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2011-2016

INTEGRATED

Environment and Natural Resources

Research, Development, and Extension

FRAMEWORK

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Relevant research, development, and extension towards a healthy environment and sustainable natural resources for an improved quality of life.

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Message

Since 2009, I have kept a keen interest on how the *2011-2016 Environment and Natural Resources* (ENR) *Research and Development and Extension* (RDE) *Framework* was being crafted. I have noted that in coming up with this document, one thing stands out: the partnership that the DENR Research Sector, through the leadership of Ecosystems Research and Development Bureau (ERDB), sought to establish with the various stakeholders to engage them in coming up with this framework.

On this note, I would like to commend ERDB and the Ecosystems Research and Development Service (ERDS) for making partnership an approach to planning and eventually in implementing the various RDE activities in the environment and natural resources (ENR) sector.

The framework embraces a six-year period of implementing RDE activities which are programmed to resolve problems on environmental degradation. This environmental degradation has spawned adverse impacts on ENR productivity, public health, economic and livelihood activities, biosecurity, and sustainability of the environment to support life as a whole.

The framework is a living document of committed and unified actions of various stakeholders to help solve the problems confronting our environment and challenging its sustainability. It is by a full measure, a systematic undertaking. It is systematic because, it is by principle and protocol— scientifically organized and scheduled to ensure proper implementation and achievement of results.

Therefore, this framework rests squarely on valid premises as it draws upon the policy resources over which the ERDB and the ERDS are mandated to carry out— chiefly, as a principal research and development arm of DENR.

It is highly notable that this framework keeps the extension component as earlier initiated in the previous RDE framework. The critical importance of this third component comes as a culmination of development work where stakeholders find use in the pieces of scientific information and technologies generated from preceding R and D work.

The magnitude of environmental problems has generally become globalized. Concerns on climate change, waste management, and inefficient energy resources are compounded with pressures of population growth, industrialization, urbanization, ENR management policy conflicts, and low capacity on environmental governance intermittently causing serious draw down on the development capital of both developing and developed nations. In this case, the Philippines acutely faces a graver challenge to install stable measures to establish ENR sustainability as it optimizes low development capital to support a large population base.

The framework, therefore, is built with a mix of resources that draws upon cooperation and collaboration with various stakeholders to ably meet the requirements of scientific undertakings– now planned out as a public and private sectors' partnership. And above all, the RDE framework establishes a distinct partnership– one that is ready to undertake shared responsibility in securing and strengthening ENR sustainability.

Having this framework as the Research Sector's roadmap in the next six years, I look forward to the successful endeavours of ERDB and ERDS and all its partners in RDE on environment and natural resources.

RAMON J. P. PAJE
Secretary, DENR

Foreword

Managing development to *efficiently* achieve its goal rests on how scientific this is being implemented. Managing development to *effectively* achieve its goal rests on how extension work makes full use of the results derived from scientific work. Development work has increasingly become a discipline of science out of necessity to ensure that resources for research are properly managed and optimized to aid in programming responsive actions to resolve problems affecting the environment and the communities depending on it. This necessity is attendant upon the limiting effect of inadequate resources for research, development, and extension (RDE) work and the adverse impacts of a degraded environment. Despite these obtaining conditions, the resolution of environmental degradation comes as an urgent cause for putting in place stable conditions in which to nurture productivity and sustainability of a robust environment and natural resources (ENR).

The *2011-2016 Environment and Natural Resources* (ENR) *Research, Development, and Extension* (RDE)*Framework* is a package of scientific activities applied to resolve ENR degradation. The framework comes as an intervention that builds on research, models development, and pursues extension with stakeholders as a culminating action to conclude degradation and begin the task of rehabilitating and restoring ENR into productivity and sustainability.

The framework looks into resource-based and ecosystem-specific problem as a springboard of RDE action. Thus, it draws in pertinent baselines as a measure to craft the necessary intervention. It also takes on global issues on climate change, renewable sources of energy, biosecurity, biotechnology, and disaster risk management. However, the social and economic dynamics interacting on and with the use of ENR raise a greater challenge to rehabilitate and restore the productive balance and sustainability of the environment. Expanding industries and growing population lead to converting resource-bases into other uses far from their natural capacities that result in siltation, desertification, surface runoffs, loss of habitat, breach of biosecurity, receding gene pools, *inter alia*. If industrialization and population growths remain unsustainably managed, ENR depletion sets an occasion of resource-use conflicts becoming more pronounced and intermittent.

Reaffirming extension work in this 2011-2016 framework holds that the preceding research and development work take into account the social and economic dimensions that are borne upon the actions of the ENR stakeholders. The framework therefore, comes as packages for problem-solving with the stakeholders as active participants in planning, implementing, and managing ENR RDE activities.

The initiative of the Ecosystems Research and Development Bureau and Ecosystems Research and Development Service to gather more time and more stakeholders in crafting this framework brings us to no other end but regaining an ENR that is sustainably productive. Both these institutions have therefore, given environmental governance a sterling quality with this framework— that of transforming RDE from a multidisciplinary undertaking to a multistakeholder cooperation.

MANUEL D. GEROCHI
Undersecretary for Staff Bureaus, DENR

Preface

The *2011-2016 Environment and Natural Resources* (ENR) *Research and Development and Extension* (RDE) *Framework* is a product of collaboration among research and development sectors in the Department of Environment and Natural Resources (DENR), other government agencies, the academe, the industry and private sector. This collaboration was achieved through a series of workshops and consultations across the country.

The efforts and resources organized to craft this framework build on participatory principle. Adopting this principle is a deliberate means to implement projects and programs that are far more useful to and doable among stakeholders. It is a means to establish a shared responsibility in resolving issues and problems on the depletion of natural resources and degradation of ecosystems, loss of productivity, and breach of biosecurity.

The framework is aligned with the *National R and D Priorities Plan* (NRDPP) *on Environment and Natural Resources* (ENR)*, 2010-2016*. The six-year NRDPP streamlines government research and development (R and D) efforts and provides guidance for allocating and utilizing public R and D funds.

To provide a turnkey platform for R and D activities, an extension component is laid out in the framework to bring into use or adoption of the technologies generated from the R and D activities. Thus, this framework triangulates the scientific efforts of conducting research and modeling development together with the packaging of extension modules to bring to the ground technologies that are useful in restoring the productive balance of the environment, creating opportunities for environment-friendly economic activities, and reinforcing environmental security.

The scope of this framework embraces the following sectors: Forest Resources and Watershed, Protected Areas and Biodiversity, Coastal and Marine, Environment, Mines, Lands, and Water Resources including Freshwater as well as Technology Transfer and Commercialization.

On another dimension, the coverage of this framework accounts sector-specific and problem-based RDE activities including those of the crosscutting themes on climate change, sustainable energy sources, and waste management.

This framework, programmed for six years, identifies resources which are attendant upon the prevailing requirements of managing the environment and natural resources with notable progress towards achieving sustainable development. Ranged over the volume of the planned activities, the framework carries a PhP 1.10-billion budgetary requirement. This budgetary requirement is allocated to the RDE activities of the seven sectors including the Technology Transfer and Commercialization that are programmed along with the respective activity timeframes within the six-year span. Thus, it critically supports an undertaking that is principally time-bound and draws upon the urgency of addressing environmental problems and issues that impact on the productivity and security of our communities and on our nation as a whole.

This framework therefore is a collective proposition of various stakeholders that offers an action agenda to firmly establish sustainable development in the environment sector.

MARCIAL C. AMARO, JR., CESO III
Director

Executive Summary

The *2011-2016 Integrated Environment and Natural Resources* (ENR) *Research, Development, and Extension* (RDE) *Framework* follows the goal-purpose-output-activities (GPOA) logical framework where it further adopts the DENR's template on General Plan of Action. The GPOA shows the succession of goals as they are being achieved precedes from the vital inputs of the research sector's activities on research, development, and extension (RDE).

The framework, therefore captures the essential principle of a purposive, programmatic, and progressive action; purposive as it clearly identifies the goals under which to establish effective environmental governance to achieve ENR sustainability; programmatic as it sequentially sets out the steps to optimize both the resources for and outputs of RDE activities to reinforce the measures in achieving the goals; and progressive as it adheres to scientific practice of development work.

The framework stands as a unified perspective through which all the RDE activities are to be implemented. The seven sectors, namely, *Forest Resources and Watersheds, Protected Areas and Biodiversity, Coastal and Marine, Environment, Mines, Lands, and Water Resources including Freshwater* ascribe their respective RDE activities with this framework to establish at the onset a clear and logical understanding between ERDB and its various stakeholders on the phases of interventions, their required resources and intermediate outputs, and the critical synergies to cultivate the desired outcomes that will eventually build towards achieving the set goals.

In addition to the seven sectors, the *Technology Transfer and Commercialization* is affirmed in this framework. It carries a set of communication-related activities to create institutional and on-ground platforms on which to facilitate technology adoption by stakeholders and market placement of technologies by entrepreneurs. Its inclusion in the framework underpins the critical role in promoting understanding and cultivating action that reinforce sustainable ENR management as viable and beneficial venture for socioeconomic improvement on long-term basis.

These sectors, including *Technology Transfer and Commercialization,* have identified over 40 complex problems and issues that generally cut down ENR sustainability and our capacity to implement responsive environmental governance. These problems and issues largely comprise concerns on declining ENR productivity; resource-use conflicts; policy, regulatory, and institutional infirmities on ENR management; and low technology adoption.

The differentiation of these problems and issues are contextualized as sector-specific concerns to provide appropriate multidisciplinary focus and a vital mix of resources including institutional resource-sharing schemes and partnership with ENR stakeholders in implementing RDE activities.

These problems and issues come as the entry points to close to a hundred of RDE activities that this framework intends to implement in the next six years while it takes special attention on global issues such as climate change, efficient energy resources, and waste management.

These RDE activities cap a PhP 1.10-billion budgetary requirement distributed to the seven sectors including the Technology Transfer and Commercialization across a six-year period. The details of this distribution are cited in this framework. This requirement is built around an enhanced internal efficiency of implementing RDE activities where its optimization is supported with multistakeholder collaboration and a roll-out plan to bring technology transfer unto commercialization.

While the Executive Order 192 creates the Ecosystems Research and Development Bureau as the principal research arm of the DENR, this framework affirms an overriding approach to implement the RDE activities as an undertaking of collaboration with ENR stakeholders.

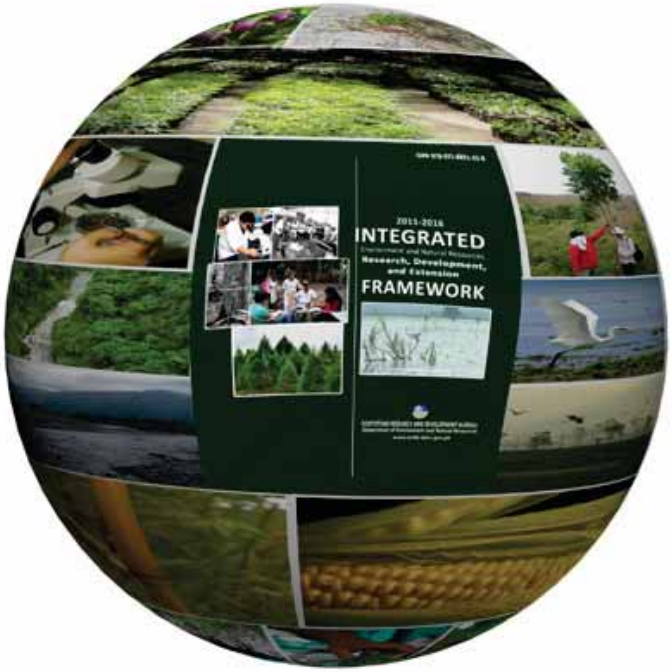
Acronyms

AO	Administrative Order
APMI	ASEAN Peatland Mat. Initiatives
ASEAN	Association of Southeast Asian Nations
CARP	Comprehensive Agrarian Reform Program
CPB	Cartagena Protocol on Biosafety
CBD	Convention on Biological Diversity
CBFM	Community-Based Forest Management
CDM	Clean Development Mechanism
CENRO	Community Environment and Natural Resources Office
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora Community Forest Program
CPA	Conservation Priority Area
DA	Department of Agriculture
DAO	Department Administrative Order
DAR	Department of Agrarian Reform
DE	Department of Energy
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOST	Department of Science and Technology
DOT	Department of Tourism
DPWH	Department of Public Works and Highways
DTS	Data Tracking System
EIA	Environmental Impact Assessment
EMB	Environmental Management Bureau
ENR	Environment and Natural Resources
ENSO	El Nino/Southern Oscillation
EO	Executive Order
ERDB	Ecosystems Research and Development Bureau
EO	Executive Order
EP	Exploration Permits
ERA	Environmental Risk Assessment
ERDIS	ENR R and D Information System
ERDS	Ecosystems Research and Development Service
ETGIS	ERDB Technology Generated Info System
EWS	Early Warning Systems
FAO	Food and Agriculture Organization
FITS	Farmers Information Technology Service
FORI	Forest Research Institute
FOWL	Forest and Other Wooded Land
FTAA	Financial or Technical Assistance Agreement
GHG	Greenhouse Gases
GIS	Geographic Information System
GMO	Genetically Modified Organism
GPOA	Goal-Purpose-Output-Activities
IAS	Invasive Alien Species
ICT	Information and Communication Technology
ICM	Integrated Coastal Management
IDC	Industries Development Corporation
IEC	Information, Education, and Communication
IPs	Indigenous Peoples
IPCC	International Panel on Climate Change
IRR	Implementing Rules and Regulations
IT	Information Technology
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature (now called the World Conservation Union)
IWRM	Integrated Water Resources Management
LAMP	Land Administration and Management Project
LGU	Local Government Unit
LMB	Lands Management Bureau
LMO	Living Modified Organism
LSC	Law of the Sea Convention
LRIS	Library Resource Information System
MFO	Major Final Output
MEA	Multilateral Environmental Agreement
MGB	Mines and Geosciences Bureau
MLC	Mining Lease Contract
MPSA	Mineral Production Sharing Agreement
MRF	Material Recovery Facility
NAMRIA	National Mapping and Resource Information Authority
NCBP	National Committee on Biosafety of the Philippines
NCR	National Capital Region
NGO	Nongovernment Organizations
NIPAS	National Integrated Protected Areas System
NLRC	Northern Luzon Research Center
NMC	National Mangrove Committee
NPC	National Power Corporation
NPCC	National Pollution Control Commission
NRDPP	National R and D Priorities Plan
NRMP	Natural Resources Management Program
NWRC	National Water Resources Council
NWMRC	Northwestern Mindanao Research Center
PAs	Protected Areas
PAMB	Protected Area Management Board
PAWB	Protected Areas and Wildlife Bureau
PCAMRD	Philippine Council for Aquatic and Marine Research and Development
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCCRD	Presidential Coordinating Council for Research and

	Development
PEP	Private Enterprise Partnership
PHES	Persistent Harmful Exotic Species
POs	Peoples Organizations
POP	Persistent Organic Pollutants
PPSRNP	Puerto Princesa Subterranean River National Park
REAS	Rare and Endangered Species
RDE	Research, Development, and Extension
SALT	Sloping Agricultural Land Technology
SEIA	Socioeconomic Impact Assessment
SEMRC	Southeastern Mindanao Research Center
SLRC	Sourthern Luzon Research Center
STF	Sewerage Treatment Facility
STP	Sewerage Treatment Plant
SUDECOR	Surigao Development Corporation
SWM	Solid Waste Management
TAP	Technology Assessment Procedure
TAPI	Technology Application and Promotion Institute
TDD	Technology Development Division
TG	Technology Generation
TSI	Timber Stand Improvement
TT	Technology Transfer
TTD	Technology Transfer Division
UNDP	United Nations Development Program
VA	Vulnerability Assessment
VRC	Visayas Research Center

CHAPTER 1

INTRODUCTION



the current framework affirms its planned activities as steps to generate information and develop technology useful in attaining the societal goal

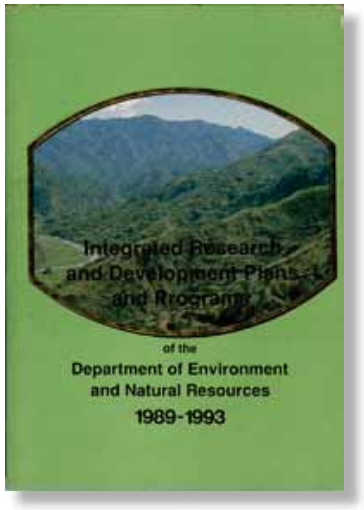
Introduction

The Ecosystems Research and Development Bureau (ERDB) is the principal research arm of the Department of Environment and Natural Resources (DENR) as mandated under Executive Order (E.O.) 192 issued by then President Corazon C. Aquino on 10 June 1987. EO 192 merged the Forest Research Institute (FORI) and the National Mangrove Committee (NMC). EO 192 mandates ERDB to:

- Formulate and recommend an integrated research program relating to Philippine ecosystems and natural resources such as minerals, lands, forests, as holistic and interdisciplinary fields of inquiry;
- Generate technologies and provide scientific assistance in the research and development of technologies relevant to the sustainable uses of Philippine ecosystems and natural resources;
- Provide technical assistance in the implementation and monitoring of the aforementioned research programs;
- Coordinate all technological researches undertaken by the regional offices, assess and translate all recommendable findings, and disseminate such findings to all possible end-users and clientele;
- Assist the Secretary in determining a system of priorities for the allocation of resources to various technological research programs of the department; and
- Assist the Secretary in the evaluation of the effectiveness of the implementation of the integrated program.

The institutionalization of ERDB transformed FORI's regional centers as Ecosystems Research and Development Service (ERDS) to become key operational units of DENR's regional offices involved in region-based research and development activities. With the emerging challenges of and gaps in ENR management raising pervasive concern on sustainability, ERDB's further institutionalization has enhanced its mandates with greater relevance by implementing extension projects and programs as viable opportunities for communities, industries, and the government evolve responsive measures in ensuring ENR sustainability.

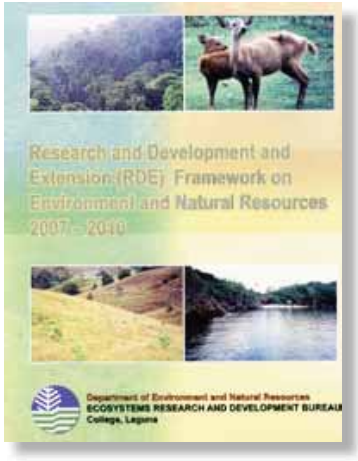
EO 192 establishes close working arrangements with the Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Department of Science and Technology



(DOST), Department of Agriculture (DA), and other research institutions, as ERDB leads in formulating the ENR RDE plans and programs.

The 2011-2016 RDE Framework precedes from the achievements made in the previous three-year framework (2007-2010) upon which cooperation and collaboration with the ENR stakeholders and RDE sector have been firmed up with continuing partnership. This partnership is organized along new R and D imperatives and emphasis and has established a network for resource-sharing schemes to optimize human and material inputs to RDE projects and programs.

The 2011-2016 RDE Framework embeds the templates of sector-based (e.g., forestry, lands, mines, water resources, *inter alia*) concerns, embodies the inputs of ENR stakeholders, and adheres to the policies and priorities set out by the government. ERDB started crafting the current framework late 2009 and subsequently, pursued its development through 2010 with a series of consultation workshops with the regional ERDS, DENR units, and other ENR stakeholders. These workshops were conducted to draw out inputs from all stakeholders. It was also conducted to build a springboard of partnership for all stakeholders to help pursue sustainable development of ENR.



The framework also incorporates crosscutting themes on climate change adaptation and mitigation; disaster risk management; biosafety and biosecurity; water resources; alternative and renewable energy sources; biotechnology; ecotourism; and technology transfer and extension. These themes pervade through some ecosystems and have manifested unique problems or potential growth opportunities that impact on ENR sustainability. These themes also generate concerns that are intrinsic with issues on technical capacities and technological resources that are being used to close the ENR development gaps or to secure the ENR productive balance.

It is by this measure in the 2011-2016 framework, that these themes see fundamental integration into the RDE designs of ecosystem-based or sector-oriented planned activities. Therefore, the current framework affirms its planned activities as steps to generate information and develop technology useful in attaining the societal goal of sustainable development and the RDE sector's vision, mission, and objectives.

Vision

Relevant research, development, and extension towards a healthy environment and sustainable natural resources for an improved quality of life.

Mission

To provide appropriate technology and information through research, development, and extension towards the enhanced productivity and sustainability of natural resources and protection of environment for the improvement of quality of life of the Filipinos.

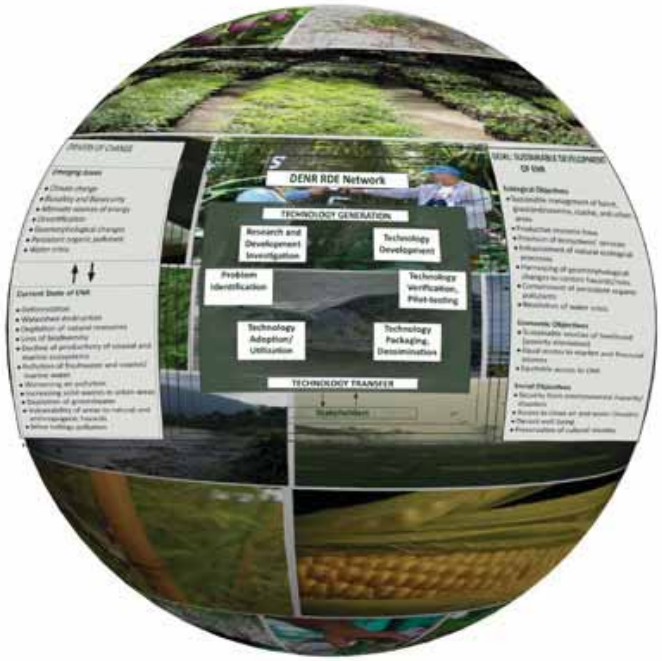
Objectives

This RDE Framework has the following objectives:

- Strengthen the conservation, protection, and rehabilitation of existing natural resources through the generation and transfer of ENR technologies;
- Generate and disseminate research-based information/database on the characterization/profiling of Philippine ecosystems and the assessment and valuation of the country's environment, natural resources, and biodiversity;
- Intensify the exchange of scientific information through a well-developed and dynamic mechanism using the most effective and practical techniques/strategies in information and communication technology (ICT);
- Formulate recommendations on effective standards for monitoring, review, and mitigation to improve environmental quality in the country; and
- Contribute to the upliftment of the quality of life of stakeholders through the transfer and adoption of generated ENR technologies.

RDE FRAMEWORK

CHAPTER 2



this framework is defined by RDE priorities set out by the government to shepherd the designing, implementation, and management of RDE activities as a unified effort

Guiding Principles/Methodology

The scope of this framework embraces the following sectors i.e., forestry resources and watersheds, protected areas and biodiversity, coastal and marine, environment, mines, lands, water resources including freshwater, and technology transfer and commercialization.

On the other hand, the coverage of this framework accounts sector-specific and problem-based RDE activities including those of the crosscutting themes. Largely, these activities as a scientific undertaking, is designed with an application module that precedes from the conduct of research to generate information and the synthesis of information to develop technology.

The coverage of this framework is defined by RDE priorities set out by the government to shepherd the designing, implementation, and management of RDE activities as a unified effort to help attain ENR sustainability and productivity.

The ENR RDE projects and programs of the DENR research sector are aligned with the National R and D Priorities Plan (NRDPP) on Environment and Natural Resources (ENR), 2010-2016. The NRDPP identifies the ENR as one of the of the 10 priority thrusts of the five-year plan. The Presidential Coordinating Council for Research and Development (PCCRD) formulated the five-year plan.

The NRDPP streamlines government R and D efforts and provides guidance for allocating and using of public R and D funds. The PCCRD, a multi-agency council, is chaired by the President of the Philippines and co-chaired by the DOST. This inter-agency council is created under EO 604 dated 16 February 2007.

The NRDPP aims to strengthen links of the government R and D institutions, nongovernment research/science organizations, and the business sector.

The growth, structure, and composition of a logged-over residual dipterocarp forest within an Integrated Forest Management Area (IFMA) area in Aurora Province is being monitored for policy recommendation.

The NRDPP applicable to ENR management include specific RDE areas. Under the NRDPP ENR thrust, the priority concerns are:

- forest production, utilization and protection;
- conservation and management of marine and coastal resources;
- treating liquid wastes, emphasizing on improving quality of water; management and disposal of solid wastes, including toxic and hazardous wastes; management of freshwater and improving its productivity; and
- climate change adaptation; and climate change risk reduction.

On the other hand, forecasting and early warning systems and monitoring and rapid assessment systems are R and D priorities under disaster mitigation and management.

The Energy R and D Priorities include renewable energy technologies; energy efficiency, conservation and management; and new energy resources. For biotechnology, included are conventional biotechnology involving tissue culture, fermentation technology and enzyme technology, and conventional biotechnology involving waste management.

The conservation and management of marine and coastal resources is among the priorities of the 2010-2016 National R and D Priorities Plan.

Conceptual Framework

The 2011-2016 ENR-RDE Framework is based on the GPOA (*Goal-Purpose-Output-Activity*) logical framework and adopts the DENR's template on General Plan of Action. It reflects hierarchical values and inputs that congruently support actions that culminate to the attainment of societal goal. The framework embodies three goals. Attendant upon the implementation of RDE, the research sector's goal is the attainment of an enabling environment that will establish the capacities for intervention such as in rehabilitating degraded areas, regulation such as in implementing resource-use standards, and adherence to good and sustainable practices in using ENR. The confluence of these three capacities becomes the framework's intermediate goal where the DENR aims to attain the sustainable management of ENR that creates opportunities for enhancing ENR and harmonizing socioeconomic activities with sustainability. This intermediate goal serves then as the trajectory for achieving the final development goal where the quality of life becomes improved and sustainable development stands as practice on a long-term basis. Figure 1 illustrates the vertical progression of GPOA where the research sector activities serve as turnkey inputs for achieving succeeding outputs and goals.

The DENR's Logical Framework has three major final outputs (MFOs). These are:

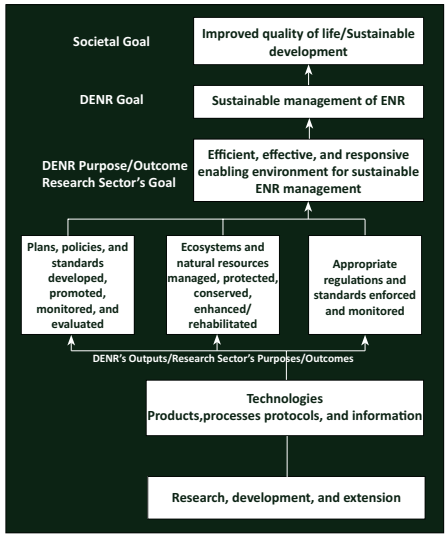


Fig. 1. A conceptual framework of research, development, and extension and its contribution to the goal of the DENR and of the society.

- Plans, policies, and standards developed, promoted, monitored, and evaluated;
- Ecosystems and natural resources managed, protected, conserved, enhanced and degraded ones rehabilitated; and
- Appropriate regulations and standards enforced and monitored.

The research sector contributes vital inputs to help achieve the MFOs in the form of technologies, products, processes or protocols, and validated information. These contributions comprise the research sector's output of technologies and are a resource mix that crucially defines the synergies for developing, implementing, and managing ENR policies, programs, and projects to achieve ENR sustainability.

Figure 2. Operational framework in implementing the DENR RDE Agenda.

The detailed RDE conceptual framework (Figure 2) shows graphically the dynamic interactions and interconnections of various drivers of change and/or factors that exert some degree of influence (high or low; strong or weak) on the operationalization of the DENR RDE agenda.

The conceptual framework places Technology Generation (TG) and Technology Transfer (TT), two main functions of the DENR research sector, as the central focus of RDE operation. TG and TT are in tandem; their usefulness will only be felt once a generated technology or information is utilized and adopted by target clientele through a well-defined technology transfer strategy or strategies. Technology and information are nothing unless they are translated into actual outputs. For instance, soil and water conservation technology like Sloping Agricultural Land Technology (SALT) will only be useful when it helps decrease soil erosion and improve the farming system of an upland area, thus alleviating the living condition of the concerned upland farmers.

In the course of ENR technology generation and its subsquent transfer to target clientele, the following specific RDE activities are normally undertaken:

- Problem identification involves situation analysis of the existing environmental condition and the identification of needs and opportunities for its conservation and management. Problem identification should take into consideration various local, national, and international issues and policies and must be relevant to the attainment of the mission and vision of the research sector and DENR as a whole.

- R and D investigation is the conduct of actual R and D itself. This shall be done through scientific observation, measurement and experimentation using various parameters and approaches applicable to the existing situation. R and D activities shall be consistent with the goals and objectives of sustainable development.

- Technology development is the actual generation of technology and the distillation of data and information for the development of innovative tools and techniques for the improvement of ENR.

- Technology verification and pilot-testing involves the initial application of generated technology through trials and experimentation. This also includes the replication of technology in other areas or in other condition.

- Technology packaging and dissemination is the stage where technology is transformed into extension materials with the main intention of instilling awareness and interest among clientele.

- Technology adoption and utilization is the final stage of the R and D cycle where the generated technology is finally utilized and adopted by target clientele either for commercialization or domestic use.

The tasks to generate and transfer technologies are the mandated functions of the DENR RDE network, composed of the ERDB and its field counterparts, the region-based ERDS. To some extent, other sectors of the DENR (e.g., mines, environment, lands, forest, and protected areas) may also assist in the performance of these tasks, although they actually form the major part of the ENR technology users. Feedback on

the relevance and effectiveness of generated and transferred technologies, as well as data and information, are provided by other DENR sectors, the stakeholders, and other clientele groups. From this feedback, new priority thrusts and programs on ENR are formulated, which are subjected later to scientific investigation. It is of utmost importance that in the performance of this scientific investigation, a multiscale approach must be applied. ENR is such a complex subject, and therefore an equally multidisciplinary team should be put on board.

The process of TG and TT is usually implemented at the national and local levels. However, there are cases that regional and global joint R and D programs may also be undertaken, particularly when such programs call for meeting some of the Philippine commitments to international agreements and protocols, expanding research operations beyond national concerns.

consideration should be accorded to the current "drivers of change" or the existing condition of the environment... continuing forest denudation; watershed destruction; depletion of natural resources; loss of biodiversity; declining productivity of coastal and marine areas; pollution of freshwater, as well as coastal and marine areas; worsening condition of air quality; increasing solid waste, particularly in urban areas; and decreasing water supply

Drivers of Change

The factors that "drive change" or influence the operationalization of RDE programs and activities must be properly identified, understood, and measured in differing degrees of accuracy. The process must be anchored on the mandate, goals, vision, and mission of the DENR to make it more viable and relevant in pursuing the goal of sustainably managing the country's environment and natural resources. These factors influence, if not dictate, the kinds of RDE programs that the research sector needs to prioritize and pursue.

The drivers of change are viewed at two levels: the emerging issues and the current state of the environment. These drivers of change are interacting with each other posing some degree of influence (either positive or negative) on one another.

Emerging Issues

RDE must be sensitive on the emerging issues and concerns that affect the environment for their impacts cross beyond national scope and interest. They have global implications and therefore RDE programs and projects must anticipate how these emerging problems could be mitigated, if not integrated, in the overall development and planning processes, without necessarily discounting their global relevance and importance. These emerging drivers of change are: climate change and global warming; biosafety and biosecurity; alternative and renewable sources of energy; land degradation, desertification; sustainable tourism or ecotourism; change in geomorphologic structure; persistent organic pollutants; and many others. Individually or collectively, they need to be incorporated in charting the direction for RDE activities of the Department.

While it is accepted that these emerging issues exert influence on the prioritization and operationalization of RDE programs, it is necessary that, in return, results and outputs of RDE help mitigate or address the negative impacts brought about by these emerging problems on the environment. For instance, since biosecurity is at the top of international biodiversity concerns, local efforts on RDE must be tailored and implemented in such a way that relevant and timely technologies are generated to help secure sensitive and threatened biodiversity species, thus, contributing in the global efforts to protect and conserve biodiversity.

Current State of the Environment

Equal consideration should be accorded to the current "drivers of change" or the existing condition of the environment in the formulation of RDE programs that have direct, local, and immediate application to the call of time. Attention should be focused on: continuing forest denudation; watershed destruction; depletion of natural resources; loss of biodiversity; declining productivity of coastal and marine areas; pollution of freshwater, as well as coastal and marine areas; worsening condition of air quality; increasing solid waste, particularly in urban areas; decreasing water supply brought about by the depletion of groundwater and other sources; vulnerability of some areas to natural and anthropogenic hazards; and many more. The current state of the environment must also be used as basis in setting RDE priority thrusts and programs, and in return, research outputs must address and/or contain the negative effects brought about by these current destructive practices.

Goal: Sustainable Development of ENR

The operational framework on implementing the DENR RDE Agenda holds for its goal the sustainable development of ENR. This goal covers three interrelated objectives namely, ecological, economic, and social to establish comprehensive and holistic development interventions. It is of primary importance that these sets of objectives are underpinned in planning, implementing, and managing RDE activities to ascertain that the interventions introduced will result into a synergistic impact of restoring degraded ENR while it continually provides the capital goods needed for economic activities and accrue into beneficial conditions of living a healthy and decent life for all.

Under the ecological concerns, the development interventions are aimed at establishing sustainable management of ecosystems over which their resource bases are:

- restored to their productive balance;
- improved to continually provide ecological services;
- enhanced natural ecological processes;
- contained from posing risks and hazards due to geomorphological changes;
- free from persistent organic pollutants; and
- facing no threat of water crisis.

While the ecological objectives are generally commodity-oriented, these play out unique influences on the economic and social behavioral patterns of ENR stakeholders. Thus, the framework's economic objectives are to implement interventions that:

- provides for sustainable livelihood to reduce poverty;
- creates equal access to market and financial sources to support build up of livelihood activities into formalized enterprises (e.g., cooperatives among farmers); and
- cultivates equitable access to ENR to discourage resource-use conflicts.

The social objectives on one hand closely correlate with the ecological and economic objectives. As resource rehabilitation and equity become founded, the social objectives reflect dependent qualities that arise as consequences of the attainment of the ecological and economic objectives.

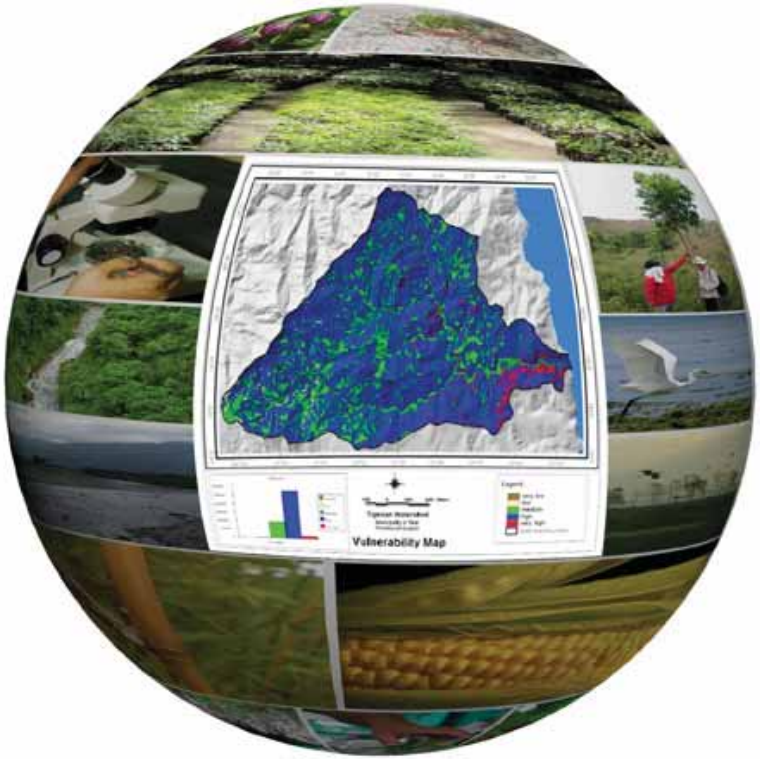
For illustration purposes however, it is important that upon putting back in place the productive balance of an ecosystem and installing equitable access to its resources, the public good becomes better served as the social objectives set forth in this framework :

- security from environmental hazards/ disasters;
- access to clean air and water;
- decent well-being; and
- preservation of cultural identify.

It is on this account that the framework's goal is set as comprehensive and holistic.

CHAPTER 3

RDE SECTORAL CONCERNS



environmental degradation has spawned adverse impacts on ENR productivity, public health, economic and livelihood activities, biosecurity, and sustainability of the environment to support life as a whole

- Secretary Paje

Forest Resources and Watersheds

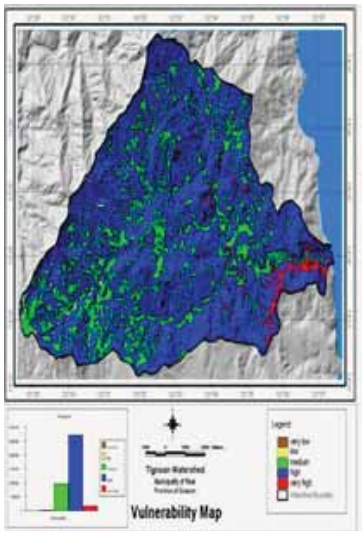
State of the Art (2007-2010)

Despite the rapid decline in forest cover, the forests continue to serve their production and protection functions. At present, the forest cover is estimated at 7.68 million hectares only or 24.27% of the country's total land area (FMB, 2008). And with the growing concern over the increasing levels of carbon dioxide (CO_2) in the atmosphere which exacerbates global warming and climate change, the importance of forest and conservation measures including concomitant RDE activities has been even more emphasized.

The *Revised Master Plan for Forestry Development* (2003) identified major issues, problems, and constraints in implementing the 1*990 Master Plan for Forestry Development*. On R and D, the following were cited: unscientific management of natural forest resource; undefined areas of protection and production forests; wasteful utilization and inadequate value addition; neglect of nontimber forest products; serious lapses in plantation development; weak information, education, and communication, and training programs; and lack of credible monitoring and evaluation system.

In support to the forestry sector, various studies and investigations were conducted on natural and plantation forests during the period 2007-2010.

In the natural forests, vulnerability assessments of 43 critical watersheds (Table 1) covering an aggregate area of 950,730 hectares were conducted. This is an approach or tool of identifying and determining the degree to which a watershed is susceptible to adverse effects to natural and anthropogenic hazards. Municipalities and barangays inside the watershed which are vulnerable to landslides, soil erosion, flooding, water pollution, forest grass fires, and biodiversity loss were identified and the interventions needed to address such problems were formulated. Results were presented to the forestry sector to serve as input in formulating and submitting an integrated watershed plan to the concerned LGUs for consideration in preparing their comprehensive land use plans.



A landslide vulnerability map of Tignoan Watershed in Real, Quezon, 2007

A study was undertaken to determine the growth, structure, and composition of logged-over residual dipterocarp forest by establishing permanent sampling plots in two licensed areas (Surigao Development

Billboard indicating the location of one plot under the *Determination of growth, structure and composition of third-growth dipterocarp forest Project* in the licensed area of SUDECOR, Surigao del Sur.

Measurement of trees within the study plot in SUDECOR, Surigao del Sur.

A 10-year old (2007) mahogany plantation in Ayala, Zamboanga City.

Corporation [SUDECOR] in Surigao del Sur and Industries Development Corporation [IDC] in Aurora Province). Now on its sixth year, the study would eventually come up with growth prediction models for the dipterocarps and nondipterocarps. Results from this study will serve as input in determining future yields/cuts from the production forest. In terms of species composition, the stand in SUDECOR was 28% dipterocarps, 36% in IDC.

On tree plantations, biomass prediction equations and carbon contents of six species namely: bagras (*Eucalyptus deglupta*), falcata (*Falcataria mollucans*), mahogany (*Swietenia macrophylla*), malapapaya (*Polyscias nodosa*), mangium (*Acacia mangium*), and yemane (*Gmelina arborea*) were determined. Prediction equations using allometric models were developed for estimating the fresh and ovendry weights of the whole tree and its components using easily measured variables such as diameter and height.

In line with the concern of improving the productivity of plantations using quality planting materials, 88 existing and new seed sources of forest tree species were verified and assessed nationwide (Table 2). The seed stands, comprising 87 species (Table 3) belonging to 28 families (Table 4) contained over 4,300 seed trees (Table 5). Data on height, diameter, phenological calendar, geographical location and other pertinent information were databased and plotted in thematic maps to facilitate identification, location, and extraction of desired information on these trees.

Macropropagation using rooted cuttings were successfully determined for 15 indigenous premium and endangered species including narek (*Hopea cagayanensis*), batikuling (*Litsea leytensis*), narig (*Vativa mangachapoi*), molave (*Vitex parviflora*), guijo (*Shorea guiso*), and dungon (*Tarrietia sylvatica*). These findings would help facilitate the production of quality planting materials to propagate and conserve the species (Table 6). A one-hectare trial planting of cloned dipterocarp species was established in Negros Occidental (Don Salvador Benedicto) in 2009 as a show window and possible seed source of dipterocarps.

To upgrade the quality of seed stands as source of planting stocks for breeding and propagation, provenance/progeny trials of narra, molave, and yemane were established in Region 4A (Quezon), Region 7 (Bohol), and Region 11 (Davao). The best provenance is now being monitored.

As a conservation strategy, a 2-hectare pilot demonstration area was established in Biñan, Laguna using 8 indigenous species and application of mycorrhizal isolate and compost. The species are: ipil (*Instia bijuga*), akleng parang (*Albizia procera*), bitaog (*Calophyllum inophyllum*), batino (*Alstonia macrophylla*), dungon (*Tarrietia sylvatica*), molave (*Vitex parviflora*), bitaog, malapapaya (*Polyscias nodosa*) and narra (*Pterocarpus indicus*). A living germplasm bank for wildfood and other fruit-bearing species was established in Cordillera Administrative Region (CAR) for the *ex situ* conservation of the species.

Bamboo nurseries for commercial and ornamental bamboo species were established and are now being maintained in selected sites (Laguna, Batangas, Pampanga, and Pangasinan) to demonstrate the effectiveness of Science and Technology (S&T) in improving the quality of bamboo planting stocks and the profitability of establishing a commercial bamboo nursery.

Workers potting bamboo cuttings in Brgy. Maravilla, Nagcarlan, Laguna.

An established bamboo nursery in Brgy. Bolbok, Lipa City, Batangas.

Routine laboratory procedures for determining genetic variation within and among population of narra, Benguet pine (*Pinus kesiya*), molave, limuran (*Calamus ornatus* var. *philippinensis*) and tagiktik (*Calamus filispadix*) were conducted using isozyme analysis. Isozyme analysis of five provenances of narra showed that Cebu has high genetic diversity thus a good source of quality seeds for plantation development. Limuran leaf samples randomly

collected from Camarines Norte, Bataan, and Quezon revealed low genetic variation in Quezon and those in Bataan as the most diverse, making it the most probable good source of quality seeds.

The four-year (2007-2010) project entitled *Demonstration and Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN-member Countries* funded by the International Tropical Timber Organization (ITTO) was implemented in collaboration with the UP Los Baños-College of Forestry and Natural Resources (UPLB-CFNR) and Forest Product Research and Development Institute (FPRDI). A total of 60 hectares rattan pilot demonstration areas has been established in the Philippines. Experiences and outputs of the project were presented during the Regional Rattan Conference on 29 August 2010 to 1 September 2010, in Makati City. On the same event, two publications on rattans: A *Field Guide to Philippine Rattans* and *The ASEAN Rattans* were launched.

The study on silvicultural management regimes for the sustained production of rattan, moderate harvesting intensity (30 percent) of 20-year old palasan (*Calamus merrilli*) plantations in Baybay, Leyte and Malaybalay, Bukidnon gave positive effects on the production and growth of suckers and canes after four years since light has penetrated the forest floor due to the opening of the canopy. Average annual growth increment of matured canes is 3.0 meters to 3.25 meters in Baybay, Leyte and 3.5 meters to 3.75 meters in Malaybalay, Bukidnon. As for mounding (mounding clumps with topsoil and dried litterfall) treatments in Leyte, mounding did not have a significant effect on cane growth and sucker production while mounded rattan plants in Bukidnon, showed otherwise. This could be attributed to the difference in physical soil properties, terrain, and rainfall patterns in the areas.

The best and most compatible malapapaya-agroforestry production technology package under a coconut-based farm was undertaken in two sites: Luisiana, Laguna and Pagbilao, Quezon. Six combinations of malapapaya under coconut plantation and horticultural crops were tested in each of the 1.2-hectare pilot area established in these two sites. So far, banana and gabi were found suitable intercrops.

To have insights on the reforestation projects of the government, three old government reforestation projects were initially sampled. These were the *Paraiso Reforestation Project* in Piddig, Ilocos, Norte; *Nassiping Reforestation Project* in Gattaran, Cagayan; and *Marinduque Reforestation Project* in Boac and Torrijos, Marinduque. The number, composition, and volume of the mature plantation species and the associated tree species in each project were determined. Recommendations on some aspects of management for the sites were forwarded to the DENR, Forest Management Bureau (FMB), and the concerned regional offices.

Issues and Concerns

The forests like other natural resources continue to be confronted with issues and problems that need to be addressed lest these resources become depleted. These relate to the following:

- Decreasing forest quality and productivity
  - Poor quality planting materials being used in forestation
  - Low survival of planted seedlings
  - Poor tree growth performance in forestation sites
  - Insufficient plantation development and nonadoption of appropriate silvi-cultural management
  - Species-site mismatching in forestation areas
  - Unproductive upland areas
- Depletion of remaining forestlands and forest cover
  - Encroachment and conversion of forestlands to other uses
  - Pests and diseases infestation
  - Soil erosion and landslides
  - Loss of forest biodiversity
- Limited baseline information and database on forest resources in support to policy and decision-making, to consider the changing climate
  - Lack of reliable data and information on existing/available forest resources
  - Limited data and information on the use of alternative and renewable sources of energy
  - Inadequate data and information on carbon sequestration rates/densities/sinks of forest stands and drivers of deforestation and forest degradation in the light of climate change
- Unstable policy environment impinging the sustainable use of forest resources

Gaps and Challenges

Based on the issues, problems, and constraints identified in the implementation of the *Forestry Master Plan*, the following may be considered gaps and, consequently, challenges for the government and other stakeholders to address:

- Scientific management of forest resources;
- Delineated areas of protection and production forests;
- Exploration and use of other nontimber forest products to beef up the raw material needs of the furniture and cottage industries;
- Appropriate plantation development practices;
- Appropriate species-site selection procedures and consideration for wood quality or enduse;
- Complete inventory of existing forest plantations and reliable growth data;
- System of natural resources accounting;
- System for criteria and indicators for sustainable management;
- Strong and effective information, education, and communication (IEC), and training programs; and
- Effective monitoring and evaluation system.

Researchable Areas

Researches in the following areas are deemed necessary to generate information to address the foregoing issues and concerns:

1. Tree improvement and production of genetically superior planting materials of priority species including biotechnology;
2 Species-site compatibility;
3. Appropriate plantation development practices;
4. Exploration/utilization of economically important nontimber species;
5. Integrated pest management;
6. Lands and degraded areas rehabilitation;
7. GIS-based mapping and geo relational information system/database of forest resources;
8. Forest resource valuation;
9. Impacts of climate change on flooding and landslides in watersheds;
10. Vulnerability assessment of critical watersheds;
11. Carbon sequestration rates, densities and sink;
12. Drivers of deforestation and forest degradation;
13. Production, establishment and management of biofuel plantations; and
14. Forest policy review and assessment.

Table 1. Critical watersheds assessed.

REGION	WATERSHED	AREA COVERED (hectare)	LOCATION (Province: Municipality, Barangay)
ERDB	Pudong Watershed Tignoan Watershed Makiling Watershed	2,395 8,710 5,853.48	Benguet: Kapangan Quezon: Real Laguna: Bay, Calamba, Calauan Batangas: Sto. Tomas
CAR	Bayudan Watershed Camcamalog Watershed Lusuac Watershed Bued Watershed	354.96 583.62 492.33 14,302	Mt. Province: Bauku, Brgy Bila Kalinga: Pinukpuk, Brgy. Camalog, Mapaco and Cawagayan Abra: Peñarrubia, Brgys. Lusuac, Patiao, Sta. Rosa and Damayco and a portion of a barangay within Bucay Benguet: Tuba (Camp 1-6, Sto. Tomas, Poblacion); Baguio City (Camp 7, Kias, Loakan, Hillside, Sta. Scholastica, Camp 8, San Vicente, Poliwes, Campo Sioco, Bakakeng, Dontongan; Itogon (Ampucao)
1	Buaya River Watershed Lower Agno River Watershed	24,138 9,596	Ilocos Sur: Sigay, Sta. Cruz, Gregorio del Pilar and Salcedo Pangasinan: San Nicolas and Natividad
3	Pantabangan Watershed (Bunga sub catchment) Pinulot Watershed	9,893.975 10,514.87	Nueva Ecija: Carranglan Bataan: Dinalupihan, Brgy. Pinulot
NCR	La Mesa Watershed	2,659.59	Rizal: San Mateo, Rodriguez NCR: Caloocan City; Quezon City, and Novaliches
4A	Lagnas Watershed Ylang-Ylang Watershed Balanac Watershed Binahaan Watershed Mabacan Watershed Yaganak Watershed	6,224 5,714.11 13,015.96 1,489.39 4438 2,264.11	Quezon: Candelaria, Dolores, Tiaong Cavite: Silang, Dasmariñas, Gen. Trias, Imus Laguna: Magdalena, Majayjay, Luisiana Quezon: Pagbilao Laguna: Calauan Quezon: Calauag, Lopez, and Guinyangan

Table 1. *Continued...*

REGION	WATERSHED	AREA COVERED (hectare)	LOCATION (Province: Municipality, Barangay)
4B	Kisloyan Sub Watershed	1,435.9	Occidental Mindoro: Sablayan Oriental Mindoro: Victoria
5	Yabo-Naga Watershed Bito Watershed	5,518 4,023.47	Camarines Sur: Pili and Naga City Masbate: San Jacinto and San Fernando (Ticao Island)
6	Mambusao Watershed Bago River Watershed Panakuyan Watershed	44,820 61,926 5,090	Capiz: Sigma and Mambusao Negros Occidental: San Carlos City, Talisay City, Bago City, and Municipalities of Calatrava, Don Salvador Benedicto, and Murcia Antique: Minaa, Aparicio, Malindog, Ibajay, Maadios, San Joaquin, Sta. Ana, Perfecta, Badiangan, Aracay, Napuid Aklan: San Jose, Agdaguyan, Maloco, and Mambusao
7	Luyang Watershed Mananga Watershed Guinabasan Watershed Hilabangan Watershed	5,537.98 7, 877 12,639.448 18,435	Cebu: Carmen Cebu: Talisay City Cebu: Asturias and Tuburan, and some portions of Danao Negros Oriental: Ayungon, Tayasan, and Himalalud
8	Taft Watershed Daguitan Watershed	55,785.31 28,385.88	Samar: Hinabangan Leyte: Borawen, La Paz, Julita, and Dulag
9	Salug-Diut Watershed	15,156.151	Misamis Occidental: Bonifacio and Don Victoriano Zamboanga del Sur: Tambulig, Aurora, Mahayag, Molave, Ramon Magsaysay, and Josefina

Table 1. *Continued...*

REGION	WATERSHED	AREA COVERED (hectares)	LOCATION (Province: Municipality, Barangay)
10	Bubunawan Watershed	26,977	Bukidnon: Baungon, Nicdao, Liboran, Poblacion: Salimbalan, and San Vicente; Libona, Pualas, Gango, Kinawe, Kiliog, Poblacion, Nangka, Laturan, Pongol, Kapehan, Sil-ipon
	Dioyo Watershed	10,939.754	Misamis Occidental: Conception, Sapang, Dalaga, Calamba, and Baliangao
	Liangan Watershed	23,034	Lanao del Norte: Bacolod, Magsaysay, Maigo, Munay, Tangkal Lanao del Sur: Madalum
	Cugman Watershed	10,250	Cagayan de Oro: Cugman, Tablon and F.S. Catanico Bukidnon: Libona, Sta. Fe, Palabucan, Crossing, San Jose, Poblacion, Maambong, Gango, Kiliog, Laturan, and Sil-ipon Bukidnon: Manolo Fortich
11	Tagum Libuganon	142,790	Davao del Norte: Kapalong and Talaingod
	Saug Watershed	99,871	Davao del Norte: Laak, Compostella Valley, New Corella, San Isidro, and Asuncion
12	Upper Allah (Parcel I)	59,276	Sultan Kudarat, Sarangani, and South Cotabato
	Kabulnan Watershed	12,667.46	Sultan Kudarat and South Cotabato
	Upper Allah (Parcel II)	37,464.2	Sultan Kudarat: Bagumbayan South Cotabato: Surallah, Lake Sebu, and Sto. Niño
	Banga Watershed	33,365	South Cotabato: Tiboli, Banga, Surallah, Tupi, and, Koronadal City
13	Casilayan Watershed	40,396	Agusan del Sur: Talacogon, La Paz, and San Luis
	Ojot Watershed	78,800	Agusan del Sur: Esperanza and San Luis Agusan del Norte: Buenavista and Las Nieves

Table 2. Seed sources with existing and newly identified stand/seed trees.

STAND TYPE BY REGION		Stem Count	Ave. DBH	Ave. TH
Region	**Existing**	**2,497**	**48.07**	**21.54**
CAR	BENGUET, Tuba, (Kennon Road)	7	92.71	16.43
1	ILOCOS NORTE, Nueva Era, Poblacion, (*Nueva Era Reforestation Project*)	*25*	*36.08*	*24.52*
	ILOCOS NORTE, Pasuquin, Tadao, (Camp Site, PFDPIN)	42	40.14	17.15
2	NUEVA VIZCAYA, Diadi, Bugnai	62	36.09	24.82
	NUEVA VIZCAYA, Diadi, San Luis	630	37.16	19.91
3	NUEVA ECIJA, Carranglan, Puncan	24	60.38	8.17
	PAMPANGA, (Airforce City, Clark Field)	14	222.79	19.64
	PAMPANGA, Arayat, Banio, San Juan	13	143.54	28.46
4-A	CAVITE, Ternate, Sapang, Malauyas (Mt. Palaypalay Nationall Park)	147	26.20	19.22
	QUEZON, Dolores, Kinabuhayan	95	142.33	26.40
	QUEZON, Lucban, Palola	31	41.94	12.58
4-B	OCCIDENTAL MINDORO, Mamburao, Sta. Cruz	31	33.13	10.67
	OCCIDENTAL MINDORO, Sta. Cruz, Tagbungan	33	127.15	13.03
	PALAWAN, Puerto Princesa City, Sta. Monica, Bagumbayan	45	60.69	19.66
5	CAMARINES SUR, Ocampo, Gatbo	36	56.83	14.31
	CAMARINES SUR, Lupi, Napolidan,(Pili Clonal Orchard)	28	35.64	7.00
	SORSOGON, Prieto Diaz, Diamante, Sabang	50	14.94	6.64
5	ALBAY, Bacacay, Iraya, (Mangrove Experimental Forest)	41	11.66	7.56
6	AKLAN, Kalibo, New Buswang,	48	12.29	11.99
	ILOILO, Dingle, Putian, Bulabog	11	28.18	18.64
	ILOILO, Dingle, Putian, Bulabog (Bulabog Putian National Park)	32	23.60	28.38
7	CEBU, Minglanilla, Camp 7	309	50.56	27.23
	CEBU, Talisay City, Juanay	64	37.06	17.81
	SIQUIJOR, Maria, Bogo	31	45.95	15.85
8	EASTERN SAMAR, Quinapondan, Buenavista	95	43.24	23.43
9	ZAMBOANGA DEL NORTE, Dipolog City, Cogon (*Cogon Reforestation Project*)	10	63.30	20.75
	ZAMBOANGA DEL NORTE, Sergio Osmeña, Buenavista	2	82.50	22.00

= Yellow rows indicate a seed source has both existing and newly identified seed trees.

Table 2 *Continued...*

STAND TYPE BY REGION		Stem Count	Ave. DBH	Ave. TH
9	ZAMBOANGA DEL SUR, Tukuran, Baclay (Baclay Reforestation Project)	4	47.50	16.25
	ZAMBOANGA DEL SUR, Zamboanga City, Dulilan Narra Outpost (Zamboanga City Water District)	37	90.33	28.21
	ZAMBOANGA DEL SUR, Zamboanga City, Upper Baluno (Baluno Natural Park)	6	104.50	32.50
	ZAMBOANGA DEL SUR, Zamboanga City, Upper Baluno (*Baluno Reforestation Project*)	7	48.00	22.29
	ZAMBOANGA SIBUGAY, Buug (Buug Biotic Park)	4	95.00	27.50
10	BUKIDNON, Impasugong [CEDAR (formerly *Impalutao Reforestation Project*)]	18	58.23	31.56
	BUKIDNON, Impasugong, Impalutao [CEDAR (formerly *Impalutao Reforestation Project*)]	32	18.69	16.95
	BUKIDNON, Impasugong, Impalutao (*Impalutao Reforestation Project*)	174	44.95	32.53
	BUKIDNON, Kitaotao, East Poblacion	88	37.69	21.35
11	COMPOSTELA VALLEY, Nabunturan	25	56.40	20.88
	DAVAO DEL SUR, Davao City, Mintal, New Loon	74	53.39	20.64
13	AGUSAN DEL SUR, San Francisco, Mt. Diwata	5	100.40	30.60
	SURIGAO DEL SUR, Bislig City	49	56.67	30.57
	SURIGAO DEL SUR, Bislig City, Maharlika	18	84.12	30.39
Region	**New**	**1,851**	**38.88**	**15.78**
CAR	BENGUET, Acop, Tublay, Daclan	7	94.71	10.57
	BENGUET, Tuba, Sablan	8	71.25	10.41
1	ILOCOS NORTE, Batac, Payao (MMMSU-Batac)	50	39.32	25.41
	ILOCOS NORTE, Batac, San Mateo, Lubbot	48	20.68	21.07
	ILOCOS NORTE, San Nicolas, San Agustin	5	9.80	23.80
	PANGASINAN, Mangatarem, Malabobo (Manleluag Spring Protected Landscape)	75	39.66	32.88
4-A	BATANGAS, Logo, Sawang	76	47.87	10.97
	BATANGAS, San Juan, Imelda	67	24.22	12.45
	BATANGAS, San Juan, Laiya	50	31.90	13.18
	QUEZON (Quezon Protected Landscape)	15	52.67	27.67
	QUEZON, Lucban, Palola	59	36.62	7.90
	QUEZON, Lucena City, Silangan, Mayao (Ouan's Worth Farm)	20	93.00	2.40
	QUEZON, Pagbilao, Malicboy	107	41.69	7.45
4-B	OCCIDENTAL MINDORO, Mamburao, San Luis, Tagum	29	21.66	15.30
5	ALBAY, Guinobatan, Agpay	14	34.40	16.90

= Yellow rows indicate a seed source has both existing and newly identified seed trees.

Table 2 *Continued...*

STAND TYPE BY REGION		Stem Count	Ave. DBH	Ave. TH
5	ALBAY, Legazpi City, Taysan, Malangka	34	34.12	16.35
	CAMARINES SUR, Lupi, Napolidan (Pili Clonal Orchard)	105	34.27	7.04
	CAMARINES SUR, Lupi, Napolidan [Pili Clonal Orchard (roadside)]	49	24.88	7.76
	SORSOGON, Bulusan (Bulusan Volcano Natural Park)	47	95.00	16.30
	SORSOGON, Prieto Diaz, Perlas	46	78.67	12.78
6	AKLAN, Malay, Nabaoy	32	22.57	20.61
	ANTIQUE, Tibiao, Tigbaboy	25	47.85	21.89
	GUIMARAS, Jordan, Espinosa, Cabaling	25	18.00	20.10
	ILOILO, Lemery, San Jose	23	8.13	10.78
	ILOILO, Leon, Omambong	34	28.94	17.08
	ILOILO, Miag-ao (UPV)	60	21.68	10.17
	NEGROS OCCIDENTAL, Bacolod City, Alangilan	35	9.79	14.99
	NEGROS OCCIDENTAL, Sagay City, Bulanon, Isla Perlas	50	9.40	5.30
7	CEBU, Alcoy, Nug-as	25	11.82	10.34
	CEBU, Cebu City, Cantipla	29	32.53	20.74
	CEBU, Tabuelan, Katigbawan, Dalinson	9	31.66	15.33
	CEBU, Talisay City, Manipis, Juanay	21	72.93	17.00
	NEGROS ORIENTAL, Mabinay, Bulwang (*Mabinay Reforestation Project*)	26	44.26	25.65
	SIQUIJOR, Maria, Bogo	35	28.47	11.47
	SIQUIJOR, Maria, Liloan, Umpas	29	18.38	16.71
	SIQUIJOR, Siquijor, Luyang	25	11.82	12.98
8	LEYTE, Baybay City, Punta, Lawis	30	9.16	4.14
	LEYTE, Baybay, Kilim, Cienda	62	80.71	22.98
	LEYTE, Mahaplag, Magsuganao	53	41.49	20.19
	SOUTHERN LEYTE, Silago, Imelda	62	49.75	23.10
9	ZAMBOANGA DEL SUR, Zamboanga City, Dulilan, Narra Outpost (Zamboanga City Water District)	25	81.80	29.80
	ZAMBOANGA DEL SUR, Zamboanga City, Pasonanca (Pasonanca Park)	25	78.88	17.60
	ZAMBOANGA DEL SUR, Zamboanga City, San Ramon (PCA Compound)	25	43.60	13.95
11	COMPOSTELA VALLEY, Nabunturan	22	40.64	24.23
	DAVAO DEL SUR, Davao City, Mintal, New Loon	53	27.25	22.02
13	AGUSAN DEL NORTE, Butuan City, Mandakpan	50	28.14	17.86
	SURIGAO DEL SUR, Bislig City	50	46.84	21.68
Grand Total		**4,348**	**44.16**	**19.09**

= Yellow rows indicate a seed source has both existing and newly identified seed trees.

Table 3. Identified species nationwide.

	Species	Stem Count	Ave. DBH	Ave. TH
1.	Agoho / Beach agoho (*Casuarina equisetifolia*)	36	10.52	15.10
2.	Akle (*Albizia acle*)	6	72.33	20.83
3.	Akleng parang (*Albizia procera*)	13	36.59	32.14
4.	Almaciga (*Agathis philippinensis*)	32	18.69	16.95
5.	Almon (*Shorea almon*)	66	66.40	26.97
6.	Apitong (*Dipterocarpus grandiflorus*)	9	32.33	17.33
7.	Bagalunga (*Melia dubia*)	25	43.60	13.95
8.	*Artocarpus* spp.	3	45.33	21.26
9.	Bagras (*Eucalyptus deglupta*)	44	52.43	27.43
10.	Bagtikan (*Parashorea malaanonan*)	23	72.80	28.03
11.	Bakauan babae (*Rhizophora mucronata*)	41	11.26	9.16
12.	Bakauan bato / Bangkau (*Rhizophora stylosa*)	50	14.94	6.64
13.	Bakauan lalaki (*Rhizophora apiculata*)	48	12.62	10.63
14.	Batete (*Kingiodendron alternifolium*)	6	43.50	16.83
15.	Bitanghol (*Calophyllum blancoi*)	4	48.88	18.49
16.	Bitaog (*Callophyllum inophyllum*)	46	78.67	12.78
17.	Black Wattle (*Acacia stenophylla*)	1	38.00	17.00
18.	Bolong-Eta (*Diospyros philosanthera*)	2	95.00	29.00
19.	Bungalon (*Avicennia marina*)	25	10.46	5.15
20.	Dao (*Dracontomelon dao*)	50	31.90	13.18
21.	Dungon (*Heritiera sylvatica*)	2	65.00	21.50
22.	Earpod Wattle / Auri (*Acacia auriculiformis*)	117	24.88	18.88
24.	Falcata / Moluccan sau (*Paraserianthes falcataria*)	132	42.54	22.38
25.	Fish poison wattle / Soapy wattle (*Acacia neurocarpa*)	3	52.07	18.00
26.	Forest Oak (*Casuarina junghuhniana*)	17	52.31	17.71
27.	Golden Wattle/Thick Podded Salwood (*Acacia crassicarpa*)	3	40.23	17.33
28.	Graygum (*Eucalyptus tereticornis*)	12	52.28	18.08
29.	Grevillea / Silky Oak (*Grevillea robusta*)	1	21.50	12.00
30.	Guijo (*Shorea guiso*)	4	55.30	30.40
31.	Ipil (*Intsia bijuga*)	68	43.79	14.64
32.	Kalantas (*Toona calantas*)	15	52.67	27.67
33.	Kalingag (*Cinnamomum mercadoi*)	15	12.57	9.73
34.	Kalumpit (*Terminalia microcarpa*)	1	85.00	26.00
35.	Kamachile (*Pithecellobium dulce*)	30	14.38	7.40
36.	Large-fruited red Mahogany (*Eucalyptus pellita*)	6	43.53	17.83
37.	Magtalisay / Palakpalak (*Palaquium philippinense*)	25	18.00	20.10
38.	Mahogany (*Swietenia macrophylla*)	1,213	53.72	23.00
39.	Malabayabas (*Tristaniopsis decorticata*)	3	43.60	21.00
40.	Malapapaya (*Polyscias nodosa*)	15	34.05	18.31
41.	Malugay liitan (*Pometia pinnata*)	1	84.00	24.00

Annex Table 3. *Continued...*

	Species	Stem Count	Ave. DBH	Ave. TH
44.	Mamalis (*Pittosporum pentandrum*)	23	8.13	10.78
45.	Mangga (*Mangifera indica*)	1	70.00	32.00
46.	Manggachapui (*Hopea acuminata*)	11	50.64	19.09
47.	Manggasinoro (*Shorea assamica*)	30	48.52	20.70
48.	Mangium (*Acacia mangium*)	76	36.50	18.91
49.	Mangkono *(Xanthostemon verdugonianus*)	1	72.00	22.00
50.	Mayapis (*Shorea palosapis*)	120	38.71	17.34
51.	Mindanao cinnamon (*Cinnamomum mindanaense*)	10	10.70	11.25
52.	Mindoro Pine (*Pinus merkusii*)	64	82.38	11.90
53.	Molave (*Vitex parviflora*)	273	51.47	16.80
54.	Mountain agoho (*Casuarina rumphiana*)	32	22.57	20.61
55.	Narek (*Hopea cagayanensis*)	4	28.25	11.50
56.	Narig (*Vatica mangachapoi*)	17	39.88	14.38
57.	Narra (*Pterocarpus indicus*)	245	46.52	17.19
58.	Nato (*Palaquium luzoniense*)	8	68.63	23.25
59.	Pagatpat (*Sonneratia alba*)	50	10.08	9.21
60.	Palosanto (*Triplaris cumingiana*)	10	18.62	30.20
61.	Palosapis (*Anisoptera thurifera*)	18	34.36	19.47
62.	Philippine teak (*Tectona philippinensis*)	76	47.87	10.97
63.	Pili (*Canarium ovatum*)	218	36.06	8.40
64.	Rain tree (Acacia) (*Samanea saman*)	31	29.32	13.10
65.	Red lauan (*Shorea negrosensis*)	56	41.54	17.16
66.	River oak (*Casuarina cunninghamiana*)	3	35.63	16.67
67.	River red gum (*Eucalyptus camaldulensis*)	23	47.03	17.48
68.	Rose gum/Flooded gum (*Eucalyptus grandis*)	2	21.55	14.50
69.	Sambulauan / Bukan (*Syzygium albayense*)	34	34.12	16.35
70.	Saplungan/Yakal saplungan (*Hopea plagata*)	38	25.60	29.76
71.	Swamp mahogany (*Eucalyptus robusta*)	6	37.70	18.83
72.	Swamp she-oak (*Casuarina glauca*)	2	28.50	16.00
73.	Talisai-gubat (*Terminalia foetidissima*)	35	28.47	11.47
74.	Taluto (*Pterocymbium tinctorium*)	12	22.82	30.75
75.	Tangal (*Ceriops tagal*)	30	9.16	4.14
76.	Tangile (*Shorea polysperma*)	97	58.48	25.16
77.	Taringtingan (Unknown)	1	56.00	19.00
78.	Teak (*Tectona grandis*)	28	45.64	17.39
79.	Tiaong (*Shorea ovata*)	3	86.67	30.00
80.	Tiga (*Tristaniopsis stellata*)	10	55.48	21.03
81.	Timor white gum (*Eucalyptus urophylla*)	13	37.18	16.31
82.	Tindalo (*Afzelia rhomboidea*)	1	55.00	25.00
83.	Tuai (*Bischofia javanica*)	22	85.55	12.38

Table 3. *Continued...*

Species	Stem Count	Ave. DBH	Ave. TH
84. White Lauan (*Shorea contorta*)	149	46.84	28.65
85. Yakal (*Shorea astylosa*)	11	37.12	21.78
86. Yakal Kaliot (*Hopea malibato*)	1	73.00	17.00
87. Yemane (*Gmelina arborea*)	240	37.18	23.30
Grand Total	**4,348**	**44.16**	**19.09**

Table 4. Families of all identified species nationwide.

Family Name	Stem Count	Ave. DBH	Ave. TH
1. ACANTHACEAE	25	10.46	5.15
2. ANACARDIACEAE	51	32.65	13.55
3. ARALIACEAE	15	34.05	18.31
4. ARAUCARIACEAE	32	18.69	16.95
5. BURSERACEAE	218	36.06	8.40
6. AESALPINIACEAE	75	43.91	14.96
7. CASUARINACEAE	90	23.93	17.62
8. COMBRETACEAE	36	30.04	11.88
9. DIPTEROCARPACEAE	657	47.68	23.44
10. EBENACEAE	2	95.00	29.00
11. EUPHORBIACEAE	22	85.55	12.38
12. FABACEAE	255	47.02	17.28
13. GUTTIFERAE	50	76.29	13.24
14. LAURACEAE	25	11.82	10.34
15. MELIACEAE	1,253	53.50	22.88
16. MIMOSACEAE	402	33.02	19.15
17. MYRTACEAE	154	45.11	20.38
18. PINACEAE	64	82.38	11.90
19. PITTOSPORACEAE	23	8.13	10.78
20. POLYGONACEAE	10	18.62	30.20
21. PROTEACEAE	1	21.50	12.00
22. RHIZOPHORACEAE	169	12.36	7.94
23. SAPINDACEAE	1	84.00	24.00
24. SAPOTACEAE	33	30.28	20.86
25. SONNERATIACEAE	50	10.08	9.21
26. STERCULIACEAE	14	28.84	29.43
27. UNKNOWN	4	48.00	20.70
28. VERBENACEAE	617	45.20	18.64
Grand Total	**4,348**	**44.16**	**19.09**

Table 5. Identified species by region and specific seed sources location.

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
Region CAR	BENGUET, Acop, Tublay, Daclan	Tuai	7	94.71	10.57
	BENGUET, Tuba, (Kennon Road)	Tuai	7	92.71	16.43
	BENGUET, Tuba, Sablan	Tuai	8	71.25	10.41
Region CAR Total			**22**	**85.55**	**12.38**
Region 1	ILOCOS NORTE, Batac, Payao (MMMSU-Batac)	Narra	20	35.20	14.29
		Mahogany	17	39.53	31.53
		Yemane	13	45.38	34.54
	ILOCOS NORTE, Batac, San Mateo, Lubbot	Yemane	48	20.68	21.07
`	ILOCOS NORTE, Nueva Era, Poblacion (*Nueva Era Reforestation Project*)	Mahogany	25	36.08	24.52
	ILOCOS NORTE, Pasuquin, Tadao (Camp Site, PFDPIN)	Mangium	42	40.14	17.15
	ILOCOS NORTE, San Nicolas, San Agustin	Narra	5	9.80	23.80
	PANGASINAN, Mangatarem, Malabobo (Manleluag Spring Protected Landscape)	Mahogany	25	40.54	34.07
		Narra	20	36.54	30.91
		Akleng Parang	13	36.59	32.14
		Palosapis	6	45.92	33.57
		White Lauan	4	43.53	35.00
		Guijo	3	50.40	37.53
		Apitong	2	51.50	33.50
		Yakal	1	20.00	25.00
		Malapapaya	1	30.50	32.40
Region 1 Total			**245**	**34.98**	**25.31**
Region 2	NUEVA VIZCAYA, Diadi, Bugnai	Yemane	62	36.09	24.82
	NUEVA VIZCAYA, Diadi, San Luis	Mahogany	428	40.52	22.95
		Mayapis	84	29.10	14.24
		Red Lauan	37	30.73	13.62

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
		Manggasinoro	16	33.13	12.50
		Narig	15	33.13	12.67
		Palosapis	12	28.58	12.42
		Tangile	12	28.42	12.92
		White Lauan	9	29.67	13.33
		Apitong	7	26.86	12.71
		Manggachapui	5	28.00	12.40
		Narek	4	28.25	11.50
		Guijo	1	70.00	9.00
Region 2 Total			**692**	**37.07**	**20.35**
Region 3	NUEVA ECIJA, Carranglan, Puncan	Narra	24	60.38	8.17
	PAMPANGA (Airforce City, Clark Field)	Molave	14	222.79	19.64
	PAMPANGA, Arayat, Banio, San Juan	Molave	13	143.54	28.46
Region 3 Total			**51**	**126.16**	**16.49**
Region 4-A	BATANGAS, Logo, Sawang	Philippine Teak	76	47.87	10.97
	BATANGAS, San Juan, Imelda	Molave	67	24.22	12.45
	BATANGAS, San Juan, Laiya	Dao	50	31.90	13.18
	CAVITE, Ternate, Sapang, Malauyas (Mt. Palaypalay National Park)	Earpod Wattlei	117	24.88	18.88
		Yemane	25	31.83	20.06
		Mangium	5	28.98	22.94
	QUEZON (Quezon Protected Landscape)	Kalantas	15	52.67	27.67
	QUEZON, Dolores, Kinabuhayan	Mahogany	95	142.33	26.40
	QUEZON, Lucban, Palola	Narra	36	53.17	9.86
		Mahogany	31	41.94	12.58
		Ipil	23	10.72	4.83
	QUEZON, Lucena City, Silangan, Mayao (Ouan's Worth Farm)	Molave	20	93.00	2.40

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
	QUEZON, Pagbilao, Malicboy	Mahogany	107	41.69	7.45
Region 4-A Total			**667**	**52.17**	**14.66**
Region 4-B	OCCIDENTAL MINDORO, Mamburao, San Luis, Tagum	Narra	29	21.66	15.30
	OCCIDENTAL MINDORO, Mamburao, Sta. Cruz	Mindoro Pine	31	33.13	10.67
	OCCIDENTAL MINDORO, Sta. Cruz, Tagbungan	Mindoro Pine	33	127.15	13.03
	PALAWAN, Puerto Princesa City, Sta. Monica, Bagumbayan	Ipil	45	60.69	19.66
Region 4-B Total			**138**	**62.40**	**15.17**
Region 5	ALBAY, Bacacay, Iraya (Mangrove Experimental Forest)	Bakauan Babae	22	10.50	7.73
		Bakauan Lalaki	19	13.00	7.37
	ALBAY, Guinobatan, Agpay	Malapapaya	14	34.40	16.90
	ALBAY, Legazpi City, Taysan, Malangka	Sambulauan / Bukan	34	34.12	16.35
	CAMARINES SUR, Lupi, Napolidan [Pili Clonal Orchard (roadside)]	Pili	49	24.88	7.76
	CAMARINES SUR, Lupi, Napolidan (Pili Clonal Orchard)	Pili	133	34.56	7.03
	CAMARINES SUR, Ocampo, Gatbo	Pili	36	56.83	14.31
	SORSOGON, Bulusan (Bulusan Volcano Natural Park)	Mahogany	47	95.00	16.30
	SORSOGON, Prieto Diaz, Diamante, Sabang	Bakauan Bato Bangkau	50	14.94	6.64
	SORSOGON, Prieto Diaz, Perlas	Bitaog	46	78.67	12.78

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
Region 5 Total			**450**	**41.87**	**10.21**
Region 6	AKLAN, Kalibo, New Buswang	Bakauan Lalaki	29	12.38	12.76
		Bakauan Babae	19	12.15	10.81
	AKLAN, Malay, Nabaoy	Mountain Agoho	32	22.57	20.61
	ANTIQUE, Tibiao, Tigbaboy	Yemane	25	47.85	21.89
	GUIMARAS, Jordan, Espinosa, Cabaling	Magtalisay	25	18.00	20.10
		Palakpalak			
	ILOILO, Dingle, Putian, Bulabog	Molave	11	28.18	18.64
	LOILO, Dingle, Putian, Bulabog	Taluto	12	22.82	30.75
	(Bulabog Putian National Park)	Yemane	10	29.52	23.70
		Palosanto	10	18.62	30.20
	ILOILO, Lemery, San Jose	Mamalis	23	8.13	10.78
	ILOILO, Leon, Omambong	Narra	34	28.94	17.08
	ILOILO, Miag-ao (UPV)	Rain Tree (Acacia)	30	28.98	12.93
		Kamachile	30	14.38	7.40
	NEGROS OCCIDENTAL, Bacolod City, Alangilan	Agoho / Beach Agoho	35	9.79	14.99
	NEGROS OCCIDENTAL, Sagay City,	Pagatpat	25	8.35	5.45
	Bulanon, Isla Perlas	Bungalon	25	10.46	5.15
Region 6 Total			**375**	**19.49**	**15.00**
Region 7	CEBU, Alcoy, Nug-as	Kalingag	15	12.57	9.73
		Mindanao Cinnamon	10	10.70	11.25
	CEBU, Cebu City, Cantipla	Mangium	29	32.53	20.74

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
	CEBU, Minglanilla, Camp 7	Mahogany	255	49.03	27.37
		Narra	29	54.24	23.66
		White Lauan	10	63.85	30.30
		Bagtikan	8	58.06	28.25
		Tangile	4	60.80	29.75
		Mayapis	3	67.20	33.33
	CEBU, Tabuelan, Katigbawan, Dalinson	Forest Oak	3	28.73	14.33
		River Red Gum	3	39.03	16.67
		Golden Wattle/ Thick Podded Salwood	1	26.90	20.00
		Timor White Gum	1	33.40	13.00
		Swamp Mahogany	1	21.30	12.00
	CEBU, Talisay City, Juanay	River Red Gum	13	36.40	17.69
		Timor White Gum	10	35.89	17.30
		Forest Oak	9	43.57	19.22
		Graygum	8	37.29	17.63
		Swamp Mahogany	5	40.98	20.20
		Large-Fruited Red Mahogany	5	38.24	18.40
		River Oak	3	35.63	16.67
		Swamp She-Oak	2	28.50	16.00
		Rose Gum/ Flooded Gum	2	21.55	14.50
		Fish Poison Wattle / Soapy Wattle	2	39.85	18.50
		Agoho / Beach Agoho	1	36.00	19.00
		Golden Wattle/ Thick Podded Salwood	1	31.30	16.00
		Rain Tree (Acacia)	1	39.50	18.00
		Grevillea /	1	21.50	12.00

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
		Silky Oak			
		Black Wattle	1	38.00	17.00
	CEBU, Talisay City, Manipis, Juanay	River Red Gum	7	70.21	17.43
		Forest Oak	5	82.20	17.00
		Graygum	4	82.25	19.00
		Timor White Gum	2	45.50	13.00
		Golden Wattle/ Thick Podded Salwood	1	62.50	16.00
		Fish Poison	1	76.50	17.00
		Wattle / Soapy Wattle			
		Large-Fruited Red Mahogany	1	70.00	15.00
	NEGROS ORIENTAL, Mabinay, Bulwang (*Mabinay Reforestation Project*)	Yemane	26	44.26	25.65
	SIQUIJOR, Maria, Bogo	Talisai-Gubat	35	28.47	11.47
		Molave	31	45.95	15.85
	SIQUIJOR, Maria, Liloan, Umpas	Molave	29	18.38	16.71
	SIQUIJOR, Siquijor, Luyang	Pagatpat	25	11.82	12.98
Region 7 Total			**603**	**42.21**	**22.02**
Region 8	EASTERN SAMAR, Quinapondan, Buenavista	Mahogany	95	43.24	23.43
	LEYTE, Baybay City, Punta, Lawis	Tangal	30	9.16	4.14
	LEYTE, Baybay, Kilim, Cienda	Tangile	19	94.11	22.00
		Nato / Red Nato	6	64.83	22.17
		Red Lauan	6	89.33	24.00
		Manggachapui	6	69.50	24.67
		White Lauan	5	70.40	23.80
		Bagtikan	4	60.25	25.00

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
		Tiga	3	66.67	17.67
		Manggasinoro	2	105.00	28.50
		Bolong-Eta	2	95.00	29.00
		Malugay Liitan	1	84.00	24.00
		Kalumpit	1	85.00	26.00
		Batete	1	86.00	22.00
		Yakal Kaliot	1	73.00	17.00
		Tindalo	1	55.00	25.00
		Dungon	1	50.00	16.00
		Mangkono	1	72.00	22.00
		Mayapis	1	120.00	24.00
		Taringtingan	1	56.00	19.00
Region 8	LEYTE, Mahaplag, Magsuganao	Tangile	13	39.29	19.55
		Almon	11	40.72	20.02
		Mayapis	10	40.65	21.09
		Tiga	7	50.69	22.48
		Batete	5	35.00	15.80
		Malabayabas	3	43.60	21.00
		Bago Nangka	3	45.33	21.26
		Red Lauan	1	37.20	21.85
	SOUTHERN LEYTE, Silago, Imelda	Almon	18	55.72	25.01
		Mayapis	12	51.02	21.64
		Red Lauan	12	51.33	24.25
		Yakal	10	38.83	21.46
		White Lauan	6	44.92	23.83
		Bitanghol	4	48.88	18.49
Region 8 Total			**302**	**48.58**	**20.79**
Region 9	ZAMBOANGA DEL NORTE, Dipolog City, Cogon (*Cogon Reforestation Project*)	Mahogany	10	63.30	20.75
	ZAMBOANGA DEL NORTE, Sergio Osmeña, Buenavista	Tiaong	1	90.00	24.00
		Nato/Red Nato	1	75.00	20.00
	ZAMBOANGA DEL SUR, Tukuran, Baclay (*Baclay Reforestation Project*)	Yemane	2	41.00	16.00
		Mahogany	2	54.00	16.50

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
	ZAMBOANGA DEL SUR, Zamboanga City, Dulilan, Narra Outpost (Zamboanga City Water District)	Almon	22	94.34	30.02
		Tangile	14	84.54	27.64
		Bagtikan	9	84.10	27.98
		Mayapis	9	81.17	28.33
		Tiaong	2	85.00	33.00
		Narig	2	90.50	27.25
		Mangga	1	70.00	32.00
		White Lauan	1	55.00	22.00
		Dungon	1	80.00	27.00
		Nato/Red Nato	1	85.00	33.00
	ZAMBOANGA DEL SUR, Zamboanga City, Pasonanca, (Pasonanca Park)	Narra	25	78.88	17.60
	ZAMBOANGA DEL SUR, Zamboanga City, San Ramon, (PCA Compound)	Bagalunga	25	43.60	13.95
	ZAMBOANGA DEL SUR, Zamboanga City, Upper Baluno, (Baluno Natural Park)	Bagtikan	2	106.00	33.50
		White Lauan	1	90.00	30.00
		Tangile	1	120.00	35.00
		Almon	1	75.00	28.00
		Mayapis	1	130.00	35.00
	ZAMBOANGA DEL SUR, Zamboanga City, Upper Baluno, (*Baluno Reforestation Project*)	Yemane	4	43.25	21.25
		Mahogany	3	54.33	23.67
	ZAMBOANGA SIBUGAY, Buug, (Buug Biotic Park)	Tangile	4	95.00	27.50
Region 9 Total			**145**	**74.35**	**23.14**
Region 10	BUKIDNON, Impasugong, (CEDAR, formerly *Impalutao Reforestation Project*)	White Lauan	12	51.18	36.92
		Akle	6	72.33	20.83
	BUKIDNON, Impasugong, Impalutao, (CEDAR, formerly *Impalutao Reforestation*) *Project*)	Almaciga	32	18.69	16.95

Table 5 *Continued...*

LOCATION (Region, Province, Municipality, Barangay, Sitio		Common Name	Stem Count	Ave. DBH	Ave. TH
	BUKIDNON, Impasugong, Impalutao (*Impalutao Reforestation Project*)	Mahogany	50	53.69	30.94
		White Lauan	46	51.64	36.43
		Saplungan/ Yakal Saplungan	38	25.60	29.76
		Tangile	30	36.86	32.08
		Almon	10	68.25	33.68
	BUKIDNON, Kitaotao, East Poblacion	Molave	88	37.69	21.35
Region 10 Total			**312**	**40.97**	**27.72**
Region 11	COMPOSTELA VALLEY, Nabunturan	Yemane	25	56.40	20.88
		Bagras	22	40.64	24.23
	DAVAO DEL SUR, Davao City, Mintal, New Loon	White Lauan	47	27.70	22.19
		Teak	28	45.64	17.39
		Narra	23	60.57	21.17
		Mahogany	23	55.65	24.04
		Almon	4	24.75	21.00
		Manggasinoro	2	21.50	20.00
Region 11 Total			**174**	**44.25**	**21.55**
Region 13	AGUSAN DEL NORTE, Butuan City, Mandakpan	Falcata / Moluccan Sau	50	28.14	17.86
	AGUSAN DEL SUR, San Francisco, Mt. Diwata,	Bagras	5	100.40	30.60
	SURIGAO DEL SUR, Bislig City	Falcata / Moluccan Sau	82	51.32	25.13
		Bagras	17	53.59	30.65
	SURIGAO DEL SUR, Bislig City, Maharlika	Manggasinoro	10	67.26	32.40
		White Lauan	8	105.19	27.88
Region 13 Total			**172**	**49.66**	**24.27**
Grand Total			**4,348**	**44.16**	**19.09**

Protected Areas and Biodiversity

State of the Art (2007-2010)

The Philippines is one of the 18 megabiodiverse countries in the world that collectively make up two-thirds of the earth's biodiversity. The country is also known as one of the biodiversity hotspots where biological diversity is under constant threat due to unsustainable resource-use, population pressure, overexploitation, and other factors. As party to the Convention on Biological Diversity (CBD), the Philippines upholds its commitment to conserve biological diversity, promote sustainable use of natural resources and equitably share the benefits derived from the use of biological resources.

Herbicide-tolerant corn planted at the foot of Mt. Isarog, Camarines Sur

Protected areas (PAs) and biodiversity are inextricably linked. Globally, the concept of PAs is viewed as an *in situ* form of conservation which is designed to protect biodiversity. The *NIPAS Act* (RA 7586) provides the legal basis for the establishment and management of protected areas in the Philippines. Other than the CBD, the management of protected areas (PAs) and the conservation of biological diversity are also part of the international commitments signed by the Philippine Government such as the Ramsar Convention, World Heritage Convention, Convention on Migratory Species, and the ASEAN Agreement on the Conservation of Nature and Natural Resources. As a party to all these multilateral environmental agreements, the Philippines supports all the provisions that ensure the conservation of the country's biodiversity resources within and outside the PAs. Generating scientific information through R and D is thus needed for sound management.

The overriding concern for the conservation of biological diversity has brought to fore two mutually exclusive but complimentary concepts – biosafety and biosecurity. Biosafety implies the need and conditional requirements to protect human health and the environment from the possible adverse effects of the products of modern biotechnology specifically living modified organisms (LMOs) or genetically modified organisms (GMOs). Being a signatory to the Cartagena Protocol on Biosafety (CPB), the Philippines agrees to ensure an adequate level of protection in the field of safe transfer, handling, and use of LMOs resulting from modern technology that may have adverse effects on biological diversity. As of 2009, a record of 14 million small and large farmers in 25 countries planted genetically modified crops in 124 million hectares, which represents a 7 percent increase or 9 million hectares over 2008 (James, C., 2009). Of the 25 countries engaged in the propagation and cultivation of GMOs, Philippines stands 11th among the biotech mega countries growing 50,000 hectares or more with an estimated 0.5 million hectares of GM farms devoted to corn cultivation in 2009 compared to 0.2 million hectares in 2006. It is noteworthy to mention that the Philippines still holds the distinction of being the only country in the ASEAN region that cultivates GMOs because of its strong regulatory system for transgenic crops.

Cluster of *P. aduncum* occupying some portions of Mt. Timolan boundaries in Zamboanga del Sur.

The spread of invasive alien species (IAS) such as animals, plants, insects, bacteria, viruses, and other life forms is now considered as one of the greatest threats to the biosecurity of Philippine ecosystems and biological resources. Continuing globalization has facilitated the spread of IAS with negative impacts. The preceding illustration therefore shows that biosecurity is a more encompassing term that requires local and international cooperation among governments, economic, and public sectors. Both biosafety and biosecurity imply a guarantee against threats to the environment or biological diversity and human health from sources which are purely biological in origin and which are directed to biological processes.

Ecotourism, as one of the many variances of sustainable tourism, gives importance to biodiversity as the major attraction feature particularly for PAs, the ultimate goal is to enhance appreciation of the natural landscape and their biological resources. Ecotourism has consistently contributed to the coffers of the government. In 2007, tourist arrivals reached the three-million mark or 3.09 million visitors, which generated a foreign exchange receipt of US$ 4.885 billion. In 2008, this grew by 1.53% with 3.14 million visitors. In spite of this significant contribution, the application of ecotourism as a management tool is still confronted with many problems, one of which is the insufficiency of scientific data and information for sustainable ecotourism.

A wide area of RDE has been done by the DENR between 2007-2010 in the country's protected areas and critical habitats which served as basis for sound management.

Research study on migratory water birds, their abundance, time of arrival and characterization of their habitats was initiated by ERDB in Naujan Lake National Park, Las Pinas-Parañaque Critical Habitat and the Candaba swamps in 2009 considering that Philippines is part of East Asian Australasian Flyway. The primary objective is to provide baseline information on migration patterns that maybe useful in explaining climate change phenomenon.

Biodiversity assessment of main Pasig River was conducted in 2008-2009. The study showed that the Pasig River is not at all dead although pollution-tolerant species of fish and insects dominate the faunal profile of the area. Assessment of flora diversity along river banks showed a relatively high proportion of exotic species. The river is also frequented by migratory birds that feed on small fishes in the area.

To address the conservation of genetic diversity, a continuing activity is being conducted on the establishment and management of gene bank of economically useful endangered forest tree species. Assessment of peatlands was also initiated by ERDB and PAWB in support of the Philippine's commitment to ASEAN Peatland Management Initiatives (APMI).

Migratory waterbirds overwinter at Candaba Wetlands and other wetlands of international importance during southward migration season.

Research conducted by the DENR-ERDB in 2006 to assess the impacts of GMOs on the environment and biodiversity was limited only to herbicide-tolerant corn. The technology suitably compares with the traditional hand-weeding practices associated with non-GM counterparts and no significant difference was observed in terms of weeds and avian diversity in GM and non-GM fields. However, the period of 3 years of close monitoring (2006-2008) is deemed short to realistically assess impacts on biodiversity.

As a followup study, ERDB embarked on a program to promote biosafety and biosecurity focusing on the environmental impact assessment of GMOs and potentially harmful exotic species. The program contributed science-based inputs to the development of draft DENR Administrative Order (AO) on the "Rules and Regulations for Environmental Risks and Biosafety Assessment of Genetically Modified Forest and Wildlife Resources" in compliance to E.O. 514 (National Biosafety Framework). Another draft DENR-DA-DOH Joint AO was also prepared on the conduct of Environmental Risk Assessment and Monitoring of Plants Derived from the Use of Modern Biotechnology for Release into the Environment consistent with DA's AO no. 8 Series of 2002. The application of a post-commercial monitoring scheme employing farmer-survey instruments to assess socioeconomic impacts of GMOs is also being done. However, the fast rate of GMO development and the inherent nature of farmers to test new crop brands limit the usefulness of the approach particularly at the level of smallholder farmers.

To address biosecurity concerns, an IAS data base is under preparation that provides not only a species listing but also substantial information on distribution status, pathways of introduction and impacts of IAS on the environment and natural resources. While a list of IAS occurring in the Philippines can be accessed from international databases, there is an urgent need to validate their presence in the country and define the range of their economic importance and ecological significance in relation to local biodiversity.

Other activities that were undertaken to promote biosafety and biosecurity include participation in various interagency committees on biosafety- and biosecurity-related concerns, linkaging with other government and nongovernment agencies and continuous capacity building for the researchers including members of DENR Biosafety Committee.

Research investigations conducted by ERDB to assess potential sites for ecotourism were as follows:

- Scoping study of the potential of the Philippine Independence Park in Kawit, Cavite for ecotourism development and mangrove rehabilitation with funding assistance from the DOST-Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and the local government of Kawit (Calanog *et al,* 2009);

- Mt. Banahaw-San Cristobal Carrying Capacity of Two Potential Ecotourism Sites in Mt. Banahaw-San Cristobal Protected Landscape (MBSCPL); and

- Ecological Analysis of the Lamao Forest Reserve as Ecotourism Site for Biodiversity Conservation in Bataan, Philippines.

Among others, it was found out that ecotourism is feasible in MBSCPL. To have a sustainable ecotourism enterprise in the area, a management plan was prepared and recommended for adoption by the Protected Areas Management Board (PAMB).

Also, under the ecotourism banner program of ERDB, assessments were made in Olango Island in Cebu (Colis *et al,* 2010) and Taklong Island in Iloilo (Marquez *et al,* 2010). The project's major outputs are ecotourism management plans for each protected area.

Visitors await for their turn to bath in one of the bathing areas in Kinabuhayan, Dolores, Quezon

Tourism carrying capacity assessments have been completed in Boracay Island (Calanog *et al,* 2009) as well as in Puerto Princesa Subterranean River National Park, PPSRNP (Calderon, et al, 2010). Both assessments found out that carrying capacity in both sites has not been exceeded yet. However, in the case of Boracay, this will be exceeded

Cave entrance to St. Paul Subterranean River in Puerto Princesa Subterranean River National Park.

very soon, while for PPSRNP, the capacity will be surpassed by year 2018. Strategies were recommended on how to increase the carrying capacity of both sites.

Studies were also conducted on ecotourism carrying capacity assessment of the various protected areas namely: Mt. Pulag National Park (Costales *et al,* 2009); Manleluag Spring Protected Landscape(Simeon *et al,* 2009); Mt. Arayat National Park Recreational Area (Loria *et al,* 2009); Mt. Guiting-guiting Natural Park Sibuyan Island(De Sagun *et al,* 2009); Mayon Volcano Natural Park (Balaguer 2009); Mt. Kanlaon Natural Park (Peñaranda *et al,* 2009); Mt. Manunggal Camping Area (Colis *et al,* 2008), Apo Island Protected Landscape and Seascape (Colis *et al*, 2008); Initao–Libertad Protected Landscape and Seascape (Alvez and Garciano, 2008); Mt. Timpoong-Hibokhibok Natural Range Monument (Alvez *et al,* 2009), Toyozu Mountain Resort-Mainit Hotspring Protected Landscape (Balmocena *et al,* 2009), Mt. Apo Natural Park (Balmocena *et al,* 2008); Camping Area in Mt. Matutum Protected Landscape (Arnoco *et al,* 2009) and; Siargao Island for Ecotourism Development (Sapid *et al,* 2009).

The study on Lamao Forest Reserve was conducted to assess the suitability of the area as ecotourism site with emphasis on biological components (flora and fauna) using Geographic Information System (GIS). This tool shall aid in identifying the geographic locations of flora and habitat range of fauna particularly the vertebrates.

Issues and Concerns

The DENR intends that RDE activities be focused on the most urgent, high priority areas to ensure a science-based disposition and rational use of the country's natural resources. It highlights the need to attain ecological balance, ecosystems productivity and resilience, social justice, equity and increased adaptation to climate change.

About 25 percent of mammal species and about 20 percent of bird species are at risk of global extinction because of climate change (IPCC, 2007). There is a high probability that other competing species or sometimes invasive species which are more adapted to a new climate, will move in and displace indigenous and endemic species which is a biosecurity issue. The threats from IAS are also global in scope that threatens biodiversity in its various spheres – ecosystems, species, and genetic level. All ecological communities are prone to invasion and can cause displacement and extinction of native species. In the Philippines, the pathway for introduction of IAS is either intentional or accidental. Intentional introduction has been done principally to diversify and increase productivity in agriculture or to provide solution to an existing problem. Accidental introduction has taken many forms such as those borne by seeds or attached to various objects such as machineries, plane cargoes, cut flowers, luggages, and traded animals. Others include importation of different alien species for zoos, botanical gardens, aquaculture, and aquarium purposes and research purposes which are originally intended for captive or contained rearing which subsequently escaped into the natural environment. With regards to the implementation of E.O. 578 (*National Policy on Biological Diversity*), the target is to come up with guidelines on critical habitat and impact assessment of IAS and PHES on the endemic and indigenous species in the country. What is needed is a uniform standards for risk referencing.

The risk that GMOs may invade natural habitats and cause environmental problems have been put forward since the start of biotech farming. The debate on GMOs is highly polarized. Many types of ecological hazard caused by GM crops has been listed such as: 1) direct invasion of natural ecosystems; 2) gene transfer and hybridization with wild relatives; 3) disruption of natural communities through competition or interference; 4) harm to nontarget species e.g., by indirect effects on food webs; 5) loss of biodiversity or genetic density; and 6) changes in nutrient cycles, primary production, and geochemical processes. However, other groups suggest that biotech crops can potentially contribute to reduction of greenhouse gases and climate change in three principal ways, namely: 1) permanent savings in carbon dioxide emission through reduced use of pesticide and herbicide sprays; 2) conservation tillage associated with less or no ploughing using herbicide tolerant biotech crops; and 3) in the future, cultivation of additional area of biotech–based energy crops to produce ethanol and biodiesel which will substitute for fossil fuel and help recycle and sequester fuel (Stern. 2006).

The EO 514 (*National Biosafety Framework*) gives DENR the mandate to ensure that environmental impact studies are done prior to the release of GMOs to the environment. Since environmental impacts take time to be felt, post commercial monitoring of commercially propagated GM crops is deemed indispensable.

While ecotourism has been vigorously promoted by the government, definitional context is a subject of considerable public controversy and concern because of green washing. A trend towards the commercialization of tourism schemes disguised as sustainable, nature-based, and environmentally friendly ecotourism is increasing. Ecotourism, especially recently, entails construction of water treatment plants, sanitation facilities, and lodges, and sometimes comes with the exploitation of nonrenewable energy sources and the exploitation of limited local resources. The conversion of natural land to tourist infrastructure is implicated in deforestation and habitat deterioration. Among the more important issues and concerns relevant to the implementation of ecotourism include the following: 1) deprivation of local people with the opportunity for a gainful enterprise since most forms of ecotourism are owned by foreign investors and corporations that provide few benefits to local communities; 2) marginalization of local and indigenous peoples; 3) inadequate science-based information and low commitment or weak capability to manage ecotourism sites; 4) ambiguity in the interpretation of policies; and 5) inadequate financing.

Gaps and Challenges

The following are some gaps and challenges that need to be addressed:

1. Improving access to relevant, up-to-date information on biodiversity status and issues relevant to the needs of stakeholders at all levels;
2. Harmonization of policies and regulatory frameworks pertinent to use of genetic resources;
3. Capacity-building to improve decision-making to address issues related to intensification and application of risky technologies in the environment vis-à-vis health, food and agriculture sectors;
4. Application of ecosystems or holistic approaches in the rehabilitation/ restoration of PAs to promote ecosystems

Janitor fish or Sailfin catfish, an invasive alien species in Laguna Lake and Pasig River

resilience of both aquatic and terrestrial environments;
5. Standardization of methodologies for carrying capacity assessment of PAs and important or key biodiversity sites for ecotourism and other uses; and
6. Promotion of appropriate social marketing strategy to enhance awareness and commitment of stakeholders including the local community in the conservation and management of PAs and biodiversity.

PAs have been recognized as an essential tool for conserving biodiversity. The impacts of climate change now give the PAs a renewed role as adaptation tools for a changing climate.

Researchable Areas

In line with the ENR RDE Framework for 2011-2016, the following priority programs and researchable areas that need to be undertaken include the following:

1. Generation of suitable baselines, standards, and indicators at the species and ecosystems level with emphasis on rare, threatened, and endangered species;
2. Development of standards for risk referencing with regards to introduction of invasive alien species and GMOs;
3. Surveillance of wildlife and its habitat including migration pattern, and adaptation to climate change;
4. Carrying capacity assessment of selected PAs and critical habitats and development of sustainable ecotourism strategies to enhance the value of protected areas and guide future ecotourism activities;
5. Resources inventory and valuation of PAs and development of sustainable financing mechanism;
6. Management effectiveness assessment of PAs and buffer zones and development of standardized method for scientific monitoring and evaluation for PAs;
7. Management strategies for economically important wildlife species;
8. Vulnerability assessment of critically endangered species and fragile ecosystems;
9. Conservation and management programs on threatened species and fragile ecosystems such as wetlands, peatlands, and caves;
10. Updating and integration of GIS-based mapping and geo-referenced information system/database of protected areas and keystone and charismatic species; and
11. Social marketing strategy to enhance awareness and stakeholder's capacity building in PA management and biodiversity conservation.

Coastal and Marine

State of the Art (2007-2010)

Protecting, conserving, and managing the coastal and marine resources are a continuing activity of the government. The Philippine government has been constantly formulating or updating policies and ploughed in substantial resources to manage and conserve the country's coastal resources. The coastal resources of the Philippines are losing their productive balance because of population pressure, industrial growth, and tourism activities. Conservation and protection efforts are dwarf-ed by ignorance, apathy, and lack of concern on the part of local governments and communities.

Overfishing has been identified as the major cause of the recent collapse of the coastal ecosystems (Jackson *et al*, 2001 as cited by Alcala and Russ, 2002). The associated destruction of coral reefs from unsustainable fishing and overfishing left only a negible area of these reefs in good condition. Twenty percent to 30 percent of the original seagrass beds has also been lost. The region's mangrove forest has been reduced to about 14,000 hectares, the bulk of which are additions from the plantations established in the late 80s. Original mangrove stands are now very limited.

Listing of some major coastal marine-related programs and projects in the last few years (2005-2009) in the Philippines are the following:

- A mangrove-friendly agroforestry system was piloted in Puerto Galera, Oriental Mindoro in a degraded mangrove swamp formerly planted to rice with some nipa palms (Baconguis *et al*, 2008). A nipa plantation was established at the center of the pond.

Adaptation strategies to climate change impacts coastal ecosystem.

Agricultural crops were planted at the dikes and surroundings. Mean annual of tilapia harvest was 3.18 ton/hectare/year. Conventional bangus stocking yields a higher average of 1.62 ton/hectare/cropping compared to 1.43 ton/hectare/cropping for natural bangus stocking.

The integration of honeybee and small ruminants farming contributes to greater benefits to the farmer and to the ecosystem. Bees improve pollination of mangroves and surrounding vegetations and croplands. The protection of the mangrove swamp enhanced biodiversity conservation and has become a tourist destination. After the nipa bore fruit, a biofuel component was initiated which gives even more benefits and help mitigate climate change (pers comm Baconguis, 2009).

- A study on the carrying-capacity of CEP/small islands was conducted and completed in April 2010 to determine the limiting factors of small islands to developments and develop a carrying-capacity model appropriate to the site (Villamor, L. *Pers. Comm.* 2010). An assessment of mud crab livelihood project in Sultan Kudarat was also

conducted to determine its viability and profitability (Atok *et al*, 2006).

- Sustainable tanbark extraction methods for *Ceriops tagal* was studied. It aims to develop the most appropriate method of tanbark harvesting from the standing crops without killing/cutting the tree (Palis, H. *Pers. Comm.* 2006).

- Nitura *et al* (2005) in their study on the impact of mangrove rehabilitation project in Sultan Kudarat indicated that majority of the respondents were aware of the Coastal Environment Program of the DENR. Majority of the respondents (93 percent) said that there was an improvement in the mangrove environment. They also indicated that it helped in making their livelihood successful. Calanog *et al* (2009) made a prefeasibility study on mangrove rehabilitation with ecotourism component for the Philippine Independence Park in Kawit, Cavite. The study aimed to assess the viability of rehabilitating the mangrove area and determine the ecotourism potential of the park.

- Sabater *et al* (2009) conducted vulnerability assessment of the Las Pinas-Parañaque critical habitat. They identified different factors for its vulnerability and develop a management plan for the area. The habitat now serves as a sanctuary of many bird species after relocating informal settlers. Acub (2009) conducted assessment of the carrying-capacity of Agutayan Island, Jasaan, Misamis Oriental for sustainable livelihood. The preferred tourism activity are: picnicking, swimming, and scuba diving. The carrying-capacity of the island is 100 visitors per day while the potential carrying-capacity is 200 visitors/day and the real capacity is 133 visitors/day.

- Ecology and stand dynamics of *Kandelia candel* (Palis, 2009) was conducted to determine the ecological requirements of the species in their natural habitat. It also was able to determine the nursery and field performance of the *K. candel*, a new reported mangrove species in the Philippines and was first reported earlier in Baler, Aurora.

For the year 2010, the DENR research sector implemented six programs/projects related to coastal marine ecosystem. A mangrove nipa-crab farming technology showcased the use of nipa mangrove areas for sustainable livelihood while protecting the areas from storm surges and tsunami. Another project assessed the socioeconomic condition of the area for the preparation of a policy recommendation that would apply to the situation.

An evaluation of the state of coastal areas in Metro Manila was also implemented to come up with a database on its conditions. Several mangrove rehabilitation activities were initiated which included developing models of mangrove and beach forest plantation for damaged coastal areas; a mangrovetum for Zambales and soil remediation strategies for oil-contaminated areas in Region 6.

Increasing climate variability has also affected coastal and marine habitat in many ways. As early as 2008, ERDB has been implementing climate change-related studies in the coastal zone. Notable among these are adaptation studies consisting of three components, namely: a) documentation on the adaptation strategies and practices of coastal and upland dwellers; b) policy responses of selected LGUs; and c) adaptation of coastal habitats on the impacts of climate change. The study sites are located in the coastal areas of Albay and Sorsogon in Bicol region, Catarman, Samar and Baler, Aurora. Similarly, coral transplantation study was also implemented in the coral reefs of Davao seas.

Clonal nursery at the Los Baños Experiment Station (LBES).

Issues and Concerns

The primary issues and concerns involving the coastal and marine resources sector include:

(a) Decreasing productivity of coastal and marine habitat

This is primarily due to pressures exerted by the growth of communities along coastal areas which have continually exploited the coastal resources beyond sustainable limits. This has led to fragmentation of mangroves forests, coral reefs, and seagrass ecosystems. This destruction has caused deterioration of water quality, declining biodiversity, decrease of fish catch and other marine resources, exposure of shoreline and foreshore areas to coastal perturbations causing massive coastal erosion and sedimentation.

(b) Increasing population pressures on coastal resources

This is singled out as one of the main problems confronting this fragile ecosystem. This has a direct bearing on economic issues and their underlying identified specific concerns. Population growth and poverty prompted people to engage in unregulated fishing activities. Most of them have low educational attainment and thus lack skills and knowledge to shift to other nondestructive means of livelihood. There are also public health issues as houses of fishermen have poor facilities and services. Resource-use conflict is another socioeconomic issue that needs attention.

(c) Conflicting provisions of policy laws and regulations

Numerous policies and regulations for coastal and marine areas have been made but some of them need updating as they are no longer relevant with its current state. Some of these areas of concern are: inadequate capacity of the LGUs to implement coastal resources management (CRM); overlapping jurisdictions/interagency conflicts; weak implementation of existing laws; weak and fragmented multisectoral support system for CRM; and lack of integration of municipal/city with CRM plans.

(d) Inadequate or absence of science-based information on the climate change adaptation and disaster risk reduction

Climate change in the light of adaptation, mitigation, and disaster risk reduction has profound impact in coastal and marine habitats. Absence and inadequate science-based information and data sets, however, can become an issue as these are requirements in quantifying the changes and its influences on biophysical elements of the ENR. Similarly, to reduce and neutralize

natural disaster impacts on built-up areas in the coastal zone, monitoring and forecasting systems have to be strengthened.

Newly completed rockwalls constructed in Sibonga, Cebu at the coastal pilot demonstration site.

Researchable Areas

1. Resource assessment of coastal and marine areas
2. Rehabilitation measures for coastal and marine areas
3. Alternative livelihood
4. Resource use conflict
5. Adaptation and coping strategies in the coastal zones
6. Early warning system (EWS) in vulnerable coastal areas
7. Review and updating of policies
8. IEC advocacy

Mangroves act as protection against soil erosion, storms, and sea level rise.

Environment

State of the Art (2007-2010)

In the process of development, urban areas are the first to be industrialized. Hence, it has very high economic, political, and social importance. More people therefore are attracted to converge in these areas for employment and improvement of socioeconomic status. Build up of transportation facilities consequently increase. Metro Manila has about a million motor vehicles operating and spewing tons of carbon monoxide (CO) and carbon dioxide (CO_2) daily into the air aside from the noise of engines and horns. The 8 million commuters who use up space and produce litter aggravate the stressed environment. Another is metropolitan Cebu. It is crowded as Metro Manila with its more than 18,000 registered business establishments (DENR, 1990).

In the 20th century, the ever-increasing population in major cities particularly Metro Manila placed greater pressure on the environment. There are about 15,000 industrial firms in the country and 69 percent of these is located in Metro Manila.

The concentration of consumption of goods and generation of wastes in one area invariably results in high per capita consumption rates that in turn causes higher demand in natural resources, yielding a host of environmental problems (ESCAP, 1990).

Urban environmental problems in the Philippines have intensified in the past 20 years. Air and water pollution, sanitation, and hygiene practices account for the cause behind an estimated 22 percent of reported disease cases and nearly 6.1 percent of reported deaths and costing PhP 14.3 billion (USD 287 million)/year in lost income and medical expenditures (Kalikasan, 2009).

Reduced spaces for urban greenery due to highly congested cities with dense population and infrastuctures.

Air pollution primarily causes respiratory diseases including acute and chronic bronchitis, pneumonia, and cardiovascular diseases.

Fine particulate emissions resulted in about 2,000 premature deaths and 9,000 cases of chronic bronchitis in the country's four largest urban areas annually (Reyes, 2007). An estimated 4,968 premature deaths each year in Metropolitan Manila due to respiratory and cardiovascular diseases from exposure to poor air quality, account for "12 percent of all deaths in the metropolis, the highest in any urban area in the country" (Kalikasan, 2009). Poor air quality from outdoor air pollution in urban areas and indoor air pollution is also affecting health, accounting for an estimated five percent of all reported disease cases and four percent of all reported deaths in the country.

The impact on the economy from health expenditures and lost income is estimated to be PhP 7.6 billion/year. A 2002 EMB survey reveals that ¾ of all commercial firms in Metro Manila are polluting the air,

while motor vehicles accounted as the most number of pollutants.

Pollution of freshwater bodies is widespread and chronic. None of the water in 158 major rivers are totally safe for drinking; while sixteen are biologically dead. Fifty one percent of all waters classified by the EMB is polluted and do not meet DENR effluent standards while 60 percent of groundwater sources are depleted and contaminated with coliform bacteria.

This pollution is due to decades of continuous dumping of waste from domestic, industrial, and agribusiness sources in inland water systems. Impacts from large-scale extractive activities such as logging, mining, and dam construction have also contributed to sedimentation and siltation of the water systems. As of 2005, 34 bodies of water (28 rivers, 3 bays, 1 strait, 1 pass, and 1 lake) in the country are in various stages of pollution, degradation, and siltation caused by mine tailings and wastes.

The Marilao River in Bulacan which is among the sources of drinking and agricultural water supplies for 25,000 people was given the dubious distinction of being among the world's 30 dirtiest rivers and worst polluted places, as named by US-based Blacksmith Institute. River pollution was due to years of indiscriminate and continuous waste dumping by tanneries, refineries of gold and precious metals, the largest lead smelter in the Philippines, and numerous municipal dumpsites.

Similarly, Laguna de Bay, one of Southeast Asia's largest freshwater lakes, could become biologically dead in a few years if dumping domestic an industrial wastes remains unabated. The lake produces about a third of Metro Manila's supply of milkfish and other edible fish. It helps generate electricity and serves as a key transport route. The *Clean Water Act,* passed in March 2004, gives more right to industries to pollute under the "polluters pay" principle and through discharge permits. The *Mining Act of 1995* also gives water rights to mining firms. These Acts therefore can be leveraged to by industries in finding ways to dump or discharge their wastes into the waters.

While household garbage collection is improving, 90 percent of sewage is not treated and is disposed of in an environmentally unsound manner to find eventually its way into the rivers, *esteros*, and drainage canals. Less than 10 percent of the country's total population is connected to sewers and others rarely maintain adequate onsite sanitation.

An average Filipino generates 35 grams to 70 grams of sewage/day and 640 grams to 1,600 grams/person of solid wastes/day. In Metro Manila alone 6,169 tons of wastes are generated every day (Reyes 2007), which is enough to fill 1,500 dump truck trips/day. From the total volume of trash generated, 1,500 tons daily is dumped illegally on private lands, rivers, creeks, and the Manila Bay, while other wastes are openly burned. In Rodriguez and Payatas waste sites, 76 kilograms of arsenic is released annually into water bodies surrounding Metro Manila. A major problem besetting inland waters is the infiltration of the leachate or "garbage juice" brought about by open and controlled dumping. Leachate emanates from bacterial decomposition of garbage eventually contaminating bodies of water used for fishing, swimming, drinking, agriculture, industry, and other domestic needs.

Meanwhile, the quantity and quality of groundwater also pose a serious problem. Since 1995, the groundwater table in Metro Manila has been receding at an accelerating rate estimated to be 5 meters to 12 meters/year. This has led to saltwater intrusion into a two-kilometer coastal strip from Cavite to Navotas-Malabon (DENR-MEIP 1992 as cited by World Bank 2000).

Flooding affects about 1.9 million people and inflicts losses of about PhP 900 million/year. Almost 7 percent of Metro Manila (about 44 square kilometers) is prone to flooding. The most affected are medium and highly dense residential districts. Flooding occurs because of poor drainage system. In river systems, easement of encroachment is a common problem. This is aggravated by the presence of informal settlers and business establishments along riverbanks. Strong typhoons and continuous downpour brought about by inclement weather exacerbates incidence of floods in many areas.

The presence of persistent organic pollutants (POPs) pose health risk on human beings and the environment. Humans are exposed to pesticides, industrial chemicals, and other toxic by-products from the emissions of incinerators, from hospital and municipal wastes, and dioxins from smelting, refining, and cement plants (EMB-DENR undated). Exposure to these can cause cancer and tumor and other diseases.

Before anyone realizes it, urban centers have already choked up because of pollutants spewed by factories, fumes, and toxic gasses into the air, and chemical pollutants into the waterways. The influx of people into the metropolis exacerbates an already stressed situation, with every space taken up, sidewalks, canals, and estuarines become colonies of informal settlement. Urban areas suffer from noise pollution coming from various sources. All these pose immediate health hazards on the population.

The build up of infrastructures along riverbanks reduces riverflow and promote growth of aquatic plants.

These prevailing problems in urban ecosystem contribute in the so-called global warming phenomenon or climate change. Hence, research thrust and directions for 2010 were geared towards the improvement of the quality of air, water, and land.

At present, there were only nine research and development projects conducted/being conducted by ERDB and ERDS.

Air Quality

To improve air quality, ERDB implemented a project titled *Development of Guidelines and Criteria for Successful Earthballing, Transporting and Transplanting of Trees*. The project formulated guidelines to save trees affected by commercial expansion, roadways construction, and other urban/industrial developments. The guideline is about earthballing, transporting and transplanting of live trees. Trees, shrubs, and other forms of vegetation, planted in highly urbanized areas are nature's own way of minimizing and controlling air pollution.

Settlements along river banks (*inset photo*) like in Pasig River exacerbates deterioration of water quality. Pollution of rivers (*above photo*) like Marilao River is due to organic wastes and industrial wastewater.

Meanwhile, the project on acid deposition's adverse impacts on vegetation and soils in heavily polluted zones in Metro Manila identified the acid deposition-sensitive plants in the urban ecosystem. It investigated the physiological and ecological effects of acid deposition on plant and soil environment.

Results revealed that acidity in the urban areas were already at the acid deposition levels (pH 5.5 and below) compared to the unpolluted areas. Seventy percent (70%) of trees had nutrient deficiencies and diseases due to acid rain. Anatomical assessment is still ongoing and it will be correlated to the morphological structures observed.

Water Quality

ERDB is developing a bioremediation protocol for water pollution control in selected creeks and rivers. The potential biocontrol bacteria isolated from Marilao and Lapad Rivers in Bulacan are being screened for bioremediation properties under laboratory condition.

Whereas, a wetland water treatment system for Marilao River would still be established. The newly approved DENR-RBCO-ERDB project on the application of phytoremediation for water treatment system in Marilao River uses aquatic plants e.g., water hyacinth, duckweed, and *kangkong* to absorb organic substances and heavy metals in the highly polluted Marilao River.

Waste and Toxic Chemicals

On 17 December 2005, NAPOCOR *Power Barge 106* still spilling oil was towed by a tugboat and was forced to moor around 200-meter off the shores of Sitio Bobog, Brgy. Semirara, Caluya, Antique. The oil spill incident was very tragic because it has adversely affected the 2,000 seaweed farmers and fishermen. Oil has penetrated the buttressed mangrove roots and has seeped down into the sediment layers of the coastline killing thousands of mangroves and other marine life.

DENR-Region VI conducted in November 2009 a mangrove species trial with soil remediation to rehabilitate the mangrove at Semirara oil spill-affected areas. In this case, the oil -contaminated soil was dug and replaced with uncontaminated one, then, different species of mangrove were planted in the new soil.

Similarly, DENR-Region VI also implemented a three-year project on mangrove nursery and rehabilitation for oil spill-affected areas in Guimaras and Iloilo. This was funded by Team Energy Foundation, Inc. The project was able to establish mangrove nurseries that supplied the planting requirements for the rehabilitation of the 40-hectare oil spill-affected sites.

Wastewater discharges from households into rivers contributes to poor water quality.

Issues and Concerns

The urban ecosystem is beset with water, air, and noise pollution; problems on solid waste management, greening problems, poverty and high energy consumption.

Air pollution (visible smog) is caused by fumes and toxic gasses coming from factories and the many transport vehicles that run on fuel.

Water pollution is aggravated by inefficient sewage collection and by discharge of untreated waste water from domestic and industries rendering major rivers in the metropolis dead.

There is much to identify and screen plants and microorganism with potential for phyto- and bioremediation for polluted water, mined-out areas, and solid wastes.

The problem on solid waste add continuous burden to water and air pollution. There is also occurrence and increase in water borne diseases in urban population due to poor sewage and solid waste management. Leachate, emanating from the decomposition of garbage in dumpsites, contaminates bodies of water while open burning of wastes contributes to air pollution. Incidence of respiratory diseases is also eminent in highly urbanized areas.

Solid wastes also clog drainage system causing flash floods aggravated by lack of greening areas.

Changes in land use result in the reduction of green spaces and could result in open unvegetated spaces causing great loss of biodiversity in urban ecosystem.

Likewise, urbanization in coastal areas leads to the deterioration of sensitive ecosystem and can also alter the hydrology of coasts and their natural features such as mangroves, swamps, reefs and beaches that form important habitat for species and serve as barriers to erosion and strong waves.

The ever-increasing population due to rural-urban migration in major cities results in the proliferation of slum areas, higher energy consumption of fossil fuel, and poverty that further stress the environment.

Research Gaps

Efforts to develop, conserve, and preserve the green spaces must be initiated to save the environment and to have clean and sustainable cities in the country.

Open areas, roads, highways, parks and green belts are examples of identified areas that need scientific application of technologies in urban greening.

Development and implementation of Geographic Information System (GIS) mapping and computer simulation models on migration, squatting, housing, population, industrial emissions, occurrence of natural calamities are important tools for planning and decision-making. GIS links together different data sets and present them clearly and concisely in a variety of ways.

Projects that will convert greenhouse gases (GHGs) in dumpsite and other solid wastes into usable/alternative energy must also be implemented. These projects will tremendously reduce GHGs in dumpsites that contribute to global warming. Additional revenue from such utilization will be realized.

Bioremediation and phytoremediation projects/studies are necessary to clean up soil and water pollution in lakes, rivers and streams instead of using chemicals and detoxifying agents/substances.

Researchable Areas

1) Assessment of sources of pollution
2) Phyto- and bioremediation studies
3) Policy study on water quality standards
4) Identification and screening of plants and microorganisms for phyto and bioremediation
5) Assessment of GHG emissions
6) Policy studies on air quality standards
7) Urban forestry/greening using pollution tolerant/resistant and aromatic species to improve air quality
8) Adaption of green architecture in urban centers
9) Carbon sequestration studies
10) Management/disposal of solid wastes including toxic and hazardous waste
11) Socioeconomic analysis of livelihood option in SWM including toxic and hazardous waste

Mines

State of the Art (2007-2010)

To address the current needs of mining rehabilitation, ERDB implemented a banner program, Rehabilitation and *Ecological Restoration of Marginal and Degraded Landscapes and Seascapes* (2007-2010). ERBD has made available R & D information and synthesis of mining rehabilitation measures in a compendium and manual for quick reference of stakeholders.

To verify applicability of mining rehabilitation technologies, pilot projects were established and assessed starting with gold-copper ore mining areas in representative regions. The pilot project took on varying coverage for each of these regions with Region 6 covering mine tailings at Maricalum Mining Company, Region 13 on mine waste dump of Manila Mining Company, and abandoned waste dump in Region 4B (Mogpog, Marinduque), and mined-out areas of Carmen Copper Corporation in Region 7.

Several packages of technologies were pilot-tested to develop the protocol on rehabilitation technologies for mined-out, mine waste areas, and mine-tailings. Ecological restoration strategies using various vegetative and some bioengineering measures were tested.

Various nitrogen–fixing species (auri, mangium, rain tree, and falcataria were among the chosen priority species whose field performance on growth and survival have been verified.

Nitrogen–fixing species auri, mangium, raintree and falcataria.

Tested were various tree, shrub, cover crop species and application of various amendments (media, biotechnology) as phytoremediation measures. To date, successful species/ strategies were:

A) For Mine waste dumps - Mangium, auri, and falcataria

Mangium field growth performance from 2008-2010 in Manila Mining Company, Placer, Surigao Del Norte.

B) For mine tailing areas (Maricalum Mining Company, Sipalay City, and Negros Occidental)

Agoho (*Casuarina equisetifolia*), one of the best performers in terms of height, diameter, and biomass recommended for mine tailing areas.

In the course of the study, certain bird species started to nest in the top three best performing species; agoho, mangium, and bani tree. Chestnut munnia seems to prefer agoho and mangium as nesting sites while spotted dove (or "*tokmo*") nests with hatchlings were observed in several bani trees. The presence of these bird species is indicative of the start of faunal biodiversity enhancement in the degraded sites. This could be attributed to the rapid vegetative growth and dense crown cover of the species under study.

Nesting birds of Tukmo in bani trees.

C) Use of nitrogen fixing cover crops to hasten increase of ground cover and improve microclimate

Nitrogen-fixing species such as forage peanut or "mani-mani" (*inset*), stylo, siratro were used as cover crop.

D. Amelioration technologies

1. Modification of Media

Soil and organic fertilizer addition in at least a 30-cubic centimeter hole (*inset*) has been a regular procedure before seedlings are outplanted.

2. The application of mycorrhiza and other symbiotic and environment-friendly technologies to all outplanted seedlings improved growth performance.

3. Periodic pH monitoring for liming application to minimize plant nutrient deficiencies in very acidic sites during the first year.

4. Bioengineering measures using various materials of check dams as barrier. Only a few schemes have been tested or demonstrated during the period 2007-2010 due to financial constraints.

Check dams for gully stabilization.

In 2009, a separate collaborative project on rehabilitation strategies and ecoutourism development for mine tailing areas were implemented by ERDB, ERDS-Region 8 and Mines and Geosciences Bureau (MGB) to develop remediation measures for mine waste dumps in Bagacay Mines. The project covered hydrologic, socioeconomic, and ecotourism components. Initially tested were forest species i.e., narra, agoho del monte, auri, mangium; grass species e.g., "talahib", wedelia, and vetiver grass, with the vetiver having best performance in terms of survival.

Soil amelioration included straw mulch, forest soil, lime, inorganic, organic, and biofertilizer application. Planting hole size was 0.5 foot X 1.0 foot depth. Field implementation will be up to 2013.

Initial growth of mangium and narra in Bagacay

The research sector was commissioned by DENR to conduct the study, *An analysis of the Environment and Natural Resources Management* (ENRM) *Devolved Functions to the Local Government Units* in 2008 to determine the administrative, technical capability, and preparedness of LGUs to implement devolved ENR-related functions, one of which is on mineral development. Results revealed that the devolution has

compounded the problem on unregulated extraction and waste management.

Issues and Concerns

Past pilot demonstration areas studied were mostly in the gold-copper abandoned mine tailings/mine wastelands. While there is a wide array of potential technologies for various mined-out areas, mine waste sites, and other mine off-site affected areas, there is a need to test and verify these technologies in more pilot areas.

With limited resources to support R & D activities, there is a need to establish research collaboration between DENR and private mining companies on rehabilitation.

Slope failure and landsliding are main problems disrupting mining operators and rehabilitation. Geohazard mapping is a vital study to address proper engineering of interventions.

The proliferation of small–scale mines due to unregulated issuance of small-scale mining permits extensively continues to degrade the environment. Where the regulatory controls devolved to LGU for permitting small-scale mining and to the national government for large-scale mining, onsite resource-use conflicts gravitate to widespread mismanagement of the mining-affected environment. Regulations on access, managing wastes, extraction, transport, and refining become muddled with jurisdictional issues on accountability and responsibility between the LGUs and the national government; and propriety rights issue between large-scale miners and small-scale miners. This prevailing milieu pits the environment to adverse degradation and engenders severe hazards on the abounding communities in the mining areas.

Harmonization of policies and streamlining of regulatory functions are an entry point to pursue institutional study from which to draw upon the effective system of managing environments affected by mining. While the regulatory aspect pertains largely to government function, the institutional study will also look into the structural aspect of the mining industry to assess its operational efficiency and build upon this the mechanism for collaborative management of the environment between the government and the mining industry.

Gaps and Challenges

The ripple effect of mining rehabilitation must be also seen in the other portions of the ecosystems such as the affected mine tailing causeway, mangrove areas, rivers, and water bodies of the damaged watersheds. Studies on socioeconomic and political aspects to improve management schemes should be part of the 2011-2016 plans. Valuation studies of the ecological impacts of mining activities are scant. The importance of these studies ascertain problem-based and resource-specific development interventions of degraded ecosystems. Additionally, these studies provide criticial inputs in crafting land use plans. Their importance therefore account for more RDE programs or projects.

There is a need for more coastal geohazards mapping information for assessment in climate change programs. Data and maps showing coastal areas vulnerable to coastal erosion or the degradation, salt water intrusion, and coastal flooding are needed to be identified for precautionary measures.

Researchable Areas

1. Rehabilitation of abandoned mines owned by the government
2. Assessment of small-scale mining practices
3. Policy review and evaluation
4. Feasibility studies
5. Socioeconomic survey of mining activities
6. Gender mainstreaming
7. Valuation studies
8. Manpower needs

Lands

State of the Art (2007-2010)

ERDB assessed the impacts of the *Handog Titulo Program* (HTP) land distribution scheme in terms of socio-economic, environmental, and institutional aspects in selected Luzon provinces particularly those covered by the *Comprehensive Agrarian Reform Program* (CARP). The results of the assessment were used as inputs to improve the government's land distribution scheme.

In support to the Land Management Bureau (LMB), a research study to determine the carrying capacities and the appropriate rentals of public lands was conducted. A bigger and long-term R & D program was prepared in coordination with LMB to attain its multi-faceted objectives for the succeeding 2011-2016.

Issues and Concerns

The issuance of the new DENR administrative orders replaces most of the outdated land administration laws and those not in accord with recent land use legislation. With the new policy guidelines, there is a need to document the effectiveness of these policies. There is a need to verify if improvements are addressed to minimize the overly bureaucratic, technically-oriented land titling and registration in the system. In terms of regulation and management, the following concerns are: (1) disposition concerns, (2) environmental concerns, (3) technical concerns, (4) monitoring concerns, (5) fines and penalty systems, and (6) research and policy.

There is still a need to improve land use to resolve conflicting interests, determine the judicious allocation of revenues, and improvement in revenue generation.

There are a number of concerns over tenurial instruments in lieu of command and control regulations and well-thought of plans and strategies for expired and cancelled leases.

Gaps and Challenges

Cursory studies and limited information reveal however, the need for consolidating certain land classification, disposition, and land development functions in one centralized agency. Currently, the system of classifying lands either as alienable or disposable does not reflect the specific use of land. There is a need to go into the deeper analysis and policy research/investigations on these.

Presently, the holistic basis for resolving land use conflicts including foreshore areas are lacking. Competing land uses continue to be a major concern to be resolved by the government. Biophysical studies for appropriate determination and allocation of land use are wanting. Biophysical studies as a strong basis for appropriate determination and allocation of land-use for a national land-use policy for the country are still lacking.

Policy recommendations prescribing the rules and regulations in the use and disposition of alienable and disposable lands and socioeconomic assessment on impact of land distribution are needed to come up with bases to efficiently implement land management.

Researchable Areas

1) Development of holistic basis resolving land use conflicts
2) Policy review and updating
3) Review of policies for foreshore area management
4) Impact of land distribution program
5) Technology transfer of LAMP technologies

Water Resources including Freshwater

State of the Art (2007-2010)

The Philippines is endowed with abundant water. The country's annual rainfall is about 2,400 millimeters of which 1,000 millimeters to 2,000 millimeters is collected as runoff by a natural topography of more than 421 principal river basins, some 59 natural lakes, and numerous small streams. It has an extensive groundwater reservoir with an aggregate area of about 50,000 square kilometers. Overall, there is sufficient water but not enough in highly populated areas during dry season and an excess amount during rainy season causing flooding in many parts of the country.

The water resources RDE concern covers water as a resource and freshwater ecosystem which provide various goods and services. It is anchored on the idea that providing sustainable water and other services to the people would be impossible unless protection of the sources of the commodity, the watersheds, is given priority attention. On R & D, the ERDB's RDE 2007-2010 identified six research and development concerns on water. These include: a) economic pricing of raw water to ensure sustainability of quantity and quality aspects of raw water sources; b) preservation of the environment, particularly maintenance and development of watershed areas; c) erosion and sedimentation control program of river basins being utilized as source for hydropower, irrigation and domestic water supply; d) impact of climate change on the hydrology of river basins; management of hazards, disasters, and risks; e) development of appropriate methods of water pollution control; and f) holistic approach in water resources development.

Limited but meaningful studies were implemented on the abovementioned concerns during the period. In terms of management of hazards, the research sector implemented the program, *Vulnerability Assessment of Selected Characterized Watersheds*. The program was initiated to address the hazards occurring in the watershed so that appropriate programs can be instituted to minimize the occurrence of the disasters. The results of the assessment serve as input in formulating an integrated watershed management plan. These can also be used in updating LGUs' land use plans. By the middle of 2010, about 43 watersheds were completely assessed as to their vulnerability to natural and anthropogenic hazards.

In response to the possible impacts of climate change, the project, *Impacts of Climate Change on the Extent and Magnitude of Flooding and Landslides in Selected Watersheds* was started in Magasawang-Tubig-Baco-Bucayao River Basin in Oriental Mindoro. Initial results revealed the increasing occurrence of flooding in downstream areas during the last decade. Factors that contribute to the increase in extent and magnitude of flooding i.e., heavy siltation in riverbed, land use changes, climate, infrastructures, and others are being analyzed.

As its response to address water crisis and support the disaster risk management program of the government, ERDB entered into an agreement with the Watershed Department of the National Power Corporation (NPC) to implement the project on the establishment of hydrometeorological stations in NPC-managed watershed reservations. The project is geared towards better management of water resources by providing information on water quantity

and distribution. The project covers eight watersheds. These are:

a) Buhi-Barit watershed - Buhi, Camarines Sur
b) Tiwi watershed - Albay
c) Caliraya-Lumot watershed - Laguna
d) Makiling-Banahaw geothermal reservation - Laguna
e) Angat watershed - Bulacan
f) Ambuklao watershed - Benguet and Mountain Province
g) Binga watershed - Benguet Province
h) San Roque watershed - Pangasinan
i) Magat watershed - Nueva Viscaya, Ifugao, Isabela
j) Pantabangan watershed - Nueva Ecija
k) Pulangui watershed - Bukidnon
l) Lake Lanao-Agus River watershed - Lanao del Sur/Norte

The project complements the ongoing DENR disaster risk reduction project on geohazard mapping in the Philippines which was spearheaded by MGB and NAMRIA of DENR. The geohazard mapping project identified areas prone to landslide and flooding in the country. Geohazard maps were presented to the LGUs so they can take the necessary precautionary measures.

Over the last five years, limited R and D financial support to the ENR sector has resulted in minimal information to describe the situation of freshwater ecosystems in selected sites. Assessment of the impacts of gravel and sand extraction in river systems in Laguna has shown that aquatic biodiversity is adversely affected by such activity but not water quality. Flooding resulting to losses in properties and livestock is a phenomenon closely associated with indiscriminate materials extraction both onsite/offsite. A landscape approach to river ecosystem assessment and water classification has also been done for the period. Research on water pricing of Laguna de Bay has paved the way for the formulation of standards that optimizes the use of the lake as a life support system.

Starting 2010, research studies were also initiated on the determination of carrying capacity of lakes such as Danao, Sebu, Buhi, and Paoay Lake for fish culture and/or

Baco-Bucayao River in Oriental Mindoro providing irrigation water.

recreation activity. The following year, the program, *Climate Change Mitigation* was also initiated and this consists of survey and documentation on the mitigation practices in selected regions of the country.

Freshwater

The freshwater ecosystems encompass aquatic systems which provide most of the water resources for drinking, agriculture, industry, sanitation, and food production. These include lakes, ponds, rivers, streams, reservoirs, wetlands, and groundwater. Approximately 78 lakes, 421 rivers and riverine systems, and about 8 major swamps/marshes make up the freshwater ecosystems. Included are numerous bays, estuaries, and mudflats. At least 6 large and 54 man-made reservoirs/dams add to the list (Sinha and Heaney, 2006). These ecosystems likewise provide recreational, educational, and aesthetic services.

It has been estimated that 40 percent of all known fish species on earth thrive in freshwater ecosystems. Depletion of groundwater resources has been an increasing problem in most urban areas. Essentially, threats to freshwater ecosystems health come from both within and outside the watershed. Local, national, and regional management approaches may be necessary, depending on the unique situation of each ecosystem.

A glimpse of the gender perspective and development in quarrying showed equal participation of men and women in actual extraction activities. In the small-scale mining operations in Itogon Benguet and Panganiban, Camarines Norte, only men are directly involved in the extraction activities but women handles processing. In both cases, poverty is a usual situation and involvement of women is largely attributed to lack of options to maintain a living in the area.

A short-term study of the main Pasig River in 2009, despite allegations of its dead status, showed that the river still supports a number of endemic species of fishes which are collected for subsistence by riparian communities, mostly informal settlers. The study showed that Pasig River is not at all biologically dead though the biodiversity level is indicative of seriously polluted environment as evidenced by the presence of pollution tolerant organisms. The Pasig River represents a typical complex freshwater ecosystems that requires the participation of the municipalities traversed by the river in the rehabilitation of major and minor tributaries. A follow-up study focusing on the assessment of major tributaries, psychosocial dimension, and testing of rehabilitation options such as bioremediation and constructed wetlands is underway starting 2010.

A feasiblity study on the use of small gallery forest catchment for community water supply indicates an annual potential income of PhP147,900.00/hectare/year. This excludes the medicinal plants (about 43 species) that can be harvested from the area and enhanced biodiversity (recorded 53 species of birds and 6 species of mammals) which in turn benefits adjacent croplands from good pollination and insect control by pollinators and predators inhabiting the protected forest. A pilot clean culture of *tulla* in streams and diversion ponds indicates a good and profitable venture considering that *tulla* in Laguna lake is already contaminated and it is a potential source of food and at the same time a climate adaptation livelihood.

The development of appropriate method for water pollution control using bioremediation for creeks and rivers was also undertaken by way of laboratory screening of potential biocontrol bacteria isolated from Marilao River which is dubbed by the Blacksmith Institute as the most polluted river in the Philippines. A research on bioinvasion wrought by janitor fish in Laguna de Bay was also undertaken through the study of its bioecology.

Issues and Concerns

Most of the watersheds in the country are in varying degree of degradation and therefore considered "hydrologically critical". As such, the priority concern for water resources management hinges largely on the three main issues and concerns:

- Shortage of water supply. In many urban centers, water availability is becoming a serious problem. The determination of available supply, demand, socioinstitutional factors affecting availability of water and maximization on the utilization of available surface water is an utmost concern. The Philippines has abundant but mostly untapped water resources. Most of runoff water in rivers goes to the sea untapped leaving most areas with limited available water the rest of the year.

Upstream portion of San Cristobal River in Laguna providing domestic water to communities.

- Inequitable water allocation. Determination of economic price of raw water to ensure water use efficiency and equitable water allocation mechanism is still an area needing more information.

- Low water quality and productivity. Maintaining the quality of water according to its intended uses and minimizing water pollution due to solid and liquid waste disposal, upland cultivation practices, mining, and industrial activities continue to be a priority concern in most of the regions in the country.

- Need to address impacts of climate change. Issues on climate change in terms of adaptation, mitigation, and disaster risk reduction still center on the absence and lack of science-based information and data sets as baselines. Baselines are very essential requirement to be able to quantify the changes brought about by climate change impacts and its influences on biophysical elements of the ENR particularly water resources. Similarly, to reduce and neutralize natural disaster impacts on built-up areas, monitoring and forecasting systems in ENR have to be strengthened. This also includes massive capacity-building to enhance and improve awareness on the impacts and how to reduce risks associated with climate change.

- Conflicting resource use. Deterioration of freshwater ecosystems is caused by an array of conflicting uses which originates from within and outside the watershed. Research which determines the best land uses and carrying capacity of the system are needed to efficiently manage the freshwater ecosystem.

Freshwater

Deterioration of freshwater ecosystems is caused by an array of conflicting uses which originate from within the watershed such as pollution, degradation of surrounding ecosystems, and changes in land use. An increasing number of threats result from outside factors such as invasive alien species and climate change and atmospherically deposited toxic substances. Poor environmental management of extractive resource industries such as mining and mineral extraction has lead to the pollution of downstream water courses and aquifers. These unsustainable practices and natural occurrences have caused accelerated and, in many cases, irreparable losses of freshwater species which is further aggravated by increasing human population.

The common management issues in freshwater ecosystems can be broadly categorized into:

(1) conflicting resource uses;
(2) socioeconomic; and
(3) institutional and law enforcement.

The first category pertains to the continuous and direct disposal of domestic and even human and animal wastes accompanied by industrial and navigational wastes which not only jeopardize environmental but also human health. On this aspect, information, education, and communication (IEC) among residents are of crucial importance.

Socioeconomic issues are seen in terms of the over-exploitation of the resources for income. The presence of informal settlers is a common sight in surrounding freshwater bodies. In Laguna lake, for instance, it is estimated that 80 percent of waste come from domestic waste and agricultural runoff and 20 percent is contributed by the fish cages.

On the other hand, legal and institutional issues are seen in terms of low awareness and knowledge of environmental laws at the community level and the observed limited support from the LGUs on activities related to rehabilitation.

All bureaus, attached agencies, and regional offices of the DENR play important roles in the conservation and rehabilitation of the country's freshwater ecosystems. As a complex ecosystem which does not respect political boundaries or municipal jurisdiction, approaches for rehabilitation necessitates a multidisciplinary and integrated RDE.

Researchable Areas

For the year 2011-2016, the research sector identified research areas to be pursued to support the DENR's water sector legislative and water resources management functions. These areas include:

1. Surface water hydrology of river basins/ watersheds;

2. Water pricing. This program covers the determination of economic price of raw

water to ensure water use efficiency and equitable water allocation;

3. Improvement of riparian areas supplying water to various users;

4. Mechanism for an effective integrated water resources management;

5. Groundwater assessment and monitoring;

6. Participatory approach in water resources management;

7. Water harvesting technology. This includes assessment of indigenous water harvesting technologies and introduction of new technologies in water harvesting including its environmental and social impacts;

8. Baseline data on climate change impacts and mitigation;

9. Vulnerability assessment of freshwater ecosystems; and

10. Carrying capacity of water bodies.

Technology Transfer and Commercialization

State of the Art (2007-2010)

Technology transfer systems and procedures were enhanced to bring about the usefulness and impact of ENR technologies. Where appropriate, new procedures were formulated and tested.

In 2007, the ERDB in coordination with all the ERDS offices, implemented a technology transfer program, *National Information, Education and Communication* (IEC) *and Capacity Enhancement Program*. ERDB and the regional ERDS offices pursued the following collaborative activities:

- Media linkage for ENR technologies through the preparation of press releases to reach a wider range of audience.
- Poster production for exhibits showing the ENR technologies promoted by the Research Sector.

- Production of the *ENR Technobulletin* to raise public awareness and interest on ENR research and technologies.
- Technology promotion where ERDB and ERDS held consensus-building activities with LGUs. Clientele in the regions were given need-based trainings as well as IEC materials.
- Monitoring of the adoption of four ENR technologies to gather feedback on the technology application process and usefulness.
- Capacity enhancement for the Banner Program implementers.

From the 14 ENR technologies identified in 2005 for transfer, eight were promoted through the project, P*romotion of ENR Technologies* which was a component of the *2007 National IEC Banner Program*. The clients' (i.e., LGUs, peoples' and private organizations) most requested technology was the production of charcoal briquettes from agricultural wastes, followed by bamboo production technology.

With respect to *Technology Assessment Procedure* (TAP), the PCARRD guidelines was tested in evaluating two of ERDB's technologies – the nursery technique for malapapaya (*Polyscias nodosa*) and the

charcoal briquetting technology. Based on the observations of the team that conducted the assessment, the PCARRD TAP was revised and adapted to fit the needs of the ENR Research Sector.

In 2008, the *ERDB TAP* was formulated and a corresponding ERDB Memorandum Order dated 14 August 2008 was issued.

To come up with appropriate guidelines and procedures on the transfer of ENR technologies, the program, *Determination of Appropriate Extension Strategies for ENR Technologies* was implemented. The ERDB TAP was applied to assess technologies in five pilot regions, namely: bamboo nursery techniques in Region 4A, tikog in Region 8, mamalis in Region 10, pagatpat in Region 11, and tiger grass in CAR.

The results of applying the *TAP* in the said sites were analyzed by the ERDB TAP Team. The analysis was used as inputs in revising the *ERDB TAP*. Hence, the revised *ERDB TAP* was issued on 23 September 2010 through Memorandum Circular No. 01 Series of 2010.

Furthermore, two more procedures pertaining to extension activities were drafted based on the abovementioned analysis. These are the *Determination of Appropriate Extension Strategies for ENR Technologies and the Selection of Site and Clientele/ Adopter*. The draft procedures were used by the same pilot regions in transferring the identified technologies. The results gathered in the pilot regions were again analyzed to come up with a basis in formulating the final procedures. After this, a corresponding memorandum order on the implementation of said procedures was issued.

Regular publications, *Sylvatrop*, The Technical Journal of Philippine Ecosystems and Natural Resources continued to be the vessel for exchange of technical information on Ecosystems RDE. DENR bureaus and attached agencies have actively participated in the Editorial Board and production of journal issues. The *Canopy International* also served as semitechnical publication of the research sector by publishing highlights of projects and programs. To determine readers' feedback and usefulness of publications, readership surveys on ERDB's regular publications were conducted to determine the usefulness of *Sylvatrop, Canopy, RISE,* and *DENR Recommends*, among readers.

Trainings on charcoal briquetting technology, bamboo

ERDB's regular publications. (*counterclockwise*): *Sylvatrop*, The Technical Journal of Philippines Ecosystems and Natural Resources; *Canopy International*; and *RISE*.

propagation, rattan nursery and plantation establishment, production of planting stocks for indigenous forest species were conducted for participants from LGUs, farmers' groups or peoples' organizations, colleges and universities, schools, and government agencies. Provision of technical assistance along technology application and technical matters were extended to groups, offices, and individuals following the ERDB Memorandum Order on technical assistance dated 16 November 2007, Series of 2007. The memorandum order defines the system and procedure for provision of technical assistance to clientele.

In 2010, the technology transfer group, through the Technology Development

Participants in the training on Propagation of Kawayan Tinik in Mamala I, Sariaya, Quezon.

Division of ERDB, started reviewing completed projects to determine and characterize the potential technologies that can be disseminated. The ERDB has 524 completed projects/studies for the period 1974-2010. The identification and characterization of technologies from the research results is ongoing.

There are three applications for patent, now with the Intellectual Property Office (IPO), through the Technology Application and Promotion Institute (TAPI): Mycorrhiza, charcoal briquettor, and five utility models of charcoal briquette stove.

One of the current and urgent concerns is transferring technology pertaining to climate change adaptation. However, the R and D projects on climate change adaptation are still at various stages of implementation. The technology outputs of these projects will be available at a later stage.

Issues and Concerns

Based on the past experiences, there is a need to strengthen technology transfer procedure and process from the technology assessment stage up to the commercialization stage.

First and foremost, many research results of the Research Sector remain untapped for transfer to the clientele. After the 14 technologies identified for transfer in 2005, there should be ensuing efforts to bring to fore other ENR technologies. The results of the previous *Banner Programs on Vulnerability Assessment, Carrying Capacity, Rehabilitation Strategies and Production of Quality Planting Materials* are vitally important inputs to developing useful technologies.

With the data from the Ecosystems Research and Development Information System, the ERDB has 524 completed projects/studies for the period 1974-2010. The ERDS has 1714 completed projects/ studies from 1974-2010. This includes the researches of the forerunner, Forest Research Institute

(FORI). Considering the available reports on these completed projects/studies, the following have to be done:

(1) identify potential technologies;
(2) organize related information;
(3) classify the status of research outputs;
(4) determine technologies for assessment;
(5) determine information technologies for patenting; and
(6) next to patenting, determine technologies for commercialization.

Thus, there is an urgent need to evaluate available research results and identify potential technologies and to integrate related technologies into one technology package. Furthermore, if there are technologies or technology packages, there is a need to determine if these adhere to the criteria along technical accuracy, economic feasibility, social relevance, environmental soundness, and political acceptance.

In the course of classifying research outputs, there is a need to organize and integrate related research outputs to come up with a technology package. Technology packaging will answer the high-demand for technology manuals, prototypes of products or utility models.

Technology packaging is the crucial stage of documenting the development of a technology which includes a presentation of the technical; description of economic, social and environmental features; how it meets regulatory requirements and standards; and satisfies political acceptance.

On IEC concerns, the Research Sector needs to publish more relevant articles from the completed programs and projects for a more vigorous IEC and publication projects and sustained information drive. IEC projects should focus on mass media (print, broadcast, and audiovisual), e-media, and interpersonal methods. With the RDE programs of climate change, a corresponding awareness and knowledge campaign to stimulate public support and action has to be done.

The capability of the DENR to perform extension services is also a big issue – the Department actually has no extension body and there are few people who are really capable of doing the extension service work – a task which the ERDS or the PENRO or CENRO could not adequately handle. Thus, there is a need for projects that would bring about the delivery of information and services to the rural areas or remote barangays. The need for systems and procedures or strategies where extension service can be performed remains a big concern. Along with this, strategies for "immersion work" have to be defined.

The area of technology commercialization needs close study including the formulation of necessary systems and procedures. There is no marketing assistance program for ENR technologies and there is lack of financial support to pursue the adoption of technologies.

To pursue technology commercialization, we need economically-viable technologies that could attract investors. Many, if not most of available ENR technologies need cost-benefit analysis. This is highly important in the application of technologies, moreso, in the commercial scale.

Upgrading of equipment and facilities for the Transfer of Technology (such as for IEC, training, documentation, and exhibit purposes) of the Research Sector Offices and Units have to be pursued along with the projects under the Technology Transfer.

Researchable Areas

Technology Transfer remains to be a key element in achieving relevance, utilization, and impact of results of ENR RDE endeavors.

In response to the identified DENR Sectoral needs, technology transfer should look at the growing concern for urgent and immediate transfer of information, knowledge and technological solutions that would address: **Environmental** concerns (management and disposal of solid wastes, including toxic and hazardous wastes, treating liquid wastes to improve water quality, and improving air quality and controlling air pollutants) and the **Natural Resources** concerns (forest production, land conservation and management, land allocation and valuation); manage freshwater and improve its productivity; conservation and management of **Marine and Coastal Resources**; improved mining and rehabilitation of mined-out/degraded areas; conservation of biodiversity through effective management of protected areas; and **Climate Change Mitigation and Adaptation**.

The above sectoral needs and the corresponding technology transfer concerns are based on the ENR Framework plan covering forest and water resources, biodiversity, coastal and marine resources, mineral resources and geosciences, and environmental management.

Alongside the larger ENR framework, are the technology transfer needs corresponding to the RDE targets of the Research Sector covering ERDB's *Climate Change Adaptation RDE Program* and the major RDE programs and subprograms that will generate technologies, information, strategies, and best practices to help communities and biodiversity cope with the changing climate. The *Climate Mitigation RDE Program* will also be part of the technology transfer concerns to underscore exploration of usefulness of biofuel species, need for fuelwood plantations, and studying carbon sequestration capacities of forest tree species.

Researchable Areas on Organizing and Assessing Technologies and Information

Considering the various research results and information that are in the files or data bank, there is a need to systematize the handling of materials and conversion of these materials into useful form. This requires the reformulation of systems and procedures in the management and use of stock knowledge and in working out ways to create an impact. Technology materials have to be drawn from the results of R and D programs and project outputs for classification, organization, and integration. This is the requirement to properly prepare and define a package of technology.

Technology Assessment Procedure as a standard measure for determining the applicability and usefulness of technologies must be applied to determine its effectiveness in assessing technical, social, economic, environmental, and political value.

Technology Packaging

Technology packaging is a crucial concern that must be looked into. This step in technology development has not been adequately done in previous years for most

ERDB makes use of exhibits to showcase its technologies to a wide range of audience and create greater appreciation of ENR technologies.

information or technology produced by the bureau or the regional research offices. Technology packaging means determining the technology features, characteristics, transferability, applicability or even marketing aspects. Technologies have to be appreciated first through the preparation of technology manuals or production of prototypes or utility models before these are transformed into their final versions.

In cases where technologies need to be translated into draft policies or policy guidelines, write-ups of draft policy guidelines shall be prepared. Technologies for databanking should also be encoded and shall form part of materials in the management information system.

Regular IEC Materials on RDE Outputs

The pursuit of regular IEC projects based on the RDE outputs have to be pursued considering the need for higher public awareness and participation and advocacy for environment and natural resources concerns.

While there are technical information on the technologies and information generated, complementary IEC materials and appropriate information campaign activities are needed to muster public appreciation and participation.

This is the transformation of technical write-ups of technologies (from the technology manuals, prototypes, and models) into readable or understandable forms such as regular, and special R and D publications or other appropriate IEC materials including electronic and mass media.

IEC Materials on Climate Change Adaptation (RDE)

Part of the IEC materials production and dissemination process, is for the Climate Change RDE. This is because of the need to popularize and disseminate research-based information that are important for the awareness and knowledge of the general public, government and nongovernment organizations.

This component is envisioned to produce and disseminate information packages on coping mechanisms, adaptation, and mitigation measures related to climate change, given the available R and D knowledge and information.

Production of research compendia ensures that ERDB's ENR outputs are well documented and are open to the general public for consumption.

Extension of ENR Technologies and Application of ENR Technologies

More substantive and meaningful headways in Extension Services have to be accomplished. Appropriate strategies for technology transfer have to be applied in the field. This includes the application of the guidelines on extension strategies, as a result of the Banner Program on Extension. Other extension modalities such as ENR Information and Technology Services or other strategies need to be explored.

For technologies transferred and information disseminated to clientele, it is necessary to gather feedbacks from end-users and clientele to scrutinize the factors of adoption and utilization. The results shall be used as inputs in the preparation of new project proposals to improve technology or generate new or more appropriate technologies.

Commercialization

The requirements for technology commercialization have to be identified. Appropriate strategies that would suit the needs of the technology, the adoptors or investors and the RDI, have to be formulated. For the marketability and adoption of ENR technologies by industries, a system for commercialization has to be formulated and instituted for the ENR Research Sector.

Technologies that shall be transferred to commercial institutions for utilization shall be covered by separate guidelines under the *Technology Transfer Law* of 2009 or RA 10055.

CHAPTER 4

IMPLEMENTATION STRATEGIES

the framework comes as an intervention that builds on research, models development, and pursues extension with stakeholders as a culminating action to conclude degradation

- Undersecretary Gerochi

ENR RDE Priority Strategies

Enabling Laws and Policies

The RDE continuum is governed by the enabling laws and policies in ENR management. They serve as the sector's lawful cause in conducting RDE activities nationwide and in specific areas and at the same time guide researchers on the bounds and limits of RDE involvement. Aside from Executive Order 192, (*Reorganization of the DENR*), researchers must be abreast with other major laws and policies *in* and *out* of the ENR sector that have implications in RDE program/project planning and implementation. DAO 96-27 amending DAO 90-44 establishes policies in R & D management systems towards the attainment of a more effective and efficient way of preparing, implementing, and monitoring and evaluating DENR R & D activities. In the sector's implementation of RDE programs and projects in specific locations, the applicable provisions of the *Local Government Code* (RA 7160) must be observed.

For forest resources management, the *Revised Forestry Code* stipulates the general directions in forest management at which RDE can link with relative to the emerging forestry issues and challenges. While the *Sustainable Forest Management* Bill is pending in Congress, the R*evised Forestry Master Plan* is a broad reference for specific RDE program implementation.

The *Fisheries Code and the Agriculture and Fisheries Modernization Act* should be carefully observed in the course of RDE program implementation in coastal and marine resources management. For freshwater, the adoption of the Integrated Water Resources Management (IWRM) plan is a major reference.

The *National Integrated Protected Areas System* (NIPAS) *Act* (RA 7586), the *Wildlife Act* (RA 9147), and the *National Caves and Cave Resources Management and Protection Act* (RA 9072) are guiding laws in biodiversity management as well as in RDE program/project implementation.

The governing laws and policies for environmental management must be fully observed in RDE program/project implementation. Among others, the *Revised Procedural Manual on Environmental Impact Assessment* of Department Administrative Order No. 2003-30 supersedes the procedural manual issued under DENR-EMB Memorandum Circular No. 2005-01 on 05 January 2005. The provisions of the *Solid Waste Management Act* (RA 9003), *Clean Air Act* (RA 8749), and *Clean Water Act* (RA 9275) are basic reference materials not just for environmental management but for RDE in support to this.

For mineral resources management, there are two existing laws that the RDE programs aim to support. These are the Philippine Mining Act of 1995 (Republic Act No. 7942) and people's Small Mining Act of 1991 governed by Republic Act 7076.

Through Republic Act 9729 or the Climate Change Act of 2009 the research sector seeks to address the gaps and issues that are relevant to the concern in addressing the impacts of climate change.

Researchers must also be familiar of the multilateral environmental agreements (MEAs) e.g., CBD, CITES, Basel Convention, Montreal Protocol, Cartagena Protocol, Ramsar Convention, in which the Philippines is a signatory. Aside from these, other agreements e.g., WTO and other regional

trade agreements with implications on the ENR use and management must be carefully understood within the sector.

The transfer and extension of RDE technologies are covered by the *Intellectual Property Code of the Philippines* (RA 8293); the *Technology Transfer Act* (RA 10055) and research journals and publications are covered by existing copyright laws.

Implementing Units

The RDE framework shall be translated into action programs and projects to be formulated and implemented by the DENR RDE Network. The network shall be composed of the ERDB, regional research units, and other DENR sectors involved in RDE. The network serves as a mechanism to effectively link offices in the DENR with their respective RDE activities.

The formulation and implementation of the RDE programs/projects/studies shall be made intersectoral where the expertise and facilities of other service sectors shall be tapped. ERDB undertakes demand-driven or action and applied researches which are nationwide in scope and where the technical expertise required is not available in the regional field units, and in other members of the network. On the other hand, the DENR regional ERDS shall focus on specific RDE programs/projects relevant to the needs of their respective regions.

With the provision of adequate funds, the implementation of R and D projects would adopt the ecosystems approach. This approach makes use of multidisciplinary and interdisciplinary means of solving problems concerning the different Philippine ecosystems by taking into account not only one or two but possibly all major factors affecting whatever problem on hand and by seeking solutions through the concerted effort of a multidisciplinary team of experts. The commodity-based approach, however, shall be employed to address a specific problem or concern depending on the exigency of the situation.

In the course of program/project implementation, the DENR Research Sector will take into account the resources, areas of excellence, strengths, and the needs of the DENR RDE centers. These include the Northern Luzon Research Center (NLRC) covering CAR, Regions 1, 2, and 3; the Southern Luzon Research Center (SLRC) with NCR, Regions 4A, 4B, and 5; the Visayas Research Center(VRC) composed of Regions 6, 7, and 8; the Northwestern Mindanao Research Center (NWMRC) of Regions 9, 10 and Caraga); and the Southeastern Mindanao Research Center (SEMRC) covering Regions 11 and 12.

The areas of excellence of the NLRC are watershed management, water resources management, biodiversity conservation, and wild food utilization. Rangeland/grassland management, solid waste management, and nontimber forest products management are the areas of excellence of the SLRC while the VRC has coastal resources management, mined-out area rehabilitation, and ecotourism. The areas of excellence of the NWMRC are wetlands management, and natural and forest plantation development and management; and that of the SEMRC are lake management, agroforestry, community-based forest management (CBFM), and wildlife management. Hence, the RDE centers with research concerns other than their own areas of excellence must coordinate with other centers that have the specific capabilities on the matter of interest.

RDE Equipment and Infrastructure Development

The improvement of research facilities is part of the overall RDE framework. ERDB's research laboratories have been performing various research services and functions for the past 36 years such as plant and tissue analyses; soil physical and chemical analyses; pests and disease diagnoses on seeds, nurseries, and plantations, and their control measures; and seed testing of various forest tree species among others.

With the current and emerging global and local concerns, there is an urgent need to acquire sophisticated pieces of equipment and facilities for carbon analysis and DNA fingerprinting. Therefore, funding support to upgrade research facilities shall be continuously sought from other sources either locally or internationally to augment the research funds coming from the government. Programs to upgrade research facilities shall include the rehabilitation and establishment of modern research laboratories; acquisition of sophisticated scientific equipment and instruments and maintenance of existing ones; acquisition of motor vehicles for more mobility; and building of additional infrastructure to facilitate the efficient conduct of RDE activities.

Enhancement of Program Planning and Monitoring and Evaluation System

As mandated, ERDB shall evaluate and monitor the progress and output/impact of the RDE programs of the network. This shall involve at least four major processes and activities, namely:

- Assessment of the progress of the project vis-à-vis the objectives, Work and Financial Plan, and giving of recommendation for decision-making to ensure that project is maintained according to the implementation plan and objectives (effectiveness);
- Assessment of how the resources have been used within the specified timeframe (efficiency);
- Assessment of how the project was able to help solve societal problem, affect behavioral changes, mobilize resources and communities, affect policies, and contribute to the scientific knowledge (impact); and
- Provision of recommendations and guidance for the planning of future projects.

The Monitoring and Evaluation (M and E) System for the Research Sector will be further refined through consultations and will be institutionalized following the finalization of the results of the DENR M and E Framework.

Development and Maintenance of RDE Information Systems

To effectively carry out the implementation of the plans and programs embodied in this RDE framework, the research sector should be equipped with Information and Communications Technology (ICT) expertise

and knowhow, equipment and facilities for easy exchange/transfer of relevant RDE information within and outside the DENR, other local and international research institutions and various clienteles. Access to georeferenced information systems on ENR RDE shall be established using the latest available technology on ICT to support the RDE management for policy and decision-making but also the information needs of various clientele.

ERDB, being the research, development, and extension (RDE) coordinating and monitoring agency for the research sector of the DENR, shall spearhead the strengthening and enhancement of the information systems such as the ENR R and D Information System (ERDIS), ERDB Technology Generated Information System (ETGIS), Library Resource Information System (LRIS), and Data Tracking System (DTS). It shall likewise develop other information systems on ENR RDE and other support systems. It also envisions to establish a parallel information systems in ERDS for easy access of information and for purposes of uniformity.

An inventory of researches on ENR conducted not only by DENR units but also by other institutions shall also be captured in the existing or new database that will be developed.

With the implementation of the IT Plan of the Department, these systems shall be linked with the Regional offices, with the DENR Central Office and with other DENR bureaus, offices, and attached agencies.

Linkaging and Networking

The Research Sector shall establish, maintain, and strengthen linkages and networks through provision of technical assistance, financial support, exchange of information, and other forms of collaborative implementation of RDE programs/projects with other DENR units, government agencies, LGUs, academe, NGOs, RDE consortia, private sector as well as with international development agencies.

Strategies for complementation and collaboration in RDE Program implementation include:

- Information exchange
- Sharing of expertise and logistics
- Collaboration/partnership/resource mobilization
- Formation of technical service providers
- Tapping research consortia
- Collaboration with Research Development Councils
- Stakeholder analyses and linkaging
- Private-public sector collaboration
- Cofinancing with OGAs and LGUs
- Pooling of Experts

Mainstreaming of RDE Outputs

The mainstreaming of RDE outputs into the operations of the DENR will be another priority concern of the ENR RDE Sector. Research outputs in terms of technologies (processes, products, and information) should be put in place in ENR management to give objective and scientific bases in policy decisions, management actions, and the Department's legislative agenda. RDE initiatives must be felt in the regulatory policies of other ENR sectors and thus, the Research Sector must push for initiatives to operationalize this mainstreaming process.

Strategies for mainstreaming RDE in ENR planning and decision making are the following:

1. Other Sectors
    - Collaboration in program/projects
    - Partnership, resource mobilization
    - Improving awareness
    - Training and social marketing
2. Policy Formulation
    - Develop guidelines to include RDE results
    - Improving awareness
    - Consultation
3. Legislative Agenda
    - Develop position papers
    - Inclusion of RDE issues during executive meeting
    - Advocacy
    - Research Sector's involvement in drafting ENR legislation
4. Public ENR-based Decision Making
    - IEC, training, technology transfer
    - Advocacy
    - Database development

CHAPTER 5

A SIX-YEAR RDE PLAN 2011 - 2016

this budgetary requirement... supports an undertaking that is time-bound and draws upon the urgency of addressing environmental problems and issues that impact on the productivity and security of our communities and on our nation as a whole

- Director Amaro

A SIX-YEAR RDE PLAN (2011-2016)

The *Environment and Natural Resources (ENR) Research, Development and Extension (RDE) Framework for 2011-2016* had been enhanced and validated through consultations with various stakeholders in the DENR, the academe, and the private sector. As a result, high priority RDE programs and projects had been identified with the corresponding strategies for complementation and collaboration with various concerned entities for the effective and efficient implementation of these undertakings. This framework precedes the 2007-2010 RDE Framework on ENR which was also reviewed and which served as starting point for the succeeding Framework (2011-2016).

This Framework covers eight sectoral concerns to wit: Forest Resources and Watersheds; Protected Areas and Biodiversity; Coastal and Marine; Environment; Mines; Lands; Water Resources including Freshwater; and Technology Transfer and Commercialization. Under each concern, priority RDE programs and the component projects are listed, with the corresponding expected outputs and budgetary estimates.

To be useful, generated technologies have to be disseminated to the intended target users and clientele. The activities to this end are also presented herein. The application on commercial scale for each technology developed has to be done also after it has passed the required assessment.

To effectively carry out the plans under this Framework, the roles and responsibilities of the major players in the implementation of these programs/ projects will have to be spelled-out and properly leveled-out. Regular monitoring and evaluation of accomplishments has to be conducted also to determine adherence to the approved Work and Financial Plans and institute corrections if necessary.

The six-year budget for these endeavors is estimated at PhP 1.10 Billion.

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: FOREST RESOURCES AND WATERSHEDS

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1. Tree improvement program								
a) Establishment and management of seed sources, seed production areas, seedling seed orchards, clonal seed orchards, and hedge gardens as sources of quality planting materials	Established sources of materials for propagation and conservation	4,000	4,000	4,000	4,000	4,000	4,000	24,000
b) Production of high quality planting materials including establishment of clonal nurseries	Increased survival and improved production of planting materials	6,000	6,000	6,000	5,000	5,000	5,000	33,000
c) Provenance/progeny trials of some important species	High quality planting materials of indigenous and endangered species (e.g., *kalantas, kalumpang, batino, sakat*, and other indigenous species)	2,000	2,000	2,000	2,000	2,000	2,000	12,000
d) Development of hybrids cum macro-propagation (e.g., clonal propagation and tissue culture) of the best hybrids and elite mother trees	Improved genetic materials	3,000	3,000	3,000	3,000	3,000	3,000	18,000
e) Isozyme and DNA analysis of forest trees and nonwood forest species	Optimized procedure for DNA analysis of forest trees and nonwood forest species	1,500	1,500	1,500	1,500	1,500	1,500	9,000
2. Enhancement of the productivity of reforestation and upland areas								
a) Improvement of reforestation strategies through scientific species-site matching in open areas	GIS maps showing areas and appropriate species to be planted		3,000	3,000				6,000

Contiinued...

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
b) Enhancement of the productivity of upland areas through sustainable farming using mycorrhiza and other soil amendment	Best practices on sustainable tree farming and improved productivity in CBFM areas	1,500	2,400	2,000	2,000	2,000		9,900
c) Restoration of vegetative cover through assisted natural regeneration	Improved vegetative cover of watershed/protection forest		2,000	2,000	2,000	2,000	2,000	10,000
3. Development and management of bamboo, rattan, medicinal plants, other economically important non-timber species to increase raw materials supply for the furniture and cottage industries	Established plantations (e.g., bamboo, rattan, medicinal plants, nito, potential LKS, etc) to increase raw material supply for the industries	5,000	5,000	5,000	5,000	5,000	5,000	30,000
4. Tree health assessment and rehabilitation of selected tree species	Trees assessed and subjected to control measures (e.g. , integrated pest management, tree surgery) in selected areas	1,165	1,165	1,165	1,165	1,165	2,500	8,325
6. Development of improved vegetative and engineering soil conservation measures in heavily eroded critical areas	Pilot demonstration areas of vegetative and engineering conservation measures	4,000	4,000	4,000				12,000
7. Development of GIS-based mapping and georelational information system/ database of forest resources in support to policy/decision-making	Regional and national GIS maps and databases for bamboo and tree plantations through survey and inventory	3,000	3,000	3,000				9,000
8. Valuation of forest resources and development of a system of natural resources accounting	System of natural resources accounting		1,000	1,000				2,000
9. Impact studies on the extent and magnitude of flooding, landslides, and other hazards in major watersheds	Impacts of climate change on flood and landslide magnitude	1,500	1,500					3,000

Contiinued...

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
10. Vulnerability assessment (VA) of critical watersheds	VA and geohazard maps in LGU	2,000	2,000	2,000				6,000
11. Estimation of carbon sequestration rates, carbon densities, and sinks of forest stands	Carbon sequestration rates and carbon densities	1,050	1,050	1,050				3,150
12. Identification of natural and anthropogenic drivers of deforestation and forests degradation	Natural and anthropogenic drivers on deforestation and forest degradation		1,000					1,000
13. RDE program on production, establishment and management of biofuel plantations								
a) Development of propagation protocol for biofuel species	developed protocol for biofuel species		2,500	2,500	2,500			7,500
b) Screening and selection of best provenance	provenance identified		2,000	2,000	2,000			6,000
c) Seed and oil yield determination of biofuel species	seed yield oil content	1,000	1,000					2,000
d) Biofuel and community-based fuelwood pilot plantation establishment using best practices	established plantations	2,000	2,000	2,000	2,000			8,000

Contiinued...

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
14. Review and assessment of existing DENR policies related to forest resources management in the light of new research findings and thrusts of the government	Growth prediction models and adjustments in cut and relations between tree basal area/hectare and crown canopy	1,000			1,000			2,000
a) Development of prediction models for tree basal area/hectare and crown canopy	Prediction models		1,500					1,500
b) Policy review of the implementation of tenurial instruments	Policies reviewed		1,000					1,000
c) Assessment/updating of the guidelines on the accreditation of nurseries and seed services	Revised guidelines		1,000					1,000
	TOTAL	**39,715**	**54,615**	**47,215**	**33,165**	**25,665**	**25,000**	**225,375**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: PROTECTED AREAS AND BIODIVERSITY

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Conservation measures, planning, development, and management strategies of PAs for ecotourism	Conservation and ecotourism management plan for various PAs		1,000	1,000	1,000	1,000	1,000	5,000
2) Baseline survey of local biodiversity prior to release and/or introduction of genetically modified organisms (GMOs) and potentially harmful exotic species (PHES)	Baseline data		1,000	1,000	1,000	800	800	4,600
3) Standard method for scientific monitoring and evaluation of PAs	Policy recommendations on PA management		500	500	500			1,500
4) Study on distribution, abundance, population dynamics of rare, threatened, endangered including economically important and commonly traded species	Comprehensive list of wildlife resources		3,000	3,000	3,000	3,000	3,000	15,000
5) Carrying capacity (CARCAP) assessment in relation to specific uses (e.g., ecotourism, protection, livelihood, subsistence farming, etc) and model generation	CARCAP model applications tested and validated		2,000	2,000	2,000			6,000
6) Development and management strategies for peatlands, caves, and other special habitats	Policy instruments for peatland, cave and karst conservation		2,000	2,000	2,000	2000	2,000	10,000

Contiinued...

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
7) Development of guidelines on critical habitats and integration of biodiversity impact assessment in EIA and ERA processeses	Guidelines on critical habitats. Biodiversity incorporated in in EIA and ERA	800	800					1,600
8) Standardization and harmonization of ERA procedures for GMOs and PHES following holistic approaches	Policy, and risk assessments and monitoring tools	500	500					1,000
9) Surveillance and monitoring of priority IAS including migratory birds	Biodiversity data/information; policy recommendations	2,000	2,000	2,000	2,000	2,000	2,000	12,000
10) Development of GIS-based/ georeferenced database for endangered species	GIS-based database of endangered species	2,000	2,000	2,000	2,000			8,000
11) *In situ* and *ex situ* conservation of premium, rare, and endangered species (REAS)	REAS planted to almaciga, Mindoro pine, igem, PhilIppine teak, etc.	1,500	1,500	1,500	1,500	1,500	1,500	9,000
12) Ecotourism as a business enterprise	Information on the feasibility of ecotourism as an enterprise		2,000	2,000				4,000
13) Effectiveness of issuance of tenurial instrument in PAs	Policy recommendations on issuance of tenurial instruments in PAs		1,000	1,000				2,000
14) Resource and ecological assessment of PA ecotourism sites	Biodiversity profile Classification of Ecotourism sites	5,000	5,000	5,000	 1,000	 1,000	 1,000	15,000 3,000

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
15) Impact assessment of IAS in natural habitats including agroecosystems	Policy recommendations for IAS management	3,000	3,000	3,000				9,000
16) Development of GIS-based/geo-refenced database for IAS and PHES	GIS maps for species modelling	2,000	2,000					4,000
17) Post commercial monitoring and environmental impact assessment of GMOs	biodiversity data/information, tools, and capacity building	1,500	1,500	1,500	1,500	1,500	1,500	9,000
18) Development of community/ socioeconomic impact assessment (SEIA) protocols for GMOs	Socioeconomic indicators, SEIA tools, capacity building		1,500	1,500	1,500			4,500
	TOTAL . . .	**18,300**	**32,300**	**29,000**	**19,000**	**12,800**	**12,800**	**124,200**

SIX-YEAR RDE PLAN (2011 - 2016)

COASTAL AND MARINE

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Coastal and marine resources assessment and monitoring	Spatial Database of coastal and marine resources developed	5,000	5,000	5,000	3,000	3,000	3,000	24,000
2) Carrying capacity assessment of coastal and marine	CARCAP Models and rehabilitation protocols for coastal areas	5,000	5,000	2,000			6,000	18,000
3) VA of degraded coastal areas	VA sites identified, policy and development recommendations	5,000	5,000	5,000	3,000		3,000	21,000
4) Protocol development for mangrove and beach areas rehabilitation	State of the coastal resources report for use in integrated coastal management(ICM) program implementation	3,000	3,000	3,000	3,000			12,000
5) Impact of population growth on coastal resources	Impact evaluation	2,500	2,500	2,500	1,500	1,500	1,500	12,000
6) Development of sustainable livelihood options for coastal communities (e.g., tourism and aquaculture)	Aquaculture products	3,000	3,000	3,000	3,000			12,000
7) Assessment of policies and implementation strategies	LGUs capacitated on ICM plan preparation and implementation; LGUs implementing ICM projects	500	500	500				1,500
8) Extension strategies for policy advocacy in coastal and marine areas	Policy recommendation			500	500	500		1,500

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
9) Adaptation strategies to climate change impacts in coastal zones and small island ecosystems	Adaptation strategies in coastal and small island communities	1,635	1,635	1,635	1,635		1,635	8,175
10) Development of early warning systems (EWS) in vulnerable coastal areas	EWS in highly vulnerable coastal zones	3,000	3,000	3,000	3,000		3,000	15,000
	TOTAL . . .	**28,635**	**28,635**	**26,135**	**15,635**	**8,000**	**18,135**	**125,175**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: ENVIRONMENT

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
WATER QUALITY								
1) Analysis of existing data on water quality of lakes and river systems	Water quality standards updated	500	500	500	500	500	500	3,000
2) Economic feasibility of sewage treatment facility/ plant	Cost benefit of STF/STP	500	500	500	500	500	500	3,000
3) Assessment of stakeholders-based protection of surface water resources management strategies	Conservation protection of surface water for domestic use	500	500	500	500	500	500	3,000
4) Assessment of sources of pollution of water bodies, rivers, lakes, etc. in urban areas	Polluted sources assessed	1,000	1,000	1,000	1,000	800	800	5,600
5) Water quality assessment on toxic substances and pollutants in freshwater bodies	Level of toxic substances and pollutants	5,000	5,000					10,000
6) Evaluation of hospital and industrial waste management	Waste management systems in hospitals/ industrial establishments	1,000	1,000	1,000				3,000
7) Phytoremediation and bioremediation studies on polluted waterways	Identification of plant species with phtyoremediation potential in polluted waterways; phyto and remediation strategies	10,000	10,000	10,000				30,000
8) Policy studies on water quality standards (e.g., Sediments)	Policy recommendations	3,000	2,000	2,000	-	-	-	7,000

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
AIR QUALITY								
1) Assessment of Green house gases (GHG) Emissions parameters	GHG effects on air quality	1,500	1,500	1,500				4,500
2) Long-term effects of substitute and alternative refrigerants	Effects of refrigerants on air quality parameters	2,500	2,500					5,000
3) Carbon sequestration studies in urban environment areas	Carbon sequestration efficiency of tree species	2,000	2,000	2,000	2,000	1,000	1,000	10,000
4) Analysis of existing data on air pollution in highly urbanized areas	Air quality status *viz* standards	1,000	1,000	1,000				3,000
5) Policy studies on air quality standards	Revised policies with updated issues/concerns	500	500	500				`1,500
6) Assessment of clean development mechanism (CDM) Projects for policy formulation	Policy recommendations on CDM projects	2,000	2,000	2,000				6,000
7) Urban forestry/greening using pollution tolerant/resistant and aromatic species to improve air quality	Selected species for pollution abatement	4,000	4,000	4,000				12,000
8) Socioeconomic evaluation of green architecture adoption including biophysical evaluation	Geen architecture adopted in urban areas	2,000	2,000	2,000				6,000

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
9) Comparative study on the occurrence of respiratory diseases of selected groups of populace residing within the air quality monitoring stations	Analysis of selected groups of populace within the air monitoring stations of NCR as to respiratory disease occurrence	1500	1500	1500				4,500
SOLID/TOXIC HAZARDOUS WASTES								
1) Survey/assessment of LGUs' solid waste management schemes and other sectors including MRF	Policy recommendations	3,000	3,000	3,000				9,000
2) Development of database on waste recovery, characterization, reduction and recycling technology	Database and solid waste management strategies	2,500	2,500	2,500				7,500
3) GIS-based assessment in determining the point sources of land pollution	GIS-based database	2,500	2,500					5,000
4) Awareness and compliance of stakeholders to RA 9003 and RA 6969	Improved awareness and compliance to RA	4,000	5,000					9,000
	TOTAL . . .	**50,500**	**50,500**	**35,500**	**4,500**	**3,300**	**3,300**	**147,600**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: MINES

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Evaluation and adoption of best appropriate rehabilitation practices in abandoned mines	Manuals on best practices in rehabilitation and remediation of abandoned mines	2,000	2,000					4,000
2) EIA and SEIA of mining practices of gold rush miners	Management and policy recommendations	3,000	3,000					6,000
3) Improved rehabilitation stategies, schemes, and technologies for areas adversely affected by mining activities	Rehabilitation technologies	5,000	5,000	5,000	5,000	5,000	5,000	30,000
4) Determination of appropriate downstream industries related to mining	Feasibility studies	2,000	2,000	500				4,500
5) Socioeconomic and gender mainstreaming surveys of mining activities in the Philippines	Management and policy recommendations	2,000						2,000
6) Valuation of environmental impacts and benefits of mining activities	Resource valuation standards for mining areas	2,000	2,000	2,000				6,000
	TOTAL . . .	**16,000**	**14,000**	**7,500**	**5,000**	**5,000**	**5,000**	**52,500**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: LANDS

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Development of standards and methodologies for land utilization, valuation, and harmonization	Clear and objective method or model for land valuation	3,000	3,000	3,000	3,000			12,000
2) Alternative modes of providing access to lands other than absolute ownership	Recommended appropriate alternative modes to land access		3,000	3,000	3,000			9,000
3) Optimal use of and revenue generation potentials of patrimonial properties under the DENR	Optimal use and economic benefits of patrimonial properties under the DENR			5,000				5,000
4) Assessment studies on efficiency of new administrative mechanisms to resolve disputes and assess timeliness, social acceptability and economic efficiency	Recommendations on the refinement of administrative mechanisms on land distribution and related land use programs			2,000	2,000	2,000		6,000
5) Determination of policy options for foreshore area management	Recommendations of viable measures for specific foreshore areas	2,000	2,000	2,000				6,000
6) Socioeconomic assessment and gender mainstreaming of the DENR's land distribution program	Determination of relative efficiency of the land distribution program	500	500	500	500	500	300	2,800
	TOTAL . . .	**5,500**	**8,500**	**15,500**	**8,500**	**2,500**	**300**	**40,800**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: WATER RESOURCES INCLUDING FRESHWATER

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Hydrometeorological assessment of rivers being used as source of hydropower mitigation and domestic water supply	Available surface water suppy	2,000	2,000	2,000	2,000	2,000	2,000	12,000
2) Groundwater assessment and monitoring	Available ground water supply		2,000	2,000	2,000	2,000	2,000	10,000
3) Community-based watershed management approach	Approaches on community participation	2,000	2,000	2,000	2,000			8,000
4) Low cost and efficient water utilization technology	Harvesting technologies	2,000	2,000	2,000	2,000	2,000		10,000
5) Review of water allocation	Policy on water		500	500	500	500		2,000
6) Economic pricing of raw water to ensure water use efficiency and equitable water allocation	Raw water price	2,000	2,000	2,000	2,000			8,000
7) Development of strategies for riparian rehabilitation to minimize erosion, sedimentation, and improve water quality.	Improve water quality	5,000	5,000	5,000	5,000	5,000		25,000
8) Generation of data through remote sensing and other technology	Climate Change adaptation and mitigation	3,000	3,000	3,000	3,000	3,000	3,000	18,000

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
9) Socioinstitutional assessment			1,000	1,000	1,000	1,000		4,000
10) VA of water resources	VA reports	5,000	5,000	5,000	5,000	5,000	5,000	30,000
11) Multiple uses of water bodies	Policy on uses	1,000	1,000	1,000	1,000	1,000		5,000
12) Carrying capacity assessment of water bodies	Carrying capacity	3,000	3,000	3,000	3,000	3,000	3,000	18,000
	TOTAL . . .	**25,000**	**28,500**	**28,500**	**28,500**	**24,500**	**15,000**	**150,000**

SIX-YEAR RDE PLAN (2011 - 2016)

SECTOR: TECHNOLOGY TRANSFER AND COMMERCIALIZATION

PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
1) Review and classification of research results generated and application of technology assessment procedure for ENR technologies	Technology assessment reports	1,000	1,000	1,000	1,000	1,000	1,000	6,000
2) Development of technology manuals or product models or prototypes	Technology manuals, products models or prototypes	10,000	10,000	10,000	10,000	10,000	10,000	60,000
3) Filing of application of patents, copyrights, and utility models	Patent granted to technologies	200	200					400
4) IEC materials production and distribution (regular and regional publications)	Brochures, posters, and printed information materials	10,000	10,000	10,000	10,000	10,000	10,000	60,000
5) Extension strategies and transfer of generated technologies	Technologies transferred	10,000	10,000	10,000	10,000	10,000	10,000	60,000
6) ENR Information and Technology Service Centers	ENR FITS Centers		8,000	8,000	8,000	8,000	8,000	40,000

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PRIORITY RDE PROGRAM/PROJECT	EXPECTED OUTPUT	Budgetary Requirement (P '000)						
		2011	2012	2013	2014	2015	2016	TOTAL
7) Establishment and use of demonstration areas for technology transfer	Knowledge and capability of Target PO/LGU trainees enhanced	500	500	500	500	500	500	3,000
8) Evaluation of utilization of technologies transferred	Report on application/ use of technologies	1,000	1,000	1,000	1,000	1,000	1,000	6,000
9) Commercialization of ENR technology	ENR technology commercialized	3,000	3,000	3,000	3,000	3,000	3,000	18,000
	TOTAL...	**35,700**	**43,700**	**43,500**	**43,500**	**43,500**	**43,500**	**253,400**

SUMMARY OF THE BUDGETARY REQUIREMENT OF THE SIX-YEAR RDE PLAN (2011 - 2016)

PRIORITY RDE PROGRAM/PROJECT	Budgetary Requirement (P '000)						
	2011	2012	2013	2014	2015	2016	TOTAL
FOREST RESOURCES AND WATERSHEDS	39,715	54,615	47,215	33,165	25,665	25,000	225,375
PROTECTED AREAS AND BIODIVERSITY	18,300	32,300	29,000	19,000	12,800	12,800	124,200
COASTAL AND MARINE	28,635	28,635	26,135	15,635	8,000	18,135	125,175
ENVIRONMENT	50,500	50,500	35,500	4,500	3,300	3,300	147,600
MINES	16,000	14,000	7,500	5,000	5,000	5,000	52,500
LANDS	5,500	8,500	15,500	8,500	2,500	300	40,800
WATER RESOURCES INCLUDING FRESHWATER	25,000	28,500	28,500	28,500	24,500	15,000	150,000
TECHNOLOGY TRANSFER AND COMMERCIALIZATION	35,700	43,700	43,500	43,500	43,500	43,500	253,400
TOTAL	**219,350**	**260,750**	**232,850**	**157,800**	**125,265**	**123,035**	**1,119,050**

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To provide appropriate technology and information through research, development, and extension towards the enhanced productivity and sustainability of natural resources and protection of environment for the improvement of quality of life of the Filipinos.

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