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PAPUA NEW GUINEA
COUNTRY ENVIRONMENTAL ANALYSIS




Mainstreaming Environmental Considerations in Economic and Development Planning Processes

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Cover photographs, clockwise from top left: flute players, Chimbu Province; traditional houses, Enga Province; coastline near Port Moresby; reef fish at Koki Market. (all photographs by James Berdach)

CURRENCY EQUIVALENTS
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K 1.00	=	$0.326
$1.00	=	K3.068

ABBREVIATIONS AND TERMS

ADB	–	Asian Development Bank
ADF	–	Asian Development Fund
ADTA	–	advisory technical assistance
AusAID	–	Australia Agency for International Development
BPOA	–	Barbados Plan of Action for Small Island Developing States
CBD	–	Convention on Biological Diversity
CDM	–	Clean Development Mechanism
CEA	–	Country Environmental Analysis
CITES	–	Convention on International Trade in Endangered Species
COP	–	Conference of Parties
CPA	–	Country Performance Assessment
CSP	–	Country Strategy and Program
CSPU	–	Country Strategy and Program Update
dbh	–	Diameter at breast height
DEC	–	Department of Environment and Conservation
DMC	–	Developing member country
EEZ	–	Exclusive Economic Zone
EFP	–	Eco-Forestry Programme (EU)
EIA	–	environmental impact assessment
EU	–	European Union
FCP	–	Forest Conservation Project
FMA	–	Forest Management Area
GDP	–	gross domestic product
GEF	–	Global Environment Facility
GHG	–	greenhouse gas
ha	–	Hectare
IFI	–	international financial institution
ILG	–	Incorporated landowner group
JICA	–	Japan International Cooperation Agency
km	–	Kilometer
km^2	–	square kilometer
kva	–	Kilovolt-ampere
LLG	–	Local level government
m	–	Meter
MDG	–	Millennium Development Goal
MoA	–	Memorandum of Agreement
MoU	–	Memorandum of Understanding
MPA	–	Marine protected area
MTDS	–	Medium-Term Development Strategy

NAP	–	National Action Programme
NBSAP	–	National Biodiversity Strategy and Action Plan
NCD	–	National Capital District
NGO	–	non-governmental organization
NTDP	–	National Transport Development Plan
NTFP	–	Non-timber forest product
OCR	–	ordinary capital resources
ODS	–	ozone-depleting substance
PARD	–	Pacific Department (Asian Development Bank)
PDMC	–	Pacific developing member country
PNG	–	Papua New Guinea
PNGFA	–	Papua New Guinea Forest Authority
PNGSDP	–	Papua New Guinea Sustainable Development Program
PNRM	–	Papua New Guinea Resident Mission (ADB)
PPTA	–	project preparatory technical assistance
PRES	–	Pacific Region Environmental Strategy
RETA	–	regional technical assistance
SIDS	–	Small Island Developing State
SOPAC	–	South Pacific Applied Geoscience Commission
SPC	–	Secretariat of the Pacific Community
SPREP	–	South Pacific Regional Environment Programme
TNC	–	The Nature Conservancy
TRP	–	timber rights purchase
UNCCD	–	United Nations Convention to Combat Desertification
UNDP	–	United Nations Development Programme
UNFCCC	–	United Nations Framework Convention on Climate Change
UPNG	–	University of Papua New Guinea
VMS	–	Vessel monitoring system
WB	–	World Bank
WMA	–	Wildlife Management Area
WSSD	–	World Summit on Sustainable Development
WWF	–	World Wide Fund for Nature

NOTE

In this report, "$" refers to US dollars.

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Executive Summary

1. The Asian Development Bank (ADB) uses country environmental analysis (CEA) as a tool to assist with early incorporation of environmental considerations into the country strategy and program (CSP) for its developing member countries (DMCs). The CEA provides targeted information necessary for informed decision-making on environmental constraints, needs, and opportunities, including those that impinge upon poverty partnership agreements. The focus is on adding value to planned and ongoing development initiatives by (i) reducing environmental constraints; (ii) exploiting environment-related opportunities; and (iii) promoting actions that can lead to improved mainstreaming of environmental considerations into national economic development and planning processes.

2. This CEA for Papua New Guinea (PNG) describes (i) the general environmental status and trends in PNG, including the role of the environment and natural resources in the economy; (ii) the existing policy, legislative, institutional, and budgetary frameworks for environmental management; and (iii) the principal constraints upon, and opportunities for, improving environmental sustainability. The CEA identifies not only proposed measures to strengthen ADB's country program, but also other measures that government and other donors and international agencies could undertake to help to mainstream environmental considerations as an integral element of future economic development planning and policy-making in the country.

1. Policies, Budget, and Legal Framework

3. Following the World Summit on Sustainable Development in 2002, the government formed a Committee on Sustainable Development, which was charged with the formulation of a new sustainable development policy. This process is still ongoing. Until such a policy is put in place, the Government's principle document guiding development of the nation is the *Medium Term Development Strategy (MTDS) 2005-2010*.[1] The MTDS outlines a three-point strategy for development: (i) good governance; (ii) export-driven economic growth; and (iii) rural development, poverty reduction, and empowerment. The MTDS also presents "Ten Guiding Principles", of which No. 4 is "to maximize the value of… natural resources and environment, through sustainable primary production and downstream processing, with a focus on agriculture, forestry, fisheries, and tourism supported by mining, petroleum and gas." Lacking in the MTDS, however, are concrete guidelines, objectives, and indicators to help achieve sustainability in development, especially in environmental terms.

4. The principal national government agency charged with environmental management and monitoring responsibilities is the Department of Environment and Conservation (DEC), which coordinates with other natural resources agencies at the national level. Several factors have prevented the department from operating effectively in carrying out its responsibilities, many of which are of national and even global importance. DEC has a complement of some 145 staff. However, its operations are hamstrung by inadequate funding and staffing to handle all the assigned functions nationwide. In 2003, the department received just K200,000 for its operations for the year, rendering the agency totally unable to carry out its most basic regulatory functions. Little or no money is available to support the very important functions of surveying, compliance

[1] Key policy and strategy documents, many of them focused on specific sectors, are the following (among others): *National Poverty Reduction Strategy* (draft); *National Population Policy 2000-2010*; *National Urbanization Policy 2005-2020*; *Sustainable Mining Policy*; *Horizon 2020* (National Agriculture Policy); *National Government Tourism Policy* (undated draft; *Papua New Guinea Carbon Trade Policy* (undated draft); and *National Energy Policy* (March 2003).

monitoring, and other field-based activities that the department is mandated to perform, or to develop state-of-the-art facilities and capabilities in data management, geographic information systems (GIS) and similar technologies, that are needed to support informed management decision-making.

5. Although environmental monitoring, regulation, and management are functions of the national government, implementation of most of these functions must occur at the provincial, district, local level government (LLG), and community/village level. However, capacity is extremely weak at the local level. Some of this weakness is partially offset through the activities of other institutions, especially non-governmental organizations (NGOs), academia, and the private sector. Customary landowners also have a potentially large role to play in environmental management matters.

6. The lack of a national sustainable development policy; the absence of a well-articulated statement regarding environmental mainstreaming as a clear policy objective in the MTDS; and weak institutions and lack of a budget allocation that reflects a genuine commitment to support effective environmental monitoring and management, all point to weakness thus far in integrating environmental considerations into the country's economic and development planning processes.

7. Regarding the legal framework, the principles of sound environmental resource management, and sustainable development, are embodied in the Preamble to the PNG Constitution. PNG also has in place a comprehensive body of legal instruments for environmental management. Key among these is the *Environment Act 2000*, which replaces three main pieces of legislation that deal with environmental protection, the Environment Planning Act, Environmental Contaminant Act, and Water Resource Management Act. The merging of these three laws was aimed at streamlining and harmonizing the previous cumbersome and confusing legislation. Other legislation with environmental implications includes the Conservation Areas Act, National Parks Act, Fisheries Act, Forestry Act, Prevention of Pollution of the Sea Act, and the Lands Act (among others). In addition, the Organic Act of 1995 enables provincial governments and Local Level Governments to make their own laws for "transferred powers." Provisions are found within the Environment Act that allow devolution of responsibility for some environmental management functions to the provinces and lower levels of government.

8. Despite this relatively complete body of laws, reality falls far short of the potential the above legal framework should allow for and facilitate. The principal barrier in this regard is the weakness in capacity already noted, both at the national and local level, to independently monitor both large-scale and small-scale activities that have potential adverse environmental impacts.

9. On a broader scale, PNG is party to more than twenty international and regional environmental and resource management agreements, conventions, and treaties. Among these, the three so-called "post-Rio" conventions—the UN Framework Convention on Climate Change (UNFCCC), the UN Convention to Combat Desertification (UNCCD), and the Convention on Biological Diversity (CBD)—are fundamental instruments that provide a framework for achieving environmental sustainability in a global context. As a party to these agreements, PNG has expressed its commitment to pursuing a sustainable development path.[2] However, PNG's

[2] PNG has also endorsed the outcomes and environmental plans of other global summits and conferences, including (among others) the Barbados Plan of Action for the Sustainable Development of Small Islands Developing States

progress on meeting the performance milestones for these conventions has been mixed. The country is perhaps farthest behind in its progress toward meeting milestones for the CBD—to date, the required National Biodiversity Strategy and Action Plan has not been produced. In cooperation with UNDP, PNG has recently initiated a national self-assessment exercise to evaluate the state of progress toward achieving the goals and objectives of the three post-Rio conventions.

10. Similarly, PNG has had mixed results in achievement of the Millennium Development Goals (MDGs). According to the most recent national progress report (2004), the monitoring indicators and the data available were too vague to support any firm conclusions about progress being made toward achieving the environmental MDG (No. 7) in PNG. While PNG is in a low-threat situation with respect to some resources (such as renewable water resources, which are among the most abundant in the world), environmental sustainability is being strained in other areas, especially, for example, through the clearing of land for timber production and agricultural use. Overall, the report cites the lack of accurate information as a key barrier that hinders accurate measurement of trends, effective decision-making, and ultimately, the achievement of environmental sustainability in PNG.

2. ADB's Assistance to PNG

11. ADB's priority focal areas for PNG are: (i) improvement of economic performance and public sector performance, through strengthening of good governance, fiscal discipline, and capacity building; (ii) promoting private sector development, especially in the agriculture and fisheries sectors; (iii) protection and provision of basic services for vulnerable or marginalized groups, including the poor and those affected by HIV/AIDS; and (iv) strengthening of conditions for pro-poor growth, especially through targeted development of key transportation infrastructure in impoverished rural areas of the country.

12. Since joining the Bank in 1971, PNG has borrowed $855.0 million through 56 loans financing 45 projects. There have been 124 technical assistance (TA) grants worth $42 million approved in the same period. Besides this country-specific assistance, PNG has also benefited from regional technical assistance (RETA) projects. Of 12 recent loans in the country program, four have environmental or natural resource linkages. These are (i) Fisheries Development (1656-PNG); (ii) Provincial Towns Water Supply and Sanitation (1812-PNG); (iii) Nucleus Agro-Enterprises (1889-PNG); and (iv) Coastal Fisheries Management and Development (1925-PNG). A tentative program proposed for the 2006 pipeline in the health sector, the Health Sector Development Program II, may also have some environmental implications. A natural resources-related loan previously in the 2006 pipeline, the Agriculture and Rural Development loan, is tentatively programmed for 2007.

13. Grant projects in the pipeline include, for 2005, an HIV/AIDS project; and a PPTA for the Health Sector Development Program II. For 2006, a Land Tenure technical assistance project; technical assistance for Health Sector Capacity Building; and a special ADF grant of $10 million for HIV/AIDS interventions, are included. Of these, the Land Tenure project may have significant ramifications for environmental mainstreaming, given the potentially large role that might be played by customary landowners in sustainable land and resources management.

(1994), the Millenium Declaration of the Millenium Summit (2000), and the Johannesburg Plan of Implementation (JPOI) of the World Summit for Sustainable Development (WSSD) in Johannesburg (2002).

3. Environmental Concerns and Constraints

14. Participatory consultations, supported by studies of relevant policy and technical documents, resulted in identification of a range of environmental issues and challenges in PNG that cross various sectors, which therefore need to be addressed in an integrated manner. Major environmental issues include: (i) *Inappropriate land use practices* due to intensified farming systems that accelerate land degradation (e.g., soil erosion, siltation, and loss of soil fertility); (ii) *Unsustainable logging practices* that result in adverse environmental impacts (e.g., soil erosion, hydrology and water quality impacts, and loss of habitat and biodiversity); (iii) *Destructive fishing practices and coastal pollution due to run-off from land-based activities and oil spills* that cause impacts on coastal and marine resources; (iv) *Environmental impacts of large-scale mining operations* (e.g., discharge of heavy metals, cyanide, and acids into rivers) that cause adverse impacts on forests and water quality; and (v) *Increase of extreme weather events due to climate change* (e.g., El Niño, extreme droughts/floods) that increase vulnerability to impacts of natural disasters.

15. In addition, the analysis identified six key underlying barriers that create or contribute to these problems, and constrain effective environmental management and mainstreaming in PNG. These barriers are as follows: (i) *Institutional* weaknesses in environmental management at national and local level, and *policy and legal framework* that needs to be further strengthened; (ii) Traditional *land tenure system* that constrains integrated land-use management and planning; (iii) need for greater *environmental awareness* generally, and appreciation of environmental values as the basis for sustainable economic growth; (iv) increasing *population pressure*; (v) *data gaps* that constrain effective decision-making and planning; and (vi) *governance issues* that lead to overexploitation of resources.

4. Priorities for Action

16. The findings of this CEA have led to the identification of four priority areas for action that are needed in order to promote more effective environmental mainstreaming, improve environmental conditions, and improve the quality of life of the citizens of PNG. Because of the close interrelationships that exist between human society and environment, the line between social, economic, and environmental priorities is not sharply defined. The four identified priorities are:

(i) alleviating poverty,[3] especially in rural communities;
(ii) improving food security;
(iii) strengthening the institutions responsible for environmental planning and management; and
(iv) taking steps to reverse current trends of environmental degradation, habitat loss, and overexploitation of resources.

[3] In PNG, the linkage between people and their natural environment is more direct than in most countries, as seen by the fact that around 80% of the population are believed to rely primarily on subsistence agriculture, fishing, forest harvesting, and hunting for their everyday food and material needs. Because of this, and the lesser role of the cash economy in the lives of the majority of people in the country, poverty in the PNG context is more appropriately defined in terms of fulfillment of basic human needs, improved quality of life, access to services (e.g., health, education, transport), and reduction in vulnerability, rather than in purely monetary terms.

5. Implications for ADB's Intervention Programs

17. Researchers working in the social and natural sciences have long recognized that the link between people, and the ecosystem and natural resource base, is stronger and more direct in PNG than in most other nations. Given the fact that natural resources are the foundation for virtually all of PNG's cash economy, and support a very large subsistence sector as well, it seems clear that effective environmental management should occupy a correspondingly important position in ADB's statement of country program objectives. The CEA therefore recommends that environmental mainstreaming be incorporated more directly and clearly as a strategic focal area in the PNG CSP.

18. The analysis determined that three projects in the country program could be improved or strengthened to further promote environmental mainstreaming objectives. These include (i) the Nucleus Agro-enterprise Project (loan, ongoing); the Coastal Fisheries Management and Development Project (loan, ongoing); and the Land Tenure Project (TA, pipeline). In addition, through an analysis of strengths, weaknesses, opportunities, and threats (SWOT analysis), it is evident that there are several new project activities that, if added to ADB's country program for PNG, might further environmental mainstreaming and strengthen environmental institutions and management processes. Short descriptions of the rationale for these projects are as follows:

(i) ***Integrated Watershed Management for Sustainable Energy Production (possible PPTA and loan)*** – Over 90% of rural residents lack access to electricity. The focus of the proposed project would be on promoting improved, integrated watershed management, to enable establishment of mini-hydropower facilities for sustainable rural electrification. The project would build upon past efforts to promote "total catchment environmental management." The project would promote improved livelihood opportunities, foster greater awareness of the importance of maintaining forest cover to ensure water retention; promote sustainable land management practices; provide improved access to services; and promote new opportunities for sustainable livelihood development. Potential exists to tap other funding sources for cofinancing of the project (e.g., Global Environment Facility [GEF] and/or the Papua New Guinea sustainable Development Program [PNGSDP] for biodiversity conservation, integrated ecosystem management, or sustainable land management; Clean Development Mechanism [CDM] for mini-hydropower certified emission reduction [CER]).

(ii) ***Facilities Improvements for Provincial Towns Food Markets (possible PPTA and loan)*** – The need for the project is based on the fact that most towns currently lack well-designed and properly built fresh food market facilities. The project would be implemented at the town, local level government (LLG), and district level, in cooperation and consultation with producers, vendors, and consumers. The project would establish or improve market facilities, including necessary infrastructure (e.g., storage and sales areas, water supply, toilets, small access roads, security fencing, waste disposal) that would enable displaying, handling, and selling fresh produce, meat, fish, and poultry in a more hygienic manner than currently practiced. Overall health and sanitation would be improved, and less waste of food would occur due to spoilage or contamination. Improved sanitation and waste disposal, and greater use of practices such as recycling, composting, and waste minimization would reduce pollution. The project would contribute to improved food security and improved opportunities for income generation.

(iii) ***Sustainable Tourism and Infrastructure Development (possible PPTA and loan)*** – Tourism development in PNG represents a sector with great, but largely untapped potential. The focus of the project is on developing tourism in a planned and sustainable manner. Already identified by the Tourism Promotion Authority (TPA) is a need for formulation of a national tourism development master plan. Carrying capacity studies would identify acceptable levels of visitor use at specified sites. Plans would be formulated for tourism development in a number of "model provinces", to be replicated in other provinces around the country. Accompanying infrastructure development would be designed and built to accommodate expected demand and utilization levels, while minimizing environmental impacts. Potential exists to tap other funding sources for cofinancing of the project (e.g., GEF for biodiversity conservation). The project would also seek to improve coordination between the TPA and the private sector, and build on past private sector successes in the industry.

(iv) ***Strengthening of Institutions for Environmental Management (possible AOTA)*** – Although past efforts have been made to improve the capabilities of the Department of Environment and Conservation (DEC),[4] the Department is not yet capable to carry out many of its assigned management, monitoring, and regulatory functions. One of the key problems is the very limited posting of DEC staff outside of the capital. The proposed focus of this project will be to ascertain which responsibilities for environmental management should reside with central government, and which should be transferred to local government; establish improve coordination between DEC and provincial offices; draft model local-level regulations; and initiate training for DEC staff (as future trainers) and provincial personnel to assume a greater level of responsibility in environmental management.

6. Implications for Mainstreaming Environmental Management within PNG

19. Through this CEA, key barriers and important issues in the areas of environmental sustainability and natural resources management have been identified, and out of these have emerged four priority areas of critical concern. Specific interventions have been identified that could help to improve environmental sustainability in various sectors. The CEA also contains an environmental roadmap that can be used to promote more effective environmental mainstreaming. It is hoped that both ADB and the PNG government will make use of this information, and the tools that are presented, to guide future development planning and decision-making processes.

[4] e.g., the AusAID DEC Strengthening Project implemented in the mid-1990s, which mainly facilitated development of the Environment Act 2000.

I. INTRODUCTION

1. The Independent State of Papua New Guinea (PNG) comprises the eastern half of the New Guinea mainland, the world's largest tropical island, along with an archipelago of nine additional main islands and some 600 lesser islets and atolls (map, Figure 1). The population of Papua New Guinea, estimated at over 5 million inhabitants, is scattered widely over 19 provinces and a National Capital District (NCD) in four regions, with the greatest concentration found in the urban areas and in the Highland provinces.

Figure 1 Map of Papua New Guinea

2. Primary activities such as forestry, agriculture, fisheries, mining, petroleum and gas form the backbone of the economy, and these sectors are the major contributors to the export earnings of the country. Subsistence agriculture sustains a large segment of the population. With PNG's development based largely on extraction of natural resources, a number of significant environmental impacts have begun to occur, including environmental degradation, habitat loss, pollution, and resource depletion.

3. In recent years, PNG has been in a state of political instability and frequent government turnover. The present Government, which came to power in August 2002, remains vulnerable, with political infighting continuing among elected members of the National Parliament. The Government, having acknowledged that there is a need for reform, has taken a number of substantive steps, as evidenced by public dialogue, statements of policy and intent, and passage of significant legislation. Despite these advances, corruption remains a critical problem recognized by government leaders and the public alike. Access to basic services is inadequate, especially in rural areas, and crime and violence throughout the country are serious impediments to development. It is believed that a lack of employment opportunities, especially among young people, is a major contributor to the deteriorating law and order situation.

4. Governance issues, and concerns over commitment to real reform, also underlie recent difficulties in relations with PNG's development partners, greatly exacerbating fiscal constraints. Awaiting stronger evidence of genuine commitment to reform, both Asian Development Bank (ADB) and The World Bank have recently terminated or suspended major loan projects. In an effort to bring about improvements in institutional performance, the PNG Government has requested that Australian civil servants be brought in to assume senior positions within the PNG bureaucracy. Also, about 230 Australian police officers are being assigned to work with counterparts on the PNG police force, in an effort to strengthen law enforcement, reduce the incidence of violence and crime, and restore peace-and-order.[1]

5. While the factors described above indicate significant obstacles to development, still there is cause for optimism—tremendous potential exists for improvement in the socioeconomic outlook for PNG. Much of the potential for economic growth and improved quality of life going forward is based upon the country's rich natural resource endowment, which, despite increasing pressures, remains relatively intact. In addition, the country possesses important human capital resources, as represented by a core of motivated, well-trained and highly capable people within government, the private sector, and civil society. With care, the goal of sustainable development can be achieved in PNG, but in order to realize this objective, it will be essential that strong steps be taken to safeguard the natural resource base, protect environmental values and ecological "goods and services," and strengthen the institutions responsible for environmental management. A table presenting current environmental indicators for PNG is presented in Appendix 1; further background details about PNG's physical, political, and economic environment are contained in Appendix 2.

II. RATIONALE FOR COUNTRY ENVIRONMENTAL ANALYSIS

6. The ADB has been providing development assistance to PNG since 1971 (prior to PNG's independence). The overall objective of ADB assistance is to stimulate sustainable economic development and alleviate poverty. One of the core cross-cutting themes of all ADB projects is environmental sustainability.

7. The guiding document that details ADB's framework for lending and technical assistance to PNG is the Country Strategy and Program (CSP). While periodic updates to the CSP have been prepared,[2] it is planned that a new CSP, to cover the program period 2007-2011, will be produced in 2006.

8. Country environmental analysis (CEA) is an integral part of the CSP preparation process, and provides the information needed to ensure that programmed funding for the future development of the nation is firmly grounded on the principles of environmental sustainability. Recognizing (i) the sizeable contribution that natural resources-based activities make to the PNG economy overall; (ii) the potential for that contribution to continue into future; and (iii) the existence of a number of key barriers and problems that threaten the sustainability of PNG's environment and natural resources base, it is imperative that the new CSP place strong emphasis on environmental management objectives, in order to ensure the viability of these critical resources over the long-term.

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[1] At this writing, a lawsuit has just been decided (announced 13 May, 2005) that has cancelled this arrangement, due to questions about its legality. Further developments on the diplomatic and legal front will be critical in determining whether or not this program moves forward.

[2] ADB January 2004. *Country Strategy and Program Update 2004-2006 Papua New Guinea*, was the most recent Update.

9. The present CEA (i) describes the role of natural resources and the environment in the national economy; (ii) provides an overview of key environmental issues; and (iii) outlines the policy, regulatory and institutional framework for environmental management in the country. The CEA goes on to analyze the existing environmental conditions, and includes a review of ADB's current portfolio. Emerging from the review and analysis, priorities for action are identified, and recommendations are made for projects for possible inclusion in ADB's future country program, that could proactively incorporate, integrate and support sound environmental management practices and mainstreaming of environmental considerations into the economic development planning and policy-making for the country.

III. METHODOLOGY

10. During the first half of 2005, ADB fielded a mission[3] to PNG to develop the CEA. Prior to and during the mission, extensive secondary research was conducted, relying on various technical reports, government publications and documents, and reports of international donor and assistance agencies, to gather comprehensive background information covering a range of environmental and natural resource issues. Site visits were conducted in six provinces,[4] plus the National Capital District, to observe first-hand the existing environmental conditions on the ground, as well as a range of natural resource-based economic activities. In addition, meetings with a broad cross-section of stakeholders were conducted. These extensive in-country consultations culminated with the organization and hosting of a consultative workshop.[5] Over 100 people were consulted, and some 50 key stakeholders participated in the workshop and provided valuable feedback on the preliminary CEA findings. The participants represented various sectors, including national and local government, international and bilateral donor and assistance agencies, NGOs, community groups, women's groups, traditional society, academia, and the private sector. The consultations and workshop discussions helped to confirm preliminary findings, further identify key issues, and develop concepts for possible interventions to address specific problems and barriers to effective environmental management. Appendix 3 provides an outline of the site visits, Appendix 4 provides a list of references, while Appendix 5 includes a list of persons contacted during the consultations.

IV. BACKGROUND INFORMATION

A. Country Setting

11. PNG is the largest Pacific island country in total land area (some 460,000 square kilometers [sq km]) and second in respect to ocean area (some 3 million sq km within its Exclusive Economic Zone [EEZ]). PNG's population of over 5 million people is sparsely distributed; population density stands at about 9 people per sq km, which is the lowest density in the Pacific region (but with some pockets of much higher density occurring especially in urban areas and the Highlands).

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[3] James. T. Berdach, Environmental Management Specialist, visited PNG from April to May 2005. Leo Mandeakali, Domestic Environmental Consultant, was assigned to the project during the same period. Edy Brotoisworo, Senior Environment Specialist, of ADB's Pacific Department, was in-country during 19-22 May, 2005.

[4] Provinces were chosen based on their "representativeness," as well as time and cost considerations for arranging the fieldwork. A wide range of environmental conditions, and natural resource-based economic activities are found within the provinces selected—Madang, Morobe, Eastern Highlands, Chimbu, Western Highlands, and Enga Provinces, as well as the National Capital District.

[5] A Consultative Workshop was held on May 20, 2005, at the Holiday Inn, Waigani.

12. Prior to colonial occupation, PNG was not a nation-state, but rather a collection of some 800 distinct tribal groups, with nearly an equal number of distinct spoken languages. Upon independence in 1975, a complex framework for governance emerged that reflected this underlying social complexity. Geophysical and demographic aspects—a relatively small population, dispersed over a large land area of mostly rugged terrain, with limited transportation and communications infrastructure—combined with the underlying socio-cultural complexities to create conditions that in general hamper delivery of basic services and economic growth. Weak governance, erosion of fiscal discipline, and deteriorating institutional capacity have further discouraged both outside and domestic investment, and created obstacles to development.

13. As a result, social indicators are among the lowest in the Pacific, with life expectancy averaging 57 years, and an adult literacy rate of 65 percent (2001 figures). Economic indicators reflect a worsening situation—per capita real gross domestic product (GDP) at year-end 2002 was about 10 percent lower than at the time of independence in 1975. Poverty is widespread, with an estimated 39 percent of the population currently living below the international poverty line of $1 per day[6]. PNG also has the worst human poverty and human development indices (52.2 and 0.314, respectively) in the Pacific region (average of 21.19 and 0.560, respectively).[7] Selected comparative social and economic indicators for PNG are provided in Appendix 6.

B. Role of Environment and Natural Resources in the Economy

14. PNG's economy has been termed a dual economy, being in some sectors and among some stakeholders cash-based, but in most rural communities, subsistence-based. Standing at the beginning of the 21st century, the majority of PNG's population are still directly and almost solely dependent upon subsistence activities—through gardening, hunting-gathering, and fishing—for the provision of their basic human needs. Only gradually is the subsistence group becoming more dependent on earning cash—largely revenues generated through the leasing of customary lands, or through the exchange of goods or services—which can then be used to purchase manufactured goods and other items not obtainable from the immediate natural environment.

15. The disparities that exist between these two different economic camps are huge. The industries that are the participants in the cash economy include, among others, mining, petroleum and gas, commercial forestry and fisheries, and large-scale agribusiness. Collectively, these industries account for some K6.5 billion in foreign exchange revenues annually (2003 figures), and about 60 percent of annual GDP. Sectoral contributions to the gross domestic product (GDP) are presented in Table 1, and export value of various natural resources products is presented in Table 2.

16. While it is difficult to measure the contribution that subsistence activities make to the economy, informal estimates[8] indicate that the vast majority of people—perhaps as high as 90 percent of rural dwellers, or some 4.4 million nationwide[9]—are primarily dependent upon non-

[6] World Bank 2003. Annex 2, *World Development Indicators*. However, it should be noted that in the PNG context, alleviation of poverty is more appropriately defined in terms of fulfillment of basic human needs, improved quality of life, access to services (e.g., health, education, transport), and reduction in vulnerability, rather than in purely monetary terms. This is because in PNG the linkage between people and their natural environment is very strong, as seen by the fact that around 80% of the population are believed to rely primarily on subsistence agriculture, fishing, forest harvesting, and hunting for their everyday food and material needs. Thus, the cash economy plays a lesser role in the lives of the majority of people in PNG, than in most other countries.

[7] ADB 2004. *Pacific Region Environmental Strategy*.

[8] Department of Agriculture and Livestock.

[9] (based on 2003 population estimates)

cash, subsistence activities. Given this large population who are directly dependent upon the environment and natural resources for their subsistence, and the fact that most of the major industries that generate the nation's revenues are also natural resource-based, it is clear that the environment and natural resources play a critical role in the economic life of the country, and in the general day-to-day well-being of its citizenry. By extension, maintaining the resiliency and sustainability of the environment and the natural resource base is of utmost importance not only for its own sake, but in order to provide a foundation for long-term continuing economic growth, as well.

Table 1 Contributions to PNG's GDP, by Sector, 2002-2005

Sectors	Contribution to GDP, million K, and percent of total GDP							
	2002 (actual)		2003 (estimate)		2004 (projected)		2005 (projected)	
	amt	% of total	Amt	% of total	amt	% of total	amt	% of total
Agriculture, Forestry, Fishing	4428.0	37.6%	5026.9	38.8%	5291.0	38.5%	5616.3	38.8%
Oil and Gas Extraction	1096.7	9.3%	1179.7	9.1%	1306.3	9.5%	1336.8	9.2%
Mining, Quarrying	1252.1	10.6%	1537.7	11.9%	1609.7	11.7%	1698.9	11.7%
all others	4989.8	42.4%	5203.2	40.2%	5520.4	40.2%	5838.7	40.3%
Total	**11766.6**	**100.0%**	**12947.5**	**100.0%**	**13727.4**	**100.0%**	**14490.7**	**100.0%**

Summations may not tally due to rounding.
Source: Bank of PNG, 2005

Table 2 Export Value of Natural Resources Products (2003)

Export	Value (mn K)
Agricultural products	1082.5
Timber	369.6
Fish products	235.0
Ore	3034.9
Oil	1814.9
Total, natural resources products	6536.9

Calculations by the consultants based on data from: Bank of PNG, 2005; National Fisheries Authority; calculation of value for agricultural products include copra, cocoa, coffee, palm oil, rubber, tea, and copra oil; ore includes gold, copper, and silver; and fish products include tuna, shrimp, lobster, and beche-de-mer

C. Key Environmental Issues

1. Land Utilization

Background, Issues and Challenges

17. Covering a land area of some 460,000 square kilometers (sq km), PNG is by far the largest of all Pacific Island nations. Its population of around 5 million is sparsely scattered over this large land area, with a density of only 12 persons per sq km on average, as compared to 45 persons/sq km in Fiji and 114 in Indonesia.[10] Topographically, PNG's varied and rugged terrain supports an extraordinary range of ecosystems.

[10] MTDS, November 2004.

18. Patterns of land utilization in PNG are determined largely by a customary land tenure system. With some 97 percent of land owned by traditional landowners, land provides a welfare safety-net for the vast majority of Papua New Guineans. Customary land tenure also supports the country's robust village-based subsistence gardening.

19. At the same time, customary land ownership is a major constraint that can hamper economic development and integrated land use management and planning. Mobilizing land for large-scale economic projects is costly and fraught with uncertainty. Setting aside land for other public purposes, such as conservation, is equally problematic. While the national government has the power to acquire lands for public purposes, doing so would be politically unpopular in a country where traditional land ownership is such a highly-charged issue. Thus this authority has only been used on rare occasions, and has often resulted in disputes and conflicts arising with the traditional landowners. Innovative solutions are needed to overcome obstacles posed by customary land ownership, both for development and for conservation efforts. This will require the full commitment and participation of the landowners themselves, to engage in open dialogue with government and development partners, in an effort to maximize the benefits that can be derived through careful and appropriate utilization of lands and the resources they contain.. Whether the customary tenurial system will survive in its present form or evolve in the direction of a more "western" system is an open question. It is evident that considerable time would be needed for any significant change to occur.

20. Despite the fact that the traditional land ownership system is so deeply ingrained, modern practices and rapid population growth are effecting radical changes on the land. The traditional practice of shifting cultivation, generally thought to be sustainable for lower-density populations, is not viable for more concentrated populations.[11] The intensification of agriculture, deforestation through industrial logging, changing drainage patterns, resultant soil erosion and siltation, the impacts of fire on vegetation succession, industrial pollution, and urban sprawl, are but some examples of ongoing processes that threaten the sustainability of land use. Areas where land degradation problems are most serious include Markham Valley, Ramu, Eastern Highlands, and the Sepik floodplain.

21. One problem that is especially prevalent is the growing shortage of arable flatland for subsistence gardening. Increasingly, small-scale farmers are being forced out of productive agricultural lowlands, to cultivate steep-slope areas. Migrants who have settled around urban areas such as Port Moresby also make use of unutilized slopes for farming. Because steep slopes are much more prone to erosion than flatter lowlands, the impact of uncontrolled agriculture in these areas is high. Without proper controls, steep slope cultivation can lead to soil erosion and even landslides, which in turn can damage infrastructure and property and pose a threat to the safety of residents of the area.

22. Large-scale plantation agriculture also may cause deterioration in the quality of the land and the fertility of the soil. At oil palm plantations in New Britain, high rates of soil erosion are resulting in excessive discharge of sediments in nearshore waters, threatening to smother coral reefs. WWF is working with oil palm plantation managers to try to adopt methods that will prevent or reduce erosion. This is of interest both to conservationists and to the growers

[11] Shifting cultivation, or swidden agriculture, involves clearing of forested land for agriculture, then moving on to new areas once the soil becomes unproductive. With low population densities, such a system is believed to be sustainable because the land is allowed to lay fallow for a sufficient period of time; during this period vegetation regenerates and the soil recovers its nutrients through natural processes of enrichment (decomposition of organic matter). However, with increasing population pressure, smaller areas of land are available to clear, and fallow periods are reduced, resulting in depletion of soil nutrients.

themselves—better methods for conserving soil will reduce the impacts on coral reefs and at the same time, will reduce plantation costs associated with soil replacement and enrichment.

Opportunities

23. PNG is a signatory to the UN Convention to Combat Desertification (UNCCD),[12] and is committed to ensuring that land management processes in the country are strengthened. However, having only recently ratified the Convention (December 2000), concrete actions toward developing plans for sustainable land management are only in the early stages; PNG has not attended any UNCCD Conference of Parties (COP) meetings, nor has it prepared the initial required planning and strategy document, the National Action Programme (NAP). Land use planning processes are impeded by lack of access to good information that accurately represents the current situation. UNDP, in cooperation with several partners,[13] has launched a Remote Sensing Land Use Initiative, which is designed to: (i) prepare a comprehensive satellite coverage database; (ii) promote awareness and information dissemination; (iii) provide interactive GIS planning tools; and (iv) establish a GIS training center. UNDP is also seeking support from GEF to initiate a process to build other needed capacities to mainstream sustainable land management.[14]

24. Careful consideration is needed to face the challenges posed by the complexities of customary land tenure, and in that context, to determine a viable mechanism for putting in place a more integrated and effective system of land management. Customary landowners need to engage in dialogue with other stakeholders from government, the private sector, and civil society, to develop workable partnerships. There is a need to determine the most appropriate uses of various land areas, and then, to map out a course to sustainably utilize those lands for their best suited purpose, so that the benefits are maximized for the greatest number of people.

25. A sustainable land use policy has been drafted. The purpose of the policy is to identify strategies, activities and the appropriate institutional and procedural mechanisms necessary to monitor and manage conversion of land use throughout the nation so as to implement government policies on sustainable economic and social development. In addition, ADB has programmed a project on Land Tenure that will study ways in which thee issues can be effectively addressed.

2. Agriculture

Background, Issues and Challenges

26. PNG's agricultural history can be traced back for hundreds of years, with many traditional farming practices still applied today. Subsistence agriculture is commonly practiced in the rural villages, where farmers produce food and cash crops on a small scale in their own gardens. Locally-produced food provides 80% of the caloric intake of rural people. Most gardens are in low intensity shifting cultivation systems, which operate on cycles of one or two years of cropping, followed by 5-15 years of fallowing. Gardens sites are cleared of vegetation manually and usually burned. Sweet potato (*Ipomoea batatas*), adopted in the Highlands about 300-350

[12] The UNCCD has a strong focus on curtailing desert-formation processes countries in the sub-Saharan region of Africa. However, for tropical countries, the focus of the Convention is primarily on preventing drought, land degradation, soil loss, and similar deleterious processes.
[13] The partners are UPNG, the German Development Service (DED), EU, and Conservation International (CI).
[14] UNDP (undated). *Capacity Building and Mainstreaming for Sustainable Land Management in Papua New Guinea.*

years ago, is the most important crop grown and consumed in PNG. It is a staple food for about 60% of the rural population. Its caloric contribution to the local diet is equal to the combined caloric contribution of other important crops such as banana, sago, taro, yams, cassava, and peanuts. Coconut and imported rice each contribute about 10% of calories consumed by rural people. Domestic livestock, including pigs, poultry, cassowary, goats, sheep, and cattle, provide an important source of protein in the diet.

27. Because a high proportion of the population is engaged in food production, have access to land, and rely on a diverse range of subsistence food sources, food security is generally good in PNG. Also, most people have access to some cash income with which they can buy food when subsistence supplies are inadequate. The major urban areas of PNG depend heavily on imported food such as rice, tinned fish and meat, and increasingly flour and dairy products. There is strong political pressure for the development of a domestic rice industry to replace imports. However, even if a domestic rice industry overcame environmental and pest constraints, it could not produce at prices competitive with world market prices. Significant increases in the price of such an important food would have serious political and nutritional consequences.

28. Besides its great importance in the subsistence economy, agriculture is also a significant contributor to the cash economy. Over the last 25 years, agriculture has provided a steadily increasing share of GDP, from around 29% in 1990, to around 33% in 2002. The agricultural sector provides incomes to about 80% of the population. While per capita income is generally low, the sector has been operating sustainably and consistently for over five decades. Commercial agriculture enterprises in PNG include oil palm, coconut (mainly for copra production), coffee, cocoa, and sugar plantations, as well as livestock. However, a significant drawback of plantation agriculture is that plantations require clearing of the original indigenous vegetation from large tracts of land. Such actions can result in loss of vegetative cover, loss of biodiversity, and increased erosion.[15] Oil palm estates in particular require large areas of land to be commercially viable. “Lease, lease-back” arrangements are used to mobilize customary land for agriculture through the formation of incorporated land groups (ILGs). These groups represent partnerships between the customary landowners, the State, and the developer; land tenure must be secured for a minimum of 60 years in order to be attractive for the investor.

29. Oil palm has overtaken coffee and cocoa as the primary export crop commodity in PNG (Table 3). Oil palm cultivation has increased in recent years in West New Britain, Oro, Milne Bay, and New Ireland. New estates have also been established in the Gusap area of Madang and Morobe provinces. While generally oil palm estates seem to function satisfactorily, existing concerns regarding erosion and runoff in nearshore areas have already been mentioned in the previous section.

30. The production of most commercial crops is dominated by smallholders. There has been a moderately rising production trend for most of the major crops in recent years. Table 4 shows crop production patterns, 1990-2003.

[15] Apparently, there is no specific law or an Act of Parliament that governs these activities, especially to protect environmentally sensitive areas, except for agriculture proposals in forested areas greater than 50 hectares. The latter require to apply for a Timber License from the Timber Authority, and to submit an Environmental Statement or an Environment Plan to DEC.

Table 3 Export Value of Principal Crop Commodities in PNG

CROP	Million Kina/Calendar year		
	1990	2000	2003
Palm Oil	33	307	421
Coffee beans	103	295	299
Cocoa	30	85	258

(ADB 2004, Key Indicators).

Table 4 Production of Major Crops in PNG

CROP	Calendar year production, '000 metric tons		
	1990	2000	2003
Coconut	644	553	570
Sweet potato	460	490	490
Copra	117	172	-
Coffee	60	63	63
Cocoa	38	39	42
Rubber	3	7	-
Peanuts	1	1	-
Sorghum	1	4	4
Rice	1	1	1

(ADB 2004, Key Indicators).

31. As already mentioned in the previous section, inappropriate agricultural practices, in both the subsistence and cash sectors, are hastening land degradation. Around 20% of rural people use land very intensively, to the point where cultivation is nearly continuous. Common methods of intensification include the shortening of fallow periods, the extension of cropping periods and the adoption of fast-growing crops such as sweet potato, cassava, chinese taro and triploid banana. As agricultural intensity increases, so has the tendency for sweet potato to become the most important crop. For intensive cultivation, productivity is maintained through the use of various land improvement practices such as composting, mounding, drainage, legume rotation, planted tree fallow periods and soil retention barriers.

32. Most of the intensification in subsistence gardening has occurred over the last three decades and it is still not clear how sustainable these more intensive methods will be over the long term. With increasing population pressure, and appropriation of the most fertile flatlands for plantation-style agriculture, more subsistence farmers have been forced to cultivate steep-slope areas, which are susceptible to increased soil erosion. Also, the trend toward monoculture (as in the case of sweet potato) may make crops more susceptible to disease outbreaks.

33. Although food security for most of the population is generally satisfactory, it is threatened by climate extremes, including periods of heavy rainfall and flooding, or droughts. Other factors indirectly affect food security, as well. For example, the emerging AIDS epidemic may have a negative effect on food security through its expected impact on the agricultural labor force. Dietary preferences, and low nutritional values of some food items, create a situation wherein a large proportion of the population have an inadequate intake of protein and concentrated energy sources such as oils and fats. Finally, inadequacies in infrastructure affect food delivery. In the course of the consultations, it was learned that an estimated K200 million in coffee could not be transported to buyers due to the poor condition of roads. The condition of markets in most towns is also unsatisfactory, causing unsanitary conditions and poor handling which results in increased spoilage and loss of nutritional value.

Opportunities

34. The cultivation practices described above weigh heavily on the long-term food security of rural populations. If intensification is not accompanied by the adoption of suitable land management practices, agricultural pressure on land will lead to land degradation and reduced crop yields. Future increases in productivity will depend upon better management of both land and crops. The Department of Agriculture and Livestock is in the process of preparing a *Food Security Policy* and *National Agriculture Development Strategy, Horizon 2020*, a sectoral sustainable development policy to address poverty alleviation and food security, especially in high-population, high-impact areas such as mining sites, urban locations, and densely-populated parts of the Highlands. It is hoped that these policy documents will provide at least a beginning framework for improvements in agricultural practices, aimed at achieving sustainable development in the sector.

35. Other strengths that exist in the sector should be capitalized upon, and steps be taken to correct weaknesses. These include building upon the rich heritage of traditional village-based gardening and husbandry that exists in PNG. Successful models for smallholder-based agricultural enterprises should be replicated. Because there is a large potential pool of laborers with agricultural skills, diversification of agricultural enterprises could help to generate higher employment, and help to reduce vagrancy and widespread crime related to joblessness. Finally, improvements in roads and market infrastructure could contribute significantly to national food security.

3. Forest Resources

Background, Issues and Challenges

36. PNG'S largest renewable primary resource is the forest, which covers three-quarters of PNG's land mass, or around 33 million hectares. Five main forest types dominate the country's landscape: lowland plains, lowland hills, lower montane forests, dry evergreen, and swamp forests. Some 200 tree species are extracted for commercial purposes. Those in greatest demand include premium furniture timbers such as rosewood, kwila, walnut, pencil cedar, taun, bintangor, malas and hopea. A summary of PNG's forest resources is provided in Table 5.

37. Forestry contributes significantly to employment creation (employing 7,500 people, or 4% of total employment), revenue generation for local landowners and the National Government, and development of infrastructure in rural areas. Landowners benefit from forestry through royalties and premiums, while the national government benefits through export taxes. Logs account for 3% by value of domestic exports. Export taxes are levied on unprocessed logs at rates of up to 70%. In 2002 the country exported 1.85 million cubic meters of logs valued at US$99.75 million (K367.0 million in local currency) mainly to the People's Republic of China (PRC), Japan and South Korea. The country also exported wood chips, high-grade sawn timber, plywood, veneer and furniture components.

38. The Papua New Guinea Forest Authority (PNGFA) was formed in 1993 as a statutory corporation to lead reform in the forestry sector and devise programs to manage tropical rainforests. The Authority administers the industry through resource acquisition or on management contract with traditional landowners (most forest resources in the country are customarily owned) and invites investors to develop the resource on behalf of the State and landowners. Revenues thus generated from forest resources are distributed among the three

parties. The policy instruments that are in place are intended to ensure that forest resources are developed on a sustainable basis and that equitable benefits accrue to the main stakeholders, namely the customary landowners, Government and investors. The principal enabling frameworks through which the industry is administered are the Forestry Act and Regulations, National Forest Policy, National Forest Plan, and Logging Code of Practice.

Table 5 Summary of Forest Resources in Papua New Guinea

CATEGORY	
Total forest area, 2000 (000 ha)	30,601
Natural forest area, 2000 (000 ha)	30,511
Plantation area, 2000 (000 ha)	90
Change in forest area:	
Total, 1990-2000	-4%
Natural, 1990-2000	-4%
Plantations, 1990-2000	6%
Original forest as a percent of total land area	96%
Forest area in 2000 as a percent of total land area	66%
Percent of tropical forests protected, 1990s	10.7%
Number of tree species threatened, 1990s	165

Source: EarthTrends, World Resources Institute; accessible at http://earthtrends.wri.org

39. It is estimated that of some 15 million hectares of accessible forest lands, about 4 million hectares (10%) of natural forests have been logged over since 1975 under Timber Rights Purchase (TRP), Local Forest Area (LFA) or Timber Authority (TA) arrangements. The PNGFA has recently adopted a more sustainable approach to forest management wherein forest concessions are acquired under the Forest Management Area (FMA) system. Under this arrangement, concession-holders can operate within timber concessions for 35 years. It is assumed that residual or undersized trees left behind by initial logging operations will have grown to an acceptable size[16] within 35 years. Thus it is believed that timber can be managed as a renewable resource and harvested in a sustainable manner according to a 35-year cutting cycle.[17]

40. Benefits accorded to resource owners under lease agreements include timber royalties, premiums, infrastructure levies, reforestation and agriculture levies, and direct employment. Priority is always given to resource owners when awarding contracts and recruiting workers. Landowners receive other benefits under lease agreements including other infrastructure services such as schools and rural health clinics. While such revenues and developments benefit the local communities, logging may also result in significant adverse environmental impacts and long-term irretrievable loss of resources. Soil erosion, contamination of water supplies, and loss of non-timber resources are among the major impacts. While more new roads are built for logging than for other general transportation purposes (which could potentially be regarded as a benefit), logging roads are typically unpaved. After logging operations cease, the

[16] More than 50 cm diameter breast height (dbh).

[17] The assumption that the residual or undersized trees below 50 cm dbh will take 35 years to reach harvestable size (upon which current harvest cycles are based) is in fact yet to be fully tested and proven as a basis for sound management practice.

roads are abandoned, quickly become unusable, and in fact contribute to further erosion problems. Perhaps the most serious consequence of these cumulative impacts is the loss of habitat and displacement of rich forest biodiversity that occurs. Some endemic forest species that are unable to adapt to new environments will face possible extinction.

41. For these reasons, it is critical that, in the future, logging operations are more carefully monitored than they have been in the past (DEC June 2004). At present, regulatory agencies (primarily DEC and PNGFA) are unable to conduct compliance monitoring of forestry projects on a consistent or regular basis because of shortfalls in manpower and financial resources. Forest development covers a very wide area within the entire logging concession and is quite dynamic and mobile. Developers often take advantage of the regulatory agencies' inability to carry out effective compliance monitoring, by conducting unsustainable and illegal harvesting of logs in restricted areas or within buffer zones.

42. Other problems being confronted within the forestry sector are as follows:

- There are difficulties associated with the customary land tenure system, including the incorporation of landowner groups and the formalization and delineation of boundaries.

- Forest resources are often being used unwisely or wastefully. For example, while sawmills are incinerating their waste wood, villages are cutting down mangroves to use as firewood.

- There is continued pressure to log natural forest areas. A single foreign-owned company (Rimbunan Hijau) dominates in the sector, accounting for over 60% of total timber production, which is based almost completely on logging in natural forest areas.

- Data for appropriate decision-making in the sector is inadequate or inaccessible. According to UNDP, "the beneficiaries of restricted access to information have been those individuals and organizations who have sought to gain from the unparalleled exploitation of PNG's natural resources… the PNG Forestry Authority, donors, landowners, and NGOs have been debating the future of the forests for over a decade, without an available and accurate understanding of the country's forest resources."[18]

43. In addition to these weaknesses and pressures, difficulties have recently arisen with proposed assistance to the sector from outside donors. One of the largest forestry conservation initiatives in recent years, the World Bank's Forest Conservation Project (FCP), was valued at $39.10 million, including some $16.99 million in grant funding from Global Environment Facility (GEF). The primary intent of the project was to promote improved capacity by government and communities to sustainably manage forest resources. However, World Bank suspended the project shortly after its inception in 2003, because of non-compliance with loan covenants. Very little substantive progress was made under the project before the suspension. While continuous discussions between World Bank and government took place during the intervening period of nearly two years, in an effort to resolve the problem, the project has recently been cancelled. Clearly, the cancellation of FCP has left a large void of intended activities that were never implemented. This creates a situation where there is even greater urgency for interventions in such areas as community strengthening, forest resources management, and forest biodiversity conservation.[19] Also, part of the agreements between government and World Bank included a moratorium on issuance of new timber permits. With this restriction having been lifted, it is

[18] UNDP Remote Sensing Program.
[19] Tapakau, Eric, and Wanita Wakus. April 1, 2005. "PNG under WB Scrutiny." *Post-Courier*, p.7.

feared that there will be a strong push to rapidly exploit natural forest timber resources beyond sustainable limits.

Opportunities

44. As the discussion above suggests, there is still considerable work to be done to achieve sustainability in PNG's forestry sector. A range of technical, regulatory, and economic options exist for supporting sustainable forestry:

- One of the key opportunities for improving environmental performance in the forestry sector is to continue to shift effort from logging of natural forests, to plantation forestry. Although this has already been started in PNG, reforestation at present is on a relatively small scale and accounts for only a small fraction of total timber production. By reforesting degraded grasslands and logged-over areas through cultivation of plantation species, pressures on natural forests can be reduced significantly.

- High-elevation forests are more susceptible to degradation that other natural forest types, because of relatively poor soils and slow regeneration of high-elevation tree species. The Forest Research Institute is conducting special studies and working with various partners to try to re-establish areas of high-elevation forest that have been cleared or altered.

- Forest resources are acquired by PNGFA through Forest Management Agreements (FMAs) with landowners in a potential forest production area.[20] The FMA concept is one of the key elements of the *National Forest Policy 1990*, intended to promote a sustained yield management approach. The FMA is awarded to a proponent for a 35-year cutting cycle. Under this arrangement, the area can be re-utilized after the 35-year cutting cycle is completed. The forest resource – which is owned by the people – is managed in close cooperation with the landowners to achieve complementary conservation and commercial objectives. Programs need to be put in place to successfully form and build the management capabilities of landowner groups.

- The PNG Logging Code of Practice has been designed mainly as an operational tool detailing the technical operational aspects to be applied to attain sustainability of the resource and the natural environment.

- Logging enterprises are required to develop and follow annual and five year logging plans. The plans specify methods for practicing selective logging. The logging company forest inventory/survey team carries out 100% surveys to determine species composition and density. Trees above 50 cm dbh are selected to be logged and marked accordingly. Felling direction is determined to minimize damage to residuals. Also during the field inventory, all conservation areas and other restricted areas are demarcated before logging proceeds.

- A number of initiatives in the country aim to develop programs for eco-labeling and certification of forest products. These are mechanisms for assuring buyers abroad that wood products are sourced from responsible producers. The forest stewardship program of the Forest Stewardship Council (FSC) is one such certification scheme that sets operational standards for some 30 million hectares of forest in 56 countries. FSC-certified operations are audited independently on a regular basis by an accredited third party. In PNG, a non-profit

[20] The old arrangements for acquiring timber concessions under Timber Rights Purchase (TRP) area, Local Forest Area (LFA) and Timber Authority (TA) are no longer applied.

organization, FORCERT, is involved in bringing small- to medium-scale producers into compliance with the FSC standards. The EU, through its Eco-Forestry Programme (EFP), is supporting the certification effort.

- In order for environmental management initiatives to be effective, they cannot be carried out in isolation. To be accepted by communities, conservation efforts need to be tied to revenue-generating livelihood activities, and to mechanisms that can help to meet people's basic needs. Several opportunities exist in this respect, including development of forest and village-based ecotourism.

- In PNG, forested areas support high biodiversity, act as carbon sinks to reduce greenhouse gases, and help to capture and retain rainwater and maintain proper water balance. Recognizing these important functions, efforts need to be undertaken to preserve forested watershed areas in an integrated way. Developing plans to support the integrated management of forested watershed areas can promote further economic development as well. One type of program which is promising would be to develop sustainable hydroelectric power that depends upon maintaining the natural water-balance functions of forested watershed areas. Electricity could be provided to local residents, which would help to stimulate additional economic activities. Also, surplus electricity could be sold for additional revenue generation. Additional funding for preserving forested watersheds might come from the Clean Development Mechanism (CDM) for reductions in greenhouse gases, or through the Global Environment Facility (GEF) for sustainable land management or protection of unique forest biodiversity.

- Another approach that holds promise for promoting sustainable forest management places emphasis on the utilization of non-timber forest products (NTFPs). Some 150 or more economically-valuable NTFPs have been identified, and include roots, bark, fruit, latex and fungi that are used for food, medicines, dyes, construction materials and other purposes. The concept that underlies the NTFP approach is that, while forest timber is generally an overexploited resource (both in PNG and within a wider global context), NTFPs are typically underexploited. Thus, there is potential to increase the utilization of NTFPs, in order to generate increased revenue streams, without threatening sustainability. Development of NTFPs is being promoted by the PNG Eco-Forestry Forum, a consortium of NGOs and sustainable forestry advocates.

- Developers are also encouraged to carry out downstream processing of round logs and minimize total round log export, in order to capture greater value in exported wood products, and create additional jobs in the sector. The potential for converting some of Papua New Guinea's premium species, such as rosewood, kwila, blackbean and taun, into high-quality furniture and other wood products, is an investment opportunity with a growing market.

45. Increasing alternative revenue streams through any of the above-mentioned options could potentially take pressure off overexploited timber resources, and help to reverse the trend toward loss of ecological values, biodiversity, and essential resources that currently threatens PNG's valuable forested lands.

4. Marine and Coastal Resources and Fisheries

Background, Issues and Challenges

46. Principal marine and coastal ecosystems in PNG include coral reefs, seagrass beds, mangrove swamp forests, and pelagic seas. Features of the marine and coastal zones are described in Table 6.

Table 6 Features of PNG's Marine and Coastal Zones

length of coastline	20,197 km
% population living within 100 km of coast	61%
claimed Exclusive Economic Zone (EEZ)	1,673,759 sq km
territorial sea (up to12 nautical miles from shore)	752,256 sq km
area of coral reefs	40,000 sq km
area of coral reefs under protection	--
area of mangrove forests	4,586 sq km
area of mangrove forests under protection	23%
area of seagrass beds	--

Source: EarthTrends 2003. *Coastal and Marine Ecosystems. Coiuntry Profile-Papua New Guinea.* World Resource Institute. accessible at http://earthtrends.wri.org; other sources; --= not known.

47. Fisheries resources in PNG are found in coastal, pelagic (open ocean) and freshwater habitats. The rich resources found in these environments create a huge opportunity, but also present an enormous challenge for monitoring and control. The total market value of PNG's fisheries catch is estimated at K350 to K400 million annually on average. Cyclical factors and commodity price movements, especially for tuna, cause large swings in value from year to year. Despite the richness of PNG's fisheries resources, and the substantial value of fisheries production in absolute terms, the contribution to national GDP is the smallest in the Pacific (Table 7). It is believed that there is significant potential to increase the economic value and returns to PNG in the sector through better management and development programs.

Table 7 Contribution of Fisheries to GDP in Pacific Island Countries

Country	Contribution to GDP, %
Kiribati	21.5
Solomon Islands	12.8
Cook Islands	9.9
Federated States of Micronesia	9.5
Palau	8.0
Tonga	7.5
Tuvalu	7.0
Samoa	6.6
Marshall Islands	3.8
Fiji Islands	2.4
Vanuatu	2.2
Nauru	2.1
Niue	1.9
PNG	**1.4**

Source: Gillett and Lightfoot 2001 (data from 1998-2000)

48. While fisheries export earnings are important, the contribution of fisheries as a source of nutritional protein for local consumption and subsistence use is also of major importance. Although reliable data on subsistence use of fisheries resources is not available, it has been estimated that subsistence fisheries production has an equivalent value of about $20 million annually. A summary of PNG's fisheries productivity is presented in Table 8.

Table 8 Estimated Annual Fisheries Production of PNG by Value, late 1990s

Fishing Category	Value (in US$'000)	% of total fisheries production
Subsistence Fishing	20,227	12.5
Coastal Commercial Fishing	21.394	13.3
Offshore Fishing-locally based	44,344	27.5
Offshore Fishing-foreign based	75,074	46.6
Total	**161,039**	**100.0**

Source: Gillett and Lightfoot 2001.

49. The National Fisheries Authority (NFA) is the non-commercial statutory authority established and operating under the Fisheries Management Act of 1988, which has primary responsibility for management of activities in the fisheries sector. Following its establishment in 2001, significant improvements were made in management, monitoring and enforcement functions. More recently, however, a deterioration in these functions has been noted, attributed to restructuring within the institution.

50. ***Subsistence and artisanal fisheries:*** More than one-fourth of the country's population relies on fish and shellfish as a major source of protein, and it is believed that about 20% of the population is engaged in subsistence fisheries. Subsistence fishing activities are practiced by one or more family members, with the harvest shared among relatives. Activities include reef and pelagic fishing and reef gleaning (picking of mollusks, crustaceans, and other attached organisms during low tide), and fishing for freshwater species (barramundi, tilapia, catfish, rainbow trout, freshwater prawns, etc.) in lakes, rivers, and streams. Provincial fisheries offices in the coastal provinces are non-operational, due to retrenchment and lack of funding, therefore fisheries statistics are not being gathered. While no reliable data are available for subsistence fisheries (and even for commercial fish catch), it is conservatively thought that annual production through subsistence fishing is around 70,000 tonnes.

51. ***Commercial Fisheries:*** PNG's Exclusive Economic Zone (EEZ) encompasses some 3.1 million sq km and supports an abundant tuna fishery resource. [21] Tuna production is the main revenue-earner in the fisheries sector. Revenues are obtained both through licensing fees and direct sales proceeds. More than 300 licenses have been issued to domestic and foreign fishing companies. Access fees from deepwater fishing nations currently form the bulk of the revenues received and managed by National Fisheries Authority (NFA). There are more 300 fishing licenses issued to foreign and domestic fishing companies. Other sources include license fees from other operators, assistance from donors and penalties arising from prosecutions under the Fisheries Management Act.

52. Principal species in the pelagic fishery include skipjack, yellowfin, and bigeye tuna, with skipjack being the most abundant and economically important species. According to stock assessments conducted through the Secretariat for the Pacific Community (SPC), it is believed that PNG's bigeye tuna resource is not sustainable at current levels of effort; yellowfin tuna are at the limits of sustainable fishing effort; and skipjack tuna are still being harvested within

[21] MTDS. November 2004.

sustainable limits. The NFA has prepared a National Tuna Fishery Management Plan to regulate activities in the tuna fishery.

53. Other commercially-important species include prawns, spiny lobster, and beche-de-mer (sea cucumber, a much sought-after food item for Oriental markets). Prawns and lobster are found mostly in the Gulf of Papua area, and are taken by trawling and other methods. Beche-de-mer are widely scattered throughout coastal areas. Harvest of all these species is performed both by commercial operators and small-scale village fishermen. Concerns have been raised about sustainability in all of these fisheries, and management plans have been prepared to guide the harvest of these species. The plans vary in the specificity and stringency of their requirements. Most make mention of seasonal or geographic limitations, or restrictions on certain gears and methods, in an effort to regulate harvests.

54. ***Aquaculture:*** Aquaculture, a significant component of fisheries activities in other countries (e.g., PRC, Philippines) is not widely practiced in PNG, but offers great potential for future development. A number of small-scale pilot and commercial projects have been implemented. Bismarck Barramundi (a project included in the proposed investment portfolio under the ADB Nucleus Agro-Enterprise Project), is one such small-scale venture in Madang, The company operates a hatchery and provides fingerlings to community growers. Product is grown-out to market size and then sold at market and to exporters. Pearl culture trials have been conducted in Milne Bay province where it was demonstrated that high-grade half and spherical pearls could be grown. These and any other aquaculture products, if developed successfully, could contribute significantly both to revenue generation, and to meeting the food security needs of the country, while relieving pressures on natural fish stocks.

55. A range of problems affect performance and sustainability in the fisheries sector. Among the key issues are the following:

- As indicated above, regulation of activities in the fisheries industry is weak. In most parts of the country, there is inadequate capacity for monitoring, control, surveillance (MCS), and enforcement, although some systems are in place (e.g., an electronic vessel monitoring system [VMS]). Surveillance in the Torres Strait is being conducted through a joint program with Australia.

- PNG is losing significant revenues[22] by exporting much of the fish product in a raw, unprocessed state. About 4-5% of the gross value of the catch is captured in licensing fees.

- Destructive fishing practices, while relatively isolated and small in scale, include use of dynamite, cyanide, and traditional fish poisons (*Derris* root).

- Lack of information poses a serious constraint for effective fisheries management planning and enforcement. As is true throughout much of the Pacific, there is a lack of coordination between fisheries agencies and fiscal statistical agencies in calculating fisheries' contribution to the national economy; there is an absence of data on subsistence and small-scale artisanal fishing activities; the contributions of fish processing are often ignored or not counted as part of the sectoral contribution; and export figures characteristically undervalue exported commodities (Gillett and Lightfoot 2001).

[22] An informal estimate (from an industry source) is that revenues could be increased by some K2.5 billion annually through value-adding (Pete Celso, CEO, RD Tuna, pers. comm.)

- Fisheries and coastal resource health are affected by occasional oil spills, as well as by runoff of pollutants from land-based activities into coastal waters.

- A long-term threat is global warming. Warming trends affect the movements of schools of pelagic fish, and any warming trends could cause reductions in fish stocks. This issue is a cross-cutting one, and in PNG is directly tied to maintaining the health of other ecosystems, especially forested areas, that can help to mitigate climate change through their function as sinks for atmospheric carbon dioxide.

Opportunities

56. The establishment of marine protected areas (MPAs) is a tool to preserve high-value areas of coral reef and mangrove as breeding grounds for fisheries. One of the largest coastal resource management projects currently underway is the UNDP's Community-based Coastal and Marine Conservation Project in Milne Bay. The $6.7 million four-year project is a collaborative effort receiving some $3.5 million in grant funding from GEF, and additional support through JICA, AusAID, and the provincial and national governments. The key focus of the initiative is to empower local communities for self-management of their coastal and marine resources. Targeted is the establishment of six MPAs. Thus far an MoU has been prepared for one area, but difficulties (such as the legal delineation and declaration of the sea area) remain before any MPAs can become operational. Other focal areas for the project are local governance, awareness building, and sustainable livelihood development.

57. One of the few operational MPAs in the country is a small protected area in Kimbe Bay that was established through a partnership guided by The Nature Conservancy (TNC PNG), and a local NGO (Mahonia). The MPA is managed through the cooperation of dive and hotel operators, the LLG, and the community members. The MPA was formalized through the LLG, and a technical team from CSIRO has been involved with conducting biodiversity surveys for the site. Lessons learned through these and similar projects can be applied in establishing new MPAs at other sites around the country.

58. One problem that has weakened fisheries and marine resource conservation efforts (both in PNG and elsewhere) has been the lack of sustainable financing to continue to support such efforts over the long term. All projects intended to promote marine and coastal conservation need to take this into account. Sustainable financing mechanisms need to be tailored to the specific conditions found in different areas. They could include incentives or disincentives, such as user fees, taxes and tariffs, or fines for violation of regulations. Success of such mechanisms will depend on having in place effective enforcement, and effective means of fee collection.

59. At present, significant quantities of fresh fish caught are wasted due to improper handling and spoilage. Also, large quantities of fish are exported in an unprocessed form. Thus, greater economic benefits could be captured in the fisheries sector if marketing and handling facilities and methods were improved, and if greater focus was placed on value-adding.

60. The need for accurate, consistent, and up-to-date information to improve management in the fisheries sector has been noted. This will require improvement of capabilities for consistent data-gathering nationwide, based on providing needed training to build human capabilities, and providing necessary equipment and software for effective data storage and retrieval. Improved

inter-agency coordination is needed, so that important data can be shared and made available to enable effective planning and decision-making.

5. Mineral and Petroleum Resources

Background, Issues and Challenges

61. Mineral exploration in PNG commenced with systematic exploration for copper deposits in the 1960s. Four world-class deposits and several smaller systems had been discovered by the mid-1970s. In the 1980s, attention shifted to gold exploration with the discovery of two gold deposits each containing more than 200 metric tons (MT) of gold and numerous smaller deposits of economic interest.

62. PNG is currently ranked as the 11th largest gold producer in the world and 13th in terms of copper production. Nickel, zinc, cobalt, and chromite have also been discovered through exploration activities. The planned nickel mine in Madang, once developed, will be one of the largest open-pit mines in the world. Manganese has been mined on a small scale in the past. All of the mining activities since 1970 have produced approximately 2,000 MT of gold, almost 2,000 MT of sliver and over five million MT of copper. There are still huge deposits of undeveloped mineral resources spread across the country.

63. All mining activities are regulated by the Mining Act of 1992 and the Mining Safety Act, and are administered by the Department of Mining. Under the Mining Act the State owns all minerals existing on or below the surface of any land. Therefore the State issues permits and licenses for any person to carry on exploration or mining activities. DEC is responsible for issuing environmental permits and performing subsequent compliance monitoring.

64. Significant oil and natural gas deposits are found in PNG, with the petroleum sector contributing around 9% to GDP. In 1991, the Hides project started generating gas for electricity for the Porgera gold mine. Commercial oil started flowing from the Kutubu project in 1992, and from the Gobe project in 1998. A development license was issued for the Moran field in 2001. Further exploration has also been actively promoted, and numerous basins that hold petroleum deposits have been identified.[23] There are no refineries in the country, but a refinery is currently being constructed in Port Moresby. Also being planned is a pipeline that would deliver natural gas from the PNG Highlands to Queensland, Australia. Activities in the petroleum sector are administered separately by the Department of Petroleum and Energy.

65. The mining and petroleum sectors as a whole contributed around 21% of estimated GDP in 2003, and accounted for some PNGK 4.8 billion (approximately US$1.5 billion) of exports (74% of all natural resources exports). In terms of employment, the mining sector employs 5% of the total workforce in PNG. Recent production figures are shown in Table 9.

Table 9 Production in the Mining and Petroleum Sector

PRODUCT	Calendar year production		
	1990	2000	2003
Gold	34 MT	73 MT	68 MT
Copper	197 MT	127 MT	231 MT
Oil	--	--	354.4 million barrels

Source: Profile--Mining and Petroleum Investment PNG 2005.

[23] Since 1996, licenses have been issued for oil and gas development in the North New Guinea, PFT, Foreland, and Cape Vogel Basins. The Bismark and Bougainville basins have yet to be promoted.

66. The mining and petroleum industries operate as “enclave activities” that have only limited direct linkages to the rest of the economy. Despite this lack of connection to the domestic economy, the industry has been an important foreign exchange earner and has accounted for roughly 15 to 20 percent of annual GDP. Unfortunately, thus far, government has largely failed to capture the potential opportunity that mining and petroleum offer to underpin broader-based social and economic development.

67. A number of key projects in the sector were thought to be approaching the end of their economic life, and revenues from the sector were expected to fall over the medium term. However, exploration activities have picked up in recent years, and significant new reserves have been located, both for existing and new projects. Thus, it appears that this sector will continue to make significant contributions to the country’s economic growth for some time to come.

68. Unlike most other natural resources, mineral and petroleum resources are non-renewable and thus it is critical that during the finite period of extraction, steps are taken to ensure that the maximum economic and social benefits are captured for the nation, while environmental impacts are kept to a minimum. Unfortunately, PNG’s mining industries have had a very poor record of environmental performance. Areas of concern regarding potential environmental impacts associated with large-scale metal mining operations include: (i) discharge of heavy metals, cyanide, and acids into rivers, streams, and coastal waters; (ii) sediment loading in rivers; (iii) land degradation and loss of vegetation associated with opening land for pit mines; and (iv) social and economic disruptions (e.g., influx of outsiders, introduction of HIV/AIDS and other sexually-transmitted diseases [STDs], increased crime, etc.) to the communities in the vicinity of the mine site. Because mines typically discharge effluents to adjacent rivers, impacts are not limited to the mine sites alone, but are disseminated downstream through the river systems. Pollutants have potential impacts on in-stream fauna, and may cause fish mortality or render these resources unsuitable for food use by the community-dwellers along the rivers. Sedimentation had also caused die-back of vegetation along rivers and streams. Three of the country’s largest mining projects are briefly discussed below.

69. ***Panguna Copper Mine:*** Operations at the Panguna gold and copper mine in Bougainville (North Solomons Province), commenced in 1967. It was one of the world’s largest mining operations. Approximately 150,000 tons of tailings, dumped into the Kawerong River daily, flowed to the sea via the Jaba River. Over 360 million tons of material were deposited over a ten-year period. Environmental degradation occurring here included the loss of fish populations within the entire Jaba watershed, declines in fish stocks, declines in wildlife and rendering of adjacent lands unsuitable for agriculture.

70. Opposition to development at the Panguna mine was a major contributing factor in the emergence of a secessionist movement on Bougainville. The people like any other Melanesian society have a deep attachment to their land. There were benefits and compensations made but the Bougainvilleans felt that the development of the mine had robbed them of their land, irrevocably changed their way of life, and left them with little of the wealth.

71. Towards the end of 1988, the longstanding antipathy of landowners towards the mining company, Bougainville Copper Limited (BCL), erupted into violence. Riots broke out in 1989, and demands were made by a militant group for compensation to landowners of K10 billion (more than double the total revenue generated by BCL since mining commenced in 1967) for

environmental and other damage caused by BCL's operations. The militants also pledged to defend their island from foreign exploitation, and claimed that Bougainville was not part of PNG. The development of the Bougainville mine was not the sole cause of this subnationalist movement but the activities of the mining company and the administration, particularly in relation to land acquisition, and the broader social impact of the mine development, were inextricably tied up with it. Economically, the closure of the mine had a devastating effect on business within the province, and has also contributed to the nation's chronic high inflation rate.[24]

72. ***Ok Tedi Gold Mine:*** The Ok Tedi Mine was established to exploit extensive copper and gold deposits on Mount Fubilan in Western Province. The mine is the single largest contributor to PNG's economy, accounting for about 10% of GDP and in 2001, 18% of exports. These achievements have not come without tremendous environmental costs. Mine tailings are disposed of directly into the Ok Tedi tributary of the Fly River, and amount to about 30 million tons of material released annually.[25] These discharges have resulted in filling in of the river basin system and subsequent flooding of surrounding forests. An estimated 1,300 sq km of vegetation has died or become blighted, populations of river fish have declined 70-90%, animals have migrated, and villagers have been forced to hunt, fish, and farm over larger areas. In 1984, a dam intended to retain tailings failed due to a landslide. By 2002 BHP, the majority partner, decided to relinquish its ownership share. Its 52% equity in Ok Tedi Mining Limited was transferred to the PNG Sustainable Development Program (PNGSDP) Ltd. With the appreciation of the value of that initial investment, it is expected that within a few years PNGSDP's annual capacity for investment in sustainable development initiatives in PNG will exceed that of any other donor except Australia. The useful life of the mine is expected to end in 2010; it is intended that monies flowing from PNGSDP and through the PNG government during the remaining years of operation can be reinvested in the communities in the area, to help to reverse some of the losses that have been suffered through damage to the environment over the past twenty years.

73. ***Porgera Joint Venture:*** The Porgera gold mine, in Enga province, is one of the six largest gold mines in the world, and over the last decade has contributed more than 15 percent of PNG's total export earnings. The Porgera mine, although not without environmental impacts, has perhaps had a somewhat better environmental record than some of its PNG-based competitors. The management of Porgera Joint Venture has taken concrete steps that illustrate its commitment to sound environmental and social stewardship, including not only required environmental safeguards, but also creation of an environmental advisory committee; development of a detailed mine closure plan; social programs (health risk assessments, HIV/AIDS awareness training), and community infrastructure (schools, hospital, and aid stations).

Opportunities

74. Given the very poor environmental performance of the mining sector in the past, it is critical that concrete steps be taken to improve the situation in the future. Challenges are to: (i) limit environmental impacts; (ii) ensure that local communities benefit from mining activities; (iii) ensure that benefits lead to poverty alleviation and provision of social services; and (iv) closely monitor all mining activities, especially in remote locations.

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[24] The Pacific Review 3(2) 1990:174-77.
[25] In 1984, a landslide destroyed the foundations of a dam that had been built to retain most of the tailings.

75. Opportunities to effect needed changes in the sector can be based on: (i) lessons learned from some of the successful community-oriented efforts made in recent years by a number of mining companies; (ii) strengthening partnerships between communities, mining companies, government agencies, and NGOs; (iii) utilizing PNGSDP funds, and similar funding sources, to promote greater environmental protection; and (iv) strengthening capacity within DEC and local government agencies to carry out effective, transparent, independent monitoring of mining activities.

76. While adverse environmental impacts in the petroleum sector have been very minor to-date, there is a high potential for such impacts to occur, especially if a major oil spill should occur in the coastal environment. Thus, strong steps should be taken now to put in place effective spill prevention measures, to avoid such a disaster in the future.

6. Water Resources

Background, Issues and Challenges

77. PNG is endowed with abundant renewable water resources. Extensive rivers and perennial streams are found throughout the country, and have a cumulative flow rate of some 5,000 cu m/sec annually. Figure 2 gives an idea of the complexity of this extensive river system. Total surface waters cover some 64,341 sq km, and include the major river systems (such as the Fly, Strickland, Sepik, Ramu and Markham rivers), and approximately 5,383 freshwater lakes and wetlands. Rainfall is greater than 3,000 mm/yr. Surface water flows recharge extensive groundwater aquifers on the PNG mainland, however, the extent of these groundwater resources has not been quantified. Freshwater aquifers and lenses on low-lying atolls and small coral islands are more limited in extent, and their usefulness as sources of fresh drinking water may also be compromised by saline intrusion. Total renewable water resources per capita were 159,171 cu m per person in 2002. This is extremely high as compared to almost any other country (Table 10).

78. DEC is responsible for management of natural watershed areas. The PNG Water Board is responsible for the management, control and public supply of fresh water resources in PNG, except in the National Capital District where Eda Ranu is the responsible institution. Both these latter bodies are state owned statutory authorities. Since the creation of the PNG Water Board in 1987, there has been an increase in coverage in terms of the public supply of fresh water. However, despite the abundance of natural freshwater resources, and despite efforts to expand service, PNG ranks in the bottom ten countries of the world with access to safe water—in rural areas, only 29% of people have access to safe drinking water. Most rural areas lack water supply infrastructure and water is taken directly from natural sources. In urban areas, 91% of the population has access to safe drinking water, although only 60% of urban households have access to improved water.[26]

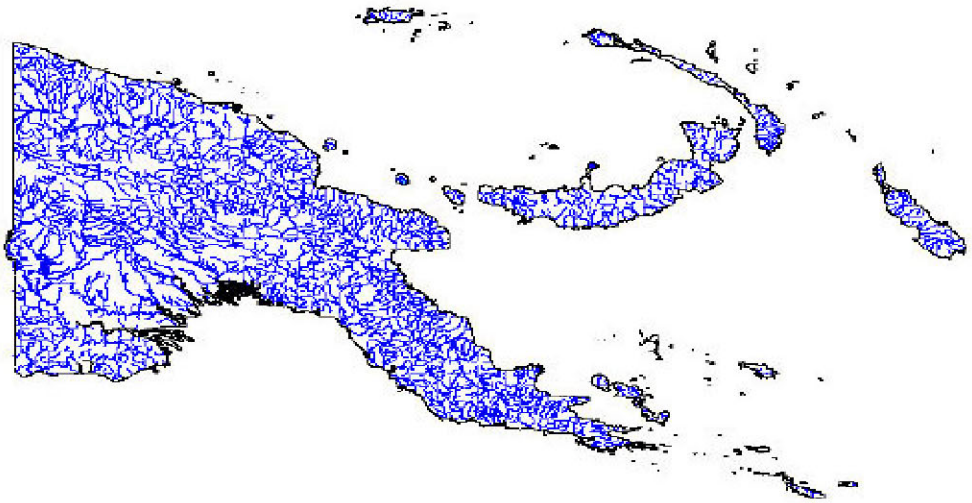
Opportunities

79. To protect the natural water endowment in PNG over the long-term, and ensure sustainability, further steps should be taken to implement an integrated approach to the management of natural watersheds. Given the extent of the available water resources, there is the possibility of their being employed for multiple purposes, such as generation of hydroelectric

[26] World Bank. *PNG EnvironmPNGent Monitor 2002.*

power, for use in aquaculture, and for recreation and tourism. These additional activities could help to promote further economic development, while protecting the resource at the same time. The discussion presented above highlights the fact that, apart from isolated low-lying small coral islands and atolls, the water situation in PNG is not constrained by water availability, but rather, by the absence of water delivery systems. ADB has undertaken the Provincial Towns Water Supply and Sanitation Project, to provide improved service delivery in eight provincial capitals nationwide.[27] Further efforts along these lines are required to improve service delivery, especially in more remote rural areas.

Figure 2 Major River Systems of Papua New Guinea



Source. Dr. S. Sauli UPNG

Table 10 Annual Renewable Water Resources

Country/Region	Available Water Resources (cu m/person/yr)	Data year
PNG	**159,171**	**2002**
Solomon Islands	107,194	1998
Lao PDR	55,251	1999
Oceania	54,795	1998
Cambodia	40,505	1999
Fiji	34,732	1998
Indonesia	13,709	1999
World	8,240	1999
East Asia	3,680	1998
Thailand	1,845	1999

Source: World Bank. PNG Environment Monitor 2002.

7. Pollution and Waste Management

Background, Issues and Challenges

80. The principal types of pollution-related problems in PNG are water pollution and solid waste. Air pollution problems are still quite negligible, generally being localized and temporary in

[27] Enga, Southern Highlands, Western Highlands, East Sepik, Madang, Morobe, Gulf, and Milne Bay provinces.

nature (e.g., exhaust fumes from heavy vehicle traffic in cities and towns, smoke from burning refuse, and dust along roadways or near construction sites).

81. ***Water pollution*** is caused mainly by unregulated discharge from industrial activities and the discharge of tailings into rivers by mining operations (as discussed in section 5, above). These actions have varied and far-reaching adverse environmental impacts. Direct dumping of a variety of wastes (domestic waste, sewage, industrial and hazardous wastes) into water bodies also contributes to water pollution. Sanitation facilities in PNG are not well developed. Approximately 96% of rural households use traditional toilet facilities, and more than half the households in urban areas also lack flush toilets. As a result of poor sanitation and absence of safe drinking water supplies in many areas, there is high vulnerability to water-borne diseases.

82. ***Solid waste*** is perhaps the most widespread and evident pollution problem. Most wastes are collected and transported to local (unsanitary) landfills where they are buried or burned. Most towns suffer from litter problems, with plastic bags contributing significantly to the volume of waste material.[28] Over the last 10-15 years, a number of small enterprises have developed to recover, reuse and recycle materials such as metal cans and glass bottles. Little attempt is made to recycle paper and cardboard, which are buried or burned. A significant volume of solid wastes in towns is composed of decaying or putrescent household vegetable and garden waste that could easily be composted. Hazardous wastes like hospital and medical wastes are either buried or burned. Such wastes pose special risks, since there are very few high-temperature incinerators available in PNG that can be used to destroy medical wastes satisfactorily. Microbes from these wastes may infiltrate the water table and contaminate public water supplies.

83. The main government agencies responsible for pollution and waste management are DEC, Department of Provincial Affairs and Local Level Government, the Department of Health, and city and town authorities. These agencies have their own legislation and regulations that address waste management issues. DEC has developed various regulations and codes of practice (e.g., Environmental Code of Practice for Vehicle/Machinery Workshops and Petroleum Storage/Resale/Usage Sites [1997], and Environmental Code of Practice for Sanitary Landfill Sites in PNG [2001]). The landfill Code provides guidelines and minimum standards for new sanitary landfills, intended to improve current waste management practices (open pits or crude dumping), which do not conform to sanitation and public health requirements.

84. The City and the Town authorities in each of the 20 provinces, including the National Capital District, manage and operate their own landfill sites. Municipal solid waste is collected by city and town authority contractors on a routine basis, the frequency depending on the amount of waste being generated as well as population size. The Department of Health administers the Public Health Act that provides the mechanism for regulating and controlling domestic refuse and the establishment of refuse points. It covers health, sanitation, cleaning, scavenging and disposal of wastes.

85. PNG is also signatory to various waste management-related conventions both regionally and globally, such as the Basel Convention on Hazardous Waste, Waigani Convention, and a SPREP convention for solid waste management.

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[28] As of January 1, 2005, the Minister of Environment and Conservation has declared a ban that prohibits the importation of plastic shopping bags, with an additional provision banning local manufacture of plastic bags to go into effect as of June 1, 2005. (Wakus, Wanita. 4 April 2005. "Public to Speak on Plastic Law." *Post-Courier*, p.9.)

86. Despite having frameworks in place that should ensure proper waste disposal, this has not been achieved in PNG, and waste management programs have generally been ineffective. This is reflected by the fact that waste collectors and operators are not adequately trained to achieve improved standards or performance, and there is no proper engineering design of waste disposal sites. No controls are in place on waste generation at the source to minimize waste, and rapid development of towns and industries results in increased waste generation, creating added pressure and making further planning difficult. Finally, customary land tenure arrangements severely limit the availability of lands to be used as waste disposal sites.

Opportunities

87. It is necessary for additional support to be given to improve sanitation facilities and practices, especially in rural areas. This will require not only provision of the needed infratructure, but also of training and awareness-raising so that households properly utilize and maintain any improved facilities that are developed.

88. Government has developed an action plan for improving waste management, which includes proposals to increase funding to Municipal Authorities to upgrade existing dumping sites and/or construct new sanitary landfills, and to achieve full implementation of standards outlined in the Environmental Code of Practice for Sanitary Landfill Sites. Opportunities also exist to tap international and regional institutions (e.g., SPREP, JICA) to help to facilitate further improvements in waste management. Pilot sanitary landfill sites are needed, to serve as a model for other such developments around the country.

89. Expanded efforts to promote recycling, composting and other waste minimization and re-use options can help to greatly reduce the burden and costs to municipalities for effective waste disposal.

8. Renewable Energy

Background, Issues and Challenges

90. PNG continues to focus primarily on the use of oil and gas for energy generation. While a large proportion of PNG's energy use is by burning biomass for cooking, and for drying of cocoa and copra (especially in rural areas), imported oil and gasoline for transport and electricity generation are major costs that are contributing to the nation's trade imbalance. This will likely change when refineries planned for Port Moresby come on-line, enabling the use of locally-sourced petroleum. Also, the emphasis in the nation's energy policies is slowly shifting toward reducing reliance on traditional petroleum resources, and further developing the nation's abundant renewable energy resources, including solar, biomass, hydropower, geothermal, wind, wave, and ocean thermal energy resources.

91. In the early 1980s, the Energy Division of the (then) Department of Mining and Petroleum (now part of the Department of Petroleum and Energy) began promoting mini-hydropower schemes. Three projects were established, including the Tari Dauli scheme (Southern Highlands) in 1987, and the Woitape (Central Province) and Telefomin (West Sepik) projects, commissioned in 1992.

92. A Rural Electrification Policy, and a National Energy Policy Statement and Guidelines, were adopted in 2001. The Energy Division promotes the adoption of renewable energy

sources, especially solar and wind power. Despite these policy advances, delivery of electricity, especially in rural areas, is very limited—it is estimated that 90% of rural dwellers lack access to electricity. Since electricity is synonymous with development, a means for providing electric power to remote, underdeveloped areas, that is economically, technically, and environmentally viable, needs to be found.

Opportunities

93. All the renewable energy options listed above present opportunities. Of these options, solar, wind and geothermal energy are technically proven, and can be economically viable depending upon site-specific parameters. Technologies are still being developed for harnessing wave and ocean thermal energy resources. Of the options mentioned, perhaps the most attractive in the PNG context is the possibility to expand mini-hydropower. For development of mini-hydropower facilities of about 160 kilovolt-amperes (kva), costs are around K3 million and usually less than a hectare of land is required. The vast surface water resource of the nation has already been described. At present, this resource is largely untapped. It should be possible, by utilizing an integrated watershed management approach, to develop sustainable mini-hydropower projects in watersheds around the country. This approach lends itself for service provision in remote areas. Mini-hydropower projects in such areas could help to promote livelihood development, generate revenue through excess power production, and be eligible for added financial support through the CDM, or possibly other funding sources (e.g., GEF or PNGSDF).

94. Land issues have been one of the major factors constraining development of mini-hydropower in the past. The Energy Division has undertaken numerous pre-feasibility studies for mini-hydropower at various sites. Two sites that appear viable, and for which land-related constraints have been removed (through government purchase of the properties) are at Menyamya (Morobe Province) and Marawaka (Eastern Highlands Province). If projects were implemented at these two sites, they could serve as models for further development of mini-hydropower projects around the country.

9. Transportation Infrastructure

Background, Issues and Challenges

95. There are more than 20,000 km of roads in PNG. About 140 ports have been constructed and are complemented by smaller beach landings, ramps, and jetties along the coasts and navigable rivers. There are about 450 operational airstrips and airports around the country.

96. The Highlands Highway, the main arterial roadway, is used to transport cash crops and needed supplies between the Highlands region and Lae. This road is also the supply line to the Porgera gold mine in Enga Province and the gas and oil fields in Southern Highlands Province. While most areas of the country are served by major roads, no road connection exists between the Port Moresby capital district and the populated areas in the Highlands and on the north coast.

97. Most minor roads, and significant portions of major roads as well, are in an advanced state of deterioration. This is due to a combination of factors, including substandard construction, lack of adequate funds for maintenance, and lack of trained engineers to

recommend appropriate design and material specifications, as well as maintenance procedures. In some areas, especially in the Highlands, sections of roadway have collapsed due to slippage in the underlying substrate. In other areas, long stretches of road are filled with deep potholes; security concerns often make regular routine repair more difficult. These conditions increase the frequency of accidents, posing a serious safety threat, and entail significant economic costs as well. In most areas, trips that once took a few hours can now take days and some roads are only passable in dry weather. It has been estimated that in the area around Mt. Hagen alone, about K200 million of coffee is not being brought to market due to the poor plantation-to-market road conditions. Poor road construction and maintenance also has environmental implications. Poorly constructed, designed and maintained roadways can accelerate erosion and soil loss.

98. Most major coastal towns in the lowlands and islands are serviced by passenger ships, and coastal and island populations are almost totally dependent upon water transport for their travel and shipping needs. Because of deficiencies in the road system, air transport is the most efficient and reliable method of travel, but due to high cost, is beyond the reach of most rural people.

99. A ten-year National Transport Development Plan (NTDP) has been prepared by the Department of Transport and Civil Aviation. This policy, drafted in consultation with the Department of Works and Department of National Planning and Rural Development, was formulated to fulfill the national government's policy on restructuring and development, aimed at delivering quality, effective transportation infrastructure to promote social and economic development in the country. However, it is clear that considerable effort is required to achieve the policy objectives that have been articulated for the transport sector.

Opportunities

100. In order to improve delivery of essential goods and services, raise living standards, and alleviate poverty, especially in underserved rural areas, improved transportation infrastructure will be critical. Higher standards need to be applied in design, construction and maintenance of roadways, in order to ensure that environmental and economic benefits are realized and sustained. To the extent practicable, roads, airstrips, and port facilities should be retrofitted or built to be climate adaptable, so that such systems are less prone to damage that might occur due to flooding, frost, storms, or high waves.

10. Human Environment, Population, and Health

Background, Issues and Challenges

101. Perhaps the factor of greatest importance in the nexus between humans and their environment in PNG is population growth. With recent annual population growth rates around 2.5 percent, population number and density in the country, though still relatively modest, are expected to increase dramatically, with the population likely to double within less than 30 years.[29] Increased population will inevitably lead to greater pressure upon the existing resource base, due to increased demand for land, food, and materials to meet other basic needs. If not properly planned, this dramatic growth in population may cause significant damage to, and even permanent loss of, many of PNG's unique, precious, and globally important natural resources.

[29] However, the rate of growth could be slowed due to the high rate of HIV/AIDS infection.

102. HIV/AIDS is an issue of grave concern in PNG, affecting the lives of thousands of Papua New Guineans. It is one of the most common causes of death in hospitals, and a consensus estimate reported by the World Bank indicates that there may already be up to 50,000 people infected with HIV in the country. Infection rates in PNG could climb to 30% of the total population within 10 years, if effective countermeasures are not taken.[30] The areas with the highest occurrence of the disease are Western Highlands, Sandaun, Western, and Morobe Provinces and the NCD. Vulnerable groups include women, sex workers, youth, the poor, and workers in industrial enclaves (mining camps, factories, etc.). Some steps are being taken to combat the disease. Government is receiving K24 million annually from AusAID for programs that include awareness raising; promotion of the use of condoms; and studies of potential treatments of the disease. Other major funding is on-line from other agencies, including ADB and GEF.

103. To begin to address both population growth and HIV issues and concerns, government has drafted a population policy and a national strategic plan for HIV/AIDS (2004-2008) that advocate culturally and technically appropriate means of family planning, contraception, reproductive health, and disease prevention.

104. The delivery of basic essential social and health services by government has deteriorated in recent years, in part due to the lack of up-keep of roads and other transportation infrastructure. This situation has been compounded by smaller government budgets and centralized funding programs, which have led to the closure of aid posts and health centers, particularly in remote areas. Those that remain open are often understocked with basic supplies, including anti-malaria drugs and antibiotics. Churches and religious organization have in part filled this gap and have been among the major providers of health services in rural areas.

105. Infant and child mortality rates are high and increasing, with large differences noted between rural and urban areas. In recent surveys, the number of infant deaths in rural areas was nearly twice that of urban areas. The Highlands region recorded the highest number of infant deaths, while the Southern region, which includes Port Moresby, had the lowest. A strong relationship was also found between child mortality and women's education. Where mothers were educated to secondary level, the mortality rate among children under five years of age was 33 percent lower than for children whose mothers had never attended school.

106. Malnutrition is another area of concern. Malnourished children have a greater risk of dying or suffering severe disease, than properly nourished children. A mid-term review of the National Health Plan (1996-2000) found that in the period 1996–1998, the percentage of moderate to severely malnourished children seen at health facilities had risen.

107. While rural areas are clearly underserved as compared to urban areas, the process of urbanization carries its own host of concerns and problems. Most migration into urban areas is tied to the search for employment. About 18% of the population (about 1 million people) are now living in urban areas.

108. Because most migration into urban areas is tied to the search for employment, urban and rural development planning must go hand in hand. The economic growth rate, currently at 2.6%, is not generating enough new employment opportunities to keep up with the 4% urban population growth rate, nor to provide jobs for the potential work force, which is growing by about 50,000 persons per year. The resulting joblessness leads to higher rates of crime, one of

[30] AusAID.

the most persistent and widespread problems in PNG society today. Poor living conditions in urban areas are exacerbated by land tenure issues, since there is a need for more land to expand the area of settlements to properly accommodate new immigrants to Port Moresby and other major towns. Only recently has the government taken steps to address urbanization problems. In 2002, a Parliamentary Committee on Urbanization and Social Development was established that gave rise to the development of a National Urbanization Policy.

Opportunities

109. It is essential that government decision-makers, especially in the health and social services sectors, take immediate steps to implement national policies on population and HIV/AIDS. This should include mainstreaming of HIV/AIDS and reproductive health awareness and training across all sectors, as well as delivery of critical support, prevention, and treatment services through the Department of Health.

110. Also, effective measures need to be put in place to combat malnutrition. One area where steps could be taken would be to improve food security, and to ensure the delivery of foods of higher quality to improve basic health and nutrition.

111. Because one of the key underlying causes of urban migration is lack of jobs (especially in rural areas), creation of livelihood opportunities could help to reverse the trend toward urbanization, and could also help to reduce widespread criminality that is linked to joblessness.

112. The correlation between higher literacy rates and improved health and nutrition has been established. Improved literacy could also lead to a more skilled workforce that could compete for better jobs and raise living standards. For these reasons, literacy initiatives should be mainstreamed across all sectors by Government, community and religious groups, NGOs, and other stakeholders.

11. Tourism Development

Background, Issues and Challenges

113. Tourism potential for PNG is based upon its abundant natural scenic beauty, unique environments and ecosystems, and cultural diversity. Opportunities exist for a wide range of activities, including scuba-diving and snorkelling; trekking, climbing, and hiking; ocean recreation and fishing; nature appreciation; and historical, cultural, and village-based tourism, among others. The prevalence of participation in these various tourism options is presented in Table 11.

114. Despite the presence of such varied attractions and features, PNG has thus far been unable to capitalize on its competitive advantages and realize its tourism potential. An interesting comparison can be made with Fiji Islands, a much smaller island neighbor state with similar, but arguably less varied tourism resources than PNG. Despite this, Fiji's annual visitor arrivals are approaching the half-million mark, while PNG's are only about 17,000 (Table 12). The total contribution from tourism to GDP is small.

115. The main factors cited as barriers to tourism growth in PNG include (i) safety and security concerns; (ii) lack of awareness about PNG as a destination; (iii) inconvenient international air schedules, and lack of non-stop flights from many originating cities, (iv) limited

capacity of domestic air carriers; (v) high accommodation and transport costs in-country; and (vi) poor infrastructure. Nonetheless, in the face of these barriers, there has been gradual growth in the industry over the last few years.

116. While government has recognized the potential that tourism offers for generating additional revenues, it has only recently made stronger funding commitments to support the Tourism Promotion Authority (TPA) in its efforts to further develop this sector. Prior to this, tourism development has been left almost entirely in the hands of the private sector. As a result, development has occurred largely on an 'ad hoc' basis, not as part of a well-planned, coordinated, and strategic effort.

Table 11 Levels of Participation in Tourism Activities in PNG

Activity	Percent Participation
Sightseeing	69%
Diving/snorkeling	68%
Visiting historical sites	47%
Attending traditional performances	42%
Shopping	40%
Trekking	28%
Bird watching	25%
Game fishing	23%
Mountain climbing	19%
River cruising	14%
Canoeing	10%
Surfing	1%

Source: Tourism Promotion Authority, results of 2001 visitor survey

Table 12 Visitor Arrivals and Tourism Expenditures in PNG

Visitors' Country of Residence	Arrivals, 2004					Arrivals, 2003	Arrivals, 2002	2001 Expenditures (K)
	Total no. of Visitors	Purpose of Visit						
		Business	Visit Friends/ Relatives	other	tourism	tourism	tourism	tourism
Australia	32290	22072	2844	243	7131	6310	5194	5048
New Zealand	1858	1367	162	31	298	309	386	4986
Oceania	1974	1468	268	41	197	217	118	5051
China	1074	790	157	20	107	118	132	
Japan	3474	809	52	29	2584	2805	2821	10826
Malaysia	2106	1678	115	9	304	279	180	4528
Philippines	2657	2253	192	43	169	216	193	
India	630	516	44	22	48	35	107	
Other Asia	2530	1688	165	22	655	603	451	5841
United Kingdom	1581	750	112	23	696	491	559	11837
Germany	1172	343	45	13	771	615	452	11855
France	164	61	19	2	91	116	98	
Other Europe	1822	716	134	23	949	726	826	11464
USA	4748	1716	311	91	2630	1799	3329	13910
Canada	586	330	40	12	204	126	373	17132
Other America	106	40	4	5	57	26	29	
Africa	241	199	16	--	26	29	37	4714
Totals, year	59013	36796	4671	629	16917	14820	15285	
Total 2003	56185	35545	5388	631	14820			
Change	2828	1251	-717	-2	2097			
% + or -	5.0%	3.5%	-13.3%	-0.3%	14.1%			

Source: TPA; 2001 data from visitor survey; while not specifically stated, units for 2001 expenditures are most likely average per-tourist, per-visit to PNG

Opportunities

117. From an environmental standpoint, tourism development has appeal because, if properly conceived and executed, it has relatively low impact on the environment; offers sustainable livelihood opportunities that can be made available to local community members; and can generate foreign exchange revenues. Having recognized the potential for growth, it is important that government now take up tourism development in PNG in a carefully-planned and sustainable manner. There are many examples from other countries of instances wherein uncontrolled tourism development resulted in adverse environmental impacts, thus harming the very industry being promoted. The more common impacts are brought about by (i) inappropriate construction of buildings and infrastructure that encroach on the shoreline; (ii) uncontrolled discharge of wastes; and (iii) social problems that arise between tourists or tourism developers and the local community. With proper planning and consultation, all these impacts can be avoided or minimized.

118. The TPA has prepared a marketing strategy, and has drafted a tourism policy. In order to ensure sustainability, what remains now is to prepare a tourism development master plan, that will help to identify opportunities and constraints, and set a strategic framework for development that incorporates parameters to ensure the sustainability of the sector.

12. Biodiversity Resources

Background, Issues and Challenges

119. Having extensive, complex and relatively intact rainforests (after the Amazonian rainforest, PNG's tropical rainforest is the second largest intact rainforest ecosystem in the world), widespread coral reefs, and other natural habitats, PNG is estimated to be home to some 5-7 percent of the Earth's total biodiversity. Many of the plants and animals found here are indigenous (occurring naturally in PNG, but also found in other geographically defined areas), or endemic to Papua New Guinea (found nowhere else in the world).

120. Apart from their intrinsic value, uniqueness, and global environmental importance, PNG's biodiversity resources have potential economic importance as well. Bio-prospecting to discover new pharmaceuticals, new strains for food crops, or substances with other new technological applications is one area that offers almost unlimited opportunities for economic gain. The biodiverse communities of plants and animals that form complex ecosystems, including PNG's rainforests and coral reefs, also can support additional revenue-generating activities such as ecotourism and scientific research. Also, preservation of biodiversity resources is essential for the welfare of the large segment of the population who, as subsistence users, depend directly on these resources.

121. The sheer variety of species found in PNG is nothing less than astonishing. Terrestrial biodiversity includes 304 mammals, and 762 bird species. There are an estimated 15,000-20,000 plant species, of which 1,500 are tree species. There are well over 3,000 species of fishes found here. A conservative estimate puts the total number of naturally-occurring species found in PNG (plants, animals, and fungi) at close to 500,000.

122. A significant proportion of the species found in the country are under threat from (i) habitat loss; (ii) hunting, harvesting, or collection; (iii) competition from invasive species; and

similar pressures. Many species have been afforded some protection or are recognized as threatened by PNG law, CITES, or IUCN. A summary table is presented (

Table 13), which indicates the total numbers of species of various indicative taxa known or believed to occur in PNG; the degree of endemism; and the number of species under threat.

Table 13 Known or estimated numbers of native, endemic, and threatened species in PNG

Group	Est. total no. of living native species	Est. no. (%) endemic (unique) to PNG	Number (%) of threatened species
Mammals	187		40 (21%)
Marsupials	71	60 (84%)	
Bats	75	57	
Monotremes	2	1 (50%)	
Rodents	58	49 (84%)	
Birds	762	405 (53%)	148 (19%)
Amphibians			
Frogs	193	115 60%)	
Reptiles			
Turtles (incl. marine)	13	3 (23%)	8 (62%)
Lizards	184	58 (60%)	7 (4%)
Snakes	98	32 (33%)	10 (10%)
Crocodiles	3	1 (33%)	2 (67%)
Invertebrates			
Insects	300,000 (est.)		23 (<1%)
Butterflies	303	56 (18%)	22 (7%)
Land snails	1000		1 (<1%)
Plants – Flora			
All Vascular Plants	15,000-20,000 (est.)		4 families (?)
Orchids	3,200		All (100%)
Mangroves	37		
Fungi	90,000 (est.)		
Freshwater bivalves and gastropods	165+		
Freshwater Fish	214	149	45 (21%)
Marine Fish	3000		
Marine Invertebrates			
Sponges	90		
Corals	700		6 (<1%)
Crustaceans	198		
Mollusks	950+		2 (<1%)
Nudibranchs	700		
Echinoderms	177		
Marine mammals (cetaceans and dugong)	25		4 (16%)

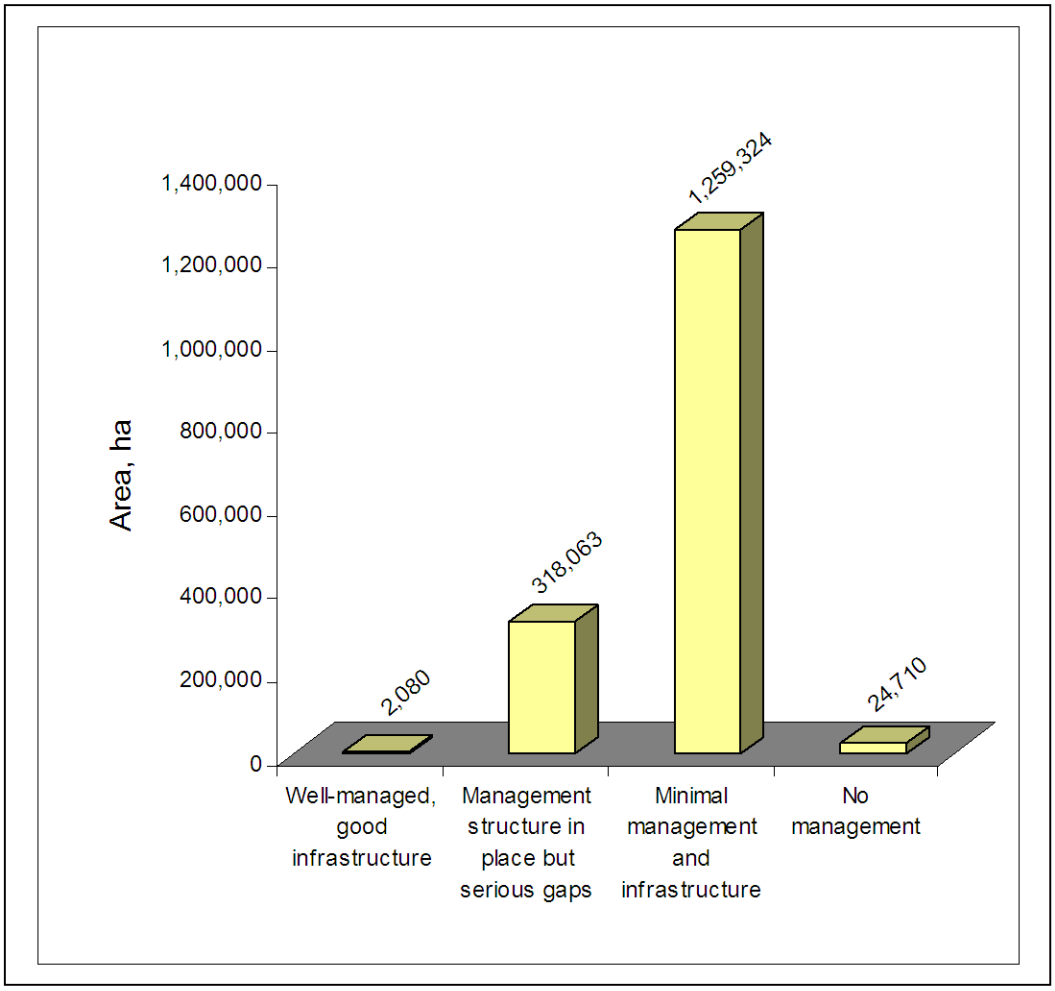
Source: Sekhran and Miller 1994; others. Note: figures for number of threatened species are based on a composite of those listed for protection under the PNG Fauna Act, CITES, and IUCN

123. Standard practice in biodiversity conservation includes the establishment of protected areas to conserve habitats and the species contained therein. WWF PNG is conducting an

assessment of protected areas in the country. There are 51 designated conservation areas[31] in PNG; a listing of PNG's declared protected areas is presented in Appendix 7.

124. At a recent workshop[32] that convened government and NGO stakeholders, it was discovered that while local landowners had an interest in participating in management of these areas, little attention was given by government to implementing management measures. An IUCN/WWF review in 1999 showed that 89% of PNG's protected areas have minimal or no management structure (Figure 3). Much greater effort is needed to protect these important sites, for both their environmental and potential economic value.

Figure 3 Summary of Management Status of PNG's Protected Areas (area in hectares)



Source: WWF

125. Another problem that affects the management of biodiversity is the lack of complete information. Basic taxonomic information, and data about location of critical habitats, rates of habitat loss, population sizes, and species distribution, are incomplete. This is another area where further research and extensive fieldwork are required. Past projects that have attempted together such information have included the Biodiversity Rapid Assessment (BIORAP) Project supported by AusAID and World Bank, which developed tools to delineate priority biodiversity areas. Further work is underway; NGOs such as Conservation International, Wildlife

[31] Of these, 48 are gazetted; three more are declared and in the process of being gazetted.
[32] February 2005.

Conservation Society, and Nature Conservancy are working to identify priority areas for conservation, and to understand more about the species comprising complex ecosystems. A government program administered through DEC, PINBio, has a budgetary allocation of K500,000 annually; since the goals and objectives of the program are quite broad and complex

Table 14), additional funding support is needed.

Table 14 Activities Under DEC's PINBio Project

Program	Activity
1	BIODIVERSITY INVENTORY: surveys and collections, documentation of indigenous knowledge
2	BIODISCOVERY: drug discovery, herbal medicine, venoms and toxins, and aromatics
3	AGROBIODIVERSITY: agricultural plant genetic resources, agrochemical development, horticulture
4	BIOTECHNOLOGY: development and support in agriculture, forestry, quarantine, horticulture, human health, and biosafety
5	BIODIVERSITY CONSERVATION: carbon trading, protected areas and hotspots, reforestation, afforestation, reduced impact logging, agroforestry, alternative energy from biomass
6	BIODIVERSITY DATABASE AND INFORMATION MANAGEMENT: facilitation of efficient and effective information sharing and use
7	POLICY AND LEGISLATION: development of appropriate policies, review of current legislation, development of appropriate international laws and agreements, addressing traditional user rights
8	TRAINING AND INFRASTRUCTURE DEVELOPMENT: capacity building, technology transfer
9	EDUCATION AND AWARENESS: awareness on PINBio, and importance of biodiversity conservation
10	CONSERVATION AREAS: development of effective structures for establishing and formalizing reserves to protect and preseve high-biodiversity areas of local, national, regional an d global importance

Source: Biodiversity Secretariat, DEC

Opportunities

126. Effective management of PNG's biodiversity resources requires integration of effort across a range of sectors and disciplines. An ecosystem approach (e.g., such as management of an area of coral reef or watershed or rainforest), rather than a species-targeted approach, will be more effective in protecting a range of interdependent species that occur together within the same environment.

127. Similarly, protection and management of biodiversity cannot be carried out in isolation—if economic benefits are tied to conserving biodiversity, then stakeholders will better appreciate the value of these resources and conservation efforts will be more sustainable. Because of the extensive biodiversity resources present in PNG, there are numerous opportunities to capitalize on biodiversity for sustainable economic development. The biodiversity-related economic activities that could be developed in a sustainable way include such enterprises as ecotourism, bio-prospecting, cottage industries, certification programs, and captive breeding programs (among others). In order to avoid irreversible damage to biodiversity resources, efforts should be made to substitute these and other low-impact economic activities for current high-impact extractive activities that are causing damage to ecosystems and depleting populations of important target species.

128. Given the long history of traditional use of various plants and animals in PNG, there is potential for capitalizing upon the traditional knowledge base to make use of PNG's biodiversity resources in a sustainable way. Traditional knowledge can be applied in many areas, including bio-prospecting, ecotourism, and biodiversity conservation.

13. Climate Change

Background, Issues and Challenges

129. In PNG, recent events tied to changing weather patterns serve as a forewarning of the types of impacts that could be expected to occur as a result of major climatic change (global warming). One dramatic example was the serious drought that affected much of the country in 1997-1998, which was linked to the large-scale El Niño/La Niña weather phenomenon. Other types of natural disasters (discussed in Section 14), which already affect thousands of people in PNG, may further intensify or become more frequent with global warming. The main climate-associated risks that face PNG include extreme wind and rainfall (which may be associated with tropical storms and typhoons), high sea levels, and extreme air temperatures.

130. Climate-related risk comprises two components, the likelihood (or hazard) and the consequence. While the consequence component of a climate-related risk will be site- or sector-specific, in general the likelihood component of a climate-related risk will be applicable over a larger geographical area, and to many sectors. This is due to the spatial scale and pervasive nature of weather and climate.

131. Scientific evidence suggests that global warming would result in increased occurrence and intensity of climate-related hazards. For Papua New Guinea, some information concerning the "likelihood" or "hazard" component of climate-related risk is found in the regional Environmental Vulnerability Index (EVI) prepared by SOPAC (2004). The EVI identifies dry climatic conditions as presenting the highest risk (6 on a scale of 7) for PNG of all the climate-related parameters that were evaluated. Wet weather (4 on the vulnerability scale) and high winds and storm surge (both 3 on the vulnerability scale) present secondary, and thus less significant risks. The primary risk associated with extreme dry weather conditions has implications for several sectors, especially for agriculture and food security. The following paragraphs include consideration of the expected consequences of climate-related events, and possible adaptive measures that would help to mitigate adverse climatic impacts.

Existing Conditions and Possible Adaptive Measures

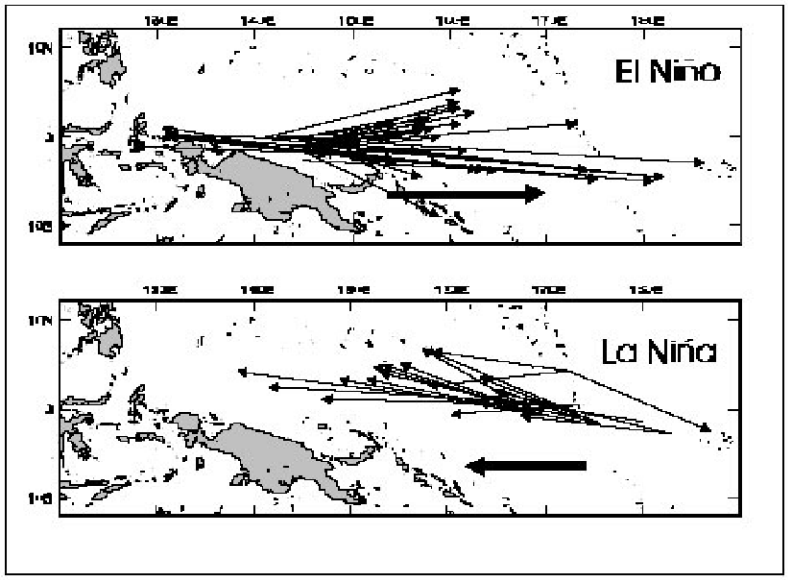
132. ***Coastal and marine environments:*** PNG's coastline, and the populations and settlements which are located along the coast, are vulnerable to extreme weather phenomena, especially through strong tropical storms and cyclones. Potential impacts include loss of foreshore; inundation of coastal wetlands; and bleaching of corals. Loss of coastal mangroves and loss of coral reefs may result in greater exposure to strong waves, thus hastening shoreline erosion. Some coastal sites in PNG are affected by weather-related impacts. Small, low-lying islands in the atolls of the Duke of York (New Britain) are subsiding further—while this is due to tectonic movement, and not weather or climate, as this occurs these land masses become ever more susceptible to inundation by strong waves and storm surges. Gardens of the Mortlock and Tasman Islands (North Solomons Province) and Wuvulu and Aua Islands (East Sepik Province) have been flooded. Limited groundwater sources on these islands are also being compromised by saline intrusion, and residents have been forced to resettle on larger islands or the mainland. PNG's efforts to develop early warning and response capabilities, and to guard against unforeseen impacts are supported by the South Pacific Sea Level and Climate Monitoring System.

133. ***Fisheries:*** Many breeding grounds for commercially important species of fish and shellfish are located in shallow waters. Mangrove areas are particularly important nursery-grounds, harboring barramundi, crabs, prawns and other important food species. Mangroves, while quite resilient and adaptable to natural fluctuations in water level and salinity, can be adversely affected if water level, salinity, or temperature rises too high. Coral reefs, which also provide important fish habitat that supports such commercially-important target species as groupers, emperors, trevallies, and snappers, may undergo 'bleaching'[33] with rising temperatures. Any changes in water temperature or sea level could therefore affect these important coastal habitats, resulting in declining fisheries productivity.

134. In addition, levels of fishing effort, fish behavior, and fish migration patterns are directly influenced by weather and ocean temperatures. In the Western Pacific, the distribution of tuna is affected by the location of the Western Pacific Warm Pool (WPWP), a moving water mass located near to PNG. During El Niño conditions, the WPWP can be displaced almost 4,000 km eastward. This affects migratory patterns, as well as the quantities and species composition of fish that make up tuna schools in PNG waters (Figure 4).

135. As an adaptive strategy, fisheries managers need to obtain accurate spatial and temporal information concerning the movements of tuna, in order to be able to adjust management practices to improve the sustainable utilization of the resource. Development of aquaculture projects and other activities that can help to provide substitutes for fish harvested from the wild, can help to reduce fishing pressure, and reliance on wild stocks.

Figure 4 Tuna Migration Patterns during El Niño and La Niña Events in the Western Pacific



Source: Dr. S. Sauli, UPNG.

136. ***Agriculture:*** The agriculture sector is much affected by changes in weather and climate. Crop yields are influenced by variations in temperature and fluctuations in rainfall. Since

[33] Coral bleaching is believed to be a biological response to warming of ocean waters, as may occur during El Niño conditions. The 'bleaching' effect occurs when corals lose their color due to the discharge of symbiotic algae that produce food for the coral polyps through photosynthesis.

photosynthetic activity decreases above 25˚C, tropical staple crops such as sweet potato, yam, cassava and taro may be adversely affected by higher temperatures. Climate also can affect soils, especially through change in moisture content, which can also retard plant growth. Reductions in agricultural productivity resulting from climate change pose a potential threat to national food security. During PNG's 1997 drought, because no fallback strategy was in place to deal with or adapt to the extreme dry conditions (especially in rural areas where food is acquired almost exclusively through subsistence activities), food shortages arose, with many people falling ill or going hungry. Agricultural production in the Highlands has occasionally been affected by die-back of crops due to frost, as occurred 1997 and 1972. The occurrence of frost is believed to be related to El Niño patterns.

137. A number of adaptive measures are available as responses to such changes, including development of drought-resistant crop strains, as well as modification of cultivation methods, especially to promote water savings through improved irrigation methods, and greater water retention in soils. Further research is needed to work out the detailed methodologies needed to more effectively cope with future drought episodes when they occur.

138. ***Biodiversity:*** The health and survival of PNG's biodiversity resources are closely tied to climatic conditions. Potential impacts on mangrove areas, wetlands, and coral reefs have already been mentioned. Dieback in forest cover would undoubtedly also have dramatic impacts on a wide range of forest plant and animal species. Major shifts in temperature and rainfall may result in the disappearance of fragile ecosystems such as montane cloud forests, and their associated biodiversity, which exist within a very narrow range of physical, topographic and climatological parameters. Strong measures that bring together resource owners, communities, NGOs, and governments for integrated monitoring, management and enforcement, are urgently needed to address these issues.

139. ***Water Resources:*** Pressure is increasing on the nation's water resources due to rapid population growth and industrial development. Climate change threatens to exacerbate the problem. Prolonged droughts can affect evapo-transpiration rates in forests, reducing water retention rates. Increased sea level could cause greater saline infiltration into freshwater aquifers along the coast. Adaptation requires that improved water storage systems are developed for communities facing frequent shortages. This has already begun to happen in the small islands, where large cisterns and fiberglass storage tanks are being installed. Awareness raising to promote water conservation is another important mechanism to ensure that adequate water supplies are available for human needs. Measures aimed at conserving the forest canopy will help to minimize evapo-transpiration and promote water retention within critical watershed areas.

140. ***Health:*** Changing climatic conditions have several possible health-related impacts. Firstly, human health and safety are directly threatened through extreme weather events such as typhoons and storms. Next, human nutrition may be affected if crops are lost or damaged due to prolonged droughts or flooding. Also, in situations where climate changes cause disruptions in infrastructure services (e.g., lack of adequate supplies of safe drinking water and water for sanitation), worsening sanitary conditions can lead to outbreaks of water-borne diseases, such as cholera, diarrhea, and dysentery. Finally, health parameters are also indirectly affected through the movements and distribution of disease vectors. In PNG, it has been noted that malaria-carrying mosquitoes are migrating into the Highlands Region. It has been suggested that this expansion of the mosquito's range is occurring because of warming weather trends. Among the adaptive measures that could be implemented, mapping and monitoring of the occurrence of vector-borne diseases needs to be conducted, in order to gain a

better understanding of where vulnerable populations are located, and to better target medical services delivery.

141. ***Infrastructure and Industry:*** Various types of infrastructure are susceptible to damage due to climate change, and without proper safeguards in place, the potential for loss is great. Most vulnerable are systems of roads, bridges, piers, jetties, and other permanent structures that are located in coastal areas. These features would be subject to possible inundation and permanent damage due to storm surges and sea level rise. Other types of infrastructure also may be affected by changes in climate patterns. For example, hydropower plants depend upon a constant minimum flow of water; during prolonged droughts, reservoir levels may fall below the minimum level needed for operation of the hydro turbines, forcing a stoppage in power generation, and possible power failures.[34]

142. Industrial operations, too, are affected by weather changes. The severe drought of 1997 resulted in temporary closures at several major facilities, including the Porgera and Ok Tedi gold mines, where water shortages prevented normal operations. Steps that have been taken:

143. Adaptation within the infrastructure sector is primarily a matter of applying preventive engineering design, anticipating the potential for larger-magnitude weather events, and avoiding, to the extent possible, developments in areas susceptible to inundation or coastal erosion. In addition, better data is needed to ascertain vulnerability in different parts of the country. Finally, existing building codes and standards could be reviewed and strengthened, considering the possible significant impact of extreme weather events due to global warming. Improved standards would lead to making buildings and structures more climate-proof, climate-efficient, and climate adaptive.

Mitigation

144. While PNG is not a major emitter of greenhouse gases (GHGs), nonetheless it can take steps to further minimize the presence of GHGs and ozone-depleting substances in the atmosphere. Use of alternative fuels and clean fuels is one way to reduce the production of GHGs. In PNG, opportunities exist to utilize biomass, biogas, and hydropower for energy production. There are a number of hydropower facilities already in operation (e.g., the Yonki hydropower facility, one of the most successful energy development projects in the country, supplies electric power to all the highlands provinces, Morobe and Madang). Given the extensive river systems throughout the country, there is further potential for hydropower development, especially small-scale systems. In addition, PNG has large reserves of clean-burning natural gas. At present, a small operation utilizing the Hides gasfield of the Southern Highlands is being used to power the Porgera Mine. Much greater potential for developing natural gas resources exists, especially in the Moran area, Southern Highlands.

145. A second, very important opportunity to mitigate GHG emissions is by maintaining mature forests, as well as by increasing forest cover through reforestation and afforestation projects. Funding assistance for such efforts would potentially be available through the Global

[34] Such occurrences are known from other countries in the region. For example, in late 2003, due to lack of rain, water levels at the Monasavu hydropower dam in Fiji dropped to a meter below the safe minimum level for operation of the electric turbines and generators. This resulted in a significant decrease in total electricity production for the year, with zero production during several months. Production returned to normal levels with the advent of heavy rains in 2004.

Environment Facility (GEF) and the Clean Development Mechanism (CDM). Long-lived forest trees serve as a natural carbon sink that can absorb and trap atmospheric carbon, thus minimizing the climatic impacts caused by higher levels of carbon gases in the atmosphere.

Policy

146. PNG is a party to the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, and has established an Ozone Unit within DEC. This office is responsible for compliance with the international conventions, and for developing and implementing policies for the country to address climate change and sea-level rise. Funding from Global Environment Facility (GEF) is being used to conduct a national greenhouse gas inventory. Also as part of this project, the Initial Communication under the UNFCCC has been completed. This document describes progress made and policies being formulated by government to address climate change issues.

147. Government has also drafted a policy on carbon trading. Recognizing that PNG's natural rainforest is a global asset and the international community derives considerable benefits from its careful management, government intends to explore options for the inclusion of natural rainforests under the Kyoto Protocol's carbon trading mechanism.[35] If established rainforests were included in the carbon trading mechanism, landowners could receive financial payments from developed nations to protect PNG's forests in their natural state.

148. Despite good progress on these fronts, only passing reference to climate change is made in the MTDS, government's key statement of strategy. Mainstreaming of climate change into the national policy agenda needs to be more clearly reflected in key planning and policy documents.

Opportunities

149. The key areas of opportunity for mainstreaming climate change considerations into future development processes in PNG are: (i) pursuing support for reduction of atmospheric greenhouse gases through the Clean Development Mechanism and other financial instruments; (ii) integrating biodiversity and ecosystem conservation function in rainforests and coral reefs to reduction of carbon in the atmosphere; and (iii) adapting existing and new infrastructure to be more resilient to climate-related impacts such as exposure to floods, frost, and storm waves.

14. Natural Hazards and Disaster Management

Background, Issues and Challenges

150. The magnitude 9.0 earthquake and tsunamis that occurred on 26 December 2004 left in their wake massive destruction and loss of human life that affected a dozen Asian and African nations around the Indian Ocean area. Those impacts have caused a global re-thinking of the critical importance of disaster preparedness. PNG is judged to be the Pacific island country most affected by natural disasters since 1990 (Table 15); the country is subject to cyclones, earthquakes, landslides, flooding and storm surges, and volcanic eruptions. In recent years, the most dramatic and most damaging disasters have included the volcanic eruption in Rabaul

[35] Background information on carbon trading and the CDM is presented in Appendix 8.

(East New Britain) in 1994, and the tsunami of 1998 that affected more than 100,000 persons and left more than 2,000 dead in the Aitape, Sandaun (West Sepik) area.

151. To address matters of disaster preparedness and emergency response, a National Disaster Management Office (NDMO) was set up as mandated in the Disaster Management Act (1984, revised 1987). The NDMO also has among its major functions (i) supervision of the state of preparedness for emergencies; (ii) coordination of relief actions; (iii) supervision of preparation of provincial disaster management plans; and (iv) promoting public awareness.

Table 15 Major Recorded Natural Disasters in PNG

Year	Event	Location	Est. Persons Affected	Deaths
2004	Volcanic eruption	Manam, Madang	10,000	
2003	Flood	East Sepik		None
2002	Volcanic eruption	Pago, West New Britain	10,500	None
2002	Drought	Various	200,000	None
2002	Earthquake	East Sepik		
2002	Earthquake, landslide	Wantoat, Morobe	13,405	9
2000	Earthquake	New Guinea Islands		None
1999	Flood	North Fly, Western	10,000	
1998	Tsunami	Aitape, Sandaun	124,270	2,227
1998	Flood	East Sepik; Ramu and Mumeng in Morobe	--	--
1998	Cyclone and gale	Milne Bay	50,000	None
1998	Storm	Milne Bay	--	--
1997	Drought/frost	Nationwide	3,159,000	--
1997	Cyclone	Central; Milne Bay	--	--
1996	Volcanic eruption	Manam, Madang	3,000	--
1994	Cyclone	Milne Bay	--	--
1994	Volcanic eruption	Rabaul, East New Britain	50,000	3
1993	Cyclone	Northern islands; Milne Bay	50,000	1
1993	Landslide	Kaiapit, Morobe; Finisterre, Madang	7,000	14
1992	Volcanic eruption	Manam, Madang	2,000	--
1972	Drought	Highlands	--	--
1957	Volcanic eruption	Manam, Madang	3,200	--
1951	Volcanic eruption	Lamington, Oro	3,000	--
1937	Volcanic eruption	Rabaul, East New Britain	8,000	500

--= no data available
Source: DEC June 2004

152. Apart from PNG's own efforts, other regional initiatives have been undertaken to measure the risks of natural disasters. In particular, SOPAC has carried out several regional programs aimed at addressing these issues. The Disaster Risk Management Project assisted Pacific SIDS in mainstreaming risk management, and training stakeholders. The recently-prepared Environmental Vulnerability Index (EVI) provides comparative data for countries around the region to enable them to assess key areas of environmental vulnerability and environmental resilience. It is intended that data in the EVI will be useful as a baseline against

which future data can be compared to measure changes in environmental vulnerability over time.[36]

Opportunities

153. To help to improve disaster preparedness, it is critical that the capabilities of the NDMO and other agencies and organizations involved with preparedness, response and relief are strengthened. Better coordination between various agencies, communities, and NGOs is also required. Using the EVI and other relevant information as a tool, raising awareness in communities can also help to reduce vulnerability and minimize damage, injury, and loss of life when disasters strike.

D. Policy, and Institutional Challenges

1. Policy Framework for Sustainable Development

154. In April 1994, Government established a National Sustainable Development Steering Committee, which was tasked to coordinate the formulation of a National Sustainable Development Strategy. Unfortunately, ensuing changes in government interrupted the formulation of a coherent sustainable development policy. In September 2002, in response to the outcomes of the World Summit on Sustainable Development (WSSD), Government renewed its efforts to strengthen the policy framework for sustainable development. This resulted in the formation of a new Committee on Sustainable Development,[37] which was charged with the formulation of a new sustainable development policy, which is still ongoing (DEC June 2004).

155. Until this process is completed, the Government's principle document guiding development of the nation is the *Medium Term Development Strategy (MTDS) 2005-2010*.[38] The MTDS was developed through a broad consultative process involving stakeholders for government, the private sector, community-based organizations and international development partners. The main purpose of the MTDS is to articulate an overarching development strategy and guiding framework for prioritizing government expenditures. The MTDS outlines a three-point strategy for development: (i) good governance; (ii) export-driven economic growth; and (iii) rural development, poverty reduction, and empowerment. The MTDS also presents "Ten Guiding Principles", of which No. 4 is "to maximize the value of... natural resources and environment, through sustainable primary production and downstream processing, with a focus on agriculture, forestry, fisheries, and tourism supported by mining, petroleum and gas." Lacking in the MTDS, however, are concrete guidelines, objectives, and indicators to help achieve sustainability in development, especially in environmental terms.

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[36] The EVI is a broad vulnerability index that includes risk categories in five general groupings: weather and climate, geology, geography, resources and services, and human populations. For PNG, the EVI indicated very high vulnerability to droughts and volcanic eruptions, and an extremely high risk of pressure due to the rapidly-growing human population.

[37] The committee is led by the Department of National Planning, and has representatives from the Office of the Prime Minister, the National Executive Council, and the Ministries of Foreign Affairs and Immigration, DEC, Education, and Health, as well as the National Fisheries Authority and National Forest Authority.

[38] Key policy and strategy documents, many of them focused on specific sectors, are the following (among others): *National Poverty Reduction Strategy* (draft); *National Population Policy 2000-2010*; *National Urbanization Policy 2005-2020*; *Sustainable Mining Policy*; *Horizon 2020* (National Agriculture Policy); *National Government Tourism Policy* (undated draft; *Papua New Guinea Carbon Trade Policy* (undated draft); and *National Energy Policy* (March 2003).

156. In order meet the objectives of the MTDS, a financing plan is mapped out in the Medium Term Resource Framework (MTRF); an indicative MTRF for 2005-2007 is included in the MTDS. The role of the MTRF is to integrate the 'top-down' resource envelope with the 'bottom-up' sector programs. The 'top-down' resource envelope is determined by the Government's Medium Term Fiscal Strategy (MTFS), which is developed by the Treasury. Over the medium term, the level of resources available to the Government is forecast to decline marginally in nominal terms, and more in real terms. Therefore, it will only be possible to increase funding to the MTDS priorities by identifying savings from non-priority activities and by achieving cost-efficiencies across the board. Because environmental management is not identified as a priority area in the MTRF, from the above statements, it can be concluded that funding for environmental management may suffer at the expense of other identified priority issues. The lack of funding commitment for environmental management in the MTRF indicates that there is a critical need to instill a stronger sense of environmental responsibility among policy- and decision-makers, in order to more effectively mainstream environmental considerations into the national strategic planning process.

157. The lack of a national sustainable development policy; the absence of a well-articulated statement regarding environmental mainstreaming as a clear policy objective in the MTDS; and lack of a budget allocation that reflects a genuine commitment to support effective environmental monitoring and management, all point to a failure thus far by government to integrate environmental considerations into the country's economic and development planning processes. Possible underlying reasons for these shortcomings may be:

- lack of adequate, accurate, and timely information upon which to base important decisions for future economic development activities;
- the perception that conservation is a "western" concept that does not apply to PNG;
- relatively low levels of awareness, especially among key decision-makers, regarding the direct linkages between continuing economic development potential, and the need to ensure that resources are utilized in a sustainable manner; and
- governance problems, including non-transparency and lack of political will.

158. These factors make it apparent that there is a need to clearly communicate—to stakeholders at all levels, but especially land- and resource-owners, policy-makers, and the private sector—the fact that livelihoods, food security, and the potential for future resource use, depend upon wise planning and managed use of natural resources, and maintenance of environmental values and ecosystem functioning. Only once this message is internalized through adoption of policy statements that clearly articulate environmental sustainability as a core objective—can there be hope for achieving the necessary reforms, and strengthening the environmental mainstreaming process.

2. Legal and Regulatory Framework

159. The principles of sound environmental resource management are embodied in PNG's Constitution. The fourth goal of the Preamble to the Constitution states:

> "*we declare …PNG's natural resources and environment to be conserved and used for the collective benefit of …all, and to be replenished for the benefit of future generations. We accordingly call for:*

- *Wise use to be made of our natural resources and the environment in and on the land or seabed, in the sea, under the land, and in the air, in the interests of our development and in trust for future generations;*

- *The conservation and replenishment, for the benefit of ourselves and posterity, of the environment and its sacred, scenic, and historic qualities; and*

- *All necessary steps to be taken to give adequate protection to all our valued birds, animals, fish, insects, plants and trees."*

160. The principal legal instrument for environmental regulation is the ***Environment Act 2000 (No. 64).*** This Act replaces three main pieces of legislation that deal with environmental protection. These were the Environment Planning Act, Environmental Contaminant Act, and Water Resource Management Act. The merging of these three laws was aimed at streamlining and harmonizing the previous cumbersome and confusing legislation. The Environment Act serves as a "one-stop shop" where a single Environmental Permit is obtained for developmental purposes, instead of three separate licenses or permits as was previously the case. The new Act proposes a more integrated approach to environmental protection.

161. To establish a framework for environmental management, the Act contains the following important terms and provisions: (i) explanation of how the Act complies with Constitutional requirements; (ii) definition of objectives; (iii) identification of the powers and responsibilities of the Department of Environment and Conservation as the principal agency for environmental regulation; (iv) mandate for the establishment of an Environment Council, whose main function is to set environmental policy; (v) mandate for the establishment of an Environment Consultative Group to serve as technical advisory body to the Environment Council; (vi) establishment of a requirement for a licensing process for development activities; (vii) definition of three levels (1,2, and 3) of activity, and specific requirements for environmental impact assessment that need to be complied with, in order for permits and licenses to be issued for activities of each level; (viii) establishment of a procedure for monitoring environmental management through audits and investigations; (ix) definition of parameters for preparation of environmental improvement plans; and (x) identification of violations, and establishment of penalties.

162. As described, the Act is quite comprehensive and complete. However, a significant weakness of the Act is noted in its bias toward mainly regulating large-scale projects. The Act does not contain adequate provisions for evaluating, regulating, and monitoring those small- to medium-size projects that may, individually or collectively, cause adverse impacts to the environment.[39] Hopefully, in future revisions, this shortcoming could be addressed.

163. Other legislation that has significant implications for environmental management is as follows:

- ***The Conservation Areas Act (1980, 1992)*** allows for the establishment of conservation areas by the Head of State. The Act also covers coastal and marine areas, as well as terrestrial sites. Apparently, this Act has not been implemented, primarily because of the failure to establish a National Conservation Council (NCC).

[39] It is recognized that at present, the government lacks capacity to monitor and enforce environmental regulations for all but the largest development projects. This deficiency will need to be addressed hand-in-hand with legislative strengthening.

- ***The National Parks Act, 1982*** provides for the establishment of National Parks as areas for the preservation of particular scenic, scientific or cultural importance on state-owned or long-leased land. Similar to the Conservation Areas Act, the National Parks Act does not allow any development. The Act is unclear to the question of whether it can be applied to marine areas. Therefore DEC has not established any marine national parks.

- ***The Fauna (Protection and Control) Act, 1974–1982*** allows for the systematic management and conservation of PNG's wildlife and provides for the establishment of Wildlife Management Areas (WMAs). This Act allows for the protection, control and harvesting of animals (but not plants). The Act provides for protected fauna, protected areas, wildlife management areas and sanctuaries. The Act also grants permits for scientific or zoological organizations to take protected fauna.

  WMAs differ from National Parks in that the land is privately owned. The requirements for consultation with customary landowners during the establishment and promulgation of rules for a WMA are more stringent than for a Conservation Area. Furthermore, the ambit of a WMA is restricted to the protection and management of fauna, whereas Conservation Areas and National Parks can be created for aesthetic and cultural values.

- ***The Fisheries Act*** gives broad powers to the Minister of Fisheries and Marine Resources to regulate fishing activity, mainly through prohibition and licensing restrictions. Regulations under this Act prohibit the use of explosives in fishing, establish management rules (e.g., gear restrictions) for a few species, and declare a 200-mile fishing zone. While the original Act was promulgated in 1974, a new Fisheries Act was approved by the Parliament in 1994 and contains provisions aimed at requiring proponents to explain how sustainable exploitation will be achieved.

- ***The Forestry Act (1991)*** represents the main legislation covering the management and conservation of forest resources. Under this act government purchases timber rights from customary landowners for a certain period and then grants a license to commercial companies to extract the timber. Royalties are paid to the provincial government and the landowners. Environmental safeguards, especially pertaining to logging on steep slopes or in proximity to rivers, are provided for by agreements between government and the permit holder.

164. Other important pieces of legislation having provisions to protect specific resources or avoid environmental damage include the ***International Trade (Fauna and Flora) Act, 1993***; the ***Crocodile Trade (Protection) Act, 1982***; the ***Continental Shelf (Living Resources) Act, 1978***, The ***Fisheries (Torres Strait Protected Zone) Act, 1978***; the ***Export (Fish) Regulation Act***; the ***National Seas Act***; the ***Prevention of Pollution of the Sea Act, 1981***; the ***Dumping of Wastes at Sea Act, 1981***; and the ***Lands Act***.

165. While not specifically targeting environmental management, one other law with far-reaching environmental implications is the ***Organic Act of 1995.*** This law enables provincial governments and Local Level Governments to make their own laws for "transferred powers." Provisions are found within the Environment Act that allow devolution of responsibility for some environmental management functions to the provinces and lower levels of government.

166. Many other Acts, regulations, and Codes of Practice focused on activities in specific sectors form part of the overall environmental regulatory framework, and contain provisions

relating to environmental management matters. The main acts that apply are listed in a matrix that summarizes government functions and responsibilities (Appendix 10.)

167. In addition to PNG's domestic laws, the country is signatory to a host of regional and international environmental conventions and agreements. Among these, the three so-called "post-Rio" conventions—the UNFCCC, UNCCD, and the CBD—are fundamental instruments that provide a framework for achieving environmental sustainability in a global context. As a party to these agreements, PNG has illustrated, at least in principle, its commitment to pursuing a development path that is in harmony with preservation of the natural environment.[40] However, implementation of many of these conventions has not progressed far, being hampered either by lack of capacity to complete the specific requirements of the agreements, or intervening events that interfered with progress. The status of implementation of some of the major international conventions and agreements has already been touched upon in the foregoing discussion of key issues (presented in Section III.C.). A comprehensive listing of PNG's international agreements is enumerated in Appendix 11.

3. Institutional Framework for Environmental and Natural Resources Management

a. Government Institutions

168. The principal national government agency charged with environmental management and monitoring responsibilities is DEC. Failure to execute intended restructuring, instability in the administration, and personnel changeovers have prevented the department from operating effectively in carrying out its responsibilities, many of which are of national and even global importance (DEC June 2004).

169. DEC has a complement of some 145 staff. However, its operations are hamstrung by woefully inadequate funding and staffing to handle all the assigned functions nationwide. In 2003, the department received just K200,000 for its operations for the year, rendering the agency totally unable to carry out its most basic regulatory functions. While budget appropriations have increased somewhat since then, little or no money is available to support the very important functions of surveying, compliance monitoring, and other field-based activities that the department is mandated to perform, or to develop state-of-the-art facilities and capabilities in data management, geographic information systems (GIS) and similar technologies, that are needed to support informed management decision-making.

170. DEC coordinates with other national-level departments and authorities who have specific sectoral responsibilities. These include, among others, the departments of National Planning and Rural Development, Land and Physical Planning, Agriculture and Livestock, Works, Mining, Petroleum and Energy, Health, the Forest Authority, and the National Fisheries Authority. The departmental structure and budget for DEC are presented in Appendix 12. (refer to Appendix 10 for specific functions of other responsible agencies).

171. Although environmental monitoring, regulation, and management is a function of the national government, implementation of most of these functions must occur at the provincial, district, LLG, and community/village level. As mentioned earlier, under the Organic Law,

[40] PNG has also endorsed the outcomes and environmental plans of other global summits and conferences, including (among others) the Barbados Plan of Action for the Sustainable Development of Small Islands Developing States (1994), the Millenium Declaration of the Millenium Summit (2000), and the Johannesburg Plan of Implementation (JPOI) of the World Summit for Sustainable Development (WSSD) in Johannesburg (2002).

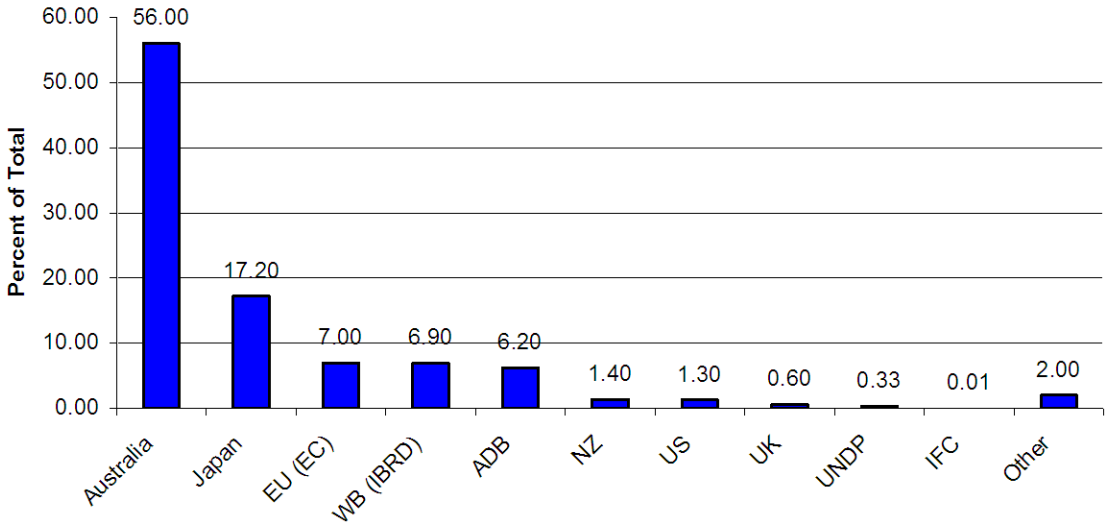
provinces and LLGs can make their own laws for "transferred powers." However, in practice, most environment-related functions are still held by the central government. Thus there is a "disconnect" between the centrally-assigned functions, and implementation of these functions at the local level. In addition, in many cases, as limited as capacity and budget are for DEC, those problems are even more pronounced at the local level. To promote more effective environmental management, it is clear that government needs to make a stronger commitment to strengthening DEC, by providing adequate budgetary resources, and hiring qualified personnel, to ensure that mandated functions can be carried out. In addition, a framework for strengthening environmental management at the provincial level could be achieved by making it a mandatory requirement that qualified environmental officers be assigned to each province.

b. Other Institutions

172. **IFIs, Donors and Regional Institutions.** Over the last decade, the principal contributors to PNG's external assistance have been Australia, Japan, EU, World Bank, and ADB (Figure 5). Australia is by far the largest, providing nearly $400 million in grants annually, close to 60 percent of all donor assistance. Australia's Enhanced Cooperation Program (ECP) reflects a 'whole-of-government' policy that aims to significantly improve institutional strength and governance functions in the country. A matrix illustrating the respective activities of key IFIs in PNG is presented in Appendix 13.

173. In addition to IFIs and donors, there are several Pacific regional cooperation and research institutions that provide significant assistance to PNG in environmental and natural resources-related areas. These include the South Pacific Regional Environment Programme (SPREP), the Secretariat of the Pacific Community (SPC), the Forum Secretariat, and the South Pacific Applied Geoscience Commission (SOPAC). SPREP is active in the areas of environmental monitoring, pollution prevention, and similar fields; SPC and the Forum are concerned with fisheries and marine resources management; while SOPAC conducts research in geological, climate, and oceanographic disciplines.

Figure 5 Official Development Assistance to PNG, 1992-2002 (% of total)



Source: OECD Database, February 2004.

174. **NGOs.** A number of environmental and related NGOs, both international and locally-based, are active in PNG. In addition to serving as advocates for environmental improvement, NGOs serve another important function, by filling in critical capacity gaps that exist within governmental agencies. For example, several NGOs (e.g., Research and Conservation Foundation [RCF], Wildlife Conservation Society [WCS], Worldwide Fund for Nature [WWF], and The Nature Conservancy [TNC]), have taken up education and training as one of their principal focal areas. While RCF, TNC, and WWF target primarily strengthening the environmental curriculum in schools, WCS is training promising third- and fourth-year college students to develop critical skills in field biology, analytical thinking, and technical writing. Thus, WCS interns are performing functions that might ordinarily be handled by government environmental officers.

175. Other programs being carried out by NGOs are equally important. Most of these focus on awareness-raising and knowledge and skills development at the grass-roots community level, to promote self-management of resources among landowners and resource users. NGOs tend to make the large investments of effort, and long term time commitments, that are needed to effect positive change. As an example, Partners with Melanesians, has been involved in the Managlas Conservation Area Support Project for nearly twenty years. The project has been successful in raising awareness among villagers about conservation issues, and is helping to build traditional, low-impact village-based livelihood activities. A listing of environment-related NGOs working in PNG is provided in Appendix 14.

176. **Academia.** The University of Papua New Guinea (UPNG) is the principal institution of higher learning in the country, and has several programs in environmental and natural sciences that prepare students for future participation in these fields. Other regional colleges and universities also have some programs targeting these areas. In partnership with WWF and the Nature Conservancy, UPNG is jointly developing a conservation leadership initiative/ conservation area planning and capacity building training program. Conservation and environment curricula have been introduced at The University of Goroka in teacher education.

177. **Social, Traditional, Religious and Women's Groups.** While few of these groups emphasize environmental activities, they do provide assistance in a number of related areas, especially in health, education, disaster relief, and community awareness and women's empowerment. Due in part to weaknesses in government institutions, these other civil society groups play an especially important role in providing needed assistance to communities.

178. **Private Sector.** Because nearly all economic activities in PNG take place on lands owned by customary landowners, private companies are compelled to undertake measures to satisfy the demands of those landowners, typically as part of lease agreements. Apart from monetary compensation, many landowners and incorporated landowner groups (ILGs) demand that a range of improvements and services be provided to their communities by private-sector developers. The level of responsiveness of private sector stakeholders to community needs and demands is quite variable. In the best cases, landowners work closely with their private sector counterparts to plan out necessary improvements (e.g., roads, hospitals, water and sewerage) that can benefit both the commercial interests and the communities. Large-scale private operators, especially the mining and petroleum companies, logging companies, and plantations, typically have their own environmental departments who are responsible for developing comprehensive environmental and social programs that often include not only activities aimed at achieving legal compliance, but going beyond compliance to provide local residents with services that can help to improve overall quality of life within the community. These may include educational programs, health care, and similar activities.

179. Because DEC and other government agencies lack sufficient funds to conduct regular environmental monitoring, it is often left to the companies themselves to self-monitor, and simply report the results of their monitoring to the appropriate agencies for review and approval. Clearly, there is a conflict of interest when operators perform their own monitoring functions without adequate inspection by regulators. Quite justifiably, this system has come under criticism from NGOs and other environmental advocates, but the reality is that, until the responsible government agencies are given adequate budgets and staff mobilization to conduct more thorough monitoring, private sector interests will likely continue their self-monitoring activities, with varying degrees of reliability and integrity.

180. **Landowners.** Customary landowners are arguably the most influential group in PNG in terms of natural resources and environmental management activities. Traditional landowners are recognized as having customary rights over natural resources found on their lands, through much of the country's resource-related legislation, including the *Mining Act* 1992, *Forestry Act* 1991, the *Fisheries Act* 1998, the *Oil and Gas Act* 2000, and *the* T*orres Strait Treaty Agreement Act.* These acts provide opportunity for landowners to participate in the development of mineral and gas resources in various ways. The position of landowners is further strengthened by the Organic Law, which specifies that resource owners must be consulted before any natural resources development is initiated in their area.

V. PRIORITIES FOR ACTION

A. Recent Environmental Record

181. Efforts on the part of the government in managing the environment and natural resources have been limited. This is reflected in the very low budgetary priority accorded DEC. Equally significant in this regard, is the fact that, while devolution of some environmental management functions to local level governments is legally mandated (under the Organic Law), the reality is that very little devolution has occurred, and thus, DEC is still accountable for implementing virtually all environmental regulatory, monitoring, and management functions across 19 provinces (and NCD) nationwide. This suggests that much greater assistance also needs to be given to provincial governments and LLGs, to enable them to enact appropriate local regulations, and assume a much larger role in environmental monitoring, compliance and management functions.

B. Environmental Information and Data Needs

182. There are extensive data gaps that need to be filled in order to provide the basis for sound decision-making in the areas of environmental planning and resource management and utilization. In some cases, these gaps are the result of limited capacity in the agencies that are supposed to conduct monitoring and data collection. In other cases, cancellation of projects has resulted in data gathering activities being curtailed (for example no comprehensive inventory has been made of forest resources, which was supposed have been completed as part of the World Bank Forest Conservation Project). Even in areas where data are available, often the information is not readily accessible, or not brought to the attention of the appropriate decision-makers. Among the types of data needed are: (i) quantitative, comparable, regularly-gathered time series of data on economic performance, preferably disaggregated for all sectors; (ii) baseline biological information, including such data as species abundance and occurrence, extent of coverage of various critical habitats (e.g., coral reefs, mangroves, natural forest areas), and the condition of those habitats; (iii) a complete, up-to-date archive of maps, aerial photographs, and satellite imagery; (iv) an integrated geographic information system (GIS)

database; (v) accurate delineation and mapping of land use and land ownership; and (vi) quantitative information on rates of extraction of primary resources (especially in the forestry and fisheries sectors).

C. Review of Country Strategy and Program (CSP) and Country Strategy and Program Update (CSPU)

1. Strategic Priorities and Focal Areas

183. As identified by Government, poor governance and inadequate public sector reform are the most pressing development problems. ADB's CSP and CSPU identify the following focal areas for PNG: (i) improvement of economic performance and public sector performance, through strengthening of good governance, fiscal discipline, and capacity building; (ii) promoting private sector development, especially in the agriculture and fisheries sectors; (iii) protection and provision of basic services for vulnerable or marginalized groups, including the poor and those affected by HIV/AIDS; and (iv) strengthening of conditions for pro-poor growth, especially through targeted development of key transportation infrastructure in impoverished rural areas of the country. A number of changes have occurred in the program since the last Update; a listing of the ongoing and pipeline projects that make up current country program is provided in Appendix 15.

184. The identified priorities are indeed urgent and warrant considerable attention. It would not be effective for ADB, or any single institution, to attempt to provide assistance in all the areas requiring action. Thus, ADB has elected to focus on those areas of need deemed to be the most urgent. Regrettably, for the present country program, this has resulted in very little focus being given to environmental concerns. Along with the other urgent matters being addressed by the country program, it should be noted that significant pressures exist that are threatening fundamental environmental values and the underlying natural resource endowment of the country. Over the long term, environmental deterioration and resource depletion, if allowed to continue unabated, will lead to more fundamental, potentially irreversible, adverse impacts that could impair or curtail further economic and social advancement. For this reason, it is appropriate that ADB should consider making a stronger environmental statement in its future country programming. This could be achieved by (i) considering the environmental outcomes of projects in other sectors, and looking for ways to improve those outcomes, and (ii) by inclusion of new projects and initiatives in the program, that have a more direct focus on strengthening environmental management and planning.

2. Assessment of Performance and Evaluation of Environmental Impacts of ADB's Country Program

185. Because of changing economic indicators, PNG was reclassified by ADB in 2001 as a category "B2" country.[41] This makes PNG eligible for borrowing at least a portion of its financing from low-interest Asian Development Fund (ADF) sources.[42] Since joining the Bank in 1971, PNG has borrowed $855.0 million through 56 loans financing 45 projects. There have been 124 technical assistance (TA) grants worth $42 million approved in the same period. Besides this country-specific assistance, PNG has also benefited from regional technical assistance (RETA) projects. Of 12 recent loans in the country program, four have environmental or natural resource linkages. These are (i) Fisheries Development (1656-PNG); (ii) Provincial Towns Water Supply

[41] Prior to 2001, PNG's annual per-capita income had been around $800, but fell to the $400-500 range.
[42] But PNG is not eligible for so-called "concessional" ADF.

and Sanitation (1812-PNG); (iii) Nucleus Agro-Enterprises (1889-PNG); and (iv) Coastal Fisheries Management and Development (1925-PNG). A tentative program proposed for the 2006 pipeline in the health sector, the Health Sector Development Program II, may also have some environmental implications. A natural resources-related loan previously in the 2006 pipeline, the Agriculture and Rural Development loan, is tentatively programmed for 2007.

186. Grant projects in the pipeline include, for 2005, an HIV/AIDS project; and a PPTA for the Health Sector Development Program II. For 2006, a Land Tenure technical assistance project; technical assistance for Health Sector Capacity Building; and a special ADF grant of $10 million for HIV/AIDS interventions, are included. Of these, the Land Tenure project may have significant ramifications for environmental mainstreaming, given the potentially large role that might be played by customary landowners in sustainable land and resources management.

187. Within the environment- and natural resources-related sectors, ADB has concentrated its lending assistance in the areas of (i) water supply and sanitation (WSS) infrastructure, (ii) agriculture, and (iii) fisheries and other marine and coastal resources. Selected comments concerning performance in these sectors follows.[43, 44]

a. Water Supply and Sanitation

188. The water supply and sanitation (WSS) sector received $45.6 million for 4 loans. Disbursement through 2002 reached $30 million. The first two loan projects, approved in 1976 and 1978 were successful in installing most of the physical infrastructure as planned. However, in post-project evaluation, water losses, and high levels of consumption and wastage were reported. The Provincial Towns WSS Project is ongoing. For this project, three water supply and three sanitation projects are proposed in six different provincial towns. It is expected that work on the first subprojects may commence by June 2005.

189. The mixed results described above may point to the fact that stronger capacity-building measures are needed to accompany physical infrastructure improvements. In addition, awareness-raising among the water-using public can help to reduce waste and high water consumption rates.

b. Agriculture

190. Some successes in the agriculture sector have been reported. For example, the East New Britain and West New Britain Smallholder Projects were both regarded as being generally successful in improving cocoa and oil palm production. However, in the CAPE review, it is stated that the sectoral impacts of ADB assistance generally were “less (than) impressive,” a statement that applies especially in the agriculture sector. For one of the largest and most wide-reaching loans to the sector, the Agriculture Sector Program Loan (ASPL), the Program Performance Audit Report (PPAR) found “no evidence of overall improvements in productivity or production, investment, or land utilization.” In fact, there were disinvestments and loss of jobs on coffee, cocoa, and coconut estates and downstream processing. Policy recommendations made under the program were found to contradict the aim of increasing the incomes of the poor. While

[43] Other donors and lenders have placed emphasis in other sectors, thus affording a degree of complementarity among the respective country programs. World Bank has assumed a key role in attempting to provide assistance in the forestry sector. UNDP has been actively involved in projects addressing such globally-important issues as biodiversity conservation, climate change, and land degradation.

[44] The evaluations are excerpted from: ADB September 2003. *Country Assistance Program Evaluation (CAPE) for Papua New Guinea.*

not presented specifically in environmental terms, the findings suggest that such failings could lead to some environmental problems, or at least non-progress, for example, in such areas as promoting sustainable land management.

191. Problems have also been encountered in the Nucleus Agro-Enterprise Project (NAEP). The premise of the project is appealing, and its approach is an innovative one that utilizes public-private partnerships, to develop nucleus enterprises as the focus for wider commercially-based smallholder and agro-industry development, with a view to improving incomes and standards of living in rural areas throughout the country. It was intended that under the loan, a pipeline of subprojects based on nucleus enterprise and smallholder development would be identified and prepared, which could be packaged into a series of projects for financing by ADB and/or other donors or financing agencies. Assistance provided under the project would consist of three activities: (i) initial project screening, (ii) subproject feasibility studies and (iii) pilot activity funding.

192. Since loan approval in December 2001, three potential projects for feasibility study, and six potential pilot projects, have been identified.[45] While these opportunities appear to be quite promising, with MoAs signed in some cases, funds have been released by ADB for only a single subproject. This has been due to financial management problems and concerns regarding use of loan funds by government for non-eligible expenses. Given that the identified portfolio of activities is quite promising, until the existing problems can be resolved, ADB is considering other options for continuing to lend support to this project.

c. Fisheries and Marine Resources

193. The Fisheries Development Project, approved in 1998, had as its objective increasing the economic contribution of the fisheries sector to the PNG economy on a sustainable basis. The project achieved considerable success in changing the institutional structure for the sector. The National Fisheries Authority (NFA) was revamped, including staff retrenchment, a merit-based selection procedure for selection of new staff, and staff training programs. The reorganized NFA was celebrated as a model for institutional reform. Introduction of transparent procedures reportedly resulted in an increase in profits to K45 million in 2002, as compared to K5 million before the project. This turnaround attracted international fishing fleets, renewed investor interest in the sector, and created new employment opportunities.

194. However, continuing success and sustainability of this effort has always been dependent on Government's commitment to managing the sector professionally and effectively. It has been reported that recent political appointments and staffing changes, as well as changing market conditions, may be undermining the past accomplishments for more effective and transparent management within the sector.

195. The Coastal Fisheries Management and Development Project was approved in 2002, with the objective of reducing poverty by increasing income opportunities among coastal communities. The scope of the project includes fisheries management, small infrastructure (e.g., boat basins and jetties), and project management. The project design goes beyond a narrow sector focus, and has a number of added interventions to address gender issues and HIV/AIDS that are of concern within fishing communities. Project activities are well underway in Kavieng,

[45] The proposed feasibility study subprojects include tea, coffee, and cocoa development enterprises, while the proposed pilot projects include essential oils extraction, poultry hatchery, coffee production, cobia fish cage farming, cocoa plantation rehabilitation, and coffee plantation rehabilitation.

East New Britain, and have recently commenced in Morobe Province. The project is ongoing and has not yet been evaluated.

3. Coordination with Other Funding Institutions

196. Australia remains the major donor to PNG (see Figure 5), providing annually about A$350-400 million in grant assistance. EU and Japan are also key donors. PNG appears to be actively seeking to diversify its sources of external assistance. ADB has provided annually about $1-2 million in TA grants and about $20-50 million in loans to PNG. Under ADB's system, PNG is categorized as a "Group B2 blend" country, and is eligible to receive some Asian Development Fund (ADF) resources. However, in recent years PNG borrowing levels have been low, around $15 million annually, as compared to levels of around $70-80 million per year in the past.

197. In an effort to improve the effectiveness of development assistance, in part by reducing the burden on government of dealing with multiple development partners, ADB, Australia, and World Bank attempted to develop a Joint Country Strategy (JCS) for activities in PNG. The purpose of the proposed JCS was to emphasize long-term partnership; strategic coordination of development assistance; improving government ownership; broadening engagement with stakeholders, and leveraging the comparative advantage of each institution. The three institutions only got so far as to discuss the strategy formulation process with the Government. However, the engagement with the Government bogged down, and the JCS has effectively been dropped. The failure of the institutions concerned to coordinate more effectively only places an added burden on the government's already taxed capacities for assistance coordination.

198. As of mid-2004, Australia enlarged its assistance program to PNG through the ECP, by including deployment of Australian officials in key positions and departments within the PNG government structure. On the other hand, World Bank has slowed its operations in PNG, mainly in response to policy compliance difficulties under its Forestry Conservation Program loan. While as a loan condition, Government was obligated to limit new forest concessions, that condition has been repeatedly violated. In response World Bank suspended the project in September of 2003.

199. ADB has had a series of problems with projects in its lending program, having to do mostly with failure by government to meet financial commitments agreed to as part of the loan conditions:

- As of March 31, 2005, ADB has closed its Public Service Reform Program loan (1875-PNG). This loan was for $70 million, but release of the second tranche of $35 million was withheld due to non-compliance with loan conditions. The loan has been closed by mutual agreement between Government and ADB.

- For the ADB Nucleus Agro-Enterprise Program (1889-PNG), a portion of loan funds disbursed were used by government for 'ineligible items' (e.g., used to cover recurrent government expenses). In addition, government has been late in meeting its stated commitments for counterpart funding to the project. As a result, the release of funds to support the proposed enterprise sub-projects has been held up, and further activities have been suspended until the project accounts can be reconciled (as of this writing). However, because the project concept is regarded as sound, and progress has been made in

identifying a portfolio of promising sub-projects, efforts are continuing to provide support for these, possibly through alternative means.

- The Smallholder Support Services Pilot Project (1652-PNG) has had insufficient counterpart funds coming from the Morobe Provincial Government. This problem has been unresolved for some time and still remains to be addressed.

200. The conditions described above have strained relations between Government and development lenders and donors, and have made it more difficult to prepare and implement projects and programs that can be effective in achieving their desired outcomes.

VI. FINDINGS, RECOMMENDATIONS, AND CONCLUSION

201. In ADB's recently published *Pacific Region Environmental Strategy* (PRES)[46]—the output of a regional environmental analysis—eight environmental challenges were identified as being of highest priority: (i) threats to freshwater resources, (ii) degradation of the marine and coastal environment, (iii) degradation of land and forest, (iv) problems of urbanization and waste management, (v) depletion of biodiversity, (vi) concern on energy use, (vii) adaptation to climate change, and (viii) weaknesses in environmental management capacities and governance. There is general consistency (but not complete consistency) between these identified regionally-important issues and those identified as priorities for PNG, Following below is a more detailed discussion of environmental priorities specific to PNG.

A. Barriers to Effective Environmental Mainstreaming and Management

202. During the CEA consultations, there was a high level of consistency and independent concurrence among informants regarding the key underlying barriers that constrain effective environmental management and mainstreaming in PNG. These barriers were identified as follows:

(i) ***Policy and institutional weaknesses:*** A clear articulation of environmentally-sustainable development objectives is not found in the recently-launched *Medium Term Development Strategy 2005-2010*, nor in other key policy documents. The primary agency tasked to look after environmental management and monitoring, the Department of Environment and Conservation (DEC), is seriously constrained by inadequate funding and staffing. This hampers many aspects of DEC's operations, particularly its compliance and monitoring functions. While many staff of DEC and other relevant government agencies have excellent academic qualifications, there is a shortage of people who have the specific technical skills and practical experience to conduct accurate and scientifically-defensible data collection, fieldwork, and monitoring.

In broader terms, the 1995 Organic Law was intended to improve service delivery by transferring significant responsibilities and funds to provincial and local level governments. In practice, service delivery has deteriorated, marked by confusion over functional and financial responsibility, and inadequate institutional capacity at all levels to carry out assigned functions.

(ii) ***land tenure issues:*** Approximately 97% of the land in PNG is under customary ownership. While the Conservation Areas Act gives DEC authority to declare

[46] ADB. 2004. *Pacific Region Environmental Strategy (2005–2009).* Manila.

areas for conservation and preservation purposes, on private land, this is only done at the request of landowners. In practice then, landowners have decision-making power for conservation actions on their lands. While some customary landowner groups may recognize a responsibility as the stewards of their own environmental and natural resources, and elect to set aside a portion of land for conservation, others may be more inclined to allow extraction of resources (whether through mining, logging, fishing, or agriculture) at a rapid rate, in order to maximize immediate economic benefits, without having in place adequate safeguards to protect the sustainability of those resources for future generations.

(iii) ***need for greater awareness:*** The general public has limited awareness of the urgency of environmental problems. More significantly, many key decision-makers are unaware of the high but often hidden costs associated with environmental degradation. To be sure, attempting to promote conservation "for its own sake" is a "hard sell" that will likely not be successful in a country such as PNG, a resource-rich nation where a large proportion of the population still lives in poverty. Thus there is a need to clearly illustrate to top decision-makers the underlying economic values associated with maintaining a healthy environment (e.g., high biodiversity, proper ecosystem functioning, and a sustainable resource base), and the very real and potentially high economic costs that accompany environmental degradation.

(iv) ***increasing population pressure:*** PNG has had a fluctuating annual population growth rate, averaging 2.5% over the period 2000-2003,[47] which gives an estimated population doubling time of around 26 years.[48] With this general growth trend, the pressures on available natural resources that are used for food, shelter, and other basic needs are expected to increase proportionately to the increase in population. Population growth has already outstripped real economic growth, and has begun to cause other demographic and economic changes, including greater in-migration to urban areas.

(v) ***lack of data:*** As already mentioned, due to a shortage of qualified technical personnel, and lack of sufficient operational funds at DEC and other agencies responsible for resource management, there are inadequacies in available data in virtually all sectors. Reliable, accurate, and up-to-date information is essential for preparing sound development and management plans, setting national development policy, and ensuring that development proceeds in a sustainable manner. Examples of areas where additional data are required include the following: (i) quantitative, comparable, regularly-gathered time series of data on economic performance in all sectors; (ii) baseline biological information, including such data as species abundance and occurrence, extent of coverage of various critical habitats (e.g., coral reefs, mangroves, natural forest areas), and the condition of those habitats; (iii) a complete, up-to-date archive of maps, aerial photographs, and satellite imagery; (iv) an integrated geographic information system (GIS) database; (v) accurate delineation and mapping of land use and land ownership; and (vi) quantitative information on rates of extraction of primary resources (especially in the forestry and fisheries sectors).

[47] ADB 2004. Key Indicators 2004.
[48] MTDS November 2004; according to World Bank (February 2005) the doubling rate could be even more rapid, as fast as 20 years. However, incidence of HIV/AIDS may significantly slow the population growth rate.

(vi) *governance issues:* All too often, government functions in PNG occur in a non-transparent atmosphere. For example, staff appointments, promotions, or awarding of contracts, may be based more on traditional affiliations than on merit, performance record, or competence. Neither staff subordinates nor the general public has been in a position of sufficient empowerment to hold government and politicians accountable for their decisions and actions. These factors have led to disillusionment, weak governance, mismanagement of the economy, and non-delivery of critical services, affecting especially the areas of environmental compliance and natural resources management. Unfortunately, improving governance in PNG is extremely difficult, largely because of underlying linguistic mega-diversity, fragmented clan-based social structure (whose obligations carry over into the political arena), gender division of labor, and the problems of effective communications between the center and physically isolated provinces.

203. Because these weaknesses create an environment in which abuses can flourish, significant and often irreversible losses of environmental values and depletion of natural resources occur as a result.

B. Priorities for Action

204. The findings of this CEA have led to the identification of four priority areas for action that are needed in order to promote more effective environmental mainstreaming, improve environmental conditions, and improve the quality of life of the citizens of PNG. Because of the close interrelationships that exist between human society and environment, the line between social, economic, and environmental priorities is not sharply defined. The four identified priorities are: (i) alleviating poverty,[49] especially in rural communities; (ii) improving food security; (iii) strengthening the institutions responsible for environmental planning and management; and (iv) taking steps to reverse current trends of environmental degradation, habitat loss, and overexploitation of resources.

C. Sectoral Strengths and Weaknesses, and Potential Actions for Promoting Environmental Mainstreaming and Strengthening Environmental and Natural Resources Management

205. A sector-by-sector analysis of strengths, weaknesses, opportunities and threats (SWOT) was conducted to determine those areas where environmental mainstreaming, environmental management, and opportunities for sustainability could be strengthened and improved. The analysis included the primary productive sectors, tourism and infrastructure, as well as the three cross-cutting areas addressed through the "post-Rio" conventions—climate change, biodiversity, and land degradation. The results of the analysis are presented in Appendix 17. In this Appendix, Table A provides the SWOT framework, including identification of opportunities that exist in each sector. This leads naturally to development of a set of possible future actions that could be undertaken to capitalize on those opportunities. Table B shows the linkages between opportunities and possible actions to be accomplished in the context of ADB's strategic

[49] In PNG, the linkage between people and their natural environment is more direct than in most countries, as seen by the fact that around 80% of the population are believed to rely primarily on subsistence agriculture, fishing, forest harvesting, and hunting for their everyday food and material needs. Because of this, and the lesser role of the cash economy in the lives of the majority of people in the country, poverty in the PNG context is more appropriately defined in terms of fulfillment of basic human needs, improved quality of life, access to services (e.g., health, education, transport), and reduction in vulnerability, rather than in purely monetary terms.

planning and programming for PNG, and Table C shows how the proposed interventions will help to address the four identified priorities for action mentioned in Section B, above.

206. There are several types of actions that can lead to improved environmental mainstreaming, which are described in the following subsections. It should be noted and stressed that these actions may be undertaken by ADB, by government, by other donors or support agencies, or other stakeholders, as appropriate.

1. CSP Revision

207. ADB's Environment Policy is grounded in its *Poverty Reduction Strategy*[50] and *Long-Term Strategic Framework*.[51] The *Poverty Reduction Strategy* recognizes that environmental sustainability is a prerequisite for pro-poor economic growth and efforts to reduce poverty. Environmental sustainability is also one of three crosscutting themes of the long-term strategic framework.

208. To reduce poverty through environmentally sustainable development, ADB's Environment Policy contains five main elements: (i) promoting environment and natural resource management interventions to reduce poverty directly, (ii) assisting developing member countries (DMCs) to mainstream environmental considerations in economic growth, (iii) helping maintain global and regional life support systems that underpin future development prospects, (iv) building partnerships to maximize the impact of ADB lending and nonlending activities, and (v) integrating environmental considerations across all ADB operations.[52]

209. Researchers working in the social and natural sciences have long recognized that the link between people, and the ecosystem and natural resource base, is stronger and more direct in PNG than in most other nations. Given the fact that natural resources are the foundation for virtually all of PNG's cash economy, and support a very large subsistence sector as well, it seems clear that effective environmental management should occupy a correspondingly important position in ADB's statement of country program objectives. However, in reviewing the latest CSPU, environmental issues and concerns are only very lightly touched upon.[53] It is therefore recommended that environmental mainstreaming be incorporated more directly and clearly as a strategic focal area in the next iteration of the PNG CSP.

2. Strategic Actions for Environment Strengthening of Existing Country Program, and Opportunities for New Interventions

210. Additional comments on how selected ongoing and pipeline projects (both loan and TA) within the country program could be improved to further promote environmental mainstreaming objectives are presented in project data sheets in Appendix 18.

211. In addition, through the SWOT analysis, it is evident that there are several new project activities which, if added to ADB's country program for PNG, might further environmental

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[50] ADB. 1999. Fighting Poverty in Asia and the Pacific: The Poverty Reduction Strategy of the Asian Development Bank. Manila.
[51] ADB. 2000. The Long-Term Strategic Framework of the Asian Development Bank (2001–2015). Manila.
[52] ADB. 29 October 2003. Operations Manual, Bank Policies. OM Section F1/BP.
[53] The essence of environmental mainstreaming as a precondition that underpins sustainable development is not factored into the main CSPU discussion. Environment is only touched upon in appendices that list the environmental objectives included as part of the Millennium Development Goals; presentation of key environmental indicators; and description of procedural compliance of projects through ADB's EIA/IEE process.

mainstreaming and strengthen environmental institutions and management processes. These are as follows:

(v) ***Integrated Watershed Management for Sustainable Energy Production (possible PPTA and loan)*** – Over 90% of rural residents lack access to electricity. The proposed focus of the project is on promoting improved, integrated watershed management, to enable establishment of mini-hydropower facilities for sustainable rural electrification. The project would build upon past efforts to promote "total catchment environmental management." The project would promote improved livelihood opportunities, foster greater awareness of the importance of maintaining forest cover to ensure water retention; promote sustainable land management practices; provide improved access to services; and promote new opportunities for sustainable livelihood development. Potential exists to tap other funding sources for cofinancing of the project (e.g., Global Environment Facility [GEF] and/or the Papua New Guinea sustainable Development Program [PNGSDP] for biodiversity conservation, integrated ecosystem management, or sustainable land management; Clean Development Mechanism [CDM] for mini-hydropower certified emission reduction [CER]).

(vi) ***Facilities Improvements for Provincial Towns Food Markets (possible PPTA and loan)*** – The need for the project is based on the fact that most towns currently lack well-designed and properly built fresh food market facilities. The project would be implemented at the town, local level government (LLG), and district level, in cooperation and consultation with producers, vendors, and consumers. The project would establish or improve market facilities, including necessary infrastructure (e.g., storage and sales areas, water supply, toilets, small access roads, security fencing, waste disposal) that would enable displaying, handling, and selling fresh produce, meat, fish, and poultry in a more hygienic manner than currently practiced. Overall health and sanitation would be improved, and less waste of food would occur due to spoilage or contamination. Improved sanitation and waste disposal, and greater use of practices such as recycling, composting, and waste minimization would reduce pollution. The project would contribute to improved food security and improved opportunities for income generation.

(vii) ***Sustainable Tourism and Infrastructure Development (possible PPTA and loan)*** – Tourism development in PNG represents a sector with great, but largely untapped potential. The focus of the project is on developing tourism in a planned and sustainable manner. Already identified by the Tourism Promotion Authority (TPA) is a need for formulation of a national tourism development master plan. Carrying capacity studies would identify acceptable levels of visitor use at specified sites. The project would work to establish plans for tourism development that could be implemented in a number of "model provinces", and then replicated in other provinces around the country. Accompanying infrastructure development would be designed and built to accommodate expected demand and utilization levels, while minimizing environmental impacts. Potential exists to tap other funding sources for cofinancing of the project (e.g., GEF for biodiversity conservation). The project would also seek to improve coordination between the TPA and the private sector, and build on past private sector successes in the industry.

(viii) ***Strengthening of Institutions for Environmental Management (possible AOTA)*** – Although past efforts have been made to improve the capabilities of the Department of

Environment and Conservation (DEC),[54] the Department is not yet fully capable to carry out many of its assigned management, monitoring, and regulatory functions. One of the key problems is the very limited posting of DEC staff outside of the capital. Through the Organic Act, it is intended that various government functions be decentralized. The proposed focus of this project will be to build up a framework that would ascertain which responsibilities for environmental management should reside with central government, and which should be transferred to local government; establish improve coordination between DEC and provincial offices; draft model local-level regulations; and initiate training for DEC staff (as future trainers) and provincial personnel to assume a greater level of responsibility in environmental management.

Further details describing the concepts for these projects are contained in a series of Project Concept Papers (Appendix 18).

3. Environmental Roadmap

212. Environmental roadmapping is a process intended to establish a framework for identifying achievable targets and then measuring the effectiveness of actions taken to reach those goals. Environmental roadmapping involves the following sequential steps: (i) identification of critical environmental concerns, needs and problem areas; (ii) determination of the current state of relevant environmental components and systems; (iii) specification of a timeframe within which improvements in environmental performance and quality are to be achieved (typically by between five and twenty years); (iv) development of goals and targets for environmental performance and quality, consistent with national policies, strategic plans and objectives; (v) identification of actions and activities that are required to meet the specified targets; (vi) identification of the implementors; (vii) identification and implementation of a system to changes in environmental performance and quality; (vi) review of progress at pre-determined intervals; and (vii) feedback of information from the review process into the implementation process. To the extent practicable, actions and strategies to promote improvement should be innovative, test new theories and alternative technologies, and promote breakthroughs for solving difficult problems.

213. The environmental roadmap is but one component of several interrelated processes, including the formulation of the CEA and CSP, as well as the utilization of the environmental performance assessment as a feedback mechanism. Figure 6 shows how these various component activities fit together.

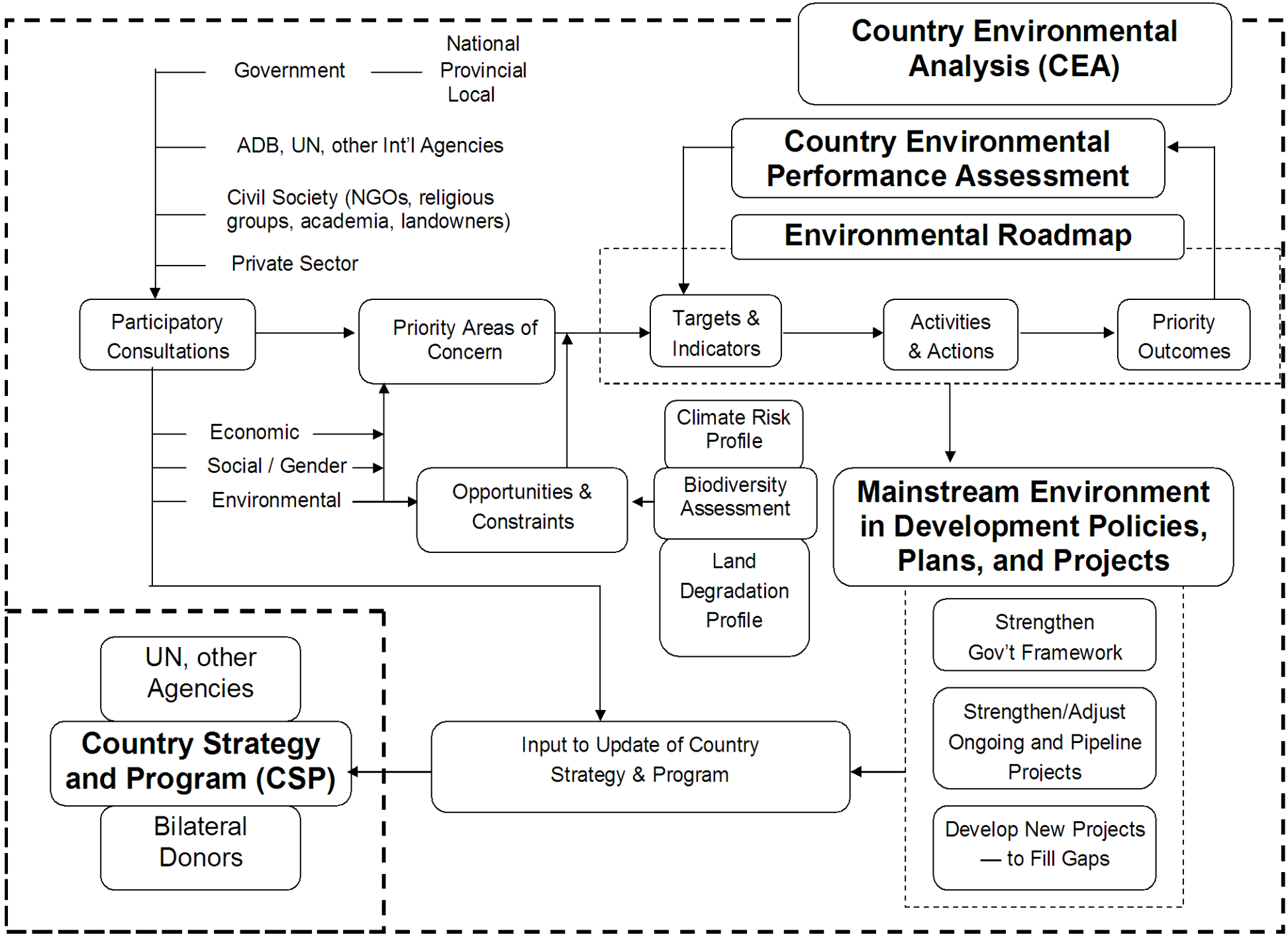
214. Information which has been gathered in the course of this CEA can be utilized to develop a framework for an environmental roadmap. This framework is presented in Appendix 19. Some of the specific data to be entered in the roadmap are incomplete, due to lack of available baseline information for a number of the parameters. Thus the roadmap suggests where data gaps lie—there is an implicit assumption that the systems and capabilities needed to obtain the required data will be put into place. The roadmap outlines indicative targets for improvements over time, typically shown as a “percent improved” basis.

[54] e.g., the AusAID DEC Strengthening Project implemented in the mid-1990s, which mainly facilitated development of the Environment Act 2000.

D. Conclusion

215. Through this CEA, key barriers and important issues in the areas of environmental sustainability and natural resources management have been identified, and out of these have emerged four priority areas of critical concern. Specific interventions have been identified that could help to improve environmental sustainability in various sectors. The CEA also contains an environmental roadmap that can be used to promote more effective environmental mainstreaming. It is hoped that both ADB and the PNG government will make use of this information, and the tools that are presented, to guide future development planning and decision-making processes.

Figure 6 Country Environmental Analysis and Related Processes



Appendixes

Country Environment Indicators: Papua New Guinea

	Item	1990 (unless otherwise noted)	Latest Year	
A.	**Energy Efficiency of Emissions**			
	1. Traditional Fuel Use (% of total energy use)	65.4 (1980)	62.5	(1997)
B.	**Water Pollution: Water and Sanitation**			
	1. % of Population with Access to Safe Water (WB)	-	42	(2005)
	2. % of Urban Population with Access to Improved Water Source (WB)	-	91	(2002)
	3. % of Rural Population with Access to Improved Water Source (WB)	-	29	(2002)
	4. % Urban Population with Access to Sanitation (WB)	-	92	(2002)
	5. % Rural Population with Access to Sanitation (WB)	-	80	(2002)
C.	**Air Pollution**			
	1. Carbon Dioxide (CO_2) Emissions			
	Total ('000 metric tons)	-	2.427	(1999)
	Metric tons per capita per year	0.6	0.5	(1999)
	Per unit of GDP (kg/PPP$ GDP)	-	0.2	(1999)
	2. Sulfur Dioxide (SO_2) Emissions			
	Total ('000 metric tons)	-	-	
D.	**Land Use and Deforestation**			
	1. Total Land Area ('000 km^2)	462.8	462.2	(2002)
	2. Total Forest Area remaining '000 km^2 (% forested)		306.0 (66.2)	(2000)
	3. Average Annual % Change in Forest Cover (-=net deforestation; +=net reforestation)	+0.1 (1980-1990)	-0.4	(1990-2000)
	4. Arable Land (% of total land)	0.4 (1980)	0.5	(2001)
	5. Cropland, Permanent (% of total land)	1.1 (1980)	1.4	(2001)
	6. Pastures, Permanent (% of total land)	0.0 (1993)	-	
	7. Rural Population Density (# persons/km^2)		2,067	(2003 est.)
E.	**Biodiversity and Protected Areas**			
	1. Nationally Protected Areas			
	Land Area under protection, terrestrial (km^2)	-	15,566	(1998)
	Number	-	48	(2005)
	% of total land area	-	2.3	(2003)
	Marine protected area (km^2)	-	2,149	(2004)
	Number	-	8	(2004)
	2. Total area of coral reef (km^2)		40,000	(2002)
	3. Area of coral reef in good to excellent condition		-	
	4. Threatened Mammal species (total known # of species)	-	58 (304)	(2002)
	5. Threatened Bird Species (total known # of species)	-	32 (762)	(2002)
	6. Threatened Plant Species (CITES Appendix I and II)	-	260	(2002)
E.	**Urban Areas**			
	1. Urban Population			
	Total ('000)	718.6	741.2	(2003)
	% of total population	15.0	13.2	(2003)
	Urban population density (# persons/km^2)	-	-	
	2. Per Capita Water Withdrawals-all uses (liters/person/day)	79.5 (1987)	-	
	3. Wastewater treated (%)	-	92	(2002)
	4. Total Solid Waste Generated Per Capita (kg/person/yr)	-	-	

NOTES:
— = no data available; GDP = gross domestic product; kg = kilogram; km^2 = square kilometer; PPP$ = purchasing power parity in US dollars

Sources: ADB. January 2004. *Country Strategy and Program Update 2004-2006, Papua New Guinea*; ADB. January 2004. *Pacific Region Environmental Strategy;* ADB. 2004. *Key Indicators 2004*. CIA. *The World Factbook 2001*, *2002*, available: http://cia.gov; National Statistics Office. 1994. *Report on the 1990 National Population and Housing Census in Papua New Guinea*; Office of National Planning, Government of Papua New Guinea, *Papua New Guinea Human Development Report 1998* (funded by UNDP); SPC. 2002. *Oceania Population*; SPREP, *Action Strategy for Nature Conservation in the Pacific Islands Region (1999-2002)*; UNDP. *Human Development Report 2000*, *2001*, *2002*; United Nations Statistics Division (UNSD). 2003. Millennium Indicator Database, available: http://millenniumindicators.un.org; World Bank. *The Little Green Data Book 2002*, *2003*; World Bank. 2003. World Development Indicators database. April; World Bank 2002. *Papua New Guinea Environment Monitor* 2002; Sekhran, N., and S. Miller (eds.). November 1994. *Papua New Guinea Country Study on Biological Diversity*. Conservation Resource Centre, Department of Environment and Conservation; Africa Centre for Resources and Environment. United Nations Environment Programme; WWF RAPPAM 2005; World Resources Institute. 2003. *EarthTrends Country Profi*les.

Papua New Guinea Country Overview[1]

Capital:	Port Moresby
Population:	4,692,400 (1999 est.)
Land Area:	462,243 sq km (km^2)
Max. Height above Sea-level:	4,697 m (Mt Wilhelm)
Geography:	Largely volcanic high islands; land area includes the eastern half of the New Guinea mainland, the Bismark Archipelago, the northenmost Solomon Islands of Bougainville and Buka & the groups of islands of the eastern most part of the mainland
EEZ:	3,120,000 km^2
Climate:	Two seasons; the southeast trade winds season (May to October) and northwest monsoon (December to March); slight seasonal temperature variation
Rainfall:	Average approximately 2,000 mm per annum
Mean Temperature:	26°C
Economy:	Diverse with strong industrial, service and agricultural sectors; exports include gold, silver, copper, copra, coconut oil, palm oil, coffee, tea, cocoa, tuna, trochus, green snail, bech-de-mer, pearl shell, cultured pearls, timber products
GDP per Capita:	US$ 1,196 (1998 est.)
Currency:	Kina
Energy Sources:	Biomass, hydro, solar, geothermal, wind
Freshwater Sources:	Groundwater, rainwater, surface water
Natural Hazards:	Cyclone, storm surge, coastal flooding, river flooding, drought, earthquake, landslide, tsunami and volcanic eruption
Minerals Potential:	On-land – hydrocarbons, gold, silver, copper, nickel; Offshore – polymetallic sulphides (gold, silver, copper, lead and zinc), hydrocarbons
Languages:	Pidgin, English plus more than 700 other languages spoken
Government:	Independent state and member of the Commonwealth

[1] Sources: SOPAC; U.S. Dept. of State (at http://www.state.gov/r/pa/ei/bgn/2797.htm)

A. INTRODUCTION

1. Papua New Guinea (PNG) comprises the eastern half of the New Guinea mainland, the world's largest tropical island, along with an archipelago of additional three islands and 600-odd lesser islets and atolls. It lies in the Southwest Pacific Ocean within an Exclusive Economic Zone (EEZ) of 3,120,000 sq km and has a total land area of 462,243 sq km. The islands are high islands of volcanic origin with a maximum height of 4,496 m above sea level. PNG has an extensive system of water bodies ranging from deltas, lagoons, rivers, marshes and over 5,000 lakes.

2. The population of Papua New Guinea was estimated at 4,692,400 in 1999. It is scattered widely over the 19 provinces, with the greatest concentrations in the Highland provinces.

3. Situated in the southern tropics, the climate of PNG is tropical with a southeast, or trade-wind season, from May to October and the monsoon, or northwest season, from December through March. Rainfall in the country has an average of 2,000 mm per annum with wide variations in different parts of PNG, and the mean temperature is 26°C.

4. Primary activities such as mining and agriculture are the mainstays of the economy with mining being the major sector contributing to the export earnings of the country. Subsistence agriculture sustains a large segment of the population and provides enough for exports. These include coconut and palm products, coffee, tea, cocoa, fish and timber products.

5. There are several resource and environmental issues, common to island nations, affecting sustainable development in PNG. These include an array of issues from climate and sea-level variability, environmental degradation and pollution to resource management. More specific challenges to sustainable development include coastal erosion, water quality, water availability and sanitation. Sustainable management of resources such as forest resources, fisheries, terrestrial and offshore minerals and renewable energy are other issues in PNG's quest for development.

B. PEOPLE

6. The indigenous population of Papua New Guinea is one of the most heterogeneous in the world. Papua New Guinea has several thousand separate communities, most with only a few hundred people. Divided by language, customs, and tradition, some of these communities have engaged in low-scale tribal warfare with their neighbors for millennia. The advent of modern weapons and modern migration patterns has greatly magnified the impact of this lawlessness.

7. The isolation created by the mountainous terrain is so great that some groups, until recently, were unaware of the existence of neighboring groups only a few kilometers away. The diversity, reflected in a folk saying, "For each village, a different culture," is perhaps best shown in the local languages. Spoken mainly on the island of New Guinea--composed of Papua New Guinea and the Indonesian province of West Papua--about 650 of these languages have been identified; of these, only 350-450 are related. The remainder seems to be totally unrelated either to each other or to the other major groupings. Most native languages are spoken by a few hundred to a few thousand, although Enga, used in Enga Province, is spoken by some 130,000 people. [However, the Enga are subdivided into clans that regularly conflict with each other.] Many native languages are extremely complex grammatically. Melanesian Pidgin serves as the lingua franca. English is spoken by educated people and in Milne Bay Province.

8. The overall population density is low, although pockets of overpopulation exist. Papua New Guinea's Western Province averages one person per square kilometer (3 per sq mi). The

Chimbu Province in the New Guinea highlands averages 20 persons per square kilometer (60 per sq mi) and has areas containing up to 200 people farming a square kilometer of land. The Highlands have 40% of the population.

9. A considerable urban drift toward Port Moresby and other major centers has occurred in recent years. The trend toward urbanization accelerated in the 1990s, bringing in its wake squatter settlements, ethnic disputes, unemployment, and attendant social problems.

10. Almost two-thirds of the population is Christian. Of these, more than 700,000 are Catholic, more than 500,000 Lutheran, and the balance are members of other Protestant denominations. Although the major churches are under indigenous leadership, a large number of missionaries remain in the country. The bulk of the estimated 2,500 Americans resident in Papua New Guinea are missionaries and their families. The non-Christian portion of the indigenous population practices a wide variety of religions that are an integral part of traditional culture, mainly animism (spirit worship) and ancestor cults.

11. Foreign residents comprise about 1% of the population. More than half are Australian; others are from the United Kingdom, New Zealand, the Philippines, and the United States, most of whom are missionaries. Since independence, about 900 foreigners have become naturalized citizens.

12. Though cultures vary widely, traditional Papua New Guinea social structures generally include the following characteristics:

- The practice of subsistence economy;
- Recognition of bonds of kinship with obligations extending beyond the immediate family group;
- Generally egalitarian relationships with an emphasis on acquired, rather than inherited, status; and
- A strong attachment of the people to land, which is held communally. Traditional communities do not recognize a permanent transfer of ownership when land is sold.
- Though land and other possessions may be inherited through the female line in some cultures, women generally are considered and treated as inferiors. Gender violence is endemic.
- Patterns and frequency of sexual activity, though never publicly discussed, contribute to the current rapid spread of HIV.

Most Papua New Guineans still adhere strongly to this traditional social structure, which has its roots in village life.

C. HISTORY

13. Archeological evidence indicates that humans arrived on New Guinea at least 60,000 years ago, probably by sea from Southeast Asia during an Ice Age period when the sea was lower and distances between islands shorter. Although the first arrivals were hunters and gatherers, early evidence shows that people managed the forest environment to provide food. There also are indications of gardening having been practiced at the same time that agriculture was developing in Mesopotamia and Egypt. Early garden crops--many of which are indigenous--included sugarcane, Pacific bananas, yams, and taros, while sago and pandanus were two commonly exploited native forest crops. Today's staples--sweet potatoes and pigs--were later arrivals, but shellfish and fish have long been mainstays of coastal dwellers' diets.

14. When Europeans first arrived, inhabitants of New Guinea and nearby islands--while still relying on bone, wood, and stone tools--had a productive agricultural system. They traded along

the coast, where products mainly were pottery, shell ornaments, and foodstuffs, and in the interior, where forest products were exchanged for shells and other sea products.

15. The first Europeans to sight New Guinea were probably the Portuguese and Spanish navigators sailing in the South Pacific in the early part of the 16th century. In 1526-27, Don Jorge de Meneses accidentally came upon the principal island and is credited with naming it "Papua," a Malay word for the frizzled quality of Melanesian hair. The term "New Guinea" was applied to the island in 1545 by a Spaniard, Íñigo Ortiz de Retes, because of a fancied resemblance between the islands' inhabitants and those found on the African Guinea coast. Although European navigators visited the islands and explored their coastlines for the next 170 years, little was known of the inhabitants until the late 19th century.

New Guinea

16. With Europe's growing need for coconut oil, Godeffroy's of Hamburg, the largest trading firm in the Pacific, began trading for copra in the New Guinea Islands. In 1884, Germany formally took possession of the northeast quarter of the island and put its administration in the hands of a chartered company. In 1899, the German imperial government assumed direct control of the territory, thereafter known as German New Guinea. In 1914, Australian troops occupied German New Guinea, and it remained under Australian military control until 1921. The British Government, on behalf of the Commonwealth of Australia, assumed a mandate from the League of Nations for governing the Territory of New Guinea in 1920. It was administered under this mandate until the Japanese invasion in December 1941 brought about the suspension of Australian civil administration. Following the surrender of the Japanese in 1945, civil administration of Papua as well as New Guinea was restored, and under the Papua New Guinea Provisional Administration Act, 1945-46, Papua and New Guinea were combined in an administrative union.

Papua

17. On November 6, 1884, a British protectorate was proclaimed over the southern coast of New Guinea (the area called Papua) and its adjacent islands. The protectorate, called British New Guinea, was annexed outright on September 4, 1888. The possession was placed under the authority of the Commonwealth of Australia in 1902. Following the passage of the Papua Act of 1905, British New Guinea became the Territory of Papua, and formal Australian administration began in 1906. Papua was administered under the Papua Act until the Japanese invaded the northern parts of the islands in1941 and began to advance on Port Moresby and civil administration was suspended. During the war, Papua was governed by a military administration from Port Moresby, where Gen. Douglas MacArthur occasionally made his headquarters. As noted, it was later joined in an administrative union with New Guinea during 1945-46 following the surrender of Japan.

Postwar Developments

18. The Papua and New Guinea Act of 1949 formally approved the placing of New Guinea under the international trusteeship system and confirmed the administrative union of New Guinea and Papua under the title of "The Territory of Papua and New Guinea." The act provided for a Legislative Council (established in 1951), a judicial organization, a public service, and a system of local government. A House of Assembly replaced the Legislative Council in 1963, and the first House of Assembly opened on June 8, 1964. In 1972, the name of the territory was changed to Papua New Guinea.

19. Elections in 1972 resulted in the formation of a ministry headed by Chief Minister Michael Somare, who pledged to lead the country to self-government and then to independence. Papua New Guinea became self-governing in December 1973 and achieved independence on September 16, 1975. The 1977 national elections confirmed Michael Somare as Prime Minister at the head of a coalition led by the Pangu Party. However, his government lost a vote of confidence in 1980 and was replaced by a new cabinet headed by Sir Julius Chan as Prime Minister. The 1982 elections increased Pangu's plurality, and parliament again chose Somare as Prime Minister. In November 1985, the Somare government lost a vote of no confidence, and the parliamentary majority elected Paias Wingti, at the head of a five-party coalition, as Prime Minister. A coalition, headed by Wingti, was victorious in very close elections in July 1987. In July 1988, a no-confidence vote toppled Wingti and brought to power Rabbie Namaliu, who a few weeks earlier had replaced Somare as leader of the Pangu Party.

20. Such reversals of fortune and a revolving-door succession of Prime Ministers continue to characterize Papua New Guinea's national politics. A plethora of political parties, coalition governments, shifting party loyalties and motions of no confidence in the leadership all lend an air of instability to political proceedings. For the first 27 years of independence, a "first past the post" electoral system resulted in many parliamentarians elected with less than 15% of their constituency. Fractious politics and a 75% loss rate for incumbents precluded the development of strong political parties or a stable national leadership. Many hope that limited preferential voting, introduced in 2003, and an organic law on political parties will stabilize national politics.

21. The 2002 elections returned Somare as Prime Minister at the head of a coalition including Rabbie Namaliu as his Foreign Minister. The next national elections are scheduled for 2007.

D. GOVERNMENT AND POLITICAL CONDITIONS

22. Papua New Guinea, a constitutional monarchy, recognizes the Queen of England as head of state. She is represented by a Governor General who is elected by Parliament and who performs mainly ceremonial functions. Papua New Guinea has three levels of government--national, provincial, and local. There is a 109-member unicameral Parliament, whose members are elected every 5 years. The Parliament in turn elects the prime minister, who appoints his cabinet from members of his party or coalition.

23. Members of Parliament are elected from 19 provinces and the national capital district of Port Moresby. Parliament introduced reforms in June 1995 to change the provincial government system, with regional (at-large) members of Parliament becoming provincial governors, while retaining their national seats in Parliament.

24. Papua New Guinea's judiciary is independent of the government. It protects constitutional rights and interprets the laws. There are several levels, culminating in the Supreme Court.

25. Papua New Guinea's politics are highly competitive with most members elected on a personal and ethnic basis within their constituencies rather than as a result of party affiliation. Members of Parliament have been are elected on a "first past the post" system, with winners frequently gaining less than 15% of the vote. There are several parties, but party allegiances are not strong. Winning candidates are usually courted in efforts to forge the majority needed to form a government, and allegiances are fluid. No single party has yet won enough seats to form a government in its own right. As the majority of Parliamentarians do not retain their seats (75% lost in 2002), party structure is weak and national leadership is not stable. The current government was formed by a coalition of several parties after the 2002 election in which virtually

the entire previous cabinet lost their seats. Sir Michael Somare, the leader of the Melanesian Alliance (and the nation's first Prime Minister in 1975), was elected Prime Minister.

26. PNG has a history of changes in government coalitions and leadership from within Parliament during the 5 year intervals between national elections. New governments are protected by law from votes of no confidence for the first 18 months of their incumbency, and no votes of no confidence may be moved in the 12 months preceding a national election. In an effort to create greater stability by reducing incessant votes of no confidence, the Integrity of Political Parties Act was passed in 1999, forbidding members of each party in Parliament from shifting loyalty to another party.

27. In 2003, the electoral system was changed to limited preferential voting, which many hope will encourage politicians to strike alliances and to be responsive to constituent concerns once elected. The new system was first used in a 2004 by-election with modest, but positive results.

28. On Bougainville Island, a 10 year rebellion was halted by a truce in 1997 and a permanent cease-fire was signed in April 1998. A peace agreement between the Government and ex-combatants was signed in August 2001. Under the eyes of a regional peace-monitoring force and a UN observer mission, the government and provincial leaders have established an interim administration and are working toward complete surrender/destruction of weapons. A constitution has been drafted and the next step should be an election of a provincial government.

E. ECONOMY

29. Papua New Guinea is rich in natural resources, including minerals, timber, and fish, and produces a variety of commercial agricultural products. The economy generally can be separated into subsistence and market sectors, although the distinction is blurred by smallholder cash cropping of coffee, cocoa, and copra. About 75% of the country's population relies primarily on the subsistence economy. The minerals, timber, and fish sectors are dominated by foreign investors. Manufacturing is limited, and the formal labor sector consequently also is limited. High commodity prices in 2004 lifted both sectors after several years of declines.

30. After years of decline and government deficit, PNG was bolstered in 2003/2004 by a general rise in commodity prices and by government steps toward spending control. The economy grew modestly and the government deficit fell from 8% of GDP to 1.7%. However, the commodity boom will be temporary and the nation continues to have serious problems of corruption, a lack of law and order, land tenure concerns stifling investment, political interference in businesses, and a lack of political will to adapt needed sweeping reforms. Mining output and oil production have led a general decline in output of the modern economy though some see long term hope in a resumption of exploration after recent regulatory reform.

31. In general, the Papua New Guinea economy is highly dependent on imports for manufactured goods. Its industrial sector--exclusive of mining--accounts for only 9% of GDP and contributes little to exports. Small-scale industries produce beer, soap, concrete products, clothing, paper products, matches, ice cream, canned meat, fruit juices, furniture, plywood, and paint. The small domestic market, relatively high wages, and high transport costs are constraints to industrial development.

32. Australia, Singapore, and Japan are the principal exporters to Papua New Guinea. Petroleum and mining machinery and aircraft have been the strongest U.S. exports to Papua

New Guinea. These have slipped as mineral exploration and new minerals investments have declined.

33. Australia is Papua New Guinea's most important export market, followed by Japan and the European Union. The U.S. imports from PNG modest amounts of gold, copper ore, cocoa, coffee, and other agricultural products.

34. Papua New Guinea became a participating economy in the Asia-Pacific Economic Cooperation (APEC) Forum in 1993. It joined the World Trade Organization (WTO) in 1996. It is an observer at ASEAN and a member of the ASEAN Regional Forum.

F. PRODUCTIVE SECTORS

35. For developing nations, natural resource development and management holds the key to rapid economic development. Papua New Guinea is one of the largest countries in the region and its natural wealth is the main bulwark of the economy. Unwise exploitation of non-renewable resources and exploitation of renewable resources at a pace higher than the natural rate of replenishment could prove detrimental to the sustainable development plans of the country.

1. Agriculture, Timber, and Fisheries

36. Papua New Guinea produces and exports valuable agricultural, timber, and fish products. Agriculture currently accounts for 30.4% of GDP and supports more than 85% of the population. Cash crops ranked by value are coffee, oil, cocoa, copra, tea, rubber, and sugar. About 40% of the country is covered with exploitable trees, and a domestic woodworking industry has been slow to develop. A number of South East Asian companies are active in the timber industry, but World Bank and other donors have withdrawn support from the sector over concern for unregulated deforestation and environmental damage. Although an official moratorium on log exports is currently in place, it is poorly enforced and logging continues at an unsustainable rate. PNG has an active tuna industry but much of the catch is made by boats of other nations fishing in PNG waters under license. Locally produced fish exports are confined primarily to shrimp.

2. Minerals

37. Papua New Guinea is richly endowed with gold, copper, oil, natural gas, and other minerals. In 2001 mineral production accounted for 25% of GDP. This will inevitably decline as old discoveries are mined out. Years of sluggish exploration mean that few new deposits will be open in the coming years. However, recent regulatory and tax reform have led to a resumption of exploration which may boost the sector in the out years. Government revenues and foreign exchange earning have depended depend heavily on mineral exports. Indigenous landowners in areas affected by minerals projects also receive royalties from those operations. Copper and gold mines are currently in production at Porgera, Ok Tedi, Misima, and Lihir. A consortium led by Mobil/Exxon hopes to begin the commercialization of the country's estimated 22.5 trillion cubic feet of natural gas reserves through the construction of a gas pipeline from Papua New Guinea to Queensland, Australia, however, the project has been stalled until major customers make purchase commitments. Interoil, an American firm, opened PNG's first oil refinery in 2004. It will produce 30,000 barrels of product a day, covering all of PNG's domestic requirements and leaving 15,000 b/d for export.

38. Environmental pollution, adverse social impact and economic redistribution are the biggest concerns arising out of mining and mineral exploration. Air pollution, water pollution and deterioration of land quality are the primary damages inflicted by mining operations. The

disposal of mine tailings is an arduous task for small, land-scarce islands. Mining also leads to loss of green cover and diminished aesthetic appeal of natural surroundings, and renders the land unsuitable for other applications, even long after the closure of the mine. Offshore mining could unleash a whole new host of problems ranging from the irreversible destruction of the fragile ecosystem to loss of fishing grounds.

39. Mineral resource development often leaves indelible scars on the fabric of traditional societies through the resultant change in lifestyle, perceptions and values that it inevitably effects. While displacement and compensation for externalities form a complex range of issues on their own, the assignment of pecuniary or economic value to communally owned properties like land has often lead to social disharmony. The loss of land or fishing grounds deprives many of their traditional lifestyles and the resultant unemployment catalyses alcoholism, violence and crime in the affected societies.

G. OTHER ENVIRONMENTAL CONSIDERATIONS

1. Energy

40. Energy is often the key constraint to island nations in their pursuit of development. Unlike the other South Pacific Island countries, Papua New Guinea is well endowed with an abundant supply of renewable energy sources. The problems have been either under-utilisation or unsustainability. Although the potential for hydroelectric power is ample, several projects have had to be closed or shelved owing to geotechnical problems. However, the high rainfall and the topography in the highlands provide several avenues for further development of this resource. PNG has ample potential for exploiting biomass, solar and geothermal energy as alternate sources. Currently, photovoltaic cells are used to a limited extend.

41. PNG also has adequate reserves of petroleum. At present, the petroleum is exported for refining, although plans have been made to construct a refinery to increase value addition within the country.

2. Water

42. Fresh water is a fundamental resource for small island nations. Most development plans depend on the availability of fresh water. Clean water and proper sanitation enhance the health and productivity of the work force and have particular implications for the children and future generations. Currently only 24% of the population of PNG has access to safe water and only 25% have access to sanitation. These two factors could have a bearing on the low life expectancy and high infant mortality in PNG. Increasing supply and reach would require proactive measures from the government, and these might be needed as the demand increases.

43. Rainfall in PNG is extremely variable with precipitation reaching a maximum of 5 080 mm a year in certain areas. Severe droughts such as the ones in 1972-'73, 1982-'83,1987-'88, 1991-'93 have exposed the inadequacy of the water supply system in PNG. The El Niño Southern Oscillation (ENSO) phenomenon has had detrimental effects on the economy and the environment. Water shortage is more severe in the rural areas, although water crisis is increasing in the cities.

3. Hazards & Disasters

44. One of the basic hurdles in the development path of the Pacific countries is their extreme vulnerability to natural disasters. The Pacific Zone bears a high risk of cyclones, tsunamis and volcanic eruptions. Papua New Guinea also lies in an active seismic area where large

earthquakes and volcanic activity can bring about immense destruction. Rabaul in North New Britain is located in a volcanic caldera, which has several active volcanoes. Since 1937, 505 lives have been lost in the series of eruptions there. The eruption in 1994 affected a total population of 53,000 and the total losses were estimated at K280 million. For a small developing country, such losses have a severe detrimental effect on future development plans as capital investment funds will have to be redirected for rehabilitation and reconstruction. The hazard is far more potent now as the population in the region has been growing at a dramatic rate. A major proportion of the current population of 70,000 lives within 15 kilometers of the center of the caldera, and an eruption in any of the nearby volcanoes could lead to a major disaster. PNG is also vulnerable to landslides and slips, given the intensity of the tropical rain in some parts of the country.

45. SOPAC conducted training in disaster management in PNG in 1998. Another training workshop was organized to help local officials in improving disaster management and response. SOPAC also assists PNG in enhancing awareness and preparedness of communities living in high risk.

4. Coastal Management

46. PNG has very distinctive coastal areas comprising features such as fringing reefs, lagoons, natural beaches and mangroves. There have been rapid changes in the coastal geography associated with increasing reclamation as a part of urbanization. To protect reclaimed land from the onslaught of the sea, various protection systems such as concrete walls, groynes, jetties and riprap revetments have been constructed haphazardly. However, the success of these protection structures has been minimal owing to a lack of understanding of the wave and current pattern around the islands, and the misconception that coasts are inherently and eternally stable. Poor construction and development practices, indiscriminate reclamation and aggregate mining in the reef areas cause coastal instability and beach erosion. In addition, coastal pollution damages and destroys reef biota.

Appendix 3: Site Visits

A trip to visit several sites of environmental and natural resources interest was conducted from 9-15 April 2005. This trip was made by air from Pt. Moresby to Madang on the southern coast, and then overland by car through Morobe Province, Eastern Highlands Province, Simbu Province, Western Highlands Province and Enga Province. Return to Pt. Moresby was made by air from Mt. Hagen. Following this field visit, other short trips in and around the Pt. Moresby area were made to observe urban and peri-urban activities.[1]

A. Madang: Coral Reef and Dive Tourism Sites

PNG has received global recognition for its world-class sites for recreational SCUBA diving, and has been the recipient of several top awards from the dive industry. It has been estimated that recreational divers constitute about 30-40 percent of the country's tourist arrivals.[2] Thus dive resources (including fish populations, coral reefs, and dive sites of special interest) should be conserved to help support this emerging industry.

Observations were made during SCUBA dives at "Magic Passage" and "Barracuda Point" of medium– to large–sized schools and aggregations of commercially–important fish and other reef fish, including groupers, emperors, trevallies, tuna, batfish and white-tipped reef sharks; notable were large Napoleon wrasses (exceeding 2m length), and a feeding school of approximately 400-500 barracuda, each around 1.5-2.0 m in length; invertebrates of interest include whip corals and intact hard coral communities.

B. Madang: Tree Plantation and Wood Chip Export

The Jant Corporation wood processing plant and loading pier was visited. The company operates an established wood chip mill and leases a forest plantation lot of some 11,000 ha within the Trans-Gogol Area (Narau Timber Rights Purchase [TRP] and Gogol TRP areas). The operation started initially harvesting natural forest but has since converted over to 100% plantation-based forestry. *Eucalyptus spp.* and *Acacia spp.* are grown, harvested, and chipped, then shipped to Japan to be used for paper production. A subsidiary, the Gogol Reforestation Company (with 49% PNG government ownership), employs about 600-700 personnel engaged in planting and maintenance of the reforestation areas.

The company produces an annual Harvest Plan that is reviewed and approved by the National Forest Service. All harvesting operations follow the approved Harvest Plan, and the company has an environmental management program that is monitored regularly by DEC. The company has a valid environmental plan and water use permit. One of the largest problems being faced is failing infrastructure (especially roads) which affects operational efficiency and thus overall profitability. Issues also arise with landowners who lease land for the plantation; disputes often arise regarding the lease conditions.

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[1] The intent of this appendix is to focus specifically on first-hand field observations of existing environmental conditions and ongoing natural resources-based activities. Therefore, notes of meetings (e.g., with government officials, NGOs, etc.) conducted during the field visits are not included in this appendix, but information gathered during those consultations has been incorporated into the main report.

[2] Personal communication from Mr. Hugh Walton reflecting the perceptions of dive business operators (members of the PNG Diving Association).

C. Madang: RD Tuna / RD Fishing

The Madang RD Tuna Cannery is owned and operated by a fishing company from the Philippines. This project is the only operating tuna cannery in PNG (a loining plant operates in Wewak, and a cannery which processes imported mackerel for domestic consumption operates in Lae). Traditionally, pelagic species have been harvested and exported raw by big fishing companies from Taiwan, Japan and other foreign fishing fleets. The introduction of fish processing at the cannery has enabled adding more value to the raw fish product. The company harvests primarily skipjack tuna, which are stored in freezer rooms prior to processing and canning. The company has complied with environmental planning and water use permit requirements since its inception 1997.

The company employs more than 3,000 workers in both its processing facility and cold storage facility 10km up the coast in Vidar. It has 12 fishing vessels and a few small support vessels and tug boats. Being a major tuna fishing company in the country, RD Tuna also participates in and complies with regional programs pertaining designed to ensure the sustainability of the fish stocks within the western Pacific region.

The company also sponsors local students studying in tertiary institutions as part of the human resources development for the local community. The local also benefit through small spin-off benefits like clinic services, providing security services to the company, trucking services and company's direct financial assistance to women and village groups.

D. Madang: Bismarck Barramundi Fisheries Company

The Bismarck Barramundi Fisheries project is a community/private sector partnership aquaculture project. It is primarily growing Papuan Barramundi (*Lates calcarifer*). Eggs and fry are reared to fingerling size at a hatchery facility at Delup Plantation, and provided to community members for grow-out. Some funding has been provided by British American Tobacco. Initial planning was for 20 pontoons to culture barramundi; to date only 8 pontoons have been funded and are in use by 8 families along the north coast near Delup Plantation. There is a request for more funding to purchase 12 more pontoons.

Because of strong market demand in Australia and Europe, and greater market-competitiveness and profit potential as compared to barramundi, another species, cobia (*Rachycentron canadum)*, is being considered by BBF for breeding and subsequent community-based grow-out. The company has already made significant investments to secure necessary clearances and authorizations to import cobia breeders from the Philippines,[3] and to set up the necessary expanded hatchery facilities. Additional funding is being sought by BBF from the ADB Nucleus Agro-Enterprise Project.

E. Morobe: Plantation Agriculture – Ramu Sugar and Oil Palm

The Markham Valley is a productive area with extensive arable lands suitable for commodity crops and pasture. Located here are the Ramu Sugar mill, several thousand hectares of sugarcane plantation, approximately 1,000 hectares of oil palm plantation, and cattle farms and pastureland. While these agriculture land uses are heavily commercialised, many local villagers are still engaged in subsistence farming. Their crops include peanuts, pawpaw (papaya), banana, and vegetables. Betelnut is widely grown and traded among the local population.

[3] While cobia is a non-exotic species indigenous to PNG, it is difficult to harvest. Breeding-size fish are more readily obtained from foreign sources.

F. Eastern Highlands, Simbu, Western Highlands and Enga Provinces: Subsistence Agriculture, Reforestation Sites, Hydropower Project, Tribal Conflict Area

Along the Highlands Highway included areas of intensive subsistence agriculture, even on very steep slopes with gradients greater that 40°, were observed. This is a clear indication of population pressure, wherein farmers without access to more desirable flatlands are forced to cultivate less accessible, steep-slope areas to plant food crops and coffee.

The Bena Bena, Kompri and Goroka areas have permanent anthropogenic grasslands. The National Forest Authority has established *Pinus* stands on grassland slopes at the Fyantina and Lapeaku Reforestation Areas.

The Yonki Dam and hydropower plant is one of the most successful energy development projects in the country. The facility supplies electric power to all the highlands provinces, Morobe and Madang.

The area around Sambakamand, Akom, Wei, Rakamanda, Aipanda, and Yakananda, in Enga Province, was formerly the site of extensive village settlements, subsistence gardens, and coffee plantations. Due to intense tribal conflicts that occurred during 2003-2004, the area has been decimated, with the resultant loss of millions of Kina worth of crops, houses, business enterprises, and human lives. Most people still residing in these areas have been seriously affected by the violence, and are living below the poverty level.

G. Enga: Lai River

Consultations were conducted with a village group from Sari and Kamas, near Wabag town. This village group lives along the banks of the Lai River. They allege that the river has experienced increased flows over the last three years resulting from a “suction effect” caused by gravel extraction at sites above and below the Sari Bridge. Previously, flows were naturally attenuated due to the presence of river gravel, which created natural eddies and pools. The pools were used in thje past for washing and bathing. The increased flows have eroded fragile riverbanks. One house close to the former bank was washed away, and several other houses and gardens are now threatened. The foundation of the bridge crossing the Lai near Sari was undermined, and had to be reinforced.

The gravel extraction was used for the Wapenamanda - Wabag road sealing project, (a donor-assisted project). Apparently, appropriate environmental seafeguards were disregarded when contractors were engaged for the road construction, upgrading and gravel crushing. DEC does not have a record of a water use permit or an environmental permit for the project. The local landowners have suffered some serious consequences which are in all likelihood irreversible.

H. Enga: Porgera Joint Venture

The Porgera gold mine is operated by Porgera Joint Venture, a subsidiary of Placer Dome (Canada) and is one of the largest open-pit mining operations in PNG. Gold ore is leached and treated, and tailings from the mine operation are discharged into the Porgera River, a tributary of the Lagaip River that drains into the Strickland River, which in turn is a major branch of the Fly River system in Western Province.

Environmental monitoring is carried out every month and reported on a quarterly basis internally, and reported to DEC once a year. DEC also stations an Environmental Officer at the

mine site to work along with the mining company's Environment Department. In addition to being responsible for compliance matters, the company's Environmental Sustainability Group is involved in addressing conservation issues, food security issues, socio-economic issues and a program for mine closure planning.

I. High-Elevation Native Cloud Forest

The dominant tree species occurring in the high-elevation native cloud forests around Maipumanda Ridge are mainly *Nothofagus* spp., *Podocarpus* spp, *Elaeocarpus* spp, and *Castanopsis* spp. These high montane species have specific microclimatic requirements; disturbances affecting the canopy and the microclimatic regime affect the survival and ecological functioning of these important species as well.

In the area visited, population pressure is resulting in land clearing for gardens and new settlements, and a portable sawmill was observed processing timber for sale along the road, all of which may threaten the fragile native forest ecosystem. With continuing escalation of human activities, impacts including habitat fragmentation and biodiversity loss, increasing erosion and loss of topsoil, and even alteration of local weather patterns, could occur. Food security is also threatened if population pressures make traditional agricultural practices (e.g., shifting cultivation) unsustainable.

J. Sites in the Port Moresby Area

Several sites in the Port Moresby area were visited or observed. These included plantings of crops just on the outskirts of the urban area. It was explained that these were informal gardens being tended by migrants from other areas, primarily the Highlands region. Crops included peanuts, sweet potato, corn and other staples. Crops were planted mostly on fairly steep slopes along highways and roadsides.

One of the main fresh markets, Koki Market, was visited. The market has recently been refurbished with assistance from Japan. Despite this, operations in the market could be greatly improved. While covered areas with raised concrete tables are available for the display, cleaning and sale of food items, these facilities largely go unused, with the majority of food items being placed on plastic sheets directly on the ground. Large piles of refuse were observed being burned in open fires just adjacent to the market site.

The main harbor of Port Moresby was also observed. The harbor serves a variety of vessels, including cargo, passenger, and fishing vessels. Among the fishing boats observed were several longline tuna vessels and trawlers. The longliners catch yellowfin for the Japan sashimi market, while trawlers target shrimp. Most of these vessels are under foreign ownership, with foreign crews. In general the harbor seems to be well-run. The facility is secure, with a fenced perimeter and a guardhouse at the gate. Public awareness posters regarding AIDS prevention are placed prominently on buildings. The only observed breach of procedure that might be of possible environmental or public health concern, was the discharge of small quantities of bilge water inside the harbor area.

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Papua New Guinea's Socioeconomic Indicators

1. PNG ranks 132 out of 175 countries in the 2003 UNDP Human Development Index, and has the highest poverty index among 12 Pacific countries. PNG's health indicators are also among the worst in the Pacific, comparable to those of the poorest countries in Asia (Table 6.1).

Table 6.1 Comparative Basic Human Development Indicators

	PNG	Fiji	Samoa	Solomon Islands	Cambodia	Lao PDR
Poverty Rate 2003 (% population living on <$1/day)	39.1	--	--	--	45.5	29.3
Infant mortality (per 1,000 live births)	64.0	17.0	20.0	21.0	95.0	90.0
Under-5 mortality rate	87.0	21.0	26.0	25.0	135.0	127.6
Maternal mortality rate (per 100,000)	390.0	75.0	130.0	553.0	450.0	650.0
Net primary school enrollment %	83.8	100.0	95.0	--	95.0	81.0
Female primary school enrollment %	79.7	100.0	47.7	--	46.3	45.4
Net secondary school enrollment %	22.0	--	68.0	--	17.0	30.0
Female secondary school enrollment %	18.0	--	70.7	--	12.3	26.9
Life expectancy, years-male/female	55/54	68/71	66.1/72.3	67.3/69.9	52.3/55.4	52.5/55.0
Access to safe water (% total population)	42.0	47.0	99.0	71.0	30	37.0
Human development index rank (of 175)	132	81	70	123	130	134

Source: World Bank February 2005.

2. Economic figures for PNG show a trend of weakness over time. Inflation has remained high, external debt has increased, the currency has weakened, and GDP has declined (Table 6.2).

Table 6.2 PNG Selected Economic Indicators

	1980	1990	1995	2002
GDP per capita (US$)	888.1	856.6	1004.3	511.3
Real GDP per capita (US$)	964.9	653.8	605.4	164.1 (est)
GDP growth (%, constant prices)	(1.0)	(3.0)	(3.3)	(0.5)
Total external debt (% of GDP)	-	36.6	29.2	46.4
Inflation	12.2	6.9	17.3	11.8
Exchange rate (US$/kina)	1.6	1.1	0.8	0.3

Source: ADB September 2003.

PNG's Protected Areas

Name	Type	Area, ha	M/T	Province	Date Gazetted
Kokoda Historical Track Reserve	RES	?	T	Central, Oro	?
Kokoda Memorial Park	MP	?	T	Oro	?
Kavakuna Caves	WMA	0.00	T	East New Britain	1 May 1997
Cape Wom Memorial Park	MP	2.00	T	East Sepik	18 October 1973
Wewak Peace Memorial Park	MP	2.00	T	East Sepik	24 April 1969
Sinub WMA	WMA	11.80	M/T	Madang	not gazetted
Nanuk Island	DP	12.00	T	East New Britain	6th December 1973
Talele Island National Park Reserve	NP	12.00	M/T	East New Britain	26th November 1973
Tabad WMA	WMA	16.20	M/T	Madang	not gazetted
Paga Hill Nat. Park Scenic Reserve	NP	17.44	T	National Capital District	10th September 1987
Nusareng	WMA	22.23	T	Morobe	9th October 1986
Namanatabu Reserve	RES	27.44	T	Central	?
Baniara Island Protected Area	PA	37.28	T	Milne Bay	13 February 1975
Moitaka Wildlife Sanctuary	SAN	44.00	T	National Capital District	?
Mt Susu National Reserve Park	NP	49.00	T	Morobe	?
Baiyer River Sanctuary	SAN	64.00	T	Western Highlands	8 February 1968
Mt Gahavisuka Provincial Park	PP	77.40	T	Eastern Highlands	2 June 1978
Loroko National Park	NP	100.00	T	West New Britain	24 September 1991
Hombareta WMA	WMA	130.00	T	Oro	6 March 1997
Balek Wildlife Sanctuary	SAN	470.00	T	Madang	4 August 1977
Sawataitai WMA	WMA	700.00	T	Milne Bay	30th June 1977
Mt Wilhelm National Reserve	NP	817.00	T	Chimbu	17th May 1990
Tab WMA	WMA	984.30	M/T	Madang	not gazetted
Variarata National Park	NP	1063.00	T	Central	18th December 1969
Mt Kaindi WMA	WMA	1502.80	T	Morobe	15th March 1990
Zo-oimaga WMA	WMA	1510.00	T	Central	15th March 1981
Mc Adams National Park	NP	1821.00	T	Morobe	22 February 1962
Tavalo WMA	WMA	2000.00	M/T	East New Britain	13th November 1997
Lake Lavu WMA	WMA	2640.00	T	Milne Bay	5 March 1981
Iomare WMA	WMA	3827.50	T	Central	24 December 1987
Neiru (Aird Hills) WMA	WMA	3984.00	T	Gulf	24th December 1987
Jimi Valley National Park	NP	4180.00	T	Western Highlands	31 October 1991
Mojirau WMA	WMA	5079.00	T	East Sepik	22 June 1978
Klampun	WMA	5200.00	T	East New Britain	4 September 2003
Ndrolowa WMA	WMA	5850.00	M/T	Manus Island	28 March 1985
Garu WMA	WMA	8700.00	T	West New Britain	9 December 1976
Pokili WMA	WMA	9840.00	T	West New Britain	26th June 1975
Siwi-Utame WMA	WMA	12540.00	T	Southern Highlands	27th January 1977
Bagiai WMA	WMA	13760.00	M/T	Madang	27 January 1997
Ranba Wildlife Sanctuary	SAN	15724.00	T	Madang	4th August 1977
Lihir Island	PA	20207.85	T	New Ireland	6 June 1991
Oi Mada Wara WMA	WMA	22840.00	T	Milne Bay	6th August 1981
Lake Kutubu WMA	WMA	24100.00	T	Southern Highlands	25 June 1992
Ranba WMA	WMA	41922.00	M/T	Madang	30th June 1977

Name	Type	Area, ha	M/T	Province	Date Gazetted
Pirung WMA	WMA	43200.00	M	North Solomons	25th May 1981
Crown Island Wildlife Sanctuary	SAN	58969.00	M/T	Madang	4 August 1977
Kamiali WMA	WMA	65541.00	M/T	Morobe	19 September 1976
Maza WMA	WMA	184230.00	M	Western	21 December 1978
Hunstein Range WMA	WMA	220000.00	T	East Sepik	13 November 1997
Crater Mountain WMA	WMA	270000.00	T	Chimbu, Eastern Highlands, Gulf	25 November 1993
Tonda WMA	WMA	590000.00	T	Western	6th February 1975

Source: WWF

Notes: M/T=marine/terrestrial; WMA=Wildlife Management Area; NP=National Park; RES=Reserve; PA=Protected Area; PP=Provincial Park; DP=District Park; MP=Memorial Park

Background Information on the Clean Development Mechanism (CDM)[1]

The PNG Case

PNG has abundant and diverse potential sources of standing carbon sinks, including its forests, seagrass beds, and coral reefs. The country's forested area alone has been estimated to have an annual carbon sequestration rate of 112,457 kilotons of carbon (ktC).[2]

Certain types of carbon sinks offer opportunities for "carbon trading" as specified under the Clean Development Mechanism (CDM) of the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC). Additional opportunities for carbon trading may be realized through the development and utilization of PNG's available alternative energy resources, which include hydropower, solar, wind, biomass, biogas, natural gas, and thermo-power.

While PNG's natural forests, old-growth forests, and potential for agroforestry areas provide possibly the largest of its available carbon sinks, these are not recognized as "certified emission reductions" (CERs) under the CDM. In the forestry sector, only reforestation projects and afforestation projects qualify as CERs. In its draft *Carbon Trade Policy*, the PNG Government makes the following points in this regard:

- Such forests may potentially be lost if resource owners believe that opportunities to derive economic benefits from carbon trading can only be realized by removing 'non-eligible' natural forests and replacing them with 'eligible' tree plantations.

- Biodiversity and other "ecological goods and services" may be irretrievably lost if natural forests are replaced by the restrictive "Kyoto" forests encouraged under the CDM.

- The issue of eligibility for using PNG's natural and old-growth forests as CERs should be vigorously pursued in the international arena, especially at the UNFCCC Conference of Parties (COP).

The PNG government has identified the inherent problems of applying the CDM, and intends to exercise caution before moving forward. However, it has taken some determined steps to press forward with its case, including active dialogue with the UN[3], and lobbying for the formation of a "coalition of rainforest countries",[4] in an effort to address these hurdles and apparent contradictions. Hopefully, PNG will be able to participate in CDM-financed actions that will yield the intended economic and environmental benefits.

History of the CDM

The CDM is one of several "flexibility mechanisms" authorized in the December 1997 Kyoto Protocol to the 1992 United Nations Framework Convention on Climate Change (signed at the Rio de Janeiro "Earth Summit").

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[1] Taken from: PNG Government (undated) *PNG Carbon Trade Policy (draft)*; and Toman, Michael, and Marina Cazorla. September 1998. *The Clean Development Mechanism: A Primer*. (accessible at: http://www.weathervane.rff.org/features/feature048.html)

[2] PNG Carbon Trade Policy.

[3] "PM Meets UN Chief", *The National*, May 18, 2005 (regarding meeting of PM Somare with UN Secretary General Kofi Annan to discuss carbon trading policy).

[4] These efforts have been criticized by some as a "smoke screen" intended to hide Government's "poor management of forests" ("International Credibility at Stake", *The National* May 23, 2005).

The Kyoto Protocol specified legally binding commitments by most industrialized countries to reduce their collective greenhouse gas (GHG) emissions by at least 5% compared to 1990 levels by the period 2008-2012. With the goal of reaching these targets at the lowest possible cost for countries that committed to reductions, the Protocol created two flexibility mechanisms, GHG emissions trading and CDM. The CDM is also intended to be an opportunity for developing countries that did not accept binding emissions reductions at Kyoto to be involved in GHG mitigation.

The Kyoto Protocol and Article 12: Organization and Purpose of the CDM

The CDM was created as a successor to "Joint Implementation" (JI). JI consists of a bilateral agreement between two entities to complete a GHG mitigation project. The investor is from an "Annex B" industrialized country that must reduce its emissions under the Framework Convention. JI potentially can provide credit for emissions abatement to the investor at a lower cost than domestic abatement. In other words, JI is a form of "emissions trading." At the same time, a developing country host can benefit from new investment that increases economic productivity and may reduce local environmental problems. Under the Kyoto Protocol, JI projects still can be undertaken between entities in Annex B industrialized countries (as specified in Articles 3 and 4). However, collaborative projects to reduce emissions or sequester carbon in developing countries are now to occur through the CDM.

Article 12 of the Kyoto Protocol identifies three specific goals for the CDM: (1) to assist in the achievement of sustainable development, (2) to contribute to the attainment of the environmental goals of the Framework Convention, and (3) to assist Annex B parties in complying with their emissions reduction commitments. In particular, Article 12 specifies that developing countries are to benefit from CDM projects resulting in CERs and that industrialized countries may use CERs to comply with their quantified emissions reduction commitments under the Kyoto Protocol. Essentially, this allows for voluntary projects similar to previous JI projects between Annex B and non-Annex B countries. The difference is that unlike previous JI projects, CERs are specifically authorized to apply to Annex B emissions reduction targets.

Article 12 establishes three bodies to oversee the CDM: the representatives of the Conference of Parties (COP), an executive board established by the COP, and independent auditors to verify project activities. However, the Protocol provides almost no guidance on what exactly the CDM would do or how it would operate. Instead, the structure and authority of supervisory bodies and the CDM are left for future negotiation.

CDM Design Issues

In order for CERs to be created from CDM projects, a number of overlapping technical, regulatory, project finance and administrative functions must be performed. Before any CDM project can be established, there must be demand for CDM projects and CERs; developing countries' concerns about uneven bargaining positions during project contract negotiations must be addressed; liability must be assigned, and insurance procured; project financing also must be obtained; and the benefits of projects must be allocated among participants. It is important to bear in mind that the CDM is a form of *market*, one in which valuable goods and services are to be bought and sold. Many of these functions may be most effectively undertaken by private markets or existing international institutions; the key question is what functions need to be undertaken by new CDM institutions.

Criteria for selection of projects. CDM projects must presumably fulfill certain criteria in order to be certified upon completion, but these criteria have not yet been established. Possible criteria include: method or extent of technology transfer; specific performance or design standards for transferred technology; capacity and willingness of both national and local governments to host the project; existence and nature of agreements for sharing project benefits (CERs and financial returns) and project liability between investor and host; and limits on local environmental or other social impacts. A particularly important question is what criteria might be established for determining "sustainable development" and other benefits for host countries. Another important question is whether references to "emission reductions" in Article 12 are interpreted as allowing or precluding carbon sequestration projects under the CDM.

Project review and CER calculation (before implementation). Prior to the initiation of projects, the "baseline" or previous amount of carbon emissions from the project facility or area in question must be established. The baseline is used to show that purported GHG reductions are "additional" to what otherwise would have occurred. One practical question that arises in assessing additionality is the issue of "project leakage" – when a particular project lowers emissions, but emissions rise in other parts of the host country economy (or elsewhere). This could happen, for example, if a reforestation project in one location was accompanied by greater deforestation elsewhere. There are a variety of options for defining project-level baselines to assess additionality. These include detailed project-level review of projected emissions with and without the project, and streamlined formula-based approaches that estimate emission reductions based on easily observed project characteristics (for example, conversion of a coal power plant to natural gas). Another approach would involve the host country establishing and enforcing "top-down" national or sectoral baselines in an effort to limit leakage, and then assigning shares of the baseline to different emission sources much as emission allowances are allocated in the US program for sulfur dioxide trading among power plants. In this case the validity of the CERs generated from a specific project would depend in part on overall sectoral emissions.

Project monitoring and CER assessment (after implementation). Related to the issue of additionality are technical questions regarding how to measure, monitor and verify the outcomes of individual projects. Both emission reduction and carbon sequestration projects pose their own measurement and monitoring challenges. In either case, some independent entity must intermittently monitor the emissions or sequestration of the project in order to ensure that the benefits of the project accrue over time as represented by project participants. In turn, standards for the accreditation of the certifiers are needed in order to ensure certifier objectivity and credibility.

Rules for CER validity and project liability. For CERs to be credible, there must be rules defining when CERs can be used and assigning legal responsibility in the event that a CDM project is found not to generate the amount of emission reduction promised (either because of misrepresentation before the fact or less than expected performance after the fact). Liability is of less concern if CERs can be used only after an independent (and honest) auditor has certified their existence. If this were the case, prospective credits would be held in abeyance between certifications; the project participants would have to trade off the value of more rapid certification against the cost. If, however, credits can be used in advance of certification, as is the case in some US emission credit trading programs, then questions of after-the-fact liability do arise. Under the Kyoto Protocol, Annex B countries have ultimate responsibility for noncompliance if credits are disallowed. In practice, the assignment of liability to Annex B investors/CER buyers is likely to be efficient since buyers have a financial and reputational stake in CDM projects, possess the resources for effective project oversight, and face enforceable emission ceilings in

their own countries. CERs could be transferred to subsequent purchasers without reassignment of liability in order to protect incentives for trading.

Recording of CER exchanges and resulting changes in Annex B parties' accounts. Some institution must be responsible for accounting for newly created CERs, CER exchanges or transactions, and the application of CER credits to Annex B parties' GHG emissions obligations.

Marketing, information, financing, and insurance services. If the CER market is designed reasonably well, most prospective investors are likely have access to market financing for well-designed CDM projects. In some cases, however, institutions like the World Bank might need to provide assistance in identifying and providing financing. Insurance against project failure is another important financial or brokerage service, which again could be provided by the private sector or in some cases by multilateral institutions. Finally, market institutions need to be developed for facilitating transactions in CERs as well as "derivative" transactions, such as options to buy or sell CERs in the future. These institutions would serve as a clearinghouse for secondary trades by matching buyers and sellers, and could also be a repository for "banked" or unused CERs. Such institutions would also facilitate exchanges between CERs and emission permits emerging from Annex B trading.

Providing negotiating support for non-Annex B countries. Some developing countries might avoid participation in CDM projects out of fear of possible exploitation by investors due to lack of capacity to negotiate fair contracts. These countries are concerned about the relationship between the CDM and international development assistance, the under-development of the private sector in some developing countries, the lack of developing country capacity to monitor and verify projects independently, and the possibility that investors will take advantage of their lack of technical expertise in project evaluation. The CDM or other institutions could assist by providing access to experienced negotiators and offering training or capacity-building services. However, undertaking these tasks requires a resolution of potential conflicts of interest among the roles of project promoter, host country advocate, and neutral market supporter.

CDM fund administration. Article 12 stipulates that "a share of proceeds from certified project activities [should be] used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation." The COP must still determine how funds will be drawn from CDM projects or CER trading, how large the fund should be, and how proceeds would be disbursed. The question of how funds are raised is of particular interest. If the funding mechanism is based on the proceeds of the project (either direct financial payment or diversion of a share of CERs to a central fund), then in negotiation investors will reduce their willingness to provide benefits to the host country accordingly in order to ensure that the net return on the project remains commensurate with other rates of return throughout the global capital market. In this case the CDM fund would simply be redistributing proceeds among non-Annex B countries. An alternative would be to levy a fixed annual registration fee on any investor interested in being eligible for participation in the CDM.

Key Decisions on CDM Structure and Function

There are several ways the CDM could be structured to address project selection, finance and implementation. The CDM could be more centralized and active in CER market operation, playing a role similar to that of the World Bank or the Global Environment Facility (GEF) in screening, selecting, financing, and assisting in implementation of projects. The CDM also could be a market maker, seeking out host countries from whom to acquire credits and reselling them.

However, a key question with a more centralized alternative is the extent to which the CDM would have a comparative advantage in carrying out all these functions, especially if by international agreement it became the only entity eligible to carry out these various functions. Experience suggests that many of the functions enumerated above can be carried out more efficiently by the private sector, and that exclusive control over the functioning of a market does not promote market efficiency or adaptability.

Another alternative would be very similar to Joint Implementation, in which an industrialized country and a developing country agree to collaborate on a CDM project which is later certified by an independent auditor. This arrangement would imply a much smaller role for the CDM, one mostly involving definition of basic criteria for project selection and implementation, general oversight of audits and recording of CER exchanges. This system likely is the most dynamic and flexible, with individual actors in the market (investors, financiers, and others) defining the functioning of the CER market through "learning by doing." How successful this approach would be in terms of accountability would depend on the criteria used for project selection and implementation and the quality of oversight applied.

There is a broad debate over the issue of "supplementarity." The Kyoto Protocol refers to the use of international emissions trading (and by extension the CDM) as being "supplemental" to domestic actions. Supplementarity constraints reflect a concern by some Annex B countries that participation in international flexibility mechanisms will limit the scope and stringency of domestic policies, thus retarding the long-term development of technology and improved energy efficiency needed to achieve and go beyond the Kyoto goals. The other side of that argument is that limits on trading and CDM are blunt instruments to improve the credibility of a nation's commitment to the Kyoto Protocol, and that by increasing the overall cost of compliance with the Protocol the restrictions also contribute to lack of willingness to achieve the target reductions.

Finally, there are inherent tensions among the goals for the CDM articulated in Article 12 of the Kyoto Protocol. For example, a more formulaic approach to project review would lower "transactions costs," but it might also decrease the accuracy of the assessment of additionality. Greater efforts to extract benefits for non-Annex B countries or to reduce uncertainty in the measurement of CERs will increase participation costs for Annex B countries and thereby reduce their interest in participation. To illustrate, requiring selection of the best available abatement technologies might facilitate technological "leapfrogging" by LDCs but would also raise the cost of the project. These tradeoffs and their consequences are the reason why the design of CDM institutions and projects must be considered carefully before implementation. Since early (pre-2008) reductions through the CDM are possible under the Protocol starting in 2000, there is little time to spare in settling some of these basic issues.

Climate Adaptation Strategies, by Sector

Mechanism	Constraints and Opportunities
I. Coastal and Marine Environments	
Coastal management policy and planning	Maintenance of the integrity of the natural systems and their buffers is important in the face of climate change. Government policy needs to take account of the potential impacts of likely changes in sea level, the need to avoid development in areas prone to inundation or accelerated erosion and the need to ensure the safety of people. The adverse effects of natural hazards are particularly important at provincial government level because the hazards usually have localized effects. Local authorities have a stake in avoiding, minimizing, and mitigating the costs and effects of natural hazards.
Integrated Coastal Management	Integrated coastal management is needed as a long-term approach. However, in the PNG context, truly integrated institutional approaches are unlikely in the foreseeable future, but these are not needed. What is needed is institutional coordination horizontally (across sectors) and vertically (local - provincial – national), that can be achieved at relatively low cost and with minimal institutional restructuring.
Community-based monitoring and management	There is essentially no routine monitoring of PNG's marine environment, except for private programs operated by mines. Academic institutions and research stations have initiated a few monitoring efforts but these are not directly linked to management efforts. The few examples of successful management interventions to ensure sustainable use of PNG's coral reef resources generally involve community-based initiatives such as codes of practice or voluntary efforts by local industry groups. The level of a project's physical presence on site should match community commitment.
Integrated research	Recommendations for integrated research in ecosystem need to focus on finding out the distribution and structure of species and ecosystem; storm events to help understand ecosystem engineering and site rehabilitation; identification of human use patterns; cultivation and management of mangroves and testing of village based ecosystem care units and; identification of sources of income from traditional shell fishing to shell crafting.
Building capacity in provincial and national government agencies	PNG has generally adequate environmental legislation but very low, and declining, capacity to implement it. The environmental planning and management capacity of relevant national and provincial government agencies is extremely limited, hampered by the nation's political and economic instability and a seemingly endless process of institutional reorganization. For example, the OEC was recently downgraded from a cabinet department, and staff cut by 50%. Even before this the department suffered from critical shortages of human and financial resources. The management of threats such as urban development, watershed degradation, large-scale industrial development, and commercial fishing urgently require technical staff and institutional capacity in provincial and national government

Mechanism	Constraints and Opportunities
	agencies. Capacity building is hampered by cultural obligations and work demands, inefficient bureaucracies and funding constraints.
Hard and soft measures	Structural measures such as sea walls and groins are costly and provide few benefits other than protection of erosion and safeguarding of assets only on a short term basis. Sea walls may also increase problems downstream. Therefore, structural options should be screened for their compatibility with community aspirations. Soft options involving revegetation to stabilize the shoreline are less costly but need constant maintenance. They may also be easily affected by increased storminess and wave action. Set back areas also help control development.
II. Fisheries	
Adaptive management	Adaptation strategies should be aimed at acquiring a capacity to respond to unexpected changes in the environment by quickly changing fishery management approaches.
Develop aquaculture	Aquaculture helps to relax the gap between demand and supply and will reduce the pressure on wild stockings.
Reduce post harvest losses	New technology may help reduce by-catch and maintain fish quality.
Stronger regional collaboration for management and research	For tuna fisheries, PNG needs to continue it's strong involvement in the establishment of multilateral agreements with distant water fishing nations. Poor resolution of climate models are not able to predict changes at the scale of fish recruitment. Data on the spatial and temporal distribution patterns of tuna can help fish management authorities adjust their management practices.
Data collection systems	Aside from data on a few fisheries stocks, existing information on the marine environment to establish any form of baseline against which trends might be identified as a basis for management is almost completely inadequate. Nearly all work has consisted of "one off" studies at one or a very few sites, and there is virtually no information about spatial and temporal variability. Some basic information about the coastal biota (e.g., species lists) has been provided by work at the UPNG and various research stations, but it is very limited both geographically and taxonomically.
Fish and marine reserves	A conservation needs assessment has identified 30 priority areas for conservation of critical habitats. This includes stock enhancement of inland fisheries. A number of marine reserves are currently being proposed in Milne Bay and highlands provinces.
III. Agriculture, Land Use, and Forestry	
Micro credit and small business expansion.	Traditional agriculture in PNG is based on a rotational bush fallow system, which is highly productive and generally sustainable, providing population pressure does not force the use of too short a rotation period. However, in order for households to maintain food and nutritional security throughout the year, they must have access to sources of income through on-farm or off-farm activities. This requires both a supportive

Mechanism	Constraints and Opportunities
	policy and planning system at the national level, effective extension services and access to credit and business opportunities.
Research into new plant varieties, crop rotation, use of irrigation, altered nutrient levels and plantation forestry alternatives.	Research is needed to find out more about adaptive measures that exist such as breeding and genetic programs; protection systems such as fire, insects and diseases; the regeneration potential of natural forests whether intact or logged; suitable plantation site and species selections; and suitability of indigenous species.
Sustainable natural forest management	One of the most contentious issues that the forest authority needs to address is how can it expand its programme on forest replacement and implement its policy on sustainable natural forest management when it is faced with the dilemma that the land and the forests on it are owned by the customary owners who may have other uses for their land and forests.
New technologies	The introduction of new and/or improved codes of practice, reduced impact logging, the provision of better information about timber stands, and the upgrading of the resource management capacity of the forestry professionals, technicians and field supervisors are key elements in the process of achieving sustainable forest management. Strategies for future farming developments through the introduction of sustainable subsistence crops and the introduction of new farming methods and practices are needed.
Capacity Building	Capacity building initiatives should be focused on piloting innovative extension systems, improving and integrating farming technologies, strengthening agricultural data collection and planning and expanding micro credit and small business training facilities.
Woodlot establishment, agroforesty and tree planting supported by active forestry extension.	These practices could be carried out where there is a shortage of wood and wood products for domestic consumption. In Port Moresby, there is an ongoing mangrove reforestation program with villagers on the Motuan coast.
IV. Biodiversity	
Slow biological invasions	Aquatic plants such as the Water Hyacinth and Salvinia have been major problems in the Sepik River and elsewhere but there is no comprehensive monitoring program on distribution, population sizes, rates of change, environmental impacts and effectiveness of control measures.
Strengthen and enforce policies that protect critical habitats	Many initiatives at protecting critical habitats on a sustainable basis have tended to become academic and research orientated exercises, which are far removed in terms of providing the tangible benefits to landowners and the community at large.
Research into the local effects of climate variability and change on species	Models of the distribution of species or species associations could be related to the drivers of climate change. Monitoring of specific plots may also allow human and climate change impacts to be differentiated.
Increase awareness of visitors and the public concerning the value of species and biodiversity	The government's priorities are to ensure resource owners play a more meaningful role in planning and implementation of development and conservation activities by improving their understanding of the environmental and social impacts of

Mechanism	Constraints and Opportunities
	different land use options and helping them achieve higher sustainable incomes.
Maintain gene pools through a system of connected protected areas	Knowledge of native species is minimal but could be useful in the future to redistribute and maximize gene pools. Reintroduction's of species are possible but not to the full range of species that once existed.
Strategic policy	The National Biodiversity Strategic Action Programme, to be developed out of the Convention on Biodiversity, will provide the framework for an integrated strategy for the country. The OEC will need considerable strengthening if it is to oversee the coordination and implementation of this strategy. Landowner issues may also need to be resolved.
V. Water Resources	
Invest in new water technologies, particularly for recycled water.	A lot of waste-water is being discharged into ponds and lagoons during the dry and wet seasons all year around.
Encourage integrated water management approaches	Changes in hydrological characteristics are likely to lead to changes in the aquatic and wetland ecosystems and increase demands for irrigation from the agricultural sector. Integrated water resource management under a 'no regrets' response option requires intensive investment but it has the potential to draw independent water users under one governing agency.
Incorporate climate change into water management legislation	Ensure that climate change and variability is incorporated in various Environmental and Conservation Acts, but focusing on water and including monitoring, data collection and management of the water resources.
Transfer of new technology to assist with water projects/ activities	Project developers have been encouraged to upgrade capability and capacity building for water quality monitoring and assist in the acquisition of upgraded resources to enhance national technologies. One example is the ALERT flow forecasting and warning soft and hardware systems currently employed by the OK Tedi Mining Limited for dredging and navigation for warning of its ore shipment. Although the system is generally functioning well, it is expensive to maintain. This system has been recommended for use in other applications such as Bumbu catchment flood preparedness and warning system in Lae, Sepik flood propagation for navigation, and modernization of Laloki River water and power supply systems.
Improve resources information and monitoring	PNG has comprehensive information on 90% of the river systems in the country with a representative rainfall network. Additional information includes water volumes and quality, (selective) attributes of resource development and developers, commercial entities and other small scale projects. Research into new technologies is underway to improve information collection and data transfer on water resource management methodology, water hazard warning and forecasting and improvement of analysis techniques. Keeping up with technology developments is a high priority for PNG. Recent use of satellite data transmission technology and remote sensing has reduced costs drastically in a short time of application, and resulted in real time data transfer with reasonable precision. The whole system is highly sophisticated and requires well trained personnel to install and operate.

Mechanism	Constraints and Opportunities
	With the assistance received from international agencies involved in water management, engineering and resource development, a primary baseline database has been established for PNG. This further implies that information transfer and exchange with other Pacific and Southeast Asian countries will commence by the end of year 2000. This includes attending specific training and job attachment programs.
Develop alternative water sources such as rainfall catchment devices as well as saltwater and brackish water desalination plants	Severe shortage of water in the small islands, atolls of New Guinea island provinces and the Central province in particular has forced an emergence of basic water acquisition technologies. Tanks have been designed to withstand salt, durability, compatibility for transportation and ease of assembly on site. This concept is inexpensive in the long term and requires no maintenance, training or management skills. Desalination plants is one of the options currently considered. Very few are in operation because of high capital and running costs. Establishment, operation and maintenance is very expensive and requires very skilled personnel. Equipment and initial labor have to be source abroad while training has to be provided for the local communities on the maintenance and management of the entire establishment.
Water conservation measures including leakage control	Licenses for large water uses could help discourage water wastage. Improved plumbing, communal tanks and stand pipes could help reduce wastage.
Water carting	Carting water to rural areas, squatter settlements and communities from a main supply system is a new concept. Specially designed vehicles are used to cart approximately 1,000 or more liters of water and travel more than 100 km (1 hour) to dislodge its contents into 100 to 1,000 liter tanks for each household. Water carting is only suitable over a short distance and time and is recommended for use in severe dry seasons only.
Runoff and precipitation retention	Open retention basins are a practical option given the very rugged nature of this country. Direct precipitation, excess streamflow and overland runoff can be trapped in retention basins and stored for an indefinite period of time for any future use.
Training	Local on job training and work attachment are not costly but simultaneously beneficial, and is the fundamental basis of information and knowledge acquisition and transfer. Because of the very unique nature of this profession in PNG, job-related training is not readily available in most of the technical and tertiary institutions in the country. Advance postgraduate training on engineering hydrology, water resources management and water biochemistry are held abroad.
Redistribution of water resources	Temporal and spatial inter basin water transfer is one viable option but requires capital investment. The basic concept is to abstract a certain portion (variable) of water from a main river system or where there is abundance of water resources, and transfer it to a receiving basin where its source is inadequate to meet all demands from it's a normal river runoff and underground sources. Inter basin water transfer due to extensive spatial coverage and lacking treatment is recommended for irrigation and hydropower

Mechanism	Constraints and Opportunities
	generation, and should be applicable during the dry weather periods only.
VI. Health	
Control vector borne diseases	Requirements to control vector borne disease such as malaria include: identify location and elevation of habitats for the various species of malaria, compile and monitor the occurrence of diseases and identify vulnerable areas and people resistant to a particular strain.
Reduction in heat stress through infrastructure improvement including adoption and enforcement of more stringent building codes	Health care infrastructure needs to be upgraded but support for these measures will place a large burden on public expenditures.
Comprehensive disaster management programmes	Areas vulnerable to tsunami, landslides and cyclones have already been identified. However, erosion risk will also be affected by tectonicity and mass movement of the earth's crust. More detailed surveying and mapping of such areas is required.
Preventative health care through public awareness programmes	
Improve medical services	The government is in the process of decentralizing the country's health system from the national to the provincial and district levels to enable more cost effective and coordinated delivery of services. Training and capacity building initiatives have been launched to enhance management skills within the health sector. International aid programmes are also in place to provide technical support to improve it's pharmaceutical supply system, cold chain logistics, blood bank system and public health laboratories. These programmes will also concentrate on vaccine preventable diseases, diahorrea control, acute respiratory diseases and tuberculosis, with much of the funds directed to rural areas.
Improve quarantine services	

Source: S. Sauli (adapted)

Government Agencies, Legislation, and Strategies Relating to Environmental Management

Agency	Mandate/Function	Relevant Policies, Plans, Legislation and Guidelines
Department of Environment and Conservation (DEC)	Broad mandate: • to work towards environmental protection and conservation of biodiversity. The divisional functions emanate from empowering legislation which DEC implements and reflect Government Policies and Directives Specific functions: • Environmental policy development and advice to government • Environmental Assessment and Evaluation of major development projects including resource development such as forestry and mining • Administer Environment Protection Legislation and Regulations • Conservation of flora and fauna • Management of Water resources • Establishment and management of natural parks and protected areas • Species Management • Administer PNG's International agreements and response to global environmental issues such as Ozone layer depletion • Provision of environmental information and advocacy of government's environmental policies	• Preamble to Constitution • Environment Act 2000 • Conservation Areas Act (1980, 1992) • National Parks Act, 1982 • Fauna (Protection and Control) Act, 1974 – 1982 • International Trade (Fauna and Flora) Act, 1993 • Crocodile Trade (Protection) Act (among others)
Forest Authority	Main Mandate: • Responsible for the management and development of the forest sector in accordance with the provisions of the Forest Act. Specific functions: • Manage the nation's forest in accordance with this Act • Make recommendations to the board on the granting of licenses and leasing of lands in accordance with this Act; • Operate research facilities aimed at the assessment of forest resources and their commercial potential for marketing; • Appraise, develop, implement and manage projects, including trial forest plantation, reforestation, and afforestation projects; • Prepare and implement appropriate public investment programmes; • Collect data relevant to forest	• Forestry Act and Regulation • National Forest Policy • National Forest Plan • Logging Code of Practice • Papua New Guinea Carbon Trade Policy (undated draft)

Agency	Mandate/Function	Relevant Policies, Plans, Legislation and Guidelines
	resources; • Make recommendations on policy regarding forestry and related activities	
National Fisheries Authority (formerly Department of Fisheries and Marine Resources)	Main Mandate: • Responsible for the management and development of the fisheries sector in accordance with the provisions of the National Fisheries Management Act 1998. Specific functions: • Manage the fisheries within the fisheries waters in accordance with this Act and taking into the account the international obligations of Papua New Guinea in relation to tuna and other highly migratory fish stocks; • Make recommendations to the board on the granting of licenses and implement any licensing scheme in accordance with this Act; • Liaise with other agencies and persons, including regional and international organizations and consultants, whether local or foreign, on matters concerning fisheries; • Operate research facilities aimed at the assessment of fish stocks and their commercial potential for marketing; • Subject to the Pure Foods Act, the Commerce (Trade Descriptions) Act, the Customs Act, the Customs Tariff Act, and the Exports (Control and Valuation)Act; • Control and regulate the storing, processing and export of fish and fish products; • Appraise, develop, implement and manage projects, including trial fishing projects; • Prepare and implement appropriate public investment programs; • Collect data relevant to aquatic resources; • Act on behalf of the government in relation to any domestic or international agreement relating to fishing or related activities or other related matters to which the independent State of Papua New Guinea is or may become a party; • Make recommendations on policy regarding fishing and related activities; • Establish any procedures	National Fisheries Management Act 1998

Agency	Mandate/Function	Relevant Policies, Plans, Legislation and Guidelines
	necessary for the implementation of this Act, including tender procedures; • Implement any monitoring, control, and surveillance scheme, including cooperation, agreements with other States or relevant international, regional or sub-regional organizations in accordance with this Act	
Department of Agriculture and Livestock	• Administer all legislation relating to Agriculture and Livestock. • Promote agricultural development and productive employment generation. • Assist Provincial Governments to increase their agricultural capacity. • Prepare and implement appropriate investment programs for major commodities and livestock. • Liaise with the Rural Development Bank and the National Plantation Management Authority. • Operate Experimental Stations and Laboratories conducting adoptive research into the production and preparation for market of primary production. • Provide advisory and technical services to Provincial Government as required. • Advise on policies and plan of international and extra-territorial bodies dealing with agriculture and livestock organizations. • Provide public extension services and scientific information. • Provide services to standing and *ad hoc* organizations relating to the functions of the Department.	• Horizon 2020 (National Agriculture Policy)
Department of Petroleum and Energy	• Determine national energy requirements and develop policies to ensure adequate energy supplies to support the nation's economic activities and development • Formulate a program to maximize economic benefits and minimize adverse environmental impacts associated with exploitation of the nation's oil and natural gas resources • Develop programs for renewable energy and sustainable energy production alternatives	• Papua New Guinea Carbon Trade Policy (undated draft) • National Energy Policy (March 2003).
Department of Health	• Responsible for all hospitals. medical, dental, nursing, preventative health and disease control services • Initiate, formulate and administer	• National Poverty Reduction Strategy (draft) • National Population Policy 2000-2010;

Agency	Mandate/Function	Relevant Policies, Plans, Legislation and Guidelines
	National Health Legislation and policies • Maintain and monitor standards of Health Services across the country • Provide pharmaceutical services • Provide mental health, radiotherapy and specialist medical services • Provide medical training • Provide services to the Medical Board, Nursing Council, Fluoridation Committee and standing or *ad hoc* organizations relating to the functions of the Department	• National Urbanization Policy 2005-2020
Department of Mining	Main mandate: • responsible for the regulating, monitoring, promoting and recording of mineral exploration and mining activity in Papua New Guinea Specific functions: • Develop the mining industry by actively encouraging socially, environmentally and technically responsible private sector exploration and development of mineral resources • Expedite rural development by promoting and facilitating small-scale mining • Provide background data, advice and services in the fields of exploration, geotechnical engineering, hydrogeology, volcanology and seismology aimed at facilitating development and identifying, monitoring and mitigating geological hazards • Negotiate mining agreements and carry out related research and policy analysis • Provide services to standing or *ad hoc* organizations relating to the functions of the Department	• Mining Act • Sustainable Mining Policy • Mine Closure Policy • Offshore Mineral Policy
Tourism Promotion Authority	• Monitor activities in the tourism sector and gather data • Promote the development of the tourism sector • Identify constraints to tourism development and advocate for needed changes to remove barriers • Represent the nation regionally and globally and provide information for potential tourists and tourism markets	• National Government Tourism Policy (undated draft) • National Tourism Master Plan (to be prepared) • Five-Year Corporate Plan (to be prepared)
National Disaster Management Office	• Responsible for monitoring and assessment of vulnerability to natural and man-made disasters, and development and implementation of disaster management plans	

Agency	Mandate/Function	Relevant Policies, Plans, Legislation and Guidelines
	• Coordinate actions of other government agencies, and communities in disaster and emergency response	
National Museum	• Responsible for research, preservation, and public education concerning the nation's cultural and historical sites and resources	
National Planning and Rural Development	• Responsible for the formulation, monitoring and update of national economic development plans and strategies	• Medium-Term Development Strategy 2005-2010 • National Poverty Reduction Strategy (draft) • National Population Policy 2000-2010 • National Urbanization Policy 2005-2020

PNG's International and Regional Environmental Agreements and Conventions

Papua New Guinea is party to the following international and regional environmental agreements and conventions:

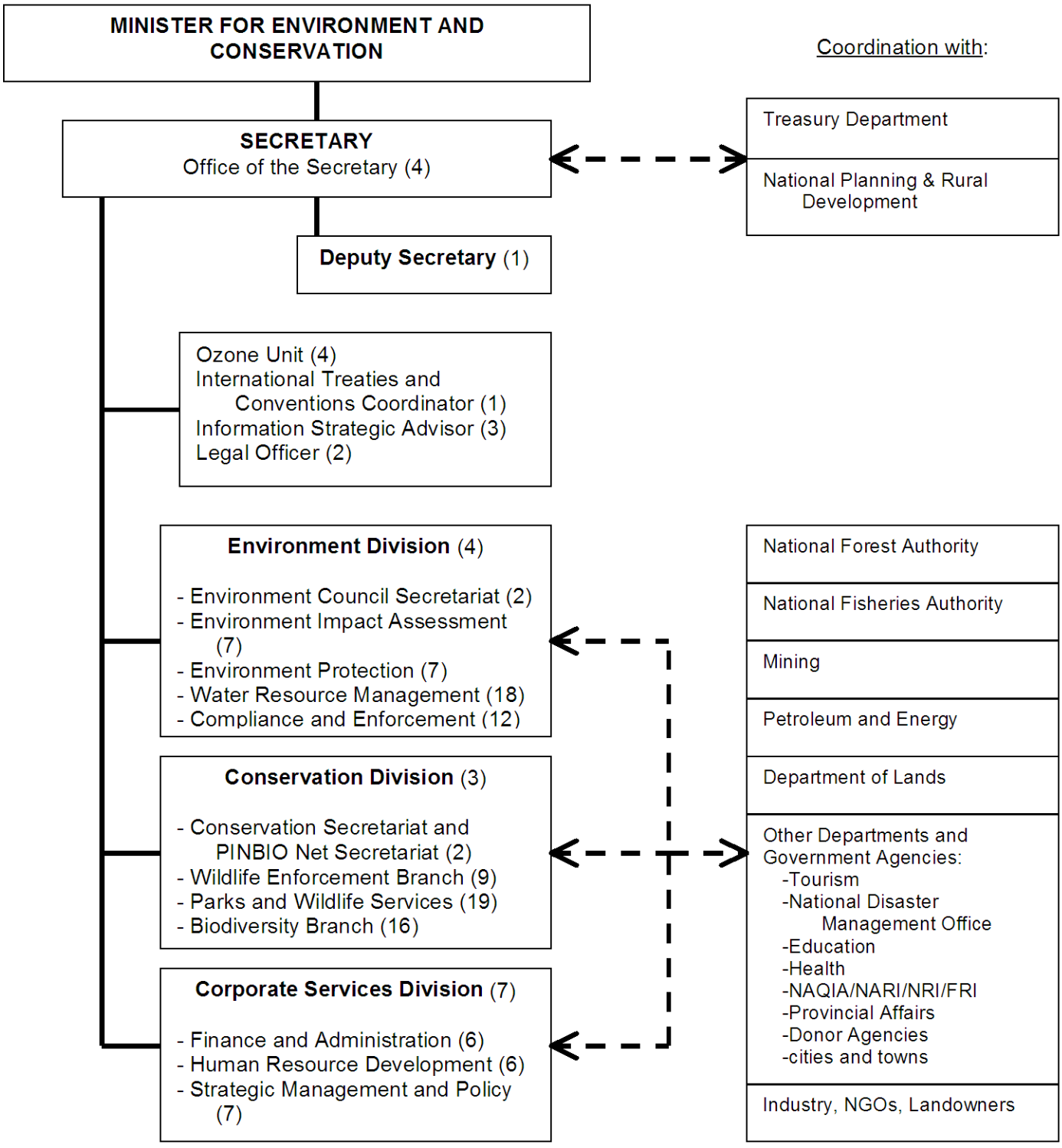
	CONVENTION OR AGREEMENT	DATE
1	United Nations Convention to Combat Desertification (UNCCD)	2000 (ratified); 2001 (entered into force)
2	Kyoto Protocol to the UNFCCC	1997 (signed); 2000 (ratified)
3	Barbados Plan of Action for the Sustainable Development of Small Island Developing States	1994
4	Convention on Biological Diversity (CBD, Rio de Janeiro)	1992 (signed); 1993 (ratified)
5	United Nations Framework Convention on Climate Change (UNFCCC)	1992 (signed); 1993 (ratified)
6	Agenda 21 and the Rio Declaration	1992
7	South Pacific Nuclear Free Zone Treaty	1989
8	Convention for the Protection and Development of Natural Resources and Environment of the South Pacific Region	1988
9	Protocol on Substances that Deplete the Ozone Layer (Montreal)	1987 (signed); 2003 (ratified)
10	South Pacific Fisheries Treaty (Port Moresby)	1987
11	Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention, Noumea)	1986
12	Convention for the Protection of the Ozone Layer (Vienna)	1985
13	International Tropical Timber Agreement	1983 and 1994
14	Law of the Sea Convention (UNCLOS)	1982
15	South Pacific Forum Fisheries Agency Convention (Honiara)	1979
16	International Convention for the Prevention of Pollution from Ships (MARPOL)	1978
17	Convention on the Conservation of Nature in the South Pacific	1976
18	Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	1973

	CONVENTION OR AGREEMENT	DATE
19	Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter	1972
20	Convention Concerning the Protection of World Cultural and Natural Heritage (Paris)	1972
21	Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar)	1971
22	Treaty Banning Nuclear Weapons Tests in the Atmosphere, Outer Space and Underwater	1963
23	Plant Protection Agreement for the South-East Asian and Pacific Region	1956 (as amended)
24	International Convention for the Prevention of Pollution of the Sea by Oil	1954 (amended 1962 and 1969)
25	International Plant Protection Convention	1951

Source: UNEP, others

Organization and Budget for the Department of Environment and Conservation (DEC)

DEC Organizational Structure



Sources: adapted from DEC, World Bank 2002
Notes: 1. The total staff strength in each Division and Branch is indicated in brackets ( )
2. DEC has a total staff of approximately 145 persons

Budget Allocation, Department of Environment and Conservation, 2003-2005

Description		Expenditure (in kina '000)		
		Actual[a]	Appropriated	
		2003	2004	2005
MAIN PROGRAM	***ENVIRONMENT PROGRAM AND CONSERVATION SERVICES***	***2,834.6***	***3,641.6***	***4,312.7***
Program	**POLICY CO-ORDINATION AND GENERAL ADMINISTRATION**	**1,058.1**	**1,771.4**	**1,931.6**
Activities	Top Management, Administrative Services, Office of the Secretary, HR, Internal Audit	1,058.1	1,771.4	1,931.6
Program	**ENVIRONMENT PROTECTION AND POLLUTION CONTROL**	**652.0**	**792.2**	**1,052.3**
Activity	Assessment, Regulation and Monitoring	652.0	792.2	1,052.3
Program	**NATURE CONSERVATION & WILDLIFE PROTECTION SERVICES**	**1,109.2**	**1,073.0**	**1,218.8**
Activity	Regulation, Research and Extension Services	723.6	616.9	673.8
Activity	Management of Protected Areas	385.7	456.1	545.0
Program	**MINISTERIAL SERVICES**	**15.3**	**5.0**	**110.0**
Activity	Minister's Administrative Support Services	15.3	5.0	110.0
MAIN PROGRAM	***HYDROLOGICAL MANAGEMENT SERVICES***	***533.8***	***407.9***	***884.7***
Program	**WATER RESOURCES MANAGEMENT**	**533.8**	**407.9**	**884.7**
Activities	Planning and Regulation of Water Resources	357.7	366.9	684.7
Activities	Crocodile Survey	176.1	41.0	200.0
	GRAND TOTAL	***3,368.6***	***4,049.5***	***5,197.4***

[a] Although "actual" amounts indicated are final, approved budget allocations, in reality, funds released by the Treasury may be much less, being reduced subject to unexpected shortfalls, rearrangement of budget priorities, or other requirements.

Source: DEC

Coordination Matrix for Key External Assistance

Sector/ Area	ADB Strategy/Activities	Other Development Partners' Strategy/Activities
A. Economic and Public Sector Reform	**Ongoing** • Strengthen public sector financial management • Public service program (build performance orientation, reorient personnel management, strengthen probity organizations, strengthen public service delivery) • Strengthen management of public service and delivery of basic services • Help develop a poverty strategy **Programmed** • Improve public sector management and service delivery at the subnational level • Strengthen economic statistics capacities • Review public expenditure • Review land tenure	• Structural adjustment (Australia, EU, Japan, World Bank) • Strengthen public sector financial management at the provincial level (Australia, UNDP) • Technical assistance for public sector reform (Australia) • Electoral capacity building (Australia) • Strengthening of national and decentralized planning (Australia, UNDP) • Support for census and statistical capacity strengthening (Australia) • Support for various agencies for management and service delivery (Australia) • High-level economic policy advice and staff exchanges (Australia)
B. Private Sector Development	**Ongoing** • Microfinance **Programmed** • Development finance • Small and medium-sized enterprises	• Structural adjustment policy support (Australia, World Bank) • Microfinance (Australia, UNDP) • Business advisory and support services (Australia, UNDP) • Training of company directors (Australia)
C. Education	**Ongoing** • Skills development (contracting out) **Programmed** • Adult and nonformal education	• Education media (Japan) • Miscellaneous projects (infrastructure and supplies) (Japan) • Strengthening of the Department of Education (Australia) • Community development (Australia, Japan) • Strengthening of the trade testing system (Australia) • Elementary school teacher training (Australia) • Provincial high school project (Australia) • Basic education infrastructure and curriculum materials (Australia, New Zealand) • Short-term training (Australia, New Zealand) • Scholarships (secondary and tertiary) (Australia, New Zealand) • Teacher education (Australia, New Zealand) • Education commodity assistance (Australia) • Curriculum reform and teacher training (Australia) • Education quality initiatives (Australia)

Sector/ Area	ADB Strategy/Activities	Other Development Partners' Strategy/Activities
		• Training awards (Australia) • Education capacity building (Australia)
D. Health	**Ongoing** • Health sector development project to support health in rural areas • Human resource development • Sector policy support • Sector review • HIV/AIDS care centers **Programmed** • Further heath sector support (sector-wide approach) • HIV/AIDS special grant	• Equipment (Australia, Japan) • Communications equipment (Japan) • Civil works (Japan) • Training of health personnel (Australia) • Research (Australia) • Women and children health services (Australia, Japan) • Medical equipment management (Australia)
E. Gender/Youth	**Programmed** • Proposal for a Population and gender project[1]	• Gender and development (New Zealand)
F. Infrastructure a. Transport and Communication	**Ongoing** • Road maintenance and upgrading (Highlands and Southern regions) • Road asset management system (whole country) • Road authority • Road fund • Maritime navigational aids • Maritime transport management • Maritime Safety Authority • Community water transport **Programmed** • Transport sector support	• Road construction and improvement (Japan) • Road maintenance and upgrading (various, whole country) (Australia, Japan) • Highlands Highway rehabilitation/upgrading (Australia) • Highlands Highway bridges (Australia, Japan) • Lae city roads (Australia) • Bridge projects (Australia, Japan) • Airport development (Port Moresby) (Japan) • Air transport project (airport maintenance, sector management) (Australia)
b. Water Supply and Sanitation	**Ongoing** • Provincial towns water supply and sanitation • Low-cost sanitation **Programmed** • Rural water and sanitation	• Maritime transport institutional reform (Australia) • Maritime navigational aids (Australia) • Transport sector support program (equipment and training (Australia) • Gazelle reconstruction (Australia, World Bank) • Bougainville roads (Australia) • Communications sector support (television) (Australia) • Groundwater development study (Japan) • Lae city water supply (Australia) • Town water supply (Japan) • Country-wide water supply project (EU) • Port Moresby sewage system upgrading (Japan)

[1] The project was originally programmed for 2004; however, the Government has requested that this project be deferred.

Sector/ Area	ADB Strategy/Activities	Other Development Partners' Strategy/Activities
G. Environment	**Ongoing** • Coastal area management (fisheries) • environmental mainstreaming (part of regional project) • water management policies and practices (part of regional project)	**Ongoing** • Milne Bay maritime environment • NGO environment projects
H. Agriculture, Forestry, and Fisheries	**Ongoing** • Smallholder support services through contracting out • Improving service delivery at the province level • Nucleus agro-enterprise feasibility studies • coastal fisheries management **Programmed** • Sector policy review • Agriculture and rural development • Fisheries policy development, institutional and sector management strengthening, fisheries infrastructure • Coastal waters fisheries management and development • Regional development (Sandaun East-Sepik)	• Nucleus oil palm estates (World Bank) • Agricultural research (Australia) • Strengthening of research institutions (Australia, New Zealand) • Quarantine (Australia) • Cocoa rehabilitation (Bougainville) (Australia, EU) • Forestry policy, institutional strengthening, forestry training (Australia) • Strengthening fisheries training (Australia) • Agricultural marketing (New Zealand) • Agriculture policy (World Bank) • Miscellaneous small projects (Australia, Japan, New Zealand)

EU = European Union, NGO = nongovernment organization, UNDP = United Nations Development Programme.

Environmental NGOs Working in PNG

1. Alotau Environment Ltd.
2. Bismarck-Ramu Group
3. Center for Environmental Law and Community Rights (CELCOR) Inc., Damien Ase, Executive Director, 323 4509 / 4237, 3112106
4. Conservation International, Mr. Peter Bossip, Conservation Officer, 323 1532
5. Conservation Melanesia, Mr. Lester Seri , Executive Director, 323 2758, 3232773
6. Department of Environment & Conservation, Ms Onika Kimui, NGO Coordinator, 3231045, 325 0182
7. Eco Forestry Forum, Mr. Thomas Paka, Executive Director, 323 9050, 3254610
8. Environmental Law Centre Ltd., Ms. Annie Kajir, CEO, 323 4480, 323 4483
9. Environment Watch Group, Mr. Yati Bun, Chairperson, 311 2966 / 2967, 311 2982
10. Foundation for People & Community Development, Mr. Bun, Executive Director, 325 8470, 3252670
11. Foundation for Rural Development (FORD), Mr. Pu, Executive Director, 542 3524, 542 3530
12. Greenpeace
13. Kamiali Integrated Conservation and Development , Mr. Karol Kisokau, Programme Director, 479 3242, 479 3233
14. Niugini Wildlife Society, Mr. Peter Wakal, Programme Officer, 547 1003, 542 1142
15. Partners with Melanesia, Mr. Ken Mondiai, Executive Director, 3239924
16. PNG Reef Check Inc., Mr. Edward Kibikibi, Programme Officer, 323 6714 / 686 3839
17. The Nature Conservancy, Mr. Paul Locani, Manager, 323 0699, 323 0397
18. Wildlife Conservation Society, Mr. Ross Sinclair, Asst. Director
19. WWF South Pacific, Daniel McCall, a/Country Manager, 323 9855, 325 3224
20. OXFAM PNG

PNG Operations Summary: ADB's Current and Pipeline Projects for PNG

I. LIST OF ONGOING LOANS BY SECTOR[1]

(as of 31 December 2004)

	Sector/Ministry/EA	Loan No.	Project Name	Sector Division	Loan Classification [a] Project/ Poverty	Loan Classification [a] Operational/ Thematic	Net Loan Amount $ mn	Milestone Dates Approval	Signing	Effectivity	Revised Closing
	Agriculture and Natural Resources										
1.	Department of Agriculture & Livestock, Konedobu	1652	Smallholder Support Services Pilot	PAHQ	PPG	HD;GD;PSD	7.6	10 Dec 98	05 May 99	21 Dec 99	31 Dec 04 (extended)
2.	Department of National Planning and Rural Devt.	1889(SF)	Nucleus Agro-Enterprises	PAHQ	OTH	ECO	7.0	18 Dec 01	24 Jan 02	02 Aug 02	01 Dec 05
3.	National Fisheries Authority	1925(SF)	Coastal Fisheries Management and Development	PAHQ	PI	ECO	6.5	24 Oct 02	27 Nov 02	22 Jul 03	28 Feb 08
			Subtotal/Average				**21.2**				
	Education										
4.	Department of Community Development	1706(SF)	Employment Oriented Skills Development	PAHQ	CPI	GD;PSD	21.5	28 Oct 99	29 Oct 99	26 Jun 00	31 Dec 07
			Subtotal/Average				**21.5**				
	Finance										
5.	Bank of Papua New Guinea	1768(SF)	Microfinance and Employment	PAHQ	PI	HD;GG;PSD	11.2	19 Oct 00	26 Feb 01	20 Sep 01	31 Dec 06
			Subtotal/Average				**11.2**				
	Law, Economic Management and Public Policy										
6.	Department of Treasury	1703	Financial Management	PAHQ	PPG	GG;PSD	25.8	21 Oct 99	21 Oct 99	27 Oct 99	31 Dec 06
7.	Department of Treasury	1875	Public Service Program	PAHQ	OTH	GG	70.0	12 Dec 01	12 Dec 01	13 Dec 01	31 Mar 05 (cancelled)
			Subtotal/Average				**95.8**				

[1] Official list of active loan projects as of most recent CSPU; see further discussion of Program in the text.

	Sector/Ministry/EA	Loan No.	Project Name	Sector Division	Loan Classification [a] Project/ Poverty	Loan Classification [a] Operational/ Thematic	Net Loan Amount $ mn	Milestone Dates Approval	Signing	Effectivity	Revised Closing
	Transport and Communication										
8.	Department of Works and Implementation	1709	Road Maintenance and Upgrading (Sector)	PAHQ	PPG	HD;PSD;GI	63.0	16 Nov 99	17 Nov 99	15 Feb 00	30 Jun 06
9.	Department of Transport and Civil Aviation	1754	Rehabilitation of the Maritime Navigation Aids System	PAHQ	PPG	HD;GG;PSD	19.8	12 Sep 00	02 Oct 00	16 May 01	30 Apr 06
10.	Department of Works and Transport	2079(SF)	Community Water Transport Project	PAHQ	TI	ECG	19.9	25 Mar 04	31 May 04	23 Nov 04	30 Jun 12
			Subtotal/Average				**102.7**				
	Water Supply, Sanitation and Waste Management										
11.	PNG Waterboard	1812(SF)	Provincial Towns Water Supply and Sanitation	PAHQ	PI	HD;GD;PSD	18.5	14 Dec 00	16 Jan 01	31 May 02	30 Sep 05
			Subtotal/Average				**18.5**				
			Total/Average				**270.8**				

CPI - core poverty intervention, EG - economic growth, GD - gender and development, GG - good governance, GI - growth intervention, HD - human development, PI - poverty intervention, PPG - pro-poor growth, PSD - private sector development, RC - regional cooperation, TC - theme clusters, TI - targeted intervention.

[a] Loan classification system implemented for loans approved before and after 2001. Prior to 2001, PPR system recorded the Project Classification and Operational Priorities. Loans approved from 2001-2003 recorded the Poverty and Thematic classifications, while targeting and theme classifications were introduced for loans approved from 2004 onwards

II. PAPUA NEW GUINEA: ACTIVE TAs BY SECTOR

(as of 31 December 2004)

	Sector/Ministry/EA	TA No.	Project Name	TA Type	TASU	Revised TA Amount ($mn)	Milestone Dates: Approval	Signing	Expected Completion
	Agriculture and Natural Resources								
1.	Dept. of National Planning Rural Dev.	4055	Agriculture and Rural Development	PP	PAHQ	1.000	19 Dec 02	16 Jan 03	31 Dec 05
			Subtotal/Average			**1.000**			
	Education								
2.	Dept. of Social Welfare & Development	4109	Literacy is for Everyone	PP	PAHQ	0.600	09 May 03	13 May 03	31 Mar 05 (completed)
			Subtotal/Average			**0.600**			
	Health, Nutrition and Social Protection								
3.	Dept. of National Planning Rural Dev.	3827	Gender and Population	PP	PAHQ	0.500	21 Dec 01	16 Jan 02	30 Jun 03 (completed)
4.	Department of Health	4057	Health Sector Development Program	PP	PAHQ	0.500	19 Dec 02	29 Jan 03	30 Nov 03 (completed)
5.	Dept. of Health	4208	Establishment of Pilot HIV/AIDS Care Centers	A&O	PAHQ	0.450	30 Oct 03	12 Dec 03	31 Mar 06
			Subtotal/Average			**1.450**			
	Law, Economic Management and Public Policy								
6.	Dept. of National Planning Rural Dev.	3280	The Governance and Public Sector Reform Program	PP	PAHQ	0.981	26 Oct 99	05 Nov 99	31 Mar 05
7.	Dept. of the Prime Minister & Executive Council	3812	Strengthening Public Sector Management	A&O	PAHQ	0.850	18 Dec 01	16 Jan 02	31 Mar 05
8.	National Statistics Office	3946	Improving Economic and Social Statistics	A&O	PAHQ	0.800	24 Oct 02	15 Nov 02	30 Apr 05
9.	Permanent Parliamentary Committee on Public Accts	4388	Strengthening the Capacity of the Parliamentary Account Committee	A&O	PAHQ	0.500	10 Sep 04	01 Oct 04	31 Dec 06
			Subtotal/Average			**3.131**			
	Transport and Communications								
10.	Dept. of Transport and Civil Aviation	3619	Rehab Maritime Navigation Aids System	A&O	PAHQ	0.800	19 Dec 00	24 Jan 01	30 Jun 06
11.	Dept. of Works and Implementation	3716	Road Authority Development	PP	PAHQ	0.700	11 Sep 01	28 Sep 01	30 Jun 05
			Subtotal/Average			**1.500**			
			Total/Average			**7.681**			

III. SUMMARY OF ENVIRONMENT-RELATED[2] REGIONAL TECHNICAL ASSISTANCE (RETA) PROJECTS IN THE PACIFIC REGION (1992[3] – PRESENT) INCLUSIVE OF PNG

No	Project	Date Approved	Amount (US$)	PDMCs Involved	Description/Objective/Scope
6204	Mainstreaming Environmental Considerations in Economic and Development Planning Processes in Selected Pacific Developing Member Countries	03 December 2004	600,000	RMI, PNG, SAM, SOL, FSM, COO, KIR, VAN	The TA will prepare CEAs that will provide inputs to CSP and CSP updates (CSPUs) for selected PDMCs and countries' medium term development strategy, particularly in addressing eight key environmental challenges. The TA's main objective is to mainstream key environmental concerns into economic and development planning processes and to help reduce poverty in PDMCs. The TA will (i) identify priority areas in policy, institutional and legislative mechanisms, and programs/projects that will help to mainstream environmental concerns into economic development planning; and (ii) strengthen the understanding among policymaking, economic planning, and environmental authorities about key environmental and natural resource management issues and their link with macroeconomic and national development goals.
6219	Promoting Effective Water Management Policies and Practices - Phase 4	20 December 2004	(total cost is $5.6 million)	PDMCs	The TA will continue the program to promote effective water management policies and practices at regional, subregional, and country levels, thereby catalyzing the implementation of ADB's water policy in the Asia and Pacific region, including within ADB.

[2] Projects with at least one environmental component in their objectives were defined as environmentally related.
[3] 1992 was used as the baseline year because of the Earth Summit (UNCED) held that year in Rio de Janeiro, Brazil, which gave environment an important recognition in development undertakings.

IV. ASSISTANCE PIPELINE FOR LENDING PRODUCTS, 2005-2006
(approval pending as of May 2005)

Sector/Project Name	Poverty Classification	Thematic Priority	Division	Year of PPTA	PROJECT COST (in $ million)					
					Total	ADB			Govt	Cofin
						OCR	ADF	Tot		(Others)
2005 Loan Pipeline										
(no lending foreseen)										
2006 Loan Pipeline										
Transport and Communications										
1. Highlands Highway Rehabilitation Project	PI	ECO	PAHQ	2001	60.0	30.0	10.0	40.0	10.0	10.0
2. Highland Regional Roads Project (Supplementary Loan 1709)	PI	ECO	PAHQ	-	30.0	20.0	0.0	20.0	10.0	0.0
Subtotal					**90.0**	**50.0**	**10.0**	**60.0**	**20.0**	**10.0**
Social Infrastructure										
1. Health Sector Development Program	PI	HD	PAHQ	2005	20.0	0.0	13.0	13.0	2.0	5.0
Subtotal					**20.0**	**0.0**	**13.0**	**13.0**	**2.0**	**5.0**
Total					**110.0**	**50.0**	**23.0**	**73.0**	**22.0**	**15.0**

Notes: Amounts shown for composition of non-ADB financing are only indicative.
ADB = Asian Development Bank, ADF = Asian Development Fund, CPI = Core Poverty Intervention, ECO = Economic Growth, GAD = Gender and Development, GG = Good Governance, HD = Human Development, PAHQ = Pacific Operations Division, PI = Poverty Intervention, PSD = Private Sector Development, SDP = sector development program

V. ASSISTANCE PIPELINE FOR NONLENDING PRODUCTS AND SERVICES, 2005-2006
(approval pending as of May 2005)

Sector/Project Name	Responsible Division	Type of Assistance	Amount ($'000)		
			ADB	Others	Total
2005 Pipeline					
Private Sector Development					
1. Policies for Private Sector Development	PAHQ	ETSW	500.0		500.0
2. Commercial Microfinance Development	PAHQ	ID	500.0		500.0
Subtotal			**1,000.0**	**0.0**	**1,000.0**
Social Infrastructure					
1. HIV/AIDS (design for 2006 ADF Grant)	PAHQ	SSTA	150.0		150.0
2. Health Sector Development Program II	PAHQ	PP	350.0		350.0
Subtotal			**500.0**	**0.0**	**500.0**
Others/Multisector					
1. Public Expenditure Review and Rationalization	PAHQ	ETSW	500.0		500.0
Subtotal			**500.0**	**0.0**	**500.0**
			2,000.0	**0.0**	**2,000.0**
2006 Pipeline					
Private Sector Development					
1. Secured Transactions Reforms	PAHQ	ID	600.0		600.0
2. Land Tenure	PAHQ	ETSW	200.0		200.0
3. Agricultural Enterprise Development	PAHQ	ID	300.0		300.0
Subtotal			**1,100.0**	**0.0**	**1,100.0**
Social Infrastructure					
1. Health Sector Capacity Building	PAHQ	ID	300.0		300.0
Subtotal			**300.0**	**0.0**	**300.0**
Transport and Communications					
1. Road Reform Support	PAHQ	PP	350.0		350.0
Subtotal			**350.0**	**0.0**	**350.0**
Others/Multisector					
1. Support for Surveys	PAHQ	ETSW	250.0		250.0
Subtotal			**200.0**	**0.0**	**250.0**
Special Grants					
1. HIV/AIDS	PAHQ	ADF Grant	10,000.0		10,000.0
Subtotal			**10,000.0**	**0.0**	**10,000.0**
Total			**12,000.0**	**0.0**	**12,000.0**

ETSW = economic, thematic, and sector work, ID = institutional development technical assistance, PAHQ = Pacific Operations Division, PP = project preparatory technical assistance, SSTA = small scale technical assistance

Strengths, Opportunities, Weaknesses, and Threats (SWOT) Analysis

Table A. Sectoral SWOT Analysis

SECTORS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Forestry	• Large areas of country (66% of total land area) with intact forest cover still remaining, much of it natural (unlogged) forest • NGOs/scientists working actively in sector • Comprehensive Forest Act, Logging Code of Practice, and underlying supporting institutions give good support for sustainable forest management • Financing available from donors, GEF, CDM • Customary landowners interested in managing their own resources	• Intensive pressure exists to extract resources rapidly • Lack of baseline information about resources • FA, DEC, other government agencies lack adequate capacity for effective monitoring • Customary landowners lack adequate capabilities to sustainably manage resources in a modern commercial context • Government's relationships with donors strained in this sector	• minimize logging of natural forests, by shifting to plantation-based forestry • reforest degraded grasslands • capture economic benefits of forest conservation through CDM • Seek additional economic alternatives to logging in natural forested areas (e.g., non-timber forest products, bio-prospecting, eco-tourism) • Strengthen working relationships with, and capacities of, landowner groups • Capitalize upon traditional knowledge to develop management and livelihood alternatives	• Poor governance • Landowner disputes
Agriculture and Livestock	• Long history of traditional agricultural practice • Large agrarian workforce available • favorable climate and soils for wide range of crops	• roads, market infrastructure in poor condition • lack of access to domestic and overseas marketing channels • ongoing inappropriate agri practices resulting in depletion of nutrients, erosion, water loss	• capitalize upon rich heritage of village-based gardening and husbandry • develop partnering arrangements between commercial agri interests and smallholders • develop alternative cultivation techniques on sloping lands to conserve soils and retain water • develop new sanitary market facilities in main towns	• increasing population pressure forces continued inappropriate farming practices • lack of access to appropriate agri lands leads to continued inappropriate farming practices • climate change, weather impacts cause shift in crop survival, increased pests and plant diseases

SECTORS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Fisheries/ Coastal	• rich coastal and pelagic fisheries resource • coastal environment relatively pristine—productive mangroves, corals, seagrass beds; good water quality • sound legal framework for fisheries management • some good monitoring systems in place (e.g., international VMS system)	• localized use of destructive fishing practices (dynamiting, poisons, targeting breeding aggregations) ongoing • localized impacts from land-based activities (sedimentation, runoff of agricultural chemicals) • lack of reliable data on size and sustainability of resource, fisheries harvests • excessive fishing pressure on some species (e.g., bigeye tuna, beche de mer) • potential economic benefits of ongoing fish extraction not being captured efficiently • inadequate local fish market infrastructure • difficult to monitor and enforce fisheries compliance	• promote effective community-based coastal management, utilizing MPAs as a means of preserving breeding stocks of food fish species • review opportunities for developing sustainable financial mechanisms to support fisheries conservation, through user fees, licensing, fines, other incentives and disincentives • promote value-adding to capture greater share of resource value • improve market infrastructure • improve data gathering to support management, enforcement	• poor governance • global warming/weather impacts negatively affect migratory fish stocks, cause coral bleaching
Tourism	• varied wildlife • scenic values • remote, exotic location • cultural variety • varied outdoor recreational opportunities (e.g., scuba diving, hiking, trekking, nature appreciation, beach and ocean recreation)	• negative image internationally due to safety /security concerns • new industry—lack of experienced workers • lack of integrated plan for tourism development • deficiencies in infrastructure (roads, sea and air connections, water and sanitation) • high internal and external transportation costs	• prepare national tourism development plan • conduct carrying capacity study • take steps to protect resources that can support sustainable tourism development (e.g., coral reef areas, wildlife • review cost structure for air transport sector; develop a structure to favor tourism growth	• continuing violence and crime • unplanned tourism development leading to degradation or loss of key tourism resources

SECTORS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Water Resources	• plentiful water resources in most areas • water resources are owned by the State (thus clearer regulatory authority-with DEC)	• low-lying islands often lack groundwater resources • DEC has limited capacity to monitor and collect data on water resources • Monitoring stations absent from almost all catchments • Water resources diverted for inappropriate uses (???)	• Develop management plans for total catchment and watershed areas • Incorporate climate adaptation strategies into water management planning	• extreme weather or climatic events • continuation of damaging practices (deforestation, shifting cultivation, industrial pollution of rivers and streams)
Mineral and Petroleum Resources	• plentiful mineral and petroleum resources • high economic return potential	• high cost of developing resources dictates that activities are conducted on large scale • community members derive limited benefit from mining and petroleum industries, which are "enclave" activities that operate in isolation from surrounding community • high risk of negative environmental impacts due to pollution of surface waters and soil with hazardous materials	• promote more meaningful partnerships with local communities • ensure that greater share of benefit stream (whether as revenues, infrastructure, services, etc.) flows to local stakeholders • undertake measures to protect, manage, and improve environmentally sensitive areas in vicinity of mine sites, especially watersheds	• community/tribal conflicts • in-migration, social destabilization around mining sites

SECTORS	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Infrastructure (transport, WSS, and energy)	• abundant supplies of high-quality potable water • donors willing to support infrastructure improvements • system of small airports allows access to remote areas through third-level airlines • abundant resources for clean energy generation (hydropower, wind, solar, gas, biomass)	• inappropriate engineering design or substandard materials cause rapid structural deterioration (esp. roads) • insufficient number of skilled engineers and technicians for adequate operation and maintenance of infrastructure • systems susceptible to climate and weather impacts • road systems not connected nationwide • unsafe and inadequate network of passenger boats service • limited ports and harbor facilities for international shipping • very limited power provision by PNG Energy (about 70,000 customers) • majority of rural population reliant on wood fuel	• design new systems and retrofit old systems to be climate-adaptable • ensure that construction best practices are employed • design systems to minimize drainage and erosion problems • improve delivery of water and sewerage services to more households and areas, especially in low-lying coastal communities • provide adequate infrastructure to support emerging sustainable industries (e.g., tourism) • develop greater capacities for energy generation from clean sources	• corruption • major climatic events or natural disasters • systems disrupted or destroyed through tribal conflict
Health, Human and Socioeconomic Dimension	• low population density • available, competent labor pool for a number of key industries	• high population growth rate • shifting patterns of population density, in-migration, urbanization • high poverty and unemployment leading to crime, conflicts, and violence • high rate of infant and maternal mortality, short life expectancy • high rate of HIV/AIDS • low literacy	• mainstream reproductive health across all sectors • improve food security to improve health and nutrition • create sustainable livelihood options to reduce criminality • mainstream literacy across all sectors	• climatic events cause epidemic disease outbreaks

CROSS-CUTTING	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Climate Change	• signatory to UNFCCC; funding available to support efforts aimed at curbing climate change impacts • most of mainland PNG landmass not susceptible to inundation • large area of remaining rainforest can mitigate global warming effects • alternative fuel sources are available	• susceptible to inundation in coastal areas and low-lying coral islands and atolls • largely agrarian-based society is especially susceptible to climatic impacts • poorly-designed or sited infrastructure susceptible to climate impacts • lack of adequate data • land tenure issues make relocation of threatened populations difficult • institutional weaknesses leading to poor management of resources having value for climate change mitigation	• develop programs/ projects for carbon trading, availment of Clean Development Mechanism; attempt to emphasize (i) potential linkages between biodiversity conservation in rainforest areas and coral reefs, with carbon sink functions; and (ii) opportunities for use of alternative fuels • new infrastructure developments to be climate-adaptive	• terms of CDM not applicable to PNG's conservation-oriented case • continuing extraction from and destruction of key ecosystems erodes their economic value for carbon trading
Biodiversity	• considerable informal database of traditional knowledge concerning biodiversity resources • signatory to CBD; funding available to support efforts aimed at biodiversity conservation • network of NGOs very active in promoting biodiversity conservation • multiple ecosystems (e.g., second largest rainforest in the world, extensive coral reefs, seagrass beds, mangrove swamps) harboring vast biodiversity resources	• rapid rate of habitat loss • rapid extraction of key target species of flora and fauna • violations of international conventions (e.g., CITES) • weak institutional structures unable to effectively manage the extraction of biodiversity resources, and enforce regulations • limited existing network of protected areas (e.g., MPAs, WMAs), and limited management of these areas • lack of accessible and accurate data (e.g., NBSAP not yet prepared)	• tie biodiversity conservation to climate change mitigation (see above) • develop other biodiversity-dependent economic activities (e.g., bio-prospecting, eco-tourism, cottage industries, certification programs, captive breeding) • capitalize on traditional knowledge base • promote lower-impact economic activities as alternatives to heavily extractive ones (e.g., non-timber forest products, agroforestry) • input data into an integrated database	• continuing loss of habitat through uncontrolled logging, destructive fishing practices, etc. • invasive species displace endemic ones • increasing population, increased market demand, creates greater pressure • land tenure situation presents obstacles to setting aside most valuable areas for biodiversity conservation
Land Degradation	• Customary landowners interested in managing their own land resource • PNG signatory to UNCCD	• Customary landowners lack adequate capabilities to sustainably manage land resources in a modern context • Lack of data • destructive practices ongoing, including deforestation, steep-slope agriculture, shifting cultivation, runoff of industrial and ag pollutants	• develop programs/ projects for carbon trading, availment of Clean Development Mechanism; attempt to emphasize (i) potential linkages between biodiversity conservation in rainforest areas and coral reefs, with carbon sink functions; and (ii) opportunities for use of alternative fuels • new infrastructure to be climate-adaptive	• land tenure issues prevent optimum management measures from being applied • major climatic events hasten soil loss (flooding), water loss (elevated temperatures)

Table B. Opportunities for Environmental Mainstreaming, and Potential ADB Program Components to Capitalize on Them, by Sector

Sector	Opportunity	Possible Program Actions/ Interventions
Forestry	• minimize logging of natural forests, by shifting to plantation-based forestry • reforest degraded grasslands • capture economic benefits of forest conservation through CDM • Seek additional economic alternatives to logging in natural forested areas (e.g., non-timber forest products, bio-prospecting, eco-tourism) • Strengthen working relationships with, and capacities of, landowner groups • Capitalize upon traditional knowledge to develop management and livelihood alternatives	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)
Agriculture	• capitalize upon rich heritage of village-based gardening and husbandry • develop partnering arrangements between commercial agri interests and smallholders • develop alternative cultivation techniques on sloping lands to conserve soils and retain water	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan) Strengthen, expand current Nucleus Agro-Enterprises Project
	• develop new sanitary market facilities in main towns	Develop "Facilities Improvements for Provincial Town Food Markets" Project (PPTA/Loan)
Fisheries/ coastal	• promote effective community-based coastal management, utilizing MPAs as a means of preserving breeding stocks of food fish species • review opportunities for developing sustainable financial mechanisms to support fisheries conservation, through user fees, licensing, fines, other incentives and disincentives • promote value-adding to capture greater share of resource value • improve data gathering to support management, enforcement	Strengthen, expand the current Coastal Fisheries Management and Development Project
	• improve market infrastructure	Develop "Facilities Improvements for Provincial Town Food Markets" Project (PPTA/Loan)
Tourism	• prepare national tourism development plan • conduct carrying capacity study • take steps to protect resources that can support sustainable tourism development (e.g., coral reef areas, forests, biodiversity) • review cost structure for air transport sector; develop a structure to favor tourism growth • develop new infrastructure to support tourism development	Develop "Sustainable Tourism and Infrastructure" Project (PPTA/Loan)
Water Resources	• Develop management plans for total catchment and watershed areas • Incorporate climate adaptation strategies into water management planning	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)

Sector	Opportunity	Possible Program Actions/ Interventions
Mineral and Petroleum Resources	• promote more meaningful partnerships with local communities • ensure that greater share of benefit stream (whether as revenues, infrastructure, services, etc.) flows to local stakeholders • undertake measures to protect, manage, and improve environmentally sensitive areas in vicinity of mine sites, especially watersheds	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)
Infrastructure (transport, WSS, and energy)	• ensure that construction best practices are employed • design systems to minimize drainage and erosion problems • design new systems and retrofit old systems to be climate-adaptable	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)
	• provide adequate infrastructure to support emerging sustainable industries (e.g., tourism)	Develop "Sustainable Tourism and Infrastructure" Project (PPTA/Loan)
	• develop greater capacities for energy generation from clean sources; capture economic benefits through CDM	Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)
Health, Education, Human and Socio-economic Dimension	• mainstream reproductive health across all sectors	Develop "Strengthening of Institutions for Improved Environmental Management" Project (TA)
	• improve food security to improve health and nutrition	Develop "Facilities Improvements for Provincial Town Food Markets" Project (PPTA/Loan) Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)
	• create sustainable livelihood options to reduce criminality	Develop "Sustainable Tourism and Infrastructure" Project (PPTA/Loan)
	• develop and distribute appropriate educational and awareness materials • strengthen integration of environmental awareness into education and health agenda • train trainers and educators • mainstream literacy across all sectors	Develop "Strengthening of Institutions for Improved Environmental Management" Project (TA) Develop "Integrated Watershed Management for Sustainable Energy Production" Project (PPTA/Loan)

Global Issues	Opportunity	Possible Program Actions/ Interventions
Climate Change	• develop programs/ projects for carbon trading, availment of Clean Development Mechanism; attempt to emphasize (i) potential linkages between biodiversity conservation in rainforest areas and coral reefs, with carbon sink functions; and (ii) opportunities for use of alternative fuels • new infrastructure developments to be climate-adaptive	Develop "Strengthening of Institutions for Improved Environmental Management" Project (TA) Develop "Financial Mechanisms to Support Conservation of Forest Biodiversity" Project (TA) Implement proposed ADB pipeline "Land Tenure" Project (TA)
Biodiversity	• develop sustainable financing mechanism(s) to support biodiversity conservation (e.g., through debt-for-nature swap, tie-in to climate change, etc.) • develop other biodiversity-dependent economic activities (e.g., bio-prospecting, eco-tourism, cottage industries, certification programs, captive breeding) • capitalize on traditional knowledge base • promote lower-impact economic activities as alternatives to heavily extractive ones (e.g., non-timber forest products, agroforestry) • input data into an integrated database	
Land Degradation	• develop mechanisms to achieve landowner consensus, resolve landowner disputes, facilitate sustainable land management decision-making • develop programs/ projects for carbon trading, availment of Clean Development Mechanism; attempt to emphasize (i) potential linkages between biodiversity conservation in rainforest areas and coral reefs, with carbon sink functions; and (ii) opportunities for use of alternative fuels • new infrastructure developments to be climate-adaptive	

Table C: Expected Benefits of Proposed Project Actions in Addressing Priority Areas of Concern

NEW PROJECTS	PRIORITY AREAS OF CONCERN			
	POVERTY ALLEVIATION	**FOOD SECURITY**	**INSTITUTIONAL STRENGTHENING**	**REVERSAL OF ENVIRONMENTAL DEGRADATION**
Integrated Watershed Management for Sustainable Energy Production	• create revenue stream • enhance standard of living, quality of life, access to services for communities in watersheds • create opportunities for sustainable livelihood	• improve land management practices to increase crop yields	• strengthen multi-sectoral coordination • establish sustainable financial mechanism for conservation • communities' capacities to manage energy resources enhanced • business skills enhanced by operating small power companies	• strengthen land management • strengthen water management • improve water quality in rivers and coastal waters • maintain forest cover • maintain globally-significant biodiversity • maintain/increase carbon sinks
Facilities Improvements for Provincial Town Food Markets	• create opportunities for sustainable livelihood • strengthen small enterprises • improve public health	• improve food handling, minimize waste • improve access to alternative food sources	• strengthen entrepreneurship • strengthen LLG and town-level administrative capabilities	• better WSS systems at markets ensures less pollution • promote waste recycling, composting
Sustainable Tourism and Infrastructure Development	• strengthen economic sector to promote new opportunities for sustainable livelihood	• creation of steady demand can increase and stabilize production	• strengthen multi-sectoral coordination • strengthen a key economic sector • prepare communities • develop new business and management skills	• unsustainable livelihood activities replaced by sustainable ones • promote preservation of environmental values to support tourism (clean air and water, scenic environment) • promote preservation of environmental resources (e.g., biodiversity, unique habitats) that are amenities for tourism
Strengthening of Institutions for Improved Environmental Management	• improved environmental management breaks the 'poverty cycle'	• sustainable subsistence harvesting • sustainable agriculture • improved health and nutrition	• strengthen multi-sectoral coordination • more informed decision-making and environmental planning	• improved knowledge and awareness leads to improved env. stewardship

Opportunities for Environmental Strengthening of Selected Projects Within the ADB Country Program for PNG

Name: Loan 1889: Nucleus Agro-Enterprise	**Type, Cost:** Loan, $5.9 million

Summary of Proposed Activities:

Both the private sector and the public sector have shown a strong interest in the concept of using nucleus enterprises as the focus for wider commercially-based smallholder and agro-industry development, with a view to improving incomes and standards of living in rural areas throughout the country. Under the proposed technical assistance program, financing will be provided to help prepare, analyze and package subprojects consisting of private sector nucleus enterprise ventures, associated smallholder and outgrower development schemes and improved infrastructure. It is envisaged that nucleus enterprises will provide market outlets, technical support, planting materials and social services which cannot be provided either by the public sector or the smallholders themselves.

The proposed TA Program Loan will identify and prepare a pipeline of subprojects based on nucleus enterprise and smallholder development which could be packaged into a series of projects for financing by ADB and/or some other donors or financing agencies. The technical assistance would consist of three activities: (i) initial project screening, (ii) subproject feasibility studies and (iii) pilot activity funding.

The TA Program will provide the Government and the private sector with the opportunity to test a new modality in development financing which is meant to bring out the combined benefits of large private sector entities (nucleus enterprises), small private sector beneficiaries (smallholders and outgrowers) and the public sector (through infrastructure provision) working together to stimulate economic growth in the previously neglected rural areas of the country. The TA Program will allow the preparation of investment packages which would not otherwise have been possible and the testing of such packages through full feasibility analysis pilot activities. Significant poverty reduction benefits may be expected from the ultimate implementation of subprojects identified and prepared in this way.

Environmental issues:	**Assessment:**
• potential for impacts on natural forest habitat, through clearing for new plantations or farms • potential for pollution and erosion and runoff to affect coastal habitats	• project assessed as environmental Category B

Opportunity to Strengthen Mainstreaming Through Project:	**Measures to Reduce Environmental Risks:**
• incorporate environmental awareness training in project activities • strengthen extension programs to promote improved land management practices • consider ways in which agricultural enterprises could incorporate adaptations to climate change (e.g., promoting drought-resistant crops etc.) that could improve food security	• take advantage of innovative technologies such as integrated pest management to minimize use of pesticides • minimize clearing of forested areas, focusing instead on utilizing previously disturbed sites

Name: PNG 1925 - Coastal Fisheries Management and Development	**Type, Cost:** Loan, $5.7 million

Summary of Proposed Activities:

PNG has a large fisheries resource base. Exports from the domestic tuna longline fishery have increased, and have led to an expended fresh fish export trade that will increasingly provide market access in selected locations for high-value products from small-scale fisheries. There is scope for on-shore processing of various types of fish for value-adding prior to export or local consumption. The investment regime in the sector has improved in recent years and several new shore-based fish processing projects are now in the planning stages. These promise to provide market opportunities for fish as well as jobs that will increase the number of local wage-earners and thus stimulate consumer demand for coastal fishery products. The main constraints are that much of the infrastructure necessary for coastal fisheries development is decrepit or in poor condition, reflecting failure of previous policies. Some of the high value resources such as sea-cucumber and shells have been over-exploited in many areas. Improved management of these resources, utilizing some form of community-based management systems, will be important to their long-term earning potential.

The objective of the project is to contribute to the alleviation of poverty in coastal communities in Papua New Guinea through increasing income. This will be achieved by (i) strengthening the capabilities of provincial fisheries departments, improving the organization of fishery stakeholders, and promoting co-management of resources, and (ii) providing infrastructure needed to promote development and investment by the private sector, and improving the efficiency and effectiveness of small-scale fishing operations.

The scope of the project encompasses:

Component 1: Coastal Fisheries Management Support and Capacity Building.
a) Institutional strengthening for coastal fisheries management: (i) human resource development, (ii) fisheries legislation development, (iii) promotion of the formation of stakeholder associations, (iv) establishment of provincial fishery advisory committees, (v) establishment of provincial fishery action plans.
b) Coastal fisheries assessment and monitoring; (i) resource inventories, and (ii) habitat mapping.
c) Strengthening information flows; (i) improved information availability, (ii) production of fishery resource profiles, (iii) production of information and awareness material, (iv) establishment of provincial-level fishery data and statistics, (v) establishment of a PNG fisheries web-site.
d) Community-based fisheries development and management: (i) awareness creation of short-term costs and long-term benefits of resource management, (ii) deployment of fish-attracting devices, (iii) small-scale business promotion, (iv) women's skills training in quality, marketing, value-added, and business management, (v) training and peer-to-peer education on HIV/AIDS.

Component 2: Infrastructure Development.
a) Longline wharf and small boat jetty in Lae, Morobe Province
b) Harbor improvements, Alotau, Milne Bay Province
c) Finger jetty, Daru, Western Province.

Environmental issues:	**Assessment:**
• component 1 activities generally have net-positive environmental impacts • possible resource depletion through deployment of fish aggregating devices • possible adverse construction-related	• assessed as environmental Category B project

impacts associated with Component 2 activities	
Opportunity to Strengthen Mainstreaming Through Project: • develop fisheries policy that incorporates and promotes utilization of fisheries resources in a sustainable manner • work with traditional resource users to promote greater awareness of the need for applying sustainable fisheries practices • evaluate options for improving responsiveness within the fishing industry to adapt to climate-related variations in fish catch	**Measures to Reduce Environmental Risks:** • ensure best practices are applied during construction of harbor and wharf facilities • design wharf facilities to promote efficient handling of fresh fish product to minimize waste and spoilage • determine sustainable levels of fishing effort for various target species, and identify and apply appropriate management measures to ensure sustainability of the resource • establish networks of marine protected areas to preserve breeding stocks of important fish species and to preserve marine biodiversity

<table>
<tr><td>Name: Land Tenure (Technical Assistance)</td><td>Type, Cost: Grant, $500,000, Japan Special Fund</td></tr>
<tr><td colspan="2">Summary of Proposed Activities:

The country strategy identifies land tenure generally as a key impediment to development in PNG. The traditional forms of land ownership are central to PNG customs and form an integral part of the strong safety systems. However, pressure is growing, in the wider community as well as within government, to examine alternative systems that retain the desirable features of traditional systems while allowing flexibility in mobilizing land resources. Land tenure greatly affects gender equality and inequity. The issue is highly sensitive and will require careful consultation. The project goal and purpose is to enable more productive use of land and thus increase income and reduce poverty.</td></tr>
<tr><td>Environmental issues:
• to be determined</td><td>Assessment:
• (pipeline project not yet evaluated)</td></tr>
<tr><td>Opportunity to Strengthen Mainstreaming Through Project:
• customary landowners have tremendous influence on how the resources on their lands will be utilized. Thus it is essential that landowner awareness is raised concerning the need for utilizing resources in a sustainable manner
• promoting improved stewardship among landowners (e.g., improved watershed management) could improve natural ecosystem resilience in the face of extreme weather variations, mitigate drought, etc.</td><td>Measures to Reduce Environmental Risks:
• The project should place special emphasis on developing a framework to encourage landowners to conserve critical land areas such as watersheds, high-biodiversity forests, wildlife corridors, etc.</td></tr>
</table>

Concept Papers: Potential New Projects for Inclusion in ADB's Country Program for PNG

A: Integrated Watershed Management for Sustainable Energy Production

1. Type/modality of assistance

☑ Lending
- ☑ Project loan
- ☐ Program loan
- ☐ Sector loan
- ☐ Sector development program loan
- ☐ Other

☑ Non-lending
- ☑ Project preparatory
- ☑ Other than project preparatory
- ☐ Economic, thematic and sectoral work
- ☐ Other

2 Assistance Focus

a. If assistance focuses on a particular sector or sub-sector specify the sector:

energy, forestry, agriculture, land use planning

b. For project preparatory and lending, classification:
- ☐ Core poverty interventions
- ☑ Poverty intervention

c. Key thematic area

☑ Economic growth	☐ Human
☐ Gender and development	☐ Good governance
☑ Environmental protection	☑ Private sector development
☐ Regional cooperation	☐ Social protection
☐ Other	

3. Coverage

☑ Country ☐ Sub-regional ☐ Interregional

4. Responsible division/Department: PARD

5. Responsible ADB officer: to be determined

6. Description of assistance

(a) Background/linkage to country/ regional strategy:

The project is expected to promote improved environmental and natural resources management, and strengthen private sector development. It is therefore consistent with

ADB's current environmental, country and regional strategies.

(b) Goal and purpose

Over 90% of PNG's rural residents lack access to electricity. The rationale for the project is based upon the premise that, by maintaining healthy functionality of forested watersheds, water resources can be tapped to facilitate establishment of mini-hydropower facilities for sustainable rural electrification. The project would build upon past efforts to promote "total catchment environmental management" as initiated by the Department of Environment and Conservation (DEC). While DEC had begun this process through a conceptual subdivision of the country into seven major catchment management areas, it appears that these areas are too large for effective on-the-ground management. In fact, each area comprises numerous natural watershed catchment areas. Thus there is a need to refine the total catchment management concept. By managing watersheds to produce tangible benefits through electricity power generation, the project would: (i) foster greater awareness of the importance of maintaining forest cover to ensure water retention; (ii) promote sustainable land management practices, especially in the forestry and agriculture sectors; (iii) promote new opportunities for sustainable livelihood development, income diversification, and private sector development; (iv) develop direct revenue streams through the sale of excess electricity, that could be utilized to support project sustainability and strengthen local economic growth; and (iv) facilitate improved delivery of a wide range of social services to remote, isolated areas. Lessons learned from mini-hydropower projects implemented in PNG in the past suggest that fuure projects could benefit if there is integration between provision of water supply and power. Also, because revenue collection for past projects (by the provincial government) was ineffective, this problem could be avoided if revenues are collected directly by the landowners/stakeholders for new projects.

Because of the high biodiversity values associated with PNG's forested areas (PNG has the second largest intact rainforest area on earth), the project would yield significant benefits in preserving globally-important biodiversity resources. Due to the cross-sectoral nature of the project, and the need for a high level of coordination across sectors and among key agencies and institutions, the project would help to promote better coordination and strengthen institutions. Potential exists to tap other funding sources for cofinancing, such as: (i) the Global Environment Facility (GEF) or the Papua New Guinea Sustainable Development Program (PNGSDP) to fund biodiversity conservation, integrated ecosystem management, and/or sustainable land management; and (ii) the Clean Development Mechanism (CDM) for mini-hydropower certified emission reduction (CER).

In addition, the PNG government has argued in international fora that the nation's biodiversity-rich old-growth natural forests are an important carbon sink which, if preserved, could help to bring about significant reductions in atmospheric carbon. While this view seems well-justified in environmental terms, natural forests are not recognized as a CER under the Kyoto Protocol's CDM.[1] Therefore a small-scale TA project would be piggy-backed to the loan portion of this project, to identify alternative mechanisms to the CDM, to secure financial compensation for conservation of PNG's globally-important forest biodiversity. Alternatives that might be considered would include establishment of a "biodiversity trust fund," development of a "debt for carbon trade" mechanism, or similar vehicles. Funding sources for these alternatives might be GEF, PNGSDP, or similar funding entities. As part of the investigation, the TA would include an in-depth

[1] Reforestation and afforestation projects are the recognized CERs for the forestry sector.

economic valuation study to further elucidate the environmental costs and benefits associated with forest biodiversity conservation.

(c) Expected results and deliverables

1. during PPTA: development of a framework for certification of emission reduction through the establishment of mini-hydropower projects in target watershed areas
2. during PPTA: (i) preparation of GEF grant proposal under an appropriate operational program, and (ii) determination of eligibility for PNGSDP funding
3. during PPTA: preparation of feasibility studies for at least two mini-hydropower facilities
4. in cooperation with the Department of Petroleum and Energy, Energy Branch, revision/refinement of DEC watershed management concept and master plan
5. identification of 6-8 target watersheds for integrated management, and production of detailed individual watershed management plans
6. identification of locations for mini-hydropower projects (correlated closely with the target watersheds), and establishment of at least 3-4 prototype mini-hydropower facilities brought into operation during the life of the project
7. community mobilization, and establishment of community-based entities (power cooperatives or corporations) in at least 3-4 communities, responsible for the set-up, operation, and management of mini-hydropower facilities, including facilitation of equitable access to electric power for all community members
8. enhancement of business, entrepreneurial, and management skills, broadening of livelihood opportunities, and strengthening of the private sector
9. as part of piggy-back TA: (i) well articulated analysis of opportunities for sustainable financing of forest biodiversity conservation; and (ii) economic valuation study of forest biodiversity

(d) Social or environmental issues or concerns

The proposed project would yield important benefits in terms of maintaining and preserving important ecosystem functions, forest cover, and biodiversity. Improved watershed management has both mitigative and adaptive advantages in relation to climate change. The project would also promote improved quality of life and economic development in marginalized communities. Thus the social and economic impacts of the project are expected to be strongly positive.

(e) Plans for disseminating results/deliverables:

To be determined

7. Proposed executing/implementing agencies

Following are the principal actors who would be involved in the project, and their respective roles:

DEC: co-executing agency, responsible for development of overall watershed management plans and concepts

Dept. of Petroleum and Energy, Energy Division: co-executing agency, responsible for review of mini-hydropower feasibility studies, and oversight of mini-hydropower facilities operations

community entities (cooperatives, community corporations): key implementors and operators of mini-hydropower projects

NGOs: community organizing, awareness-raising, environmental fieldwork and natural resources management; skills strengthening and entrepreneurial development for small business enterprises

Private sector: involved in establishing new enterprises made possible by access to continuous source of electric power

8. Nature/extent of government beneficiary involvement in identifying or conceptualizing the assistance

DEC has already begun work on developing a total catchment environmental management process, which would be developed further under the project. The Energy Division of the Dept. of Petroleum and Energy has prepared a large number of feasibility studies for mini-hydropower projects. Past efforts to implement such projects have been hampered by land ownership issues, and lack of funds. For development of mini-hydropower facilities of about 160 kilovolt-amperes (kva), costs are around K3 million and usually less than a hectare of land is required. Two possible projects for which land issues have been resolved are the proposed mini-hydropower schemes for Menyamya (Morobe Province) and Marawaka (Eastern Highlands Province). Possibly these two sites could be among the first to be developed under the proposed project. Expansion to other sites could build upon the numerous feasibility studies that have already been prepared by the Energy Division.

9. Timetable for assistance design, processing and implementation

The activities envisioned under the project will be organized in phases, as follows:

Project preparation (1 year)

Phase 1: community preparation, watershed management planning and implementation, mini-hydropower prototyping (6 years)

Phase 2: replication of Phase 1 activities at additional sites (6 years)

10. Financing Plan (through Phase 1 only)

☑ For lending

- ☐ Ordinary Capital Resources
- ☑ Asian Development Fund: $35M
- ☐ Other-:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements, (e.g., total cost, ADB financing, other financing, and government financing):

☑ For Nonlending

- ☐ No resources required, other than ADB staff
- ☐ ADB's administrative budget: $
- ☑ Grant TA funds: 1 million
- ☑ Other: $10 million

If cofinancing is required indicate sources, and amount sought:

GEF, PNGSDP, or CDM funds

If known, provide cost estimates and financing arrangements (e.g., total cost, ADB financing, other financing, and government financing):

B: Facilities Improvements for Provincial Towns Food Markets

1. Type/modality of assistance

☑ Lending
- ☑ Project loan
- ☐ Program loan
- ☐ Sector loan
- ☐ Sector development program loan
- ☐ Other

☑ Non-lending
- ☑ Project preparatory
- ☐ Other than project preparatory
- ☐ Economic, thematic and sectoral work
- ☐ Other

2 Assistance Focus

a. If assistance focuses on a particular sector or sub-sector specify the sector:

b. For project preparatory and lending, classification:
- ☐ Core poverty interventions
- ☑ Poverty intervention

c. Key thematic area

☑ Economic growth	☐ Human
☐ Gender and development	☐ Good governance
☑ Environmental protection	☑ Private sector development
☐ Regional cooperation	☐ Social protection
☐ Other	

3. Coverage

☑ Country ☐ Sub-regional ☐ Interregional

4. Responsible division/Department: PARD

5. Responsible ADB officer: to be determined

6. Description of assistance

(a) Background/linkage to country/ regional strategy:

The project is expected to promote improved food handling, public health and sanitation, waste management, and strengthen private sector development. It is therefore consistent with ADB's current environmental, country and regional strategies.

(b) Goal and purpose

The need for the project is based on the fact that most towns currently lack well-

designed and properly-built fresh food market facilities. The project would be implemented at the town, local level government (LLG), and district level. Because a number of past attempts to improve market facilities have not received strong acceptance at the local community level, project design would place emphasis on participation, cooperation and consultation with local stakeholders, including government agencies, food producers, vendors, and customers. Awareness-raising and community preparation activities will pave the way for more widespread acceptance of the project concept among local stakeholders. The project will establish or improve market facilities, including necessary infrastructure (e.g., storage and sales areas, water supply, toilets, small access roads, security fencing, waste disposal) that would enable displaying, handling, and selling fresh produce, meat, fish, and poultry in a more hygienic manner than currently practiced. Overall health and sanitation would be improved, and less waste of food would occur due to spoilage or contamination. Improved sanitation and waste disposal, and greater reliance on practices such as recycling, composting, and waste minimization. would reduce pollution. The project would contribute to improved food security and strengthen opportunities for income generation and private sector development. Financial mechanisms would be incorporated to ensure that the market facilities, once operational, could be financially self-sustaining.

(c) Expected results and deliverables

1. Identification of 4 to 6 sites for new market facilities in provincial towns, and detailed designs for user-friendly market facilities

2. community preparation and awareness-raising activities

3. 4-6 new market facilities constructed and brought into operation, with local management committees formed to oversee the efficient and proper utilization and operation of the facilities

4. training for community members in economic and livelihood activities that could generate revenue and complement market operations (e.g., food processing, value adding, recycling, composting)

(d) Social or environmental issues or concerns

The proposed project would yield important benefits in terms of improved hygiene and sanitation, and reliable delivery of higher quality food products, promoting better health and nutrition, and improved food security. Minimization of waste, and better disposal of waste, would also represent a significant environmental improvement. Better conditions in the market facility would stimulate economic activity. Thus the expected overall social and environmental effects of the project are strongly positive.

(e) Plans for disseminating results/deliverables:

The project will make use of a modular design for market facilities. This will promote easier replicability in establishing additional market facilities at new sites. The modular approach will also allow flexibility in tailoring the design of new facilities to match site-specific needs (by selecting those modular components to be included for each target market, depending on site-specific requirements). Coordination with other projects will be needed to avoid duplication of effort—for example, plans are already underway to

develop new market facilities at Goroka and Mt. Hagen with assistance from other donors. Toward the end of the project, a study will be undertaken to identify additional candidate sites where new market facilities could be established, possibly through a continuation of the project in a subsequent phase, or with support from other financial institutions working in partnership with government. Lessons learned during the implementation of the project will be applied in establishing other new market facilities around the country.

7. Proposed executing/implementing agencies

Executing agency (to be determined):
-Department of Provincial and Local Government Affairs
-Office of Rural Development, Department of National Planning and Rural Development
-Department of Community Development

Implementing Agencies:
-LLGs
-Towns/municipalities
-Districts

Other participating institutions:
-NGOs
-community associations

8. Nature/extent of government beneficiary involvement in identifying or conceptualizing the assistance

local-level stakeholders confirmed the need for the project during CEA consultations

9. Timetable for assistance design, processing and implementation

PPTA-1 year
Loan/Implementation-5 years

10. Financing Plan (through Phase 1 only)

☑ For lending
:

- ☐ Ordinary Capital Resources
- ☑ Asian Development Fund: $18M
- ☐ Other-:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements, (e.g., total cost, ADB financing, other financing, and government financing):

☑ For Nonlending

- ☐ No resources required, other than ADB staff
- ☐ ADB's administrative budget: $
- ☑ Grant TA funds: $1 million
- ☐ Other:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements (e.g., total cost, ADB financing, other financing, and government financing):

C: Sustainable Tourism and Infrastructure Development

1. Type/modality of assistance

☑ Lending
- ☑ Project loan
- ☐ Program loan
- ☐ Sector loan
- ☐ Sector development program loan
- ☐ Other

☑ Non-lending
- ☑ Project preparatory
- ☐ Other than project preparatory
- ☐ Economic, thematic and sectoral work
- ☐ Other

2. Assistance Focus

a. If assistance focuses on a particular sector or sub-sector specify the sector:

tourism, environment (biodiversity conservation), and infrastructure

b. For project preparatory and lending, classification:
- ☐ Core poverty interventions
- ☑ Poverty intervention

c. Key thematic area

☑ Economic growth	☐ Human
☐ Gender and development	☐ Good governance
☑ Environmental protection	☑ Private sector development
☐ Regional cooperation	☐ Social protection
☐ Other	

3. Coverage

☑ Country ☐ Sub-regional ☐ Interregional

4. Responsible division/Department: PARD

5. Responsible ADB officer: to be determined

6. Description of assistance

(a) Background/linkage to country/ regional strategy:

The project is expected to promote the sustainable growth of a much-neglected but potentially significant economic sector. It will stimulate investment of the private sector in tourism, deliver needed infrastructure, and at the same time encourage preservation of globally-significant biodiversity resources. It is therefore consistent with ADB's current environmental, country and regional strategies.

(b) Goal and purpose

Tourism development in PNG represents a sector with great, but largely untapped potential. The focus of the project is on developing tourism in a planned and sustainable manner. Already identified by the Tourism Promotion Authority (TPA) is a need for formulation of a national tourism development master plan. Carrying capacity studies would identify acceptable levels of visitor use at specified sites. The project would work to establish plans for tourism development that could be implemented in a number of "model provinces", and then replicated in other provinces around the country. Accompanying infrastructure development would be designed and built to accommodate demand and utilization levels expected through tourism growth, while minimizing environmental impacts. Steps would be taken to make tangible improvements in preserving general environmental quality, cultural and historic resources, all important assets that support sustainable tourism development. Marine biodiversity is especially important in this regard, since it supports nearly 50% of tourism interest in PNG in the scuba diving subsector. Potential exists to tap other funding sources for cofinancing of the project (e.g., GEF) to support marine biodiversity conservation.

One significant barrier to continued development in tourism has been a "disconnect" between government and private sector operators. Therefore, the project will take steps to address this gap, by (i) building on the experience of existing private operators, and replicating successful models; (ii) encouraging improved dialogue between government entities and the private sector, and improving responsiveness by government to private sector needs; and (iii) taking steps to promote meaningful partnerships between government and the private sector, wherein responsibilities for continued tourism development are equitably shared between the two.

(c) Expected results and deliverables

1. national sustainable tourism development master plan, including analysis of current barriers to tourism and means for overcoming them

2. establishment of 4 prototype "model tourism provinces" in which new tourism activities are promoted

3. preparation and training of communities to engage in sustainable tourism activities

4. design and construction of appropriate infrastructure (e.g., water and sanitation, power, road and airport improvements, etc.) needed to support sustainable tourism development

5. creation of tourism coordination committees, which meet regularly to facilitate improved liaison between tourism operators and government tourism agencies

6. establishment of a network of marine protected areas in selected tourism sites, to be managed in cooperation with dive tourism operators

(d) Social or environmental issues or concerns

The proposed project would yield important benefits in terms of capturing the large economic potential that exists in the tourism sector. By enhancing job creation, the project can help to overcome one of the problems afflicting the tourism sector specifically and PNG society in general—the high incidence of crime among disaffected, out-of-work youth. On the other hand, tourism development has the potential to disrupt existing traditional social structures. This potential problem can be avoided through careful community preparation. Tourism development as promoted under the project will be carried out based on a careful assessment of environmental carrying capacity, thus avoiding negative environmental impacts. Overall, the social and environmental impacts of the project are expected to be net positive.

(e) Plans for disseminating results/deliverables:

Sustainable tourism development will be promoted most strongly first in four "model" provinces. Successful development within these provinces could then be replicated in other areas. Establishment of coordination committees will facilitate exchange of information regarding successful projects.

7. Proposed executing/implementing agencies

Tourism Promotion Authority (TPA)
Private sector tourism operators
NGOs

8. Nature/extent of government beneficiary involvement in identifying or conceptualizing the assistance

The TPA has already identified the need for preparation of a national tourism master plan as a top priority, and the proposed designation of four model provinces for tourism development. The proposed project adopts this general framework and takes it further in promoting the implementation of tourism development projects.

9. Timetable for assistance design, processing and implementation

project preparation TA: 1 year
implementation in 4 provinces: 6 years

10. Financing Plan

☑ For lending

- ☐ Ordinary Capital Resources
- ☑ Asian Development Fund: $35M
- ☐ Other-:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements, (e.g., total cost, ADB financing, other financing, and government financing):

☑ For Nonlending

☐ No resources required, other than ADB staff
☐ ADB's administrative budget: $
☑ Grant TA funds: $1 million
☑ Other: US$10 million

If cofinancing is required indicate sources, and amount sought:

GEF financing sought to support conservation of marine biodiversity resources that would form the foundation for sustainable tourism in coastal areas. Revenues generated through tourism activities could in turn support long-term marine biodiversity conservation initiatives.

If known, provide cost estimates and financing arrangements (e.g., total cost, ADB financing, other financing, and government financing):

D: Strengthening of Institutions for Environmental Management

1. Type/modality of assistance

☐ Lending
- ☐ Project loan
- ☐ Program loan
- ☐ Sector loan
- ☐ Sector development program loan
- ☐ Other

☑ Non-lending
- ☐ Project preparatory
- ☑ Other than project preparatory
- ☐ Economic, thematic and sectoral work
- ☐ Other

2. Assistance Focus

a. If assistance focuses on a particular sector or sub-sector specify the sector:

b. For project preparatory and lending, classification:
- ☐ Core poverty interventions
- ☐ Poverty intervention

c. Key thematic area

☐ Economic growth	☐ Human
☐ Gender and development	☐ Good governance
☑ Environmental protection	☐ Private sector development
☐ Regional cooperation	☐ Social protection
☐ Other	

3. Coverage

☑ Country ☐ Sub-regional ☐ Interregional

4. Responsible division/Department: PARD

5. Responsible ADB officer: to be determined

6. Description of assistance

(a) Background/linkage to country/ regional strategy:

The project is expected to strengthen institutions responsible for improved environmental and natural resources management, and improve environmental awareness among community stakeholders and top decision-makers. It is therefore consistent with ADB's current environmental, country and regional strategies.

(b) Goal and purpose

Although past efforts have been made to improve environmental management functions

in PNG, the Department of Environment and Conservation (DEC),[2] the key responsible agency, is not yet fully capable to carry out many of its assigned management, monitoring, and regulatory functions. One of the key problems is the very limited posting of DEC staff outside of the capital. Through the Organic Act, it is intended that various government functions be decentralized.

In addition, while there is a strong tradition of environmental practice at the community level, traditional practices are not always adequate or appropriate to address environmental management needs in the modern context. Efforts have been initiated in primary and secondary schools to develop an environmental curriculum, but more needs to be done in terms of general community-level awareness-raising. Furthermore, the importance of effective environmental management to safeguard the country's natural resource endowment, and its potential for future economic growth, is not always clearly perceived. especially among key decision-makers.

The proposed project would therefore take a multi-level approach to address these weaknesses. The activities that would be included are as follows:

Strengthening of Environmental Institutions: (i) build up a framework that would ascertain which responsibilities for environmental management should reside with central government, and which should be transferred to local government; (ii) establish improved coordination between DEC and provincial offices; (iii) draft model local-level regulations; and (iv) initiate training for DEC staff (as future trainers) and provincial personnel to assume a greater level of responsibility in environmental management.

Building Community Awareness: (i) through a multi-media awareness campaign, disseminate information to communities regarding the importance of properly managing the environment and utilizing natural resources in a sustainable manner; (ii) engage community members in participatory planning and management activities, such as community participatory resource mapping, and (iii) conduct other participatory and special events (e.g., community beautification and clean-up, recycling drives, children's contests) to foster a greater sense of local-level ownership for environmental management.

Incorporating/strengthening environmental considerations in national policy statements (e.g. MTDS, sectoral plans), in order to enhance mainstreaming: The recently-launched Medium Term Development Strategy lacks a clear articulation of environmental sustainability objectives. Under the proposed project, efforts would be undertaken to reorient this important policy document in a direction that more strongly reflects a sustainable development agenda, rather than economic growth alone. Efforts would also be directed toward preparing a national sustainable development policy (either separate from or incorporated with, the MTDS), and toward ensuring that other important sectoral policy papers include consideration of environmental sustainability.

Clarifying the Link Between Environmental Values and Economic Development: In the course of the CEA consultations, it became apparent that many top decision-makers in PNG lack adequate information about, or a clear understanding of, the need for preserving environmental values and the natural resource base, in order to ensure continued economic development over the long term. In order to address this deficiency, an economic valuation study of environmental and natural resource assets will be

[2] e.g., the AusAID DEC Strengthening Project implemented in the mid-1990s, which mainly facilitated development of the Environment Act 2000.

carried out, and presented to decision-makers in key sectors. It is expected that the outcome of such an analysis will help decision-makers to better understand the fundamental importance of preserving environmental values to capture economic benefits, and therefore will lead to more effective environmental mainstreaming in policy-making and economic planning processes.

(c) Expected results and deliverables

1. analysis of centralized and de-centralized environmental functions, and review of local environmental regulations in all 19 provinces and the National Capital Region which identifies significant regulatory gaps and deficiencies
2. draft regulations for key functions needed for effective environmental management and compliance at the local level
3. staffing plan for assigning and posting DEC staff outside of Port Moresby, and assignment of environment officers within provincial and/or district offices
4. training modules prepared and presented to train trainers at DEC and train new officers at the local level
5. integrated community-level program to raise environmental awareness
6. environmental mainstreaming measures undertaken in addressing deficiencies in policy and planning documents
7. economic valuation study of environmental assets and natural resources undertaken

(d) Social or environmental issues or concerns

The proposed project would strengthen environmental institutions and increase public awareness of the environment. The impacts of the project are expected to be strongly positive.

(e) Plans for disseminating results/deliverables:

Training and awareness-raising activities built into the project design are the intended dissemination mechanism.

7. Proposed executing/implementing agencies

DEC
Department of National Planning and Rural Development
Provincial and district level government planning agencies

8. Nature/extent of government beneficiary involvement in identifying or conceptualizing the assistance

DEC was involved in detailed consultations during the CEA, which led to the identification of the project

9. Timetable for assistance design, processing and implementation

2 year timeframe for the technical assistance

10. Financing Plan

☐ For lending

- ☐ Ordinary Capital Resources
- ☐ Asian Development Fund
- ☐ Other-:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements, (e.g., total cost, ADB financing, other financing, and government financing):

☑ For Nonlending

- ☐ No resources required, other than ADB staff
- ☐ ADB's administrative budget: $
- ☑ Grant TA funds: $2 million
- ☐ Other:

If cofinancing is required indicate sources, and amount sought:

If known, provide cost estimates and financing arrangements (e.g., total cost, ADB financing, other financing, and government financing):

Appendix 19: Framework for Environmental Roadmap for Papua New Guinea

Indicators	Targets (data year 2005 unless otherwise indicated)				
	Current	Year 5	Year 10	Year 15	Year 20
GENERAL/INSTITUTIONAL/POLICY					
1. % of EISs independently monitored	Above 90%	100%	100%	100%	100%
2. Number of Environment Officers assigned to Provinces/LLGs/Projects	about 6 nationwide	At least 1 in each province	At least 2 in each province	At least 4 in each province	At least 4 in each province
3. Environmental sustainability clearly articulated in key policy documents (e.g., MTDS, sustainable development policy, etc.)	Goal articulated in Preamble to Constitution, Environment Policy	In MTDS	In MTDS and Sus. Dev. Plan	in 4 documents	In 4 documents
LAND USE, FOREST COVER, BIODIVERSITY					
3. area of natural forest cover	306,000 km^2	1% decrease over previous	1% decrease over previous	no change over previous	no change over previous
4. area of degraded land reforested/revegetated	67,000 km^2; less than 0.02% of degraded land reforested; logged-over areas allowed to re-grow naturally	10% increase over previous	10% increase over previous	10% increase over previous	10% increase over previous
5. # of protected areas established/area	48/15,566 km^2 (1998)	50/18,000 km^2	55/20,000 km^2	60/30,000 km^2	65/35,000 km^2
6. % of PAs effectively managed (% of total area)	<20%	40%	60%	80%	90%
7. # threatened birds and mammal species	90 (2002)	5% reduction over previous	5% reduction over previous	5% reduction over previous	5% reduction over previous
MARINE, COASTAL RESOURCES, FISHERIES					
7. # of marine protected areas (MPAs) established/area	8/2,149 km^2 (2004)	10/3,000 km^2	14/5,000 km^2	18/8,000 km^2	25/10,000 km^2
8. fishing license fees collected as % of export value	~12.5% (1999)	15%	15%	15%	15%
WATER RESOURCES, HEALTH AND SANITATION					
9. % of population with access to safe water supply	42%	45%	48%	50%	55%
10. % rural households with adequate sanitation	80% (2002)	82%	85%	87%	90%
11. population growth rate	2.5% (2000-2003)	2.5%	2.5%	2.0%	1.8%
12. # cases HIV/AIDS	50,000	75,000	100,000	100,000	100,000
POLLUTION AND SOLID WASTE					
13. # of municipalities with landfills functional according to Landfill Code of Practice	3 municipalities, 2 mining co's	20%	30%	40%	50%

Indicators	Targets (data year 2005 unless otherwise indicated)				
	Current	Year 5	Year 10	Year 15	Year 20
CLIMATE CHANGE					
14. CO_2 emissions	0.5 MT/capita/yr (1999)	To be determined	To be determined	To be determined	To be determined
15. SO_2 emissions	Data not available	To be determined	To be determined	To be determined	To be determined
16. carbon credits awarded (through CDM and similar)	Data not available	To be determined	To be determined	To be determined	To be determined