermine the credibility of the government intervention (OECD 2008).

Integrating environmental policies into national development strategies and sectoral policies as well as incorporating environmental matters in trade agreements and removing restrictions on imports of environmentally sound technologies can also contribute to better environmental performance (OECD 2008).

Resolving Overlaps and Moving Toward Integrated Management

A comprehensive review of ENR laws and institutions must be undertaken to find out where the fragmentation and overlaps lie and to determine how to consolidate or reallocate mandates, powers, and functions. Efforts at improving interagency coordination have been initiated and are laudable. (See Box 1.7.) However, these continue to reflect sector-based planning and management. That is, in any given locality, protected area management, air quality management, solid waste management, and so on would still be treated as separate concerns. Integrated, spatially based management has been offered as an alternative to this. Under this scheme, management units are organized around a critical resource following ecosystem boundaries. This has already been done in several areas, such as the Laguna Lake region and the Agno River Basin. Following this approach, overlaps between planning and management units must be avoided.

Box 1.7. Government Agencies Ordered to Clean Up Manila Bay

The Supreme Court has created an Advisory Committee to verify the compliance reports of the government agencies tasked in a recent court decision to clean up Manila Bay. A Supreme Court committee, assisted by three NGO representatives, was appointed to help the court evaluate compliance by the concerned government agencies. The decision, among others, required various government agencies to each submit to the court a quarterly progressive report of the activities undertaken in line with the principle of a continuing court order.

In addition to the Metropolitan Manila Development Authority and the DENR, the Department of Education, the Department of Health, the Department of Agriculture, the Department of Public Works and Highways, the Department of Budget and Management, the Philippine Coast Guard, the Philippine National Police Maritime Group, and the Department of the Interior and Local Government were also charged with the responsibility of cleaning up Manila Bay.

Source: *Metropolitan Manila Development Authority v. Concerned Residents of Manila Bay* (GR Nos. 171947-48), December 18, 2008.

On Local ENR Management

Providing Enabling Conditions

Various experiences in the forestry, fisheries, and solid waste management sectors have shown that local governments can be effective ENR managers, provided enabling conditions are present. First, they must understand the value of the ENR and helped to formulate a vision for ENR management in their locality. Second, they must be given the space that would allow them a sense of ownership over ENR initiatives. Part of this would entail clarifying the boundaries between responsibilities of the NG and LGUs. Third, the DENR must be on hand to render technical assistance. Fourth, networking and knowledge sharing among LGUs should be facilitated (for example, through study tours to LGUs with good environmental programs). Fifth, the formation of broad-based partnerships with communities and community groups and the business sector should be encouraged.

Expanding the Financial Resource Base

As to budgetary constraints, LGUs may consider tapping into their share of natural wealth using private sector financing, maximizing user fees, and establishing social enterprises (such as eco-tourism). LGUs can also tap into local taxes and revenues generated from natural resource use (through quarry taxes, for instance), which, in the case of some localities like the province of Pampanga, can be quite substantial in amount. LGUs must be given an incentive to generate their own resources. For example, financial assistance by the national government or by international funding agencies should be conditioned upon the provision by the LGU of counterpart funds and good performance. Delays have been noted in the release to LGUs of their share in natural wealth utilization (from mining operations, for instance). Automatic release or even direct payment of these shares to the LGUs should be reconsidered.

Strengthening the Role of LGUs

The role of LGUS should be strengthened by removing DENR control over functions that have previously been devolved and by devolving other functions not previously passed on to LGUs, subject to a readiness criterion. Further devolution can be done on a phased approach by starting with LGUs that are ready and willing to assume additional responsibilities, to allocate sufficient human and financial resources, and to be accountable for ENR management (World Bank 2005).

Functions that can be devolved may include the administration of the EIA system and other matters where the impacts and usual concerns raised are primarily local in scope.

Combating Corruption

Several things can be done to combat corruption, such as efforts to heighten media interest and involvement in environmental issues; regular surveys on corruption by poll outfits such as the Social Weather Station and Pulse Asia; simplification of procedures for bringing corruption complaints; ensuring speedy disposition of corruption cases, improving the conviction rate, and regularly disseminating to the public the outcome of these cases; and public disclosure on environmental information and the performance of both the DENR and the regulated community. All of these are expected to increase citizens' awareness on the issues and heighten their vigilance against corruption.

On the Role of Citizens

Improving Access to Information and Mechanisms for Participation

The DENR needs to put in place a management information system that would integrate information scattered among different agencies. Setting up a system should be placed at the top of DENR's priorities. While the legal framework for public participation is already strong, one glaring flaw is the absence of an effective mechanism to enforce compliance with the requirements set by law. Deterrents and speedy remedies against noncompliance with public participation requirements need to be put in place. This may take the form of administrative imposition of penalties against noncomplying officials and administrative nullification of acts that did not follow the required processes.

Continued Advocacy

The demand for good ENR governance must be increased. Citizens and citizens' organizations have been successful in advocating for progressive environmental laws. This advocacy must be carried on to exact greater accountability in the implementation and enforcement of laws. Citizens' organizations should continue, if not intensify, critical engagement with government. There are also existing legal tools that people can use to compel the government to perform its duties. The Clean Air Act and the Ecological Solid Waste Management Act contain provisions allowing citizen suits if the government fails to implement their mandate. Also, the Office of the Ombudsman has created a Task Force for Environmental Concerns to address complaints against national and local officials for noncompliance with environmental laws.

Tapping Citizens for Law Enforcement and the Private Sector

Participation of citizens in law enforcement must be encouraged. At the local level, a wide range of stakeholders should be engaged with and mechanisms for mobilizing them into a strong enforcement group must be put in place. Funds to support citizens' enforcement activities must be provided. In the private sector, the business model approach has been successfully applied to reforestation and the management of tree plantations. Other activities where the participation of

the business sector can either be tapped or expanded include ecotourism development, sustainable agriculture, sustainable forestry, and the development of renewable energy.

Enhancing Community-based Natural Resource Management and Strengthening Partnerships with the Private Sector

Enhancing the productivity of community-based natural resource management initiatives requires providing marketing assistance, improving means of transportation, improving access to credit, and fostering partnerships with the private sector (WRI 2005).

Although conservation and the community-based approach have been given stronger emphasis in the forestry and fisheries sectors since the 1990s, the strong bias for commercial exploitation continues to influence the government's decisions at present with regard to other natural resources that are still relatively underdeveloped (such as minerals, oil, and natural gas). Given the trend observed in the forestry and fisheries sectors, the government should approach mineral, oil, and gas utilization bearing in mind conservation-community based management principles.

Improving Access to Justice

The recent designation of environmental courts by the Supreme Court is a positive development. However, this is only an initial step, as a number of measures are still needed to make these courts fully functional and more effective. These include an enhanced training program for environmental court judges and the amendment of procedural and evidentiary rules that appear to be inappropriate for environmental cases, given their peculiar nature.

The Need for Environmental Champions

Success stories have been noted in the implementation of local government initiatives on clean air, solid waste management, and forestry conservation in cities such as San Fernando (La Union), Puerto Princesa (Palawan), and Marikina. A common characteristic among these LGUs is the presence of a strong local chief executive with a clear environmental perspective and vision. Political will is a key ingredient to effective ENR management. There is a need for environmental champions in government at both the national and local levels.

The Role of Legislature

As it is, the Philippines has a good set of environmental laws. Thus much of the reform needed to improve ENR management can be done through executive action:

- Expanding the financial base for ENR management activities
- Realigning DENR's personnel to reflect its current mandates
- Building and strengthening partnerships with citizens' organizations and the business sector
- Providing technical assistance to LGUs and community groups engaged in ENR management
- Stepping up environmental monitoring efforts

- Consistent using the conservation community-based approach for relatively undeveloped resources (such as minerals).

It is critical for Congress to allocate adequate resources to the executive department to implement the laws. As mentioned, there is a big disconnect on the new mandates given to the DENR on new laws and the resources allocated by Congress to implement these mandates. Finally, legislation is also needed to carry out some of the reforms, particularly in institutionalizing the integrated, spatially based management approach and redefining the role of the DENR.

Summary

In summary, the Philippines has sound and comprehensive ENR laws and policies but suffers from weak implementation because of inadequate capacity and financial constraints both at the national and local levels, poor prioritization within a fiscally constrained environment, low accountability, and corruption and a business-as-usual attitude despite shifting priorities and pressing environmental problems. A shift in strategy toward more devolution, resource mobilization and transfer, better prioritization, and retooling of human resources is urgently needed.

Environmental governance is an overarching concern that needs to be reinforced to increase incentives for investments and behavior that would lead to a better environmental quality. Poor governance has led to sporadic and often fragmented and overlapping programs and projects as well as a lack of sense of urgency in addressing the fast deteriorating quality of the environment, particularly in urban areas.

Transparency and accountability in government transactions and private sector undertakings should be key in improving the regulatory environment in the country. Starting at the national level, the role of government—particularly DENR—should shift from being a "doer" to an "enabler" that includes providing open access to justice and information. A core function not fully implemented at the national level is policy integration and monitoring of results of policy objectives and environmental mainstreaming of ENR matters, particularly in local government units. Effective decentralization of ENR functions should include setting up an enabling environment that develops individual competencies and organization capacities and sustains a strategic environmental management approach that contains a strong compliance and enforcement system, sound public expenditure management, and strong public participation.

In spite of weak government institutions, environmental consciousness is rising in the Philippines, with civil society playing an active role in promoting environmental stewardship. Various NGOs, business enterprises, and private individuals have taken the lead in developing and implementing numerous community-based programs and projects, raising funds, and advocating for key environmental issues such as climate change and pollution management.

Meanwhile, corruption remains a bane for raising the quality of civil service, in particular, and for equal access to environmental goods and services in general. The ENR sector has a number

of areas that are vulnerable to different kinds and levels of corruption. Thus it is important that ENR programs assess any potential risk of corruption and develop a strategy to address it.

Chapter 2: Outdoor Air Pollution

This chapter reviews the status of air pollution in urban areas and provides estimates of impacts on health in terms of morbidity and premature mortality, as well as the cost to society of these impacts. Using evidence from international studies on how air pollution raises the risk of certain diseases and causes of mortality, the share of such diseases and mortality attributable to air pollution can be derived. The chapter estimates the economic cost of this burden of disease and mortality using two different methods that both show very significant costs to the Philippines from outdoor air pollution (OAP).[13] In view of these costs, the chapter discusses several options for cost-effective interventions, including improved vehicle inspection and maintenance programs, a shift from two-stroke to four-stroke tricycles, introduction of cleaner fuels, installation of pollution control devices in vehicles, and additional investment in mass transport systems. While more detailed studies of the costs and benefits of such interventions are needed, the chapter argues that many of these options hold promise and are worth pursuing further.

2.1 The Growing Problem of Outdoor Air Pollution

Air pollution can be visually observed in major cities in the Philippines. The main driver of outdoor air pollution is the rapid urbanization and motorization of transport and the associated increase and concentration of emissions from vehicles. Increasing industrial production also contributes.

Philippine legislation requires the Environmental Management Board (EMB) to monitor air quality in the country and to establish an inventory of air emissions every three years. The monitoring, however, has been limited to a review of studies conducted by nongovernmental and international development agencies, limited field surveys, and collation of information from self-monitoring reports submitted by industry members.[14] The latest emissions inventory (the Philippine Emissions Inventory 2001) included particulate matter (PM), sulfur oxide (SO_x), nitrogen oxide (NO), carbon monoxide (CO), volatile organic compounds, and total organic gases from mobile sources (ADB 2006). Regular source apportionment analyses are done not by EMB but by the Philippine Nuclear Research Institute (a government facility) and the Manila Observatory (a nongovernmental group).[15] The regular apportionment analyses of both these

[13] See Annex A for a derivation of the results presented here. Further details are found in Arcenas 2009. Note that this chapter uses 2007 prices for comparability across chapters in the CEA. Arcenas 2009 uses 2003 prices, as most health data are from that year. Prices were converted using the CPI, as published by the National Statistics Office.

[14] The law requires that industry members submit periodic self-monitoring reports as one of the conditions in their Environmental Compliance Certificate.

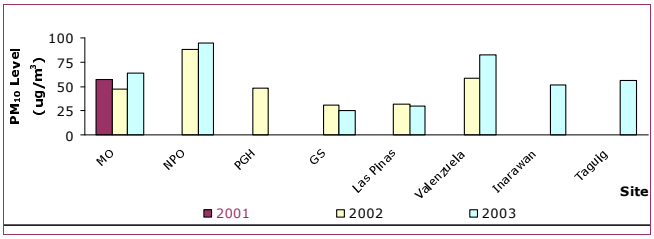
[15] Source apportionment analysis determines the contribution of each source of pollutant to a specific location.

institutions are only concerned with small particulate matter—PM_{10} and $PM_{2.5}$ (which measure, respectively, up to 10 and 2.5 micrometers in diameter) and the samples are gathered from stations that so far are only in or close to Metro Manila. The air quality of a few cities outside of Metro Manila was monitored by EMB, but this stopped in 2006.[16]

Given the data availability, this study can only focus on the health impacts associated with PM_{10} and $PM_{2.5}$ particulate matter. Although it is recognized that other pollutants have potentially significant impacts on the health of Filipinos, the data gaps that characterize other outdoor air pollutants are too wide to be overcome. Nevertheless, a meaningful assessment of the economic impacts of health problems is possible because there is sufficient information on PM_{10} and $PM_{2.5}$ levels as well as epidemiological studies that establish the "ambient concentration-response" connections between exposure to particulate matter and specific illnesses and mortality.

Monitoring of ambient PM_{10} and $PM_{2.5}$ in Metro Manila indicates a population-weighted average of 72 $\mu g/m^3$ and 48 $\mu g/m^3$, respectively, in 2001–2003/04.[17] This is significantly above the guidelines set by the World Health Organization (WHO 2005) of 20 $\mu g/m^3$ for PM_{10} and 10 $\mu g/m^3$ for $PM_{2.5}$. Figures 2.1 and 2.2 present the PM ambient air concentrations at monitoring stations in Metro Manila and one municipality right outside of Metro Manila (the municipalities of Inarawan and Good Shepherd (GS) in Antipolo City).[18]

Figure 2.1. Annual Average PM_{10} Levels in Metro Manila and Antipolo City



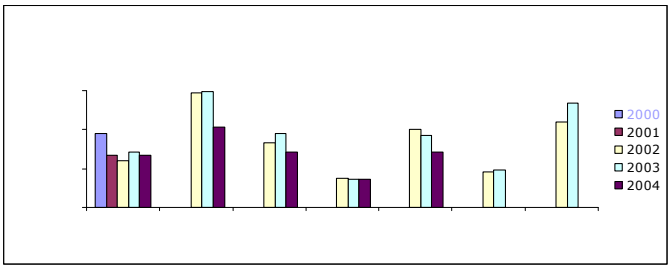
Source: Manila Observatory 2004.

Figure 2.2. Annual Average $PM_{2.5}$ Levels in Metro Manila

[16] These cities are Indang (Cavite), Batangas City (Batangas), Angeles City (Pampanga), and Los Baños, Laguna. Cebu city is also monitored but only for NO_2, SO_2, O_3, benzene, toluene, and xylene. Source: EMB's *National Air Quality Status Report, 2003*, as cited ADB 2006.

[17] The PM_{10} and $PM_{2.5}$ average concentrations in Metro Manila were calculated using data collected by the Manila Observatory and weighted according to population around the stations—Manila Observatory (MO), National Printing Office, Philippine General Hospital, Good Shepherd, Pasig, Las Pinas, Valenzuela, Pateros, Taguig, and Inarawan. For the urban areas other than Metro Manila, the Antipolo data from Manila Observatory was used. For PM_{10}, there are two stations in Antipolo—GS and Inarawan with an average annual ambient concentration of 38.5 ug/m^3. For $PM_{2.5}$, only GS has a station (average 17.8 ug/m^3).

[18] The population weighted $PM_{2.5}/PM_{10}$ ratio in Metro Manila is estimated to be 48/72=0.67. The ratio is, however, significantly higher at some monitoring stations. This may be associated with high contribution of vehicle emissions to ambient concentrations at these sites, but it deserves further scrutiny.



Source: Manila Observatory 2004.

2.2 Economic Costs of OAP-related Morbidity

To estimate the health effects and economic burden of morbidity caused by exposure to particulate matter, it is necessary to identify the illnesses that should and can be feasibly included and to determine the attributable fractions (AFs) of these illnesses from PM ambient concentrations.[19] This chapter is limited to analyzing the economic burden of disease of three health endpoints: acute bronchitis in children under 15 years, hospital admissions for respiratory disease, and respiratory symptoms (see Table 2.1). Other diseases associated with PM pollution that could not be included due to data gaps are chronic obstructive pulmonary diseases, cardiovascular disease, exacerbation of asthma, lung cancer, and possibly tuberculosis.

Table 2.1. Attributable Fractions for OAP-related Morbidity, 2003

Health Outcome	Attributable Fractions*
Acute bronchitis, under 15	42%
Hospital admissions for respiratory disease	2.6%
Occurrence of respiratory symptoms, all ages	11%

* Attributable fractions of national incidence.
Source: Arcenas 2009, based on relative risks of disease in Martuzzi et al. 2002 and annual PM concentrations in Metro Manila and other urban areas.

Table 2.2 presents annual cases of disease by age group associated with the three health endpoints.[20] The calculations show that the number of people who became ill due to exposure to PM totaled more than 1 million in 2003.

Table 2.2. Incidence of OAP-related Illnesses by Age Group, 2003

Age	ALRI (including Pneumonia)*	Acute Bronchitis**
0 to 4	274,112	427,711

[19] See Annex A for calculation of attributable fractions—defined as the fraction of incidence of illness that can be attributed to a certain health risk, such as exposure to particulate matter.
[20] Due to data limitations, hospital admissions for respiratory disease only include acute lower respiratory infection (ALRI, including pneumonia) and acute bronchitis, while respiratory symptoms only include ALRI (non-hospitalized cases). Technically, acute bronchitis is included in ALRI. The data from the Department of Health, however, list ALRI and acute bronchitis separately. This chapter is consistent in distinguishing between the two.

5 to 14	60,766	195,812
15 to 19	8,464	10
20 to 29	13,875	16
30 to 64	40,374	41
65 and older	16,844	12
Total	414,437	623,602

* Hospitalized and non-hospitalized cases.
** Cases in age group 15+ years are hospitalized cases only.
Source: Arcenas 2009.

The estimates in Table 2.2 indicate that the youngest members of society bear the heaviest burden of lower respiratory infections due to outdoor air pollution. This is alarming because it hits the potentially productive members of society during their formative stage and may affect the productivity of the future labor force in the Philippines. It should however be noted that these estimates do not include cardiovascular disease, chronic bronchitis, and other diseases that predominantly affect the adult population.

OAP-related morbidity (as measured in 2003) cost the national economy PhP 950 million (in 2007 prices, about $21 million) (see Table 2.3). A closer look at the components of morbidity costs (see Figure 2.3) reveals that productivity loss (i.e., income and time loss due to absence from work and household activities) is the largest category (PhP 502 million, or $11 million), followed by personal costs for treatment of disease (PhP 360 million, or $8 million). Only a minor part of the cost is covered by a governmental subsidy (PhP 88 million, or $2 million).[21] Hence, from a fiscal perspective, the savings from lower OAP would be limited, but there would be additional tax revenue from higher income.

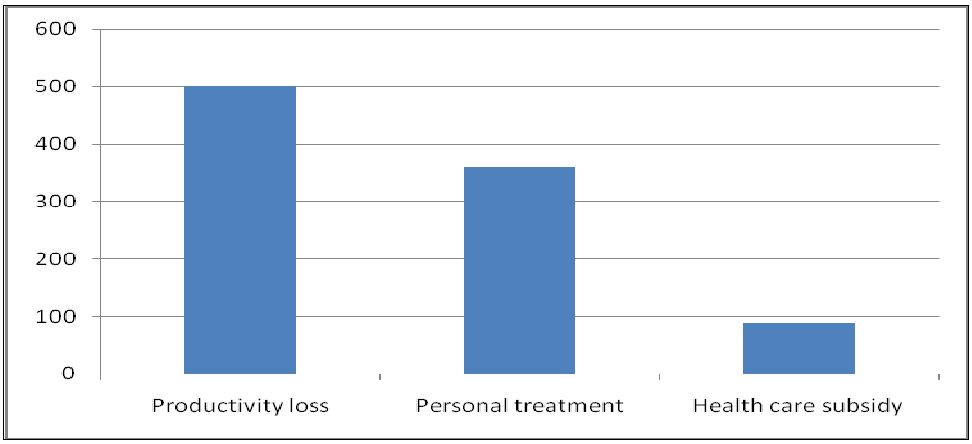
Table 2.3. Annual Cost of Morbidity from OAP (2007 prices)

Morbidity Source	**Annual Cases from OAP**	**Average Cost per Case** (PhP)	**Total Annual Cost** (PhP million)
Acute bronchitis (children < 15 years)	623,523	486	303
Hospital admissions for respiratory disease			
Acute bronchitis (15+ years)	79	11,018	0.9
Other ALRI (all ages)	22,179	13,427	298
Respiratory symptoms (all ages)*	392,258	890	349
Total morbidity cost		916	950

* Non-hospitalized cases of ALRI (other than acute bronchitis).
Source: Based on Arcenas 2009 for year 2003, with costs adjusted to 2007 prices.

Figure 2.3. Components of Morbidity Costs (PhP million, 2007 prices)

[21] The health care subsidy represents PhilHealth payments to its members and subsidy to patients who are admitted in public hospitals for treatment.



Source: Re-calculated from Arcenas 2009.

2.3 Economic Costs of Premature Mortality due to OAP

International epidemiological studies provide evidence of the increase in risk of premature death associated with exposure to PM in outdoor air. Table 2.4 summarizes the estimated relative risks. The relative risk level is raised substantially for cardiopulmonary mortality and lung cancer in adults in Metro Manila and for lung cancer in other urban areas. Based on the relative risk ratios, the attributable fractions of mortality from PM are calculated, as was done for morbidity. No elevation in risk is assumed for rural areas, which ignores the localized impacts of, for example, road dust from unpaved streets and agricultural field/waste burning.

Table 2.4. Relative Risk Ratios and Corresponding Attributable Fractions for Specific Causes of Mortality from OAP

Health Outcome	Relative Risks			Attributable Fractions*
	Metro Manila	Urban	Rural	
Respiratory mortality, under 5	1.1	1.0	1.0	3%
Cardiopulmonary mortality, older than 30	1.3	1.1	1.0	8%
Lung cancer, older than 30	1.5	1.2	1.0	13%

* Attributable fractions of national incidence.
Source: Arcenas 2009 based on Ostro 2004 and PM ambient concentrations in Metro Manila and other urban areas.

Estimated mortality incidence attributable to OAP is presented by age group in Table 2.5 based on applying the attributable fractions of mortality to the Philippines mortality statistics.[22] This indicates that nearly 15,000 people died prematurely from OAP in 2003.

Table 2.5. Mortality Incidence due to OAP by Specific Age Group, 2003

Age	Lung Cancer	Cardiopulmonary Mortality
0 to 4	NC	393

[22] See Annex A for discussion of the mortality statistics.

5 to 14	NC	NC
15 to 19	NC	NC
20 to 29	NC	NC
30 to 64	498	5,090
65 and older	413	8,956
Not reported	NC	17
Total	911	14,456

NC= not calculated.
Source: Arcenas 2009.

Calculating the cost of premature death may seem impossible or even unethical. It should be noted that it does not involve an attempt to value a particular person's life—that would be unethical. However, society has to make choices about how much to invest in saving statistical lives—for example, by building an elevated passage for pedestrians across a road to reduce accidents. If the passage is not built, it implies that the value attached to the reduced number of accidents is not seen as sufficient compared with the cost of building the passage. Hence decisions are made every day that indicate an economic value is given (or implied) to prevention of loss of life. Controversy remains as to exactly how to estimate the cost of premature death. Two quite different approaches are therefore applied:

- The value in terms of the lost contribution of the individual to economic activity (human capital approach or HCA);
- The value as measured by how much individuals are willing to pay to marginally reduce the risk of dying—this average willingness to pay (WTP), divided by the risk reduction, provides a value of statistical life or VSL.[23]

In the human capital approach, the cost of premature death for people of labor force age is foregone future income from the time of death to the age of 65, the mandatory retirement age in the Philippines. For premature death in children, foregone income is assumed to be from age 20 to 65. An average annual income of PhP 72,000 ($1,560) in 2007 is applied.[24] This income figure is adjusted annually by a growth factor of 2.13%, equivalent to the recent gross national product per capita growth in the Philippines (1999–2006) and the future stream of foregone income is in turn discounted by WHO's standard annual rate of 3%.

Estimates of VSL from international studies are applied in the absence of sufficient studies of VSL in the Philippines. Mrozek and Taylor (2002) provide a meta-analysis of VSL estimates from labor market studies from around the world and conclude that a VSL range of $1.5–2.5 million can be reasonably inferred from these studies when "best-practice" assumptions are invoked. However, the countries sampled in Mrozek and Taylor have average incomes and therefore willingness to pay for risk reduction that are much higher than in the Philippines. Scaling down the VSL

[23] Consider, e.g., an average WTP among the population of $100 for a risk reduction (RRed) of 1 in 1,000 of premature death. VSL=WTP/RRed = $100,000.
[24] See Annex A for calculation of average annual income.

estimate in proportion to the difference in income gives a value of about $105,000 (close to PhP 5 million) for the Philippines in 2007.[25]

Table 2.6 illustrates some clear conclusions. First, it shows just how much depends on which valuation method is used. Valuing mortality using VSL magnifies the economic cost enormously to almost PhP 75 billion or more than $1.6 billion per annum in 2007 prices. This compares to less than PhP 6 billion (about $122 million) when the HCA is applied. It is not surprising that the two approaches yield very different results, as the HCA is simply the value of lost income while the VSL is an attempt to estimate what people would assign as a value for reducing the risk of premature mortality.[26]

Second, it is clear that the cost of morbidity from OAP is dwarfed by mortality costs using either valuation technique, as illustrated in Figure 2.4 (where HCA and VSL are the cost of mortality using the two valuation techniques). The number of episodes of morbidity is considerable, but each episode costs relatively little. Hence, from an overall perspective it is the assessment of premature mortality that deserves the closest scrutiny, although, as previously noted, the estimated cost of morbidity does not include several health endpoints of significance because of data limitations.

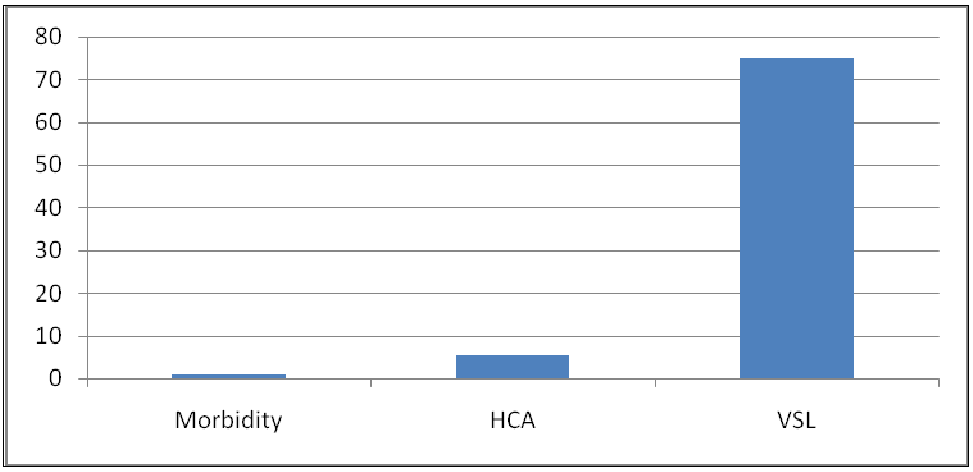
Table 2.6. Annual Cost of OAP-related Premature Mortality (in 2007 prices)

Mortality Group	**Annual cases**	**Average cost per case** (PhP thousand)		**Total annual cost** (PhP million)	
		HCA	VSL	HCA	VSL
Mortality in children under 5	393	2,050	4,867	806	1,913
Mortality in adults (age 30+ years)	14,974	315*	4,867	4,715	72,881
Total	15,367			5,521	74,794

*This "low" cost per case reflects a zero cost of mortality for adults over 65 years of age, because they are assumed to no longer be in the labor force.
Source: Adapted from Arcenas 2009.

Figure 2.4. Annual Cost of OAP-related Health Effects (PhP billion, in 2007 prices)

[25] Alternatively, Cropper and Sahin (2009), using an income elasticity of 1.5 and a VSL of $5.4 million in high-income countries from Kochi et al. (2006), estimate a VSL of $110,000 for the Philippines in 2005 (based on PPP dollar GDP per capita differentials).
[26] As seen in the previous Table, estimated mortality from OAP is predominantly in adults and especially in elderly. The average human capital value is therefore particularly low compared with the VSL.



Source: Calculated from Arcenas 2009.

Some perspective is provided by comparing the size of these estimates with the total income of the Philippines as measured by the gross national product (GNP). In 2007 this amounted to some PhP 7,249 billion, according to the Central Bank of the Philippines. Hence, the cost of health effects when using the VSL for mortality amounts to over 1% of GNP. Although international comparisons are difficult because of differences in methodology, similar results from 11 other countries are available. These show a span of about 0.2–2.5% of gross domestic product (GDP) (Guatemala and China respectively) (PEP 2008).[27] However, an even more interesting comparison to make is what it would cost to reduce the damage from OAP, as discussed in the next section.

2.4 Suggested Interventions

The *Philippines Environment Monitor 2006* reported that the bulk of particulate matter in Metro Manila is from mobile sources (84%) (World Bank 2007). The annual growth of the number of vehicles since 2000 has averaged 12%, or roughly 50,000 vehicles each year. Therefore, one of the necessary interventions in order to limit PM emissions is traffic management. This chapter focuses on several options for doing this.

Inspection and Maintenance Programs

A well-functioning inspection and maintenance (I/M) program is one of the most cost-effective interventions in abating outdoor air pollution, according to Subida et al. (2005). Vehicle inspection, in particular, strengthens the enforcement of emission standards as well as increases the demand for vehicle repair and maintenance (Kojima and Lovei 2001). Gwilliam et al. (2005) conclude that an I/M program must be able to target gross polluters, which requires an examination of the characteristics of the vehicle fleet. The I/M program must be complemented by laws and by checks and balances to ensure that it is not tainted by corruption.

[27] Some sources quote a comparison with GDP; others, with GNP. The distinction is ignored here, as the difference is often small and does not critically affect the comparison made in this section of the magnitude of environmental cost in terms of national income.

A review of the existing initiatives in the Philippines that address outdoor air pollution indicates that positive steps have been taken. This is attributed mainly to the government's successful phase-out of leaded gasoline. In addition, the emission standards were tightened to comply with Euro 2 standards. The government also continues to review and revise the allowable emission limits for vehicles equipped with compression ignition and spark ignition.

Currently, the country has a Motor Vehicle Inspection System (MVIS) that requires motor vehicles to pass emission testing prior to registration. Emission testing is performed either by private emission testing centers (PETCs) or by the Land Transportation Office (LTO). For private vehicles, more than 300 private centers all over the country conduct the emission testing, while for public utility vehicles, the LTO MVIS offers emission testing services at lower costs (EMB-DENR 2005).

The Philippines also has an existing smoke-belching program that was established to enforce motor vehicle emission standards. Teams who were trained by a multiagency group led by the Metropolitan Manila Development Authority and LTO implement the initiative (EMB-DENR 2003). This program could be improved with solid support from local government units. Local ordinances, capacity building, and roadside apprehension are best handled by the municipal and city governments.

Adjusting findings from Lima in Peru by ECON (2006), Larsen (2009) estimates a benefit-cost ratio of 3.9 of an inspection and maintenance program for diesel vehicles in the Philippines. This indicates that health benefits (averted loss in human lives and reduced morbidity) of such a program are almost four times higher than the cost of the program.

From Two-stroke to Four-stroke Tricycles

Many motorcycle drivers prefer two-stroke over four-stroke engines because they are more powerful and oftentimes less expensive. Tricycles—which often are two-stroke, and a very popular mode of public transportation—are ubiquitous and will most likely remain popular for a long time. The social cost of using two-stroke tricycles, however, remains unaddressed satisfactorily. Aside from the noise pollution they create, a significant volume of particulate matter comes from these two-stroke tricycles. The challenge is how to create an incentive system to entice two-stroke drivers and owners to switch to less polluting modes of transportation or, at the very least, to maintain their motorcycles properly and reduce emissions. As they barely earn the minimum wage, tricycle drivers do not have enough money for tricycle maintenance. There is also very little incentive to conduct maintenance operations, since most tricycle drivers do not own the units they drive (Camagay et al. 2005).

The social benefit of a switch to four-stroke engines is potentially large. In the strategy scenarios evaluated by Subida et al. (2005), switching from two-stroke to four-stroke tricycles will result in an 80% reduction in PM emissions from these vehicles. The biggest issue is cost, not just in terms of providing the funds to help finance the switch but also in promoting the acceptability of the program among the citizens by providing information. In the short run, the government can ban the introduction of new two-stroke tricycles while providing inspection and maintenance services to the existing ones. Owners of "retiring" two-stroke vehicles should also be encouraged

to make the switch. The city government of San Fernando in La Union offered a loan package to encourage the shift to four-stroke tricycles. Operators were offered an interest-free loan amounting to PhP 9,000 repayable within one year for the down payment on a four-stroke machine. Two-stroke tricycles that were at least 20 years old were phased out (San Fernando City Government 2007). As of July 2005, a total of 643 two-stroke units were converted into four-strokes, of which 97 units received financial assistance (Ortega, undated).

Box 2.1. Improving Air Quality

Poor air quality arising from emissions of two-stroke engine tricycles is a problem in many urbanizing areas in the Philippines. The tricycles are high emitters of carbon monoxide, hydrocarbons, and particulates—with emissions from just one tricycle estimated as being the equivalent of 50 automobiles. Yet two-stroke tricycles provide the cheapest and dominant mode of public transport in almost all cities and major towns in the Philippines. Their proliferation is actually encouraged by local governments: licensing fees to operate tricycles are a source of LGU revenues.

When the city of Vigan in northern Philippines decided to become a cultural heritage destination, one of its major environmental management challenges was the air pollution created by its more than 3,500 motorcycle taxis, 85% of which have two-stroke engines. Although an influx of visitors was good for tourism-related services, industries, and facilities, it put a strain on local transportation and added to Vigan's pollution problem.

A comprehensive environmental analysis in July 2008 noted that air pollution problems were largely localized in certain areas, particularly the major streets in the core area of its heritage zone, and were worse during "rush hours." Emissions were mainly due to two-stroke motorcycles operated as tricycles-for-hire (TFH) and personal motorcycles.

To address its air quality problems, Vigan passed City Ordinance No. 8, series 2006, which regulated the use of carbureted two-stroke engines by tricycles-for-hire in the city, including those coming from other towns, and required them to convert to four-stroke engines or be retrofitted with a direct injection system, which significantly reduces tailpipe smoke and harmful emissions as well as increasing fuel economy.

A major obstacle to the enforcement of the program was the added economic cost for TFH owners and operators. To make the law compliant-friendly for these individuals, the city set up a parallel financing program to help fund the engine conversions. A local cooperative network, the Nueva Segovia Consortium of Cooperatives (NSCC), was tapped to run the loan assistance package. To date, the city government has invested PhP 3 million ($69,000) in the NSCC for its micro-lending program, which includes loans for THF operators and drivers who convert their tricycles.

The conversion to direct-injection engines will result in annual fuel cost savings of PhP 23,520 ($470.40). This will more than pay for buying and installing the conversion kit (PhP 18,000 per engine). Actual daily savings range from PhP 80 to 150 on fuel and oil, which is additional income for tricycle operators.

Vigan City's engine conversion program is succeeding because of the strong community and political will shown by both local and community leaders. The consistent application and enforcement of the laws and the apprehension of violators, along with a continuous education and information campaign, facilitated better understanding and cooperation among all sectors. Just 18 months after the program's full implementation, air pollution in the city was "significantly reduced" in the central area. By September 2008, two-thirds of the TFHs had been converted or had adopted an environment-friendly technology.

From 2004 to 2008 Vigan was deemed the cleanest and greenest city in the region, and in 2007 it was recognized as having the most outstanding LGU-initiated environmental management program. Its engine conversion ordinance has been reviewed by various other cities for possible replication. Vigan's efforts to reduce air emissions through the engine conversion program and other environmental laws are seen to contribute immensely to its heritage conservation program and its growing image as a primary tourist destination site in northern Philippines.

Source: Adapted from Elmer S. Mercado, *Preserving Cultural Heritage through Good Environmental Management in Vigan City, Ilocos Sur: A Contribution to the Philippines Country Environmental Analysis* (Washington, DC: World Bank, September 2008).

Low-Sulfur Diesel and Installation of Pollution Control Devices

Larsen (2009) adjusted cost-benefit analyses (CBA) from other developing countries to determine if retrofitting in-use diesel vehicles with diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs) would make economic sense in major urban areas in the Philippines. These control devices can reduce PM emissions from diesel vehicles by >25% and >80% respectively. While DPFs are more effective in reducing emissions, they are also more expensive. Using the experience of Mexico, Peru, and Senegal as the basis for the analysis, the results indicate that the health benefits of a retrofitting program more than outweigh the average costs. Table 2.7 provides the benefit-cost ratios of retrofitting in-use diesel vehicles in the Philippines.[28]

Effective functioning of the catalysts and filters requires diesel fuel with maximum sulfur contents of 500 and 50 ppm, respectively. A CBA for low-sulfur diesel was therefore also undertaken, adjusting results from other developing countries to the Philippines. The results indicate that the health benefits outweigh the incremental cost of providing 500 ppm and 50 ppm sulfur diesel.[29] A study from China also suggests that benefits of requiring EURO 4 standards on new vehicles in the Philippines would outweigh incremental costs. This, however, requires that 50 ppm sulfur diesel and very low sulfur gasoline are available to motorists.

Table 2.7. Benefit-Cost Ratios of Low-sulfur Diesel and Diesel Vehicle Control Technologies

Control Technology	Benefit-Cost Ratios	Original Study
Low-sulfur diesel		
500 ppm diesel	5.06	Senegal (Larsen 2007)
500 ppm diesel	1.62	Colombia (Larsen 2005)
50 ppm diesel	4.09	Senegal (Larsen 2007)
50 ppm diesel	1.40	Peru (ECON 2006)
Control technology for new vehicles		
Euro 4 standards	2.10	China (Blumberg et al. 2006)
Retrofitting of in-use diesel vehicles (DOC)		
Old buses	6.54	Mexico (Stevens et al. 2005)
Large buses	6.74	Senegal (Larsen 2007)
Buses	4.12	Peru (ECON 2006)

[28] Larsen applies a VSL of $109,000 to the Philippines (reflecting GNI per capita in 2007) for valuation of mortality.
[29] The CBA of 50 ppm sulfur diesel is an incremental analysis from 500 ppm diesel.

Newer buses	2.97	Mexico (Stevens et al. 2005)
Old delivery trucks	2.23	Mexico (Stevens et al. 2005)
Newer delivery trucks	1.81	Mexico (Stevens et al. 2005)
Retrofitting of in-use diesel vehicles (DPF)		
High usage taxis	5.30	Senegal (Larsen 2007)
Old buses	2.80	Mexico (Stevens et al. 2005)
Large buses	2.89	Senegal (Larsen 2007)
Newer buses and delivery trucks	1.47	Mexico (Stevens et al. 2005)

Source: Larsen 2009.

Vehicle emission technologies are useful short-term interventions while the country is building capacity, awareness, and adoption of cleaner fuels. As such, a national program that requires vehicles (new and in-use)—especially public utility vehicles such as jeeps, buses, and tricycles—to install pollution control devices must be implemented.

Several pollution control devices are offered in the market today. Kojima and Lovei (2001) note that for gasoline-powered vehicles, catalytic converters are the most effective in reducing exhaust emissions. As much as 95% reduction in CO and hydrocarbon emissions and around 75% NO_x reduction can be achieved if the three-way catalytic converters are used efficiently.

Vehicle emission technologies entail additional costs to vehicle owners. Moreover, given certain technologies, lower emissions come at the price of fuel efficiency, making installation of emission technologies even more costly. While newer vehicle imports come with installed catalytic converters, the problem lies with older vehicles (Gwilliam et al. 2005). If emission standards are being strictly enforced through a well-functioning I/M system, vehicle owners are left with no choice but to install pollution control devices. In addition, the government can remove the barriers that prevent the entry of anti-pollution technologies or can lower tariffs on the importation of emission technologies to help ease the price in the domestic market (Kojima and Lovei 2001).

Rehabilitation of Current Traffic Management System

To illustrate the potential of traffic management, a study conducted in Bangkok and Kuala Lumpur in 2004 revealed that a similar reduction in emissions from the installation of three-way catalytic converters in 50% of cars can be achieved by increasing vehicle speeds from 12–15 kilometers per hour to 30 kilometers per hour (Kojima and Lovei 2001). Strategies that can greatly improve the flow of traffic include coordinated signals/traffic lights, channelization, reversible lanes, one-way street pairs, area licensing schemes, parking controls, exclusive pedestrian zones, vehicle bans (Faiz et al. 1990), and segregated busways (Gwilliam et al. 2005). However, reduced travel time encourages more trips and thus translates into higher emissions, which can partially cancel the benefits of better traffic flows.

Investments in Additional Mass Transport Systems

Investments in additional mass transport systems such as electric trains will significantly reduce the public's reliance on jeepneys and tricycles, which are notorious for outdoor air pollution emissions. Currently, three light-rail transit lines are available in Metro Manila, serving about a million passengers daily.

A number of analysts have suggested the use of trains and railways as an effective strategy combating air pollution (Gwilliam et al. 2005; Ostro 2004; Kojima and Lovei 2001; Subida et al. 2005). By expanding the railway network, it is expected that the number of commuters using this option will increase. The projections made by Subida et al. (2005) show that in 2015 the use of metro railways will generate an 18% reduction in particulate emissions, and 13% reduction in CO_2 emissions. The costs of this intervention are summarized in Table 2.8.

Table 2.8. Proposed Railway Projects and Costs (in million dollars)

Railway Line	**Route**	**Distance**	**Fixed Cost**	**Variable Cost** (operation and maintenance)	**Total**
LRT line 6	South extension of line 1	30 km	600	750	1,350
MRT line 3 extension	North Ave-Navotas; Taft-Reclamation	12 km	306	261	567
MRT line 2 (east west extension)	Recto-North harbor; Santolan-Masinag	15.7 km	351	182	533
MRT line 2	Masinag-Antipolo	22.8 km	288	150	438
MRT line 4	Recto-Novaliches	26 km	724	646	1370
North Rail	PNR line	45.5 km	589	649	1238
MCX	PNR Line		554	996	1550
Total Cost			3,412	3,634	7,046

Source: JICA in Subida et al. 2005.

MRT and LRT operations are financed by government subsidies, to an extent approaching one fifth of the total cost. In theory, the fare rate should reflect the economic costs of the service being provided. However, this is not a viable option in practice for political and demand elasticity considerations. Without the subsidy, the MRT fare would be more expensive than the jeepneys and buses that ply the same route. Studies of the optimal tariff regime can be found in Morales-Mariano (2006) and Martinez and Tolentino (2007), but it is beyond the boundaries of this chapter to make specific recommendations in this regard.

Chapter 3: Indoor Air Pollution

This chapter analyzes household use of solid fuels and indoor air pollution (IAP) in the Philippines and the associated health impacts, in terms of both morbidity and premature mortality. Estimates of the cost of morbidity (in terms of lost income and activity time and treatment cost) and the cost of mortality using a human capital approach (HCA) and a value of statistical life (VSL) approach are presented.[30] The main finding is that these costs are significant, but less than the costs associated with outdoor air pollution. But indoor air pollution is quite likely to have a much higher impact than outdoor air pollution on the poorest households. The final section discusses promising interventions to cost-effectively mitigate this burden of disease, such as improved ventilation, better stoves, and switching to cleaner fuels.

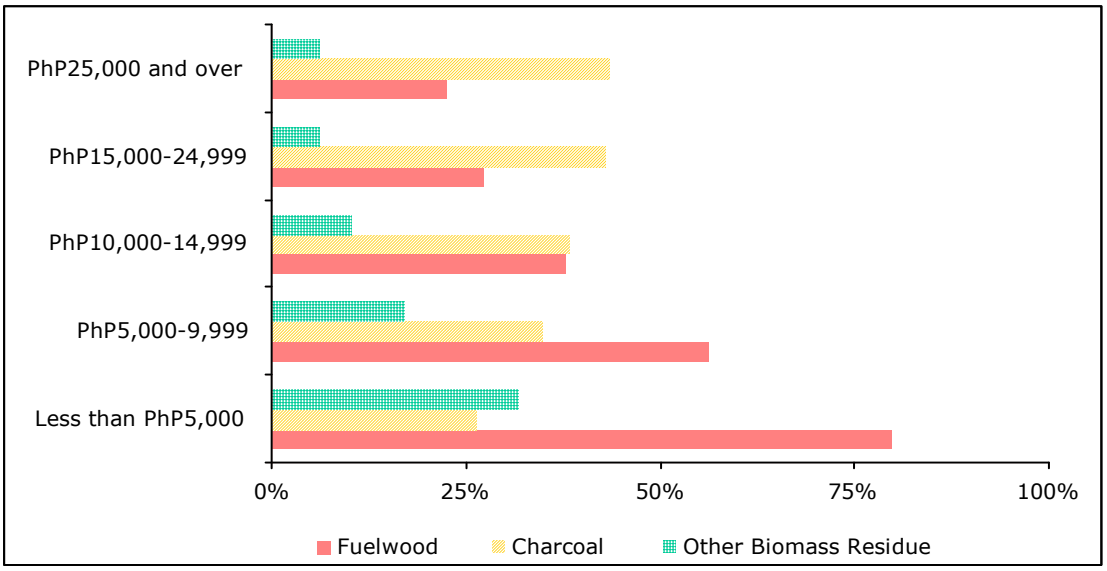
3.1 Household Solid Fuels and Indoor Air Pollution

The World Health Organization (WHO) reports that indoor air pollution from solid fuel used for cooking and other purposes causes an estimated 1.5 million deaths a year globally due to respiratory diseases and lung cancer and is the eighth most significant risk factor in the global burden of diseases, contributing over 3% of the disease burden in developing countries.[31] IAP-related illnesses also result from cigarette smoking and other sources. In this chapter, however, the focus is only on IAP from household use of solid fuels.

Following Desai et al. (2004), solid fuel use is defined as "the household consumption of biomass (dung, charcoal, wood, or crop residues), or coal." The literature on IAP suggests that the bulk of the environmental burden of disease due to household use of solid fuel is borne by low-income households. This is confirmed by evidence from the Philippines, where the use of fuelwood and other biomass residue is several times more prevalent in the lowest-income groups than in the highest-income groups. Use of charcoal, considerably less smoky than fuelwood and other biomass residue, increases with income level (see Figure 3.1).[32]

[30] See Chapter 2 and Annex A for a description of these two approaches to valuation of mortality.
[31] See WHO 2002, WHO 2007, www.who.int/indoorair/health_impacts/burden_global/en/index.html, and www.who.int/mediacentre/factsheets/fs292/en.
[32] Ezzati and Kammen (2002) provide a comparison of air pollution concentrations from charcoal and fuelwood stoves.

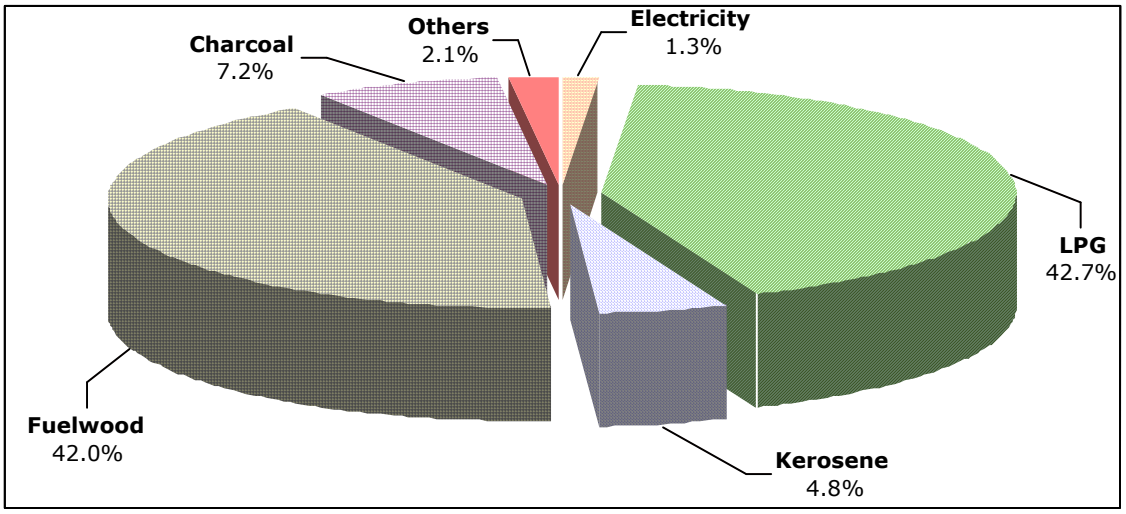
Figure 3.1. Household Use of Solid Fuel by Income Level, 2004



Source: HECS 2004.

To estimate the national burden of disease from household use of solid fuels, population exposure to IAP needs first to be determined. Factors influencing population exposure include type of fuel, type of stoves in which the fuel is combusted, household ventilation characteristics, cooking practices (e.g., indoors vs. outdoors), and household member activity patterns. In the absence of detailed information on each of these factors, the most common approach to estimate population exposure is to consider the primary fuel that households use for cooking. Figure 3.2 shows that just over 48% of the households in the Philippines use solid fuels as their primary cooking fuel,

Figure 3.2. Primary Cooking Fuel in Households in the Philippines, 2004

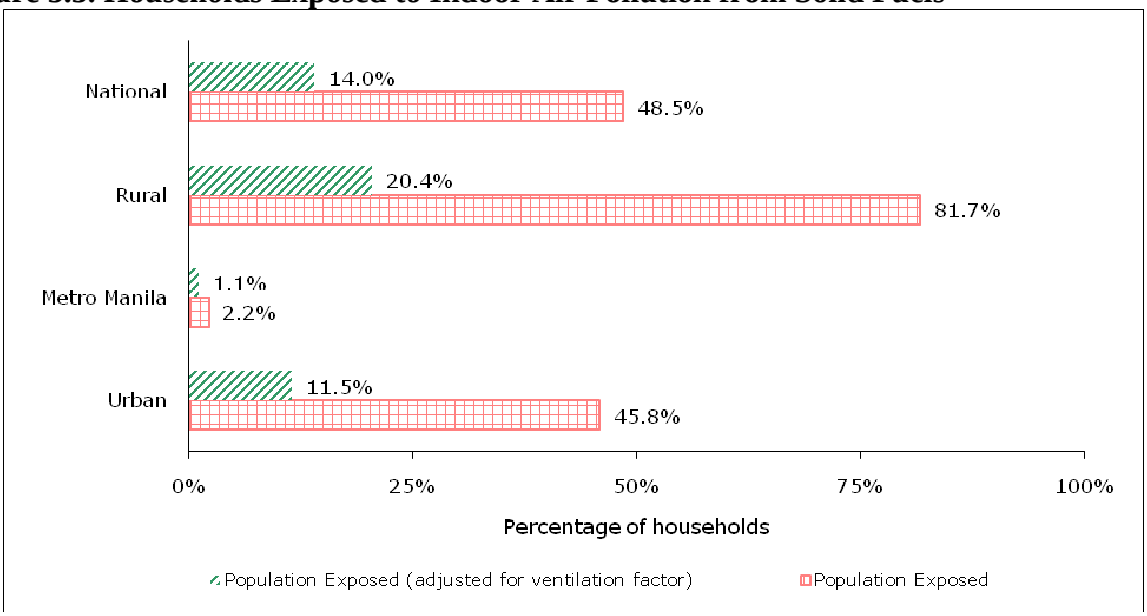


Source: HECS 2004.

Because cooking practices, types of stoves, and the structural characteristics of houses affect the level of exposure, there is a need to adjust population solid fuel use prevalence by the associated ventilation factors (VFs). Desai et al. (2004) suggest using a VF of 0.25 for households that use improved stoves or cook outside, and a VF of 1.00 for those that use traditional stoves and cook indoors. A ventilation of 0.25 means that the health effects of indoor air pollution emanating from cooking fuel are expected to be reduced by three quarters as the result of the ventilation conditions.

Saksena et al. (2005) summarized these mitigating ventilation conditions in the Philippines based on a variety of factors, including the distance of rooms and walls, height of ceiling, size of windows, materials used to build the house, and whether the household uses improved stoves or not. Taking into account the prevailing conditions in the Philippines, a factor of 0.25 is used for urban and rural areas outside Metro Manila, as households in these areas typically do their cooking outside their houses. Metro Manila households that use solid fuel are assigned a ventilation factor of 0.5, since they would normally be found in informal settlements where houses are crammed together. The population exposed to IAP in the Philippines is presented in Figure 3.3 in terms of households using solid fuels as primary cooking fuel, but adjusted for ventilation conditions.[33]

Figure 3.3. Households Exposed to Indoor Air Pollution from Solid Fuels



Source: Estimates by Arcenas 2009, based on HECS data.

[33] See Desai et al. (2004) for application of the ventilation factor to estimate population exposure from solid fuels.

3.2 Economic Costs of IAP-related Morbidity

Most health outcomes associated with exposure to indoor air pollution have been limited to children younger than 5, adult women, and to some extent adult men. Attributable fractions (AFs), or the proportion of the cases of the health outcomes that can be attributed to exposure to IAP, can be computed for these population groups. AFs were estimated by gender, age, and specific illnesses based on the population using solid fuels, adjusted for ventilation factor, and the relative risk of illness from IAP from meta-analyses of epidemiological studies, as explained in Annex A.. The estimated AFs for each health endpoint most commonly associated with IAP are presented in Table 3.1. Applying these AFs to the total cases of illness of each health endpoint in the Philippines provides estimated annual cases of morbidity from IAP, as presented in Table 3.2.

Table 3.1. Attributable Fractions of Morbidity from IAP

Health Endpoint	Relative Risk Ratios	Ventilation Factor	Attributable Fractions
Acute lower respiratory infections (ALRI), children younger than 5 and women over 30*	1.8	0.25	10%
Chronic obstructive pulmonary diseases (COPD), women over 30	3.2	0.25	24%
Chronic obstructive pulmonary diseases, men over 30	1.8	0.25	10%
Tuberculosis, women and men over 15	1.5	0.25	7%

* The relative risk ratio of 1.8 for ALRI is estimated by Dherani et al. (2008) for children under 5; this figure is also applied here to women over 30, based on evidence of health effects in adult women in Ezzati and Kammen (2001).

Source: Adapted from Arcenas 2009, based on relative risk ratios from Dherani et al. 2008 (ALRI) and Desai et al. 2004 (other conditions). The relative risks reflect a ventilation factor of 1.0. Attributable fractions are adjusted for ventilation factor and are of national incidence of disease for each health endpoint.

Table 3.2. Morbidity Cases Attributable to IAP, by Age, 2003

Age	Acute Bronchitis	ALRI and Pneumonia	COPD	Tuberculosis
0-4	101,949	289,753	NC	NC
5 to 14	NC	NC	NC	NC
15 to 19	NC	NC	NC	716
20 to 29	NC	NC	NC	1,173
30 to 64	18,630	22,842	2,670	3,604
65 and older	4,900	8,839	1,558	1,139
TOTAL	125,479	321,433	4,228	6,631

Source: Arcenas 2009. NC= not calculated.

The calculations show that the estimated IAP-related morbidity costs society and the economy over PhP 1.5 billion ($33 million) annually (see Table 3.3). Over 80% of this cost is from ALRI, and 90% of those cases are in children under 5 years old with the other 10% in women over 30. As with the economic cost of outdoor air pollution, the cost of IAP-related illnesses include the

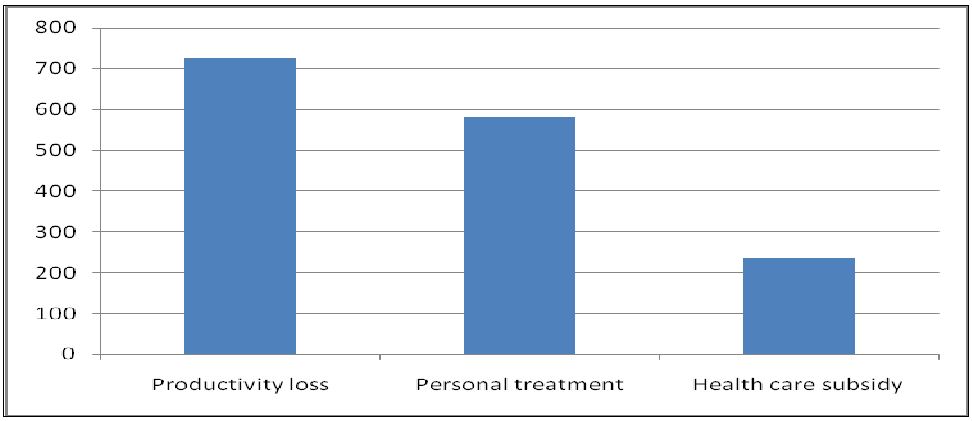
loss of income and time due to absence from work and household activities, treatment costs to households, and the cost to the government health care system in terms of subsidy to PhilHealth members' medical treatment costs and patient hospitalization subsidy. (See Figure 3.4 and Annex A for the detailed assumptions.) Productivity cost is the major share (47%), followed by personal treatment costs (38%) and government health care subsidy (15%).

Table 3.3. Annual IAP-related Morbidity Costs (2007 prices)

Morbidity Source	**Annual Cases from IAP**	**Average Cost per Case** (PhP)	**Total Annual Cost** (PhP million)
Acute lower respiratory infections, children younger than 5 and women over 30	446,913	2,809	1,255
Chronic obstructive pulmonary disease, women and men over 30	4,228	47,195	200
Tuberculosis, women and men over 15	6,631	13,577	90
Total morbidity cost			1,545

Source: Adapted from Arcenas 2009 and converted to 2007 prices.

Figure 3.4. Annual IAP-related Morbidity Costs (PhP million, in 2007 prices)



Source: Adapted from Arcenas 2009 and converted to 2007 prices.

3.3 Economic Costs of Premature Mortality due to IAP

The relative risks and thus the AFs calculated for morbidity are also used to estimate mortality from these illnesses, with the addition of lung cancer in women over 30 from biomass smoke, for which the relative risk is 1.5 and attributable fraction is 7%.[34] In total, there were an estimated 5,800 deaths from IAP in 2003, with the largest share being from chronic obstructive pulmonary disease, followed by tuberculosis and acute lower respiratory illness (see Table 3.4).

Table 3.4. Mortality Incidence due to IAP by Specific Age Group, 2003

[34] ALRI mortality is not estimated for women over 30.

Age	Respiratory Tuberculosis	Lung Cancer	Pneumonia	Acute Bronchitis	COPD
0-4	NC	NC	1,273	12	NC
5 to 14	NC	NC	NC	NC	NC
15 to 19	19	NC	NC	NC	NC
20 to 29	82	NC	NC	NC	NC
30 to 64	937	59	NC	NC	894
65 and older	707	60	NC	NC	1,725
Not Reported	2	0	NC	NC	1
Total	1,745	119	1,273	12	2,620

NC= not calculated.
Source: Arcenas 2009.

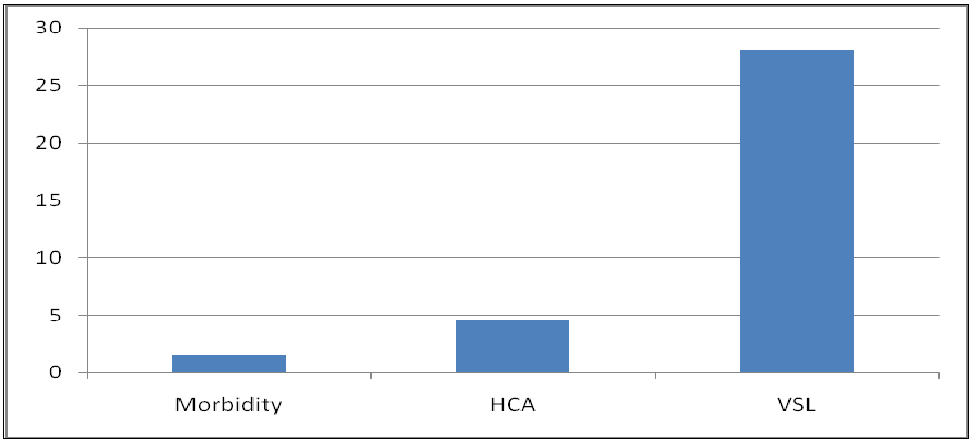
It is estimated that premature deaths from IAP cost the Philippine economy PhP 4.6 billion ($100 million) in lost productivity using the human capital approach, or PhP 28 billion ($610 million) using the VSL approach (see Table 3.5). Adding the previously derived morbidity costs of PhP 1.5 billion, total IAP-related costs are on the order of PhP 6–30 billion per annum in 2007 prices ($130 million–$650 million). This is equivalent to about 0.1–0.4% of gross national product in 2007. The international comparison shows a span of costs related to OAP of 0.1–1.7% of GDP across 11 countries (Tunisia and Nigeria, respectively) (PEP 2008).As with outdoor air pollution, the cost of morbidity is dwarfed by the cost of mortality, whether using the HCA or VSL for valuation (see Figure 3.5).

Table 3.5. Annual Cost of IAP-related Premature Mortality (in 2007 prices)

Mortality Source	Annual Cases	Average Cost per Case (PhP thousand)		Total Annual Cost (PhP million)	
		HCA*	VSL	HCA	VSL
Acute lower respiratory infections, children younger than 5	1,286	2,050	4,867	2,635	6,257
Chronic obstructive pulmonary diseases, women and men over 30	2,620	291	4,867	764	12,752
Tuberculosis, women and men over 15	1,747	661	4,867	1155	8,505
Lung cancer, women over 30	119	405	4,867	48	577
Total	5,771			4,602	28,090

* The average cost of mortality per case using the HCA varies in relation to age of death.
Source: Adapted from Arcenas 2009.

Figure 3.5. Annual Cost of IAP-related Health Effects (PhP billion, in 2007 prices)



Source: Calculated from Arcenas 2009.

3.4 Suggested Interventions

Since the analysis of the health impacts of indoor air pollution in this chapter centers solely on household solid fuel use, the suggested interventions in this section only address exposure to smoke from solid fuels and focus on improvement of ventilation, change in cooking practices, and change in the kind of stoves and fuels used in the home.

Promoting Improved Household Living Environment

The household living environment (that is, house structure, room layout) is one of the most important factors affecting the level of exposure of a household to indoor air pollution. House layout design greatly affects the concentration and distribution of pollutants inside a home. There are significant differences in pollutant concentrations based on the location of cooking areas and kitchen (Zhang and Smith, undated; Jin et al. 2005; Qin et al. 1991). It is apparent, therefore, that a simple but logical solution to the issue of indoor air pollution is to have a separate or outside kitchen. This is not always possible, however, because of the costs.

There are other ways to increase ventilation without great expense or inconvenience. These include "increasing the number of windows/openings in the kitchen, providing gaps between the roof and the walls, or moving the stove out of the living area" (Desai et al. 2004). Remarkable benefits from a "cooking window" or a "fume cupboard" have been noted by Nystrom (WHO 2000). In rural Kenya, the usefulness of stove hoods with flues, enlarging and repositioning windows, and enlarging eaves has been studied. These interventions, developed with the participation of local women, were very effective in reducing exposure to harmful pollutants (WHO 2000).

Interventions in the form of marketing, advertising, and education come into play for influencing behavior. Education, in particular, is very important in conveying the value of cleaner kitchens and air to households and thus can help reduce the impact of indoor air pollution (Desai et al. 2004).

Improved Stoves and Cleaner Fuels

Studies of indoor air pollution exposure prevention have concluded that the use of improved stoves lessens exposure to indoor air pollution (Mehta and Shaphar 2004). Other researchers have highlighted the benefit that a household gains from using liquefied petroleum gas (LPG) or kerosene. Biomass stoves cost $50–100 per disability-adjusted life year (DALY)[35] averted, according to Smith (1998), while Hughes et al. (2001) estimated that the introduction of kerosene or LPG stoves in rural areas costs around $150–200 per DALY averted.

While households can directly observe the reduction of emissions or greater fuel efficiency of improved stoves, the health and monetary value of these benefits are less apparent (Larson and Rosen 2000). It is essential that communities are engaged in designing an improved stove, as this will ensure that the proposed solutions are culturally acceptable and financially affordable.

Choosing the correct stove to promote is therefore essential to the proposed intervention. As a guide, information from various sources on the cost effectiveness of improved stoves is useful. Foremost among these is the study done by Hutton et al. (2006), which evaluated the cost and benefits of household energy and health interventions using data from 11 developing WHO subregions. Net intervention costs included intervention costs less fuel savings, while economic benefits included health benefits and savings on health care costs, productivity gains due to reduced morbidity, time savings, and environmental benefits. The study assumed a 35% reduction in health effects from the improved stove based on Naeher et al. (2000), Bruce et al. (2002), and Bruce et al. (2004). The improved stove in the study is the chimneyless "rocket stove." This is a type already used in Latin America, Asia, and Africa that is relatively cheap (about $6) and has an estimated useful life of three years (Hutton et al. 2006). The results are not country-specific but generally lend credence to the cost-efficiency of promoting improved stoves as well as of switching to LPG.[36]

For the Philippines, Larsen (2009) estimated benefit-cost ratios (BCRs) for programs that promote household conversion of unimproved wood stoves to improved wood stoves or LPG stoves (see Table 3.6):[37]

- Scenario 1: Conversion to improved wood stove from unimproved wood stove (with the assumption of a 50% reduction in health risks)

[35] A DALY is a year lost to premature death or to illness or injury adjusted for degree of disability or severity of the illness or injury. DALYs are usually calculated by applying age weighting (adults in prime age are given a higher weight than children and elderly) and an annual discount rate of 3% (for deaths and illness/injury with a duration over one year).

[36] Other cost-benefit analysis and cost-effectiveness analysis studies of improved stoves and fuel switching include a global/regional study by Mehta and Shahpar (2004), a study from Colombia by Larsen (2005), a study from Peru by Larsen and Strukova (2006), and a study from Uganda by Habermehl (2007). Larsen et al. (in press) provide a review of most of these studies.

[37] Unimproved stoves are low fuel-efficiency stoves whose smoke is uncontrolled and directly emitted into the immediate environment. Improved stoves are those with higher fuel efficiency and provisions to reduce immediate exposure to smoke.

- Scenario 2: Conversion to LPG from unimproved wood stove (the conversion results in the elimination of all health risks from the use of solid fuel)
- Scenario 3: Conversion to LPG from improved wood stove (the conversion results in the elimination of all health risks from the use of solid fuel)

The costs of an improved wood stove and LPG stove are assumed to be $20 and $60, respectively, with a 10-year useful life. Costs are annualized using a discount rate of 10%. LPG costs $1 per kg, as of November 2008 in the Philippines. Program promotion cost is assumed to be $5 per household converting to improved wood stoves or LPG.

BCRs are presented for two ventilation factors, reflecting a range of household air pollution conditions to which households in the Philippines may be exposed.[38] Health benefits are valued using two methods—VSL for mortality and cost-of-illness (COI) for morbidity, and the human capital value (HCV) for mortality and COI for morbidity.[39] Time savings from reduced fuelwood collection associated with improved wood or LPG stoves are valued at 75% of rural wage rates.

The BCRs for replacing unimproved wood stoves with improved ones are greater than 1 (i.e., benefits > costs) for both valuation methods under the whole range of household air pollution exposure conditions (VF: 0.25–1.0). This is the case even when only health benefits are included. When time savings from reduced fuelwood collection are included (due to increased energy efficiency of improved stoves), the BCRs for exposure conditions with VF=0.25 increase significantly.

The BCRs for replacing unimproved wood stoves with LPG stoves are greater than 1 in the highest exposure conditions (VF=1) when mortality is valued using VSL or when time savings or fuelwood purchase savings ($45 per ton) are included as benefits. In low exposure conditions (VF=0.25), BCRs are only greater than 1 when mortality is valued using VSL and time savings are included (scenario 2). BCRs for replacing improved wood stoves with LPG stoves are only greater than 1 in the highest exposure conditions and when mortality is valued using VSL (scenario 3).

Table 3.6. Benefit-Cost Ratios of Converting to Improved Wood Stoves and LPG to Control IAP in the Philippines

	Valuation method			
	VSL & COI		**HCV & COI**	
Ventilation factor (VF)	VF=1	VF=0.25	VF=1	VF=0.25
SCENARIO 1:				
Improved wood stove (health only)	14.5	5.02	3.08	1.00
Improved wood stove (health & time savings)	18.8	9.32	7.38	5.30

[38] VF=1 represents indoor cooking with no or minimal separation between cooking and living areas and no or minimal ventilation; VF=0.25 represents outdoor cooking or cooking indoors in a well-ventilated area separated from the living area.

[39] These valuation methods are the same as applied for estimating the cost of health effects previously in this chapter.

SCENARIO 2:				
LPG from unimproved stove (health only)	2.03	0.70	0.43	0.14
LPG from unimproved stove (health & time savings)	2.63	1.30	1.03	0.74
LPG from unimproved stove (health & wood cost savings)	2.83	1.50	1.23	0.94
SCENARIO 3:				
LPG from improved stove (health only)	1.02	0.35	0.21	0.07
LPG from improved stove (health & time savings)	1.32	0.65	0.52	0.37
LPG from improved stove (health & wood cost savings)	1.42	0.75	0.62	0.47

Source: Larsen 2009.

These results show that the intervention with the highest return in the Philippines per unit of cost will be household conversion of unimproved wood stoves to improved wood stoves. This is primarily due to the fact that the conversion to improved stoves is less expensive than the conversion to LPG, even if the health benefits from switching from unimproved stoves to LPG is higher. This highlights the significance of reducing the cost of switching to the new stove technology as an important consideration in intervention efforts.

Several improved stoves are being promoted in the Philippines. These include the Mayon Turbo Stove (advanced conical rice hull stove) developed by REAP Canada (Samson and Lem, undated), a rice husk gas stove developed by Belonio (Belonio 2005), and a Maligaya rice hull stove developed by Philippine Rice Research Institute (PhilRice 1995). Studies done on these stoves show significant reduction in smoke emitted. There is still, however, insufficient documentation on how much reduction in particulate matter exposure can be associated with the use of these improved stoves. Currently, these stoves are being packaged and promoted as an intervention to reduce greenhouse gas emissions. By converting agricultural wastes like rice hull into fuel, agricultural waste burning is mitigated. In addition, these improved stoves are more fuel-efficient than traditional stoves. However, availability of rice hull can be one limitation. Promotion and adoption of these stoves will only be successful in areas where fuel is readily available. The rice husk gas stove developed by Belonio needs electricity to run, which limits its adoption. Thus there is a need to improve stove designs further and to make them flexible enough to suit local conditions.

Chapter 4: Water Pollution, Sanitation, and Hygiene

This chapter analyzes the health impacts and costs of water pollution and of poor sanitation and hygiene (WSH). In addition to the common concept of direct mortality from diarrheal disease, this chapter estimates indirect mortality caused by diarrhea-induced malnutrition in young children. These indirect costs are shown to be quite significant and are borne primarily by the poor. Finally, the chapter discusses priority interventions to mitigate the damage. Several of these are quite inexpensive and effective.

4.1 Water, Sanitation, and Hygiene Problems

The Department of Health reports that 83% of households have access to improved drinking water supply, while 76% have access to improved toilet facilities (Department of Health 2003a). Improved water supplies are those that are generally accessible to people and for which some measures are taken to protect the water from contamination. Improvements in sanitation facilities involve better access and safer disposal of excreta (Hutton and Haller 2004). Table 4.1 summarizes these groupings in terms of classifications of drinking water supply and sanitation facilities provided in the Philippines Demographic and Health Survey 2003 (the DHS 2003).

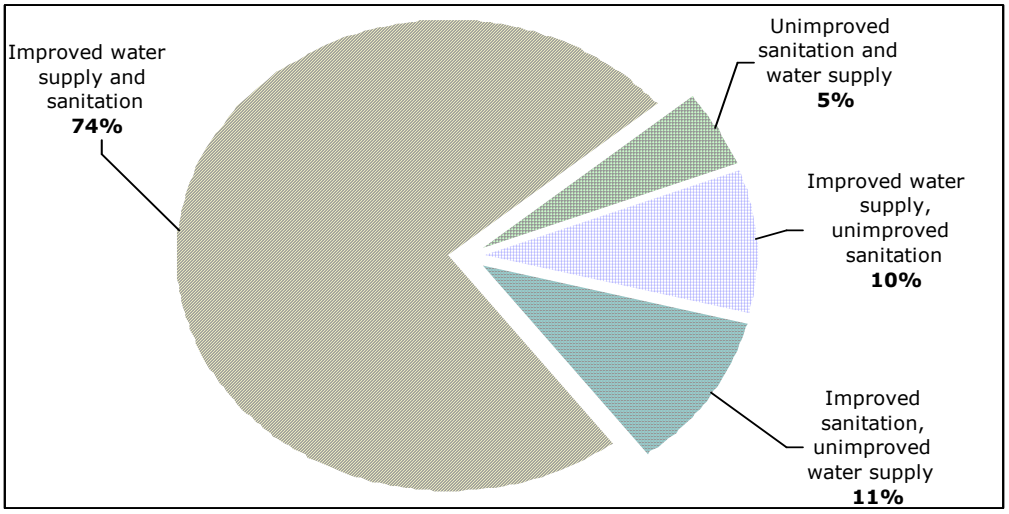
Table 4.1. Responses to the Demographic and Health Survey 2003

Source of Drinking Water		Sanitation Facility	
Improved	**Unimproved**	**Improved**	**Unimproved**
Piped into dwelling Piped into yard/plot Public tap Protected well Developed spring Rainwater	Open dug well Undeveloped spring River, stream, pond, lake, or dam Tanker truck or peddler Bottled water or refilling station	Flush toilet (own) Flush toilet (shared) Closed pit	Open pit Drop/overhang No toilet/field/bush

Note: A toilet shared by more than one household is usually not considered as a household having access to improved facilities. Rainwater may be considered unimproved water supply unless hygienically collected, stored and dispensed.

Figure 4.1 illustrates the distribution of households in the country according to access to improved water supply and sanitation, per the DHS 2003. About 74% of households have both improved drinking water supply and improved sanitation facilities, 21% have either improved water supply or improved sanitation, and 5% rely on unimproved water supply and unimproved sanitation facilities. The most common sources of improved drinking water supply are piped water into dwelling and protected wells. The predominant type of improved sanitation facility is flush toilet, while less than 6% have a closed pit toilet. Nearly 10% have no toilet facility and must rely on open fields or bush. A larger percentage of the population in Metro Manila has better access to both improved water supply and sanitation than the rest of the country.

Figure 4.1. Household Access to Improved Water Supply and Sanitation, 2003



Source: Arcenas 2009, based on the Philippines DHS 2003.

4.2 Economic Costs of WSH-related Morbidity

Seven water pollution, sanitation, and hygiene-related diseases are examined in this chapter: diarrhea, schistosomiasis, typhoid, paratyphoid, cholera, viral hepatitis (hepatitis A), and, in the case of mortality, helminthiasis. These diseases are widely accepted as partly or largely due to contaminated water and poor sanitation and hygiene. Attributable fractions (AFs) of these diseases from WSH are presented in Table 4.2. AF of diarrhea is estimated based on type of drinking water supply and sanitation coverage in the Philippines and the relative risks of disease associated with various types of water supply and sanitation as well as hygiene conditions as presented in Pruss-Ustun et al. (2004) (see Annex A).

Table 4.2. Attributable Fractions for WSH-related Illnesses

Disease	Region Applied	Attributable Fraction (%)	Source
Cholera	National	100	World Bank (2007)
Diarrhea	Metro Manila	86	Arcenas (2009)
	Other urban	86	Arcenas (2009)
	Rural	87	Arcenas (2009)
Schistosomiasis	National	100	Prüss-Üstün et al. (2004)
Typhoid and paratyphoid fever	National	50	World Bank (2007)
Viral hepatitis A	National	50	World Bank (2007)

These attributable fractions, and cases of morbidity reported by the Department of Health, were used to estimate the number of cases of WSH-related diseases in 2003, except for diarrhea.

Estimates of annual cases of diarrhea were estimated from the Philippines DHS 2003 for children under 5 years of age and from World Health Organization (WHO) regional estimates of diarrheal incidence per person for the population older than 5. The calculations show that a total of 33.5 million cases of WSH-related illnesses occurred nationally in 2003. Diarrhea accounted for approximately 99% of all cases, or nearly half a case per person per year (see Table 4.3).

Table 4.3. Estimated Annual Cases of Illness from WSH, by Age, 2003

Age	Diarrhea	Cholera	Viral Hepatitis	Schistosomiasis	Typhoid and Paratyphoid Fever
0-4	19,456,631	477	2,405	1,230	9,480
5 to 14	6,125,743	349	7,649	17,114	20,045
15 to 19	264,366	41	2,216	4,889	6,113
20 to 29	433,304	67	3,631	8,010	10,018
30 to 64	6,567,969	142	6,603	17,788	17,675
65 and older	473,119	70	667	2,653	2,018
Total	33,321,133	1,144	23,172	51,684	65,349

Source: Arcenas 2009.

As with the economic costs of air pollution-related diseases (see Chapters 2 and 3), the economic costs of WSH- related illnesses are household costs for treatment of illness, government subsidies for hospitalization, and the income and time losses due to illness. (See Annex A for further details on the assumptions.)

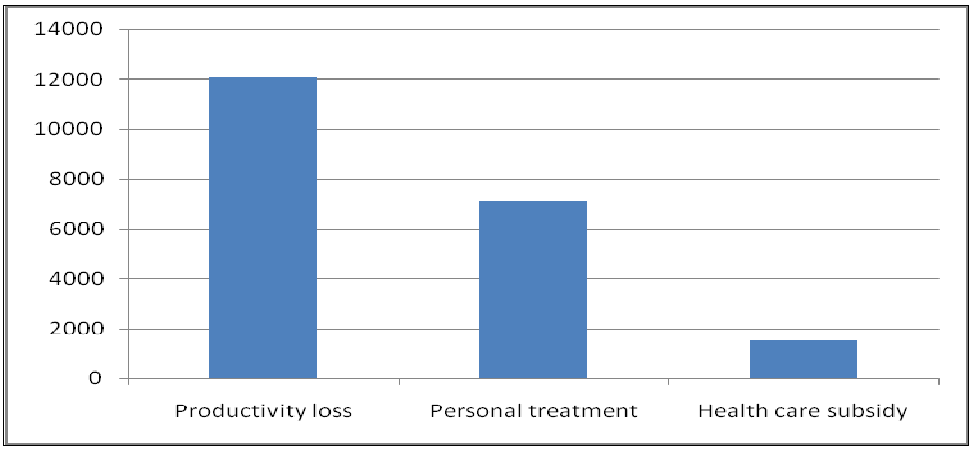
The calculations indicate that WSH-related morbidity costs society a total of almost PhP 21 billion in 2007 prices, or more than $450 million (see Table 4.4). About 58% of this cost is productivity loss (income and time losses from illness), 34% is personal cost of treatment of illness, and 7% is government subsidies of hospitalization costs (see Figure 4.2).

Table 4.4. Annual Cost of Morbidity from WSH (in 2007 prices)

Morbidity Source	Annual Cases from WSH	Average Cost per Case (PhP)	Total Annual Cost (PhP million)
Diarrhea	33,321,133	605	20,172.3
Typhoid and Paratyphoid Fever	65,349	4,511	294.8
Schistosomiasis	51,684	3,092	159.8
Viral Hepatitis	23,172	3,632	84.2
Cholera	1,144	3,842	4.4
Total			20,715

Source: Based on Arcenas 2009 for year 2003, with costs adjusted to 2007 prices.

Figure 4.2. Components of Morbidity Costs (PhP million, 2007 prices)



Source: Re-calculated from Arcenas 2009.

4.3 Economic Cost of Premature Mortality due to Poor WSH

It is estimated that more than 14,000 Filipinos died directly from WSH-related illnesses in 2003, by far the majority of them from diarrhea in children under 5 years old (see Tables 4.5 and 4.6).[40] In addition, frequent diarrhea in young children can contribute to malnutrition. Diarrhea impairs the ability of the body to absorb nutrients, making the child weak and susceptible to other diseases, and increases the risk of mortality from acute respiratory infections, measles, malaria, and other infectious diseases (Fishman et al. 2004, Fewtrell et al. 2007). This impact of diarrhea-induced malnutrition should be included in the burden of disease from WSH and is estimated to be 7,600 deaths in children under 5 years of age (see Annex B and Larsen 2008).[41]

As with air pollution, the economic costs of WSH-related health impacts include the cost of mortality. Valued in 2007 prices, the estimated cost of mortality directly from WSH is a total of PhP 27 billion (almost $600 million) using the human capital approach (HCA). Over PhP 21 billion were from deaths in children under 5. Using the value of statistical life (VSL) approach, the cost of mortality is PhP 70 billion ($1.5 billion), of which over PhP 51 billion were from deaths in children under 5. The malnutrition-related deaths in children under 5 that are associated with diarrheal infections cost the Philippines nearly PhP 16 billion ($340 million) using the HCA approach or PhP 37 billion ($800 million) in terms of VSL. Hence, this indirect impact is over half of the direct cost of mortality.

Table 4.5. Annual Cost of Mortality in Children under 5 from WSH (in 2007 prices)

Mortality Source	**Annual Cases ***	**Average Cost per Case** (PhP thousand)		**Total Annual Cost** (PhP million)	
		HCA	VSL	HCA	VSL
Diarrhea	9,251	2,050	4,867	18,964	45,024
Typhoid and Paratyphoid Fever	1,023	2,050	4,867	2,097	4,978

[40] This is estimated by applying the same attributable fractions as used for morbidity.
[41] Malnutrition in young children also increases the risk of illness, such as acute lower respiratory infection (ALRI) and malaria. The cost of this additional morbidity from WSH is minor compared with mortality and is not included in this chapter.

Helminthiasis	247	2,050	4,867	506	1,201
Viral Hepatitis	25	2,050	4,867	52	124
Cholera	5	2,050	4,867	10	24
Sub-Total	10,550	2,050	4,867	21,628	51,351
Malnutrition-related deaths**	7,616	2,050	4,867	15,613	37,068
Total	18,166	2,050	4,867	37,241	88,419

* No deaths in children under 5 from schistosomiasis and filariasis were recorded/reported in 2003.

** ALRI, malaria, measles, protein energy malnutrition, and other infectious diseases (not including HIV).
Source: Adapted from Arcenas 2009 and its annex by Larsen.

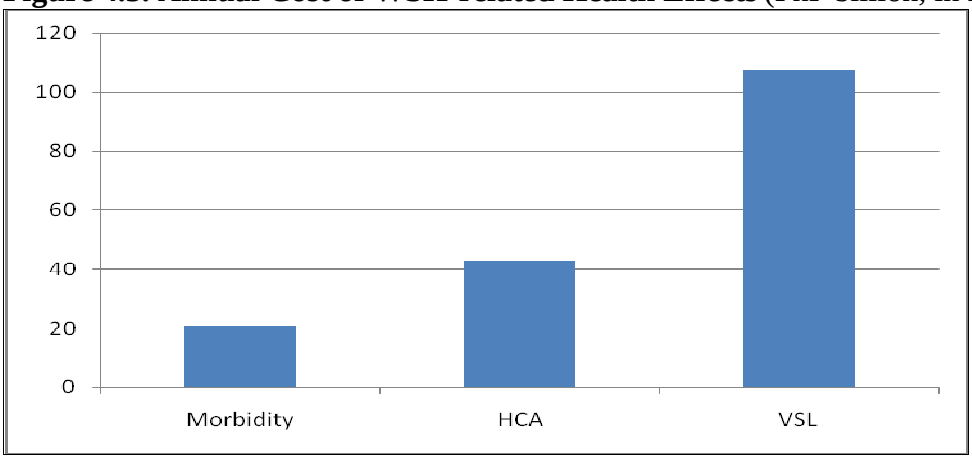
Table 4.6. Annual Cost of Mortality in Population Age 5 or Older from WSH (in 2007 prices)

Mortality Source	**Annual Cases**	**Average Cost per Case** (PhP thousand)		**Total Annual Cost** (PhP million)	
		HCA*	VSL	HCA	VSL
Diarrhea	1,866	1,495	4,867	2,789	9,081
Typhoid and Paratyphoid Fever	1,147	1,572	4,867	1,802	5,581
Viral Hepatitis	418	1,195	4,867	500	2,034
Schistosomiasis	319	911	4,867	291	1,554
Helminthiasis	77	1,504	4,867	115	373
Cholera	22	1,172	4,867	26	107
Filariasis	8	973	4,867	8	38
Total	3,856	1,434	4,867	5,530	18,768

* The average cost of mortality per case using the HCA varies in relation to age of death.
Source: Adapted from Arcenas 2009.

The total estimated annual cost of WSH-related morbidity and direct and indirect mortality is PhP 64–127 billion ($1.35–2.75 billion). These are very significant annual losses, even compared to the cost of outdoor and indoor air pollution, and are disproportionately borne by the poor. For comparison, the gross national product of the Philippines was about PhP 7,249 billion or $157 billion in 2007 according to the Central Bank of the Philippines. Hence the estimated total cost of WSH-related disease and mortality is on the order of 1–2% of national income per annum. The international comparison shows a span of costs related to WSH of 0.1–2.2% of GDP (China and Iran respectively) (PEP 2008). In contrast to the cost of indoor and outdoor air pollution health effects, the cost of WSH-related morbidity is quite significant in comparison to cost of mortality (see Figure 4.3).

Figure 4.3. Annual Cost of WSH-related Health Effects (PhP billion, in 2007 prices)



Source: Calculated from Arcenas 2009.

4.4 Suggested Interventions

The proposed interventions to address water pollution, sanitation, and hygiene issues need not be grand. The empirical literature indicates that interventions promoting washing of hands with soap at critical junctures have significant impacts on the reduction of disease, as does household point-of-use treatment/disinfection of drinking water. In many cases, the most effective intervention is to induce good sanitary practices and hygiene. However, these must be underpinned with the right "hardware" investments in water supply and sanitation.

Access to Water

Access to plentiful water is essential for preventing illness. Curtis et al. (1995), for instance, observed that the likelihood that a mother will wash her hands after cleaning her child after defecation increased by nearly 100% with the provision of a yard tap. Likewise, the likelihood that linen soiled with feces will be washed right away also increased by more than 100% (Cairncross and Valdmanis, 2006).

Studies show that access to piped water has the greatest impact on health when it comes to water supply provision. A study by Bukenya and Nwokolo (1991) showed a 56% reduction in diarrhea in Papua New Guinea when a household tap was used rather than public standposts (Cairncross and Valdmanis 2006).

Water consumption increases with the availability of piped connections. An Asian Development Bank study notes that in Metro Manila, people who have piped water connections tend to consume more than those relying on non-piped connections (ADB 2007). It follows that in order to make hygiene promotion more effective, people need to have access to plentiful water. Educating people to wash their hands is less effective when water for such activities is unavailable or insufficient.

In many cases, water may be available but the quality is poor, necessitating further treatment. Sobsey (2007) lists the most promising household water treatment systems available. These include "boiling, solar disinfection by the combined action of heat and UV radiation, solar disinfection by heat alone (solar cooking), UV disinfection with lamps, chlorination plus storage in an appropriate vessel and combined systems of chemical coagulation-filtration and chlorine disinfection."

Clasen et al. (2007a) report, from a meta-analysis of empirical studies, that household point-of-use treatment/disinfection of drinking water reduces diarrheal disease by 30-40% in children under 5, and by 35–50% in all age groups. Arnold and Colford (2007) found in their meta-analysis that household point-of-use chlorination treatment reduces diarrheal disease by about 30%, and Fewtrell et al. (2005) report that household treatment/disinfection in rural areas reduces diarrhea by nearly 40%.

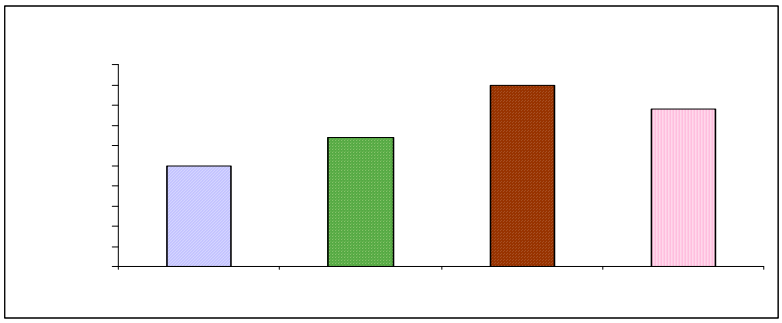
Sanitation and Hygiene

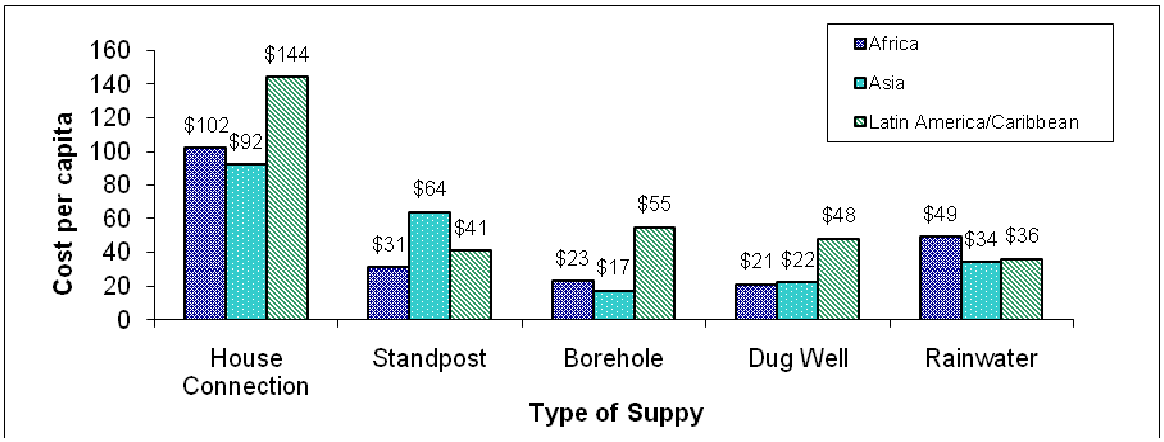
Improved sanitation and hygiene practices are essential for health protection. Fewtrell et al. (2005) report from findings in their meta-analysis that improved toilet facilities reduces diarrheal disease by over 30%. Moraes et al. (2003), in a study from Brazil, report that the likelihood of frequent diarrhea is over 80% lower in children in communities with improved drainage and sewage systems, after controlling for potential confounders. And Curtis and Cairncross (2003) found in a meta-analysis that hand washing with soap reduced diarrhea by over 45%.

Hand washing with soap can also prevent acute respiratory infections like pneumonia. Luby et al. (2005) studied the effect of hand washing with soap on children's health using 600 hand-washing promotion households and 300 control households in Karachi, Pakistan. Major findings included a 50% reduction in pneumonia cases in children younger than 5, 53% lower diarrhea cases in children younger than 15, and 34% lower impetigo incidence in households who received soap and hand washing promotion.

In summary, Fewtrell et al. (2005) present the health benefits of different water and sanitation interventions in developing countries. Figure 4.4 shows the percent reduction in diarrheal morbidity from improved water supply, improved sanitation (that includes excreta disposal facilities like latrines), improved hygiene (hand washing), and household point-of-use drinking water treatment (rural areas). The benefits are clear, with hand washing and household drinking water treatment being the most effective interventions in reducing diarrhea, followed by improved sanitation facilities and improved drinking water supply.

Figure 4.4. Percent Reduction in Diarrhea from Water and Sanitation Interventions

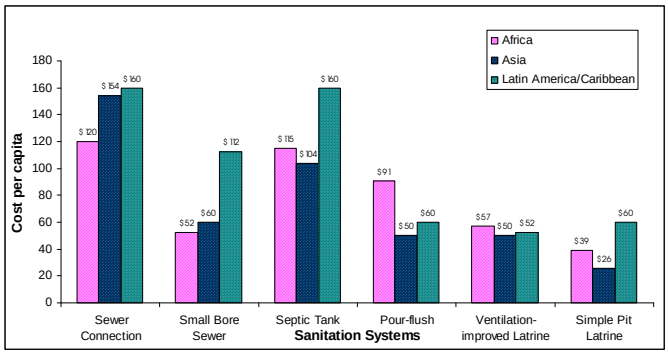




Source: Jamison et al. 2006.

Figure 4.6 shows the average per capita cost of constructing sanitation facilities in Africa, Asia, and Latin America. In Asia, simple pit latrines are the cheapest option ($26 per capita), followed by ventilated improved pit latrines and pour-flush toilets. In terms of disposal, small bore sewer is cheapest, followed by septic tanks, while sewer connection is the most expensive ($154 per connection per capita) (Cairncross and Valdmanis 2006).

Figure 4.6. Median Per Capita Construction Cost of Sanitation in Selected Regions
(in US dollars)



Source: Jamison et al. 2006.

In contrast, improved hygiene (such as hand washing with soap) and household drinking water treatment/disinfection can be promoted at a cost of a few dollars per household. However, recurrent costs of hand washing and water disinfection (e.g., soap consumption and fuel for boiling of water) tend to be higher than recurrent costs of many water supply and improved sanitation options (other than piped municipal water and sewage).

A CBA was undertaken for the Philippines of the two interventions that international evidence indicates provide the largest reduction in diarrheal disease, namely hand washing with soap and household point-of-use drinking water treatment. Benefits and costs are evaluated for hand washing promotion to mothers and caretakers of children under 5 years of age and to other household members separately. Hand washing by mothers and caretakers of young children involves hand washing with soap at critical times such as after going to the toilet, after cleaning a child, and before preparing meals or feeding a child. For water treatment, benefits and costs of

boiling of drinking water are evaluated, and, as for hand washing, evaluations are undertaken for children under 5 and older household members separately.[44]

In line with international evidence, reduction in diarrheal morbidity and mortality is assumed to be 45% from improved hand washing, and 25 and 35% from household drinking water treatment in urban and rural areas respectively. Thus, benefits of the two interventions are corresponding reductions in the cost of health effects previously presented in this chapter.[45] The private cost of hand washing is estimated at $5.35 per person per year (soap and water). The private cost of drinking water treatment using liquefied petroleum gas (LPG) for boiling the water is estimated at $3.10 per person per year for children under 5 years (0.5 liter per person per day) and at $6.20 per person per year for the population over 5 (1 liter of water per person per day). Boiling drinking water using fuelwood is estimated to cost $1.75 and $3.50 per person per year for, respectively, children under 5 and the population over 5.

Benefit-cost ratios (BCRs) are presented in Table 4.7 for two promotion program interventions. The programs are assumed to each cost $1.20 per household, one in which 15% of households are assumed to improve their hand washing practices for two years (i.e., mothers improve their hand washing for protection of the health of children under 5) and one in which 15% of households start treating their drinking water for two years (i.e., drinking water for children under 5).[46]

The following can be observed: BCRs are all greater than 1 and are higher in rural than in urban areas because of larger health benefits there.[47] In the case of drinking water treatment, BCRs are higher for fuelwood than LPG (rural areas) because of fuel cost differentials.[48] It can also be observed that the BCRs for urban areas are larger for hand washing than for drinking water treatment, while they are quite similar in rural areas. This is influenced by the assumed lower percentage reduction in diarrheal illness from water treatment in urban compared with rural areas.

BCRs for the population over 5 years of age are estimated to be less 1 for both interventions. The reason for the low BCRs for this population group is the much lower incidence of diarrheal disease and mortality in the population over 5 than in younger children.

Table 4.7. Benefit-Cost Ratios for Children under 5 Years of Age

[44] Alternative treatment or disinfection methods could be evaluated, such as household chlorination, filtering, solar disinfection, and flocculation disinfection (see Clasen and Haller 2008). Boiling of drinking water is, however, a common treatment method for households in many developing countries and is therefore evaluated here.

[45] Potential benefits in terms of improved child nutritional status from reduced incidence of diarrheal infections from WSH and reduced respiratory infections from improved hand washing are not presented here.

[46] Note that a 15% response rate implies that the program cost per household that responds to the program is $8.

[47] This is from higher baseline child mortality in rural areas and, in the case of water treatment, a higher percentage reduction in diarrheal illness in rural areas.

[48] It should be noted that the use of fuelwood has air pollution health effects that are not reflected in the estimated BCRs.

Improvement	Benefit Valuation Method	
	VSL & COI	HCV & COI
Improved hand washing (urban areas)	5.2	3.0
Improved hand washing (rural areas)	8.0	4.2
Drinking water treatment (urban, boiling using LPG)	3.8	2.2
Drinking water treatment (rural, boiling using LPG)	8.1	4.3
Drinking water treatment (rural, boiling using wood)	9.9	5.2

Note: VSL is value of statistical life and HCV is human capital value, used for valuation of mortality. COI is cost-of-illness, used for valuation of morbidity.
Source: Larsen 2009.

A CBA for the Philippines was also undertaken for improved water supply and toilet facilities to rural households, as lack of improved water and sanitation is more prevalent in rural than in urban areas (the DHS 2003). The capital cost of the interventions are as reported in the *Global Water Supply and Sanitation Assessment 2000 Report* by WHO/UNICEF for the Asia region and adjusted from year 2000 to 2007 by an annual inflation rate of 6% ($30 per capita for borehole/protected well; $40 per capita for improved pit toilet; and $70 per capita for pour-flush toilet). A high-cost scenario for borehole/protected well (i.e., $50 per capita) is also evaluated to provide a range of costs that may reflect various conditions in rural Philippines. Annual maintenance cost is assumed to be 3% of initial capital cost. Useful life of intervention is 20 years for borehole/protected well and pour-flush toilet and 15 years for improved pit toilet.

Health benefits are a 25% reduction in diarrheal illness and mortality from borehole/ protected well and a 32% reduction from improved toilet facilities (Fewtrell et al. 2005).[49] In addition to health benefits, households are also likely to benefit from reduced access time to facilities. In rural Philippines, 20% of households have are more than 15 minutes from their drinking water source. Thus it is assumed that household time savings are 30 minutes per day (two collection trips per day). For improved toilet facilities it is assumed that time savings are five minutes per person per day, as the majority of rural households without improved sanitation rely on open defecation (field/bush) according to the DHS 2003. Time savings are valued at 30–75% of a rural wage rate of 50¢ per hour. Capital costs are annualized with a discount rate of 5–10%.

Benefit-cost ratios are presented in Table 4.8 for the three rural interventions and for two assumptions of discount rate and valuation of time savings from reduced access time to facilities. BCRs for rural household boreholes/protected wells are all greater than 1, but are sensitive to annual discount rate and valuation of time savings from reduced access time to facilities. Although not presented in the table, estimated health benefits alone (excluding time savings benefits) are greater than intervention costs in all cases when health benefits are valued using VSL for mortality. When using HCV for mortality, health benefits are only greater than intervention costs in the low capital cost scenario with a discount rate of 5%.

BCRs for rural household improved sanitation are all greater than 1 except for pour-flush toilets with a 10% discount rate, low valuation of time benefits, and mortality benefits valued using the

[49] Potential benefits in terms of improved child nutritional status from reduced incidence of diarrheal infections are not presented here.

HCV. The BCR for pour-flush toilets is however greater than 1 if a discount rate of 5% is applied or if valuation of time benefits is increased to 45% of the rural wage rate. Although not presented in the table, estimated health benefits (excluding time savings benefits) are greater than intervention cost when health benefits are valued using VSL for mortality, except in the case of pour-flush toilets when a 10% discount rate is applied. When using HCV for mortality, health benefits are only greater than intervention cost for closed/improved pit toilet with a discount rate of 5%.

Table 4.8. Benefit-Cost Ratios for Rural Household Improved Water Supply and Sanitation

Improvement	Benefit Valuation Method	
	VSL & COI	HCV & COI
Improved water supply (borehole/protected well)		
Capital cost is $30 per capita		
Discount rate: 5%; valuation of time savings: 75% of wage rate	6.6	5.4
Discount rate: 10%; valuation of time savings: 30% of wage rate	3.0	2.2
Capital cost is $50 per capita		
Discount rate: 5%; valuation of time savings: 75% of wage rate	3.9	3.3
Discount rate: 10%; valuation of time savings: 30% of wage rate	1.8	1.3
Closed/improved pit toilet		
Discount rate: 5%; valuation of time savings: 75% of wage rate	4.3	3.4
Discount rate: 10%; valuation of time savings: 30% of wage rate	2.0	1.4
Pour-flush toilet		
Discount rate: 5%; valuation of time savings: 75% of wage rate	2.6	2.0
Discount rate: 10%; valuation of time savings: 30% of wage rate	1.1	0.8

Note: VSL is value of statistical life and HCV is human capital value, used for valuation of mortality. COI is cost-of-illness, used for valuation of morbidity.
Source: Larsen 2009.

In summary, the BCRs for hand washing and drinking water disinfection promotion programs targeted at mothers and caretakers of young children in rural areas are higher than the BCRs for rural household improved water supply and toilet facilities. BCRs for similar programs for mothers and caretakers of young children in urban areas are also as high or higher than for improved water supply and toilet facilities in rural areas, especially if households value their access time to facilities at less than 75% of their wage rate.

The CBA of improved sanitation presented here does not include wastewater/excreta disposal. Septic tanks, sewers, and sewer connections fall under this category as well. In the rural areas in the Philippines, and in most of the poor households, sewerage facilities are severely lacking, significantly increasing the risk of the spread of diseases. Without proper disposal of wastes, contamination of food and water are likely to take place, as well as direct human contact. Public investment in alternative waste disposal facilities that the poor—both urban and rural—can have regular and inexpensive access to should therefore also be considered.

Chapter 5: Coastal and Marine Resources

Coastal and marine resources (CMR) are very important—both ecologically and economically—to the Philippines. A rich and interlinked set of ecosystems, CMR include coastal lands (home to the majority of the population), mangrove forests, seagrass beds, coral reefs, and the fisheries/fish stocks—both coastal and pelagic—that depend on them. These resources are an important part of the Philippine economy, generating net economic benefits of more than PhP 24 billion per year both directly through the production of various marketed goods and services as well as indirectly through the flow of ecosystem services. Coastal and marine-based tourism is a small but potentially growing part of the economy. The annual cost from degradation and mismanagement of CMR is estimated at PhP 5.7 billion. If these costs could be avoided, the net contribution of CMR to the Philippines would be even larger. If environmental costs that are avoided are considered as one measure of the benefit of avoiding those damages, then the total net value of the Philippine's CMR would be about PhP 30 billion per year, or about PhP 340 per person annually.

5.1 The Resource Base

The CMR of the Philippines include fish stocks, coral reefs, seagrass/algal beds, mangroves, and other coastal areas. Although these are largely biological resources and ecosystems, they are also important economic assets and sources of value. These include those goods and services that are bought and sold in the market (such as fish or commercial recreational uses) as well as ecosystem services that are known to be important but that are not normally priced in the market, such as storm-surge protection for coastal areas, water filtration and pollution reduction of freshwater flows, and recreational and other nonconsumptive uses (including both domestic and international tourism) of the coastal and marine environment. The totality of direct uses and indirect uses, as well as various values that economists call "non-use" values, comprise the total economic value of the CMR.

Sound management of these resources therefore requires understanding the various goods and services produced by the different parts of the CMR system and then quantifying those goods and services in monetary terms (to the extent possible). This two-step process allows analysts to understand both present levels of economic value produced by CMR and the economic importance of threats to the CMR system. It is then possible to analyze different management alternatives and policy options and consider the benefits and costs of each alternative. (See Padilla 2008 for further details.)

Table 5.1, following the typology of the Millennium Ecosystem Assessment, lists the main ecosystems/ resource systems included in CMR (MA 2001). It divides the goods and services produced into four main categories: *provisioning* (usually marketed goods and services), *cultural* (including education services as well as recreation), *regulating* (often indirect uses and ecosystem services), and *supporting* (often indirect marketed uses). Provisioning and supporting uses are both very important and can usually be valued via the market: fisheries, aquaculture, and timber (from mangrove forests) are all major economic activities in the Philippines. Other uses

produce economic values more indirectly but can often be measured using markets, such as recreational or tourism uses. Regulating services and benefits can be either of local or national importance (such as waste assimilation and coastal protection) or global importance (carbon sequestration, for example). Finally, there are non-use values like existence values that are important but often hard to measure.

Table 5.1. Categories of Ecosystem Services and Benefits

Ecosystem/ Resources	Provisioning	Cultural	Regulating	Supporting
Mangroves	• fisheries • forest products (e.g., timber, fuelwood)	• ecotourism • education and research	• carbon sequestration • coastal protection • waste assimilation	
Seagrass	• fisheries	• education and research	• coastal protection • waste assimilation	
Coral reefs	• fisheries	• ecotourism • education and research • existence value	• coastal protection	
Coastal	• fisheries	• ecotourism • education and research • existence value of certain species	• waste assimilation	• mariculture, excluding brackish water aquaculture
Oceanic	• fisheries	• education and research	• waste assimilation	

Source: MA 2001.

The distribution of coastal and marine ecosystems in the Philippines is seen in Table 5.2: with a coastline of about 36,289 kilometers, the total territorial waters of the Philippines included within the exclusive economic zone (EEZ) are over 2,200,000 square kilometers. Of this amount, coastal waters cover about 266,000 square kilometers, of which coral reefs account for 27,000 square kilometers and mangroves another 1,397 square kilometers. The coastal and marine areas are highly productive and also under threat from both overuse and pollution. The importance of coastal and marine areas is reflected in the economic values estimated for each part of the CMR system, as well as the costs to the system from resource degradation and pollution.

Table 5.2. Philippine Coastal and Marine Ecosystems

Ecosystem	Area (sq. km.)
Total territorial water area (including EEZ)	2,200,200
Coastal	266,000
Shelf area (up to 200 m depth)	184,600
Coral reef (within 10-20 fathoms)	27,000
Mangroves	1,397
Seagrass / algal beds	978
Other coastal	52,025

Oceanic	1,934,000
	(km)
Coastline (length)	36,289

Sources: Philippine Fisheries Statistics 2006; Fortes 1995 for seagrass area.

CMR can be divided into the following broad categories of either resource systems or ecosystems:

- **Fish stocks.** The Philippines has a very diverse fishery resource located within its EEZ: of some 2,800 species of finfish found in the Philippines, the majority (about 1,730 species) are reef-associated—dependent on coral reefs for all or part of their health. The fishing industry is divided between the municipal and commercial sectors. The municipal fishery is small scale, and often fishes coastal waters (it is often referred to as an artisanal fishery). Municipal fisheries are usually composed of many fishers, using simple technology, and producing low yields per unit effort. Most municipal fishers are poor. Commercial fisheries, on the other hand, usually use larger boats and more sophisticated gear. They may fish further offshore, catch different species (including both pelagic and demersal species), and have the potential to earn greater returns. Some commercial fisheries are overcapitalized, however (too many boats and too much equipment chasing too few fish), resulting in low economic returns. Both municipal and commercial fisheries are important to the economy of the Philippines, even if the management issues (and species caught) are often quite different between the two.

- **Coral reefs**. The Philippines are exceptionally rich in coral reefs, with more than 480 of the 700 stony coral species documented globally (Carpenter and Springer 2005). The combination of great coral diversity and warm waters results in a very rich marine ecosystem that includes corals, shells, and fish of all types. Besides the inherent values of coral reef biodiversity, the reefs are also important economic assets. These values come from the fish that are dependent on healthy coral reefs, the recreational values associated with coral reefs, and the coastal protection provided by coral reefs. The Philippine territorial waters include some 27,000 square kilometers of coral reefs (measured to a depth of about 40 meters).

- **Seagrass/algal beds**. Seagrass beds are areas of salt-tolerant plants that occur in shallow near-shore waters, estuaries, lagoons, and areas adjacent to coral reefs. Seagrasses are not true grass but are flowering plants that need sunshine and thus thrive in shallower parts of the coast. Of the 58 species counted globally, 27 species are found in Asia and 19 are found in the Philippines. They provide an array of environmental services; seagrass beds hold sediment in place and stabilize coasts, filter sewage, produce nutrient flows that are part of the broader food chain, and provide food and habitat for many important near-shore fish species. The Philippines has approximately 1,000 square kilometers of seagrass beds (Fortes 1995).

- **Mangrove forests**. Mangroves are forests that grow at the meeting of salt and fresh water and include various species of trees, shrubs, vines, and herbs found on coasts, swamps, or the borders of swamps. The Philippines has one of the richest mangrove ecosystems in the world, which are home to over 128 fish species (Chong et al. 1990). Although there

has been large-scale loss of mangroves areas in the past few decades (especially due to development of aquaculture), mangrove areas may be expanding due to rehabilitation and replanting. Mangrove forests also serve an important storm-surge function and hence are closely linked to various dimensions of climate change and sea level rise. At present, mangrove cover in the Philippines is estimated at about 1,400 square kilometers.

- **Other coastal uses**. These areas are listed at 52,000 square kilometers and are primarily coastal lands as well as aquaculture development and other coastal wetlands.

The pertinent laws governing CMR are the following (Vera et al. 2007):

- Executive Order 533 (2006)—Adopting Integrated Coastal Management as the national strategy and policy framework for sustainable development of the coastal and marine resources, pooling together various agencies and civil society.

- Republic Act 8550 (1998)—Providing for the development, management, and conservation of fisheries and aquatic resources, otherwise known as the Fisheries Code. The Code creates the establishment of Fisheries and Aquatic Resource Management Councils that allow fisherfolk to participate in fisheries policy-making and the establishment of the fish refuges and sanctuaries known as marine protected areas (MPAs).

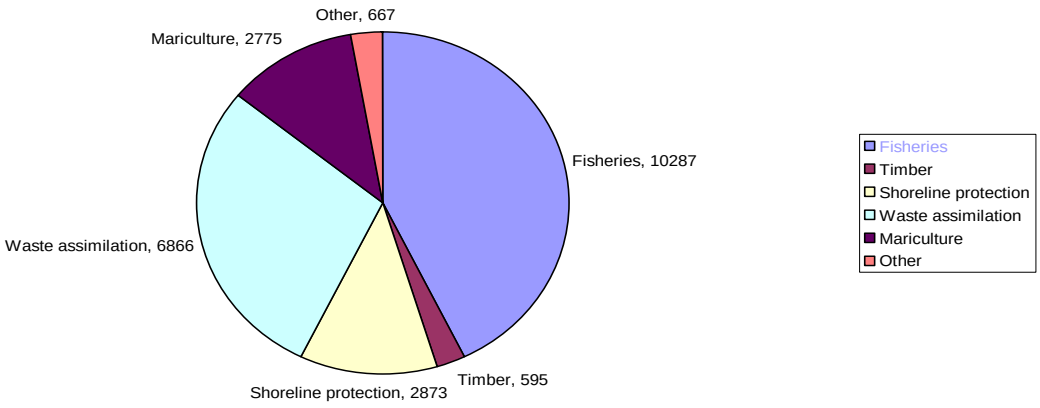
5.2 Economic Values of CMR in the Philippines

Healthy coastal and marine resource ecosystems produce important economic benefits. These can be measured directly from the production of goods and services that are sold in the market place (such as fish or mangrove timber products) or through important ecosystem services that are provided by nature but are not usually bought or sold (such as silt retention by seagrasses, waste assimilation by mangroves, shoreline protection by coral reefs; see Burke et al. 2002). Other important economic benefits come from recreational uses of CMR—snorkeling or scuba diving are two examples that also show potential for growth in the future, especially if ecosystem health is maintained. Finally there are important economic values that do not involve any direct or indirect use: these non-use values include “bequest values” (what it is worth to an individual to leave a healthy resource for the next generation) and “existence values” (a benefit from just knowing that something exists and is there).

Recent estimates (Padilla 2008) of the net economic values of different CMR in the Philippines total over PhP 24 billion a year—the equivalent of almost $480 million (or almost $5.50 for every man, woman, and child in the Philippines). As seen in Figure 5.1, coastal and pelagic fisheries account for almost half (some PhP 10.3 billion per year) of the net economic benefits of CMR. Timber benefits (largely from mangrove products) are much smaller: about PhP 600 million per year. The economic value of ecosystem services is also large (even if they are more difficult to measure in economic terms). The economic values associated with waste assimilation (about PhP 6.9 billion per year, based on data from Orbeta 1994 and Morales et al. 1997) and shoreline protection (about PhP 2.9 billion) are almost equal to the value of fisheries. Smaller amounts of economic benefits are provided by recreation, education and research, carbon sequestration, and various non-use values. The estimates in Figure 5.1 are based on the best

information available at present and represent net economic benefits in the strict technical sense: the economic benefits are adjusted to remove the costs of production.

Figure 5.1. Net Benefits from Coastal and Marine Resources (million PhP)



Source: Adapted from Padilla 2008.

This concept of "economic benefit" can be a bit confusing. The ultimate goal of the estimates presented here is to measure the real change in the "welfare" of the Philippines for each major good or service provided by CMR. For natural resources, economists call this amount the "economic rent" generated by the resource. In the fishery sector, for example, a net economic measure is used that deducts the costs associated with fishing from the gross revenues derived from the sale of fish (based on the assumption that if there were no fish to catch, there would be no expenditures on boats, gear, and labor). Since productivity in the fishery sector is low, the "economic rent" associated with fishing is also small. Most of the pesos earned by fishers go right back into paying salaries, buying fuel and equipment, or paying the costs of boats and fishing gear. The "economic rent" generated by fishing may be as low as 10% of the gross value of the catch. Note that this analysis does not consider alternative employment for fishers. This is an important policy issue that needs to be discussed elsewhere. The focus here is on the economic rents generated by each component of the CMR.

Estimating economic values of regulating services is handled differently from provisioning and supporting sectors. Here the estimates are of what it would cost to provide these benefits (shoreline protection or waste assimilation, for example) if the healthy CMR ecosystem did not do so. In this case the gross and net estimates are the same. Consider shoreline protection. If the coral reefs and mangroves did not provide shoreline protection, then money would need to be spent on infrastructure to replace this function or there would be damage to shore-based

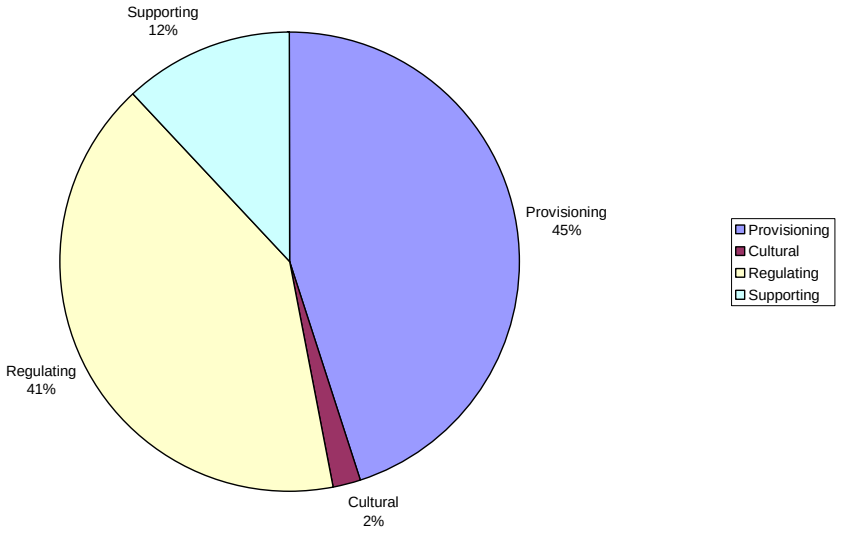
resources. Hence one measure of the economic value of the shoreline protection services is equal to these "avoided costs."

Estimating non-use values (usually considered to include both existence and bequest values) is another problem area. There are no proper country-wide studies for the Philippines estimating these values, and the specific studies that have been done are very location- and resource-specific (estimates of the economic values associated with whale sharks [Indab 2007], for instance, or marine turtles [Indab, in progress] or Tubataha reef [Subade 2005]). The results from these individual studies are reported in Padilla (2008) and often show willingness-to-pay amounts in the range of a few dollars per household per year. However, because of a number of technical issues (the sample surveys asked the "wrong question" to the "wrong population") it is not proper to scale up these results to the entire population of the Philippines.[50] Non-use values are certainly not zero, but it is unclear how large they actually are. Figure 5.1 lists a conservative yearly estimate for existence values of PhP 218 million, but this should be considered as a "place-holding" figure rather than a complete estimate.

The percentage share of each of the four main types of ecosystem functions/ services is seen in Figure 5.2. Particularly striking is the large share of total net economic benefits of Philippine CMR generated by regulating services such as waste assimilation and shoreline protection. Note that these benefits are normally only "valued" by society when they are lost—and are rarely acknowledged when they are being provided by healthy ecosystems. Note also the small share of the total value provided by cultural services (recreation, education/research, and various non-use values). This may well be an underestimate, but it is based on the best information available at present. Padilla (2008) discusses the estimates of these values and the assumptions and studies underlying these estimates. (See the Annex B for further details on these estimates.)

Figure 5.2. Percentage Distribution of CMR Net Benefits by Type of Service, 2006

[50] The "correct question" would have used a national sample survey to respond to a general question about willingness-to-pay for conservation in general, and how that total amount would be divided among different species or resources. The results of such a survey could then carefully be scaled up to a national result.



Source: Adapted from Padilla 2008.

When these economic valuation results are examined on a per hectare basis, an interesting story emerges (see Table 5.3). Mangroves, for example, although relatively small in size, generated net economic benefits per ha of PhP 8,859 per hectare per year—the largest of any single coastal or marine resource on a per hectare basis. This somewhat surprising result reflects the large economic values associated with coastal protection, waste assimilation, and the role of mangroves in sustaining a healthy fishery. Mangroves, an often overlooked resource considered as having little or no value, are actually a very important economic asset. (As mentioned earlier, mangroves will be increasingly important if climate change leads to rising sea levels; healthy mangroves provide important economic benefits too in land areas by controlling damages from storm surges.) Coral reefs were second on a per unit basis (PhP 1,487 per hectare per year), reflecting the important contribution of healthy coral reefs to fisheries, recreation, and shoreline protection.

Table 5.3. Net Benefits from CMR per Unit Area, 2006

Ecosystem	Provisioning	Cultural	Regulating	Supporting	Total
	(PhP per hectare)				
Coastal	289	19	372	104	785
Mangrove	3,531	163	5,165	–	8,859
Seagrass	579	85	257	–	921
Coral reef	369	113	1,005	–	1,487
Other coastal	250	6	258	118	632
Oceanic	16	0	–		16
All ecosystems	49	2	45	13	109

Source: Adapted from Padilla 2008.

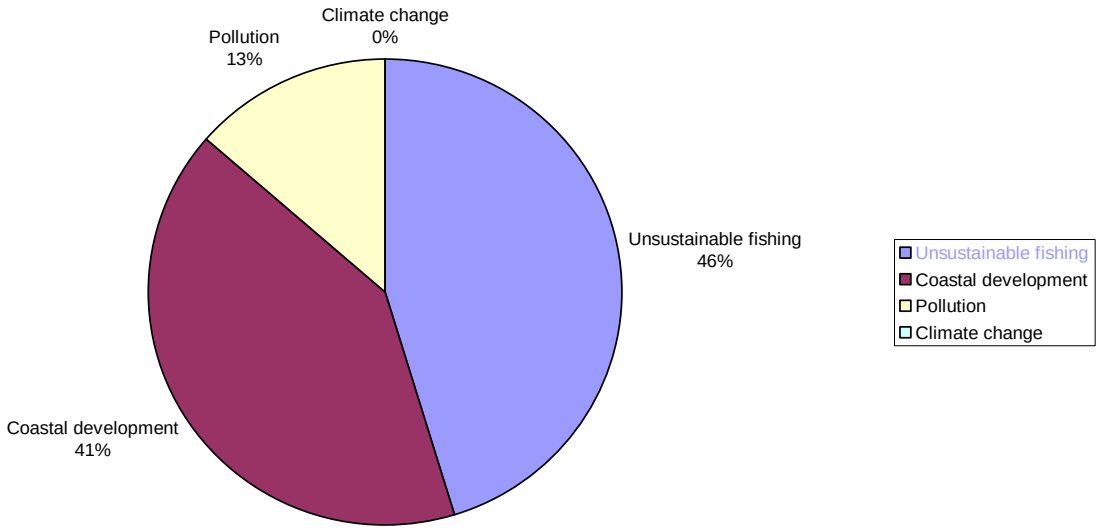
Almost all the economic benefits from CMR in the Philippines stay within the country (only 6% of total net economic benefits are considered global). The location of these benefits can be further divided between those found in local areas (about 65% of total benefits accrue locally) and those that are truly national benefits (about 29%). Thus although CMR are national assets, their management and the majority of their economic benefits are local concerns.

5.3 Costs of Environmental Degradation of CMR

The environmental degradation of coastal and marine resources costs the Philippines about PhP 5.7 billion a year, or about one-quarter of the estimated net economic benefits (see Padilla 2008 for the details). Figure 5.3 presents a summary of the environmental costs associated with the CMR of the Philippines in 2006. (See Annex B for further details on the data.) The broad distribution of environmental costs is instructive—almost half is due to unsustainable fishing, largely from overfishing (for example, driving down economic rents from fishing), with a much smaller share attributable to habitat degradation and conversion (pollution and the conversion of mangroves). The major issues that need to be addressed in the CMR sector are:

- Serious resource depletion problems, particularly fishery resources
- Decrease in catch per unit of fishing effort, particularly by subsistence fishers
- Loss of or damage to productive coastal ecosystems (e.g., mangroves, seagrass beds, and coral reefs)
- Cases of local extinction of economically important marine species
- Conflict among uses/users of coastal resources
- Poverty and other social problems of coastal communities
- Sectoral/fragmented approach to coastal resources management
- Lack of capacity among local government to manage coastal resources.

Figure 5.3. Cost of Environmental Degradation (%)



Source: Adapted from Padilla 2008.

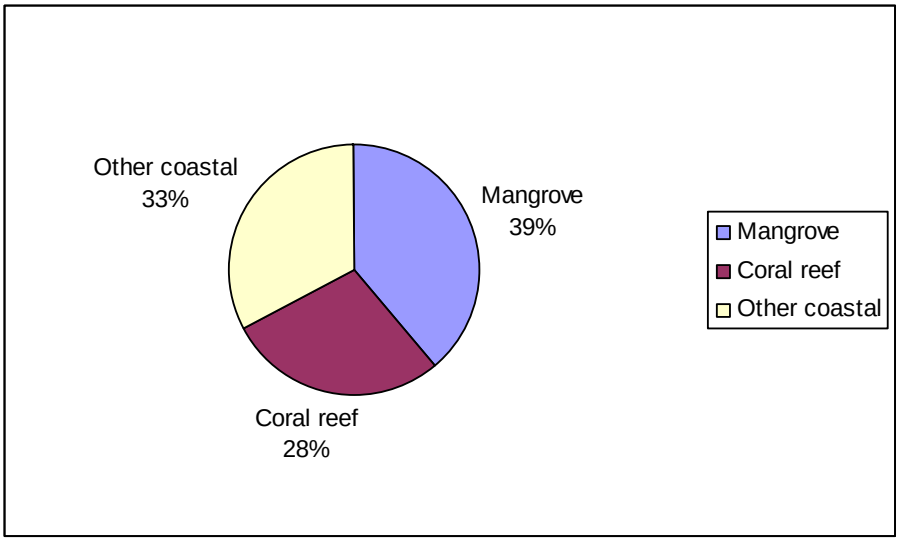
Thus the major economic cost of resource degradation in the fishery sector (almost 94% of the total environmental cost due to unsustainable fishing) comes from the actions of the direct users of the resource (fishers) as opposed to broader ecosystem management problems. Any solution, therefore, will require a social approach to managing fishers and their efforts rather than managing indirect ecosystem impacts on the fishery. This makes the problem of fishery management more difficult, especially since many fishers are poor and located in remote areas, both factors making normal controls and regulations difficult to implement.

Coastal development—largely the conversion of mangroves and other lands to fishponds as well as other land reclamation—is almost equally important as an environmental cost: about PhP 2.3 billion a year, most of which is due to the conversion of coastal areas to fishponds (PhP 1.9 billion). Although there may be some "double counting" here with the fishery estimates presented earlier, the environmental costs of lost mangroves are very large. Pollution impacts, largely on human health and ecosystem impacts from oil spills, are considerably smaller in scale—some PhP 760 million per year.

Figure 5.4 shows the distribution of the different environmental costs across ecosystems. The total environmental costs are distributed roughly equally between mangroves, coral reefs, and

other coastal areas. Because mangroves are smaller in overall size, the cost of environmental damage per hectare is highest for this ecosystem (PhP 9,743 per hectare), compared with coral reefs (PhP 595 per hectare) or other coastal areas (PhP 68 per hectare).

Figure 5.4. Share of Environmental Costs Across Ecosystems



5.4 Conclusions on Costs and Benefits

Total net economic benefits generated by the coastal and marine resources of the Philippines amounted to over PhP 24 billion in 2006. The distribution of this total among provisioning, cultural, regulating, and supporting services vary from about 2% (cultural) to over 45% (provisioning). Looking at specific goods and services, the net benefits from capture fisheries (including both coastal and pelagic fisheries) and mariculture combined for almost 58% of the total, followed by waste assimilation services (28%) and shoreline protection (12%). Recreation values are minimal at present but could increase sharply in the future due to both growth in demand (marine recreation has a large positive income elasticity of demand) and increasing scarcity of pristine coral reefs in other parts of the world. Recreational uses are one area in which sound environmental management reinforces sustainable economic benefits. Across ecosystems types, the most productive is the "other coastal" category, with 62% of the total at about PhP 15 billion in 2006. This is followed by coral reefs, oceanic areas (open seas), mangroves, and seagrass beds. The living coastal ecosystems—mangroves, seagrass beds, and coral reefs—contribute about a quarter of the total.

Looking across ecosystems, the highest value per ha is for mangroves, with coral reefs a distant second (but a resource that should increase in relative value over time, especially if demand for recreational uses continues to grow as expected). Provisioning services are highest for seagrass beds while regulating services dominate in mangroves, coral reefs, and other coastal ecosystems. For all ecosystems, however, the share of provisioning services exceeds that for regulating services by a small margin. These results show which type of service will be delivered by specific conservation management activities.

Analysis of the distribution of benefits from CMR shows that at least 64% of the benefits from all coastal ecosystems (mangroves, seagrass beds, coral reefs and other coastal) accrue locally; most of the rest are considered national benefits. Global benefits are small and largely come from carbon sequestration by mangrove forests. (The absence of effective global carbon markets and the current fairly low price per ton of carbon stored mean that carbon sequestration is an interesting potential future value but not a current major source of monetary benefits to the Philippines.) The results show that the impetus for coastal and marine conservation should primarily be for the local (coastal) population and secondarily for the country as a whole.

Analysis of the costs of depletion and degradation of CMR provides an indicator of the extent of the damages to CMR. Total damages in 2006 were estimated as PhP 5.7 billion, equivalent to about $110 million. The biggest source of damages is from foregone fisheries production due to overfishing and habitat degradation, which contributed about PhP 2.6 billion or 45% of the total. Foregone benefits from coastal development accounted for over PhP 2.3 billion (41% of the total), while the environmental cost from pollution amounted to about PhP 800 million (13%). Damages from climate change are minimal; the only impact included is from coral bleaching in 1998. With the potential for more frequent coral bleaching in the future due to climate change, however, this figure could increase substantially.

At present, stresses on the coastal and marine sector have had their primary negative impact on the mangrove forests, followed by negative impacts on coral reefs and other coastal areas. The largest environmental damage costs per hectare occur in the mangrove forests and are estimated at more than PhP 9,700 per hectare; the damage estimates per unit for coral reefs and other ecosystems are much smaller. This finding reinforces the idea that conservation of mangrove potentially results in higher marginal benefits per hectare when compared with other ecosystem interventions.

Box 5.1. Protecting Fishery Resources

Fishing is the lifeblood of the economy in Ubay, in Bohol province, and provides a food staple in every household. More than half its 65,000 people are directly engaged in fishing, while as much as 70% of people generate their income from fishing-related services and enterprises. Yet the rapid increase in the town's population and the booming economy in the late 1980s and the 1990s exerted too much pressure on Ubay's fish habitat and resources. Overfishing has been aggravated by the use of illegal and destructive fishing methods—such as dynamite and cyanide fishing, trawl fishing, and fine mesh nets. But the biggest threat is the intrusion of commercial fishers and illegal poachers.

The continuous threats of overfishing, destructive fisheries, and intrusion into its waters forced Ubay and its neighbors to act. In 2001, the Fishery Development Conservation Program was established to strengthen the municipal fishery law enforcement group by approaching the problem of fisheries protection in a more integrated manner—through improved fishery governance, community participation, greater transparency and accountability, local knowledge and capacity building, strong local enforcement, and coastal habitat and resource conservation and rehabilitation.

One of the first steps was to recruit capable and dedicated personnel who could provide technical support and professional assistance on fisheries. Selected individuals were recruited from different LGU departments to serve as a technical working group. They were complemented by a team of field technical personnel from various national agencies who provided expert knowledge and training. Local community representatives from different coastal barangays were also recruited, based on personal commitment and familiarity with marine resource conservation. In 2006, the municipality budgeted more than PhP 4 million ($92,000) for coastal fishery protection and conservation activities. The funds were used to support enforcers, provide honoraria for volunteers, maintain patrol boats, and procure equipment and instruments.

By working closely with fisherfolk organizations in the barangays and forming community-managed resource councils in almost all coastal barangays, the initiative gained strong local grassroots support, improved fish policy credibility among local stakeholders, and enhanced local governance accountability of local fishery resource management measures. Through interaction with local fisheries management councils, in 2006 Ubay approved an integrated Municipal Fisheries Ordinance to provide a strong local policy framework that unified various regulatory, jurisdictional, licensing or permitting, and administrative rules for protection as well as local community efforts such as patrolling and on-site conservation activities of fishery resources. Community and private-sector volunteers bolstered the law enforcement work and conservation programs, with improved technical competence, training, and skills provided by local professionals and community volunteers to local coastal and agriculture offices and community coastal enforcement teams.

After two years, there was a reported steady increase in fish catch per unit effort for the hand lines, lift nets, and stationary gillnets traditionally used. And the use of destructive fishing methods dropped considerably, largely due to strong coastal law enforcement initiatives on destructive fishing methods and regular seaborne patrolling. Fees and penalties for violations of fishery and coastal management ordinances increased to more than PhP 140,000 ($3,182)—more than twice as much as in previous years.

While Ubay's fishery protection and conservation program has achieved moderate economic gains and improved fishery stocks, the greatest gain has been empowering local fisherfolk to directly influence barangay and municipal policy and development plans. Their participation in local village fishery resource councils, coastal resource assessments, seaborne patrols, habitat monitoring, and reviews of local and community ordinances has given them a stronger voice in the sustainability of local fishery resources.

Source: Adapted from Elmer S. Mercado, *A Case Study of Ubay, Bohol on Sustainable Coastal and Fishery Resource Management: A Contribution to the Philippines Country Environmental Analysis* (Washington, DC: World Bank, September 2008).

5.5 Suggested Interventions

Expanded Network of Marine Protected Areas

The results presented in this chapter highlight the large and diverse potential economic benefits provided by marine protected areas. It is proposed that 10% of each major ecosystem be included in MPAs, which would expand the area included in that system. Table 5.4 presents the data on area in each ecosystem, area protected at present, and additional areas to be protected to reach this goal.

Table 5.4. Target MPAs in the Philippines

Ecosystem	**Total Area in Each Ecosystem**		**Total Target Area** (10% of total area)	**Existing MPAs, 2006**	**Remaining Area to be Declared as MPA**
	(hectares)	(% of total)			(hectares)
Coral reef	1,019,900	82.9	101,990	32,919	69,071
Mangrove	209,109	17.0	20,911	6,749	14,162
Seagrass	978	0.1	98	32	66
Total	1,229,987	100.0	122,999	39,700	83,299

While recognizing that even providing better management for existing MPAs is a major challenge, the proposed intervention would further increase the area in the MPA system by over 200%, requiring even more management effort. Details on the benefits and costs of establishing MPAs are given in Padilla (2008), and a review of the data show a wide range of both annual costs per hectare (from less than PhP 300 to more than PhP 10,000) and expected benefits. Once new MPAS are established, the overall benefits are expected to exceed costs, on average, by about 25%, with the highest net benefits for mangrove areas. The net benefits from coral reef MPAs are quite modest, although the value will increase substantially with ecotourism—one use that has strong and increasing demand in the future. Seagrass MPAs are the only component where expected costs are about equal to benefits, probably due to lack of knowledge of these systems and an undervaluation of the benefits. The connectivity of mangroves, seagrass beds, and coral reefs should be recognized in valuing benefits, particularly in proposed MPAs that contain all three ecosystems.

The total net benefit for the targeted, expanded MPA area is estimated at about PhP 187 million per year, with over half accounted for by coral reefs. In aggregate terms, net benefits represent about 50% of the annualized costs, which makes a good case for investment in expanded MPAs. For the average MPA of 34 hectares, the net benefits would range from PhP 49,000 to PhP 210,000 per year. On top of the net benefits from provisioning services are ecotourism and improved social well-being from healthy ecosystems and a sense of livelihood security. Successful community collaboration through a well-managed MPA brings about community pride and also helps related initiatives. MPAs can be declared nationally or by local government, as appropriate.

Development of Aquaculture

The largest source of damage to CMR, as noted, is overfishing. One solution to this problem is to provide fishers with alternative sources of income that would reduce their dependence on capture fishing. A potentially attractive option (if environmental issues can be overcome) is the development of aquaculture, especially aquaculture that is pro-poor. Aquaculture is not only potentially beneficial in terms of sustainable use of marine resources, it can accelerate socioeconomic growth and food security. Aquaculture is an important activity in Philippines and produces seaweed and a number of different fish and crustacean species. (See Table 5.5.)

Table 5.5. Major Species Produced in Aquaculture Fisheries, 2006

Species	Quantity	Share
	(metric tons)	(%)
Seaweeds	1,468,906	70
Milkfish	315,075	15
Tilapia	202,041	10
Shrimps/prawns	40,654	2
Others	65,600	3
Total	2,092,276	100

Source: BFAR 2006.

Aquaculture contributed an annual average of around 1.7 million metric tons to the supply of fish and seaweed in the Philippines in 2002–06, averaging a gross value of about PhP 44 billion per year during this period. In 2006 aquaculture production constituted 47% of total fish production, much larger than the share of commercial capture fisheries (25%) and municipal capture fisheries (28%). While capture fisheries production has been declining, aquaculture production has been increasing. The growing role of aquaculture relative to capture fisheries is a global trend brought about by the continuing overexploitation of wild fish stocks.

A recently completed study developed a medium-to-long-term strategy for Philippine aquaculture to maximize its contribution to the economy and help secure food supplies and create employment. The study recommended an integrated action plan and investment program that would reduce poverty and enhance the sustainability of Philippine aquaculture.

Promoting aquaculture, however, is not without environmental risk and requires careful management and implementation plans. Many studies in the Philippines, as well as in other countries, highlight the environmental damage done by aquaculture expansion (and mangrove loss.) Although past aquaculture development in the Philippines has been quite harmful to CMR, technology exists that permits the environmental impacts of aquaculture to be mitigated and regulated, if not totally eliminated. The biophysical impacts of aquaculture may include fecal discharge of fish, waste food, and changes to genetics and biodiversity. In addition, bad aquaculture practices such as poor siting, overcapacity, overstocking, and overfeeding may have negative impacts on the environment. The most alarming consequence of aquaculture is habitat loss and modification. Aquaculture affects sensitive coastal environments either by conversion or alteration. It has been recommended that a 1:1 mangrove-to-fishpond ratio be maintained to improve the balance between production and conservation. This would mean conversion of applicable fishponds to mangroves and rehabilitation of degraded mangrove forests.

The rapid expansion of aquaculture development shows that it is financially attractive to individual operators. Estimated rates of return on private investment are very high, especially for selected species such as milkfish and groupers (with benefit-cost ratios of about 2.2 and 1.6 respectively). Seaweed farming also shows considerable promise. However, a full economic accounting of the benefits and costs is necessary (including the costs of any negative environmental impacts of aquaculture development) to determine if it is an attractive development strategy from a national, social welfare perspective.

Registration and Licensing of National and Local Fisheries

The need to regulate capture fisheries is clearly seen in the severity of overfishing in the Philippines.[51] The roots of problem can be traced to the common property and “open-access” regime common in Philippine fisheries. Even when municipalities have declared their municipal waters to be for the exclusive use of their small-scale fishers, no limits have been set on the number of fishing boats. This results in overfishing of even “owned” fishery resources.

[51] The Bureau of Fisheries and Aquatic Resources of the Department of Agriculture and the LGUs are responsible for regulating the CMR.

Any effort to rationalize the Philippine capture fisheries sector though limiting entry is politically difficult, particularly in the municipal sector. The fisheries have become an employer of last resort in coastal areas, and in isolated villages it may be the only source of food, cash income, and livelihood. Thus, limiting or controlling entry ends up being a choice between social and environmental objectives (unless alternative employment is provided to displaced fishers).

Proposals have been developed for improved registration and licensing of both the municipal and the commercial fishing sector. Considering that this intervention does not provide a clear target for the reduction of fishing effort, particularly in the municipal sector, it is difficult to estimate the benefits and costs (and is not attempted here). Considering the general macroeconomic conditions in the country, with real employment alternatives limited, the level of confidence is quite low in predicting the extent to which registration and licensing could reduce the level of fishing effort toward, say, the point of maximum sustainable yield or the more conservative maximum economic yield.

Summary on Interventions

Collectively, the three interventions proposed here are mutually reinforcing by protecting and conserving habitats through MPAs, providing real alternatives through pro-poor aquaculture, and instituting a licensing scheme with the long-term objective of limiting entry to the open access fishery. Combined, these could all help reduce environmental strains on coastal and marine resources in the Philippines while promoting sustainable future uses of these resources.

Chapter 6: Forestry

Forests, a potentially renewable natural resource, have seen a long-term decline in the Philippines. Changes in definitions over time obscure the trend, but there are indications that the overall loss in forest area has been reversed and that the volume of secondary forests is recovering, while old-growth forests are still losing ground. At present, forest areas in the Philippines are estimated to produce some PhP 5 billion per year in net benefits (more than $100 million), almost equally divided between timber and non-timber benefits. Overextraction of forestry products and conversion to other uses are estimated to cost the Philippines some PhP 3 billion ($60 million) a year. Improved management of forestlands, including tenure issues and enforcement of existing regulations, is a major social and institutional challenge.

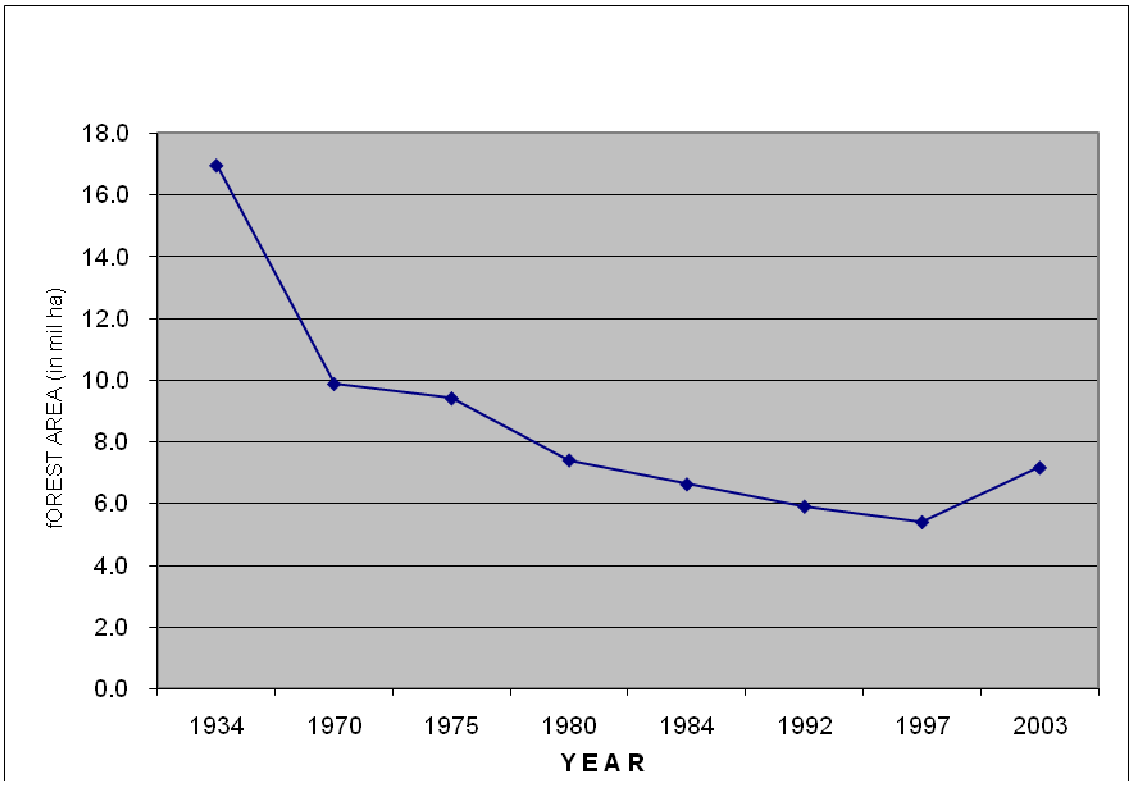
6.1 Forests in the Philippines

An archipelago of 7,100 islands, the Philippines has a total land area of around 30 million hectares. More than 52% of the land area (15.8 million hectares) is classified as "public forestlands," while the rest is alienable and disposable. Much of the forestlands are in hilly and mountainous areas, with slopes greater than 18%.

The past 100 years have seen substantial loss of forest cover in the Philippines as land has been logged or converted to other uses (see RMPFD 2003, Acosta 2005). One of the oldest forestry maps at the UPLB College of Forestry and Natural Resources library shows some 17 million hectares of forested lands in the early 1930s. According to the Forest Management Bureau (FMB), there have been three national forest resources inventories—in 1969, 1988, and 2003. Data for other years are interpolations based on modeling. The inventories showed a forest cover of 10.6, 6.5, and 7.2 million hectares respectively. There was an apparent increase in forest cover between 1997 (at 5.4 million hectares) and 2003, probably due to a redefinition of what is included in forest cover (based on percent canopy cover and other factors). For example, areas that were formerly called "submarginal areas" are now termed "open broadleaf" and "open mixed" forests. Figure 6.1 shows the trend in forest area from 1935 to 2003. Work to reconcile data over time is under way.

Forest depletion in the Philippines can be divided into three periods: an early period of mechanized logging (1935–70), the logging boom years (1971–91), and the most recent period, including a time when various bans on logging and log and lumber exports were introduced (1992–2003). As seen in Figure 6.1, the greatest depletion happened during 1935–70, a time of rapid rural population growth and population movement and a consequent expansion of agricultural lands into previously forested areas. During the logging boom period, the rate of depletion was also very high: about 181,000 hectares of forest were lost each year, in part due to the large number of logging concessions, covering almost 10 million hectares of forest. Once lands were logged, people often moved into these logged areas to practice shifting agriculture.

Figure 6.1. Philippine Forest Cover, 1934–2003



By the beginning of the 1990s, the government became stricter in allocating public forest areas to logging, and logging in old-growth forest was banned in 1991. Exports of logs from natural forests were banned. Ordinary lumber exports were also banned (in 1992), and only kiln-dried lumber could be exported. Logging in all protected areas was also banned. The entry of imported logs, lumber, and veneer has been liberalized, and, according to the FMB, about two-thirds of the country's wood supply was imported from 1997 to 2007.

Forests were usually not managed as a renewable resource but rather as a resource to be exploited: timber to be cut, land to be cleared for agriculture, or a source of other products to be extracted. Since the Philippines had so much original forest cover, very little attention was paid to protection or conservation. In addition, the ecosystem services from forests were largely ignored until they were lost and environmental damages ensued (such as changes in the quality or quantity of water flows from watersheds, increased soil erosion, and the downstream impacts of siltation).

There is a great deal of uncertainty about the rate of change in forest cover over the past decade. According to the World Bank (2007), the rate of deforestation during 1990–2005 was about 2.2% per year, on the basis of Food and Agriculture Orgnaization data.. Estimates of forest loss of 100,000 hectares per year were noted in the Philippine Congress hearings held to examine a proposed total commercial log ban for the country. On the other hand, other studies have shown

a reversal of the trend of deforestation. ENRAP (2000) indicated that by 1996 a reversal from forest depreciation to appreciation had taken place, at least in economic terms (that is, the asset value of forests was increasing over time). Kummer (2005) analyzed deforestation in the Philippines from 1995 to 2000 and concluded that poor data and mixed trends (e.g., loss of primary and secondary forest, some expansion of "other forest lands") led to his finding that "in short, at this point, it is almost impossible to come up with any genuinely meaningful statements about reforestation in the Philippines other than to say that it is very diverse, geographically widespread, and covers a large and growing area."

6.2 Estimating Economic Values of Forests

Economic values within the forests themselves are largely due to the extraction of forest products, whether or not forests are being managed on a sustainable basis. Off-site goods and services produced by forests are often ignored but can be quite important. The off-site impacts of changes in forested areas include the health of watersheds, the quantity and quality of water that leaves forested areas, and various forest-linked services such as biodiversity conservation and—at a global level—carbon sequestration. Some of the various goods and services produced by forests can be valued quite easily (such as timber, marketed forest products), others are more difficult to value (such as watershed services, sediment retention, carbon sequestration), and some are extremely difficult to value (such as genetic material, biodiversity conservation).

Forests (like fisheries) are potentially renewable resources that should be able to produce a constant stream of benefits over time. A well-managed forest will yield a flow of timber, non-timber forest products (NTFPs), and various indirect benefits and non-use values year after year without reducing the starting stock of forest. Most forests in the Philippines are not well managed, however, and therefore the economic analysis must divide the annual benefits from the forest resource into those that come from sustainable management and those that come from "mining" the resource and extracting goods and services (largely timber and some other NTFPs) in an unsustainable manner. Unsustainable management can result in a lower productivity per hectare of forest (that is, the resource is being degraded), or it can result in deforestation—the actual loss of forest cover. Both effects are commonly noted in the Philippines, and both impose large economic costs. (Comprehensive coverage of forest rehabilitation in the Philippines is found in Chokkalingam et al. 2006.)

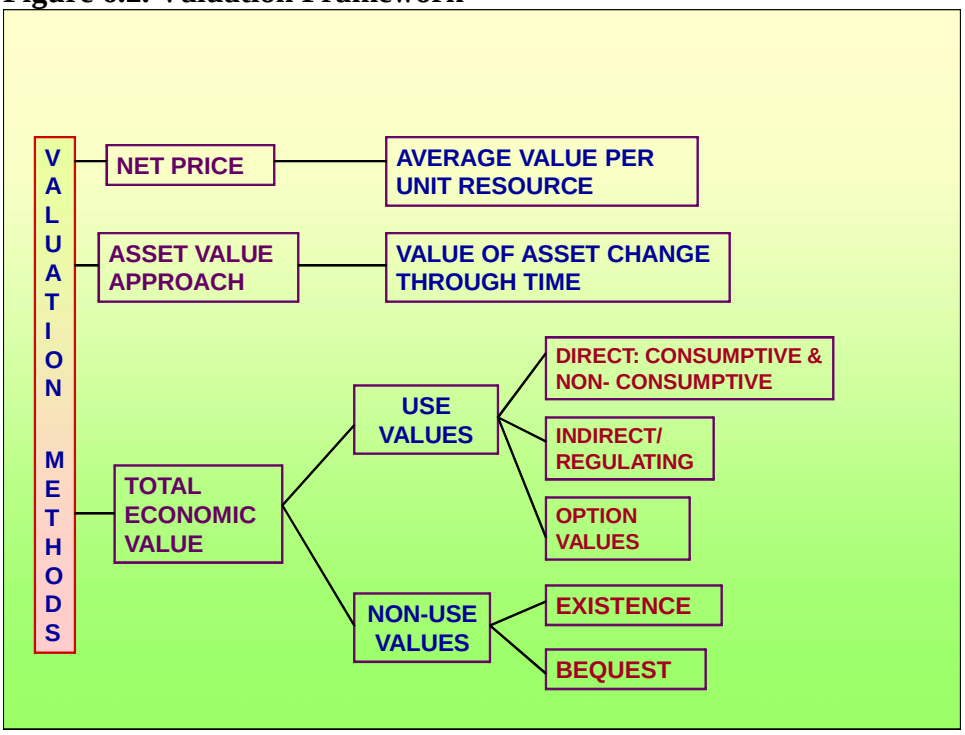
Regardless of recent trends in forest cover, it is necessary to estimate the economic benefits to the Philippines from forested areas (however defined and managed). In a background paper on the forestry sector, Carandang (2008) presented several different valuation approaches. Two are used here: the net price (NP) method to estimate timber values, and the total economic value (TEV) approach to estimate a broader set of values for a forest ecosystem, including timber values but also important NTFPs, indirect use values, and non-use values. Figure 6.2 presents the broader analytical framework for this analysis.

The Net Price Method

The net price method estimates the expected economic rent ("extra" profit) from harvesting a cubic meter of timber. It is usually defined as the difference between the current revenue from

and production costs of a cubic meter of timber. Costs include extraction charges, transportation costs, normal profits, interest payments for capital, and any other costs incurred in the course of production. Revenues are the actual sales price of timber. The NP value is a point estimate, and it indicates what the forest resource is worth from an economic welfare point of view per cubic meter of timber harvested at a certain point in time. It is the maximum price an "economically rational" person would be willing to pay to harvest a cubic meter of timber. This is also sometimes called the "stumpage value." The annual sustainable "economic value" of the forest is found by multiplying the NP per cubic meter (the economic rent) times the number of cubic meters harvested under a sustainable forestry regime. (Of course the net price value is species- and location-specific, since different types of timber have different market values and different extraction costs.)

Figure 6.2. Valuation Framework



The Total Economic Value Approach

Forests are usually thought of as a source of timber, but as indicated earlier, they also produce many other goods and services. The total economic value includes direct uses, indirect uses, option values, and non-use values. The first three are generally referred to as "use values." The TEV method is similar to the approach applied to resource valuation in the Millennium Ecosystem Assessment and includes a similar set of goods and services. Bennagen and Javier (2006) discuss the application of this approach to the Philippines.

Direct use values reflect ecosystem goods and services that are directly used by society—more specifically, by forest dwellers and those who harvest and sell forest resources. Examples are the

value of consumptive uses such as harvesting of timber and non-timber forest products (such as medicines, plants and flowers, nuts, small animals, and other economic goods) and the value of non-consumptive uses such as recreation and ecotourism activities that do not require extraction of products**. *Indirect use values*** refer to ecosystem services that provide benefits outside the forest ecosystem itself; these include such environmental services as carbon sequestration, natural water storage in watersheds that benefit lowland areas, and aquifer recharge. ***Option values*** are derived from preserving the resource in order to have the option to use it in the future (although at one level this is a "non-use" value, it actually is a "deferred use" and hence is counted under use values).

Non-use values refer to the enjoyment people may experience simply by knowing that a resource exists even if they never expect to use that resource themselves. This kind of value is usually known as existence value. Another type of non-use value is the benefit that people receive from leaving the forest resource for future generations to enjoy. This is referred to as a bequest value.

Assessing the full TEV of a forest ecosystem requires considerable data and skill; only a few parts of the total economic value are easily set using market prices. Valuing timber production is fairly straightforward—harvested volumes are multiplied by the appropriate economic rent or stumpage value per cubic meter. Even for forestry production, data are often partial or underreported. Data are even weaker with respect to non-timber values. A number of very site-specific studies have been done, but these results cannot be easily expanded to the entire country or to all forest areas. In addition, different forest types are likely to produce quite different sets of values, both for NTFPs and for ecosystem services.

Carandang (2008) presents selected numbers for various use and non-use values, usually presented on a per hectare basis in PhP (and with a conversion to dollars using a rough conversion factor of $1 = 50 PhP) (see Table 6.1). Most of these non-timber values are presented on an annual basis (PhP/ha/yr) while the value for NTFPs is an asset value price (PhP/ha). An average stumpage value per cubic meter is also given for comparison.

Table 6.1. Selected Use and Non-use Values of Forests

Category	Value in PhP	Value in Dollars
Stumpage value of average production forest (economic rent from harvesting timber)	1,800 per cubic meter	36 per cubic meter
Non-timber forest products (based on the asset value approach)	70,000 per hectare	1,400 per hectare
Non-timber forest products on an annual basis, assuming a 5% discount rate	3,500 per hectare	70 per hectare
Recreation (for those area suitable for such use)	911 per hectare	18 per hectare
Carbon sequestration (based on implicit carbon price of about PhP 1,233/ton)	1,665–5,551 per hectare	33–111 per hectare
Soil retention	1,065–4,261 per hectare	21.30–85.20 per hectare
Non-use value	28 per hectare	0.56 per hectare

Source: Carandang 2008.

The sum of these non-timber values varies from about $143 to $285 per hectare per year, a very large number—especially given that most of these values are not reflected in the marketplace. Even if carbon sequestration is excluded (since these are global benefits and no payments for these services are presently being made to the Philippines) the total is still large: as much as $174 per hectare per year (depending on the extent of recreational use and soil retention benefits). The results are driven by the large values for NTFPs (about $70 per hectare per year) and the range of values for soil retention (from $21 to about $85 per hectare per year).

6.3 Estimating the Economic Contribution of Forests

In order to estimate the economic contribution of forests to the Philippines it is necessary to make assumptions about sustainable rates of harvest, changes in the rate and composition of the harvest, and the value of non-timber forest goods and forest ecosystem services. Because of the very confusing statistical picture in the forestry sector at present, some simplifying assumptions were made:

- The year 2006 was chosen as the starting point or base year, and the assumption was made that forest harvesting was being carried out on a sustainable (e.g. non-declining) path over time. Then estimates are made of the annual flow of timber and non-timber goods and services.
- All prices and values for forest goods and services (timber and non-timber, direct use values, indirect use values, and non-use values) are assumed to be constant over time.

These assumptions allow an estimate of the present economic contribution of forests to the economy of the Philippines and potential costs of resource degradation (as well as the benefits of resource improvements). The estimates are very rough, but they provide a snapshot of economic values at this point in time.

Forestry statistics in the Philippines are especially weak with respect to production of timber and non-timber products. Table 6.2 reports an average forest production estimated at almost 1.4 million cubic meters of timber and rattan production of nearly 38 million linear meters for 2006.Using an average stumpage value of PhP 1,800 per cubic meter of timber and PhP 6 per linear meter of rattan, the forestry sector in the Philippines produced net economic benefits of approximately 2.6 billion PhP from timber and rattan production that year. This is the annual flow of benefits from a sustainably managed forest sector using the net price method.

Table 6.2. Reported Production of Forest Products and Estimated/Actual Production, 1995–2006

Year	Rattan Production		Timber Production	
	Reported[1]	Actual Estimated	Reported[2]	Actual Estimated
	(thousand linear meters)		(thousand cubic meters)	
1995	17,457	67,209	758	1,008
1996	24,613	94,760	771	1,025
1997	19,519	75,148	556	739
1998	10,463	40,283	634	843
1999	15,552	59,875	730	971
2000	32,336	124,494	800	1,064

2001	8,767	33,753	571	759
2002	6,641	25,568	541	720
2003	9,079	34,954	689	916
2004	16,074	61,885	741	986
2005	12,970	49,935	812	1,080
2006	9,773	37,626	1,036	1,378

[1]Underreported and unreported rattan production is around 385% of actual reported, per Dr. Isabelita Pabuayon during NRAP1 (Rattan Resources Accounting 1991).
[2]An estimated additional 33% on top of this is produced through illegal means, hence is not reported in official log production data.
Source: Carandang 2008.

The non-timber benefits to be added include all the other goods and services included in a TEV calculation. Although some partial estimates of these values were presented earlier, many of these studies are very-site and time-specific. An alternative approach to valuing the wide array of non-timber benefits is suggested by a meta analysis of over 35 different forestry valuation studies carried out by Lampietti and Dixon (1995). They found that in developing countries the various NTFPs and services, indirect use values (largely ecosystem services), and non-use values (largely bequest and existence values) were on average equal in value to the timber benefits. Each side produced about half of the total per-hectare value. (See Box 6.1.)

Box 6.1. Valuing Non-timber Forest Benefits

In a 1995 study, Lampietti and Dixon reported on the results of a meta analysis of available studies from around the world on non-timber forest values. Althought individual results were quite country-specific, the analysis did find an interesting division between the sources of value for a hectare of forest: the hypothetical value was roughly equal in both industrial and developing countries, but timber values were larger overall in developing (about 50% of the total) than in industrial countries (about 33% of the total).

Extractive values were similar (about 30–33%) in all countries studied. A major difference was the finding that in developing countries, recreation and hunting and fishing values were much lower (about 8% of the total) than in industrial countries (about 60% of the total). This difference helps explain why in many developing countries forestlands are seen as more valuable as timber, while elsewhere forestlands are often considered more valuable as ecosystems.

The meta analysis—a technique that examines a large number of valuation studies to determine a distribution of values—included some 20 studies to value non-timber forest products, studies to consider hunting values (six in developing countries and nine in industrial ones), and a half-dozen studies in each case for recreational benefits and ecosystem services. Although of necessity the meta analysis contained much variation, the central tendencies were strong when comparing sources of value and their size in all countries studied.

Source: Lampietti and Dixon 1995.

Using this assumption in the Philippines means that non-timber forest goods and services (all the other parts of the TEV calculation) are therefore worth about PhP 2.6 billion per year. The total value added in the forestry sector is therefore close to PhP 5.2 billion per year (just over $100 million), which represents a minimum estimate of what the annual net economic contribution of the Philippine forest sector would be in the absence of resource degradation (or resource enhancement). Note that the non-timber values may well be underestimates since they are based directly as a percentage of the value of harvested timber. If there are roughly 7 million hectares of forests, the total value added in the forestry sector represents about PhP 750 (equivalent to $15) per hectare per year.

6.4 The Costs of Resource Degradation

The situation just described (with the explicit base condition of sustainable forest management) is unlikely to be the actual case in the Philippines. In fact, forest resource degradation has been the story for many decades and is unlikely to change, especially for the commercially attractive forest resources such as old-growth forests, pine forests, rattan forests, and mangroves. To estimate the costs of resource degradation (basically loss of forest cover or forests resources as measured by cubic meters per hectare), it is possible to use the recent past as a guide to what will probably happen in the future. Note that loss of forests can be from land-clearing or conversion with minimal timber production or from clear-cutting and maximum production of timber. In either case the land is converted and future streams of forest products are lost. The cost of resource degradation includes both the loss of the timber resource (valued as a function of the volume of timber harvested or lost) and losses of associated forestry ecosystem goods and services (valued as a function of the area in hectares that is converted to other uses).

To estimate the costs of resource degradation, the focus is on three forest types: old-growth, secondary growth, and pine forests. Table 6.3 shows forestry numbers from 1992 to 2003. There has been annual depletion (loss) of all three types measured in hectares in this period. In terms of volume, there was sizable annual loss of volume for old-growth forests (1.7 million cubic meters per year), a smaller amount of loss for pine forests (0.3 million cubic meters per year), and an actual increase in volume for secondary-growth forests (0.7 million cubic meters per year). This seemingly contradictory result implies that secondary growth forests, while decreasing in area over time, have increased in volume due to increased density of forest resources per hectare. Note that the category “other forests closing area” has been excluded since there is considerable uncertainty about what is included here and how it may have been redefined over time. Note also that the volume lost can come from both clear-cutting of forests as well as extracting timber at a higher than sustainable level, thereby degrading the forestry stock.

Table 6.3. Summary of Forest Depletion, 1992–2003

Forest Account	**Total Depletion**	**Annual Depletion**
Area	(thousand hectares)	
Old-growth	76.7	7.0
Second growth closing	348.8	31.7
Other forests closing	(1,053.5)	(95.8)
Pine forest	33.0	3.0

Volume		
	(million cubic meters)	
Old-growth	18.9	1.7
Second growth closing	(7.8)	(0.7)
Other forests closing	(63.2)	(5.7)
Pine forest	3.1	0.3
	(million linear meters)	
Rattan	236.1	21.5

Source: Carandang 2008.

Using estimates of the net price per cubic meter for the different forest types, the annual economic cost of resource degradation (or, in the case of secondary forests, resource appreciation) can be calculated. Based on Carandang 2008, the average net economic value (based on the net price method) for old-growth and secondary growth forests is about $40 per cubic meter, and for pine forests the value is about $25 per cubic meter. (Plantation forests, basically "cellulose factories," have a much lower value per cubic meter—only about PhP 400, or about $8—but are not an important factor here.)

Adding the annual costs of resource depletion in old-growth forests (about $68 million) and pine forests (about $7.5 million) to the annual appreciation of secondary growth forests (about $28 million) yields a net depreciation (loss) of forest resources over time of about $47.5 million per year (equivalent to about PhP 2.375 billion). Note that the "other forest" category (which is also supposed to be an appreciating asset over time) is not included in this analysis.

These results are in part driven by the increase in the cubic meters of forest resources per ha for secondary growth forests. If this number was actually constant, then the overall costs of resource degradation in the forestry sector in the Philippines would be even larger. As it is, the present analysis has the losses in old-growth and pine forests being partly offset by the increase in value from secondary growth forests.

In addition to the value of timber lost, there are also important losses in non-timber values. Given the uncertainty of these estimates, the same "100% rule" applied earlier is used to value the non-timber benefits from sustainably managed forests. The estimated non-timber benefits from forests (estimated earlier at about PhP 750 per hectare per year) are now applied to the area "lost" each year due to forest degradation—about 41,700 hectares per year (again ignoring the change in "other forests closing area" category in Table 6.3). For one year, this loss of non-timber benefits from deforested lands equals PhP 31.3 million (41,700 hectares multiplied by PhP 750 per hectare). However, this amount is not a loss for one year only. Rather, it is an economic value that is lost forever when forests are converted, so the capitalized value (the present value of an infinite stream of future losses) of this loss should really be used. The capitalized value is defined as the present value of the infinite stream of future losses of PhP 31.3 million per year, for every year in the future. Based on a 5% discount rate, the capitalized value is equal to PhP 626 million (the formula used to calculate the capitalized value is to divide the annual loss, 31.3 million PhP, by the discount rate, 0.05).

The total annual cost of resource degradation in the Philippines is therefore the sum of the timber values lost (about $47.5 million or about PhP 2.375 billion) plus the non-timber parts of the TEV calculation (another $12.5 million or PhP 626 million). The total is therefore about PhP 3 billion per year—equal to almost 58% of the PhP 5.2 billion produced annually by the sector under sustainable management.

Box 6.2. Managing Forests

For several decades, flooding and siltation have been a problem for the city of Bayawan. They have destroyed millions upon millions of pesos worth of property and crops. The prospect of living under a perpetual threat of disaster prompted the city government to address the root cause of these problems: the widely denuded forestlands.

Bayawan City has 20,245 hectares of lands classified as forestlands. Of these, 5,811 hectares are officially and legally allocated to individuals and communities by virtue of various kinds of tenurial instruments issued by national government. The remaining 70% are considered untenured. These "open access" areas are subject to uncontrolled and unmonitored conversion to agricultural lands and unsuitable cultivation practices that result in significant loss of soil cover and the regular occurrence of landslides, siltation, and flashfloods in Bayawan's lowland barangays.

The Bayawan forest and land use plan (FLUP) was formulated with the highest priority accorded to protection of land uses. It aims to protect critical ecosystems and biodiversity from further human activities, to rehabilitate degraded land resources, and to protect people from future environmental hazards. It involves integrated consensus building and the direct participation of local stakeholders, especially from the affected barangays and communities. Local community members led by barangay technical working groups did community surveys—profiling and mapping local forest and land resources. Local people also collated, summarized, and validated the information gathered in these surveys.

To support implementation of the FLUP, the city signed a Memorandum of Agreement with the national environment department to co-manage all 14,434 hectares of open access forestlands. This gave the city direct responsibility for its unallocated forestlands as well as for overseeing the proper management of existing management regimes in allocated forestlands.

Bayawan's commitment to supporting and achieving the goals and objectives identified in its FLUP was clearly seen in the regular appropriations made to environmental and natural resources services. Local ordinances to protect and preserve natural forest were enacted to further strengthen community and barangay enforcement of forestry and environmental laws. Finally, the effectiveness of Bayawan's FLUP was due to its link to and integration with other LGU development plans. The FLUP was also a critical input in the preparation of the city's climate change mitigation plan.

The initial effects of the city's efforts to upgrade and restore its denuded forestlands are slowly being felt as flashflooding and siltation in lowland barangays and city centers are being reduced. Where flooding does occur, the waters easily subsided. This is due to the soil erosion and riverbank protection measures implemented at the start of the FLUP in 2004. Over three years the city established 134,000 linear meters of riverbank protection lines, covering 78% of riverbank areas needing vegetative protection. It also established more than 14 kilometers of 10-meter-wide firelines covering around 40 hectares of grasslands in the city's primary watershed area.

Local policies on water production areas for 17 barangays within the forestlands were also formulated, with about 63 hectares replanted with fruit and forest trees. And some 100 hectares of jatropha and 378 hectares of rubber plantations were established to diversify traditional farm crops in the city's upland areas. To date, more than 500 households have directly benefited from these projects. Another 2,000 households are potential beneficiaries in the next five years.

Bayawan's effort to manage all its forestlands effectively and sustainably is a long-term process that requires strong political will and commitment not only from local leaders but also from the whole community. The city has largely spent its own funds to implement its FLUP and remains fully committed to completing the implementation. Bayawan's leaders know that addressing the loss of the city's forestland is the only way to overcome the local effects of climate change, improve productivity of its vast agricultural lands, and achieve long-term economic growth.

Source: Adapted from Elmer S. Mercado, *A Case Study of Bayawan City, Negros Oriental on Controlling the Effects of Lowland Flooding and Siltation through Sustainable Forest Land Use Planning and Management: A Contribution to the Philippines Country Environmental Analysis* (Washington, DC: World Bank, September 2008).

6.5 Summary and Conclusions

Forests in the Philippines have been a primary environmental and economic resource for centuries. However, the record of forest resource management in the past 50 years has not been good. There has been large-scale conversion of forests to other uses as well as extensive commercial logging, often with limited or no replanting.

The contribution of the forestry sector to the Philippine economy has two major components: the production of economic rents from the sustainable use of the forest resource (both timber and various non-timber goods and services) and the loss of forestry-dependent economic value from deforestation and land conversion.

The annual contribution of the forestry sector is estimated at PhP 5.2 billion, considering only the most important forest types and uses. Of this amount, half comes from the production of timber products and the remainder comes from other indirect and non-use values, including important non-timber forest products and ecosystem services.

Deforestation is still occurring in some of the major forest types in the Philippines. The annual cost to the Philippine economy from these losses is estimated at about PhP 3 billion per year, an amount equivalent to 58% of the benefits produced by the forestry sector if managed on a sustainable basis. Although forest resource loss or degradation does produce other benefits (from logging or conversion of land to other uses, including agriculture), there is no question that the degradation of forestry resources in the Philippines imposes large costs on both the economy and society.

Selected interventions to remedy this situation show promise in helping to maintain the sustainable flow of goods and services from forests and contributing to the reforestation and expansion of forest areas. Several concrete actions or interventions are proposed, including the following:

- Better forest statistics and consistent application of definitions are required in order to track what is actually happening to forests in the Philippines over time.
- Long-term tenure arrangements must be developed to give forest users the proper incentives to make long-term investments in forest management and security about future benefits. The present uncertainty in tenure in many areas leads to short-term, destructive actions.
- Illegal logging is a related concern, and poor enforcement of logging regulations (including both logging techniques and reforestation and land management) is another major issue standing in the way of more sustainable forest management.

- Community forestry, especially when tenure issues are addressed, shows promise of prompting improved long-term management of forests.

The management and institutional costs of these interventions are high, but the potential exists for there to be large gains for the Philippines if interventions can be successfully and efficiently carried out. Although not discussed here in detail, these interventions all require considerable institutional strengths and social "buy-in" on the part of those using forestlands. Neither condition is likely to be easily met in the Philippines.

Chapter 7: Land Management

This chapter analyses land degradation in the context of the crop production sector of agriculture. It reviews the evidence of degradation, particularly soil erosion, as well as estimates of the economic impacts using various analytical approaches. Land degradation is often measured at the micro level, which makes extrapolations to an overall national context difficult; what is lost to a particular field is not necessarily lost to the agricultural system. Using the best available local evidence, and comparing this with international evidence, the chapter estimates the magnitude of economic impacts of soil erosion. The final section discusses some methods of intervention to mitigate these impacts. The divergences between what is financially appropriate for a farmer to undertake and what is motivated by the full economic cost of land degradation provide a rationale for selective public interventions.

Soils are a potentially renewable resource and, similar to other renewable resources like fisheries or forests, can be managed in such a way that the quality of the "stock" of land or soil is maintained year to year, producing an annual flow of products. Unlike forests or fisheries, however, the natural rate of regeneration of soils is very long, and so land is often considered to be a nonrenewable resource. Poor management of land, such as soil erosion or the leaching of nutrients, is a form of "mining" the resource, which usually has negative impacts on productivity.

Land degradation, often due to mismanagement of upland areas, is a major problem in the Philippines. The environmental problem of land degradation, in addition to water-induced soil erosion, also includes waterlogging of soils, salinization, and compaction. Estimates of some degree of erosion/ degradation vary from 45% to 70% of all lands in the Philippines (NSCB 2003; FAO 2005). The impacts of land degradation include reductions in the productivity of lands and pastures directly affected, as well as off-site impacts via the movement of eroded soil/sediment that affects the productivity of other sectors—downstream fields, infrastructure such as dams and canals, rivers and coastal wetlands, and finally coastal waters (including coral reefs as well as harbors and other coastal infrastructure).

Table 7.1 presents information on the major crops grown in the Philippines in the period 1990 to 2007. Most crops, with the exception of corn, showed an increase in area planted during this time.

Table 7.1. Area Harvested by Crop, the Philippines, 1999–2007

Crop	Area Harvested/Planted					Shares in Total Area	
	(thousand hectares)					(%)	
	1990	1995	2000	2005	2007	1990	2007
Palay	3,319	3,759	4,038	4,070	4,273	28.1	33.4
Corn	3,820	2,692	2,510	2,442	2,648	32.3	23.9
Banana	312	339	382	418	437	2.6	3.0
Coconut	3,112	3,095	3,144	3,243	3,360	26.3	27.5

Sugarcane	235	302	384	369	383	2.0	2.7
Other	1,018	1,069	1,029	1,058	1,116	8.6	9.5
Total	11,815	11,256	11,487	11,600	12,216	100.0	100.0

Source: FAO, FAOSTAT.

The productivity of the major crops is seen in Table 7.2 for 1970 to 2006. All crops (with the exception of sugarcane) have shown an increase in yield over time—the result of new seeds, more agricultural inputs, and better management.

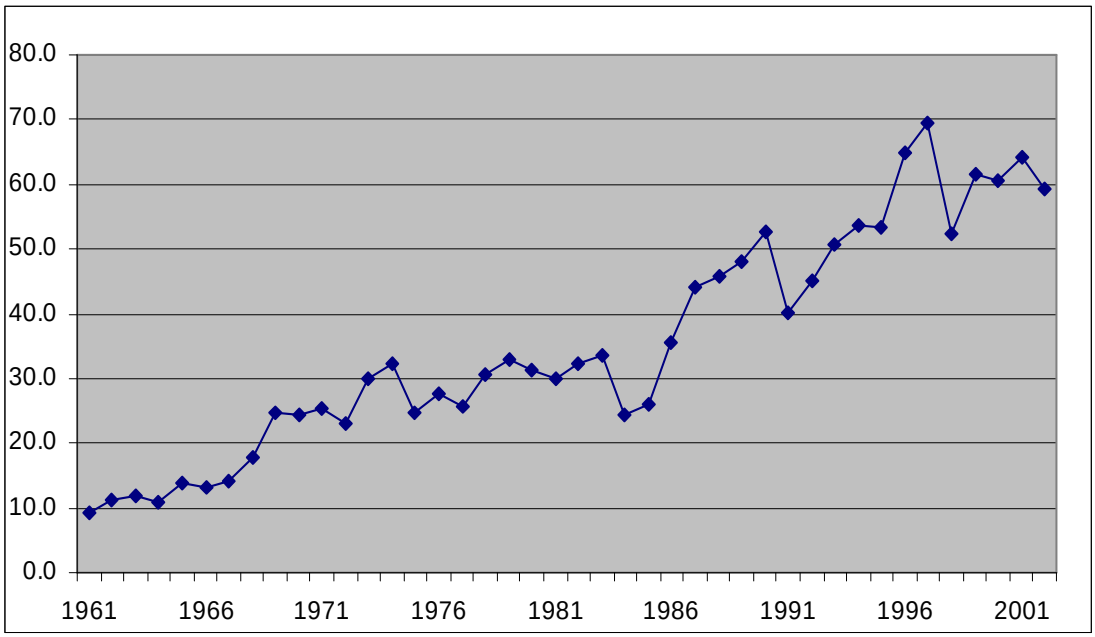
Table 7.2. Yield of Major Crops, the Philippines, 1970–2006

Crop	1970	1975	1980	1985	1990	1995	2000	2006	Annual Growth
	(tons per hectare per year)								(%)
Paddy rice	1.7	1.7	2.2	2.6	3.0	2.8	3.1	3.7	3.1
Maize	0.8	0.9	1.0	1.1	1.3	1.5	1.8	2.4	5.2
Coconuts	3.0	4.0	2.8	2.6	3.5	4.0	4.2	4.5	1.3
Sugarcane	71.4	66.9	72.8	62.0	80.0	65.6	62.0	62.1	–0.4
Bananas	4.5	8.9	12.9	11.6	9.7	10.9	15.0	15.8	7.1
Pineapples	8.1	13.9	16.0	17.8	19.4	21.0	36.3	36.8	9.9

Source: FAO, FAOSTAT.

When this information is combined with data on soil erosion, the conclusion appears to be that erosion does not have a negative impact on yields or total production of crops. This would be incorrect. The correct measure of the impact of land degradation and soil erosion is, of course, the difference in what it costs to produce a given level of agricultural output in the absence of soil erosion and land degradation and what it costs to do so with soil erosion and land degradation. Even with increasing yields, soil erosion and land degradation impose an extra cost on production and reduces the net benefits to producers. Figure 7.1 gives an indication of this burden, showing a strong increase in fertilizer application in the last four decades.

Figure 7.1. Fertilizer Application, All Types, the Philippines, 1961–2002 (kg/ha)



Source: FAO, FAOSTAT.

Numerous studies confirm that a shift in land use from forest cover or permanent crops to upland farming of annual crops accelerates the rate of erosion at least by an order of magnitude—and probably more (that is, from 1–5 tons per hectare per year to 50 or more). Loss of nutrients and soil cover inflicts a high cost—whether in the added expense of replacing nutrients with fertilizer or in reduced agricultural yields. Although short-term effects may be barely perceptible, the cumulative effect is irreversible decline in land quality over the long term. The costs of land degradation are even more serious when off-site costs are considered (though the quantification of off-site costs is far less developed than that of on-site costs).

Policies to arrest land degradation can be either direct or indirect. Among the direct instruments, soil conservation technology has been the most extensively evaluated. This technology requires an initial investment on the part of the farmer, and investment analysis suggests that adoption of soil-conserving technology has a high payoff in the long term. However, upland farmers may have difficulty adopting these measures because of a short planning horizon, a high personal discount rate (i.e., attaching great weight to immediate costs and benefits), or simple capital constraints. These benefits and costs are even more pronounced for forestry projects, which shift upland annual crop farming toward more permanent crop cover. Meanwhile, indirect instruments can also affect land use and soil conservation choices: changes in upland land tenure and market price policies are two examples. Although the former may have limited effects, the latter (such as trade liberalization for import-competing annual crops) can have significant environmental benefits by reducing the area of erosive crops.

7.1 Extent of Land Degradation in the Philippines

Up until the mid-twentieth century, the Philippine uplands were almost entirely forested. Then with rapid agricultural development, population growth, and timber extraction came the expansion of annual crop farming by upland settlers. The end of rapid agricultural growth in the 1980s coincided with the close of the land frontier and the emergence of structural problems affecting agriculture, such as the weakening of technical progress, stagnant productivity growth, slow labor absorption outside agriculture, the lack of product diversification within agriculture, and land degradation due to soil erosion. Upland farming is a major cause of soil erosion, leading government and nongovernmental organizations to pursue a number of sustainable agriculture initiatives in the uplands.

Land degradation in the Philippines is often reported as a serious environmental problem, although as noted earlier there are differences in the estimates of the extent of the problem. NSCB (2003) reports that 45% of the country's land area suffers from moderate to severe erosion. Other sources, such as work done for FAO (2005), suggest that up to 70% suffers from severe erosion and land degradation (note that the classification "severe" denotes a combination of different types of erosion and land degradation: light degradation for over 50% of the land area, moderate degradation for 10–50%, strong degradation for 5–25%, and extreme degradation for 5–10%). Population pressure contributes to increased cultivation of steeply sloping land. Stalinization and waterlogging are problems in some irrigated areas, and saline water intrusion

affects coastal areas. Regardless of which is the correct figure, there is no doubt that soil erosion and land degradation impose important economic costs on the Philippines.

7.2 Impacts of Land Degradation on Agricultural Productivity

Measuring the impacts of land degradation on agricultural productivity requires establishing a baseline case (e.g., the situation without soil erosion) and analyzing three alternatives if soil erosion and land degradation do take place. The "baseline" case is characterized by constant productivity, and land is managed as a sustainable, renewable resource without using any additional agricultural inputs. The other scenarios all include some level of land degradation and differ by how the negative impacts of land degradation are felt or mitigated:

- Productivity falls over time as land is degraded and there is no use of additional agricultural inputs
- Productivity is held constant over time with the use of additional agricultural inputs
- Productivity increases over time with the use of additional agricultural inputs

The on-site impact of land degradation with respect to agricultural productivity is therefore the difference between the baseline case and whichever alternative scenario is observed in the real world. The on-site cost of land degradation is estimated by measuring the with-degradation outcome compared with the baseline case. Although conceptually simple, actual measurement of these different scenarios can be complicated.

Data from the Philippines suggest that Scenario 3—increases in productivity over time due to the use of additional agricultural inputs to hide the negative impacts of soil erosion—is in fact the most common case. This impression is supported by the data in Table 7.2, which show increasing productivity over time for all crops except sugarcane. (The decline in productivity in sugarcane reflects declines in the quota for and price of Philippine sugar exports to the United States over the past 30 years. Farmers thus had little incentive to mitigate environmental impacts or increase yields through the use of purchased inputs.) One way to estimate the costs of soil erosion and land degradation in the Philippines is to examine the extra expenditures in the production process that are used to "mask" the impacts of land degradation as opposed to those inputs that increase yields above the baseline case. In addition, the important downstream impacts of soil erosion also have to be measured. The latter are usually referred to as off-site costs.

7.3 Costs of Land Degradation

<u>On-site Costs</u>

One way to estimate the costs of soil erosion is to estimate the cost of replacing soil nutrients that are lost due to erosion. Francisco and de los Angeles (1998) converted Francisco's (1994) soil loss estimates into monetary values based on replacement cost for nutrients as of 1993**.** The nutrients lost per ton of soil eroded are very similar across land uses and are in the range of PhP 26–30 per ton of soil (in 2007 prices). The major macronutrients are nitrogen, phosphorus, and potassium; by far the greatest component of this loss per ton of soil is due to its nitrogen content. Losses per ton of soil can be converted into losses per hectare based on average erosion rates.

For agricultural land, erosion-induced nutrient loss is estimated to be about PhP 1,800 per hectare in 2007 prices, which is an amount small enough to be masked by the use of fertilizers.

Not surprisingly, soil erosion rates are higher on steeper slopes, and the nutrient replacement cost likewise increases with slope. The nutrient loss costs for the second slope category (8–15% slope) is more than double that at less than 8% slope. The nutrient replacement costs of the third slope category (15–35% slope) is 62% above that of the second.

An alternative to the nutrient replacement cost approach is to examine changes in productivity by examining loss of agricultural yields that can then be valued at market prices. Decena (1999) applied this method based on data from a study by the Philippine Council for Agriculture and Natural Resources Research and Development and the International Board for Soil Research and Management. Studies conducted in upland farms in the provinces of Rizal in Luzon compared farmer's traditional agricultural practices (up-and-down cultivation with no fertilizer used) with soil conservation farming systems. The research found that there were significant benefits from reducing soil erosion and thereby reducing the need for additional agricultural inputs while maintaining yields. There were differences in the results from the two methods: change in the productivity impacts of soil erosion tended to be larger than the cost of replacing key nutrients. When that applies, it would pay to replace the lost nutrients.

Alternatively, the yield difference (with and without erosion) can be computed using agronomic models. In one set of studies, yields from open field maize farming were compared with yields from conservation farming of maize. Model parameterization used data from comparative field trials, and economic data were collected from communities adjacent to the field trials. For conservation farming, the predicted maize yields ranged from 1,000 to more than 3,000 kilograms per hectare with no clear time trend; for open field cultivation, however, maize yield initially peaked at 2,000 kilograms per hectare but deteriorated steadily over time (as erosion continued) until it fell below 500 kilograms per hectare from year 35 onward. The difference in average yields between the two systems was about 1,250 kilograms per hectare, which converted to about PhP 23,000 in 2007 prices.

Change-in-productivity studies all indicate that land degradation and soil erosion have negative impacts on yields, only part of which can be "masked" by increasing application of agricultural nutrients. Estimates of the net impact vary widely by location and study, but reported values are as large as PhP 500–1,500 per hectare in steeply sloped lands (roughly $10–30 per hectare at current exchange rates). Although this is only a small percentage of the value of output, these are continuing (and often growing) costs and they represent a major loss of rural income.

Off-site Costs

Most analyses of the costs of land degradation have been restricted to on-site costs; studies on off-site costs are sparse. One early study on such costs by Cruz, Francisco, and Conway (1988) focused on two major irrigation and hydropower dams in Luzon (Magat and Pantabangan). In the watershed areas of these two systems, large areas of forest cover had been replaced by grassland and farmland. The measured sedimentation rate in the early 1980s was 73% higher than projected, largely due to unanticipated land degradation in the watershed. Sedimentation shortens dam life and reduces the storage capacity for irrigation and power generation. The estimated

annual costs of erosion to Pantabangan dam mostly due to lost irrigation services is about PhP 271 million ($6 million), summed over both wet and dry seasons.

A fairly comprehensive national-level assessment of off-site impacts and their economic costs is found in Saastamoinen (1994). Many of the estimates are based on educated guesswork. Aside from impacts on irrigation systems, the other important off-site impacts analyzed include the following:

- Rainfed agriculture—erosion reduces water supply and retention in rainfed areas, increases siltation in rivers, and contributes to flooding
- Fishery and aquaculture—silt reduces light penetration and primary productivity in the water column; flooding damages fish cages and fish ponds; siltation of rivers and lakes reduces productivity of inland fisheries; sediment deposits damage coral reefs (fisheries experts view sediment damage as the greatest threat to coral reefs and associated reef fisheries)
- Food and beverage manufacturing—reduced water quality increases manufacturing costs
- Construction—flooding increases costs for the construction sector
- Water supply—loss of natural cover and associated watershed degradation reduces available freshwater quantity and affects water quality
- Tourism—sedimentation reduces the quality of beaches, coral reefs, and coastal waters, with reduction in their income-earning potential

Hard data for many of these various impacts are sketchy and often very site-specific. Some selected examples follow. In one location a 30% loss of reef fisheries was estimated for areas with high sedimentation. A site-specific study for the Manupali watershed (Rola et al. 2008) indicated a 27% drop in lowland rice yield due to siltation of the irrigation system. The area served by the irrigation system was also sharply reduced. In the case of the Malinao dam in the Visayas, siltation from steeply sloped upland areas has shortened the expected service life from 80 to 20 years. In the uplands, traditional maize and cassava cultivation results in an elevenfold increase in soil erosion over more soil-conserving cultivation systems.

In other cases the replacement cost was used in the calculation, and this led to lower estimates—for example, power loss from sedimentation-induced reductions in hydroelectric generation was set at 3% of the total, which was then valued by the additional cost of replacing lost power through petro-based generation. An assumed domestic water supply loss of 5% was valued by the additional cost of replacing the water supply through other methods, such as from deep wells. Summing all these off-site costs together produced a final figure of PhP 6.8 billion for 1988 or 0.8% of gross domestic product (GDP) at that time. Adjusted to current prices, this was roughly equivalent to PhP 27 billion (more than $500 million) in 2007. This amounted to some 0.4% of GDP that year. Even if this estimate is not based on very solid data, it gives an indication of a significant externality and therefore a reason for government at different levels to encourage soil and water conservation beyond what is privately rational.

Summary of Costs

The large variations between per hectare estimates of the costs of land degradation depend on the location, slope, and valuation method used. Extrapolating to nationwide figures is therefore a highly uncertain exercise. Nevertheless an attempt was made, with the following caveats: First,

with few exceptions, the yield difference approach tends to result in larger economic costs than those estimated by the cost of nutrient replacement. However, these estimates came from site-specific studies, which may be poor approximations of the national average. Hence the lower estimate from the replacement cost approach (which purports to estimate a national average, i.e. from Francisco and de los Angeles (1998)) was further amended using more conservative erosion estimates (38 tons per hectare per year), based on Presbitero et al. (1995). These values were applied to an estimate of the upland area of about 7.49 million hectares, based on an assumption of the upland percentage of the total agricultural area in 2007 of some 12.2 million hectares. The resulting figure for on-site costs of land degradation in upland areas only is about PhP 7.6 billion per year in 2007 prices (approximately $150 million). This is equivalent to 0.6% of gross value added in agriculture. This figure may be considered a conservative “lower bound” estimate.

How does this compare with estimates from other countries? Bojö (1996) reviewed 12 studies from Sub-Saharan Africa, showing estimates of annual losses from—in most cases—less than 1% of agricultural GDP to as much as 9% in one case. Some estimates from other regions in the world are considerably higher; for example, Young (1994) reckoned the cost of land degradation at about 3.8% of agricultural value added in South Asia. However, Huang and Rozelle (1997) found that, controlling for agricultural inputs and institutional changes, erosion and salinization reduced grain yields in China by about 0.4% per year in 1976–89. Further work is needed to more accurately pin down the average impact of land degradation on agriculture, and therefore its cost, but these estimates give a sense of the likely magnitude. Finally, the most extensive global compilation of empirical erosion-productivity studies available notes that "In most cases, mean yield losses range between 0.01% and 0.04% per ton of soil loss" (Wiebe 2003:29). Hence, using the erosion estimate of 38 tons per hectare per year implies an annual yield loss on average of 0.4–1.5%.

As noted earlier, the best “guesstimates” of the off-site costs of soil erosion/ land degradation are considerably larger: as much as PhP 27 billion in 2007. Although this number is based on a series of assumptions and individual studies, it does highlight the fact that the off-site costs of land degradation may well be considerably larger than the on-site costs—even though the latter receive much of the attention of government officials and the general public.

Summing on-site and off-site costs yields a total of about PhP 34.6 billion for 2007, or almost $700 million per year. Even if the estimate of the off-site costs was reduced by 50% to take into account some of the uncertainties in this number, the total cost was still over PhP 21 billion in 2007—about $420 million a year.

7.4 Potential Policy Responses

Direct Interventions

Soil conservation technologies can prevent or reduce soil erosion, hence providing on-site benefits to farmers and also reducing the off-site impacts of soil erosion. Under hedgerow intercropping, for example, soil loss drops to a range of 1–5 tons per hectare per year (Sidle et al. 2006). However, the benefits from avoided soil loss should be balanced against the costs of intervention. It turns out that in many cases it is hard to justify the costs of soil erosion measures

based solely on expected on-site benefits. Therefore off-site impacts need to be included to justify many soil control measures.

Decena (1999) found that contour hedgerow technology incurs three types of costs: investment costs, opportunity costs, and maintenance cost. The first category includes labor and planting materials to establish contour hedgerows. The last two cost items are recurring costs: opportunity cost is the loss in farm production due to losing arable land to establish hedgerows, and maintenance costs are largely labor (and perhaps some planting materials) to maintain the hedgerows. In 1989, investment costs were estimated at PhP 28,000 per hectare per year in 2007 prices; opportunity cost was estimated based on the fact that, on average, 16% of farm area is occupied by the hedgerows; and finally, maintenance costs were only PhP 2,000 per hectare per year (in 2007).

Given the expected increase in yields after establishing hedgerows, it turns out that the profitability of the hedgerow investment (from the farmer's perspective) is highly dependent on the interest rate and the erodibility of the soil. Annex Table B.4 gives costs information but in the price level of the original; Appendix Table B.5 presents the net present value (NPV) analysis of different alternatives. The results confirm the intuition that farmers would have an incentive to invest in soil conservation technologies only if they have a low rate of time preference (that is, have long planning horizons) and are able to borrow at a low rate of interest. In most parts of the Philippines, neither condition is likely to be met.

Box 7.1. Introducing Sustainable Upland Development

Nabunturan in Compostela Valley province is one of the many upland municipalities in Southern Mindanao that is perennially plagued by poverty and declining economic productivity because of the continuous degradation of its upland areas from deforestation, soil erosion, slash-and-burn farming, and poor farming techniques. Mayor Macario T. Humol realized the need for a "holistic but radical approach" to protect the uplands from further degradation.

Land use–based barangay development planning (BDP) was the first step toward a sustainable upland development (SUD) strategy. It stems from the principle of engaging all members of the community in an analysis and review of development needs and directions, based on the community's appreciation of existing natural, physical, economic, productive, and biophysical assets and uses of its locale and linking this with future demands and a vision for the future.

The BDP contained schemes to move from mono-cropping to cash crops, agroforestry, and fruit tree production and the use of appropriate land management techniques that support soil and water conservation. Local organizations of community members were established and served as implementation arms for barangay forest protection, labor-based barangay road maintenance, community agricultural extension services, upland village enterprises development, and rural financial services. Local government officials and staff coordinated and partnered with the SUD villages' local organizations, barangay extension workers, barangay forest protection teams, local road maintenance teams, and farmer trainers' groups in the implementation of SUD activities and plans.

By 2006, Nabunturan was considered the fastest LGU adapter of the SUD approach in the province. In 2007, the program reached 6 of the 18 upland barangays in the municipality. The LGU expects to cover all 18 barangays by 2010. It appropriated PhP 250,000–500,000 ($5,750–11,500) a year from 2003 to 2008 from its internal revenue allotment to support implementation of the SUD barangays, with another PhP 300,000 of support from the province. The local barangay councils also allocated PhP 25,000–100,000 of their meager barangay budgets to support extension workers and labor-based community road maintenance activities of the SUD projects.

Partnership and participation of other stakeholders were critical ingredients to Nabunturan's SUD program. A municipal convergence team from other national and local agencies, academic institutions, nongovernmental organizations, and private-sector groups was organized by the LGU to provide

technical assistance and resource support at different stages of implementation—from barangay development planning to road maintenance and marketing development activities. At the village level, the municipal government also deployed full-time agricultural technicians in each SUD barangay to provide day-to-day technical guidance and assistance.

By the second year of implementation, local community members reported 60–80% improvement in production, with dramatic increases in average yields per hectare for all crops in SUD barangays. Farmers attributed this to improvement in farm production and slope management techniques. In many cases, farmers also reported some 30% reduction in production costs as a result of using organic fertilizers they produce themselves. With the improvements in the upland farmers' income and productivity, the local economy improved, along with the LGU's local tax collections.

Finally, Nabunturan's SUD model gave upland community members the opportunity to directly be part of their own development and "triggered a more dynamic barangay local governance system." Through the land-use barangay development planning process, poor upland farmers and their families were able to identify projects that directly addressed their needs as well as participate in implementation. SUD initiatives and activities in the barangays' land use–based development plans became the basis for the long-term development plans of the municipality.

Source: Adapted from Elmer S. Mercado, *A Case Study of Nabunturan, Compostela Valley on the Rehabilitation of its Degraded Uplands through Sustainable Management* (Washington, DC: World Bank, September 2008).

Indirect Interventions

Indirect measures include the use of both property rights (tenure) and economy-wide policies. In the Philippines, property rights policies have included the formalization of tenure in the uplands, which in theory should encourage farmers to make long-term investments in land quality, such as soil conservation, or to shift to permanent crops. In the Philippines, however, there is no clear evidence that formal tenure programs have encouraged long-term behavior. One reason may be that farmers already feel reasonably secure about their informal tenure even without a formal instrument, whether individual or collective (Cramb et al. 2000).

Another set of indirect instruments includes economy-wide policies not specifically targeted to land degradation. (See Box 7.2.) The effect of policy reform packages on land degradation has been explored using local and economy-wide (general equilibrium) models. An example of a local-level analysis is given in Nelson et al. (1998), who applies the APSIM or Agricultural Production Simulator model to simulate the effect of removing trade protection on corn production. This policy is expected to reduce domestic corn prices by 76% (the nominal protection rate at the time of the analysis). All types of land use involving corn planting (open-field, with fallow, and hedgerow intercrop) register negative NPV under any time horizon; this should induce farmers to move to other land uses, hopefully to less erosive crops. Other studies have examined the impact of changes in pricing for various crops and their impact in turn on soil erosion.

Whether the measures are direct interventions (usually on-site) or indirect intervention (either through changes in prices of inputs and products or through the trade regime), the impacts on land use decisions are often complex. Social, cultural, and economic factors all play a role, and, as the results presented have shown, the off-site impacts (both costs and benefits) of changes in land use and land degradation can be substantial—often considerably larger than the on-site impacts.

Box 7.2. Payments for Ecosystem Services

One frequently mentioned solution to the challenge of improved upland management is the new concept of payment for ecosystem services (PES). The idea behind PES is quite simple: healthy ecosystems produce many benefits that are enjoyed by other members of society who pay nothing for these services (usually because they are located downstream or at some distance from the producer of the benefits). Hence, markets fail to send a signal that the ecosystem services have value and that the beneficiaries are willing to pay something to help ensure that those benefits continue. A commonly cited example is the case where upland watersheds that are well managed provide water to downstream consumers. Since traditionally there is no economic link between the upland watershed owners and the downstream consumers, the watershed managers may decide to deforest the watershed, thereby yielding benefits to the landowners, but imposing costs on the consumers—both the quantity and the quality of the water they depend on may be degraded. PES sets up a mechanism whereby payments can be collected from the downstream beneficiaries and transferred to upstream landowners or managers to promote better watershed management.

In theory, both sides benefit: upstream landowners are compensated for land management practices that promote sustainable production of ecosystem services (in this case, clean water), while downstream users can avoid the extra costs of cleaning dirty water or finding alternative (more expensive) sources of water. In practice, PES systems require many conditions to be in place: the downstream beneficiaries must recognize what they are "buying," there needs to be a system in place to collect the payments (perhaps via a water utility bill), some organization needs to hold the funds and then pay the upland providers of the ecosystem services (perhaps a nongovernmental group), and there are monitoring and supervision requirements to ensure that those who receive the payments provide the services being paid for.

Many of the early examples of PES systems involve watershed management and downstream water utilities: two well known ones are Heredia in Costa Rica and the New York City water utility in the United States. Other ecosystems services can also be supported by PES systems. Introducing PES systems in the Philippines has potential, but it is definitely not a universal panacea. The institutional and social requirements to introduce these systems are quite high and in part explain the current fairly limited use of PES around the world.

Source: Pagiola and Platais 2002, 2007.

Chapter 8: Climate Change

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change states that Earth's climate system has changed significantly since the pre-industrial era (IPCC 2007). These developments were partly traced to atmospheric concentrations of key greenhouse gases (GHGs) that posted their highest recorded levels in the 1990s, mainly due to fossil fuel combustion, agriculture, and land use changes. Changes in the climate system include increased frequency and intensity of extreme weather events, which caused global damages of some $40 billion annually in the 1990s, an almost fourfold increase from that of the 1980s (IPCC 2001). Climate change is therefore likely to play an increasingly important role in the development agenda and in the activities of countries and the international development community.

Although the Philippines makes an extremely minor contribution to global greenhouse gases, it is nevertheless highly vulnerable to the impacts of climate change because of its location, geography, and exposure to periodic El Niño and La Niña climatic effects (World Bank 2008). These extreme and recurring natural events have consequences for a range of sectors, including agriculture, infrastructure, fisheries, and water resource management, among others. This chapter reviews climate-related problems, trends, and impacts at an early stage, as well as the Philippines' response to climate change so far. In line with the recently approved Country Assistance Strategy (CAS) (World Bank Group 2009), recommendations are also made to help further integrate climate risk awareness and responsiveness into economic, operational, and development planning. The CAS commits the World Bank to assist both in adaptation to climate-induced risks and in the reduction of greenhouse gas emissions.

8.1 Climate Change Vulnerabilities and Impacts

In 2005, the Philippines was responsible for only about 0.4% of the world's carbon dioxide equivalent(CO_{2e}) emissions (142 Mt, including from agriculture, but excluding emissions from land use changes) (WRI 2009). Nevertheless, the country is significantly at risk and vulnerable to extreme weather events that are expected to be exacerbated by climate change. About half of its total area and more than 80% of its population are considered vulnerable to natural disasters. Some 85% of its annual gross domestic product is endangered, as it is based on areas of risk (World Bank 2008). Usually 20 typhoons hit the country a year, of which 5 are expected to cause major damage in terms of both lives and property. The Philippines is also vulnerable to sea level rise, since about 70% of the country's 1,500 municipalities are along the coast. A large portion of the population also lacks the socioeconomic resiliency to withstand climate-related and other stresses on their own, given that 28% of total households were below the poverty line in 2006 (Balisacan 2008). A large segment of the poor live in natural disaster–prone areas.

Various models and indicators project that unabated climate change will considerably change the temperature, precipitation, and sea level conditions and patterns in the country. A warming of

0.1°–0.3° C per decade is projected by the Climatic Research Unit (CRU) of the University of East Anglia (Hulme and Sheard 1999). The major impact areas were identified to be eastern Mindanao, portions of Samar, Quezon, western Luzon, Metro Manila, and other highly urbanized areas. Meanwhile, a doubling of atmospheric CO_2 is expected to induce a 60–100% increase in annual rainfall in the Central Visayas and Southern Tagalog provinces, including Metro Manila; a 50% or less increase in the other areas of Luzon, Samar, and the Central and Western parts of Mindanao; and a decrease in annual rainfall in other sections of the country such as Northern and Eastern Mindanao and parts of Western Luzon (Republic of the Philippines 1999). The National Mapping and Resource Information Authority (NAMRIA) estimated that a sea level rise of 100 cm would inundate a total area of 129,114 hectares, affecting approximately 2 million people. The CRU estimated that a 30-cm rise in sea level (which may be reached by 2045) would regularly inundate over 2,000 hectares of the Manila Bay area, threatening about half a million people, while a 100-cm rise would threaten over 5,000 hectares of the Bay and affect more than 2.5 million people.

Changes in temperature, precipitation, and sea level in turn have impacts on agriculture through crop yields and irrigation demands; on forestry through changes in forest productivity and forest composition; on water resources through the variability of water supply and quality; on coastal areas through the erosion of beaches and inundation of these areas; on species and natural areas through shifts in ecological zones and the loss of habitat and species; and on health through infectious diseases, air quality-respiratory illnesses, and water-related mortality (Lasco et al. 2007).

Meanwhile, the Philippines' Midterm Progress Report on the Millennium Development Goals (MDGs) expects climate change to have a devastating impact on the attainment of the MDGs, mostly through a series of natural disasters. It therefore highlighted the importance of climate change adaptation and long-term disaster risk management.

8.2 Philippine Response to Climate Change

Policy and Legal Initiatives

In terms of international commitments, as early as 1991 the Philippines began to address the issue of climate change in its thrust to achieve sustainable development with the formulation of the Philippine Strategy for Sustainable Development. This paved the way for the country's official adoption of *Agenda 21* and its formulation of the *Philippine Agenda 21 (PA 21)*. The country also ratified the United Nations Framework Convention on Climate Change (UNFCCC) on August 2, 1994. The Kyoto Protocol, in turn, was signed on April 15, 1998, and then ratified on November 20, 2003, enabling the Philippines to participate in the Clean Development Mechanism (CDM), even though the Philippines does not have any responsibility or commitment to reduce or limit its anthropogenic emissions of greenhouse gases. Moreover, the Philippines is a signatory to various international conventions related to climate change. These include the Convention on Biological Diversity, Convention on Wetlands, Convention on Migratory Species, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Convention to Combat Desertification, Montreal Protocol on Substances that Deplete the Ozone Layer, Rotterdam Convention on the Prior Informed Consent Procedure for Certain

Hazardous Chemicals and Pesticides in International Trade, Basel Convention on the Trans-boundary Movements of Hazardous Wastes and their Disposal, Cartagena Protocol on Bio-safety, and Convention on the Law of the Sea.

In terms of national laws, the Philippine Constitution states that "it is the policy of the State to protect and advance the right of the Filipino people to a balanced and healthful ecology in accord with the rhythm and harmony of nature". There are also four laws that explicitly address climate change:

- The Agriculture and Fisheries Modernization Act (1997) states that the Department of Agriculture (DA), together with other appropriate agencies, should take into account climate change, weather disturbances, and annual productivity cycles in order to forecast and formulate appropriate agricultural and fisheries programs.
- The Philippine Clear Air Act (1999) provides that the Department of Environment and Natural Resources (DENR), together with concerned agencies and local government units (LGUs), should prepare and implement national plans that are in accordance with UNFCC and other international agreements, conventions, and protocols on reducing greenhouse emissions. In addition, it establishes that meteorological factors affecting ozone depletion and GHGs should be monitored and standards should be set.
- The Biofuels Act (2006) seeks to pursue energy sufficiency and security in ways that help reduce the emission of GHGs.
- The Renewable Energy Act (2008) provides incentives for renewable energy investors, including tax credits on domestic capital equipment and services, special realty tax rates on equipment and machinery, tax exemption of carbon credits, duty-free importation mechanisms, and income tax holidays, among others. The new law also provides for the establishment of a Renewable Portfolio Standard system, which would require electricity suppliers to source a certain amount of their energy supply from renewable resources such as wind, solar, hydro, geothermal, and biomass. The standard would also be complemented by a feed-in tariff system to encourage speedy entry into renewable energy projects.

Climate change is also mentioned in the Medium Term Philippine Development Plan (MTPDP) for 2004–2010 in connection with the potential of participating in the CDM and emerging carbon market. Adaptation to climate change is usually referred to in the document within the context of disaster risk reduction, which has also been incorporated as one of the priority concerns in the government's 10-Point Action Plan for Effective Governance (Lasco et al. 2007). Similarly, in at least four chapters the government addresses the needs of victims of disasters. The recent update of the MTPDP 2004–2010 shows additional progress in the mainstreaming of climate change in decision making. Climate change was, for the first time, mentioned in the agribusiness chapter—first, in the context of science and technology–based innovations in the sector, especially for mitigation, and, second, in the call for the adoption of climate change adaptation models and technologies for agriculture.

In the energy sector, the major programs center on energy efficiency as well as promotion and use of new and renewable energy (NRE) sources. Under the Philippine Energy Plan–2004 to 2013, NRE sources are envisioned to contribute significantly to the country's electricity supply. The primary energy supply from NRE by 2013 is projected to reach 53% of the total supply

(about 400 million barrels of fuel oil equivalent), an increase from 51% (274 million barrels) in 2004.

At the subnational level, some LGUs, especially those in disaster-prone areas, have been active in the promotion of climate change risk management. For instance, a multistakeholder National Conference on Climate Change Adaptation was convened by the Provincial Government of Albay in partnership with the DENR and the World Agroforestry Centre. It was held in Legazpi City on October 22–24, 2007, to discuss the potential impacts of climate change on the Philippines, to explore adaptation options for current climate risks and future climate change, and to discuss the policy implications of climate change to local government units. The major output of this conference was the Albay Declaration on Climate Change, which was subsequently submitted to President Arroyo (See Annex 1 in Garcia Rincón and Virtucio 2008). The Province of Albay is actively pursuing follow-through activities within the framework of the declaration, which includes working on a plan of action to give priority to climate change adaptation in the national agenda, promoting "climate-proofing" development through multisectoral participation in the development national strategic framework on climate change adaptation, among other programs.

Organizational and Implementation Mechanisms

At the level of broad policy oversight and coordination, the Philippine Council for Sustainable Development (PCSD) was created on September 1, 1992, as a multistakeholder participatory body in order to chart environment and sustainable development initiatives in the country as well as to oversee and monitor the implementation of *PA 21*. The PCSD is headed by the Director-General of the National Economic and Development Authority (NEDA) as Chairperson and the Secretary of the DENR as Vice-Chairperson. The members come from various government departments and civil society groups and organization. One of its main functions is to establish guidelines and mechanisms to operationalize the sustainable development principles embodied in the Rio Declaration and incorporate them in the preparation of the MTPDP at national and local levels.

On disaster management, the highest policy-making body is the National Disaster Coordinating Council (NDCC). It also coordinates the actions of the respective member agencies responsible for disaster preparedness, mitigation, response, and rehabilitation. The NDCC does not have a regular budget but operates through member agencies and their local networks, namely the regional and local disaster coordinating councils. Members of the NDCC include the Secretary of the Department of National Defense as chair as well as the Secretaries of the Departments of Public Works and Highways, Transportation and Communication, Science and Technology (DOST), Social Welfare and Development, Agriculture, Education, Finance, Interior and Local Government (DILG), Trade and Industry (DTI), Health (DOH), Environment and Natural Resources, Tourism, Budget and Management (DBM), Philippine Information Agency, National Economic and Development Authority, and Labor and Employment (DOLE). Other members include the heads of the Philippine Atmospheric, Geophysical, and Astronomical Services Agency (PAGASA); Philippine Institute of Volcanology and Seismology; Philippine Nuclear Research Institute; National Housing Authority; Philippine Red Cross; Armed Forces of the

Philippines; and the Office of Civil Defense (OCD). The OCD also serves as the secretariat and operating arm of the NDCC.

On climate change policy oversight and coordination, the Presidential Task Force on Climate Change (PTFCC) was created in 2007 to address and mitigate the impact of climate change in the Philippines, paying special attention to adaptation, mitigation, and technological solutions. In particular, the task force focuses on improving compliance with air emission standards and acts to combat deforestation and environmental degradation. Executive Order 774, issued on December 26, 2008, reorganized the PTFCC in order to clarify the lines of authority and oversight as well as to give more prominence to climate change. The President and the newly established Presidential Adviser on Climate Change (PACC) are now respectively chairs and vice-chairs of the task force, which now includes the whole Cabinet as well as two representatives from the private sector and civil society. The office of the PACC also now serves as the secretariat of the PTFCC. Moreover, 16 PTFCC task forces, composed of the relevant national government agencies, were also created for more focused and time-bound interventions on solid waste management; protected areas; watershed protection; clean water conservation; rainwater conservation; water recycling; atmospheric activities; fossil fuels; information; fisheries; agriculture; education; foreign affairs; renewable energy; conservation, protection, and restoration economics; and outdoor and rooftop structures. More recently, Executive Order 785, signed on February 26, 2009, directed the PTFCC to develop a national climate change framework and information and education program and to coordinate and review government and donor-funded climate change projects.

Supporting the PTFCC is an Advisory Council on Climate Change Mitigation, Adaptation and Communication; the Inter-Agency Committee on Climate Change (IACCC); and the Klima Climate Change Center (KCCC). The council includes the leading climate change experts in the country. The IACCC was created in 1991 to coordinate various climate change–related activities, propose climate change policies, and prepare the Philippine positions on climate change convention negotiations. It also serves as the technical arm of the PTFCC. Meanwhile, the KCCC serves as the national body that disseminates information on climate change, raises awareness, conducts relevant research, and supports national capacity building.

In the area of climate change mitigation, the Philippines' Designated National Authority for the Clean Development Mechanism is the DENR, which evaluates, in accordance with the Philippines' national approval criteria, whether a project activity contributes to the country's sustainable development and whether the Philippine-based project participants have the legal capacity to participate in the proposed project. DENR Administrative Order No. 2005-17 prescribes the national approval criteria for CDM, where participants must be in a legal capacity to participate and where CDM projects must contribute to the Philippines' sustainable development. There were 19 projects registered with the CDM Executive Board as of 3 July 2008, which are expected to prevent emission of 611,824 tons of CO_2 equivalent per year (see Annex 3 of Garcia Rincón and Virtucio 2008). This makes the Philippines No. 7 in terms of the number of project activities registered globally.

Partnerships with International Organizations

Various programs and projects have also been undertaken in cooperation with concerned international development agencies. Most of these initiatives are grant-funded assistance that is focused mainly on capacity building. These include the Asia Least Cost Greenhouse Gas Abatement Project, which identified mitigation options; the formulation of the National Action Plan on Climate Change, which designed mitigation measures that are "no regrets" in character; and the "Enabling Activity on Climate Change," which intends to build the capacity of various government institutions to prepare its initial national communication to the UNFCCC. Most donor-funded projects have been on climate change mitigation, largely in the energy sector. Nevertheless, these also include environment programs with climate change mitigation components either through community-based forest management or air pollution abatement programs (e.g., the Metro-Manila Air Quality Program of the Asian Development Bank (ADB)).

Only recently have climate change adaptation interventions been initiated, focusing initially on the agriculture sector. These include the recently concluded ProVention Consortium grant-funded Agriculture Climate Risk Assessment Project, which undertook risk analysis for climate and disaster risk management for the agriculture sector. In addition, a $5 million GEF-funded Philippine Climate Change Adaptation Project Phase 1 will soon be implemented to develop and demonstrate the systematic diagnosis of climate-related problems and the design of cost-effective adaptation measures, while integrating climate risk awareness and responsiveness into economic and operational planning, particularly in agriculture and natural resources management. GTZ and the German Environment Ministry are also assisting the Philippines with a euro 4.25-million, three-year (2009–11) Adaptation to Climate Change and Conservation of Biodiversity in the Philippines project, which seeks to assist in the development of national adaptation and mitigation policies policies and strategies, the conservation and sustainable management of biodiversity, and preparation for getting access to funds from international carbon trade. The DENR is leading a team of concerned national government agencies, LGUs, nongovernmental organizations, and other civil society organizations in these projects.

Meanwhile, the UN system, with Spanish government funding, is partnering with the NEDA and selected national government agencies and LGUs to implement an $8-million, three-year (2008–10) project on Strengthening the Philippines' Institutional Capacity to Adapt to Climate Change. This project will determine the vulnerability of critical sectors to climate change, strengthen the capacities of key stakeholders in adapting to climate change, and pilot adaptation demonstration projects. The Coral Triangle Initiative, which is a new multilateral partnership to help safeguard the marine and coastal resources of the Eastern Pacific, has also been launched.

At the local government unit level, the U.N. International Strategy for Disaster Reduction (ISDR), together with CITYNET and the World Bank's East Asia Sustainable Development Department and in partnership with the Global Facility for Disaster Reduction and Recovery (GFDRR), held a regional workshop for city planners on May 12–13, 2008, in the city of Makati to initiate a dialogue on strategies to mitigate and adapt to potential impacts of climate change and associated natural disasters at the local level. More particularly, it pilot-tested the World Bank–developed *Practitioner's Handbook for Reducing Vulnerability to Climate Change Impacts and Related Natural Disasters in East Asia* among the participating city planners.

In addition, the GFDRR plans to sponsor two upcoming engagements with LGUs: a World Bank–UN ISDR partnership with the League of Cities on Climate Change and Cities (an initiative that seeks to support cities with analysis, investment planning, and capacity building for climate change adaptation using the recently released *Practitioners' Handbook on Climate Change*) and a World Bank partnership with NDCC/DILG and local institutions on Supporting Local Government Capacity to Manage Natural Disaster Risks in the Philippines (an initiative to help high-priority local governments assess their risks and take necessary action to improve mitigation and take adaptive measures). Moreover, there is also a joint ADB–World Bank–Japan Bank for International Cooperation initiative on Climate Impact and Adaptation in Asian Coastal Cities. This supports the analysis of future climate conditions and assists local governments to adapt their investment plans to those future conditions. Several coastal mega-cities have been identified for analysis, including Bangkok, Ho Chi Minh, Jakarta, Karachi, Kolkata, and Manila.

8.3 The Way Forward

The assessment of current climate change–related needs, initiatives, and capacities shows that there is a need to further mainstream climate change risk management in national, local, and sector decision-making processes. This is especially important for climate change adaptation concerns, which should be the strategic focus of the Philippines, as a minor emitter of GHGs. Moreover, the enabling environment for climate risk management would benefit from further improvements in awareness raising and advocacy, financing, and technology transfer. The recently approved CAS gives significant attention to the topic of climate change and provides a mandate for increasing World Bank support to the Philippines in this area (World Bank Group 2009).

National Level

Although climate change has been mentioned more frequently in the updated 2004–2010 MTPDP, it continues to be narrowly directed since it is mentioned in only two chapters: three times in the Green Philippines Chapter and twice in the Agribusiness Chapter. To the extent that the MTPDP determines public resource allocation, climate change risk management is not expected to be a high-priority government expenditure. Similarly, in terms of national laws, it was found that few laws address mitigation of climate change, such as the Clean Air Act, or prescribe adaptation strategies to potential impacts of climate change. In addition, a Land Use Act has yet to be passed, making the protection of land resources more difficult.

Moreover, further elaboration appears to be needed in the current Philippine Climate Change Strategic Framework and Action Plan, given the very general statements provided here. For instance, the framework merely states that climate change adaptation and mitigation measures will both be undertaken in an integrated and balanced manner without elaborating on how this will be achieved. It puts mitigation and adaptation on an equal footing even though the latter should be the more strategic concern for a minor GHG emitter like the Philippines. Meanwhile, the framework states that GHG emissions will be reduced mainly through an energy-friendly energy supply mix that targets energy reduction goals by 2012. Even though land use is the

major source of GHG emissions in the country, it is not mentioned as a priority area of intervention.

Although the Philippines is a minor GHG emitter, it should nevertheless fully exploit the available technical and financial global facilities addressing climate change, which, for now, more heavily support mitigation. The strategic framework should provide clear directions that would address obstacles and opportunities to enhance the country's participation in the growing carbon market. If further developed, the Philippine Climate Change Strategic Framework and Action Plan can be more helpful in mainstreaming climate change in the MTPDP and other sector strategies, plans, and programs. It can also more effectively input into the DBM's annual Paper on Budget Strategy, which rationalizes the configuration of the following year's National Government budget. And by integrating climate change issues into thematic concerns, it could further enrich the *Philippine Agenda 21*, which is an instrument of government, civil society, and business for monitoring the country's compliance to its *Agenda 21* commitments.

By sector, most climate change mitigation activities in the country involve energy and reforestation. Meanwhile, current climate change adaptation interventions are mostly in agriculture. Other sectors, however, also require attention, given the significant impact that climate change is expected to have on them. These include fisheries, coastal management, urban transport, and water supply and resource management.

Local Level

The mainstreaming of climate change risk management in the decision-making processes of LGUs may still take some doing due to the lack of information as well as the short planning horizon of local government executives. The former challenge can be handled through a more intensive and extensive information, education, and communication campaign. This can be institutionalized and regularized through the development of orientation and training materials for use by the Local Government Academy of the DILG in its mandatory orientation program for new LGU officials as well as in the regular skills upgrade and training of LGU staff. Getting LGU executives to deliberately and systematically consider climate change risk management in their decisions is, however, more of a challenge. These executives are in office for nine years at the most and thus usually focus more on short-gestating development programs and concerns. Hence, the strategic focus of the advocacy and capacity building efforts should perhaps be in stabilizing the local bureaucracy and in constituency-building within this bureaucracy and in local communities. This would foster a strong demand that local executives have to respond to as well as help gear a local bureaucracy for long-term planning and development.

Box 8.1. Preparing for Natural Disasters

The town of Infanta in Quezon province almost got obliterated when millions of cubic meters of floodwater, uprooted tree trunks, cut logs, and mud ran down from the eroded slopes of the Sierra Madre mountains near the end of the 2004 November monsoon season. A day after Typhoon Winnie hit Infanta and the neighboring towns of Real and General Nakar, the whole area was completely devastated and isolated from the outside world. The hundreds of lives lost, the property destruction, and the livelihoods uprooted by this disaster left an indelible memory on all Infanta residents about the threats of natural calamities to the town's very survival.

Infanta's community-based disaster preparedness and management (CBDPM) program was born out of the November 2004 disaster. The town focused its disaster plan on the empowerment and mobilization of its people to respond effectively to any kind of calamity. "You are on your own," or *YoYo*, was the lesson people learned: they alone will have to respond within 24 hours to any future disasters.

Infanta organized and trained individual residents, their families, their barangays, and their communities to respond appropriately to any disaster or emergency. The LGU also empowered small multisectoral "core groups" within the community to plan, implement, monitor, and sustain, in a participatory manner, any disaster preparedness and risk reduction program.

The barangays learned that their community could reduce the risks of natural hazards by reducing residents' vulnerabilities, implementing the important four Ps of the CBDPM program—Predict, Plan, Prepare, and Practice—and focusing on their own community-based early warning and communication systems. Infanta installed community-based early warning systems and established two-way radio communication between barangays. It also conducted annual drills and exercises for flashflood, fire, and earthquake preparedness.

The municipality focused critical attention on the underlying cause of the November 2004 disaster and previous natural calamities in the area: the denudation and deforestation of the Sierra Madre mountain ranges. Together with the towns of Real and Nakar, in 2006 Infanta formed a forest management council to counteract rampant illegal logging and protect the remaining forestlands in their upland areas with strict enforcement of forestry laws, joint patrolling and operations against illegal loggers, and monitoring of illegal activities. With strong coordination with environment departments, local police, and military authorities, the council significantly reduced illegal activities over three years.

Many people had speculated that it would take at least 10 years for Infanta to recover from the havoc brought by the landslides and flashfloods in 2004, but this was accomplished in just three years. Through prudent fiscal management and maximization of the LGU's budgetary outlays plus the continuous support of its residents, the town managed to rehabilitate and repair all its municipal roads, bridges, and other infrastructures that were damaged by the disaster.

One of the more stunning effects of Infanta's recovery is its impressive fiscal performance, which increased its local revenue collection and reduced its dependence on the internal revenue allocation. The town's rehabilitation efforts pushed its economy forward, with increases in the number of new business investments and operations in the municipality. By September 2008, the Municipal Business Permit Office reported that 527 new enterprises had been registered since 2005 and that the total number of registered business was more than double the pre-disaster level.

Although Infanta's recovery from the November 2004 catastrophe is not complete, the physical, social, emotional, economic, and institutional rehabilitation it has determinedly pursued have made its people, communities, and institutions stronger and better prepared to face the future challenges of nature and its devastating effects.

Source: Adapted from Elmer S. Mercado, *A Case Study of the Municipality of Infanta, Quezon Province Community-based Disaster Preparedness and Management (CBDPM): Surviving and Recovering from a Natural Catastrophe: A Contribution to the Philippines Country Environmental Analysis* (Washington, DC: World Bank, September 2008).

Cross-Cutting Concerns

There is a need to upgrade as well as build decision-making tools that would foster the mainstreaming of climate risk management in national and local development processes. There is insufficient capacity among the concerned nongovernmental agencies for climate change monitoring, modeling, and evaluation. Thus empirical evidence of policy impacts vis-à-vis sectoral baseline status is currently unavailable. In addition, available and accessible data and information relating to environment and its degradation are yet to be systematically linked to the trends of climate change in the Philippines. Similarly, supplementary development planning, programming, budgeting, monitoring, and evaluation manuals or primers on climate change that

will provide the framework, specific steps, and indicators of the integration of climate change in public sector decision-making processes should also be developed. These can be used in the regular planning, programming, and monitoring and evaluation activities of both national and local government agencies. The World Bank's *Practitioner's Handbook for Reducing Vulnerability to Climate Change Impacts and Related Natural Disasters in East Asia for Cities/LGUs* can be used to develop such supplementary manuals/primers.

The enabling environment for climate risk management should be further enhanced. For instance, the relative affordability of GHG mitigation technologies (e.g., using renewables in power production interventions) is often cited as a critical factor that determines the pace of climate change management promotion in decision-making processes. There is likewise a dearth of technological and resource support for climate change adaptation interventions, especially in comparison with the support received by mitigation programs. It should be noted that most developing countries, like the Philippines, are better off focusing more on climate change adaptation measures.

The inadequate mainstreaming of climate change concerns in decision-making means that local financing for these initiatives has been constrained. Meanwhile, global financial facilities for climate change have been largely used for mitigation. So far, most of these are available and accessible only to national governments. There is therefore a need to further mobilize greater, more diverse, sustainable instruments and sources of domestic and international financing that are locally appropriate for climate change risk management. Local governments, communities, and the private sector must also be helped to gain access to these financing facilities and instruments. Annex 7 of Garcia Rincón and Virtucio (2008) provides a comprehensive list and description of the various global climate change funding facilities. These include the recently established Clean Technology Fund, which has begun to support national-level investment plans to transform the energy and transport sectors in several countries. The Government of the Philippines has recently requested the assistance of ADB and the World Bank to pursue this avenue. More generally, it is hoped that the global negotiations around a new climate change regime in Copenhagen in late 2009 will provide additional institutional certainty and financial means to combat the world's most pervasive externality: climate change.

Annex A: Environmental Health: Methodology and Assumptions

This annex provides further detail of estimation and valuation of health effects presented in the chapters on outdoor air pollution (OAP), indoor air pollution (IAP), and water, sanitation, and hygiene (WSH). It starts with an overview of the general methodology used to estimate health effects and their economic cost. There are many similarities across the three areas of pollution impacts. This is followed by a more detailed discussion of the estimation of health effects and their valuation, with subsections on OAP, IAP, and WSH. Further detail is provided in Arcenas (2009).

The estimation of health effects begins by identifying the relevant health endpoints—that is, the types of diseases that have a well-documented relationship with air or water pollution and sanitation and hygiene. The second step is to examine the existing health statistics to see which illnesses have sufficient data for the calculations.

Third, in order to estimate the number of morbidity and mortality cases due to the environment from the total cases in the country, the attributable fractions (AF) are calculated based on population exposure to environmental risk factors and relative risks (RR) of illness or mortality from exposure. Fourth, the AFs are multiplied with the total number of cases of illness and mortality in the Philippines to determine the number of cases that are due to the environment.

Fifth, once the health effects of OAP, IAP, and WSH are estimated, economic valuation techniques are applied to estimate the cost to society of these health effects. For the cost of morbidity, the cost-of-illness (COI) approach is applied, which involves estimating treatment costs and income and time losses. For the cost of mortality, the human capital approach (HCA) is applied as a lower bound and the value of statistical life (VSL) is applied as an upper bound.

A.1 Estimating Health Effects

The selection of relevant diseases is based on international literature, as identified in the main text. The analysis follows a conservative approach and only includes diseases for which a well-documented relationship with air or water pollution and sanitation and hygiene exists.

Baseline Health Data

The second step involves a review of available data in the Philippines. The main data source for baseline morbidity cases for the diseases under consideration (except diarrhea, chronic obstructive pulmonary disease (COPD), and tuberculosis) is the 2003 Field Health Surveillance Information System (FHSIS) Report of the Department of Health. However, these data need to be adjusted, as the FHSIS only reports figures for those who sought treatment from rural health centers and barangay health units.

Since almost all the cases of WSH-related illnesses are diarrhea, a more detailed approach to calculating the number of cases is described here (see Table A.1), based on the Philippines Demographic and Health Survey 2003 (the DHS 2003) for children under 5 and World Health Organization (WHO) regional incidence estimates for the population over 5 years of age (World Bank 2008a). The figures for treatment-seeking behavior derived for diarrhea are then applied to the baseline case figures for the breakdowns necessary for economic valuation.

Table A.1. Per Capita Diarrheal Cases, 2003

Age Group	Diarrhea Cases per Capita	Source
Under 1	2.75	DHS 2003
1 to 4	2.08	DHS 2003
5 to 14	0.33 (improved sanitation) 0.52 (unimproved sanitation)	WHO, WPR-B
15 and older	0.16 (improved sanitation) 0.26 (unimproved sanitation)	WHO, WPR-B

Source: Philippines DHS 2003, World Bank 2008a.

For COPD, 2003 Philippine population figures are divided into age groups to which regional COPD incidence per 1,000 people is applied from Shibuya (2001) (see Table A.2).[52] Appropriate treatment-seeking figures were then applied to the baseline incidence figures.

Table A.2. COPD Incidence Rate for Each Age Group

Age Group	Incidence Rate (per 1,000 population)	
	Male	Female
0 to 4	0	0
5 to 14	0	0
15 to 29	0.03	0.06
30 to 44	0.36	0.44
45 to 59	1.21	0.38
60 to 69	4.44	1.75
70 to 79	5.19	2.07
80 and older	5.14	3.43
Total	0.55	0.32

Source: Shibuya 2001 for SEAR B region.

The 2003 FHSIS reports figures for visits to barangay health units and rural health centers for respiratory tuberculosis. The general methodology used for the other diseases is applied to respiratory tuberculosis data to arrive at 2003 baseline morbidity figures, but no distinction is made as to whether these cases are new or old. The study adopts WHO estimates of 108,062 cases for the Philippines in 2003.

[52] The Philippines is in the WHO region of WPR B. This region is predominately China in terms of population; thus regional incidence largely reflects China (with much higher incidence than most other countries in the region). Incidence in SEAR B region (Indonesia, Thailand, Sri Lanka) is therefore applied to the Philippines.

In terms of mortality, baseline annual figures are taken from the Department of Health's *Philippine Health Statistics* (PHS) report (DOH 2003). The official number of deaths reported may be significantly underestimated due to underreporting (particularly in the rural areas and for deaths of those under 5) and to some extent inaccurate reporting of the cause of death. To address this, the published data on the number of deaths reported per disease were adjusted by age-specific adjustment factors in light of an under-5 child mortality rate of 36 per 1,000 live births and a crude mortality rate of 5.0 per 1,000 population in the Philippines in 2003 (see Table A.3).

Table A.3. Adjustment Factor Used to Adjust for Published Mortality Figures from PHS

Age Group	Adjustment Factor
Under 5	2.42
5 and older	1.05

These adjustment factors are applied to mortality figures caused by all the diseases under consideration except those caused by diarrhea and typhoid fever. Mortality from these two diseases are from WHO 2002 country-specific estimates of diarrheal mortality in the Philippines adjusted to 2003 and from typhoid mortality in the *Economic Impacts of Sanitation in Southeast Asia* report (World Bank 2008b). These figures were then divided according to age group using the ratio derived from the number of deaths due to diarrhea and typhoid reported by the PHS (DOH 2003).

The third step involves determining relative risk ratios and from there on calculating the attributable fractions of morbidity and mortality from OAP, IAP, and WSH.

Morbidity Cases

Outdoor Air Pollution

Relative risk ratios from Martuzzi et al. (2002) based on their review of international literature are used to estimate OAP-related morbidity, outlined in Table A.4. Only the health endpoints marked with an * are used in the calculations for the Philippines, as these are the only endpoints for which morbidity figures and full treatment-seeking behaviors can be estimated.

Table A.4. Health Outcomes and Relative Risks (per PM_{10} 10 µg/m3)

Cause	Central Estimate	Lower Limit 95%	Upper Limit 95%	Notes
Mortality excluding accidental causes	1.026	1.009	1.043	Adults 30+
Hospital admissions for CVD causes	1.009	1.006	1.013	
Hospital admissions for respiratory disease*	1.016	1.013	1.020	
Chronic bronchitis	1.093	1.009	1.180	Adults 25+

Acute bronchitis*	1.306	1.135	1.502	Children <15
Asthma exacerbation	1.051	1.047	1.055	Children <15
Asthma exacerbation	1.004	1.000	1.008	Adults 15+
Restricted activity days	1.094	1.079	1.109	Adults 20+
Occurrence of respiratory symptoms*	1.07	1.02	1.11	

Source: Martuzzi et al. 2002.

There is a need to adjust these RRs, as they represent a 10 μg/m^3 increment in PM_{10} concentrations.

To compute the relative risk ratios for the diseases due to PM_{10} exposure, population-weighted annual PM_{10} concentrations are substituted into an equation taken from Ostro (2004)[53]:

$$RR = \exp\left[\beta\left(PM_{10,Actual} - PM_{10,Counterfactual}\right)\right] \qquad \text{Equation 1}$$

Using 15 μg/m^3 as the counterfactual PM_{10} level, the β coefficients and the RR ratios for each of the health endpoints under consideration are given in Table A.5.

Table A.5. Relative Risks for OAP-related Illnesses, 2003

Health Outcome	β	Relative Risks		
		Metro Manila	Urban	Rural
Acute bronchitis, under 15	0.0267	4.6356	1.8733	1.0
Hospital admissions for respiratory disease	0.0016	1.0955	1.0380	1.0
Occurrence of respiratory symptoms	0.0068	1.4751	1.1804	1.0

Note: An RR of 1 means that no elevated risk is assumed in rural areas due to OAP.

The attributable fraction of diseases that are related to outdoor air pollution are calculated using a general formula in Ostro (2004):

$$AF = \frac{\sum_{i=1}^{n} P_i(RR_i - 1)}{1 + \sum_{i=1}^{n} P_i(RR_i - 1)} \qquad \text{Equation 2}$$

where P_i is the proportion of the subpopulation that is exposed to outdoor air pollution and RR_i is the respective relative risk of a specific disease or health outcome in the subpopulation.

[53] This equation produces a substantially higher RR than the log-linear equation in Ostro, i.e., $RR=[(PM_{actual} + 1)/(PM_{counterfactual},+1)]^{\beta}$ and may overestimate cases of morbidity from OAP. However, due to data constraints, the health endpoints for which OAP morbidity is estimated for the Philippines is only a subset of endpoints evidenced in the international literature.

Table A.6 summarizes the attributable fractions that were computed using the relative risk ratios above and, in turn, were used to estimate the number of cases of OAP-related diseases. The AF for acute bronchitis was applied to reported/registered cases in children under 15. The AF for hospital admissions was applied to hospitalized cases of acute bronchitis in population 15+ years old and hospitalized cases of acute lower respiratory infections in all age groups. The AF for respiratory symptoms was applied to non-hospitalized cases of acute lower respiratory infections (other than acute bronchitis) in all age groups. Upper respiratory symptoms were not included because of data unavailability.

Table A.6. Attributable Fractions Used to Calculate the OAP-related Illnesses

Health Outcome	Attributable Fractions
Acute Bronchitis, under 15	0.42343
Hospital Admissions for Respiratory Disease	0.02555
Occurrence of Respiratory Symptoms, all ages	0.11297

Source: Arcenas 2009.

Indoor Air Pollution

For IAP the methodology is adapted from Desai et al. (2004). The AFs used to estimate the number of cases of illnesses resulting from exposure to IAP are computed as for OAP. Only those health outcomes strongly associated with indoor air pollution and with accessible and adequate Philippine data are included. Table A.7 outlines the relative risk ratios used for IAP-related morbidity. Health outcomes associated with coal smoke (**) are not included in the analysis because coal is not regularly used as a fuel for cooking in the Philippines.

Table A.7. Relative Risk Ratios Used to Calculate the Number of Cases of IAP-related Illnesses

Evidence	Health Outcome	Group (based on gender and age)	Relative Risk Ratios
Strong	Acute lower respiratory infection (ALRI)*	Children <5	1.8
	COPD	Women □30	3.2
	Lung cancer (from exposure to coal smoke)**	Women □30	1.9
Moderate-I	COPD	Men □30	1.8
	Lung cancer (from exposure to coal smoke)**	Men □30	1.5
Moderate-II	Lung cancer (from exposure to biomass smoke)	Women □30	1.5
	Tuberculosis	All □15	1.5

Source: Desai et al. 2004, * Dherani et al. 2008.

One other important piece of information needed to calculate the AFs for IAP-related illnesses is the size of the population in the Philippines that is exposed to IAP. This is approximated by the

percentage of the population that reported using solid fuels as their primary cooking fuel in the Philippines Household Energy Consumption Survey 2004 (HECS 2004). The results indicate that 48% of household members are exposed to indoor air pollution.

Data from the HECS make it possible to determine the percentage of households in Metro Manila, other urban areas, and rural areas that use fuelwood, charcoal, and other biomass residue as their primary cooking fuel. Because cooking practices and the structural characteristics of houses in the Philippines may mitigate the exposure of Filipino households to indoor air pollution and the subsequent health outcomes, these figures are adjusted by the associated ventilation factors. Desai et al. (2004) suggest using a ventilation factor of 0.25 for households that use improved stoves or cook outside, and a ventilation factor of 1.00 for those that use traditional stoves. A ventilation factor of 0.25 is used for urban and rural areas outside Metro Manila—as households in these areas typically do their cooking outside their houses. Metro Manila households that use solid fuel, however, are assigned a ventilation factor of 0.5, since they are generally found in informal settlement areas where houses are crammed together. With these assumptions, the proportions of the cases of the relevant health outcomes identified that can be attributed to exposure to indoor air pollution are computed. By applying these ventilations factors, the adjusted population exposure is 0.14, in contrast to the unadjusted exposure of 0.48.

Water, Sanitation, and Hygiene

For water, sanitation, and hygiene, the analysis included five diseases—diarrhea, cholera, schistosomiasis, typhoid and paratyphoid fever, and viral hepatitis—for which 2003 morbidity data are available and for which there is sufficient information relating these illnesses to WSH. Table A.8, which is based on the Philippines Environment Monitor 2006 (World Bank 2007), lists the attributable fractions for these illnesses (excluding diarrhea, which has a separate section).

Table A.8. Attributable Fractions for WSH-Related Diseases (Excluding Diarrhea)

Disease	Attributable Fraction	Source
Cholera	100%	World Bank 2007
Schistosomiasis	100%	Prüss-Üstün et al. 2004
Typhoid and paratyphoid fever	50%	World Bank 2007
Viral hepatitis (Hepatitis A)	50%	World Bank 2007

Source: World Bank 2007.

Prüss-Üstün and Corvalan. (2006) list more diseases that are related to water: helminthiasis, malaria, intestinal nematode infections (ascariasis, trichuriasis, hookworm disease), trachoma, chagas disease, onchoceriasis, leishmaniasis, Japanese encephalitis, and dengue fever. These diseases, however, are excluded from this report either due to a lack of national data or a lack of sufficient evidence of AFs and WSH .

The attributable fraction for diarrhea is computed using Equation 2, where P_i corresponds to the proportion of the population subject to a specific WSH exposure category and RR_i is the relative risk of diarrhea associated with that WSH category relative to a WSH environment absent of

disease transmission (Table A.9). The exposure categories used for diarrhea are based on Prüss-Üstün et al. (2004).

The FHSIS 2003 indicates that 83% of households have access to safe drinking water, while 76% have access to sanitary toilets. Since national coverage is less than 98%, all households in the Philippines can be categorized under exposure scenarios IV, Va, Vb, and VI, as described in Table A.9.

The FHSIS Reports contain national, regional, provincial, and city-level data on the number of households that have access to safe drinking water and sanitary toilets across the country. However, these data are insufficient to be able to come up with the number of households that are under the classifications in Table A.9. Therefore the Philippines DHS 2003 is used to estimate the national, Metro Manila, urban-area, and rural-area population proportions that are exposed to the four different exposure scenarios.

Categorizing Philippine households into the four applicable exposure scenarios makes use of Hutton and Haller's (2004) definitions for improved water supply and improved sanitation. Improved water supplies are those that are relatively accessible to people and for which some measures are taken to protect the water from contamination; improvements do not however guarantee the safety of the water from these sources. Improvements in sanitation facilities involve better access and safer disposal of excreta.

Table A.9 shows the proportion of the national population under the different exposure scenarios and the corresponding relative risk of diarrhea. So even for the population with improved water supply and basic sanitation, the risk of diarrheal disease remains high—i.e., 6.9 times higher than absence of transmission of disease from WSH.

Table A.9. Relative Risks and Population Proportions Used to Compute Attributable Fraction for Diarrhea

Exposure Categories	Category Description	**Relative Risk Of Diarrhea**	Percent of Population in Exposure Categories
VI	Population not served with improved water supply and no improved sanitation in countries that are not extensively covered by those services (less than 98% coverage), and where water supply is not likely to be routinely controlled	11.0	5.2
Vb	Population having access to improved water supply but not served with improved sanitation in countries that are not extensively covered by those services, and where water supply is not likely to be routinely controlled (less than 98% coverage)	11.0	9.8
Va	Population having access to improved sanitation but no improved water supply in countries where less than 98% of the population is served by water supply and sanitation services and where water supply is likely not to be routinely controlled	8.7	10.8

IV	Population having access to improved water supply and improved sanitation in countries where less than 98% of the population is served by water supply and sanitation services and where water supply is likely not to be routinely controlled	6.9	74.2

Source: Exposure categories and relative risks are from Prüss-Üstün et al. (2004). Percent of population in exposure categories is estimated from the Philippines DHS 2003 (Arcenas 2009).

Applying equation 2 to the relative risks and population shares in each exposure category, suggests that nearly 86% of all diarrhea cases in the country can be attributed to water and sanitation conditions. A summary of these AFs is presented in Table A.10.

Table A.10. Attributable Fractions for WSH-related Illnesses, 2003

Disease	Region Applied	Attributable Fraction
Diarrhea	Metro Manila	85%
	Urban	85%
	Rural	86%

Source: Arcenas 2009.

Mortality Cases

Mortality from IAP and WSH was calculated using the same RRs and AF as for morbidity. Mortality from OAP is calculated using the framework suggested by Ostro (2004). The following equations are used to compute locality-specific relative risks, depending on ambient particulate matter (PM) exposure concentrations:

PM_{10} exposure: $$RR = \exp\left[\beta\left(PM_{10,Actual} - PM_{10,Counterfactual}\right)\right] \quad \text{Equation 3}$$

$PM_{2.5}$ exposure: $$RR = \left[\frac{PM_{2.5,Actual}+1}{PM_{2.5,Counterfactual}+1}\right]^{\beta} \quad \text{Equation 4}$$

where PM_{Actual} are annual average monitored concentrations (see Chapter 2) and $PM_{Counterfactual}$ is 15 ug/m^3 for PM_{10} and 7.5 ug/m^3 for $PM_{2.5}$ (see Ostro 2004). Equation 3 is used to estimate the relative risk of respiratory mortality in children under 5, and equation 4 is used to estimate relative risk of cardiopulmonary and lung cancer mortality in adults 30 or older. Tables A.11 and A.12 show the β coefficients used, the resulting relative risk ratios, and the attributable fractions of mortality due to PM exposure.

Table A.11. Relevant Particular Matter and β Coefficient of RR Formula for OAP-related Health Outcomes

Health Outcome	Particulate Matter	β Coefficient
Respiratory mortality, under 5	PM_{10}	0.00166
Cardiopulmonary mortality, 30 and older	$PM_{2.5}$	0.15515

Lung cancer, 30 and older	$PM_{2.5}$	0.23218

Source: Ostro 2004.

Table A.12. Relative Risk and Attributable Fraction for OAP-related Health Outcomes

Health Outcome	Relative Risk			Attributable Fraction
	Metro Manila	Urban	Rural	
Respiratory mortality, under 5	1.10006	1.03980	1.0	0.03058
Cardiopulmonary mortality, 30 and older	1.31085	1.13199	1.0	0.08298
Lung cancer, 30 and older	1.49940	1.20386	1.0	0.12472

Source: Arcenas 2009.

Diarrhea and Malnutrition Links to Mortality[54]

Indirectly, poor WSH contributes to child malnutrition through the effect of diarrheal infections on nutritional status. Malnutrition increases the risk of child mortality from disease as well as increases the incidence of disease (Fishman et al. 2004).[55] This indirect effect of WSH mainly affects children under the age of 5. The approach used to estimate the indirect health effects of WSH in children is as follows: the effect of diarrheal infections on children's nutritional status is first determined from a review of the research literature; the counterfactual nutritional status is estimated (that is, the nutritional status that would have prevailed in the absence of diarrheal infections); and the health effects of observed nutritional versus counterfactual nutritional status are estimated.

Commonly used indicators of poor nutritional status are underweight, stunting, and wasting.[56] Underweight is measured as weight-for-age (WA) relative to an international reference population.[57] Stunting is measured as height-for-age, and wasting is measured as weight-for-height. Underweight is an indicator of chronic or acute malnutrition or a combination of both. Stunting is an indicator of chronic malnutrition, and wasting an indicator of acute malnutrition. Underweight status is most commonly used in assessing the risk of mortality and morbidity from poor nutritional status (Fishman et al. 2004). A child is defined as mildly underweight if his or her weight is in the range of –1 to –2 standard deviations (SD) below the weight of the median child in the international reference population, moderately underweight if in the range of –2 to –3

[54] This section is based on Larsen 2008.
[55] Malnutrition and poor nutritional status are used here interchangeably.
[56] Micronutrient deficiencies are not explicitly evaluated here but are found in other studies to have a significant cost (Horton 1999, Horton and Ross 2003, World Bank 2006). Also, Alderman and Behrman (2006) find a significant cost associated with low birth weight, which in part is caused by low maternal pre-pregnancy body mass index (Fishman et al. 2004).
[57] The international reference population is defined by the National Center for Health Statistics, United States, or by the World Health Organization's international reference population.

SDs, and severely underweight if below –3 SD from the weight of the median child in the reference population. The standard deviations are also called z-scores and noted as WAZ (weight-for-age z-score).

Repeated infections, and especially diarrheal infections, have been found to significantly impair weight gains in young children. Studies documenting and quantifying this effect have been conducted in communities with a wide range of infection loads in a diverse group of countries, and World Bank (2008c) provides a review of these studies. These studies typically find that diarrheal infections impair weight gains in the range of 20–50%. A mid-point—that is, 35% of children's weight deficit—is here attributed to diarrheal infections to estimate the indirect disease burden from WSH (Larsen 2007).[58] So in the absence of weight-retarding infections, the weight-for-age z-score of an underweight child would be approximately 40% greater than the observed z-score (that is, observed WAZ*(1–0.4)).[59] For instance, if a child has a WAZ of –3, then in the absence of weight-retarding infections the child's WAZ would be –1.8.

The prevalence of underweight malnutrition rates in the Philippines is presented in Table A.13. Current rates are for the most recent year available. Prevalence of mild underweight is not officially reported. Mild underweight is however important in relation to increased risk of child mortality (Fishman et al. 2004). This rate was therefore estimated based on international comparisons.

Counterfactual prevalence rates of underweight—that is, prevalence rates in the absence of weight-retarding infections—were estimated based on comparative countries in Asia for which original survey data of child nutritional status are available. This was performed through the following procedure: Counterfactual WAZ-scores were calculated for each underweight child in household survey using the formula discussed above (WAZ reported for each child in the survey multiplied by (1–0.4)). Counterfactual underweight prevalence rates were then tabulated using the counterfactual WAZ-scores.

In the absence of diarrheal infections, it is estimated that practically no children would be severely underweight and the prevalence of moderate underweight would be as low as 2%. The prevalence of mild underweight would increase somewhat, as child nutrition status would change from severe/moderate underweight to mild underweight.

Table A.13. Current and Estimated Counterfactual Underweight Prevalence Rates in Children under 5 in the Philippines

	Current prevalence rates*
Severe underweight (< –3 SD)	8.8%
Moderate underweight (–2 to –3 SD)	19.2%
Mild underweight (–1 to –2 SD)	29.3%
Not underweight (> –1 SD)	42.7%
	Counterfactual prevalence rates

[58] A child's weight deficit is the difference between observed weight and the weight of the median child in the international reference population.
[59] This is calculated using the WHO Anthro 2005 software.

Severe underweight (< –3 SD)	0.10%
Moderate underweight (–2 to –3 SD)	2.0%
Mild underweight (–1 to –2 SD)	32.0%
Not underweight (> –1 SD)	65.9%

* Moderate and severe underweight prevalence combined was 28% in the Philippines and is not reported separately. Nor is the prevalence of mild underweight reported. Distribution of mild, moderate, and severe underweight is therefore estimated by international comparison.
Source: Current prevalence rate of underweight malnutrition is from Philippines National Nutrition Surveys 2003 (ENRI).

Various health and debilitating effects from malnutrition are documented in the research literature. This includes long-term chronic illnesses from low birth weight, effects of iodine, vitamin and iron deficiencies, and impaired cognitive development (UN 2004; World Bank 2006). The focus here is on mortality in children younger than 5 associated with underweight.

Fishman et al. (2004) present estimates of increased risk of cause-specific mortality and all-cause mortality in children under 5 with mild, moderate, and severe underweight from a review of available studies. Severely underweight children (WA < –3 SD) are five times more likely to die from measles, eight times more likely to die from ALRI, nearly 10 times more likely to die from malaria, and 12 times more likely to die from diarrhea than non-underweight children (WA > –1 SD). Even mild underweight doubles the risk of death from major diseases in early childhood (see Table A.14).

Table A.14. Relative Risk of Mortality from Mild, Moderate, and Severe Underweight in Children Under 5

Weight-for-age	**< –3 SD**	**–2 to –3 SD**	**–1 to –2 SD**	**> –1 SD**
Pneumonia/ALRI	8.1	4.0	2.0	1.0
Diarrhea	12.5	5.4	2.3	1.0
Measles	5.2	3.0	1.7	1.0
Malaria	9.5	4.5	2.1	1.0
Other causes of mortality*	8.7	4.2	2.1	1.0

* Only other infectious diseases are included here (see Fewtrell et al. 2007).
Source: Fishman et al. 2004.

These relative risk ratios can be applied to the underweight prevalence rates in Table A.13 to estimate attributable fractions of mortality from diarrheal infections through their effect on nutritional status (underweight status).[60] The following formula is used to calculate attributable fractions of mortality from ALRI, measles, malaria, and "other infectious diseases" indirectly caused by diarrheal infections:

[60] The attributable fraction of mortality from malnutrition is the percent of deaths (e.g., percent of ALRI deaths) caused by malnutrition.

$$AF = \frac{\sum_{i=1}^{n} P_i RR_i - \sum_{i=1}^{n} P_i^C RR_i}{\sum_{i=1}^{n} P_i RR_i} \qquad \text{Equation 5}$$

where RR_i is relative risk of mortality for each of the WA categories (i) in Table A.13; P_i is the current underweight prevalence rate in each of the WA categories (i); and P_i^c is the counterfactual underweight prevalence rate in each of the WA categories (i). For diarrheal mortality the AF estimation procedure would be different because there are two risk factors: the direct effect of WSH and the indirect effect through malnutrition. As already 86% of diarrheal infections and mortality are estimated to originate from WSH, the additional effect of malnutrition is minimal and is therefore ignored here.[61]

The most recent available estimates of annual cases of mortality in children under 5 are presented in Table A.15. These estimates reflect an under 5 child mortality rate of 36/1000 in 2003, and the structure of cause-specific deaths is estimated from WHO country estimates of cause-specific mortality in 2002 (WHO 2004).

Table A.15. Estimated Cause-specific Annual Deaths in Children Under 5 in 2003

Cause	**Deaths**
Diarrheal disease	10,700
ALRI	12,600
Measles	2,900
Malaria	400
Protein-energy malnutrition	1,100
Low birth weight	8,600
Other perinatal conditions	16,500
Other infectious and parasitic	3,200
Other causes	18,500
Total	74,500

Source: Adjusted to 2003 from WHO country estimates of mortality by cause in 2002 (WHO 2004), by applying child mortality rate in 2003.

Applying the AFs from equation (5) to the cases of mortality in Table A.15 provides an estimate of malnutrition-related mortality from poor WSH (see Table A.16). Mortality in children from protein-energy malnutrition is estimated separately using the methodology in Fishman et al. (2004) and attributing a fraction of this mortality to WSH in proportion to the effect of diarrheal infections on malnutrition.

[61] See Larsen (2007) and World Bank (2008) for methodology and estimation of environmental health effects from multiple environmental risk factors in Ghana and Pakistan.

In total, child mortality attributable to WSH from malnutrition (that is, the indirect effect of infections through malnutrition) totals more than 7,600 deaths per year, or over 10% of total under 5 child mortality.

Table A.16. Estimated Annual Malnutrition-related Mortality in Children under 5 from Poor WSH, 2003

Cause	Number of Cases
ALRI	4,828
Measles	880
Malaria	164
Protein-energy malnutrition	475
Other infectious diseases	1,269
Total	7,616

A.2. Economic Valuation of Health Effects

Economic Valuation of Morbidity

The economic burden of morbidity is broken down into direct cost to households for treatment, government subsidies to treatment, and income and time losses due to illness.

The data used to derive treatment-seeking behavior (see Table A.17) were taken from the Philippines DHS 2003 and from key informant interviews conducted by Arcenas. For each disease, the percentage of people who sought treatment from rural health centers and barangay health units was used to estimate the baseline data from the FHSIS figures. The baseline morbidity cases data are then appropriated to the treatment-seeking behaviors outlined for each disease. Cost of illness also depends on the duration of the disease. The duration (treatment/confinement) of the diseases is shown in Table A.18.

Table A.17. Percentage Share of Illnesses per Health-Seeking Behavior

Disease	Health Center	Gov't Hospitals	Private Hospitals	Private Doctor	Self Treatment	Traditional Healer	No treatment
ALRI	14.2	8.4	11.6	6.3	19.8	39.7	NA
Bronchitis	25.7	0.2	0.3	11.4	22.1	40.3	NA
COPD	26.1	0.6	0.9	11.5	11.6	8.7	40.6
Tuberculosis	13.9	7.6	10.5	6.2	7.5	9.6	44.7
Cholera	14.1	8.7	12.1	6.2	16.5	42.4	NA
Diarrhea	17.5	0.6	0.9	7.7	31.0	20.6	21.7
Hepatitis	11.6	7.2	10.0	5.1	33.3	32.8	NA
Schistosomiasis	9.3	5.8	8.0	4.1	34.9	27.8	10.1
Typhoid	12.3	7.6	10.5	5.4	25.6	38.5	NA

Source: Arcenas 2009.

Table A.18. Average Number of Days of Treatment/Confinement

Disease	Health Center Cases	Government Hospital Cases	Private Hospital Cases	Private Doctor Cases	Self Treatment Cases	Traditional Healer Cases
ALRI	8	3	3	8	8	8
Bronchitis	4	3	3	4	4	4
Cholera	10	8	8	10	10	10
Diarrhea	5	3	3	5	5	5
Hepatitis	7	6	6	7	7	7
Schistosomiasis	7	5	5	7	7	7
Tuberculosis	180	180*	180*	180	180	180
Typhoid	14	4	4	14	14	14

* Five days of hospitalization.

Source: PhilHealth and key informant interviews as reported in Arcenas 2009.

Household Treatment Cost

To determine the direct costs of treatment to households, the calculated number of cases for each disease attributable to OAP, IAP, or WSH according to health-seeking behavior was multiplied by the associated unit costs and days of treatment. These include the cost of confinement, consultation fees, and medicines. The costs were based on PhilHealth data and key informant interviews. Table A.19 presents the associated costs per health-seeking behavior and other assumptions regarding treatment costs. The cost of hospitalization varies depending on type of disease and is estimated at PhP 500–1,250 per day of confinement in government hospitals and PhP 1,000–2,500 per day of confinement in private hospitals. All costs in Table A.19 are adjusted to 2007 prices by an inflation factor of 1.246.

Table A.19. Associated Costs per Health-Seeking Behavior, 2003

	Health-Seeking Behavior					
Cost	Health Center Cases	Government Hospital Cases	Private Hospital Cases	Private Doctor Cases	Self-Treatment Cases	Traditional Healer Cases
Cost of confinement*	None	Adjusted PhilHealth data	Adjusted PhilHealth data	None	None	None
Consultation fee	PhP10	Included in the lump sum amount reported by PhilHealth	Included in the lump sum amount reported by PhilHealth	PhP500 MM and Urban PhP300 Rural	None	PhP150 MM and Urban PhP90 Rural
Medicine cost**	PhP12/day	Included in the lump sum amount reported by	Included in the lump sum amount reported by PhilHealth	PhP12/day	PhP12/day	PhP12/day

		PhilHealth				

*Confinement costs include doctors' fees, in-house medicines, room and board. The cost is based on the lump sum figure from PhilHealth adjusted with assumption that PhilHealth pays 35% of total cost per confinement. ** Medicine cost per day is assumed to be the same for all diseases. Total medicine cost depends on the duration of the disease.

Government Subsidy

Total confinement cost (net of PhilHealth contribution) for government hospitals cases is the basis for the computation of the government subsidy. This report assumes that 50% of the total cost (net of PhilHealth contribution) of confinement (mainly the daily room rate) in public hospitals is subsidized by the government.

Income and Time Losses due to Illness

The indirect costs of morbidity are: (a) lost income of individuals who missed work while getting treated and recovering from illness or caring for ill children; and (b) time losses of other individuals while getting treated and recovering from illness or caring for ill children. The latter group is individuals who do not work for income but nevertheless perform valuable household and other activities for the welfare of the household. The assumptions regarding the indirect costs are as follows:

- Lost income due to illness and caretaking of ill children is calculated only for the members of the population working for income in the 20–64 year age group.[62] Age-specific employment rates in the DHS 2003 were used to estimate the population share working for income (see Table A.20).
- Foregone income from caretaking of ill children is only computed for parents of children under 5 years old. It is assumed that caretaking is by mothers. Thus income loss from caretaking is in relation to the employment rate of women.
- Time losses from illness and caretaking of children (under 5) of individuals not working for income was valued at 75% of wage rates. This rate was applied only to the age group 20–64 years old.
- No indirect cost is estimated for the age groups 5–19 and 65+. Thus total indirect cost is conservatively estimated in this respect, as the time losses of these individuals also have a value.

Table A.20. Employment in Age Group 20–64

Sex	Employed
Women	51.6%
Men	80.1%

Source: Estimated from DHS 2003.

Income or time losses for ill adults (20–64 years) are calculated for the full number of days of hospitalization or treatment elsewhere, with the exception of non-hospitalized cases of diarrhea.

[62] Mandatory retirement age in the Philippines is 65. Only a small share of the population under 20 is working, according to DHS 2003. Income loss calculations are therefore restricted to age group 20–64 years.

For those, only 25% of days of treatment/disease duration are applied to calculation of income or time losses, as diarrhea is generally less severe than the other illnesses included in this report. Income and time losses from caretaking of children being ill (all diseases in this report) is calculated for the full number of days of hospitalization or for 25% of disease duration/treatment for cases treated elsewhere or not treated. Days of disease treatment/duration are presented in Table A.21. Share of cases of illness for each category of treatment is as in Table A.17.

Table A.21. Days of Illness Used for Estimating Indirect Cost of Morbidity

Disease	Health Center Cases	Government Hospital Cases	Private Hospital Cases	Private Doctor Cases	Self-Treatment Cases	Traditional Healer Cases	No Treatment
ALRI	6	8	8	6	6	6	NA
Bronchitis	4	3	3	4	4	4	NA
Cholera	8	6	6	8	8	8	NA
Diarrhea	5	3	3	5	5	5	1
Hepatitis	5	5	5	5	5	5	NA
Schistosomiasis	5	10	10	5	5	5	5
Tuberculosis	60	60	60	60	60	60	60
Typhoid	10	10	10	10	10	10	NA

NA=not applicable (all cases are assumed treated).
Source: Arcenas 2009.

The government of the Philippines publishes wage rates in industrial sectors. These rates are not sufficient, however, to calculate national average agriculture, industry, and service sector weighted wage rates. Gollin (2001) reports factor or income shares for the Philippines from UN National Accounts Statistics 1992 (latest year available at time of publication). Employee compensation is 35% of gross domestic product (GDP). However, self-employment income is treated as capital income and therefore substantially underestimates labor income share of GDP in countries with high agriculture share of GDP and/or non-agriculture self-employment share of labor force. Assuming 50/50 to labor and capital of self-employment income, Gollin suggests that labor income share of GDP is 66% in the Philippines. To be conservative, a labor income share of GDP or gross national income (GNI) of 50% is applied here to estimate national average wage rates. Thus national wage rate is estimated as follows:

$$W = \beta * GNICAP /(P_s * L_s) \qquad \text{Equation 6}$$

where β is labor share of GNI (assumed to be 50%); GNICAP is GNI per capita; P_s is population share in age group 20–64; and L_s is labor force participation or employment rate in age group 20–64. According to the DHS 2003, about 50% of the population is 20-64 years old and 65% of individuals in this age group are employed. Thus, in 2003, with a GNI per capita of $1,070, the national average wage rate is about $1,650 or PhP 89,000 per year, or $6.35 (PhP 340) per day

assuming 260 working days per year. Adjusted to 2007 prices, the annual wage rate is PhP 111,000 or $2,410.[63]

Economic Valuation of Mortality

Two approaches to valuation of mortality is used: the human capital approach (HCA) and value of statistical life (VSL). To determine the economic burden of mortality in terms of the HCA, the present value of foregone potential lifetime earnings is calculated per death. To calculate foregone lifetime income, income is assumed to grow at 2.1%—equal to the average GNI per capita growth rate from 1999 to 2006—per year in the future. Since life expectancy for Filipinos is 67 for men and 72 for women, as reported by WHO, each premature death is assumed to reflect lost income from the time of death until the mandatory retirement age in the Philippines of 65. For children, lost income is calculated from age 20 to age 64. Future income is discounted from age of death at an annual rate of 3% following WHO standard practice.

Annual income applied to calculate the human capital value at time of death is the estimated wage rate used for morbidity—i.e., $1,650 or PhP 89,000 in 2003. As only about 65% of individuals in age group 20–64 are employed, per the DHS 2003, weighted average annual income is about PhP 58,000 ($1,070) per person in the age group in 2003, or PhP 72,000 in 2007 prices. This weighted annual income is applied to all deaths, resulting in the human capital values in Table A.22. The human capital value for children under 5 is the same of OAP, IAP, and WSH, but varies for the population over 5 years in relation to the age distribution of estimated mortality from OAP, IAP, and WSH.

[63] Using an inflation factor of 1.246 in local currency and exchange rates of PhP 54.2 in 2003 and PhP 46 in 2007.

VSL is based on valuation of mortality risk estimated through revealed or stated preferences. It is important to note that VSL does not imply placing a value on any particular person's life or on the suffering and grievance that are associated with death. However, people's behavior and statements reveal something about the economic benefits of reducing the statistical risk of death. This is important for rational social decision-making. Mrozek and Taylor (2002) provide a meta-analysis of VSL estimates from labor market studies around the world. The study concludes that a range for VSL of $1.5–2.5 million can be reasonably inferred from these studies when "best-practice" assumptions are invoked. The sample of countries used in Mrozek and Taylor (2002) has an average GNI per capita of $30,000.[64] Since there are insufficient studies of VSL conducted in the Philippines, the benefit transfer approach is applied using an income elasticity of 1 as a conservative estimation. In other words, it is assumed that willingness to pay for mortality risk reductions is proportional to the income level across countries. This results in a VSL of $72,000 in year 2003, or about $105,000 (PhP 4.867 million) in 2007 prices. Table A.22 presents the VSL applied to mortality and is uniform across age groups. VSL is used as an upper bound and the HCV as a lower bound for cost of mortality.

Table A.22. Unit Valuation of Mortality (PhP thousand in 2007 prices)

Valuation	OAP	IAP	WSH
VSL	4,867	4,867	4,867
HCV (children under 5)	2,050	2,050	2,050
HCV (population 5+ yrs)	315	438	1,434

Note: VSL is value of statistical life, and HCV is human capital value.
Source: Based on Arcenas 2009 for year 2003, adjusted to 2007 prices.

[64] Atlas methodology—i.e., market-based exchange rates—are used, as opposed to purchasing power parity.

Annex B: Natural Resource Data

Annex Table B.1. Summary of Net Benefits from Coastal and Marine Resources, 2006
(million PhP)

Benefits	Ecosystem					Oceanic	Total	
	Mangrove	Seagrass	Coral Reef	Other Coastal	Subtotal		Amount	Percent
Provisioning								
Fisheries	143.1	56.7	997.6	5,912.4	7,109.8	3,176.9	10,286.7	42.7
Timber	595.2				595.2		595.2	2.5
Subtotal	*738.4*	*56.7*	*997.6*	*5,912.4*	*7,705.0*	*3,176.9*	*10,881.9*	*45.2*
Cultural								
Recreation	26.5		94.7	125.6	246.8	—	246.8	1.0
Education/ research	7.5	8.3	10.1	4.7	30.6		30.6	0.1
Existence			199.3	16.8	216.1	1.4	217.5	0.9
Subtotal	*34.1*	*8.3*	*304.1*	*147.0*	*493.5*	*1.4*	*494.8*	*2.1*
Regulating								
Carbon seq.	172.2				172.2		172.2	0.7
Shoreline protection	854.1		2,018.4		2,872.5		2,872.5	11.9
Waste assimilation	53.8	25.2	695.1	6,091.9	6,866.0		6,866.0	28.5
Subtotal	*1,080.1*	*25.2*	*2,713.5*	*6,091.9*	*9,910.8*		*9,910.8*	*41.2*
Supporting								
Mariculture				2,775.1	2,775.1		2,775.1	11.5
Total	**1,852.6**	**90.1**	**4,015.2**	**14,926.5**	**20,884.3**	**3,178.3**	**24,062.6**	**100.0**
Percent	**7.7**	**0.4**	**16.7**	**62.0**	**86.8**	**13.2**	**100.0**	

Notes:
The value of shoreline protection assumes 10% probability of occurrence of major disturbances that will have widespread impact on the coastal zone, based on a cursory analysis of the frequency of major storms in the country over the last 60 years. Existence values are for the survey sites of studies cited. Waste assimilation pertains to avoided costs to mitigate environmental pollution on coastal and marine waters. Derivation of other values is discussed in Chapter 5.

Annex Table B.2. Summary of Net Benefits from Coastal and Marine Ecosystems per Unit Area, 2006

Ecosystem	Area		Provisioning	Cultural	Regulating	Supporting	Total
	(sq. km.)		(PhP per hectare)				
Coastal	266,200		289	19	372	104	785
Mangrove	2,091		3,531	163	5,165	—	8,859
Seagrass	978		579	85	257	—	921
Coral reef	27,000		369	113	1,005	—	1,487
Other coastal	236,131		250	6	258	118	632
Oceanic	1,934,000		16	0	—	—	16
All ecosystems (per ha)	**2,200,200**		**49**	**2**	**45**	**13**	**109**
			(percent of row total)				
Coastal			36.9	2.4	47.5	13.3	100
Mangrove			39.9	1.8	58.3	—	100
Seagrass			62.9	9.2	27.9	—	100
Coral reef			24.8	7.6	67.6	—	100
Other coastal			39.6	1.0	40.8	18.6	100
Oceanic			100.0	0.0	—	—	100
All ecosystems			**45.2**	**2.1**	**41.2**	**11.5**	**100**

Annex Table B.3. Summary of Environmental Costs to Coastal and Marine Resources, 2006 (million PhP)

Source/ Impact	Ecosystem				Total	Percent
	Mangrove	Seagrass	Coral Reef	Other Coastal		
Unsustainable fishing, etc.						
Total related to Fisheries	207.97	no est.	1,036.33	1,335.01	2,579.31	45.4
Fisheries impacts from habitat degradation and conversion	169.32	0	0.28	0.28	169.89	3.0
Fisheries impacts from overfishing (depletion)	38.65	no est.	1,036.06	1,074.70	2,409.43	42.4
Coastal development	1,890.61		451.41	0.01	2,342.03	41.2
Conversion to fishponds	1,886.19				1,886.19	33.2
Reclamation	4.42		451.41	0.01	455.83	8.0
Pollution	108.15	5.70	115.62	529.93	759.40	13.4
Human morbidity/ mortality				401.66	401.66	7.1
Oil spill (Guimaras)*	108.15	5.70	115.62	122.80	352.27	6.2
Harmful algal blooms				3.47	3.47	0.1
Fish kills				2.01	2.01	<0.1
Climate change			2.10		2.10	<0.1
Coral bleaching			2.10		2.10	<0.1
Total	**2,207**	**no est.**	**1,606**	**1,864**	**5,677**	**100.0**
Percent	**39**		**28**	**33**		
Per unit area (PhP per hectare)	**9,743.27**		**594.52**	**67.96**		

*The Guimaras oil spill was an extraordinary event that occurred in 2006.

Annex Table B.4. Cost Comparison: Open Field and Hedgerow Intercropping

	Open Field	Establishment Phase		Regular Farming	
		Hedgerow	Difference	Hedgerow	Difference
Site with relatively erodible soil					
Labor	16,200	26,500	10,300	18,200	2,000
Others	18,760	17,845	–915	15,645	–3,115
Total	34,960	44,345	9,385	33,845	–1,115
Site with less erodible soil					
Labor	6,200	11,400	5,200	6,900	700
Others	8,500	8,400	–100	8,200	–300
Total	14,700	19,800	5,100	15,100	400

Source: Nelson et al. 1996b.

Annex Table B.5. Approximate Net Present Value for Alternative Farming Methods

	5-year Horizon			25-year Horizon		
	Open Field	With Fallow	Hedgerow	Open Field	With Fallow	Hedgerow
Site with highly erodible soil						
25% discount	10,000	17,000	>10,000	8,000	16,000	<16,000
10% discount	12,000	22,000	15,000	–2,000	20,000	40,000
Site with less erodible soil						
40% discount	11,500	9,000	7,000	10,000	8,000	7,000
12% discount	17,500	12,000	15,000	–18,000	–500	5,000

Sources: Nelson et al. 1996a, 1998.

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