INDONESIAN BIODIVERSITY STRATEGY AND ACTION PLAN 2015 - 2020

Cover and Sub-Cover : Landscape of Raja Ampat
Photo : Courtesy of CI Indonesia

Back Cover : 16% of the world's coral reefs are in the waters of Raja Ampat
Photo : Courtesy of Tobias Zimmer, Coral Reef Alliance

REPUBLIC OF INDONESIA

INDONESIAN BIODIVERSITY STRATEGY AND ACTION PLAN 2015-2020

Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2015-2020

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LIPI

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gef

UNDP
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Nyadeng Pond

Merabu traditional forest area,
a forest area that stands on
the Kulat karst landscape,
Berau, East Kalimantan

Photo : Courtesy of Pindi Setiawan (ITB)

FOREWORD

THE MINISTER OF THE NATIONAL DEVELOPMENT PLANNING/HEAD OF THE NATIONAL DEVELOPMENT PLANNING BODY

Biodiversity has given real contributions to national development in all spheres of activity. Political commitment, cohesive policies, and coordination at the line level is key to assuring the protection of biodiversity and its sustainable use for the welfare of the community, benefit of today's generation and of posterity. The need to place biodiversity as a resource pillar for economic development has called for clear directives in the form of national strategies and action plans that can be implemented without difficulty even at the sub-national level.

The Indonesia Biodiversity Strategy and Action Plan (IBSAP) for 2015-2020 has been finalized and contains a national strategy and action plan for the management of Indonesia's biodiversity, addressing such aspects as relevant for biodiversity issues and the prioritized national development agenda that spans several years into the future, with a special focus on strengthening the people's productivity and national competitiveness and economic self-sufficiency. It very much stresses on the cohesiveness between the outcomes of international conventions and Indonesia's national policy priorities, it is based on analyses and the latest data, and it represents a consensus among stakeholders working in the sector of sustainable biodiversity management and utilization in the framework of attaining the development goals. Updating of the 2015-2020 IBSAP has as a matter of fact all of the stakeholders in mind with the intention that it will be treated as a principal guideline in policy making and in conservation and utilization planning in the biodiversity sector, and that it will be used as a reference in the implementation of programs and activities in other development sectors, be they the government, private, or civil society sectors at either national or sub-national level.

Strategy formulations and real action to attain national goals under this document must be implemented by all the nation's components. This in turn has called for the mobilization of all powers starting from national and sub-national governments to the community to non-governmental organizations and the private sector in order to comprehend, refer to, and implement strategies and action plans related to biodiversity management under this document. Institutional capacities and the capacity to coordinate must be urgently built, sustainable funding must be mobilized, and institutional mechanisms and support and commitment from all stakeholders must be urgently organized and adapted to the strategies set forth in this document.

I greatly appreciate the cooperation that was given by all stakeholders during the formulation of the national strategy for biodiversity management, which gave us the 2015-2020 IBSAP document. I hope that it can be implemented without difficulty and that it will provide real contributions to the national economic development while strengthening the quality of life of Indonesia's community.

SOFYAN DJALIL
Minister of National Development Planning/
Head of the National Development Planning Body

Snail biodiversity

The Sangkulirang-Mangkalihat karst
is a location with a high snail biodiversity
Photo : Courtesy Aidil (Pecinta Alam Sangatta Forum)

Photo : Courtesy Aidil (Pecinta Alam Sangatta Forum)

WELCOME SPEECH

THE MINISTER OF THE ENVIRONMENT AND FORESTRY

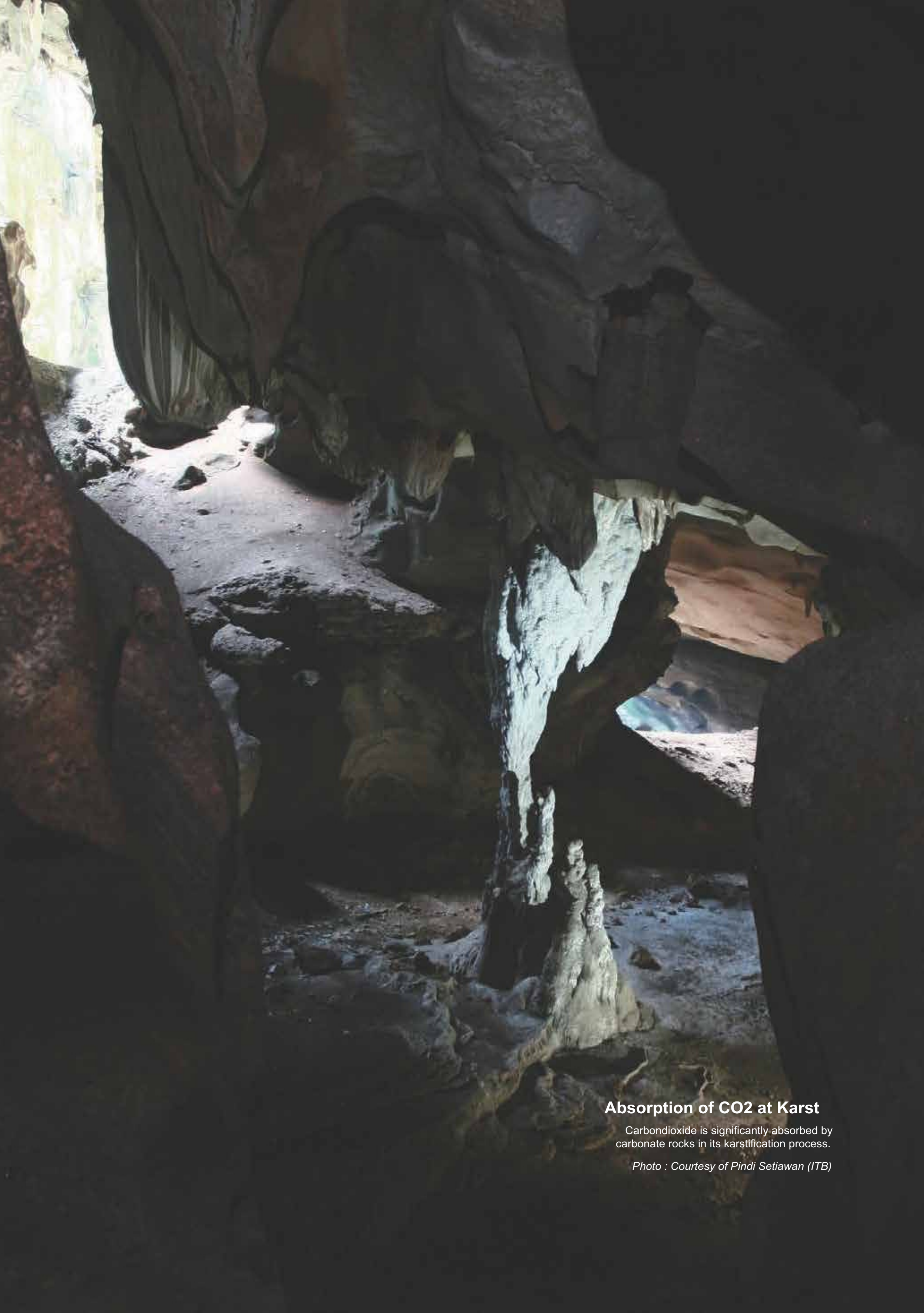
Indonesia has shown a commitment in the management of global and national biodiversity through the ratificationof the Convention on Biological Diversity (CBD) into Law Number 5 Year 1994. The course of biodiversity management in Indonesia started with the formulation of the biodiversity management action plan in 1993 with the focus on conservation programs. When IBSAP 2003-2020 was issued as a guideline for the management of biodiversity for the period of 2003-2020 and became part of the national development planning, in particular related to the management of biodiversity in Indonesia.

Biodiversity as an asset and basic capital of development should be managed wisely so as to benefit the entire nation of Indonesia. Eforts to manage biodiversity consist of the aspects of conservation, utilization and benefit sharing of the biodiversity component utilization, in accordance with the purpose of the Convention on Biodiversity. In 2010, COP 10 CBD became a milestone in the management of biodiversity by generating three global agreements, i.e. the Aichi Targets (global target to reduce the loss rate of biodiversity), the Nagoya Protocol (the agreement to regulate access and to share proits from the utilization of genetic resources) and Resource Mobilization as an important support for the achievement of global targets. This is the basis for updating IBSAP so that the global commitment may be implemented on national and regional levels in order that Indonesia as one of the nations with exceptional wealth of biodiversity can contribute to the reduction of the global biodiversity loss rate.

Updating IBSAP is also an attempt to support the Nagoya Protocol, the Cartagena Protocol and the issue of climate change. Updating IBSAP consist of an action plan agreed by stakeholders and equipped with the latest information on Indonesian biodiversity, institutional framework and other supporting instruments such as mechanisms for monitoring, evaluation and reporting, an Indonesian Biodiversity Clearing House as the information medium and knowledge centre of biodiversity.

We express our gratitude to the parties that are actively involved in updating IBSAP. We hope that this document will serve as a guideline to protect and manage biodiversity for all parties, government institutions, non-governmental organizations, research institutions, educational institutions, the business world and the community.

SITI NURBAYA BAKAR
Minister of the Environment and Forestry



Absorption of CO2 at Karst

Carbondioxide is significantly absorbed by carbonate rocks in its karstification process.

Photo : Courtesy of Pindi Setiawan (ITB)

WELCOME SPEECH

HEAD OF THE INDONESIAN INSTITUTE OF SCIENCE

With gratitude to God Almighty for the abundance of grace and guidance, the updated IBSAP document is properly completed. The biodiversity contained in this book covers all variations of genetics, species and ecosystems. The function of biodiversity is very essential in fulfilling the needs of human life and providing various services to support the life of living creatures, such as the provision of clean water, food, plant pollination, climate control and loods. Biodiversity also contributes to a better quality of life, human health and reduce environmental inequality.

As scientific authority of biodiversity, LIPI has the responsibility to provide enlightenment regarding the importance of biodiversity for human beings and other living creatures as well as the concept of protection. Knowledge of biodiversity is extracted from various sources and IBSAP evaluation outcomes version 2003 -2020. The enrichment target of IBSAP information document provides a framework based on the current Indonesian biodiversity status to be used as the basis for management planning strategy and its implementation. Identification of important ecosystems, type of priority and genetic sources can potentially be used to establish an action program of sustainable preservation and utilization within the next 10 years. This framework contributes to the economic development and environmental harmony.

The many challenges in the management of biodiversity, such as preventing the loss of species, preventing habitat destruction, dealing with climate change, as well as dealing with economic pressures. Such conditions are significant efects on the quality of the Indonesian biological resources and in addition also provide illustrations that the loss of biodiversity, which is an important asset for human life may have a more apparent impact in the future. Meanwhile, understanding the loss of assets is still very limited, for example, information on the number of biodiversity species in Indonesia, number and species of lost biodiversity and the amount of loss that will occur to life at present and for future generations. Therefore, the updated IBSAP document is prepared after additions, corrections and formulation that take a long time to answer the challenge.

We thank all the researchers, experts and resource persons from various institutions and civil society organizations (the Zoological Society of London [ZSL], Burung Indonesia, Flora and Fauna International [FFI], Harimau Kita Forum, Conservation International [CI], World Wildlife Fund [WWF], the Indigenous People's Alliance of the Archipelago [AMAN], KEHATI Foundation, etc.) that worked hard in contributing to provide ideas and information/ data for the realization of this book.

ISKANDAR ZULKARNAIN
Head of the Indonesian Institute of Science

Clown Fish

Raja Ampat Island coral reefs area,
heart of the world diversity.

Photo : Courtesy of Edy Setyawan, CI Indonesia

We profusely praise the God Almighty for the discretion endowed, so that we can complete the preparation of this very valuable document. he Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2015-2020 document compiled is an update of the document that was prepared 12 years earlier, namely IBSAP 2003-2020.

This update is an efort to improve the implementation of IBSAP in the future and simultaneously adjust to the global direction and target (Aichi Target) on the mandate of Decision X/2, COP 10 UNCBD, Nagoya. This document is prepared in the efort to support the UNCBD strategic plan (Strategic Plan for Biodiversity 2011-2020) and to contribute to the prosperity of the nation.

Further, the currently prepared document is sought to be more easily understood by the parties, so that it is expected to facilitate the stakeholders to obtain a guideline in the formulation of policies and contribute to the management of biodiversity in a sustainable manner.

On that basis, the IBSAP document was updated, in particular into a number of action plans that were agreed by the stakeholders and completed with information related to the Indonesian biodiversity status, institutional framework and other supporting instruments such as the monitoring mechanism, evaluation and reporting and the Indonesian Biodiversity Clearing House as a medium of information and knowledge centre of biodiversity.

The updating also indicates that I ndonesia is committed for the biodiversity management on the global and national levels through the ratiication of the Convention on Biodiversity (CBD) into Law Number 5 Year 1994. he course of biodiversity management in Indonesia started with the compilation of the Action Plan on biodiversity management in 1993 with the focus on conservation programs. We hope that this document will serveasa guide line to protect and manage biodiversity for all stakeholders, government institutions, non-governmental organizations, research institutions, educational institutions, the business world and the community.

We apologize if there is still lack of perfections in this document. This IBSAP document is also a compilation of various other complimentary documents, such as: Contemporary Indonesian Biodiversity, Mobilization of Indonesian Biodiversity Financing and Economic Valuation of Natural Resources.

We thank the members of the Steering Committee, Technical Team and other parties that have been actively involved in updating IBSAP. We also thank UNDP that provided support in the process of updating IBSAP.

Jakarta , January 2016

On Behalf of the Drafting Team

ENDAH MURNININGTYAS

Deputy of Maritime and Natural Resources - Bappenas

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Manta Karang (*Manta Alfredi*). Foto : *Courtecy* Tobias Zimmer, Coral Reef Alliance

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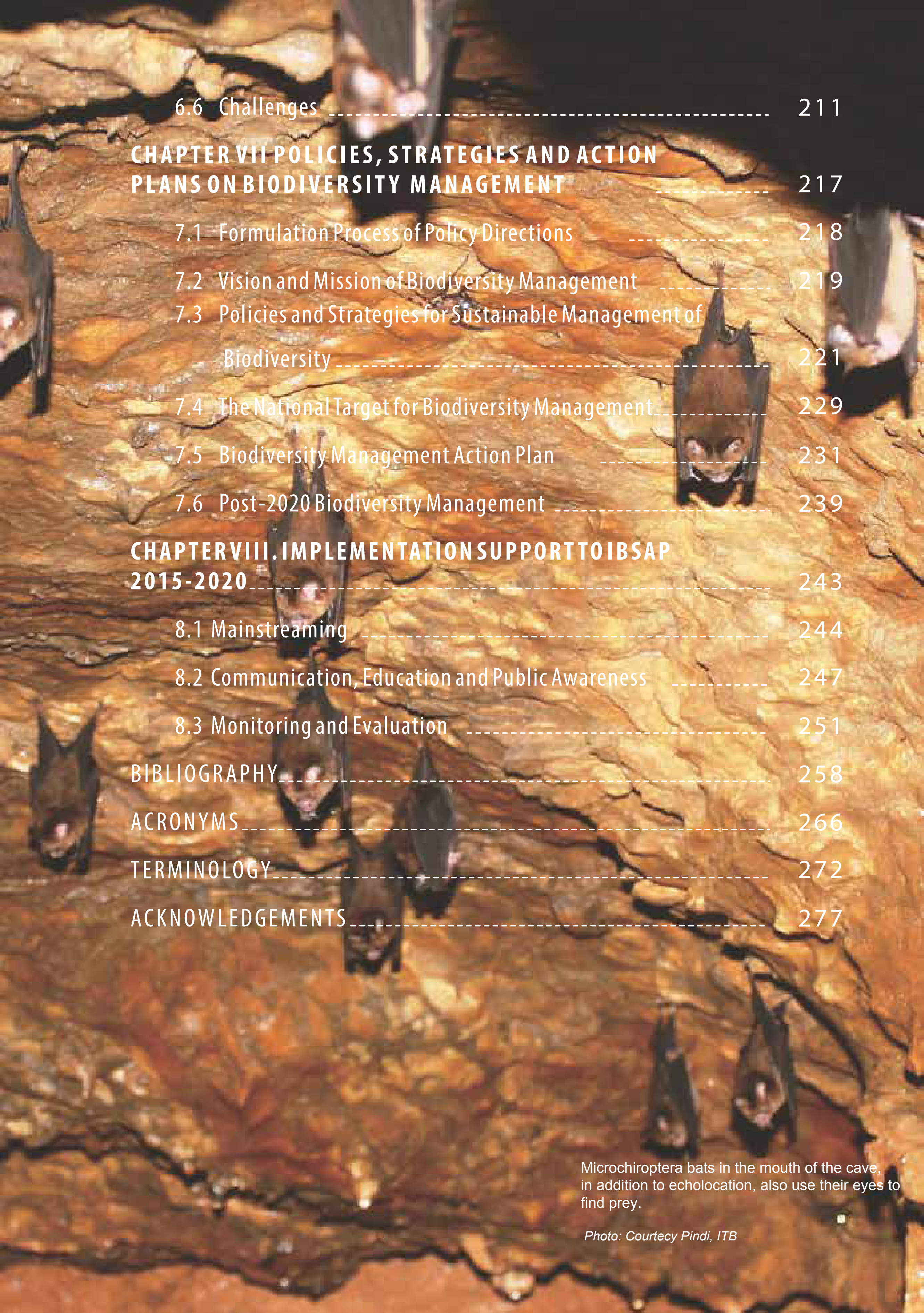

Microchiroptera bats in the mouth of the cave, in addition to echolocation, also use their eyes to find prey.

Photo: Courtecy Pindi, ITB

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"

Biological diversity (biodiversity) have a significant role and contribution to national development in all fields. Political commitment, policy alignment and co-ordination at the technical level is necessary, to ensure the protection and sustainable use of resources for the welfare of the community, both the current generation and future generations.

Joko Widodo, President of the Republic of Indonesia

"

Lukisan *courtecy* Agus Prabowo

Misool, Raja Ampat, Papua

In the waters of the Raja Ampat Islands 574 coral reefs and 553 reef fish species (bullseye) were discovered and are known as the richest marine region with the highest biodiversity in the world.

Photo : Courtesy of Tobias Zimmer, Coral Reef Alliance

1

1. Introduction

1.1 BACKGROUND

Biological diversity (biodiversity) comprises all forms of living creatures on this earth, which are classified into various levels, from ecosystems and species to genetic types. Between one level and another, interactions take place in a circle.

Indonesia is a distinctive and strategic maritime nation that is composed of tens of thousands of islands and groups of islands, spread out along and around the equator and located between two continents (Asia and Australia) and two oceans (Pacific and Indian). Indonesia is blessed with unique and rich biodiversity that serves as the backbone for the lives of hundreds of ethnic groups within the country's territory.

Each ethnic group has its own traditional knowledge relating to the utilization and management of biodiversity, as a source of food, source of raw materials for medicines and various resources needed for living and life. In fact, Indonesia's biodiversity in the last few decades has become an asset to the development of the national economy.

The richness and variety of biological resources and their habitats form ecosystems that are specific and unique and which, as a whole, function as a lung for the world. The uniqueness and beauty of the ecosystems in Indonesia have attracted the attention of the international community and provided a huge contribution to the growth of the tourism industry.

In actual fact, much of the beauty of these ecosystems has still not been utilized, and many of the biological resources have not yet been identified or their potential explored as sources to support life in the future. Management to preserve biodiversity and ecosystems is extremely important, that is to safeguard the integrity of services provided by ecosystems, and open new opportunities for the sustainable utilization of biodiversity.

Planning the management of biodiversity as an asset to development should be an important part of development, so that the Indonesian people can have a reference for the sustainable management and utilization of biodiversity for the prosperity of the nation. The government of Indonesia in 1993 prepared and issued guidelines that were presented in the Biodiversity Action Plan for Indonesia (BAPI). Later in 2003, this action plan was renewed and became the Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2003-2020. Currently, the 2003-2020 IBSAP has been implemented for more than 10 years.

Therefore, it is necessary to make updates in order to improve the plan by accommodating new issues that conform to both global and national dynamics, such as those provided in the Biodiversity Action Plan 2020, Aichi Targets, Access and Benefit Sharing (ABS), biodiversity economy and climate change.

Meanwhile, other important matters that need to be perfected in the 2003-2020 IBSAP document so that it can be used as reference in managing biodiversity are:

1. Updating data regarding the current status of biodiversity and the rate of decrease that has occurred over the past decade, and improving the formula used in preparing policies and action plans

so that the management of biodiversity can enter mainstream development and be more easily implemented, particularly with the mechanism of decentralization and regional autonomy;

2. Inserting new elements, such as economic utilization of biodiversity for the welfare of the people, particularly communities living around habitats of biodiversity, and meet the agreement of the 10th Conference of the Parties (COP) Convention on Biological Diversity (CBD) in Nagoya.

In addition to the above matters, the updated 2015-2020 IBSAP also refers to three important documents, namely:

1. The book *Kekinian Keanekaragamanan Hayati Indonesia* (Current Indonesian Biological Diversity) published by the Indonesian Institute of Sciences (LIPI) in 2014;

2. Several documents regarding the results of studies facilitated by the Ministry of National Development Planning/National Development Planning Agency (Kemen-PPN/Bappenas), such as to identify sources of funding, on the contributions of biodiversity, on mainstreaming biodiversity, on climate change and institutions as well the results of a study on increasing the capacity and process facilitated by Ministry of Environment, which is now Ministry of Environment and Forestry (MoEF) The main document on national strategy and an action plan for the management of biodiversity, or the 2003-2020 IBSAP, which also contains the vision for managing biodiversity after 2020.

I.2 OBJECTIVE

To prepare a national reference book on the management and utilization of Indonesian biodiversity as contained in the 2015-2020 IBSAP. This book is intended to be a document that will be binding for the people of Indonesia in implementing national development in in accordance with the mandate of Law Number 5 Of 1994 on Ratification of the United Nations Convention on Biological Diversity, Law Number 21 Of 2004 on Ratification of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Law Number 11 Of 2013 on Ratification of the Nagoya Protocol On Access To Genetic Resources And The Fair And Equitable Sharing Of Benefits Arising From Their Utilization To The Convention On Biological Diversity, and other laws and regulations related to Biodiversity management and utilization.

I.3 OUTPUT

The 2015-2020 IBSAP is a form of improvement on the previous IBSAP document (2003-2020) with several updates in data that were obtained from:

1. Data and information about the latest status of biodiversity in Indonesia;
2. Identification of programs and action plans to achieve national targets and global targets (Aichi Targets);
3. Results of a study on the economic value and utilization of biodiversity, sources of funding, and a strategy for mainstreaming biodiversity into the development plan;
4. Result of identifying the challenges of managing biodiversity, particularly in the system of institutions;

5. Result of identifying the need for support in implementing the programs and action plans, such as, for example, in determining the mechanism and coordination of institutions between those that have authority in management and those that have authority in scientific knowledge, improving capacity, mechanisms for the exchange of data and information, and mechanisms for monitoring, evaluation and reporting.***

Bunga Bangkai
Entrance to Ageng Cave, Blora

This unique flora commonly known as bunga bangkai or 'carcass flower' actually belongs to the taro family (Araceae) that is an endemic plant growing in tropical forests and exocarst areas.

Photo : Pindi Setiawan, ITB

White Bellied Sea Hawk

Photo: Haryadi, Kutai National Park, East Kalimantan

2

Process of Drawing Up IBSAP 2015 -2020

2.1 EVALUATION ON IBSAP 2003-2020 DOCUMENT

More than 10 years after the 2003-2020 Indonesian Biodiversity Strategy and Action Plan (IBSAP) was issued and became a reference, a lot of changes have occurred, both in the latest data and due to the dynamics of economic and political policy changes at national and global levels.

One of the causes of such changes is presumed to be the more worrying biodiversity depreciation rate during the last decade. Meanwhile, with regard to the scientific world, a lot of progress has been made in the discovery of new species, in terms of plants, animals and microbes. Therefore, carrying out an overall evaluation of the 2003-2020 IBSAP is necessary, particularly in connection with future strategy and planning ahead.

In 2012, Ministry of National Development Planning/National Development Planning Agency (Kemen-PPN/Bappenas) Biodiversity Convention Implementation Strategy in 2012 by reviewing the implementation of the 2003-2020 IBSAP.

FIGURE 2.1 EVALUATION PROCESS ON IMPLEMENTATION OF IBSAP 2003-2020

The objective was to map out the conformity and implementation of the 2003-2020 IBSAP program.

The main documents used in this study are the National Mid-Term Development Plan (RPJMN) 2010-2014 and five ministries (K/L) strategic plans for 2010-2014. Those four Ministries and one institution are Ministry of Environment, Ministry of Forestry, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture and the Indonesian Institute of Sciences (LIPI).

The result of a study by Bappenas (2012), indicated in 2012 indicated that only 37 (26 percent) of the RPJMN 2010-2014 activity programs conformed to the activity programs or targets in the IBSAP, while in fact the IBSAP 2003-2020 document contained five action plans consisting of 72 activity programs to be achieved by 2020.

Particularly in the field of Natural Resources and Environment (SDALH) and Science and Technology (Iptek) in RPJMN 2020-2014, it was identified that four priority sectors and 121 activities were considered relevant to the management and conservation of biodiversity.

Further, based on the results of analysis on the conformity of the IBSAP Action Plan to the 2004-2014 strategic plans of the five K/L,

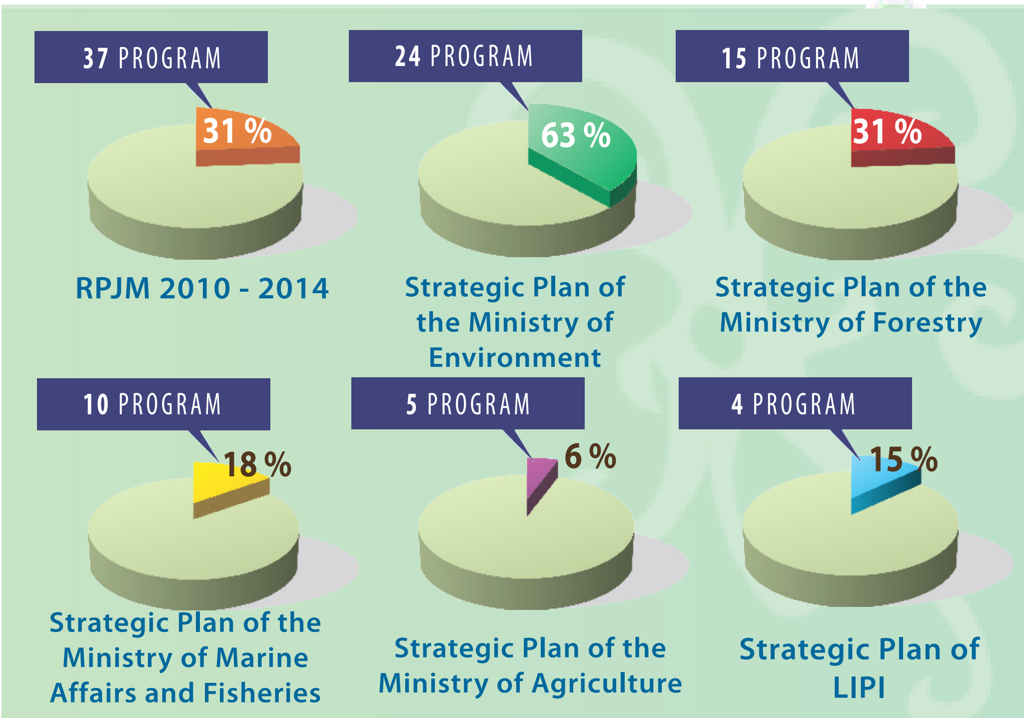
Figure 2.2 Results of analysis on conformity of IBSAP-RPJMN 2010-2014 program

the following results were obtained:

1. Strategic Plans of Ministry of Environment 2010 -2014. Twenty-four activity programs (63 percent) of a total 38 activity programs determined in the ministry's strategic plan were identified as conforming to the activity programs of the IBSAP, including: improvement of community participation; improvement of environmental education and communication; improvement of coast and sea ecosystem conservation and damage control; and management of environmental cases.

2. Strategic Plans of Ministry of Forestry 2010-2014. Fifteen programs (31 percent) of the total 48 activity programs determined in the ministry's strategic plan conformed to the activity programs of the IBSAP, including: development of species and genetic conservation; implementation of forest and land rehabilitation, as well as forest reclamation in priority riparian areas; forest area use control; and forest investigation and protection.

Figure 2.3 Results of analysis on conformity of RPJMN 2010-2014 program, K/L strategic plans and 2003-2020 IBSAP program



3. Strategic Plans of Ministry of Marine Affairs and Fisheries 2010-2014. Ten programs (18 percent) of the total 57 activity programs determined in the ministry's strategic plan conformed to the activity programs of the IBSAP, including: spatial layout and sea, coast and small island area management planning; development of fish germination systems; empowerment of small islands; and area and type conservation management and development.

4. Strategic Plans of Ministry of Agriculture. Only five (6 percent) of the total 80 activity programs determined in the ministry's strategic plan conformed to the activity programs of the IBSAP, including: agricultural biotechnology and genetic resources research and development; improvement of agricultural quarantine service quality and biological security control; agricultural socioeconomic and policy research/analysis; and development of germination, fertilizer and other production means systems.

5. Strategic Plans of Indonesia Institute of Sciences 2010-2014. Four programs (15 percent) of the total 27 activity programs determined in the LIPI strategic plan conformed to the activity programs of the IBSAP, including: development of ex-situ plant conservation areas in the region; biological research; biotechnological research; and limnology (land water resources) research.

Overall, it may be concluded from the results of the evaluation and review that:

1. The adoption of the action plan and programs of the 2003-2020 IBSAP was not optimally carried out in accordance with what was determined in the RPJMN and the K/L strategic plans for 2010-2014. This is proven based on the evaluation of the four ministries and one institution.

2. Most of the adopted programs were related to the action plan of 3rd IBSAP (C), namely improvement of biodiversity conservation and rehabilitation;

3. Point 1 and point 2 show the still low budget allocation from the

National Budget for the management of biodiversity.

The results and review of the achievements of the program and action plan of the 2003-2020 IBSAP are presented in the following Table 2.1:

Table 2.1 Result of review on achievements of 2003-2020 IBSAP action plan implementation

ACTION PLAN IBSAP 2003-2020	*REVIEW ON IMPLEMENTATION*
ACTION PLAN 1 **Development of human and community capacity in management of biodiversity 2003-2020**	The following were established as of 2014: Kalpataru working units in 15 provinces in Indonesia; 463 national Adiwiyata schools and 120 independent Adiwiyata schools; and 516 Biodiversity Warrior Programs, namely environmentally concerned youth movements.
ACTION PLAN 2 **Development of resources, technology and local wisdom in management of biodiversity 2003-2020**	A total of 470 local genetic resources (SDG) were identified and collected until 2014, consisting of 229 fruits, 121 plantations, 55 vegetables and 29 decorative plants/flowers; eight Organic Certification Institutions were available; and 845 companies that obtained wood legality certificates were recorded.
ACTION PLAN 3 **Conservation and rehabilitation improvement of biodiversity 2003-2020**	• A total of 571 conservation areas were determined as of 2014, whereby the management plans of 182 were legalized, 87 were not yet legalized, and the management plans of 252 were not yet drawn up. A total 4.5 million hectares (ha) of water conservation areas were sustainably managed, an addition of 2 million ha of water conservation areas, while 14 priority species were determined to be endangered with populations that should be increased 3 percent in 2010-2014. • The establishment of botanical gardens regulated by Presidential Regulation Number 93 Of 2011. In terms of Ex-situ conservation until 2013, 21 new botanical gardens were established and developed in the regions, making 25 botanical gardens in Indonesia that represent 15 existing ecoregions with a total extent of 4,078.6 ha (Purnomo et al. 2014). • In terms of conservation of fish species, three fish species considered endangered, rare and endemic were identified, mapped, protected, conserved and sustainably utilized in 2010 along with six species in 2011 and nine species in 2012. • Following 12 species in 2013, 15 fish species were conserved in 2014, and in an effort to prevent overfishing, a National Action Plan for Preventing and Overcoming an Illegal, Unreported and Unregulated Fishing (IUU Fishing) 2012-2016 has established through Ministerial Decree of Marine Affairs and Fisheries Number KEP/50/MEN/2012.

ACTION PLAN IBSAP 2003-2020	*REVIEW ON IMPLEMENTATION*
ACTION PLAN 4 **Improvement of institutional capacity and policy regulation of biodiversity 2003-2020.**	• Law Number 41 Of 2009 on Sustainable Protection of Food Agriculture Land was enacted. • The government committed to reducing greenhouse gas emissions through Presidential Regulation of the Republic of Indonesia Number 61 Of 2014 related to Government commitment Law Number 11 Of 2013, which was ratified on May 8, 2013; a draft of the PSDG bill was drawn up and included on the long list for 2010-2014, which will be jointly discussed at the House of Representatives; and a draft of Government Regulation on Karst Area was drafted.
ACTION PLAN 5 **Improvement of capacity on biodiversity conflict settlement** **Objective: Realize justice and balance of roles and interest and minimize potential for conflict among all components**	Handling of environmental cases within the circles of the former environment ministry (currently the Ministry of Environment and Forestry)

Source: Extracted from (i) environment ministry (2008); (ii) BAPPENAS (2012); (iii) environment ministry (2014) in prep, 5th UNCBD National Report

Based on those various weaknesses, recommendations for biodiversity management policy to draw up in the future include:

1. Improve understanding on the importance of biodiversity values and conservation through mainstreaming biodiversity issues at institutional and community levels, including by

   a. Mainstreaming biodiversity issues into national and regional development plans;

   b. Education and socialization on the importance of biodiversity values and conservation as a form of life support for the community and business world;

   c. Strengthening biodiversity issues in the educational curriculum at various levels;

   d. Supporting various activities for improvement on the understanding of important values for community-based biodiversity conservation.

2. Improve human resources quality as well as political, regulatory and budgetary support from various stakeholders in the implementation of biodiversity management, including through the following strategies:

   a. Efforts to improve understanding of legislative members at central and regional levels;

   b. Strengthening of regulations related to biodiversity issues at central and regional levels through the establishment of operational central government regulations and local administration regulations;

   c. Mapping of programs, activities and budgets related to biodiversity issues at various government agencies at the central and regional levels, and encouraging the increase of the institutional budget;

   d. Mobilization of funding from the private sector and community for management of biodiversity;

   e. Institutional strengthening through coordination and collaboration with various parties, such as the government, private sector or community, for the management of biodiversity.

3. Improve the identification, inventory, mapping and publication of biodiversity values, including through the following activities:

   a. Research related to the potential and value of biodiversity by stakeholders;

   b. Drawing up the profile and status of biodiversity and a Management Master Plan for biodiversity in each region; mapping of potential and values of biodiversity in Indonesia;

   c. Economic calculation or analysis of biodiversity in each region.

4. Improve implementation of biodiversity management, for which impacts and benefits may be felt by various parties, particularly the general public, through activities such as:

a. Activities that support biodiversity conservation outside protected areas;

b. Efforts to utilize environmental services that have impacts on biodiversity conservation through an environmental service reward mechanism (payment for environmental services or PES);

c. Empowerment and improvement of community participation in sustainably utilizing the biodiversity potential in their area;

d. Application of economic instruments in sustainably utilizing biodiversity potential.

2.2 APPROACH AND DRAWING UP PROCESS FOR 2015-2020 IBSAP

The 2015-2020 IBSAP was done in a participatory manner by engaging in various processes facilitated by three institutions: LIPI, Bappenas and MoEF. The engagement of those three institutions in the 2003-2020 IBSAP evaluation and review process was due to the following reasons:

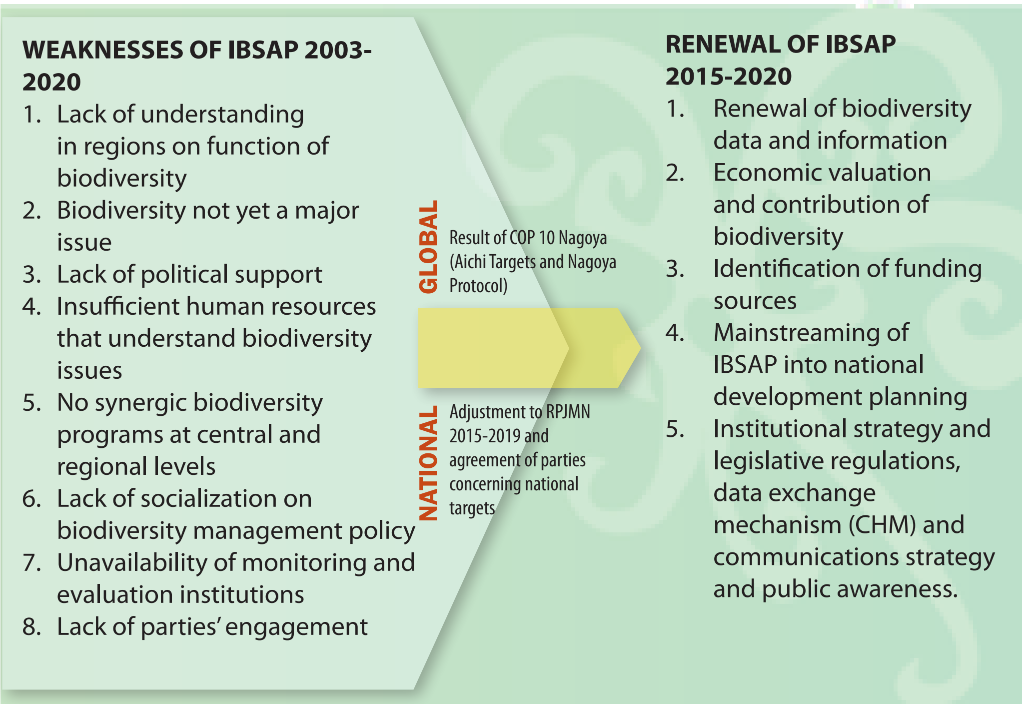
1. LIPI is the institution that has the capacity and authority to collect and renew data and information on biodiversity in Indonesia (biodiversity stock). It is very important that this data and information on the existence of biodiversity is well documented and cataloged so as to become the scientific reference (reference collection) for biodiversity in Indonesia. The important national targets that are determined as part of the overall biodiversity management in Indonesia can be drawn up based on the data and information on this biodiversity stock, which in several respects are the Aichi Targets of Indonesia.

2. MoEF has an important role as it, due to its authority and function, has the mandate to be the focal point for biodiversity management. In this regard, in the 2015-2020 IBSAP process the ministry was responsible for carrying out evaluation,

reviews and studies from an institutional aspect; improvement of capacity, Communication Education and Public Awareness (CEPA); Biodiversity Clearing House Mechanism (CHM); national monitoring, evaluation and reporting mechanism in the National Report (Natrep).

3. Bappenas as the institution with the mandate to “mainstream” biodiversity into national development planning, so that the biodiversity action plan is integrated in the RPJMN and National Long-Term Development Plan (RPJPN) in accordance with the

Figure 2.4 Renewal of 2003-2020 IBSAP program



activity programs of K/L, which are responsible for the existing action plans, as well as the identification of funding sources. As such, results of a review in point 1 (stock and its management), maintenance and utilization of biodiversity at various relevant K/Ls, and the role of the MoEF as a focal point were jointly compiled and synthesized as a result of the 2003-2020 IBSAP review, including drawing up its strategy and action plan.

The combination of components in accordance with the authority and competence of those three K/Ls was further formulated into a national biodiversity management document, or the 2015-2020 IBSAP, in the framework of renewing the 2003-2020 IBSAP.

The process, as shown in Figure 2.5, is described in detail as follows:

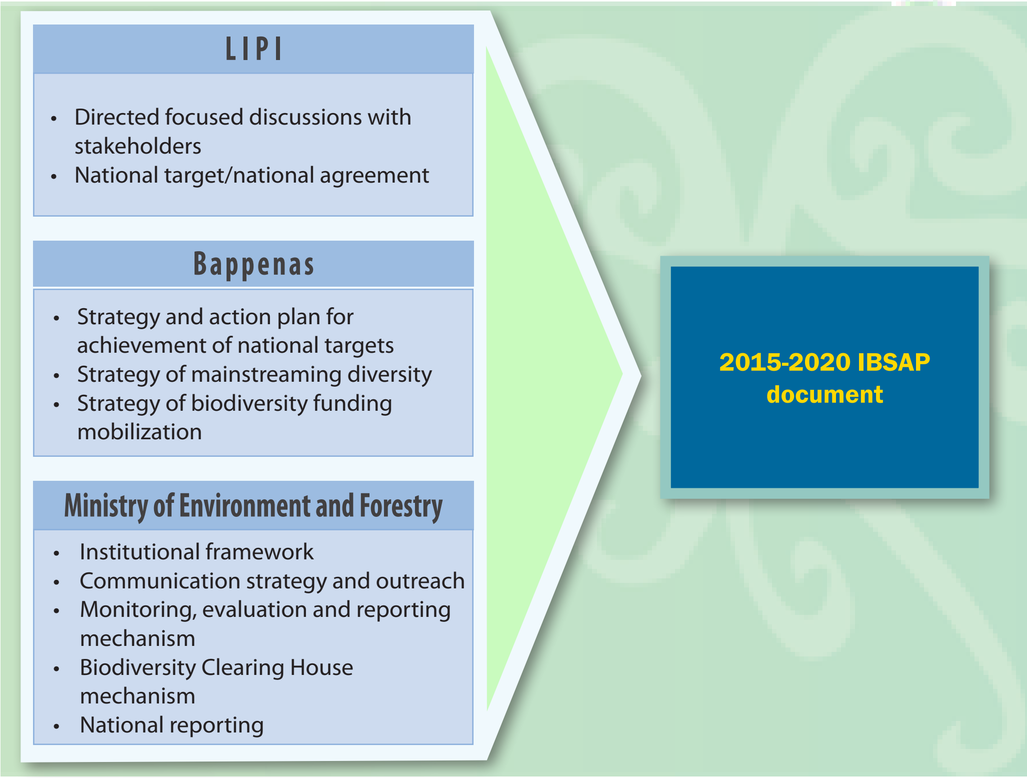
1. **First was renewing data and information on the present status of biodiversity in Indonesia.** The initial data/information on biodiversity stock used to draw up the present status of biodiversity was on species of flora, fauna and microbes from the Biology Research Center of LIPI, the Indonesian Biodiversity Information System (IBIS). Initial data/information such as the database was the result of exploration conducted by various experts since 1841 (the Dutch colonial era) and compiled by LIPI. Data from the database was combined with the databases of herbariums and museums abroad, as well as other databases sourced from the Global Biodiversity Information Facility (GBIF), National Herbarium of The Netherlands (NHN) and Fish Database.

   The completion of this collection of data and information on biodiversity in Indonesia engaged researchers and policymakers of various K/Ls, government institutions, research institutions, government, local administrations, universities and international organizations. The data and information completion and renewal process was carried out through workshops, seminars and focus group discussions (FGD) from 2013 to 2014.

   The collected data from the process was then grouped based on area and analyzed in more detail. Further on, FGD were conducted based on bioregion in order to obtain the latest information on flora, fauna and microbes in the respective areas, and public consultation was simultaneously conducted for the data validation of participants in each bioregion.

   This process was carried out through around 22 meetings, commencing from the data analysis, review and its completion during 2013, and continued with the writing, validation and final review during 2014.

Figure 2.5 Ministries and Institution involved in drawing up 2015-2020 IBSAP



The results of this process were drawn up in a book titled *Current Indonesian Biological Diversity*. The issuance of this book by LIPI was through a standard mechanism that is determined for a book study, namely through a review, book editing and Indonesian language editing. This book was launched (soft launch) on April 28, 2014 at the former environment ministry.

2. **Second was the program and action plan identification process to achieve national and global targets (Aichi Targets).** This process was initiated by the results of LIPI's study recommendations on the renewal of data and information on biodiversity in Indonesia. Based on the problems and challenges experienced in this data and information renewal process, it was decided that the recommendations for several national targets would be accommodated and updated in the 2015-2020

IBSAP document. Other input was obtained from the program identification process related to biodiversity contained in the RPJMN 2010-2014, government work plan (RKP) of 2015 and RPJMN 2015-2019.

Opinions and input on the national target identification were then requested from biodiversity experts, biodiversity management members of K/Ls, local administrations, biodiversity private sector actors and civil society organizations (CSO), through various workshops, seminars and FGDs conducted during 2013-2014. Consultation at the regional level was also carried out in three locations, namely Makassar (South Sulawesi province), Manado (North Sulawesi province) and Yogyakarta (Yogyakarta province) by engaging various resource persons.

3. **Third was the process of a study on funding sources, biodiversity economic contributions and a strategy for mainstreaming biodiversity into the development plan.** This study used two approaches, namely a literature study to obtain secondary data and directed discussions to obtain primary data. The directed discussions were conducted with stakeholders from government institutions, universities, the private sector, as well as civil society organizations. The consultation process was carried out during 2013-2014. In order to draw up the identification study of funding resources, the literature study was carried out on a number of documents of Financial Notes and the Draft Amendment of State Revenues and Expenditures Budget of Ministry of Finance for 2012's Fiscal Year; Biodiversity-Related Aid issued by Organization for Economic Cooperation and Development OECD (2013); and the Guide to Conservation Finance issued by the World Wildlife Fund (WWF) in 2009.

   The extent of biodiversity actors and funding sources made it necessary to not only use resource persons from expert and donor institutions but also the private sector in order to obtain diverse perspectives.

   The preparation of the Biodiversity Economic Contribution Study commenced with a literature study on documents issued by Central Statistic Board (BPS), Ministry Energy and Mineral

Resources, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture, Ministry of Environment and Forestry, as well as resource persons from three important biodiversity sectors, namely agriculture, forestry and maritime affairs and fisheries.

Further on, preparation for a study on mainstreaming biodiversity into the development plan was carried out through tracing various biodiversity programs in the RPJM 2010-2014, RKP 2014 and 2015, and a draft of the Technocratic Plan (RT)-RPJMN 2015-2019, as well as through discussions with biodiversity policymakers at various related K/Ls.

4. **Fourth was the identification of the need for support for the program and action plan implementation, such as from institutions, capacity improvement, data and information exchange mechanisms and monitoring and evaluation mechanisms.** The support-identification process was carried out through directed discussions to obtain input from resource persons, a study carried out by experts, as well as organizing a national workshop with the theme of "Biodiversity as Basic Capital for Development" in October 2013, and a meeting of national biodiversity experts in August 2014.

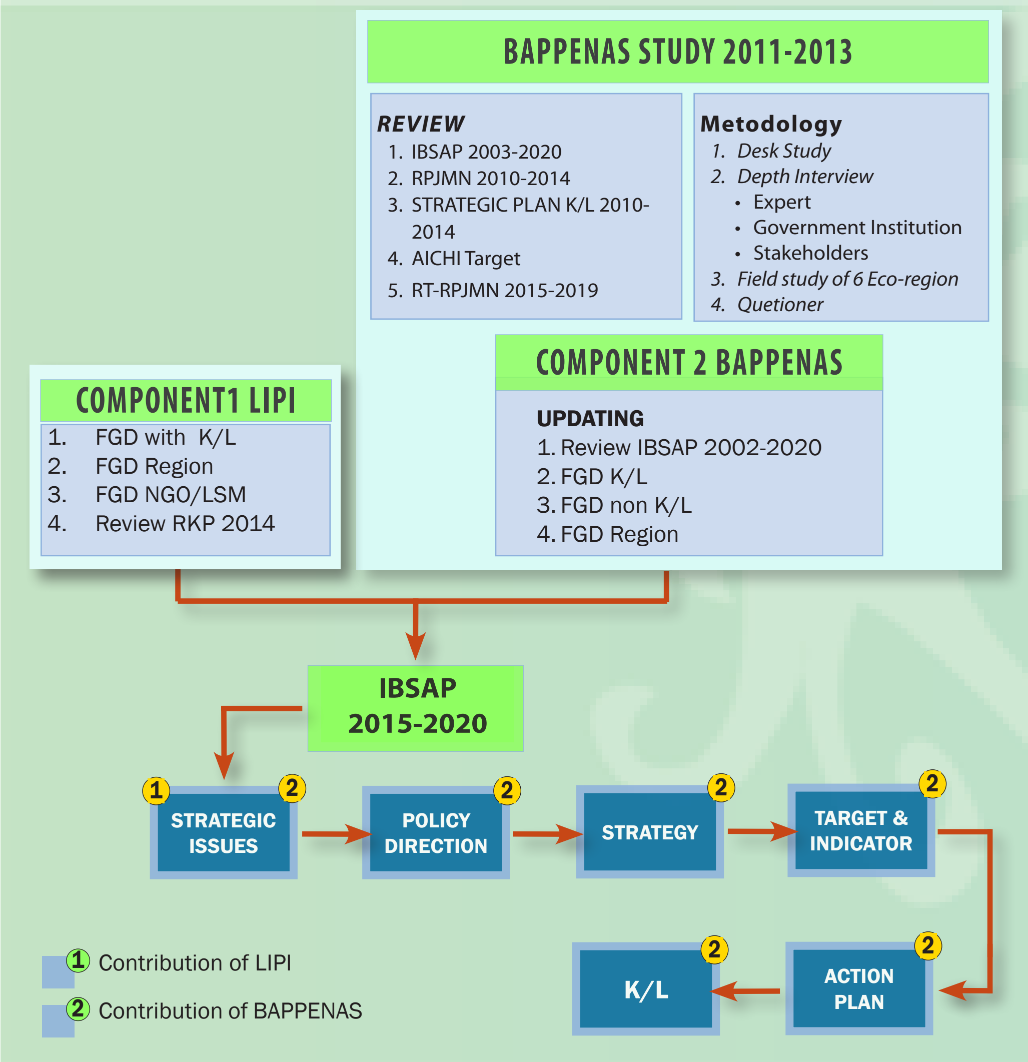
   The results of the national workshop recommendations were one of the considerations and inputs when carrying out the support-identification process for the program and action plan implementation.

   Based on the engagement of experts in the abovementioned processes, as well as the existence of recommendations from the National Biodiversity Experts Meeting attended by researchers from LIPI, universities and local administration representatives, it was agreed that the existence of the Diversity Expert Forum was important.

   The abilities of those experts are an asset to biodiversity knowledge and expertise that has been accumulated for dozens of years, not only at the national level but also at the international level.

   This forum is an instrument that may constructively utilize the management strategy of updating knowledge assets of the

FIGURE 2.6 PROCESS OF DRAWING UP 2015-2020 IBSAP



2015-2020 IBSAP and the utilization in the future. The next identification process is the connection between biodiversity and climate change, institutions, the importance of the Biodiversity Clearing House and CEPA by engaging experts and resource persons who have expertise in their sectors.***

Hippocampus denise (Pigmy Seashorse) This seashorse live in coral reef gorgonian area, found accidently for the first time in 1969, by scientist who collected the gorgonian/sea fan.

Photo Courtessy: Tobias Zimmer, Coral Reef Indonesia

Bekantan (Nasalis Larvatus)

Bekantan are an endemic monkey found in the mangrove forests, swamps and coastal forests of Kalimantan. This species spends part of its time in trees and lives in groups. Due to a decrease of forest habitats in Kalimantan and continuous illegal poaching as well as a very limited area and habitat for their population, bekantan are currently considered endangered according to the International Union for Conservation of Nature (IUCN) Red List

Photograph: Courtesy Wawan Setiawan,Klikclub Kaltim Prima Coal

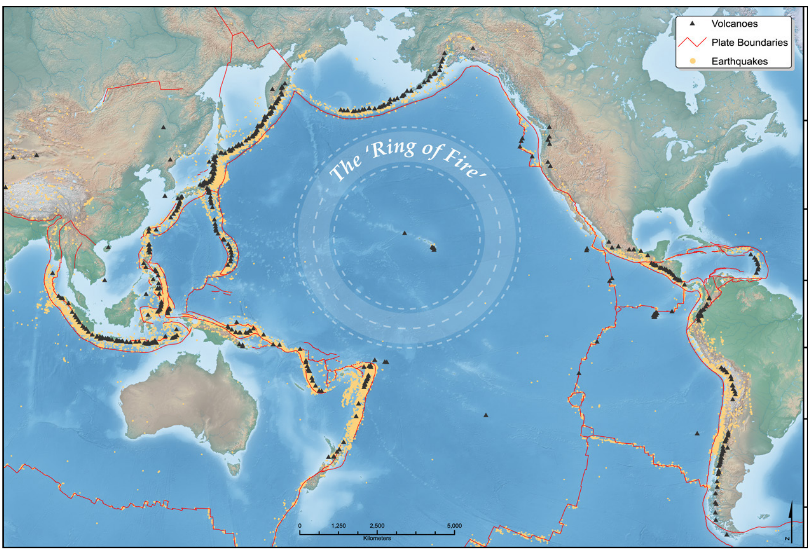
3

Current Status of Biodiversity in Indonesia

Indonesia is an archipelagic country with a tropical climate, located between two continents, namely Asia and Australia, and two oceans, namely the Indian Ocean and Pacific Ocean. As an archipelago with thousands of islands, Indonesia has remarkably diverse and specific ecosystems, each with a special community and high endemism.

Only 13,466 islands of the estimated 17,000 islands are currently understood in detail, provided with a name and registered under the United Nations Convention on the Law of the Sea

Figure 3.1 Ring of Fire



Source: Earth Observatory of Singapore, downloaded in June 2015.

(UNCLOS). Information on the geographical position, extent of area and large number of islands was sourced from the Earth Observatory of Singapore, downloaded in June 2015.

Indonesia is a country with very high biodiversity, featuring a combination of Asian and Australian (Australasian) biodiversity and acting as a meeting point between the two continents

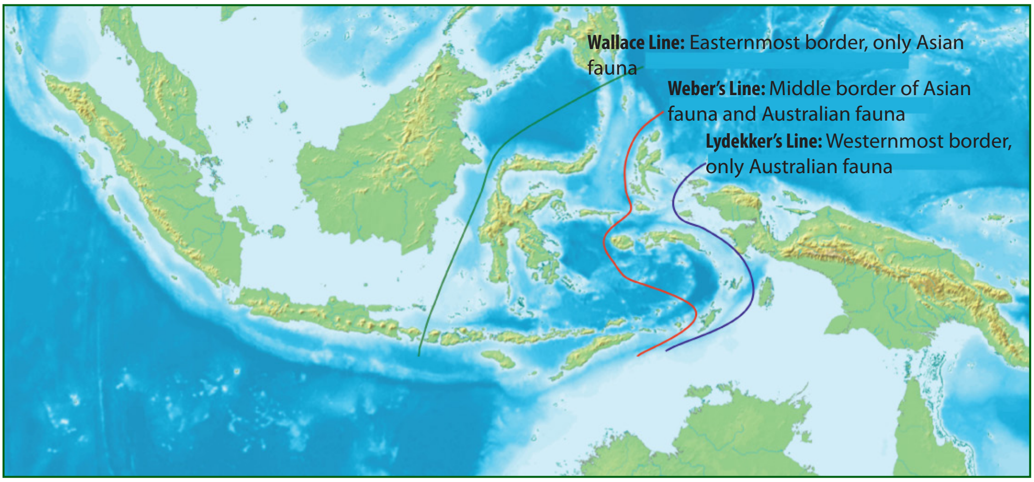
The land territory of Indonesia covers 1,919,440 square kilometers while the country's waters extend over 3,257,483 km2, with 99,093 km of coastline (BIG, 2013). Geologically, two world mountain tracks pass through Indonesia, namely the Mediterranean mountain system in the west and the Circum-Pacific mountain system in the east. Those two mountain tracks result in the country having many active volcanoes, with what is often called the Pacific Ring of Fire leading to Indonesia being vulnerable to earthquakes.

The division of bioregions in Indonesia is based on the biogeography of the country's flora and fauna, tied together by the existence of the Wallace Line (Wallace, 1860 and 1910), Weber's Line (Weber, 1904) and Lydekker's Line (1896). The Wallace Line initially separated the zoogeographic areas of Asia (the Sunda Shelf) and Australasia.

Alfred Russell Wallace was aware of the different fauna groupings between Borneo and Sulawesi and between Bali and Lombok. This line was confirmed by the theory of Antonio Pigafetta, and the Wallace Line was then shifted to the east and became Weber's Line (Weber, 1902). Lydekker's Line is the biogeographical line drawn from the border of the Sahul Shelf (Papua-Australia) located in the eastern part of Indonesia (Hugh, 1992). This division of bioregions is strengthened by the latest research results (Berg and Dasmann, 1977; Duffels 1990; Maryanto and Higashi, 2011).

As such, based on the abovementioned research, Indonesia is biogeographically determined into seven bioregions, namely: (i) Sumatra, (ii) Java and Bali, (iii) Kalimantan, (iv) Sulawesi, (v) Lesser Sunda Islands, (vi) Maluku and (vii) Papua. The bioregion of Papua has an extensive landscape as well as high biodiversity and endemism that influence its ecosystem functions

Figure 3.2 Wallace, Weber, and Lydekker Lines



Source: adapted from S.J.Moss and M.E.J.Wilson).

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3.1 UNDERSTANDING ON BIODIVERSITY

Biodiversity is interpreted as all living creatures on earth, including all plant, animal and microbe species. The existence of biodiversity is interrelated and needs one to another in order to grow and breed and to form a life system. Biodiversity is an important component for the sustainability of the earth and its contents, including the human being existence.

Various biodiversity resources have been utilized since the beginning of human life, from food and medicines to energy and clothing, water and clean air, protection from natural disasters and climate regulation. Biodiversity is also utilized by the public for social, economic and cultural development. The relationship between human interests and biodiversity has produced a lot of traditional knowledge, including on medicines and food types, as well as genomic knowledge, which produces industrial products. Biodiversity is divided into three categories, as follows:

1. **Ecosystem Diversity:**

   Ecosystem diversity covers various forms and structures of landscapes, land or water, where creatures or living organisms (plants, animals and microorganisms) interact and form linkages with the physical environment. Examples in Indonesia are the existence of grassland, moss land, ice fields at the top of Mount Jaya Wijaya in Papua, tropical rainforests in Sumatra and Kalimantan, coral reef stretches in Bunaken, sea grass fields in the Sunda Strait and other ecosystems.

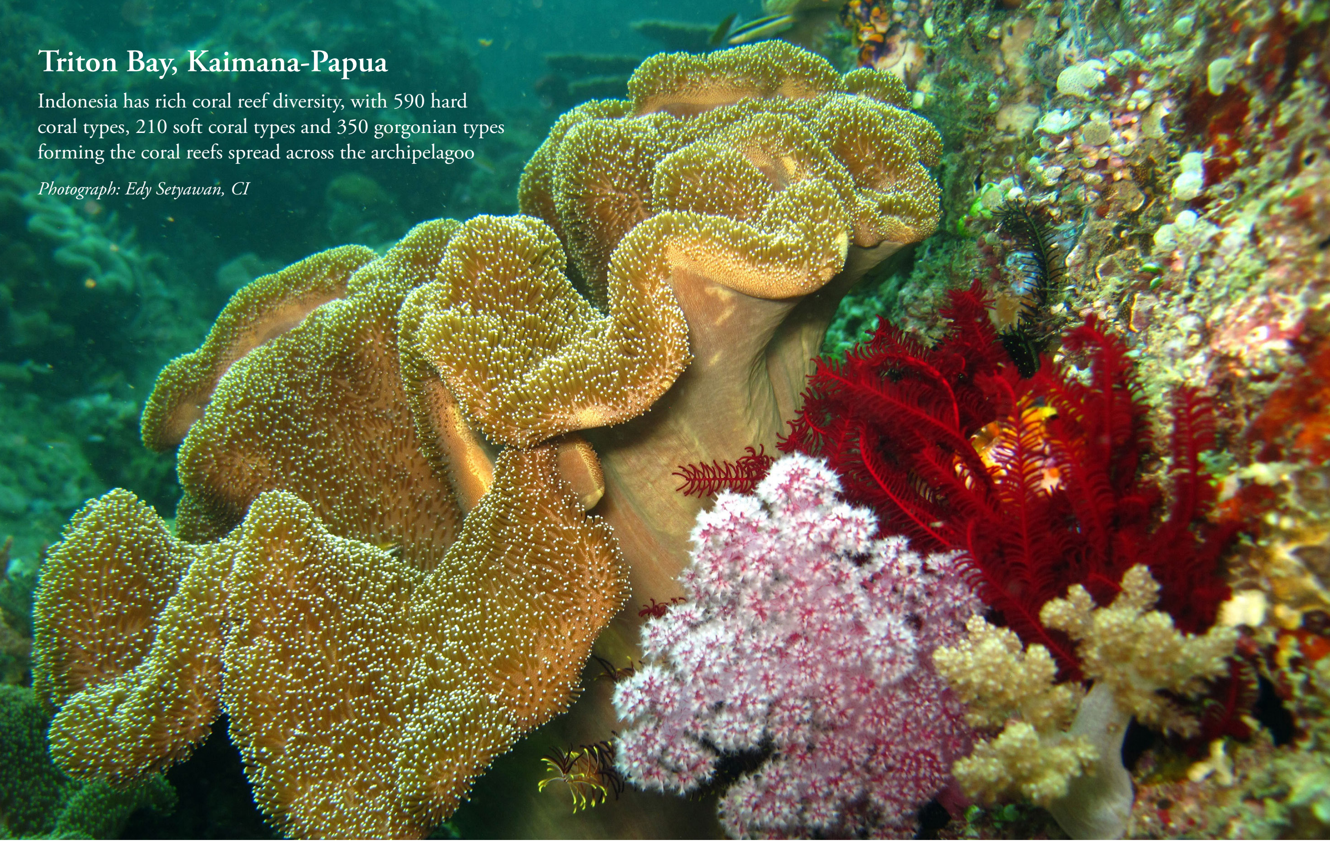
2. **Species Diversity**:

   Species diversity is the diversity of organisms occupying an ecosystem, on land as well as in the water. As such, organisms have different characteristics to one another. For example, there are six species of turtle in Indonesia, namely green sea turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley sea turtle (*Lepidochelys olivacea*), flatback sea turtle (*Natator depressus*), leatherback sea turtle (*Dermochelys cariacea*) dan loggerhead sea turtle (*Caretta caretta*), which all have different physical characteristics (*phenology*). Species diversity is not only measured by the amount of species in a certain area but also by taxon diversity (taxonomy group, namely class, antion, genus, group and family).

3. **Genetics Diversity**:

   Genetic diversity is the diversity of individuals in a species. This diversity is caused by interindividual genetic differences. Genes are the characteristic carrier factors of each organism and may be inherited from one generation to another. As such, the individual in a species carries the gene structure that is different from the gen structure of other individuals. For example, this is shown in the diverse paddy varieties (such as Rojolele, Menthik and Cianjur) or mango varieties (golek, harum manis and manalagi).

Those three biodiversity levels are interrelated. Areas with high ecosystem diversity usually also have high species diversity and high genetic variations. Those three categories are described in more detail in the following section.



Triton Bay, Kaimana-Papua

Indonesia has rich coral reef diversity, with 590 hard coral types, 210 soft coral types and 350 gorgonian types forming the coral reefs spread across the archipelagoo

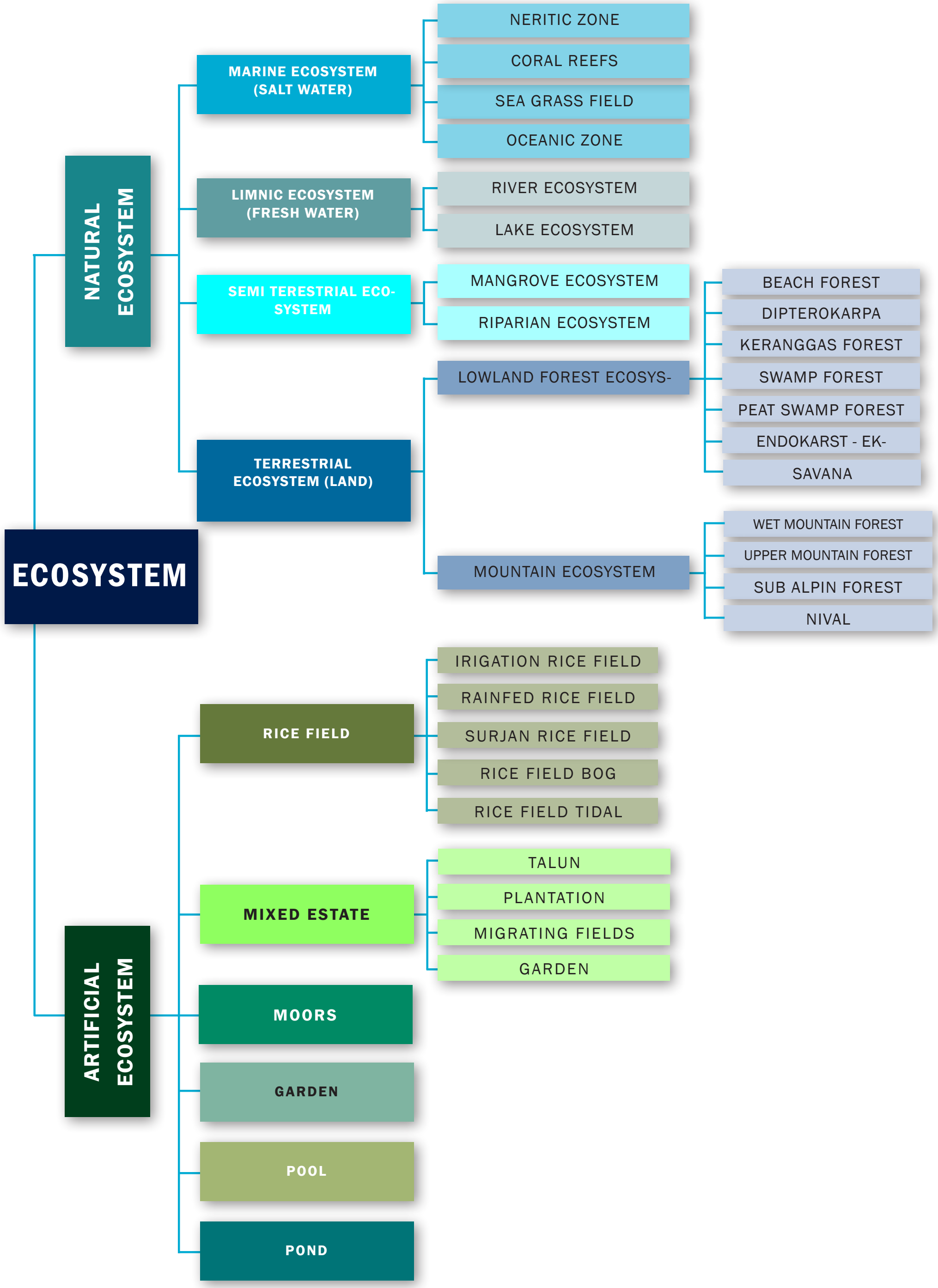
Photograph: Edy Setyawan, CI

3.2 ECOSYSTEM DIVERSITY

Indonesia's ecosystem diversity consists of natural ecosystems and artificial ecosystems (Figure 3.3). A natural ecosystem is an ecosystem that is naturally formed without human intervention. Meanwhile, an artificial ecosystem is formed through human intervention.

Ecosystem diversity is systematically simple, so that it is easy for communities to understand various complex ecosystem types in Indonesia that are interrelated and interdependent (Kartawinata, 2013). Ecosystem diversity in Indonesia is divided into 19 natural ecosystem types that are spread out in various areas from Sumatra to Papua. Those 19 ecosystem types are divided into 74 vegetation types spread across nearly all bioregions in the country (Kartawinata, 2013). Such variation shows that each ecosystem is rich in flora and fauna species. However, not all general information on vegetation in Indonesia has been fully identified.

Figure 3.3 Classification and types of ecosystem in Indonesia



Source: extracted from LIPI (2014)

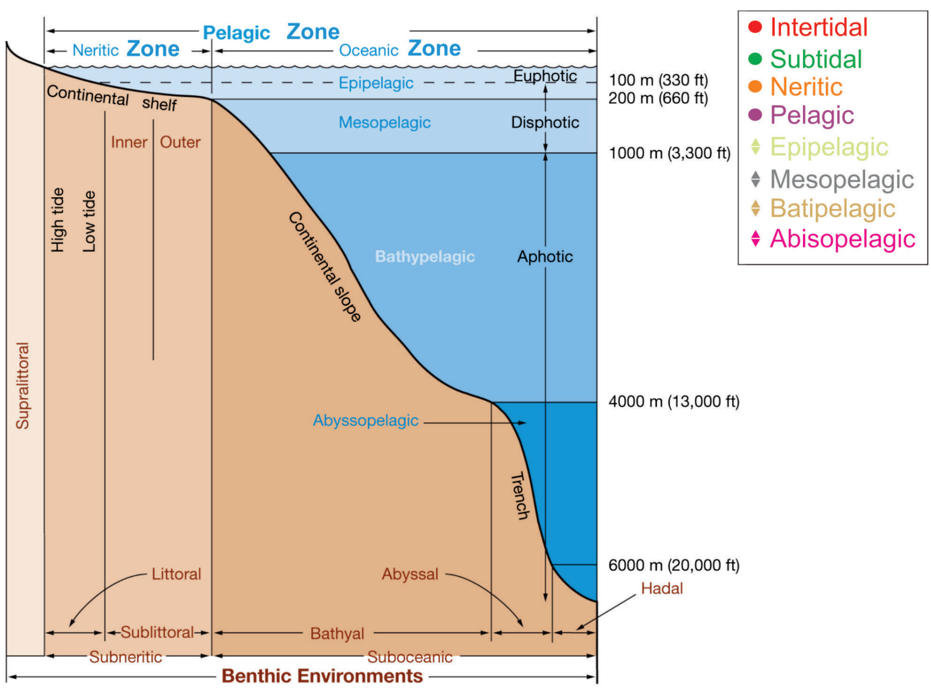
Natural ecosystems are based on general life media, such as water, land and air, distinguished as: (i) marine ecosystems, (ii) limnik ecosystems, (iii) semiterrestrial ecosystems and (iv) terrestrial ecosystems (Ellenberg, 1973).

3.2.1. Marine ecosystem

Marine ecosystems consist of various organisms jointly functioning in a saltwater mass in a certain area, either dynamic or static, and thereby enabling the occurrence of energy flow and material cycles among biotic and abiotic components.

Indonesia, as an archipelagic country, has living media in saltwater (sea) that is more extensive (70 percent) than its total terrestrial media (30 percent). Extensive seawater has different zones, horizontally or vertically, creating varying environmental conditions and thereby

Figure 3.4 Horizontal and vertical division of zones at seawaters



Source: Modifcaton from Odum (1983) and Clark (1992), extracted by LIPI (2014) creating ecosystem diversity in a smaller hierarchy. There are horizontally two marine ecosystem zones, namely neritic and oceanic, and if vertically combined, there are again several zones, namely epipelagic, mesopelagic, batipelagic, abisopelagic and hadal.

The epipelagic zone includes the neritic or oceanic zone, which is up to a depth of 200 meters and is penetrable by sunlight. Most salt water biota is found in this zone. The mesopelagic zone is at a depth of 200-1,000 m with minimal light existence. The batipelagic zone is at a depth of 1,000-4,000 m, the abisopelagic zone is at a depth of 4,000-6,000 m and the hadal zone is at a depth of more than 6,000 m (Figure 3.4).

The marine ecosystem (seawater) is divided into four areas, as follows:

1. **The Neritic Zone,** an area near the shore, is located along shallow shorelines at a width of around 16 to 240 km. The neritic zone stretches from the seashore, which is reachable by the highest tide, in an offshore direction where the seafloor is still reachable by sunlight (sublittoral base) until the oceanic zone (Figure 3.4).

   This zone is divided in two areas, namely:

   a. **Intertidal,** which is the tidal area located at the littoral base, namely the beach bordered by the highest tide and lowest ebb;

   b. **Sub-tidal,** which is the water area bordered by the beach with the lowest ebb until high seas with a depth of around 200 m, also referred to as shallow sea.

Figure 3.5 Photograph a: Sea grass (Genus Enhalus). Photograph b: Coral reef overlay of Acropora type in Tokong Berlayar Island, Anambas Islands.

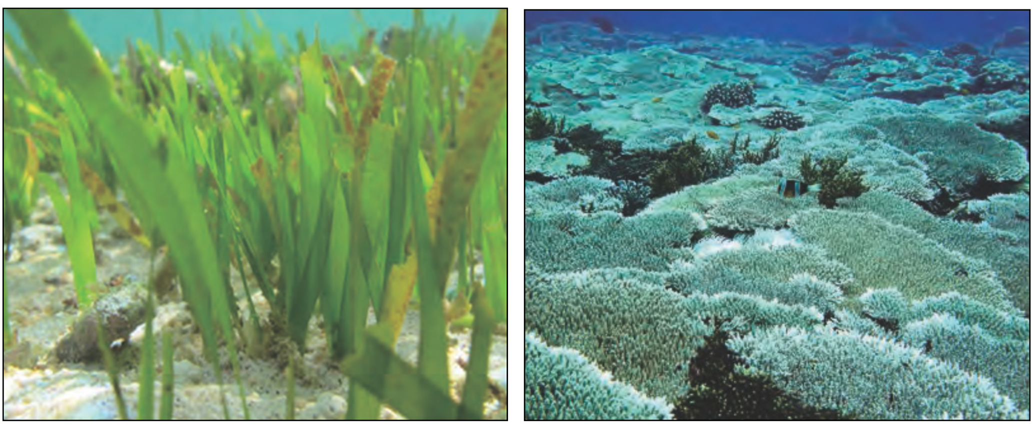


Table 3.1 Price of several types of rock reefs and soft coral

TYPE	PRICE USD/PIECE
Acanthastrea spp	35
Acropora spp	12
Caulastrea spp	14
Discossoma	2
Echinopora	18
Euphyllia ancora	22
Euphyllia glabresscesns	8
Fungia spp	6
Heliofungia actiniformis	9
Ricordea spp	8

Source: Suharsono, 2014

Life in the neritic zone is located along the shore, which is always inundated during low tide, covering the open coast that is not influenced by large rivers or located between steep rock walls. This area is dominated by various seaweed, plankton, nekton, neuston and benthos.

2. **Sea grass ecosystem** in Indonesia cover around 31,000 km2 (Kuriandewa, et al., 2003), and 13 plant species have been identified in them (Figure 3.5a). Sea grass field ecosystems have an important role in supporting the life and development of living creatures in shallow seawater, including as a feeding ground for dugong and as a nursery ground for various sea biota species.

3. **Coral reefs** are occupied by various coral species, namely hard coral (hermatypic, stony coral), soft coral (ahermatypic, soft coral) and gorgonian. The extent of coral reefs in Indonesia covers 51,000 km2, which is 51 percent of the total coral reefs in Southeast Asia, and it has even been said that coral reefs in Indonesia could reach 75,000 km2 (Burke, et al., 2002; Hutomo and Moosa 2005; Spalding, et al., 2001) or 85,000 km2 (Tomascik, et al., 1997).

However, only 6.5 percent of coral reefs in Indonesia are still in very good condition, while 22.5 percent are in good condition and the remaining can be categorized in medium, somewhat bad and bad states (Dutton, et al., 2000). Indonesia has high coral reef diversity, with around 590 hard coral species (82 families), 210 soft coral species and 350 gorgonian species recorded (Hutomo and Moosa, 2005).

Coral has direct and indirect benefits. The indirect benefits of coral are protecting beaches from pounding sea waves and as a carbon absorber. The S320 content of coral, used as a medicinal and cosmetic substance, is an anti-ultra violet ray substance. Coral is ecologically beneficial as a nursery area, a place for egg laying, diverse decorative fish species and consumption fish. The direct economic value of coral is that it is able to be sold as a result of cultivation. For example, living Corallium coral with a beautiful red color has quite a high price, reaching Rp 10 to 15 million per kg. Decorative sea fish also have the potential to be cultivated.

4. **Oceanic zone** is an open sea ecosystem that is unable to be penetrated by sunlight down to the bottom, so the seafloor is very dark. The life in this deep sea ecosystem is not known about in detail. This is due to few experts and limited technological equipment able to carry out research in deep water.

   Human resources and supporting equipment badly need to be developed so that Indonesia can identify species and the potential of existing biodiversity in deep sea areas. If the ability to explore sea biodiversity was improved, Indonesia could be positioned first in the world for biodiversity riches.

   The deep sea environment has a very large role for other ecosystems, as it is the habitat of several fish, mollusks, crustaceans and coral that are able to survive with very minimal oxygen content, very high hydrostatic pressure, low water temperatures and a dark environment. Several samples of deep sea (depth >200 m) fauna are recorded in Table 3.2.

3.2.2. Limnic Ecosystem (Freshwater Ecosystem)

The limnic ecosystem is freshwater ecosystem consisting of river ecosystems and lake ecosystems.

Table 3.2 Several marine fauna in Indonesia

GROUP	SCIENTIFIC NAME	LOCAL NAME	GENERAL NAME
Fish	*Latimeria chalumnae*	*Raja laut*	Coelacanth
Mollusks	*Tridacna gigas*	*Kima raksasa*	Great clams
Crustaceans	*Pagurites antenarius and P. aciculus*	*Kelomang*	Hermit crab
Coral	*Antiphates spp*	*Akar bahar*	

Source : LIPI, 2014

1. **The River Ecosystem** has its own distinctiveness since it is a long corridor from upstream to downstream (Watershed), and the conditions along the right and left sides differ between one river to another, and also differ between the upstream, midstream and downstream areas. Indonesia has thousands of rivers with recorded data. There are 10 longest rivers out of those thousands of rivers, namely:
   a. Kapuas River, West Kalimantan (1,143 km);
   b. Mahakam River, Kalimantan (920 km)
   c. Barito River, Kalimantan (909 km)
   d. Batanghari River, Sumatra (800 km)
   e. Musi River, Sumatra (750 km)
   f. Mamberamo River, Papua (670 km)
   g. Bengawan Solo River, Java (548 km)
   h. Digul River, Papua (525 km)
   i. Indragiri River, Sumatra (500 km)
   j. Seruyan River, Kalimantan (350 km);

   A river ecosystem is a habitat for the aquatic biota within it, such as fish, shrimp, plankton, benthos and crabs as well as various snail and clam species. The body of a river, with its strong current, is dominated by biota that form coverings or whose bodies attach to rocks. Horizontal zones are found in puddles of water, namely the littoral zone and limnetik zone.

There is in addition the vertical zone, known as layers. Such layers can be determined based on the existence of light entering water columns, or based on water temperature. In general, the water layer is based on light existence. In sequence from the surface to the bottom are the euphotic layer (receives a lot of light), disfotic layer (a little light) and afotic layer (without light). Further on, based on temperature conditions, are the epilimnion layer (warm), metalimnion (sharp temperature gradation) and hipolimnion (cold).

Riparian areas in several parts of Indonesia generally experience quite serious threats that can affect the quality and quantity of groundwater, which is useful as a source of healthy drinking water, and is a living place for river biota. The threat originates from the use of rivers, typically from transportation infrastructure.

Another threat is the disposal of waste into rivers, either domestic waste or waste from large, medium or small industries. This contamination not only disrupts the health of communities along the river, which in general utilize river water, including for agricultural irrigation, but may also kill and exterminate biota living in the river.

2. **Lake Ecosystem** are located in lowland areas and mountain areas and may be distinguished based on their formation, such as the occurrence of tectonic, volcanic, crater and caldera sections, which are in general located in highland areas in mountainous surroundings. Conversely, flood lakes are located in lowland areas and are relatively shallow and tend to continue growing shallower due to siltation and the growth of invasive water plants. Indonesia has around 840 lakes and 735 small lakes with a total extent of around 491,724 ha.

   The widest lake in Indonesia is Toba Lake (110,260 ha) while the smallest, deepest lake is Matano Lake (600 m). A total of 521 lakes of the 840 have an extent of more than 10 ha, spread out across almost all islands, mainly in Sumatra, Sulawesi, Kalimantan and Papua (Nontji 1991), and include three of the

Box 3.1. River Water Contamination and Damage

Many rivers have experienced damage because of being contaminated, such as in the cases of the Ciliwung River and Cisadane River in Java. However, although rivers experience environmental degradation, a river's habitat and its biota will be able to carry out water quality recovery (self-recovery process) from the contamination, particularly organic waste.

The self-recovery process occurs along with the time and distance that organic substances which experience degradation have traveled, causing changes and decreases of organic substances. Therefore, there are several recovery zones in river water contaminated by organic substances, from water that is still clean in the upstream area, to polluted areas, the area experiencing recovery and then clean water in the downstream area. However, naturally clean water in the downstream area is not as clean as that seen upstream.

The natural effort in the form of the self-recovery of such waters persists gradually. The possibility of self-recovery in such waters strongly depends on the minimum dissolved oxygen (DO) content that can still enable the oxidation of all contaminating organic substances. Aeration can support the acceleration of the self-recovery process.

In a case where river water is heavily contaminated, self-recovery will not run perfectly. It is then necessary to take additional actions in the form of preventing or processing the input load in the river. A clear example is the Clean River Program (PROKASIH), which is intended to make rivers healthy.

Success with regard to PROKASIH has been proven in the Thames River (England), Seine River (France) and Rhine River (Germany-the Netherlands)).

Table 3.3 Classification of water quality based on dissolved oxygen contents

Group	Dissolved oxygen contents (ppm)	Water quality
I	>8 or changes occur in a short time	Very good
II	6,0	Good
III	4,0	Critical
IV	2,0	Bad
V	<2,0	Very Bad

Soruce: Pratiwi, dkk., 2009.

20 deepest lakes in the world (>400 m) (environment ministry, 2008.

3.2.3. Semi-terrestrial ecosystem

The Semi-terrestrial ecosystem are spread out in limnik (freshwater) and marine (saltwater) areas. This ecotone has important functions and roles and is often included as an essential ecosystem. A semiterrestrial ecosystem consists of (1) mangrove ecosystems and (2) riparian ecosystems.

1. **Mangrove Ecosystem**.

   The composition of cover plants in mangrove ecosystems is determined by several major factors, namely substrata (form of texture and stability), tidal conditions (frequency, depth and or duration of inundation) and salinity (daily and seasonal variation).

   Mangrove diversity in Indonesia has been recorded as reaching 243 species, classified in 197 genera and 83 families of the 268 species in Southeast Asia (Giesen, et al., 2007). In Indonesia, the species diversity recorded in mangrove ecosystems differs from one island to another.

TABLE 3.4 AMOUNT AND EXTENT OF LAKES IN INDONESIA

ISLAND	AMOUNT OF LAKES (EXTENT >10 HA)	TOTAL EXTENT (HA)
Sumatra	170	190.043
Kalimantan	139	84.231
Java dan Bali	31	6.270
NTB dan NTT	14	6.041
Sulawesi	30	141.871
Maluku	10	3.438
Papua	127	59.830
TOTAL	**521**	**491.724**

Source: LIPI 2014

Of the 202 identified mangrove species, 166 are in Java, 157 in Sumatra, 150 in Kalimantan, 142 in Papua, 135 in Sulawesi, 133 in Maluku and 120 in the Lesser Sunda Islands. The extent of mangrove areas in Indonesia in 2013 reached nearly 3.24 million ha (Saputro, et al., 2009). Due to the pressure on mangrove ecosystems, it is necessary to increase mangrove areas.

2. **Riparian Ecosystem**.

Riparian ecosystems are a transitional ecosystem (ecotone) between bodies of water and the land outside the water environment. This zone is an important natural biofilter that protects the aquatic environment from excessive sedimentation, polluted surface water flow and land erosion. In addition, it also provides protection and food to many aquatic species, and provides important shelter in water temperature regulation. This area is based on its characteristic role as a buffer zone for surrounding areas.

The riparian ecosystem is an ecosystem with high biodiversity which functions as an animal corridor that connects one area to another, and connects animals in downstream areas with animals in upstream areas, particularly in maintained riparian zones, which are the habitats of various animal species.

Viewed in terms of location, saltwater, freshwater and semiterrestrial ecosystems are spread across all bioregions of Indonesia. There is no area that does not have this type of ecosystem (see Table 3.5).

Figure 3.6 Photograph a: Mangrove Ecosystem; Photograph b: Riparian Ecosystem

Source of photograph: Mangrove Photograph: Pramudji, 2013. Riparian Photograph: Partomihardjo, 2013.

Box 3.2 Importance of mangrove ecosystem and conservation type existence

An examples of the importance of ecosystems and the existence of species is the existence of Uca spp crabs and mangrove ecosystems. Their existence is so interconnected that the Uca species may be said to be the keystone species in the area, and its presence is the fertility key to mangrove ecosystems.

As a conservationist species in coastal areas, this species has in each of its activities a key impact on various ecosystem processes. The key roles of crabs in the ecosystem include converting nutrients and increasing nutrition, increasing the distribution of oxygen in the soil, supporting the lifecycles of carbon and nitrogen and providing natural fodder for various water biota species.

Crabs that constantly dig holes apparently have an indirect role in balancing the physical and chemical structure of mud sediment in mangrove forests. Mangrove forests, which are generally muddy, make the soil substrata condition in such areas become anaerobic. Such conditions cause animals to be unable to live.

However, the presence of mangrove crabs, which are in general herbivores and like to place litter in their excavated holes, causes a lot of oxygen to enter the holes. Such a condition causes an aerobic condition in the soil. The leaf litter and twigs of mangroves that crabs carry into their holes, which are aerobic, are crushed and consumed. The remnants become smaller and finer parts. Further on, the litter decomposition process in the soil and adequate oxygen occurs aerobically and then decomposes into nutrients, which are useful for life in the ecosystem.

The crushing of leaf litter and twigs clearly accelerates the decomposition and release of nitrogen, or denitrifying. The muddy and anaerobic condition of the soil substrata in mangrove areas may be reduced due to the presence of crabs. The impact of that presence is that mangrove areas become a life source for other animals, such as fish, shrimp and others. The presence of crabs in mangrove ecosystems is key for the lives of others, and without their presence mangrove areas would become aerobic, which would be poisonous for other life forms.***

Source: Noerdjito, dkk.,(2011)

Indonesia. There is no area that does not have this type of ecosystem (see Table 3.5)..

Table 3.5 Distribution Spread of Saltwater, Freshwater and Semi-Terrestrial Ecosystem in Indonesia.

Type of Ecosystem	BIOREGION						
	Sumatra	Java Bali	Kalimantan	Sulawesi	Lesser Sunda	Maluku	Papua
Marine Ecosystem (Saltwater)							
Coral Reef	✔	✔	✔	✔	✔	✔	✔
Sea grass field	✔	✔	✔	✔	✔	✔	✔
Freshwater Ecosystem							
River Ecosystem	✔	✔	✔	✔	✔	✔	✔
Lake Ecosystem	✔	✔	✔	✔	✔	✔	✔
Semi-terrestrial Ecosystem							
Mangrove	✔	✔	✔	✔	✔	✔	✔
Riparian	✔	✔	✔	✔	✔	✔	✔

3.2.4. Terrestrial Ecosystem

Terrestrial ecosystems border coastal ecosystems, from the lowland to mountains with a height of 1,000 m above sea level, until alpine areas at a height of 4,000 m above sea level. Almost all of those ecosystem types can be found in Papua, particularly on Mt. Lorentz, where a tundra and eternal snow are found at a height of 4,000 m above sea level. The sighting (physiognomy) of vegetation is one of the ecosystem components that can be used to easily identify and define the borders of terrestrial ecosystems (Mueller-Dombois and Ellenberg in Kartawinata, 2013).

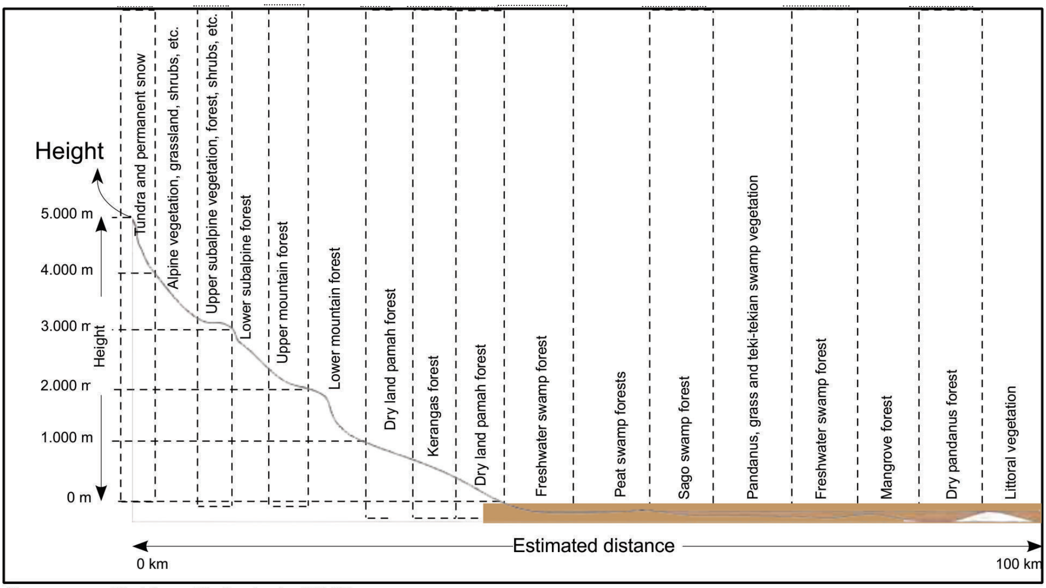
Terrestrial ecosystems are divided into two types: (1) Low land ecosystem and (2) Mountain ecosystem. Low land ecosystem consists of: (1) coastal forest, (2) dipterocarp forest, (3) kerangas forest, (4) swamp forest, (5) peat swamp, (6) karst and caves (7) and savanna. The divisions of the mountain forest ecosystem consist of: (1) lower mountain ecosystems, (2) upper mountain ecosystems, (3) subalpine ecosystems, (4) alpine ecosystems and (5) nival, which is an eternal snow zone (see Figure 3.7).

1. **Low Land Ecosystem** and located at a height of 0 to 1,000 m above sea level, and can be found in nearly all areas of Indonesia.

Based on the latest data, Papua has the largest pamah forest area in Indonesia, at around 60 percent of the total area of Papua (Kartikasari, et al., 2012). Pamah forests in general feature trees with a diameter of >100 cm and a height of up to 45 m. Sticking-out trees, trees with large papan/banir roots and liana are the general characteristics of this type of forest. Following is a description of the types of ecosystems in pamah forests.

a. Coastal Ecosystem, especially the sandy beach has an important role as a habitat for many species of fauna, such as spawning grounds for sea turtles. There are three coastal vegetation formations which are commonly found in the same floristic composition throughout Indonesia. The first is the formation of *pescaprae*, dominated by species of bayhops (*Ipomoea pescaprae*) and grasses, such as *Spinifex littoreus, Ischaemum muticum, Chloris barbata, Dactyloctenium aegyptium*. The second formation is formed behind the *pescaprae* formation, generally in the form of beach forests, particularly on more stable soil. The third formation is sand hills (dunes). Not many sand hill formations are found in Indonesia. Beach forests with stony substrata are found in

Figure 3.7 Samples of various ecosystem types in Indonesia



Source: modifed from Kartawinata (2013) several areas, such as southern parts of Java, part of the west coast of Sumatra, Bali, Nusa Tenggara, Maluku and small islands throughout the country.

b. **Dipterocarp forest** The best remaining was found in Kalimantan until 1996 (MacKinnon, et al., 1996). However, the size of the dipterocarp forest keeps decreasing. The causes are the many pressures from various activities, such as illegal logging, land clearing for oil palm plantations and agriculture. Dipterocarp forests have high diversity of plant species, namely reaching 200 to 300 tree species per ha. Several among them have high value, such as meranti (*Shorea spp*), keruing (*Dipterocarpus spp*) and camphor (*Dryobalapnops spp*).

   This type of forest in Indonesia is found in Kalimantan, Sumatra, Java, Sulawesi, Nusa Tenggara, Maluku and Papua. Dipterocarp forest develops at a height of 0 to 1,000 m above sea level. There are currently at least 371 dipterocarp types recorded and validated in Indonesia. Kalimantan is the center of this species' diversity (MacKinnon, et al., 1996), as more than 50 percent of this species is found there. Around 199 dipterocarp species in Kalimantan and 103 dipterocarp species in Sumatra have been recorded (LIPI, 2014).

c. **Non Dipterokarpa Forest** in pamah areas can be found in Java, Bali, Nusa Tenggara, Sulawesi, Maluku and Papua (Kartawinata 2013). This is seen in the drastic decrease of dipterocarpaceae family plant species to 27 percent (Kartawinata, 2013). Several types of non-dipterocarp forests that will be discussed in this book are kerangas, swamp and savanna forests.

d. **Kerangas forest** normally grow in podzol soil, sand and sour soil, originating from master rock materials containing silica (Rautner, et al., 2005). Kerangas forests feature certain tree species with small, fairly thick leaves that are tolerant of sour and low-nutrient soil. The stratification of trees consists of one or two layers with a height of around 4.5 to 9 m,

Figure 3.8 Canopy of dipterokarpa forest in East Kalimantan Province

Source of photograph: Pindi (ITB), 2012

consisting of small trees or seedlings of large tree species

Kerangas forests generally have less biodiversity compared to other tropical forest types. According to Rautner, et al. (2005), there are 123 plant species recorded in the kerangas forests of Kalimantan. Large areas of kerangas forests are found in eastern tropical areas but are not continuous (Whitmore, 1984).

Kerangas forests in the Malesia area have a limited spread across Kalimantan (Indonesia), Sarawak (Malaysia) and Brunei (Richards, 1996). Hilwan (1996) added that kerangas forests are also found in Sumatra, Belitung and Singkep. Due to the habitat conditions, Kusmana and Istomo (1995) and Hilwan (1996) expressed that kerangas forests were sensitive to disruptions, such as fire.

e. **Swamp Forest** grows and and develop in an alluvial soil habitat with bad aeration due to being continuously or periodically inundated. A lot of swamp forest ecosystems are found in the eastern part of Sumatra, West Kalimantan, Central Kalimantan, Maluku and southern parts of Papua. Swamp forest ecosystem vegetation varies from grasses, palms and pandanus to trees resembling those in pamah forest. The riches of tree's species in swamp ecosystems are generally low with several species, including *Eucalyptus deglupta, Shorea uliginosa, Campnosperma coriaceum* and *Xylopia malayana*. Swamp forests also develop in locations behind mangrove forests, generally in the form of permanently inundated swamp forests due to being affected by ebb and flow, so sometimes the structural components are mixed with mangrove species.

f. **Peat Ecosystem** feature main structural components of around 65 percent organic substances, so this type of ecosystem has a role in determining the amount of carbon emissions every year. The thickness of peat in Indonesia varies from 1 to 12 m, and in several areas the depth may even reach more than 20 m.

Thirty percent of the peat substrata in Sumatra has a depth of more than 4 meters and most of those peat forests are found in Riau province. It is estimated that a total of 20.7 million ha of peat forests in Indonesia are in Sumatra (4.7 to 9.7 million ha), Kalimantan (3.1 to 6.3 million ha) and Papua (8.9 million ha) (Page, et al., 2006; Rieley, et al., 1996).

Figure 3.9 Kerangas forest in Bawan Village, Central Kalimantan

Source of photograph: Rahayoe, 2013

It has been recorded that peat forests' total flowering plant and fern species in Kalimantan reach 927 species (Anderson, 1963). More than 300 plant species have been recorded in the peat forests of Sumatra (Giesen, 1991). Peat forests in Papua are widely spread across lowland and highland areas.

g. **A Karst ecosystem** is the ecosystem located in a landscape that develops particularly from carbonate rocks, such as limestone, and is structured due to the karstification process in the geological space and time scale (Samodra, 2001; Pindi, 2014).

Karst rocks have unique landscape characteristics, for example karst in Java generally has a thin soil layer but is rich in lime content. Karst in Java has nearly no surface water, though a lot of water is found below its surface (Samodra, 2001). Unlike other karst areas, parts of Maros-Pangkep, Sangkulirang-Mangkalihat and Muller are still covered by forest.

The karst landscape is part of carbonate rock. Carbonate rock in Indonesia covers around 154,000 km2, spread across almost all islands (Surono, et al., 1999).

There are several areas in Indonesia where the karst landscape is still able to be maintained. Conversely, several other locations have been disrupted due to the mining of rocks (quarries), either legally or illegally. This is because karst is a natural resource in the form of carbonate rocks with quite high economic value as a raw material for the cement industry, causes interest in carrying out rock mining.

The karst landscape, which has a specific topographical form, causes karst ecosystems to be highly sensitive toward topography morphology changes. As such, changes may directly affect water system balance, sun energy flow systems and cause a reduction of carbon dioxide absorption capacity. Therefore, the supporting capacity of the karst ecosystem is low and difficult to correct if damaged (Hadisusanto, 2012;

Pindi, 2014).

Several karst ecosystems are quite well-known worldwide, such as the Bantimurung-Maros karst area (South Sulawesi), Sangkulirang-Mangkalihat (Kalimantan), Bukit Barisan (Sumatra), Gunung Sewu (Yogyakarta-Central Java-East Java) and Lorentz (Papua). Several areas, such as in Southeast Sulawesi, on Muna Island and Halmahera Island, also have their own karst attractions.

This karst area should actually be rescued as it contains a priceless and relatively large quantity of natural water reserves. Considering the important values of karst and cave ecosystems, the understanding of karst and cave biodiversity including its potential should immediately be sustainably explored and utilized.

The measures that should be carried out are: (i) the potential value of karst and caves should immediately be uncovered, (ii) the important value of the karst ecosystem should be made a basis for management, (iii) data collection of biodiversity riches should be carried out as soon as possible in view of the still minimal data on karst and cave ecosystem biodiversity

Figure 3.10 Tengah Cave in karst area of the Kutai National Park, East Kalimantan

Source of photograph: Rahayoe, 2013

riches (see Box 3.3), (iv) protection/conservation efforts should immediately be carried out considering the potential for many species that are not yet discovered.

h. **Savanna** is characterized by the presence of trees and shrubs in various patterns with low density and associated with various undergrowth species, dominated by grasses (Richards 1996). Trees are seldom found in the savanna ecosystem and are even scattered in several locations forming canopy mosaics covered by grass landscapes in open places.

Trees in the savanna ecosystem are generally small and short with a height of around 10 m and a trunk diameter of no more than 40 cm. Savanna is normally formed after forest area is damaged, particularly by fire. Forest clearing and dry field practices over a long time are also considered major causes for the formation of savanna.

Nevertheless, savanna may also exist due to pressure from big mammals, particularly herbivores, such as deer and bulls. Savanna formation takes quite a long time but may be faster in dry climates (Backer and Brink 1968; Steenis 2006).

Box 3.3 Java Island at Critical Ambient

Java Island is currently assessed as critical in terms of poor supporting capacity and agrarian conflicts. However, mining licenses are still issued by converting water catchment areas, forests and agricultural areas.

"Our data from 2003 to 2013 shows that mining business licenses [IUP] in Java reached around 1,000 with the total area to be converted reaching 471,378 hectares," said Hendro Sangkoyo, a researcher at the School of Democratic Economics in Jakarta on March 10, 2015.

Such data does not include land controlled by oil blocks, new invasion for cement, extraction by water companies, conversion for property and new industrial areas, as well as international industrial infrastructure, such as the Cilemaya motor vehicle port.

"In view of such large amounts of land conversion, it may be ascertained that the situation of Java in the future will become more terrible and highly vulnerable to conflict," Hendro said. A research report by the Mine Advocacy Network until 2013 showed there were 76 karst mining licenses for Java. Those licenses were for 23 regencies, 42 districts and 52 villages with a total karst mine concession extent of 34,944.9 ha.

Based on data from Kompas in 2014, a number of domestic and international cement companies had entered or were ready to enter Java, including Siam Cement (Thailand) in West Java; Semen Merah Putih (Wilmar) in Banten; Ultratech in Wonogiri; and Jui Shin Indonesia, also in West Java. Semen Puger will operate in Jember and Semen Panasia in Central Java. The data did not include those entering outside Java.

Java is not only loaded with extractive industries, but is also the country's most populated island with 1,057 inhabitants per square kilometer. More than 50 percent of the Indonesian population lives on Java, so each new instance of the extractive industry in Java has the potential to come into contact with communities. According to Eko Cahyono, executive director of the Sajogyo Institute, the crisis on Java is shown by intensive conflicts related to the struggle for natural and agrarian resources. An example is conflict related to the development of cement factories in Rembang and Pati, Central Java, which contradicts farmers defending their land, water resources and the industry.

In Pati district, one of the food production centers of Central Java, a number of cement industries are ready to operate. Farmers who rejected the mine want to defend their land and independence. "We were in 2012 able to thwart the cement mining plan. However, they came again this year and obtained licenses from the district administration after the RTRW [spatial plan], which was initially intended for agriculture, was amended for industry," said Gunarti, a female farmer in Sedulur Sikep, Pati.

She said the motto of the area was "Pati bumi mina tani". According to Eko, the amount of mining license issuance on Java showed the government was inconsistent in applying the National Mid-Term Development Plan (RPJMN) for 2015-2019. The development of the plan was encouraged to improve food sovereignty, was not allowed to damage environmental supporting capacity or disrupt ecosystem balance, and must not increase social gaps. The ongoing mine licensing is considered to have the potential to impoverish local community members, who are mainly farmers, and may as such widen the social gap.

Social conflicts in many areas show that development based on the extractive industry causes problems. "According to our research in Rembang, land to be taken over by the cement company is not fully owned by Perhutani. Part of it had SPPT status long before the mine," said Eko. (AIK)

Source: Kompas, 11 March 2015

Savanna ecosystems can be found in nearly all areas of Indonesia, including in Ujung Kulon National Park, Gunung Gede Pangrango, Pangandaran, Dieng, Bromo Tengger, Baluran, Alas Purwo, West Bali, Komodo and Lorentz. Savanna areas, including grassland, reach 10,275,300 ha, or 5.27 percent of the mainland of Indonesia (Konpalindo 1994).

Data on the extent and spread of savanna ecosystems is not nationally available. It is assumed that savanna ecosystems will keep increasing along with damage to natural forest communities, so serious efforts are needed.

2. **Mountain Forest Ecosystem** are seen in Indonesia, which has a fairly extensive mountain area with active and non-active mountains, though only some reach a height above 3,500 m.

   Mountain areas above 4,000 m are only found in Papua, namely Mt. Lorentz. The height difference causes a change in the plant community, which ultimately affects the animal species living in such communities (Richards, 1996).

Figure 3.11 Savanna in West Nusa Tenggara with widoro stand (Zyzypus jujuba).

Photograph: Partomihardjo, 2012

a. **Lower Montane Forest,** the border between pamah forest and lower mountain forest is at a height of 800 to 1,300 m above sea level, while according to Steenis and Kruseman (1950) it commences at a height of 1,000 m to 1,500 m above sea level. Lower montane forest is often named the Fago-Lauraceous zone as it is dominated by the *Fagaceae* family, such as *Lithocarpus, Quercus* and *Castanopsis* and *Lauraceae* family, such as *Litsea, Neolitsea* and *Phoebe*.

   Other plant families found in lower montane forest community structure are *Annonaceae, Apocynaceae, Araceae, Asclepiadaceae, Burmani- aceae, Connaraceae, Cucurbitaceae, Menispermaceae, Euphorbiaceae, Myristicaceae, Palmae, Papilionaceae, Rhamnaceae, Sapindaceae, Thymelaeaceae, Vitaceae dan Zingiberaceae*. The plant species that structure lower mountain forests differ from one island to another.

b. **Upper Montane Forest,** normally has one canopy layer so it is easy to distinguish from lower montane forest. The low forest crown, slimmer trunks, reduced liana and abundant epiphytes, moss and stern are the characteristics of the upper mountain forest (Ashton, 2003). There are also fewer tree species in this forest type compared to the forest type below it. Other plants are from the *Ericaceae family*, such as *Rhododendron*, *Vaccinium* (see Figure 3.12) and *Gaultheria*, and other species, such as *Aristatus Piperata* and *Phyllocladus Hypophyllus*.

c. **A Wet Land** type that are very specific to upper mountain areas in Indonesia, characterized by "peat sponge" sediment, sour water and ground covered by thick Sphagnum moss that looks like a carpet. Moss swamps are often referred to as highland swamps. Moss swamps receive all or most of the water from rain, surface water, ground water and river flow. The unique physical and chemical characteristics in mountain swamp areas cause special adaption of plants and/or animals, such as carnivorous plants adjusting to low nutrient conditions, being submerged in water and

Figure 3.12: Photograph a: Rhodendron sp.; Photograph b: Vaccinium sp. These are the plant species found at the upper mountain ecosystem

Photograph of Rhodendron sp: Keim, 2011. Photograph of Vaccinium sp: Widjaja, 2011.

sour water. Moss swamps can be found, for example, in Mekongga, Southeast Sulawesi.

d. **Sub-Alpin Forest** in Indonesia, among other places, found in Lorentz National Park, Jayawijaya, Papua, at a height of between 3,200 m and 4,600 m above sea level. The results of research on these two zones, particularly on Mount Trikora and Puncak Jaya, show high flora endemism. At Lorentz National Park there are at least five vegetation zones according to height, namely the lowland zone, mountain zones (lower mountain and upper mountain), subalpine zone and nival zone.

   Forests in the subalpine zone are found at a height of 2,400 m to 3,000 m above sea level with poor nutrient habitat conditions and stony soil species (litosol). Such a habitat seems to affect the existing vegetation, namely that this type of forest features a lot of small trees, normally with a height of only around 15 m, so that only two forest canopy layers are formed. Likewise, its forest floor seldom features herb species.

   Figure 3.14 shows that several tree species samples which dominate the subalpine forest on Gede Pangrango are

Figure 3.13 Moss swamp at the height of 2,000 m above sea level in Mekongga, Southeast Sulawesi

Source : Widjaja, 2011

Figure 3.14 "Edelweiss" (Anaphalis sp.), plant species found at the sub-alpin ecosystem in Papua

Photograph: Rahajoe, 2012

cantigi (*Vaccinium varingiaefolium, Ericaceae*) and *Anaphalis sp*. Like in West Java, trees in the subalpine forest of Papua only reach a height of 10 to 15 m.

e. **Alpin Forest** in Indonesia is only found on Mount Jayawijaya, Papua, at a height of 4,100 m to 4,600 m above sea level. The vegetation in this area has shrub category species, with vegetation types of grassland, kerangas and tundra. The short grassland vegetation (at a height of 4,200 m above sea level) is dominated by the grass species *Agrostis infirma, Calamagrostis brassii, Anthoxanthum horsfieldii var. angustum, Rytidosperma oreoboloides, and Poa callosa*. The forest floor is covered by moss, particularly *Racomitrium crispulum, Frullania reimersii, Cetraria spp. and Thamnolia vermicularis* (LIPI 2014).

   Kerangas shrub vegetation is short and is located on the mountain ridge top at a height of more than 4,200 m above sea level, which is affected by neoglacial ice movement. This community consists of a shrub stretch of 200 cm in thickness, which in general consists of *Styphelia suaveolens, Tetramolopium klosii, T. piloso-villosum, and sometimes Coprosma brassii, semak Senecio sp., and Rytidosperma oreoboloides* (LIPI 2014).

   The alpine tundra, which is found at a height of 4,230 to 4,600 m above sea level, is uncovered due to the continuously melting ice over 30 years and growth of moss as well as several herb species that are able to grow in alkaline mineral soil.

f. **Nival** is the ecosystem found at a height of more than 5,000 m above sea level. The nival zone in Indonesia is only found on Mt. Lorenz, which is covered in snow the whole year.

3.3 DIVERSITY OF SPECIES

Biodiversity is based on species grouped into two parts, namely: (i) biodiversity that lives in sea and shore ecosystems (sea biota) and (ii) biodiversity that lives in terrestrial ecosystems (terrestrial biota).

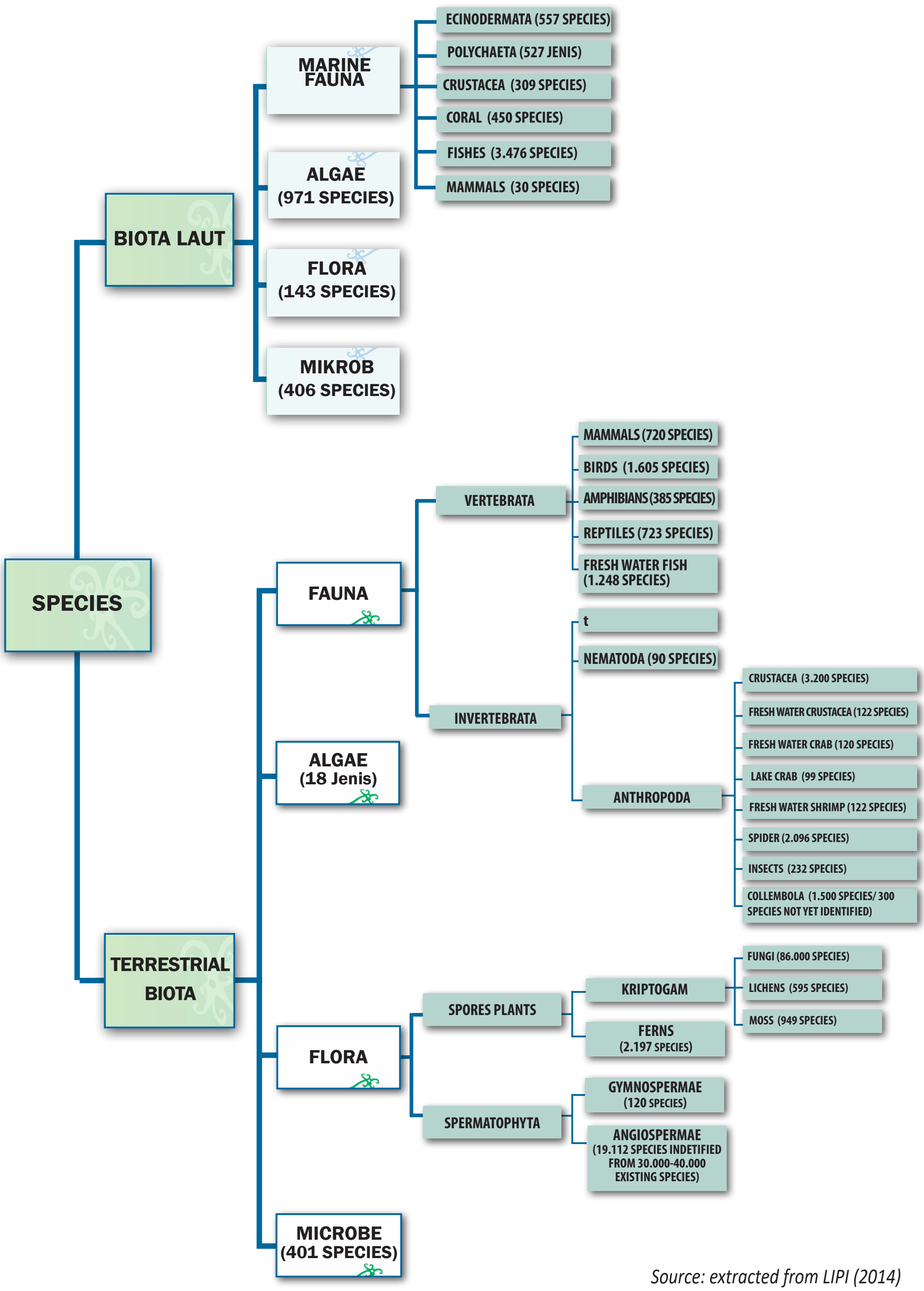
3.3.1. Marine Sea Biota

It is believed that Indonesia has very rich sea resources, which are spread out along more than 99,093 km of coastline with 70 percent sea area (BIG, 2013; Farhan and Lim, 2011). Data collection for sea biodiversity is a separate challenge due to Indonesia's extensive waters. In addition, marine taxonomy experts are very few, so the collected data on biota species in the country's seawaters covers only around 6,396 species, including data on plants, such as mangroves, algae and sea grass. For example, the riches of fish species that live in coral reefs number around 225 species (Allen, 2008), and the

Figure 3.15 Alpine Ecosystem in Papua

Photograph: Rahajoe, 2012

Figure 3.16 Diversity of Species in Indonesia



Source: extracted from LIPI (2014)

coral reef and fish riches on the east coast of Kalimantan, Derawan Island, total 460 species and 700 species, respectively (TNC, 2009). The waters of Raja Ampat Island are the richest sea area in the world as they contain 574 coral reefs and 553 coral fish species (*bullseye*) (Turak and Souhoka, 2003).

1. Marine Fauna. The amount of sea fauna that has identified at present, reaches 5,319 species. The most identified species are fish, followed by *Echinoderms* and *Polychaeta* (see Table 3.6.)

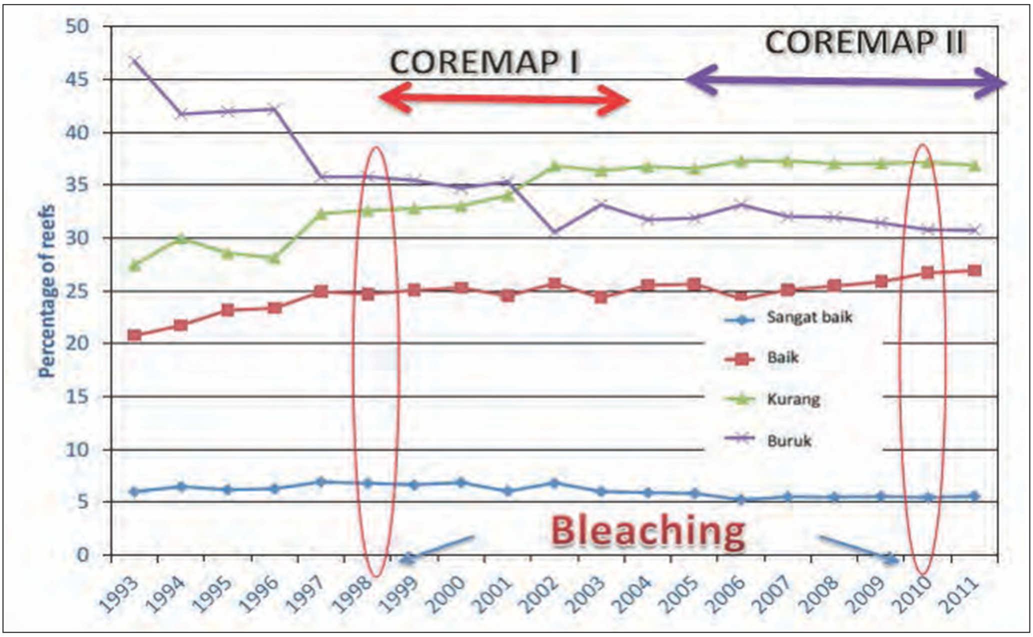
According to Lagler, et al., (1962), fish are divided in three large groups, namely agnatha, which are primitive fish such as lampreys and hagfish; cartilaginous fish *Chondrichthyes*, such as sword fish (shark), stingray and real bone fish (*Osteichthyes/ Teleostei*).Sharks and stingrays that are normally caught in Indonesian waters include hammerhead (*Zygaena spp*); shark hat (*Galeorphynus australis*); saws shark (*Lamna nasus*); parang shark (*Alopias vulpinis*) and blue shark (*Prionace glauca*). The species that are often found in coral reef areas are black tip reef (*Carcharhinus spp*.), White tip reef (*Triaenodon spp*)

Table 3.6 Spread of Terrestrial Ecosystem at Bioregion in Indonesia

Ecosystem Type	BIOREGION						
	Sumatra	Java Bali	Kalimantan	Sulawesi	Lesser Sunda	Maluku	Papua
Pamah Forest Ecosystem							
Pamah Forest Ecosystem	✔	✔	✔	✔	✔	✔	✔
Coastal Forest	✔	✔	✔	✔	✔	✔	✔
Dipterokarpa Forest	✔	✔	✔	✔	✔	✔	✔
Kerangas Forest	✔	✔	✔	✔	✔	✔	✔
Swamp Forest	✔	✔	✔	✔	✔	✔	✔
Peat Swamp Forest	✔	✔	✔	✔	✔	✔	✔
Karst and Cave	✔	✔	✔	✔	✔	✔	✔
Savana	✔	✔	✔	✔	✔	✔	✔
Mountain Forest Ecosystem							
Lower Montana Forest	✔	✔	✔	✔	✔	✔	✔
Upper Montana Forest	✔	✔	✔	✔	✔	✔	✔
Sub Alpin Forest	✔	✔	✔	✔	✔	✔	✔
Alpin and Nival Forest	-	-	-	-	-	-	✔

Source: modified from LIPI (2014)

Figure 3.17 Coral Conditions In Indonesia In The Past and At Present.



and the white muzzle sword (Carcharhinus amblyrhychos) Those eight sea fish species are mainstay commodities for food exports, and four of them have the potential to be cultivated (Romimohtarto and Juwana, 1999).

There are currently 557 Echinodermata species recorded in Indonesia, which are included in 60 families and four classes. Species included in the Echinodermata group are, among others, starfish (*Linckia spp.*), sea urchins (*Diadema spp.*), sea cucumber (*Holothuria spp.*), sea lilies (*Lamprometra spp.*), brittle stars (*Ophiothrix spp.*), mahkota seribu or mahkota berduri (*Acanthaster spp.*) (Lilley, 1999). The majority of species of Echinodermata are from the Ophiuroidea class, consisting of 142 species (11 families), while the fewest are found in the Echinoidea class (84 species in 21 families).

The current recorded diversity of sea crustacean species in Indonesia covers five families with a majority of 118 crustacean, (*Stomatopoda*), species, while the fewest are the Syllaridae family (two species). A total of six crustacean species in Indonesia have important economic value, such as lobster and shrimp, but their population in nature

Table 3.7 Total Marine Fauna Found In Indonesia.

SPECIES	TYPE
Echinodermata	557
Polychaeta	527
Crustacea (prawn and crab)	309
Coral	450
Fish	3.476
TOTAL	**5.319**

Source: LIPI 2014.

keeps decreasing. Even mimi (*Tachypleus gigas*) are close to extinction and need to be protected (Moosa, 1984; Moosa and Aswandy, 1984). Data on sea worm diversity (*Polychaeta*) in Indonesia is quite complete, covering 43 families and 527 species (see Table 3.7). It has been recorded that most sea worms are included in the *Terebillidae* family, followed by the *Plynoidea* and *Nelerididae* families, while the others have only one to three species.

The diversity of sponges in Indonesia is estimated to be no more than 850 sponge species (Nontji, 1999; Soest, 1989). Rachmat (2007) found 441 sponge species in the waters of eastern Indonesia, consists of 339 species of the *Demospongiae* class and two species of the *Calcarea* class. The common species that are found in the waters of eastern Indonesia are *Aaptos spp, Clathria vulpina, Callyspongia spp, Oceanopias spp, Petrosia spp* and *Xestospongia spp*.

Coral is included in the animal group in the form of flowers, so it is considered a plant group. Coral is divided into the hermatypic group and ahermatypic group. The hermatypic group includes coral that is able to form coral reefs with support from algae cells

Table 3.8 Total Classes And Species Of Five Echinodermata In Indonesia.

SPECIES	SPECIES
Ophiuroidea	142
Crinoidea	101
Asteroidea	89
Echinoidea	84
TOTAL	**557**

Source: LIPI 2014.

Table 3.9 Total sea crustacean species

CLASS	SPECIES
Pengko shrimp (Stomatopoda)	118
Commercial shrimp (Penaeidae)	110
Mangrove rajungan and crab (Portunidae)	72
Sand shrimp and fan shrimp (Syllaridae)	2
Coral shrimp or lobster (Palinuridae)	7
TOTAL	**309**

Source: LIPI, 2014

(zooxanthellae) found in its body tissue, while the ahermatypic group has no zooxanthellae, lives in deep areas and does not form coral reefs (Lilley, 1999). No less than 70 coral species have been identified in Indonesia (Suharsono, 2014) and the result of data compilation during two decades (1993-2011) showed changing conditions.

2. **Algae** species that live in the waters of Indonesia may be divided into three groups, namely algae containing red pigment; algae containing green pigment; and algae containing brown pigment.

Table 3.10 Total Algae and Sea Flora found at waters in Indonesia

WATERS	CLASS	SPECIES
Sea grass	2	13
Algae	81	971
Mangrove	19	55
Mangrove Associate	39	75
TOTAL	**135**	**1.077**

Source: LIPI, 2014

A total of 1,077 algae and sea flora have been identified (see Table 3.10).

Algae is taxonomically divided into divisions, namely *cyanobacteria, prochlorophytes, glaucophytes, Rhodophyta, heterokontophyta, haptophyta, cryptophyta, dinophyta, euglenophyta, chlorarachniophyta* and *chlorophyta* based on the evolution of cell nucleus walls, pigment and cell genetic structure of such algae (Van Hoek dkk., 1995).

3. **Sea Flora.** Most of sea flora in Indonesia found in coastal waters is sea grass. Sea grass is included in the high-level plant group, as its stems, leaves, flowers and nuts can be clearly distinguished. Most sea grass lives in relatively calm waters with substrata of fine sand and mud. Only 13 species are known of in Indonesian waters, namely *Halophila spinulosa, Halophila decipiens, Halophila minor, Halophila oval, Halophila sulawesii, Enhalus acoroide, Thalassia hemprichii, Cymodocea serrulata, Cymodocea rotundata, Halodule pinifolia, Halodule uninervis, Syringodium isoetifolium* and *Ruppia maritima* (Romimohtarto and Juwana, 1999).

4. **Sea microbes** are found in water, which is a good habitat for microbes. Not much is known about the diversity of abundant sea microbe species in Indonesia. Nevertheless, several separate researchers have been able to identify the existence of bacteria in the waters of Sangihe Talaud, namely 14 classes (Patantis, et al., 2012).

   The abundant sea microbe species diversity in Indonesia has yet to be handled optimally. Likewise, that associated with coral reefs is also not greatly known about, while several particular microbe species, although identified, live in symbiotic mutualism with coral reefs. Based on the research of Patantis, et al. (2012), a number of bacteria families are found in the waters surrounding Sangihe Talaud, such as A*lteromonas, Pseudomonas, Pseudoalteromonas, Shewanella, Vibrio* and other bacteria that are not yet able to be cultured.

   The 14 microbe classes were identified from the results of research in the sea surrounding Sangihe Talaud, namely *Acetobacteraceae, Actinobacteria, proteobacteria, Bacilli, Bacteroidetes, proteobacteria, Chlorobi, Chroococcales, Clostridia, proteobacteria, Erysipelotrichia, proteobacteria, Synergistia* and *Zetaproteobacteria*, while others were not able to be identified and cultured.

   The minimal records on sea biodiversity species show that many sea biodiversity species are not yet identified and documented, especially in eastern Indonesia.

Box 3.4. Utilization of algae and its economic value

Algae cultivation is referred to as aquaculture, while that specifically using a species and sweater media is referred to mariculture. The development of algae mariculture in Indonesia increases rapidly year by year. For example, seaweed production in the country in 2005 totaled around 910,636 tons, which increased to 2,574,000 tons in 2009 with international market segments or exports (IFC, 2014).

Compared to other mariculture industries that originate from sea biomass, algae cultivation, which includes seaweed, has increased very rapidly in terms of production and demand level. It is estimated that in 2015 Indonesia will be the world's main producer with a predicted production level of 10,000,000 tons from Lampung, Banten, Jakarta Bay, Bali, West Nusa Tenggara, East Nusa Tenggara, North Sulawesi, South Sulawesi and Southeast Sulawesi.

Indonesia is said to be an ideal location for cultivation of the Euchema cottoni species, in addition to the Philippines, Papua New Guinea (PNG) and Pacific islands (Hurtado et al., 2014). In addition to Euchema, the cultivated seaweed species in Indonesia are Gracilaria, Gelidium, Sargassum, Turbinaria, Halimeda and Rhodimenia.

Table 3.11 Volume (ton) of aqua-culture production in Indonesia

SPECIES	2003	2009	2003-2009	*Share* 2009
Shrimp	192,912	338,060	75%	7%
Seaweed	233,156	2,963,556	1,171%	63%
Grouper	8,637	8,791	2%	0%
Common carp	192,912	249,279	29%	5%
Milk fish	227,854	328,288	44%	7%
Clarias	58,614	144,755	147%	3%
Pangasius	12,904	109,685	750%	2%
Giant gourami	22,666	46,452	105%	1%
Shells	2,869	15,857	453%	0%
Mud crab	3,172	7,516	137%	0%
Nile tilapia	71,947	323,389	349%	7%
Baramundi	5,508	6,400	16%	0%
Others	164,568	166,734	1%	4%
TOTAL	**1,224,192**	**4,708,565**	**285%**	**100%**

Source: MMAF (2011) in http://indonesia-oslo.no/indonesia-projected-to-become-global- seaweed-producer/ (2014

Seaweed production may contribute economic benefits to the trade sector of Rp 300 million to 1 billion per year (with the assumption that 1 kg of dry seaweed is worth Rp 1,000 at the farmer level) as contained in the following table:

Table 3.12 Production and value of seaweed in Indonesia 1979-1983

YEAR	VOLUME (ton)	VALUE (thousand)
1979	5.945	334.000
1980	7.848	421.000
1981	7.251	362.000
1982	7.479	398.000
1983	9.607	515.000

SOURCE: BPS, 1985

3.3.2. Terrestrial Biota

Information on terrestrial biota species riches is more complete compared to sea biota. However, the relatively complete terrestrial biota data is on flora/plants compared to fauna. Meanwhile, information on algae and microbes is still very limited.

1. **Fauna,** In the group of fauna, information on invertebrate is more completely than vertebrate. The insects, hymenoptera and mollusks in the invertebrate group have the most information, with 151,847 species, 30,000 species and 5,170 species, respectively. Meanwhile, bird species in the vertebrate group have more information compared to others. Mammals are recorded at 720 species (13 percent of the total species in the world), along with 1,605 bird species (16 percent of the total species in the world), 723 reptile species (8 percent of the total species in the world), 385 amphibian species (6 percent of the total species in the world) and 1,900 butterfly species (10 percent of the total species in the world).

   With regard to comparisons of species in the world, Indonesia has 20 percent of the hymenoptera species in the world. In this group, six species of the seven honey bee species in the world are found in Indonesia. In this group the country has 15 percent of insects, while 25 percent of dragonfly species are in Indonesia (see Table 3.13).

2. **Flora** The diversity of flora is distinguished between spore sporophyl plants and Spermatophyta. Sporophyl plants consist of (1) cryptogams and (2) ferns. Spermatophyta consist of (1) Gymnospermae and (2) Angiospermae.

Table 3.13 Comparison between total and diversity of fauna species in Indonesia and in the world

DIVERSITY OF FAUNA SPECIES	WORLD	INDONESIA	PERCENTAGE
A. VERTEBRATA	**39.707**	**3.982**	**10**
• Bird	10.140	1.605	16
• Reptile	9.084	723	8
• Amphibian	6.433	385	6
• Lizard (varanus)	50	21	40
• Freshwater fish	14.000	1.248	9
• Mammals	5.416	720	13
B. INVERTEBRATE		**197.964**	
• Molusca	194.552	5.170	3
• Gastropoda	181.525	4.000	2
• Bivalvia	9.947	4.000	40
• Scaphopoda	-	70	-
• Cephalopoda	952	100	11
• Nematoda	?	90	-
C. ARTHROPODS	**130.128**	**5.137**	**4**
• Crustaceans	66.900	1.200	5
• Freshwater Shrimp	-	122	-
• Freshwater Crab	--	120	--
• Mangrove Crab	--	99	--
• Spider (Arachnida)	57.228	2.096	4
• Spring Tail (Collembola)	6.000	1.500	25
D. INSECT	**10.000.000**	**151.847**	**15**
• Butterfly	17.700	1.900	11
• Moth	123.738	*) 12.000	10
• Beetle	260.706	21.758	8
• Dragonfly	5.900	1.500	25
E. HYMENOPTERA	**150.000**	**30.000**	**20**
• Fly (Diptera)	144.377	27.694	
• Honey Bee (Apidae)	7	6	86
• Ant (Formicidae)	11.000	1.863	17
• Wasp (Vespidae)	5.000	541	11
• Orthoptera	20.000	2.000	10

**) 300 belum teridentifikasi*

a. Sporophyl Plant A total of 1,5 million Sporophyl plants species have identified in the world and Indonesia is able to identify 91,251 species, around 6 percent. The largest identification in the spore plant group is for the mushroom species, both in the world and in Indonesia. With regard to the spore plant group in Indonesia, 94 percent or 86 thousand are mushroom species. The total number of mushroom species identified in Indonesia is 6 percent of the mushroom species in the world. The total identified lichen in the world is around 20,000 species.

Lichen, in the spore plant group, has an important role in ecosystems, and it has been identified that several species are indicators for air pollution. Trees that grow with a lot of lichen indicate that air is not yet polluted, while trees without lichen indicate that the air is starting to be polluted.

Based on data in 2013, 595 species were recorded in Indonesia, with the majority of 300 species in Java, while the smallest amount of 19 species was in the Lesser Sunda Islands. A collection of around 330 species in Indonesia is kept in the Herbarium Bogoriense. The species in Indonesia that have been described only reach 2.98 percent of the total species in the world.

The area spread of mushrooms, lichen, hepaticea and musci is presented in Table 3.14. It has been identified that the results of cryptogam data study are only around 2.98 percent to 8 percent of the data recorded in the world. Therefore, serious attention is needed to complete the data collection of cryptogam species in Indonesia, because exploration has seldom been carried out since 1945, resulting in limited information. Meanwhile, the total of stern plants in Indonesia has reached 2,197 species, 22 percent of the stern species in the world (see Table 3.14).

The growing ground of mushrooms, as the most identified spore plant, is quite spread out in Indonesia. Most macro and micro mushroom species are in Java, namely 1,350 species, while the least are in the Lesser Sunda Islands, namely 58 species.

Meanwhile, there is still a lack of information on the benefits of mushrooms in Indonesia, so it is necessary to find mushrooms that are beneficial for human interests (see Box 3.5).

It is estimated that there are 10,000 species of ferns in the world and based on study and data analysis, 2,197 fern species have been identified, around 22 percent of ferns growing in Indonesia. This fairly large amount of fern species is spread across Indonesia, with most found in Sumatra (see Figure 3.18).

b. **Spermatophyta** are a seed plant grouped in Gymnosperms and Angiosperms. There are 14 classes, 88 families and 1,000 species of Gymnosperms in the world, and six to eight classes are included in conifers with 65-70 families and 696 species of evergreens, while only nine Gymnosperm classes are found in Indonesia, consisting of 120 species (LIPI, 2014).

Gymnosperms are quite spread out in Indonesia and most are found in Sulawesi (see Figure 3.19). Angiosperms are

Table 3.14 Comparison between total and diversity of flora species in Indonesia and the world

DIVERSITY OF FLORA SPECIES	WORLD	INDONESIA	PERCENTAGE
A. SPORE PLANTS	**1.560.500**	**91.251**	**6**
1. Cryptogam			
• Mushroom	1,500,000 (750,000 identified)	86,000 (Micro Mushroom: 64,000; Macro Mushroom: 16,000)	6
• Lichen	9.084	723	8
• Hepaticae	6.433	385	6
• Musci	50	21	40
2. Ferns	14.000	1.248	9
B. SPERMATOPHYTA	**251.000**	**19.232**	**8**
1. Gymnospermae	1.000	120	12
2. Angiospermae	250.000	(19,112 identified from around 30,000-40,000 in Indonesia)	8

Source: modified from LIPI (2014)

Box 3.5. Benefit of Mushroom

The Indonesian community generally knowns about cultivated mushrooms sold at markets. *Termitomyces* or Termite Fungi are very common in Indonesia and are a favored snack. In addition to *Termitomyces*, several mushroom species that are normally consumed by in Indonesia are the *Lactarius, Russula* and *Cantharellus species.*

In their development, communities in Indonesia also know fruit mushrooms, both original Indonesian mushrooms (*Volvariella volvacea*) or those that originate from external cultivation, such as *Agaricus bisporus* from Europe, *Pleurotus ostrearus* from China and *Lentinus edodes* from Japan. In addition, there are still a lot of mushroom species from nature that can be introduced to and consumed by people in Indonesia. In addition to those mushroom species, Bisema (1968) reported other edible mushrooms, amounting to 51 mushroom species from the *Basidiomycota* and *Ascomycota* groups.

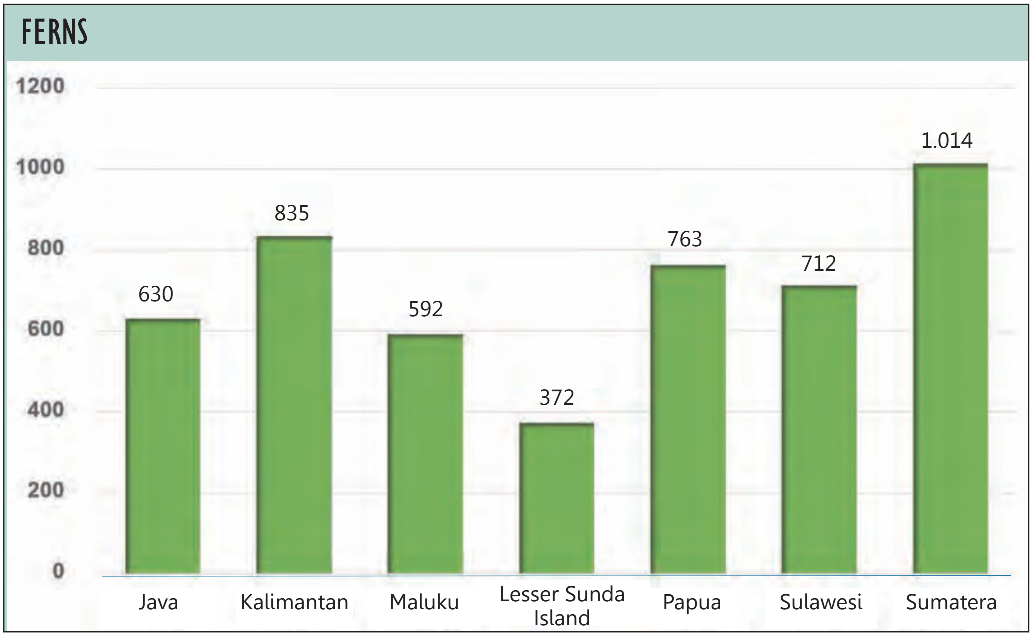
In addition to being able to be utilized as food, mushrooms are also used as a medicinal ingredient. Lingzhi (*Ganoderma lucidum*) are identified as an anticancer drug. Several Cordyceps species are used as medicinal ingredients to regulate body immunity, for their antitumor effects or to hamper tumor cell growth and heart disease.

Species, for which benefits have not been explored, are mushrooms causing hallucinations, including *Psilocybe, Panaeolus, Pluteus, Gymnopilus, Conocybe* and *Inocybe. Psilocybe* is from the six mushroom families that are most well-known among people.

Psilocybe and several mushroom families that cause hallucinations and contain *Psilocybin* and *Psilocin*, for which the chemical name is 4 hydroxylated N-dimethyltryptamine (Benjamin, 1995) have begun to be used by a drug company in Switzerland as the main ingredient to produce drugs that cause hallucinations (*psychedelics*). *Psilocybe* is known to grow in dung, moss, twigs, leaves or rotten wood, habitats that are easily found in Indonesia. Other *Psilocybe* species could be found through intensive exploration ***

seed-producing plants. Therefore, angiosperms are a group of plants that produce seeds from the inflorescence system. Angiosperm plants in Indonesia number around 30,000 to

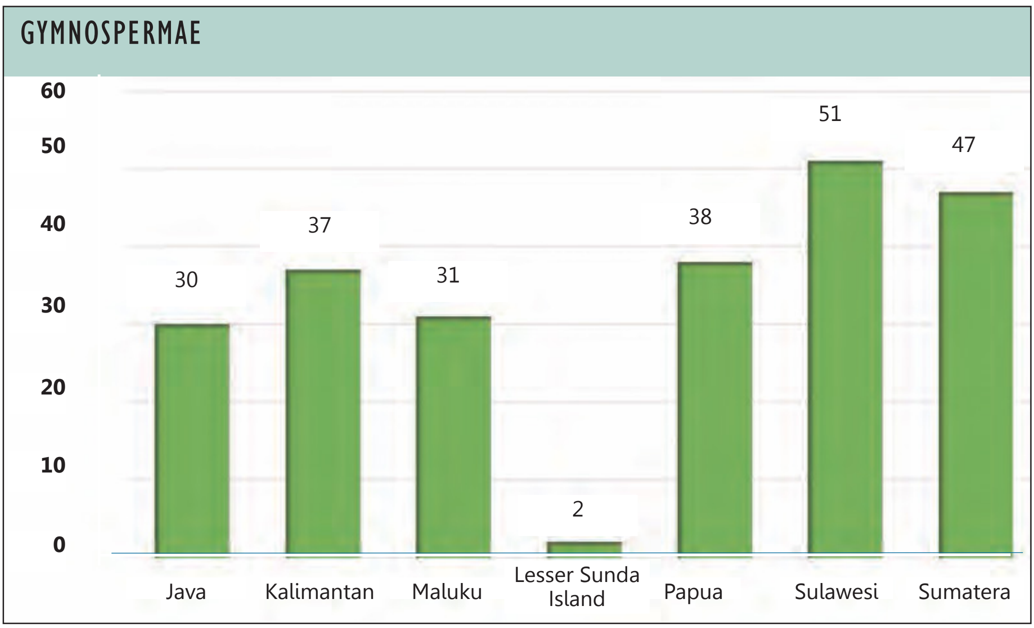
Figure 3.18 Spread of Ferns in Indonesia



40,000, though this data is not yet accurate and data collection and name validation are still needed

Figure 3.19 shows that only 50 percent have been identified as

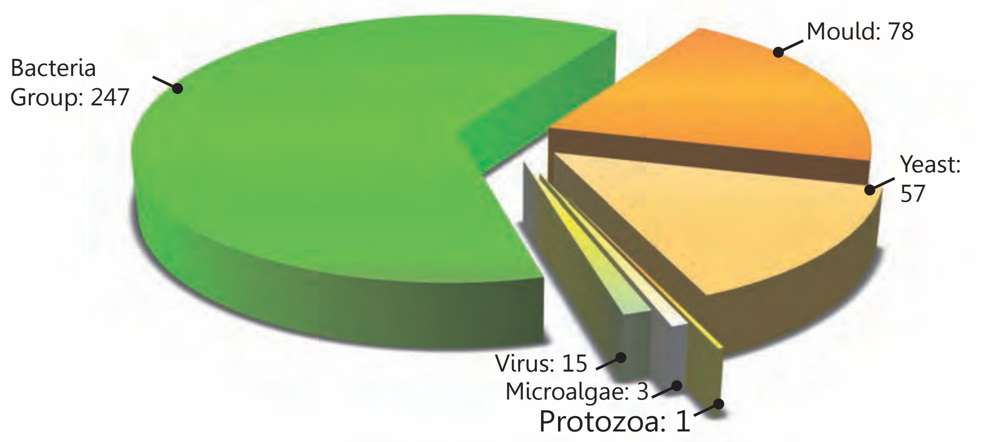
Figure 3.19 Total Gymnospermae in Indonesia per island



Source: modified from LIPI (2014)

Figure 3.20 Total microbe species found in Indonesia

MICROBE



Source: Modified from LIPI (2014).

collected data out of all flora, namely 19,112 species. In this regard, efforts to explore these seed plants are important to discover species that have not yet been identified.

b. **Microbe.** A total of 401 microbe species have been identified in Indonesia based on data collection of microbes at various culture collections in Indonesia. The results of exploration-bioprospection research in Indonesia show that such microbes consist of the bacteria group (247), mould (78), yeast (57), protozoa (1), micro-algae (3) and viruses (15) (Figure 3.21). The presented data has not yet uncovered all microbe species in Indonesia.

This is constrained by the non-maximal exploration of microbe species information, particularly those that have the potential to be developed and utilized.

3.4 GENETICS DIVERSITY

The diversity of genetics in plants, animals and microbes has long been utilized by human beings for various objectives, particularly for the welfare of humans. The variation of plant genetics is the main source of medicines and food for the welfare of humans.

Farmers have long utilized such variations and the relationship between humans and genetic variation has developed rapidly until today. Millions of microbe species and billions of genetic variations have greatly supported the agricultural plant nutrition cycle, while thousands of insect species and their genetic variations have greatly supported the pollination of agricultural plants and other plants. Researchers have recorded that 39 agricultural commodities in the world strongly depend on pollinators.

Genetic diversity currently supports the agricultural and medicine

Figure 3.21 (A) Histogram of total angiosperm species in Indonesia and (B) Total angiosperms per island and total endemic species

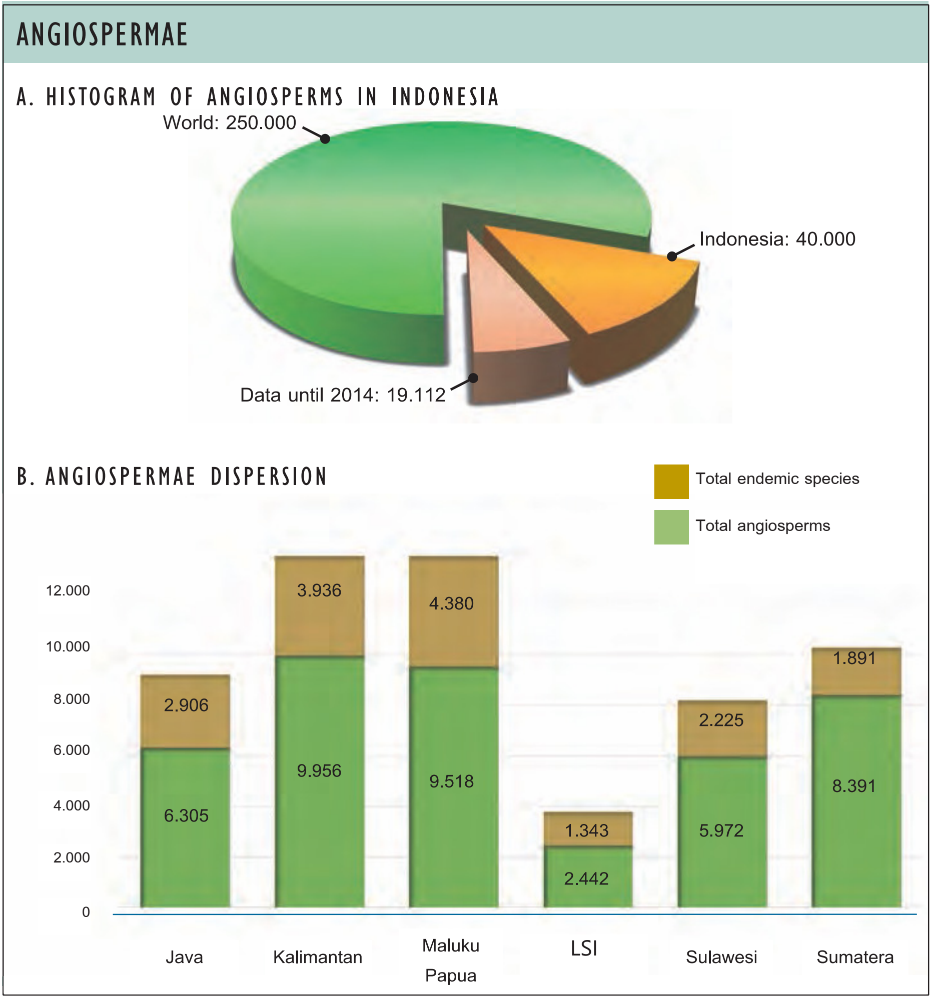
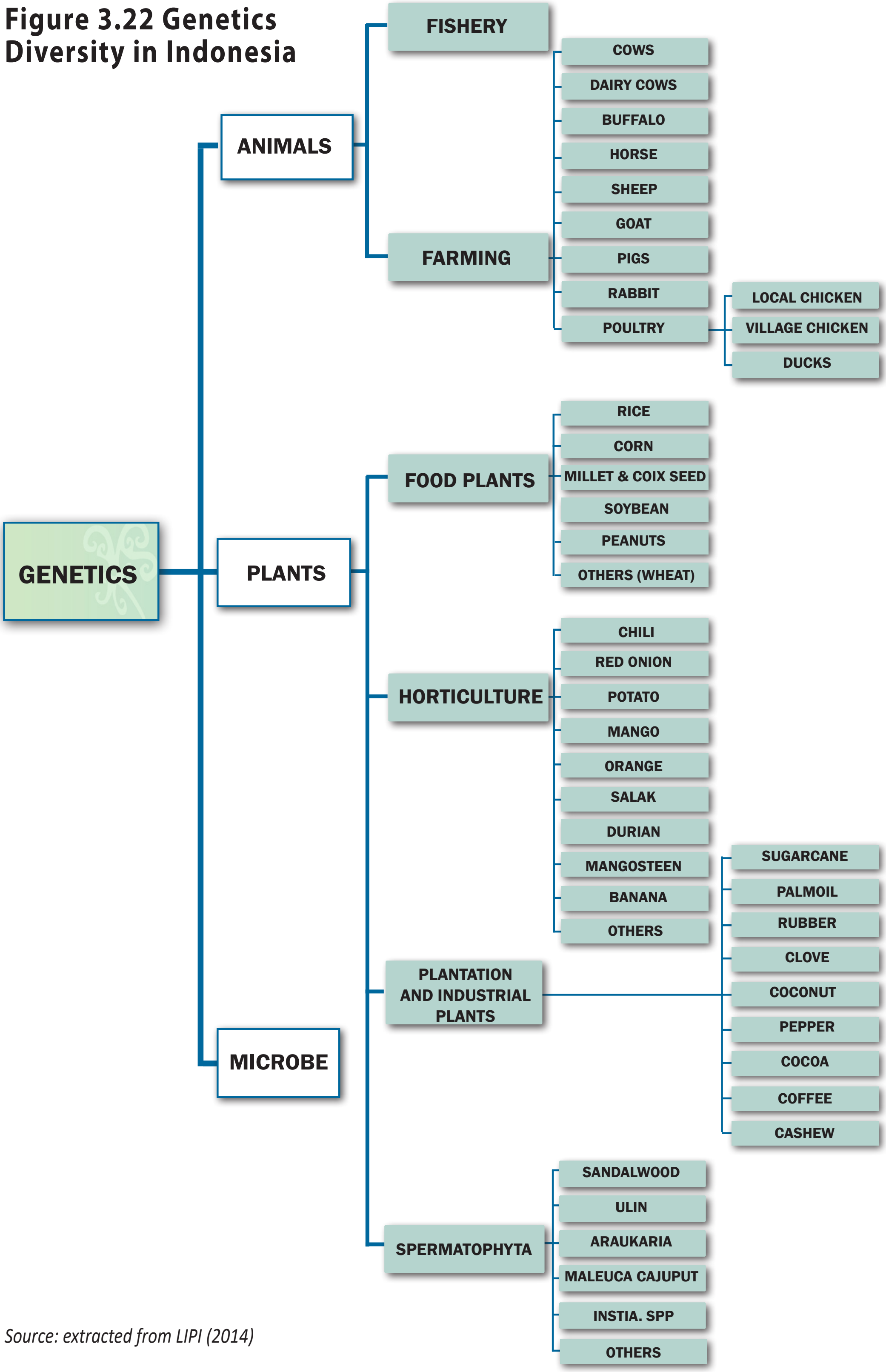
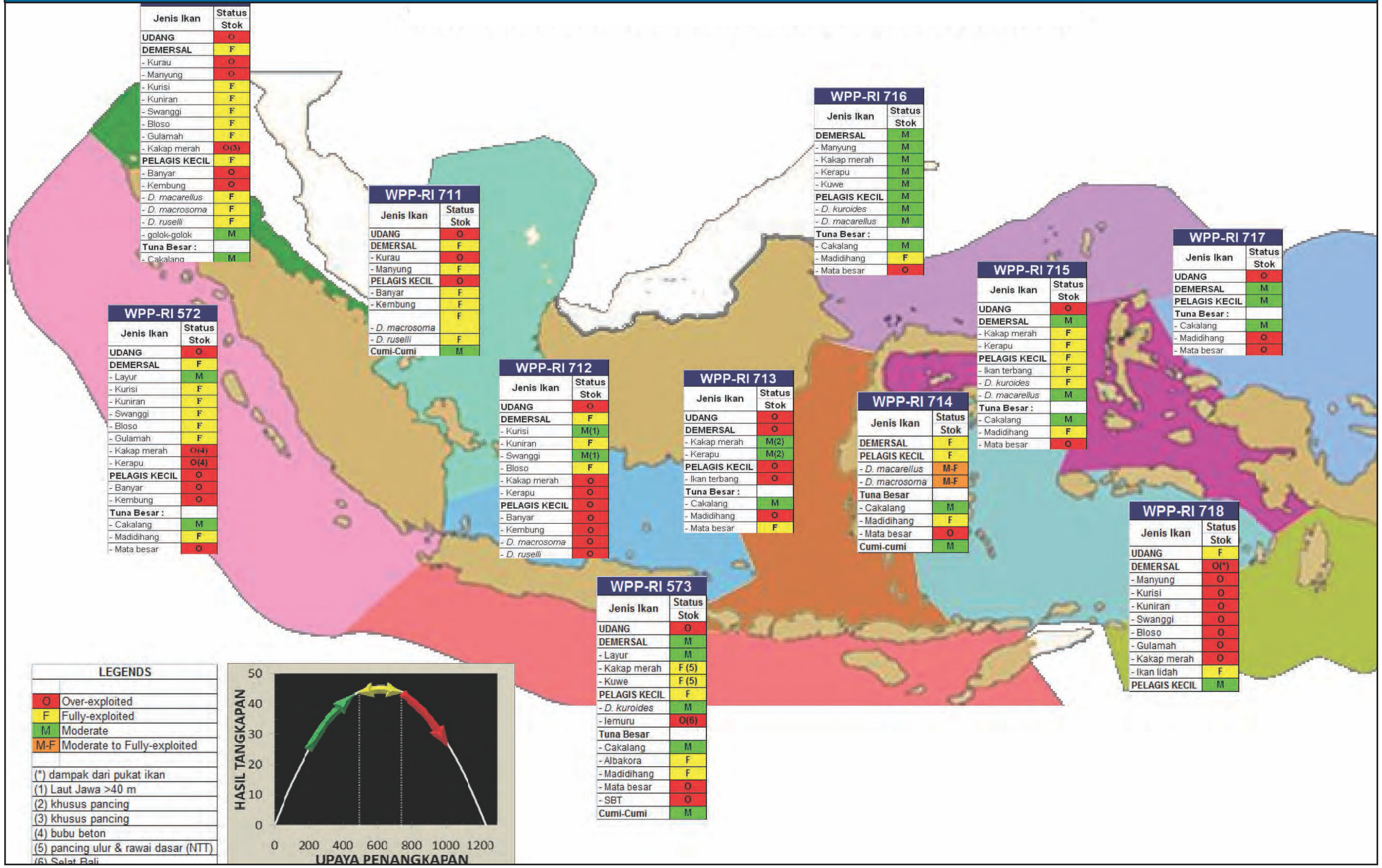


Figure 3.22 Genetics Diversity in Indonesia



Source: extracted from LIPI (2014)

Figure 3.23 Distribution of Fish Genetic Resources



Source: Appendix III of the Decree of the Minister of Marine and Fisheries of the Republic of Indonesia Number 45/MEN/2011 industries, which until now have produced various medicines and plant varieties, from sugarcane to fruits, potatoes, rice, corn and cattle. As such, genetic diversity can become part of the health resources and food security of countries, including Indonesia. The loss of genetic resources will threaten human life and the lives of other creatures.

This concern was highlighted by the Food and Agriculture Organization (FAO) in 1999, namely that 75 percent of the genetic diversity of agricultural plants had disappeared. We refer to this phenomenon as genetic erosion. LIPI in 2014 identified genetic diversity in the form of genetics resources of animals, plants and microbes (see Figure 3.22). Genetic resources are grouped in genetic resources of animals, plants and microbes.

Figure 3.22 shows that plant genetic resources have experienced an increase, cattle resources are developing, while fisheries are just being commenced. Microbe genetic resources are still limited although microbes have a very large role, as outlined above.

3.4.1. Animal Genetics Resources

Animal resources are grouped in fisheries and farming, both those that have been domesticated and those that are still wild. The animal cultivars of Indonesia include land fisheries (bilih fish and gabus fish) and farming (cows, buffaloes, sheep and rabbits). For example, fisheries with sperm plasma are spread throughout Indonesia (Figure 3.23). Land fisheries have several advantages and unique elements that can be developed for welfare of communities.

First, endemic varieties or species have high utilization potential. An example is bilih fish (*Mystacoleucus padangensis*), which in the world is only found in Singkarak Lake, West Sumatra.

Second, the existence of endemic fish unites with the behavior and life patterns of local communities. In addition to being considered part of the culture and traditionally consumed, the conservation of endemic fish is also maintained as part of local wisdom.

Third, endemic fish ecologically have a specific living habitat and breeding patterns. For example, breeding of bilih fish from Singkarak Lake is not able to be carried out in other places.

Fourth, endemic fish species have high economic value, so they become a specialty of the area. Examples are *Tor tambra, Tor douronensis, Tor tambroides* and *Labeobarbus douronensis* from the Kapuas River. Such endemic species have superiority with regard to tolerance in the local ecosystem.

However, land fisheries cultivation containing endemic fish species has not been optimally utilized. Only several areas cultivate endemic fish for tourism, such as Tondano Lake, Singkarak Lake, Poso Lake and Sentani Lake.

A lot of problems threaten the sustainability of endemic fish cultivation and conservation, including excessive exploitation or the introduction of other fish that are predators or competitors and may become invasive. In addition, the threat of environmental damage caused by agricultural activities and forest clearing is also a serious problem for endemic fish.

3.4.2. Plant genetics resources

Plants are grouped based on a plant cultivar that has been domesticated and released as prime seeds and that are also still wild. The plant cultivars of Indonesia include rice, nuts and tubers. An example of a plant cultivar for which the area spread is able to be identified is the banana. Bananas are an important fruit in Indonesia and in the world.

Bananas provide the largest contribution (± 30%) to national fruit production. Indonesia is positioned sixth among banana-producing countries worldwide, with production of 6,189,052 tons (6.07 percent of the world's production of 101,992,743 tons) in 2012. However, the export value is very low and is thereby not recorded by the FAO.

This export value needs to be improved so that bananas can have high economic value. Bananas are included in the *Musa genus, Zingiberales* order, *Musaceae* family. The center of *Musa spp* is Southeast Asia,

Box 3.6. Utilizing Banana Genetic Resources in Bananas

Breeding ritploid bananas

Banana cultivars are characterized by having multiple genomes (AA, AAA, AAB, ABB, BB, AAA, AAAB), sterile pollen, failed pollination/fertilization systems and parthenocarpy (carpels growing without fertilization, embryo development failures resulting in seedless fruits).

Banana cultivars/clones have been proven to originate from hybridizations between M. acuminata (AA) and M. balbisiana (BB). The AA genome is responsible for sweetness or acidity and low starch levels, while the BB genome relates to high starch levels. The combination of the two has produced a number of cultivars differentiated by genome group, including:

1. AA diploid bananas (lady finger, crocodile finger, senorita, pisang oli, which are generally small and have thin skin that stick to the flesh),
2. AAA triploid bananas (gros michel, cavendish,
3. Indonesian cavendish banana
    a. AAB (king banana, silk banana, horn plantain, Thai crocodile finger),
    b. ABB (angels' food, cultivated cardaba banana, Bali cooking banana),
    c. BB (Klutuk banana, Klutuk Wulung banana, and Klutuk Warangan banana)
4. AAAB tetraploid bananas (Papua New Guinea banana).

The multiplication of diploid banana chromosomes with desired characteristics may produce tetraploid bananas for parental hybridization ends. LIPI has produced more than 12 tetraploid banana accessions by way of in-vitro multiplication of chromosomes, two of which have been registration with a Variety Protection and Agriculture License under No. 180/PVHP/2013 and No. 181/PVHP/2013 designated, respectively, as Pisang LIPI MJ4 and Pisang LIPI ML4. The triploid hybrid of Madu x Musa acuminata var malaccensis has likewise been successfully produced (Poerba, et al., 2012.

while the secondary diversity center is in East and Central Africa. There are 12 Musa species in Indonesia of the 66 Musa species in the world (Nasution and Yamada, 2001). According to Nasution (1991) there are at least 15 wild Musa acuminate varieties spread from Aceh to Papua. The breeding of cultivated bananas is very difficult due to the complex genetic system, parthenocarpy, sterility of female/non seeds, sterile pollen/male ploidy levels and different genome groups as well as the long plant lifecycle.

Therefore, the utilization of wild bananas as a pollen source and simultaneously as an endurance source against diseases becomes important. One of the strategies followed for banana breeding is the crossing of a tetraploid parent and diploid parent as source of pollen in order to produce triploid bananas (Stover and Simmonds, 1987) (see Box 3.6).

3.4.3. Microbe

Meanwhile, the SDG microbes are grouped in the currently utilized microbe species, either in the food, health or energy sector. Microbial genetic resources are the genetic material originating from microbes, either in form of organisms or their parts, population or other ecosystem biotic components that carry heritage functional units and have clear values and potential for humanity. This definition does not only cover the genetic material contained in one certain organism species but also covers genetic material collection in one community. This is also known as *microbiomes*. Microbes, either in the form of cells or their parts, such as *genomes, plasmid*, *viruses* and DNA, are a biotechnology set.

Most microbes are still hidden and need molecular-level exploration, identification and conservation. The microbe SDG study of various sources keeps developing along with the mastery of gene-based molecular techniques. The genotype of the species can be determined by using the polymerase chain reaction (PCR). Mould(*Monascus purpureus*) as the organism that has a role in the fermentation of red rice or *red mold rice* (angkak) in Indonesia has diverse genotypes.

3.5 ENDEMIC FLORA AND FAUNA

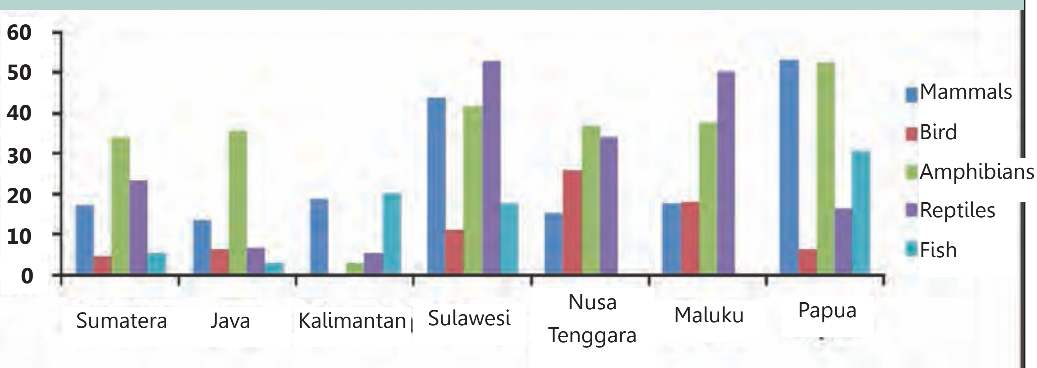
The geological and ecosystem uniqueness of Indonesia causes high endemism of fauna, flora and microbes. Indonesia has very high fauna species endemism, and even has the highest endemism in the world for several groups such as Aves, mammals and reptiles.

3.5.1.Endemic Fauna

Endemic fauna in Indonesia totals 270 mammal species, 386 Aves species, 328 reptile species, 204 amphibian species and 280 fish species. Each group of taxon on each island in Indonesia shows different endemism levels (see Figure 3.24).

Another sample is the spread of honey bees. There are seven species of honey bees (*Apis*) in the world, which are six found in Indonesia, except *Apis florae*. Of the six species in Indonesia, *Apis mellifera* is an introduced species. This species arrived for the first time through missionaries in Papua. The status and spread of honey bees in

Figure 3.24 Area of vertebrata fauna endemism spread in Indonesia



Source: Puslit-Biologi in LIPI (2014).

Table 3.15 Honey Bees Distribution Area in Indonesia.

Species	Java	Sum	Kal	Bali	Lombok	NTB	NTT	Sul	Papua
Apis dorsata	■	■	■	■	■	■	■	■	
Apis cerana	■	■	■	■	■			★	★
Apis andreniformis	◆	■	■						
Apis nigrocincta								■	
Apis koschevnikovi	●	■	■						
Apis mellifera	★	★	★	★				★	★

★ Introduction ● extinct ◆ rare

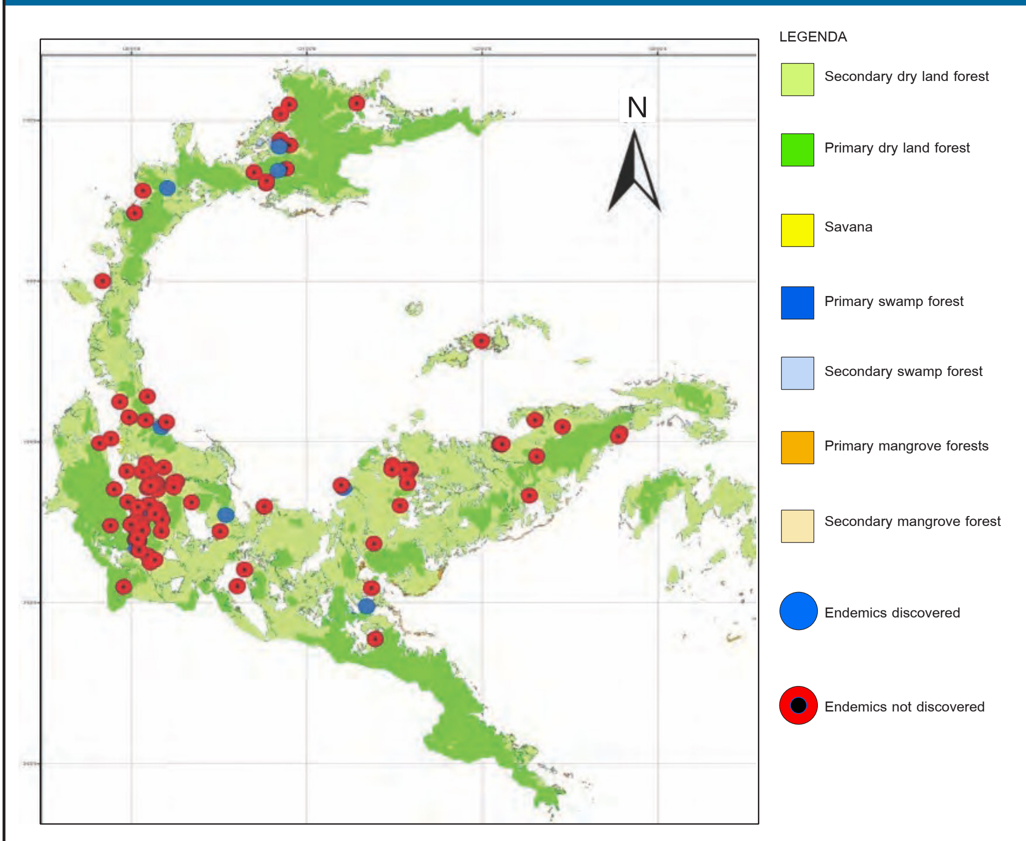
Indonesia is presented in Table 3.15.

3.5.2. Endemic Flora

The flora endemism level in Indonesia is recorded between 40 percent and 50 percent of the total flora species on each island, except Sumatra, where endemism is estimated at only 23 percent. For example, plants that breed with spores are cryptogams and ferns. Cryptogams consist of mushrooms, lichen and moss. Based on data from Herbarium Bogoriense, mushroom species around the world total 1,500,000 species (Hawksworth, 1991), consisting of all mushroom groups.

Around 750,000 species of that number have been described, including micro and macro mushrooms. It is estimated that Indonesia has 80,000 mushroom species, consisting of 80 percent of micro mushroom (around 64,000 species) and 20 percent of macro

Figure 3.25 Spread of plant species in Southeast Sulawesi



mushroom species (around 16,000 species). Only 864 species of the Basidiomycota group and around 336 species of the Ascomycota group of the 16,000 macro mushroom species have been uncovered.

The results of small mammal biography analysis show that small islands apparently have very high endemism levels, as seen on Flores Island, Enggano Island, Mentawai Island and others (Maryanto and Higashi, 2011).

Therefore, data collection and exploration/exploitation of small islands and areas with specific ecosystems become more and more important due to the discovery of new biodiversity species from areas that have not been explored or even from areas that have been explored. For example, during the 10-year time frame from 1993 to 2004 there was the addition of new fauna (Noerdjito and Maryanto, 2004), while more than 269 new biodiversity species were discovered the period of 2005 to 2014 (Wijaya, et al., 2011; Sutrisno, et al., 2015) from LIPI researchers alone.

Those discoveries will keep increasing if expeditions are carried out quickly and as much as possible, while simultaneously competing with land functional shifts. This endemic, characteristic biodiversity forms the riches of Indonesia, which is irreplaceable in the world.

Due to these characteristics of endemism, the conservation of habitats of flora and fauna and the preservation of biodiversity ecosystems become very important.

3.5.3. Threat of Endemic Biodiversity Extinction in Indonesia

The largest threat in biodiversity extinction, particularly endemic examples, is due to the loss of biodiversity habitats. Loss of habitat is mainly caused by:

1. Habitat damage, either due to natural disasters, forest fires, environmental pollution or climate change, causing damage to a biodiversity habitat;

2. Loss of habitat due to the use of biodiversity forest/habitat for

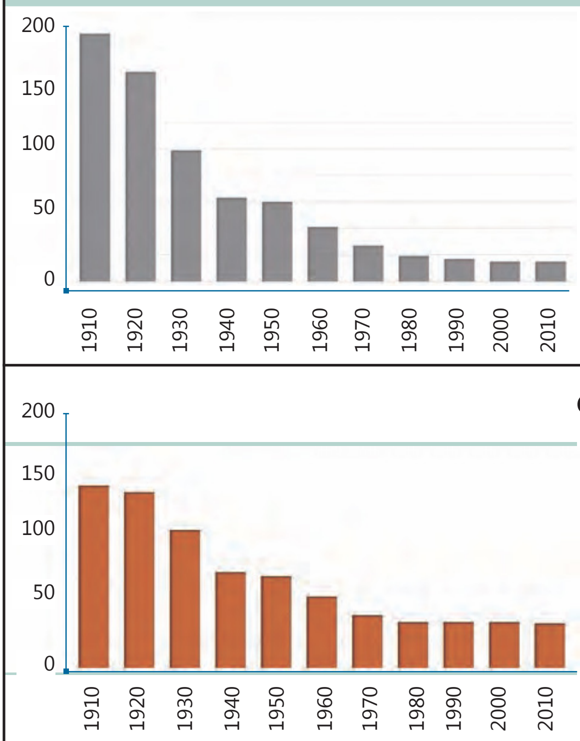
agricultural land, mining, industry or settlement. An increasing population, which is not followed by tight controls on spatial layout, causes the continuous clearing of forest and biodiversity habitats, resulting in the loss of living places or killing due to being considered as disturbance;

3. The killing of flora/fauna due to their content, where value is driven by irresponsible trade. One example is the loss of endemic flora species in Sulawesi.

It has been identified that the loss of Sulawesi's endemic species biodiversity was a decrease of between 83 percent to 94 percent of endemic species, based on the results of a study that has been described in the Current State of Biodiversity (LIPI, 2014). Following is the spread of plant species in Southeast Sulawesi based on data from the study and reference data collected at Herbarium Bogoriense compared to the results of a field survey in 2013.

The results of the study on the loss of endemic species biodiversity

Figure 3.26 Loss of fish species in Ciliwung and Cisadane River



CILIWUNG RIVER FISH

Volume of loss:
1910-1920: 15.5% lost (29 species)
1920-1930: 47.1% lost (88 species)
1930-1940: 66.3% lost (124 species)
1940-1950: 67.9% lost (127 species)
1950-1960: 78.1% lost (146 species)
1960-1970: 85.6% lost (160 species)
1970-1980: 89.8% lost (168 species)
1980-1990: 90.0% lost (170 species)
1990-2009: 92.0% lost (172 species)

CISADANE RIVER FISH

Volume of loss:
1910-1920: 3.7% lost (5 species)
1920-1930: 4.4% lost (33 species)
1930-1940: 47.4% lost (64 species)
1940-1950: 49.6% lost (67 species)
1950-1960: 60.7% lost (82 species)
1960-1970: 71.7% lost (96 species)
1970-2000: 74.8% lost (101 species)
2000-2009: 75.6% lost (102 species)

Source: modified from LIPI (2014).

in several provinces in Sulawesi, shown in the table in Figure 3.26, indicates quite a drastic decrease, namely around 88 percent for West Sulawesi, 94 percent for Central Sulawesi, 83 percent for South Sulawesi and 84 percent for Southeast Sulawesi. This value could increase if ground checks and exploration on biodiversity were carried out to check on existence in habitats.

Figure 3.26 also explains that a lot of the biodiversity loss occurred in rivers containing flora and fauna riches. The contamination of the Ciliwung River and Cisadane River has killed fish and exterminated fish species in their habitats.

As consequence, biodiversity in those rivers has disappeared. It could be said that the water quality of those rivers is dangerous for the economic, social and community activities of the surrounding communities.

3.6 CHALLENGES

3.6.1. Research to Update Information on Biodiversity Riches

The IBSAP documents contain biodiversity riches and their functions for the interests of human beings. Compared to the previous IBSAP documents (1993 and 2003), the information presented in the IBSAP has been collected from various sources and is completely contained in the Current Status of Biodiversity (LIPI, 2014).

Such data was collected from 150 experts from government research institutes, universities and CSOs that are active in the biodiversity sector (forestry, marine and agriculture).

Although the collected biodiversity information only reaches 30 percent of the actual natural riches for fauna and 50 percent for flora, the presented information is adequate for management action design. The reason for updating the IBSAP was based on the drastic changes to biodiversity species riches information and the loss of biodiversity. The importance of updating species riches data is because during a time frame of 20 years, the total flora and fauna species, as indicated in Table 3.16, showed a significant increase.

Table 3.16 The comparison of Indonesian birds, mammals, amphibians-reptiles and plants in 1993, 2003, and 2004

TAKSA	YEAR	SUMATRA	JAVA - BALI	KALIMANTAN	SULAWESI	NUSA TENGGARA	MALUKU	PAPUA
Bird	1993 1)	465	362	420	289	242	210	602
	2014 3)	630	507	523	417	417	365	671
Mammals	1993 1)	194	133	201	114	41	69	125
	2014 3)	257	193	268	207	125	149	241
Amphibian & Reptiles	1993 1)	217	173	254	117	77	98	223
	2014 3,4)	315	196	374	166	93	104	359
Amfibia	2000	70	36	100	29	?	?	197 7)
	2014 3)	91	42	147	36	24	19	151
Fish	2000 2)	272	132	394	68	?	?	282
	2014 3)	594	408	738	293	161	?	422
Butterflies	2000 1)	49	35	40	38	?	?	26
	2014 3)	890	640	790	557	350	380	466
Plants	1993 1)	820	630	900	520	150	380	1030
	2014 3)	8391	6305	9956	5972	2442		9518 6)

1) = Bappenas 1993; 2) = BAPPENAS 2003: 3) = LIPI 2014; 4) = Written in IBSAP 1993 as reptiles; 5) = Written in IBSAP 1993 as plants; 6) = Maluku and Papua; 7) = Data includes Papua New Guinea.

The increase of total species nearly doubled and will keep increasing if exploration expeditions are increased.

In addition to biodiversity information as a result of study and exploration, expeditions and research, Indonesia is also facing a loss of biodiversity. For example, a loss of biodiversity can be found in the case of the existence of fish in the Ciliwung River and Cisadane River, West Java province. The loss of fish species in the Ciliwung River is 92 percent and in the Cisadane River is 75.6 percent compared to 1910.

Such losses were caused due to river quality and were worsened by the existence of invasive fish along the rivers, such as nila fish (*Oreochromus niloticus*), mujaer fish (*Oreochromus mossambicu*) and sapu-sapu fish (*Pterygo-plichthys pardalis*).

3.6.2. Management of Data and Information on the Stock/Riches and Utilization of Biodiversity

Data collection, documentation and conservation of biodiversity riches in Indonesia commenced long ago. This was initiated by data collection and documentation through the establishment of s'Lands Plantentuin (1817) and the establishment of a reference collection in Bogor. This establishment was an initial step in data collection to rescue plants in Indonesia.

At the time of its pioneering by the Dutch government, the data collection and rescue of plants at the Bogor Botanical Gardens was inaugurated under the name s'Lands Plantentuin te Buitenzorg in 1817, as a reference for living flora, particularly in the agricultural and horticultural sectors, which was then followed with the establishment of a herbarium (1844), the Museum Zoologicum Bogoriense (1894) and the microbe culture of Ina CC-LIPI (2014) for the data collection of flora, fauna and microbes.

Along with data collection on biodiversity riches that has been carried out through expeditions in Indonesia since 1899 until now (LIPI, 2014), the collection of data, which is further on kept in live collections, such as at the Bogor Botanical Gardens, microbe culture (InaCC-LIPI) and specimens at the Herbarium and Zoological Museum, has not yet been entirely completed.

Data collection samples of living plants at the Bogor Botanical Gardens is until now only able to accommodate 8.5 to 11 percent of flora riches in Indonesia (LIPI, 2014). Therefore, LIPI has established a regional botanical garden program in all provinces to collect data and simultaneously accommodate flora riches originating from various ecosystem species.

Biodiversity data collection, of which results are kept in the herbarium, zoological museum and microbe culture at InaCC, is no less important, as through the collections that are kept in those places, all distribution pattern sequences, morphological forms and potentials become the main references for the biodiversity sector in Indonesia.

However, unfortunately the collections of specimens in those three places is not fully able to describe the existence of biodiversity in Indonesia.

Exploration and expeditions are still badly needed to uncover more existence and potential, especially in island areas and eastern Indonesia.

Ilas Keirim, Upstream of Bengalon

Bengalon River, Berau River and Mahakam River are rivers with the nickname 'Mahakam' in East Kalimantan. The nickname 'Mahakam' is only directed to rivers that have an important role in the social-economic history of the East Kalimantan community. What is not much known is that at least 60% of those Mahakam rivers water is supplied by the karsts-upstream areas that are still unexploited with dense rain forests. If the upstream-forest area is the 'heart' of Kalimantan, then the karsts-upstream area is the 'kidney' of Kalimantan.

A lot of forest and karsts areas in Kalimantan still keep uncovered biological riches.

Courtesy photograph: Pindi Setiawan, ITB

In order to uncover data on potential biodiversity riches, Steenis and Kruseman (1950) established an origin density index.

Based on the density index, collection per 100 km2 shows that exploration activities on all islands are still very minimal compared to extensive locations, such as in Indonesia.

Therefore, additional collection is much needed. This situation is similar to data collection on the existence of fauna, and although fauna distribution data is already available with regard to the 3 million fauna samples kept at MZB-LIPI, such collected data is still minimal (LIPI, 2014).

As example, collected data on mammals is only from around 25 percent of the regencies/cities in Indonesia. The data collection of birds commenced in 1866 (preceding the establishment of the MZB) (MZB-Biology database, LIPI). This means that inventory activities of birds have been implemented over 148 years.

Nevertheless, apparently the total of collected species only reaches 1,210 species of the 1,605 species or around 75 percent, and data collection is considered minimal, so insect and microbe riches should also be collected.

3.6.3. Conservation of Biodiversity Habitat in Indonesia

Preservation of Biodiversity is one of the principles of conservation of natural resources and its ecosystems. Biodiversity conservation activities related to preservation are:

a. Protection activities of life support systems;

b. Preserving diversity of plants and animals and their ecosystems.

The protection of life support systems is realized in the form of Nature Conservation Areas (KPA), while the conservation of plant and animal species diversity, including their ecosystems, is realized in form of Nature Reserve Areas (KSA). KPA and KSA are the realization of in-situ biodiversity conservation. KPAs are areas with specific characteristics, either on land or in water, that have a major function of protecting life support systems, conservation of plant and animal species diversity, and sustainable utilization biodiversity resources and their ecosystems. KPA consists of:

a. National Park Area;
b. Grand Forest Area;
c. Natural Tourism Park Area

Meanwhile, KSAs are areas with certain specialties, either on land or in water, which have a principal function for the preservation of plant and animal diversity and their ecosystems, and that also function as a life support system area. KSAs consist of:

a. Nature Reserve Forest Area
b. Wildlife Sanctuary.

The government has determined around 49 percent of forest areas as natural protected areas in the form of protected forests and conservation forests, while the remainder may be utilized as production forests, with the total forests in Indonesia at around 131 million ha (LIPI, 2014). KPAs and KSAs currently have a total 528 areas with an extent of around 31.15 million ha. The majority of conservation areas are natural preservation zones, natural tourism parks, wildlife reserves and national parks.

In addition to in-situ conservation, biodiversity conservation efforts are also carried out in the form of ex-situ area conservation. Ex-situ conservation areas are protected areas outside natural habitats. Several ex-situ conservation areas include botanical gardens, biodiversity parks, arboretum and germplasm collections.

A presidential regulation has defined botanical gardens as ex-situ plant conservation areas with documented plant collections that are arranged based on the classification patterns of taxonomy, bioregion, theme or a combination of those patterns for the purposes of conservation, research, education, tourism and environmental service activities. From the establishment of botanical gardens in the colonial era until the issuance of regulations on botanical gardens, 25 botanical gardens were established, representing 15 ecoregions in Indonesia with a total extent of 4,078.6 ha (Purnomo et al., 2013).

Botanical gardens under LIPI have only conserved around 24 percent of the 30 percent to 40 percent of species estimated to be threatened with extinction (Purnomo et al., 2010; 2013). Meanwhile, the development of botanical gardens outside the management of LIPI commenced in 1999, under the management of district, city or provincial administrations, initiated with the development of Bukit Sari Botanical Gardens in Jambi province. Only around 79 percent of collections from all botanical gardens in Indonesia have been recorded in the database of PKT Bogor Botanical Gardens.

The development of biodiversity parks is the mandate of Law No. 32 of 2009 concerning Environmental Protection and Management. The central, provincial, district/city governments or individuals are mandated to develop biodiversity parks outside the forest area as the efforts to reserve natural resources

The ex-situ conservation program implemented by the Plant Conservation Center (Bogor Botanical Gardens LIPI) has since 2000 been integrated with in-situ conservation efforts, in the form of a reintroduction program for extinction-threatened species in order to recover populations in nature.

Since the commencement of the program, six extinction-threatened flora species have been reintroduced, namely *Calamus manan* (rotan manau), *Pinanga javana* (pinang jawa), *Alstonia scholaris* (pulai), *St- elechocarpus burahol* (kepel), *Intsia bijuga*, and *Diospyros macrophylla*, which all still need monitoring in order to be successful.

The natural population status of other extinction-threatened species with narrow areas of spread is still being examined in order to be included in reintroduction and species recovery programs, such as *Dipterocarpus littoralis*, *Dipterocarpus cinereus, Hopea bancana, Hopea nigra and Vatica teiysmanniana.*

The development of Biodiversity Park (Taman Kehati) is mandated under the Law Number 32 Of 2009 on Environmental Protection and Management. The central government, provincial, district and city administrations or individuals are mandated with developing biodiversity parks outside forest areas in an effort to preserve natural resources, including biodiversity natural resources.

Plants that are found in biodiversity parks are endemic local plants with a planting methodology based on the ecosystem approach, where the main plants to be preserved should be associated with supporting plants as a source of food for pollinators, which could help the pollination process in order to spread the main plants in the biodiversity parks concept refers to the existing lifecycle in an ecosystem.

The reciprocal relationship in an ecosystem is between flora and fauna. Animals, microorganisms and their habitats are the keys for survival of all life within an ecosystem. The disruption of only one species may impact the survival of all species in an ecosystem. Those species are arranged and recollected in biodiversity parks by taking into account the interspecies relationships and their habitats as well as the minimum population in order to maintain their survival.

Biodiversity park development is an effort to develop and expand biodiversity in natural resources preservation areas, which function as in-situ and ex-situ conservation areas, in order to save various local plant and animal species, either wild or cultivated, particularly rare examples and those threatened with extinction.

In addition to its main function as a local plant rescue area, biodiversity parks are also expected to function as sources of seeds/breeding, a means of science and technology development, education and counseling, natural tourism attractions and as green open space.

The biodiversity park program is expected to be able to enhance the bargaining position at the time of the access and benefit sharing process / ABS from the genetics resource utilization in Indonesia

The biodiversity park program is expected to be able to enhance the bargaining position at the time of the access and benefit sharing (ABS) process of genetic resource utilization in Indonesia. One function of biodiversity parks that is also very important is as a means of biodiversity research and development, including biotechnology development.

This biotechnology research and development is expected to be able to produce more qualified and abundant products so that they ultimately will have a role in the improvement of community welfare. Since the enactment of the Biodiversity Law, 29 biodiversity parks have been developed, spread across 29 regencies in 13 provinces.

Another effort in preserving biodiversity habitats is through Indonesia's Man and Biosphere (MAB) program, which has been implemented since 1972. The MAB program is a cooperation between the government and UNESCO with an objective to synergize biodiversity conservation, economic development and national cultural empowerment for the welfare of the people.

One of the outputs of the MAB program is the establishment of biosphere reserves, which integrate the protection of landscapes, ecosystems, species and sperm plasma as well as sustainable economic development. The biosphere reserves also provide contributions in accordance with the objectives of the Convention on Biodiversity (UN-CBD).

Conservation District is the district that is established with the objective to maintain the regional income through the sustainable biodiversity resource management without the land functional shift

Indonesia has developed eight biosphere reserves since the declaration of the program. In addition to MAB, other UNESCO programs carried out in Indonesia include the determination of world heritage areas. This program is intended to identify and conserve cultural world heritage and natural world heritage, which have noble values for humanity. World heritage has various forms, from unique ecosystems to unique historical heritage.

In addition to MAB, the establishment of conservation districts also supports biodiversity conservation in the regions. Conservation districts are established with an objective to maintain regional income through sustainable biodiversity resource management without land function shifts. The establishment and realization of conservation districts is evidence of independence in supporting regional life during the time of regional autonomy.

The realization of conservation districts is expected to be able to reduce pressure on biodiversity decreases and simultaneously encourage the utilization of local biodiversity resources without having to reduce regional income.

Conservation regency pilot projects have been carried out in several regencies, among others in Lebong regency (Bengkulu), West Lampung regency (Lampung), Kuningan regency (West Java), Kapuas Hulu regency (West Kalimantan), Malinau regency (North Kalimantan), Paser regency (East Kalimantan) and Wakatobi regency (Southeast Sulawesi). Currently, the regency of Kuningan, West Java has shown the successful of this concept.

The conservation of biodiversity in water is carried out through the development of waters conservation areas. The proposed locations for the development of water conservation areas for the Coral Reef Rehabilitation and Management Program (Coremap) in Indonesia cover 21 regencies in 11 provinces.

Bird conservation efforts are carried out through the ecosystem approach initiated by Bird Life International (currently Birds Indonesia) and adopted by the government through the former forestry ministry (via the Directorate General of PKA Forestry-Bird Life Indonesia Program 2001). This concept covers Endemic Bird Areas (DBE) and Important Bird Areas (DPB).

DBE have two or more limited spread types, which are only found in the concerned area. Indonesia's total of 38 DBE compared to 22 DBE in the world makes it the country with the most DBE. Meanwhile, Indonesia has currently 227 DPB, spread out in conservation and non-conservation areas (LIPI, 2014).

Biodiversity protection is also carried out through traditional wisdom. The community of Ngata Toro in Central Sulawesi Tengah and the Baduy community in Banten province have a clear structure in their area systems, resulting in sustainable life products (Baso, 2009 and Iskandar, 2009, in LIPI, 2014). Darmanto (2009) in LIPI (2014) proved that the Mentawai community on Siberut Island was able to structure dry fields without sacrificing natural forest conservation, and even cultivated original forest fruits such as durian.

The community of Ngata Toro, Central Sulawesi Tengah and the Badui community in Banten Province has a clear structure on their area system and resulted in a sustainable life product

The traditional Dayak community in East Kalimantan develops settlements in areas that are unsuitable for dry fields as more fertile land is utilized to plant rice and other food plants (Soedjito 2005; Soedjito 2014).

The Umak Lung Dayak community in Setulang village, Malinau district, North Kalimantan, uses the Tanah Ulen concept to conserve part of its area as natural forest in order to provide fresh water and utilize sufficient forest products so that the forest ecosystem is maintained (Soedjito, 2009).

Traditional community wisdom that protects wild species biodiversity in forests is found in the local knowledge of many other ethnic groups in Indonesia. The Sundanese community of Kampung Leuwi Sapi, Cimande village, on the edge of the Mount Gede-Pangrango National Park (TNGP) in Bogor district, West Java, utilizes the forest as a source of medicinal ingredients.

Cimande oil, which is known for healing fractured bones, is nearly 100 percent produced from forest plants. This community has also planted canar (Smilax zeylanica) fruit in their gardens since the 1970s, which are taken from the TNGP area. The community selects one of the seeds from a canar sprout that is bearing fruit, and leaves the other sprouts to develop naturally.

The domestication of wild plants from this forest is more efficient and is economically very useful. Another sample is saninten (Castanopsis argentea), one of the mountain-forest specific trees of West Java. ***

Trap Thread

The sticky traps made by this larva species are only found along the alleys that are eroded by the river inside the dark cave. This is one of the uncovered biological riches in the karsts areas.

Courtesy photograph: Pindi Setiawan, ITB

Euphyllia spp

(Euphyllia Baliensis) New Bubble Coral Indonesia is rich in hermatipik coral biodiversity, which is the richest in the world with a total of 590 species (73% of species in the world) in 2009. The utilization of the sea biota riches through genetic engineering for the source of medicines and pharmacy is still very minim compared to the land area biodiversity.

Photograph: Mark Erdmann, Conservation International Indonesia

4

Economic Utilization and Contribution of Biodiversity

As explained in chapter III, Indonesia is a country rich in biological resources, however not all have been identified. From these abundant biological resources, much benefit can be gained for the community life, in connection with genetics, species and the ecosystem. Biodiversity in the form of an ecosystem is the foundation for human life because of its various functions, and the processes that take place in the ecosystem are a reflection of the activities in the collective life of plants, animals and microbes that interact with the physical components of the environment. Degradation in the function of the ecosystem occurs if the variety and number of species in the ecosystem decreases. Several important processes in the ecosystem influence the productivity, since processes in the ecosystem also affect many other issues, such as the fertility of land, water quality and chemical composition of the atmosphere and other environmental conditions that ultimately impact the welfare and lives of human beings. Degradation of biodiversity in the ecosystem reduces the dimension and stability of the processes in the ecosystem and disturbs the process of evolution. Thus, the biodiversity and function of the ecosystems play an important role in supporting and maintaining the existence of mankind (Naeem, et al, 1999).

The ecosystems, with their processes and functions, contribute to the welfare and life of humans through ecological system services and a stock of natural capital provided by the ecosystem. Such ecological system services and stock of natural capital, part of which is intangible, have a certain value and will cause changes in the welfare of man (Constanza, et al, 1997). Therefore, preservation of the ecosystems that comprise the habitat of biodiversity is absolutely necessary. The diversity of species also has a specific function in the food chain and in life, and sometimes this function cannot be replaced.

Some of the types of flora and fauna that make up the diversity of species are individually known as having benefits for man, but with many others we do not know what their benefits are, although both groups have a function in the ecosystem. The flora and fauna that are not yet known to bring benefits may very well become a source of life in the future. Therefore, there needs to be efforts to protect and conserve the individual species of flora and fauna so that their current benefits or potential benefits can be preserved.

The biological diversity and services of the ecological system play an important role since they provide various benefits to support the lives of man, for example as a source of food, health and energy, as well as providing ecosystem services, the functions of which are difficult to replace. The benefits provided by the existence of biological diversity contribute both directly and non-directly toward the welfare of man, and thus represent part of the total economic value.

The economic value of these environmental services is just an estimate, since most of the ecosystem services have values that are not reflected or even quantified adequately in the commercial market. Although the value is not always reflected in the market, biological diversity is an invaluable asset for the current generation, as well as future generations, and therefore serious efforts in conservation and sustainable utilization form the foundation for sustainable development. For the efforts of conservation and sustainable utilization of the biological diversity to be compared to other economic activities, the economic benefits of biological diversity must be declared explicitly (Pearce, et al, 2002)..

4.1 THE SIGNIFICANT VALUES OF BIODIVERSITY

According to Laverty et al (2003), biodiversity has two significant values: (i) the intrinsic value (inherent value) and (ii) extrinsic value (benefit value or instrumental value). The intrinsic value is inherent in the biodiversity itself and is focused more on the philosophical concept of biodiversity, while the extrinsic/external value is the value of any benefit, both direct and indirect, that the biodiversity brings for mankind. Whereas Pearce, et al (2002) distinguishes the value of biodiversity as : (i) the use value, that is the value of direct use (goods), the indirect value (service); and (ii) non-use value . This grouping of values according to Pearce shall be used here as it is easier to apply in assessing the benefits of biodiversity.

The value of biodiversity that has a direct use may consist of the consumptive value and productive value that can be in the form of food, medicine, building material and fibers or fuel. Whereas, indirect value is the value of environmental service and among others can consist of the processing of organic waste, pollination, climate and atmosphere regulation, protection of plants and the cycle of mineral nutrients; as well as the aesthetic value of the biodiversity and values utilized together by the community culture and spirit.

Non-use value consists of the potential value/selection value, existence value. The existence value is the value of the biodiversity in the future, because the existence of the various species will be beneficial for the future, even though it is not yet known what their specific benefits are. The existence value will provide an opportunity for future generations to gain knowledge as an asset for living (see table 4.1).

With these potential/unknown values, each generation will have a selection value of biodiversity that will be utilized today or be conserved for future generations. The values that we are aware

Table 4.1. Category of Biodiversity Benefit Values

CATEGORY OF BIODIVERSITY BENEFITS		FORM
Direct Use Value	• Consumptive Value • Productive Value	Food, medicines, building materials, fiber, fuel
Indirect Use Value	• Environmental Service Value	a. Organic waste processing, pollination, climate regulation and atmosphere, protection of plants, mineral nutrients cycle, and water purification; b. Cultural, spiritual and aesthetic (beauty)
Non-Use Value: • Selection Value (potential) • Existence Value		a. Future value, both as goods or services; b. Existence value and knowledge about their existence

Source: modified from Pearce, et.al., (2002)

of today can be gained because the existence value of the said biodiversity had been maintained by earlier generations.

Based on the category of benefits obtained from the biodiversity, as given in the above classification, an explanation of the significance of biodiversity can be provided as follows:

1. Consumption Value

The consumption value is a direct benefit that can be obtained from the biodiversity, for example food, clothing and housing. Indonesians consume no fewer than 100 types of plants, seeds and tubers as sources of carbohydrates, that can be consumed directly (food) or be used as material for production (for housing and clothing). No fewer than 100 types of legumes, 450 types of fruit and 250 types of vegetables and mushrooms are also seen on the menus of Indonesians. The richness of our biodiversity has been cultivated to produce food, in the form of rice, tubers, sugar, meats, eggs, milk, fish, and fruits and vegetables. Of this foodstuff, some are consumed directly, but many are produced as processed foods or used as supplementary material in the processing/manufacturing industry.

The contribution of our biodiversity is immense, and only several are utilized to meet the need of creating national food security. For example, to meet the need for carbohydrates, rice is still dominant, yet there are many types of tubers that grow or are produced in various parts of the country that have strong potential to be utilized optimally.

The need for sugar in Indonesia is still fulfilled by sugar cane, yet sugar made from coconut and sugar palm has very good potential to be utilized (see box 4.1). Likewise, for the supply of meat, particularly beef, Indonesia still relies on imported meat, yet many of the local beef cattle have not been bred and raised optimally to support food security.

Box 4.1. Tangible Benefits of Biodiversity: Revitalizing the Sugar Palm (Arenga Pinnata) for National Sugar Autonomy

Many rivers have sustained physical damage as market demand for sugar is very high (3.44 million tons/year), whereas the national industry is only able to provide 2.31 million tons/year. Consequently, each year the country must import 252,368 tons of sugar, with 108,889 tons of this sugar being raw sugar. The Indonesian Sugar Board has proposed to increase the import of raw sugar in 2012 to 240,000 tons.

To reduce our dependency on imported sugar, the sugar made from sugar palm can be used as an alternative sweetener. The area of land used for sugar palm plantations in Indonesia as of the year 2007 was approximately 70,000 ha. The largest sugar palm estates are located in the provinces of East Kalimantan (17,794 ha), Central Kalimantan (17,000 ha), and province of West Java (13,878 ha). If developed further, palm sugar has the potential to fill the sugar supply shortage.

Revitalizing sugar palms is important for the people's economy because from one male flower that is tapped for three months, we can produce as much as 360 kg/three months/flowering period. The normal selling price of palm sugar is Rp. 8000/kg. Thus, the total amount received will be Rp. 2,880,000/three months/flowering period or equivalent to almost Rp. 1,000,000/month/flowering period. From each tree there will be one to three flowering periods, therefore on average a farmer can produce 720 kg sugar/three months/flowering period/tree or an income of Rp. 2,000,000/tree/month. The farmer's income will multiply if the by-product of harvesting, that is palm fiber, can also be marketed. Good quality palm fiber can be exported to South Korea and India at a selling price of Rp. 13,000/kg. Meanwhile, the bark of the palm tree is very hard and durable and has the potential to be used as material to make roof tiles in support of the housing industry. Another by-product of sugar palm is its fruit, called kolang-kaling. In addition, the fungus that grows in the waste material from processing kolang-kaling is edible and can be eaten as food, as done in the village of Sidamulih, Ciamis district.

Source: summarized from LIPI (2013

There is a possibility that many other consumption values can be developed to increase the diversification of food nationwide in the framework of supporting food security to strengthen food autonomy on a national scale.

2. Production Value

The production value is the market value obtained from the processing and trade of biodiversity in the local, national and international markets. A portion of the goods consumed above are also the raw materials for industry and are also traded directly in the domestic and global markets. Efforts are increasing to boost the benefits of biodiversity for food industries, in line with the increased development of food industries and increased consumption by the middle-income segment that demands processed foods. This increased consumption by the middle-income segment and health awareness has also stimulated the development of drugs and supplements (health maintenance). The production of drugs and supplements is not carried out only by the medium and large manufacturing industries but also by the home industries (jamu or traditional herbal medicine, for example). No fewer than 940 types of plants produce the material used for traditional herbal medicine (KMNLH 1997).

The jamu industry is well-known as a home industry. Today, the jamu industry has developed and become a modern industry with large manufacturers such as Jamu Sido Muncul, Jamu Tjap Orang Tua, Jamu Tjap Jago, among others. This growth has pread to the cosmetics industry, which began as a simple home industry and now has grown and developed into big industries, such as Sari Ayu and Mustika Ratu. Meanwhile, various types of wild forest plants such

Box 4.2 Herbal: Taking Advantage of the Potentials and Opportunities of Biodiversity

The tendency to live a healthy lifestyle with the belief that consuming natural medicine is relatively safer than synthetic drugs has resulted in higher global demand for natural medicine, and therefore the market prospect for medicinal plants and herbs from Indonesia has become stronger. The WHO declares that 80 percent of the world population uses herbal products. The WHO also recommends the use of herbs to maintain health and prevent and treat diseases, particularly chronic diseases, degenerative diseases, and cancer. Today, degenerative diseases / non infectious diseases are the highest cause of deaths in the world, and result in millions of US dollars in losses. In 2012, the market for herbal medicine in Indonesia reached Rp. 13 trillion, approximately 2 percent of the total market for herbal medicine in the world. The global herbal market is predicted to reach $100 billion in the year 2015 and will increase to $5 trillion in 2050. The rich biodiversity of Indonesia is huge capital that can be used to take advantage of this opportunity and current trend.

Source: Iswantini (2015)

as pasak bumi (*Euriycoma longifolia*), tabat barito (*Ficus deltoidea*) and akar kuning (*Arcangelisia flava*) along with cultivated plants such as ginger (*Zingiber officinale*), turmeric (*Curcuma domestica*), kencur (*Kaempferia galanga*) kumis kucing (*Orthosiphon aristatus*) and cardamom (*Amomum cardamomum*) are also used in traditional medicine making by the local population. Several species such as kayu angin and tapak dara are used in manufacturing modern medicine, The economic value of jamu products in the market has the potential to reach up to Rp. 6 trillion per year and create 3 million jobs in the field of jamu production and herbal cultivation activities in 1,166 industries. (Muslimin, et al, 2009). It has also been noted that in the pharmaceutical industry, there are 45 major drugs made from tropic medicinal plants and 14 of those plants come from Indonesia.

Another contribution of biodiversity in industry is the supply of materials. More than 100 types of wood, 56 types of bamboo and 150 types of rattan are used to build houses and make household utensils and furniture (KMNLH 1997). Forest products, besides used in the paper and pulp industry, are also developed as raw material for energy in the form of pellets that have higher burning capacity than regular firewood. When viewed in terms of gen and molecules, biodiversity also has a significant role in the production of advance materials. Cellulose is a primary polymer that has extraordinary chances in the future of becoming a raw material in the modern food, health and material industries. The main source of cellulose is plants, however cellulose that is synthesized by bacteria has more advantages, namely a higher level of purity, better crystals, ability to absorb water, simple polymerizing, is stronger and has better capacity for biological adaptation. Technological developments in the processing of cellulose from bacteria make it possible to utilize cellulose in the food, health and material industries. (Sukara and Mellawati, 2014).

Wood biomass in the form of lignoselulosa waste is currently entering a new phase in the industrial world. Today, scientists are focusing on the application of advanced fiber technology capable of processing the lignoselulosa biomass into nano fibers. Now, nano-fibril from cellulose can be easily isolated from a variety of lignoselulosa that can be utilized as filling material to strengthen and improve the mechanical characteristics and eliminate the various weaknesses of polymer, including thermoplastic rubber and thermoset. The use of nano fibers is also promising in the field of biomedics, bioimaging, nano composite and as optic material. Recent research conducted in Japan shows us that nano fiber can also be used as raw material in the manufacturing of advance material to replace LCD and be developed into a flexible LCD.

Meanwhile, the cultivation of seeds is an industry that has also grown and developed. Seeds are traded worldwide, particularly hybrid seeds to increase the richness of biodiversity with genetic engineering. Using the superior qualities of specific genetics to create a species that has the desired qualities has become a big industry. Companies such as Monsanto develop various types of hybrid seeds to increase the productivity of certain agricultural species.

In the meantime, at home, the development of a variety of biodiversity benefits has also flourished. Many coffee products of the Robusta and Arabica species that are cultivated in specific locations in Indonesia have adapted to the local conditions, such as Gayo, Bali/Kintamani, Toraja, Manggarai coffees, and their uniqueness is enjoyed by the community. In addition, there is an increased utilization of biodiversity for health supplements, for example mangosteen rind, soursop leaves, and others. Using modern production standards, these products attract a specific market, particularly consumers who want to avoid health products made with chemicals. This type of industry will continue to grow and can become a source of income for the community that conforms with and encourages the efforts to preserve the species of local biodiversity..

3. Environmental Service Value

Biodiversity provides environmental services for man through the formation of ecosystems with the uniqueness of the biodiversity within them. Forests protect the balance of the hydrology cycle and water system, and thus help man avoid both floods and drought. Forests also maintain the fertility of soil by supplying nutrients from the offal of the forest, preventing erosion and controlling the micro climate. The ecosystems of coral reef and seagrass bed protect the shoreline from abrasion. Likewise, mangrove forests provide a breeding place for various species of fish and shrimp. Cave ecosystems provide reserve water for living creatures in the area and shelter for bats that pollinate flowers and predators that prey on pests, and are therefore helpful in the growth of cultivated plants (LIPI 2013).

These environmental service values are illustrated by the result of research conducted at the Bogor Botanical Garden, which indicates that there are at least 52 plant families with flowering and production of fruit depending on bats. The presence of bats, which assist in the pollination, is very important for fruit-bearing trees, such as durian and petai (bitter bean), for example, and therefore the existence of, and balance in the ecosystem where the bats live must be preserved.

The biodiversity also provides environmental service because they play a significant role in contributing to the ability to sequester carbon, in addition to other environmental services. Out of the number of existing ecosystems, the ecosystem with the highest ability to sequester carbon is the seagrass bed, that is amounting to

830 tons/ha, while forests on land are able to store 300 tons/ha of carbon. At the species level, it is noted there are 10 species with the highest stock of carbon ranging between 0.159 and 2.624 tons of carbon per ha, they are : *Schima wallichii, Vaccinium varingiaefolium, Castanopsis tungurrut, Lithocarpus sundaica, Leptospermum flavescens, Platea latifolia, Myrsine hasseltii, Toona sureni, Symplocos Castanopsis javanica*, and *Cyathea junghuhniana* (LIPI 2013). .

• Selection Value

The selection value or potential value is related to the potential of the biodiversity to provide advantages or benefits for the community in the future (Indrawan, et al, 2007). The biodiversity contains beneficial values that the people are not yet aware of or that cannot be utilized by humans. However, along with the changes in demand, pattern of consumption and technological intake, these values may become important in the future. The potential for wild plants to become sources of material for medicines is one of the forms of selection value. Many pharmaceutical companies and health institutions of the government have intensively attempted to find new sources of medication from the biodiversity in its original habitat to fight diseases such as AIDS and cancer.

Facts indicate that 20 of the most often used drugs/medicine in the United States, amounting to $6 billion per year, contain chemical substances that are found in nature (Indrawan, et al, 2007). This is the monetary value of utilizing the selections made by earlier generations that have been handed down to be enjoyed by today's communities.

The same applies to the various collections of germ plasma at the research institutions which, perhaps at this time do not appear to have any direct benefit and their cost of conservation is quite high, but in the future, the collection of germ plasma will certainly become a source of gens that are invaluable for life. LIPI notes that in several botanical gardens there are 3,000 species of indigenous plants in Indonesia and 50 plant species in the collection are reported to have an actual contribution toward increasing economic value, for example coconut and sugar cane (LIPI 2013). In 2012, the production of coconuts in Indonesia reached more than 3.18 million tons, with the volume of export reaching 1.52 million tons and an export value of $1.19 billion. Whereas, with sugar cane, the production reached 2.44 million tons, with export volume reaching around 388,000 tons and export value of $46.2 million (Kementan 2013b). However, the development of benefits is not only obtained from the parts that people have consumed so far. The benefits of biodiversity can also be gained from parts that up until now have not been consumed because they are considered to be "waste", but actually contain many benefits, for example mangosteen rind, soursop leaves, among others.

Thus, with the limited knowledge regarding the benefits of biodiversity, the variety of biological species in the ecosystem, both ex-situ and in-situ, should continuously be maintained. If any of the species of biodiversity that have a high selection value become extinct before they can be identified, then their value for the welfare of man in the future will disappear. The challenge is to protect the said biodiversity, among other ways by continuing to conduct research on utilization and seeking methods of utilization that do not damage the biodiversity..

4. Existence Value

In line with developments in living style and the increased loss of open space, man attempts to seek and is willing to spend his money to enjoy the beauty of nature. Such developments in liking conform to the utilization of the existence value of biodiversity, namely the value of biodiversity because of its existence in a certain place (Laverty, et al, 2003). This value is not related to the potential of its benefits and the service provided directly by a certain organism, but rather the "utilization" of the right to live and existence of biodiversity as part of nature.

Limestone mountains, which have an environmental service value as a source of water, need to be preserved. However, communities often use and mine the limestone to be sold as material in the cement industry. Such action, of course, should be prevented. The first step in prevention is to determine the limestone areas as a nature reserve. However, this measure alone is not enough because when a poor community lives in the surrounding area, the easiest way for them to get income is to mine the limestone. The existence value can be improved to help the people earn an income without causing damage, that is by creating limestone recreation, which involves the local community directly (as workers) as well as indirectly (encouraging the people to provide tourists), for conservation of the limestone areas.

Similarly, various locations in Indonesia, for example the mangrove forests on the coast, coral reefs, or natural forests, can be developed as tourist areas because their panoramas are attractive (existence) and also as scientific recreation for certain segments of consumers. The coral reefs in Wakatobi, Raja Ampat and Bunaken are locations that take advantage of the existence of the coral reefs as a source of income for the local community and the region.

A study on the willingness of people to pay for the conservation of coral reefs, seagrass beds and mangrove forests in the marine conservation area in the Thousand Islands shows us that people's willingness to pay is, on average, Rp. 146,000 per capita per year or, on aggregate, $78,751.03. This value illustrates the value of the marine conservation area in the Thousand Islands. Although the willingness to pay for conservation does not reflect the full perception of the area's economic value, this value can be used as a reference for the economic value of a conservation area (Fauzi, et al, 2007).

The estimated value of coral reefs in larger areas is known to be able to support 120 million people whose lives depend on coastal water resources and coral reefs in the Coral Reef Triangle. Furthermore, the profit gained from the sustainable management of coral reefs throughout Southeast Asia is recorded at $2.4 billion.

Meanwhile, the income from nature-based tourism in the Coral Reef Triangle, which stretches from Tubbataha, Komodo, Sipadan (East Kalimantan) to Raja Ampat, stands at $12 billion (Bisema 1968; WWF 2013).

The benefit value of another ecosystem, namely the mangrove trees, also continues to develop, not only because the benefits can be felt, but at the same time encourages a community movement to conserve the mangroves because the community realizes the multiple benefits of the coral reefs (see box 4.3).

Another potential that can be developed from the existence value of biodiversity is the uniqueness of certain species. Besides the existence of a certain species being able to maintain a balance within the ecosystem, the life and interaction of that biodiversity with nature is an attraction for recreational and scientific tourism. Flora and fauna have become tourist attractions, for example the orangutans at Tanjung Puting, and in Cambodia.

Orangutans are an interesting tourist attraction, and at the same time their existence also gives an example of their behavior/instinct

Box 4.3. Mangroves, an Ecosystem Function with Economic Value

Many parties were not aware of the benefits of mangrove forests when, in the 1900s, the mangrove trees were all cut down and cleared to make shrimp breeding ponds. The impact was only realized when the coastal environment sustained damage. Serious abrasion not only swept away the coast land but also the source of income of the coastal villagers. Mangrove forests not only protect the land from abrasion and the intrusion of sea water, as well as restrain the waves, but also form a place for many animal species to seek shelter, in particular crustaceans such as shrimp and crabs. Mangroves also absorb carbon and heavy metals and therefore help restore the condition of polluted water. These functions cannot be replaced by other plant ecosystems. Therefore, efforts to rehabilitate the mangrove forests must continue. Based on data from the Central Java Provincial Environment Board in 2013, it is known that 8,594.89 ha out of 11,732 ha of mangroves along the coast of Central Java, especially the northern coast, are damaged. The coastal land swept away by abrasion up to 2013 reached 5,235.74 ha..

Mangrove Functions

- As a permanent or temporary habitat, to seek food, for reproduction, spawning and raising the offspring of various biota such as fish, shrimp and crab.
- Ecosystem to support the variety of types of flora and fauna.
- To protect the coast from abrasion by sea waves.
- Area of resources that has an ecological, social or economic function and role for the coastal communities if managed sustainably for conservation.

Source: Zoology Section, Biological Research Center - LIPI

Mangroves in Semarang

There has been an increased awareness of the people to save the mangrove forests. In Semarang city, for example, there are 10 community groups that are active in the efforts to save mangrove forests. Among them is the student group from the Marine Study Program of the School of Fisheries and Marine Science, Diponegoro University (UNDIP) Semarang and the youth group at Tapak, Tugurejo Village, Tugu subdistrict. The area of Tapak is the area most damaged by abrasion in Semarang city. Tens of hectares of fisheries in this area that had been developed by cutting down the mangrove forests, were lost by abrasion.

In 2001, while conducting a study in Teluk Awur, Jepara, university students from UNDIP saw the seriously damaged coast land. Mangrove forests had been cleared away and replaced by fisheries that were now lost to abrasion. The students took the initiative to begin a movement to plant mangrove trees using their own pocket money. They formed the Mangrove Ecosystem Study Group of Teluk Awur (keSEMaT).

In Tapak, Tugurejo village, also in the year 2001, a group of young people formed the Prenjak community, which is active in growing and planting mangroves. According to the leader of the Prenjak community, Arifin, the community was established to prevent the youth from engaging in negative activities. They pool their money to buy mangrove seedlings and plant them. Eventually, they were able to grow their own seedlings.

Progress

KeSEMaT and Prenjak both see the benefits of mangrove forests for the environment and for life. As a student organization, KeSEMaT intends to develop research on the mangrove ecosystem and environmental conservation. This youth group activity has developed well. In Teluk Awur, KeSEMaT has planted 6.4 ha of land with 17 types of mangrove that have now become the habitat for various species of primates, birds and reptiles.

This group often assists and accompanies citizens in their efforts to gain the attention of the government. They are members of work groups at the district/city, provincial and national level. This group was presented with the Tunas Lestari Kehati award last January. The alumni of KeSEMaT Mangrove Indonesia (Kemangi) engage in business such as supplying mangrove seedlings for the government and state-owned enterprises. Prenjak also produces mangrove seedlings that are offered to state enterprises, the government and community members. Furthermore, Prenjak breeds bandeng (milkfish) and produces breakwaters. "Fisheries in this area are contaminated by the waste material disposed by factories into the rivers. The fish are becoming increasingly smaller in size. After the mangroves are fully grown and abundant, hopefully the size of the fish will increase. Apparently the mangrove trees help restore water to its ideal state, explained Arifin"

Ecotourism

The spirit of the youth to rehabilitate the mangroves is further encouraged owing to the economic benefit from the sale of seedlings, managing the mangroves to make a variety of foods and the breeding of milkfish. These young people aim to help develop their village into a mangrove forest ecotourist destination. However, this effort has been hampered by land ownership problems involving a private company. Through Prenjak, many school dropouts have been able to continue their education through high school.

Although efforts to rehabilitate the mangrove forests have been carried out by many parties, they have not been proportional to the rate of damage. The head of the Department for Environmental Damage Control and Conservation of Central Java, Wahjudi Djoko Marjanto, says a coastal belt is established every year, but the needs are still far from being met.

Source: Amanda Putri, Kompas, Wednesday – 11 February 2015

in choosing foods. Their pattern of selecting types of biodiversity for consumption give an example of foods that might be consumed by humans as well and therefore can be developed as a food material.

Animal behavior can also be used to assess the benefits of the biodiversity animals consume when sick, which possibly could have curative benefits for man's health. The existence of animals and their eating behavior can, at the same time, spread the types of seeds within its habitat, thus ensuring the growth of certain vegetation/ trees and maintaining the biological diversity of their habitat.

The biodiversity value is often linked to culture. For example, the tradition of slaughtering a "white" buffalo in Tanah Toraja is useful for the conservation of this species of buffalo. The cultural activities related to this tradition are also a tourist attraction that brings income to the community and the regional government.

The use of flowers in preparing the ritual offerings of the people of Bali and also certain communities in Java encourage the people to continue to use these species of flowers. The use of pigs as a bride price in Papua also preserves the raising of pigs among the local communities. In brief, all the biodiversity values and empirical examples of each benefit value can be seen in Table 4.2.

4.2 ESTIMATED VALUE OF ECONOMIC CONTRIBUTION BY THE BIODIVERSITY

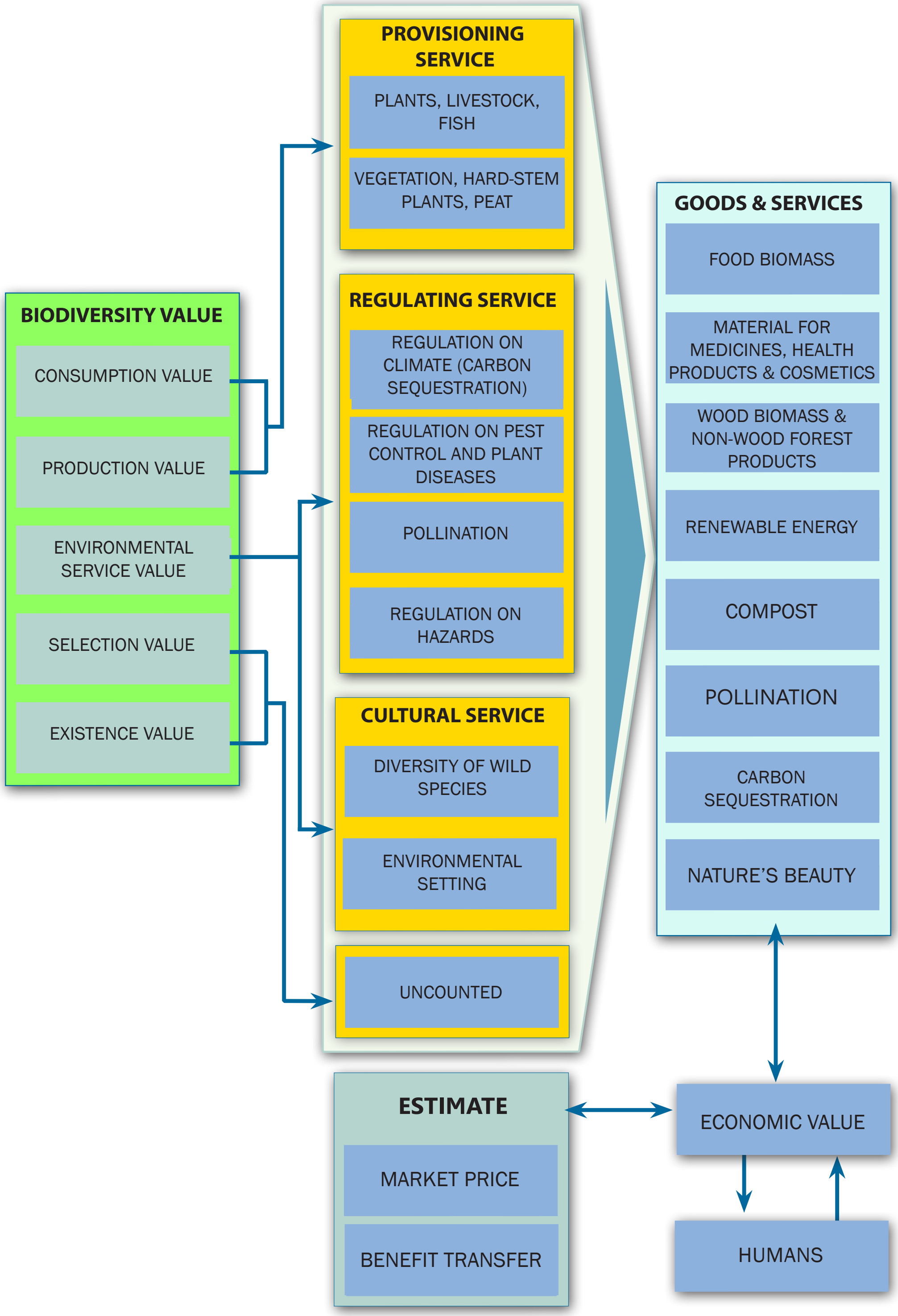
Based on the definition of benefit value as meant above, the estimated value of economic contribution of biodiversity and ecosystem services in Indonesia is found by applying the method and approach used by UKNEA (2011). This method and approach is chosen as it

Tabel 4.2. Biodiversity benefit value and empirical samples

No	Biodiversity Value	Empirical Sample
1	Consumption Value	Various species of wild plants from the forest, such as Pasak Bumi (Euriycoma longifolia) and various species of cultivated medicinal herbs, such as Ginger (Zingiber officinale) are used to make traditional medicine. The economic value of jamu products that circulate in the market have the potential to reach up to Rp. 6 trillion, in addition to providing work for millions of people.
2	Production Value	The potential economic advantages that can be gained by Indonesia from the sustainable utilization and management of coral reefs for fisheries, tourism, protection of the coast and aesthetic values can reach at least $16 billion/year.
3	Environmental Service Value	The ability for carbon sequestration by the ecosystem of seagrass beds reaches 830 tons/ha and the forests on land are capable of capturing carbon up to 300 tons/ha, whereas at the level of species there are 10 types of plants with the highest carbon stock ranging from 60,159 to 772,624 tons carbon/ha.
4	Selection Value	Several botanical gardens in Indonesia have a collection of 3,000 species of vegetation indigenous to Indonesia, and 50 types of plants in this collection are reported to give actual contribution to increasing the economic value, such as sugarcane and coconuts.
5	Existence Value	The existence value of the Marine Conservation Area in the Thousand Islands in aggregate reaches $78,751.03 per year.

Source: summarized from Burke, et al (2002), Fauzi et al, (2007), Muslimin et al, (2009) and LIPI (2013).

Figure 4.1. Concept for calculation of economic contribution from biological diversity



Source: modified from UKNEA (2011)

is more realistic, relating to the available data, and it can reduce the difficulties in separating and the possibility of multiple calculations arising.

According to this approach, the calculation of biodiversity value is based on the goods and services from:

a. Provisioning services
b. Regulating services
c. Cultural services
d. Regulating services

Provisioning services include the provision of sources of food biomass, sources of material for medicine, health products and cosmetics, sources of renewable energy and sources of wood as well as non-wood forest products. Regulating services include the processing of organic waste, pollination service and carbon capture and sequestration service, whereas cultural service consists only of recreation to enjoy the natural beauty of conservation areas. The economic contribution of biodiversity calculated in Indonesia is the extrinsic value of the biodiversity, while the intrinsic value of biodiversity particularly includes the selection value that is not calculated / uncounted (Table 4.3). The selection value of biodiversity is difficult to calculate before the choice of utilization to be used for the biodiversity is carried out. After the choice has been determined, the contribution of biodiversity shall be calculated from the consumption value, production, environmental service value or existence value.

According to the grouping given in Table 4.3, the method of calculating the economic value of biodiversity is carried out as described in Box 4.4. Meanwhile, the sources of data used for estimation are BPS (2012, 2013a, 2013b, 2013c, 2013d, 2013e), the Energy and Mineral Resources Ministry (2014), KKP (2013), Agriculture Ministry (2013a), Forestry Ministry (2013), Morse and Calderone (2000).

• Provisioning Services Value

Calculation of the economic contribution of biodiversity that are

Tabel 4.3 Basis for calculation of economic contribution from various biodiversity values

No	Biodiversity Value	Basis of Calculation	Goods/Service
1	Consumption Value	Provisioning services	• Food biomass • Material for medicines, health products and cosmetics • Wood biomass and non-wood forest products • Renewable energy
2	Production Value		
3	Environmental service	Regulating services	• Organic waste processing • Pollination • Carbon capture/sequestration
		Tourism services	Ecosystem existence tourism
4	Selection Value		Difficult to calculate if the “choice” of biodiversity to be used has not yet been determined (production, consumption, or environmental service).
5	Existence Value	Tourism services	Tourism on ecosystem existence and species of biodiversity.

Source: adapted from UKNEA (2001)

Box 4.4. Estimating the Values of Biodiversity and Ecosystem Services

Contributions of biodiversity economies, biodiversity resources and ecosystem services in Indonesia are estimated by means of the following approaches and formulas:

1. **Provisioning services** are estimated by means of market prices and
   a. Contributions of biomass economies of food = ∑ Food Products x Food Product Prices at the producer level/year;
   b. Contributions of biomass economies of medicinal, health and cosmetic materials (BOKK) = ∑ BOKK Products x BOKK Product Prices at the producer level/year;
   c. Contributions of biomass economies of timber and non-timber forest products (BKHHBK) = ∑ BKHHBK Products x BKHHBK Product Prices at the producer level/year
   d. Contributions of renewable energy (ET) economies = ∑ ET Products x ET Product Prices at the producer level/year;
2. **Regulating Services**
   Calculated by means of product market prices or processing expenses and estimated economies of:
   a. Contributions of economies of organic waste processing services = ∑ Population of waste source x waste production/year x Compost prices,

b. Contributions of economies of pollination services = ∑ Horticultural products x dependency index x product prices at the producer level/year,
c. Contributions of carbon sequestration services = ∑ C Sequestration/hectare/ year x Area x Carbon prices;

3. **Cultural Services,** which remains confined to nature-based tourism services. Contributions of economies of cultural services = ∑ Stakeholder x average consumer surplus/year

Source: adapted from Pearce et al. (2002)

sources of food from the terrestrial, semi-terrestrial and marine ecosystems. Contribution in the form of food biomass, which consists of crops, vegetables, fruit plants/trees and biomass from livestock breeding and fisheries, have reached a total value of Rp. 1.33 quadrillion (in 2012). The result from various biodiversity for the provision of material for medicine, health products and cosmetics, which consist of biopharmaceutical plants (about 449,300 tons) in 2012 amounted to Rp. 4 trillion. This value is a low estimation (underestimate) since the biopharmaceutical contribution on the whole, particularly from the home industries, is probably not recorded / no official data is available. Further, the provision of energy, in the form of biomass for energy (18 percent), for hydrothermal (2.1 percent), and sources of water energy, the value of economic contribution reached Rp. 336.88 trillion (equivalent to the price of oil which is US$112.7/barrel) Meanwhile, the vegetation providing varieties of wood for building, sap or resin for rubber and other material for the adhesive industry, gave a value of Rp. 1.08 quadrillion. Thus the total value from provisioning services was Rp. 1.68 quadrillion.

• Regulating Services Value

In total, the population of man, animals and plants produce a large amount of organic waste. If the world did not have various species of microbes that are capable of processing this organic waste, the world would be full of organic waste material. In 2012, the volume of organic waste from man and animals in Indonesia reached about 175.28 million tons. Such organic waste would certainly disrupt the lives of humans if there were no microbes to decompose the waste material. The economic contribution from biodiversity of microbes in processing the organic waste is estimated at Rp. 134.1 trillion, not including the amount/volume of waste that comes from the agricultural industries.

Pollination services are provided by the diversity in pollinators such as bees, butterflies, birds and insects. The biodiversity in pollinators play a significant role in the production of various agricultural commodities as well as products that are not yet agricultural commodities (their benefit is not yet known). For example, nearly one-third of food production is highly dependent on these pollinators. The effectiveness of a pollinator in pollinating flowers will determine the level of productivity and the production of the agricultural plants or crops. Therefore, reduction in the population of pollinators caused by conversion in the use of forest land, as well as increased use of pesticides may cause increased failure in reproduction and in the produce of the crops (Abrol – 2012). The result of an evaluation on the value of economic contribution from pollination services (using the dependency index of plants on pollinators) (Morse and Calderone 2000) was a value of Rp. 183.7 trillion.

At the same time, the existence of forests dominated by trees, within one ecosystem, has an important function in the carbon cycle, as an absorber and processor of carbon dioxide (CO2) into oxygen (O2). In other words, the forest absorbs toxic substances and processes them into a source of life (oxygen), or has the function of lungs for the world. According to data from FAO (2013), the size of the area covered by forests in Indonesia in 2010 had been reduced 20.3 percent compared to the year 1990, from 118.5 million hectares to only 94.4 million hectares in 2010. Part of this area is conservation forest area.

The conservation forest area consists of wildlife sanctuary area of 8,983 ha and nature preserve of 22,141 ha, including national parks of 12,329 ha (Kemenhut 2013). Various sources provide varied information about carbon capture. With the assumption that the forest ecosystem absorbs as much as 10 tons of carbon/hectare/ year and the price of carbon is $5.9/ton (Peters-Stanley and Yin 2013), the economic contribution value for carbon sequestration in 2012 was Rp. 54.64 trillion. Thus, the total value of contribution by the biodiversity from regulating services was Rp. 372.47 trillion. .

• Cultural Services Value

The economic value of ecotourism in the form of cultural environmental services able to provide job opportunities and work for the community to produce regional income. The beauty of the nature and uniqueness of the ecosystem, including the biological diversity contained in the ecosystem, constitutes a tourist attraction for both domestic and foreign tourists. The economic value of nature tourism can be calculated from the costs expended by tourists and

Table 4.4 Total economic contribution of biological diversity and ecosystems in 2012

No	TYPE OF BIODIVERSITY SERVICE	VALUE (RP IN BILLIONS)
1.	**Provisioning Services:**	**1.680.758,1**
a.	Food biomass	1.338.748,5
b.	Material for medicines, health products and cosmetics	4.043,9
c.	Wood biomass & non wood forest products	1.081,3
d.	Renewable energy	336.884,4
2.	**Regulating Services**	**372.473,2**
a.	Waste processing	134.105,6
b.	Pollination	183.723,6
c.	Carbon capture/sequestration services	54.644,0
3.	**Cultural/Tourism Services**	**602,7**
	TOTAL	**3.134.016,7**

Source: result of UKNEA calculation (2001).

their willingness to visit the biodiversity ecosystem and its content. According to research, the economic value of cultural services offered by the conservation areas in Indonesia in 2012 reached Rp. 602.7 billion.

Thus, on the whole, from the three types of economic contributions by the biodiversity and ecosystems in Indonesia in 2012, the amount reached Rp. 3.13 quadrillion or equivalent to $329.9 billion. 42.7 percent of this contribution came from the biodiversity as a source of food biomass (42.7 percent) followed by sources of wood and non-wood forest products (34.5 percent). Whereas the smallest economic contribution of the biological diversity and ecosystem services comes from the cultural services, namely nature tourism (0.02 percent) and as a source of material for medicine, health products, and cosmetics (0.1 percent).

However, these values are still undervalued, since the data on biodiversity services is very limited, and the methods of calculation are also not able to capture all the existing values. The challenge is, to carry on development research to continue identifying and exploring the benefits that the plant and animal species have and are inherent in the biodiversity, and turn them into real economic value.

As an illustration, the value of trading a certain drug in the United States produced by an anti-cholesterol compound formed by the fungus Monascus Purpureus reaches $16 billion/year. Each new drug or medicine manufactured, including for prostate cancer, and developed by Takeda, has a minimum turnover of more than $8 billion. The biodiversity of Indonesia has strong potential to create immense economic benefits.

4.3 LOCAL WISDOM AND THEIR ROLE IN SUSTAINABLE UTILIZATION OF BIODIVERSITY

Indonesia has a long and varied cultural history, which contains local wisdom (local traditions and customs) that have been proven to be able to preserve the richness of biodiversity and with the advancement of knowledge and modern technology, local wisdoms are in harmony with sustainable living. Today, local wisdoms are no longer evident among communities that have assimilated with the modern way of life (technology-centered), however many customs and traditions are still evident among indigenous peoples.

Indigenous peoples are defined as communities that live based on ancestral origin on indigenous territory. The socio-cultural aspects of their lives are governed by customary law and traditional institutions that manage the lives of their people. Indonesia has a mega cultural diversity consisting of 365 ethnic groups, and more than 500 languages (Figure 4.2). Of the 220 million population it is estimated that around 50 to 70 million identify themselves as indigenous (a generic term for "indigenous peoples"), 30 to 50 million of them consist of communities that depend on forest resources (Nababan 2002).

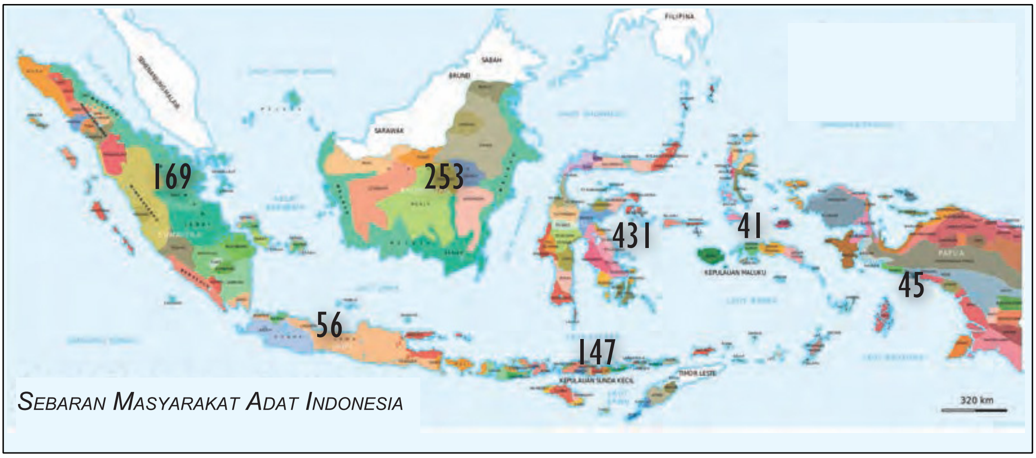
local wisdom are very important and strategic in empowering communities, in addition to togetherness; trust; social network and mutual support; involvement / participation; institution; community leadership; as well as traditional norms and cultural values (Haeruman 2010). Law Number 32 Of 2009 on Environmental Protection and Management, Article 1, paragraph 30, states local wisdom are the noble values that exist within a community, to among others, protect, and manage the environment sustainably.

In 2001, the Environment Ministry identified about 300 local wisdom on the issues of the environment and biodiversity in Indonesia spread across several provinces such as Aceh, North Sumatra, West Sumatra, Riau, South Sumatra, Lampung, East Java, West Nusa Tenggara, East Nusa Tenggara, Southeast Sulawesi, South Sulawesi, Maluku, and Papua (KLH 2001).

In relation to the management of biodiversity, local wisdom can be grouped into three categories:

1. **Biodiversity Custodian:** Local Knowledge of the indigenous people in maintaining a certain ecosystem in their everyday lives. Several examples are: The practice of the Naga community in the province of Banten, of growing local rice crop varieties to meet their food requirements and use of certain varieties in various traditional ceremonies. Another example is the use of the bule (Caucasian) buffalo in funerals among the people of Tana Toraja (Tedong Bonga).

Figure 4.2 DISTRIBUTION OF INDIGENOUS PEOPLE IN INDONESIA



Source: Map of tribes in the Ethnography Room, National Museum Indonesia.

An example of ecosystem preservation that has been incorporated into the practices of the people of Sumatra is the existence of lubuk larangan (prohibitions for rivers/seas/ lakes), where within the ecosystem, the public is prohibited from taking fish / fishing.

2. **Biodiversity Beneficiaries:** An example of a traditional knowledge that preserves biodiversity in its utilization is the implementation of sasi (oath) among the people of Maluku in fishing practices. Fishing is prohibited during this time because it is the fish nesting period, so fishing during this period will eliminate brood and young fish, thereby disrupting the supply of fish during the fishing season.

   In today's modern era, this prohibition period is practiced to control the amount of catch that corresponds to the amount of fish regenerated (maximum sustainable yield). The taboo system established by the people of Kampung Naga and Kampung Kuta prevents them from the excessive clearing of forests and the agricultural system developed by these tribes are successful in preserving rice crop germplasm and decreasing pests and diseases.

3. **Biodiversity Knowledge Disseminator:** Local wisdom that provide knowledge about the benefits of biodiversity for human survival. The practice of the people of Java, Madura, Kalimantan and many other areas in using certain herbs to maintain their health and as remedies for diseases which resulted in the development of traditional herbal medicine industries.

   Most industries develop on a household scale (jamu gendong - traveling jamu sellers), however some have already developed into modern herbal industries such as Jamu Cap Nyonya Meneer, Jamu Cap Jago, Jamu Sidomuncul and others. Similarly, the practice of using certain plants for refreshment has generated industries producing refreshment beverages such as ginger drinks, coconut water and so on. The practice of using certain herbs for cosmetic purposes have also generated products such as lulur (scrubs) for the spa and beauty salon industries and others. On the large industrial scale, cosmetics industries such Sari Ayu Martha Tilaar, Mustika Ratu and others have been established.

Within a community, life likely that the people apply various types of practices in their everyday lives that include the three types of local wisdom as described above (Box 4.5).

4.4 OUTLOOK FOR FUTURE DEVELOPMENT OF BIODIVERSITY INDUSTRIAL PRODUCT

- ### Bioresource and Bioprospect and development of biodiversity product

There are many benefits of biodiversity for our lives that are still unknown. Research and development is needed not only in quantity but also in quality that is better structured. As a start, an inventory of all biodiversity has been taken periodically. Formerly it was grounded on taxonomy, however in 2014 it has been published in a form that

Box 4.5. Local Wisdom that Applies the Practice of Preservation

Local Wisdoms on the Preservation of Forest and Agricultural Ecosystems

Kampung Naga and Kampung Kuta, West Java. The following are forms of local wisdoms practiced by the people of Kampung Naga and Kampung Kuta in forest and agricultural management:

- Structuring of the environmental landscape that divides an area into three regions: clean, pure and dirty areas.
- Improving soil fertility for farming by using organic materials (manure).
- Processing agricultural land with traditional tools (hoes, rakes, and plows).
- Conservation of seedlings and building food defense / security by building leuit (granaries).
- Establishing social capital in the form of traditional institutions that regulate and establish institutions and regulations.
- Protecting water catchment areas by building stage-shaped houses from fibers, woven bamboo, and wood.
- Protection of forests and the Cibulan watershed by designating some forest areas as sacred forests that cannot be disturbed.

Source: abstracted from the National Development Planning Ministry / Bappenas (2010)

Social Capital in Managing Biodiversity in Marine and Coastal Ecosystems

Aceh province. Panglima Laot and the distinctiveness of maritime customary law. Panglima Laot is the institution that rules the existing traditions and customs in regard to sea fishing, including the arrangement of fishing areas, jetties and settlement of profit sharing disputes. The following are distinct characteristics of the maritime customary law:

- Pantang Laot, namely the prohibition of fishermen to sail during Islamic holidays, Friday, Khanduri Laot Day, and days of disaster.
- Social customs, for those who do not heed the pantang laot (maritime restrictions), their catch is confiscated and submitted to the mosque, and penalized with a sailing restriction for three to seven days.
- Laot (maritime) customary law covers sailing sanctions, confiscation of catch, and administrative actions.

Bali province (Serangan and Les villages). Customary regulations that exist among coastal fishing communities include marine zoning regulations, zoning regulations for coastal ecosystems and residential areas. The following are forms of local wisdoms practiced by the residents of Serangan village in this context:

- Models for coral reef rehabilitation, mangrove rehabilitation and conservation of turtles established independently by the community and supported by the traditional institutions in the village / hamlet;

- Customary regulations in the division of marine areas for conservation and utilization; and
- Social capital of the residents of Serangan village who have always had customary institutions and social systems that protect the environment.
- The forms of local wisdoms present among the residents of Les village are as follows:
- Social capital is present in the form of traditional institutions that regulate the forms of institutions and regulations.
- A foundation within the indigenous community in regard to communal ethics and morals (the principle of gotong royong - community, family, and others); and
- Other empowering values: a sense of belonging, a willingness to learn and improve.

Source: abstracted from the National Development Planning Ministry / Bappenas (2010); the Environment Ministry (2001)

The use of types of buffalo (the Tedong Bonga, Pudu', Sambao', and Belang Buffalo) in Tana Toraja district, South Sulawesi.

The color of the tedong bonga buffalo is a combination of black and white, which is considered the most beautiful. They cost tens to hundreds of millions of rupiah. In Tana Toraja district, this type is extremely rare. The birth of a spotted buffalo is viewed as a blessing to its owner. One bonga buffalo is usually worth between 10 to 20 black buffalos. The Pudu' Buffalo is a type of buffalo that is very strong in fighting. The Pudu' Buffalo usually appear as strong fighters in buffalo fights held during funerals. They are usually worth half the price of the Tedong Bonga. The Sambao' Buffalo is gray and is considered the least expensive.

Meanwhile, the belang buffalo is considered the best endemic buffalo in Tana Toraja. Its price can reach Rp. 1 billion / each. An estimated 18,000 buffalo are slaughtered each year as part of traditional ceremonies held in Tana Toraja, approximately 70 percent of the buffalo from the area.

Source: abstracted from the National Development Planning Ministry / Bappenas (2014)

is easier to understand by the public, in the book, "Bioresources for Green Economic Development".

In this book, biodiversity is organized into information that provides direction for already known utilization of biodiversity, namely: food bioresources, pharmaceuticals, energy, materials, marine resources potential, and environmental services. One of the industries where its development will benefit the wider community and contribute to reducing poverty is the seaweed industry.

It is highly beneficial to develop this industry in Indonesia because of the presence of a coastline measuring 99,093 km (NGI 2013). This industry does not require technology that is too advanced, and seaweed not only can be used for food, but also as a material for cosmetics and as a value adding support material. The development of this industry will not only increase income but can also serve as an alternative solution for the fishing community, especially during bad weather and difficult fishing times.

Furthermore, from the above description, the known benefits obtained and derived from local wisdoms have already been widely developed into industries on a household scale that provide livelihoods and additional income for the community, and into modern industries that not only increase the value in utilizing biodiversity but also provide jobs and increase local and national revenue. One industry that is growing, is the processing of mangosteen skin, soursop leaves and so on. Equally important, the development prospects for moringa leaves (Moringa oleifera) which contain nutrients that are beneficial for babies and seeds that are beneficial for maintaining health, is high to be developed into an industry and quality standards can be regulated. .

- ## Bioprospecting

Bioprospecting is a method to discover the potential or prospect of biological resources, especially at the species and genetic level of those that have direct benefits on our lives, such as bioactive substances, medicinal potential and so forth. Fundamentally, biodiversity can create promising business opportunities. Several developing countries, in cooperation with developed countries grant industries the right to conduct bioprospecting, for example in 2011, the Colombian government, issued a policy for bioprospecting collaboration valued at $14 million, in order to obtain sustainable benefits in terms of commercial biodiversity (Fog 2011).

In addition to the direct benefits for the medicine industry,

Box 4.6. Processing of Seaweed in the Province of South Sulawesi

Indonesian waters contain approximately 555 species of seaweed germplasm (Basmal, 2001 in Azis (2011). A species that is processed in South Sulawesi is Kappaphycus alvarezii. This species has important economic value, because it is a producer of carrageenan. In the industrial and trade field, carrageenan has the same benefits as gelatin and alginate, which is used as a raw material for the pharmaceutical, cosmetic, and food industries and others (Anonymous 2011; Azis 2011).

The province of South Sulawesi has approximately 600,500 ha of marine aquaculture potential. Approximately 250,000 ha of this potential can be utilized to cultivate seaweed with an estimated production of 1,250,000 million tons of dry weight / year. The Kappaphycus alvarezii species is a "superior fisheries" commodity of South Sulawesi with production and export volumes that continue to increase. In 2003, the export volume reached 15,339 tons with a value of $5.7 million and the industry was able to absorb a substantial amount of labor in the production, processing and marketing sectors.

Meanwhile, the price of seaweed at the fishermen level today, is Rp. 12,000/kg of dry weight (Aziz 2011). As a comparison, in September 2013, the governor of South Sulawesi granted the export of seaweed amounting 739.5 tons to China with an export value reaching $ 720,075. One exporter from South Sulawesi is PT. Bantimurung in the District of Maros whose production capacity is relatively small, at approximately 100 tons/month. This amount only meets approximately 30 percent of the market demand (Wahyudin 2013).

Figure 4.3 Photo a: Kappaphycus alvarezii species and Photo b: its processed products. Photo a source: Aziz (2011), photo b: Anonymous (2011).

biodiversity can also garner the attention of the market in carrying out efforts to preserve biodiversity as a natural capital for sustaining life, such as their role in balancing the ecosystem. Industries based on biodiversity preservation will grow and create markets, for example in the use of natural materials for medicines, ecosystem services and carbon sinks. Furthermore, efforts have been carried out to measure, study and calculate risk of biodiversity loss or biodiversity risk 'footprints'

Parallel to this, efforts or attempts to address the loss of biodiversity may cost $ 4 to 5 trillion per year. A study conducted by the World Economic Forum (WEF 2010) by Pricewaterhouse Coopers (PwC) showed an increase in demand for products that were environmentally friendly, and the market for services for the preservation of biodiversity has increased rapidly from just $ 65 billion in 2009, to more than $80 billion by 2020 to $2 billion by 2050.

In the 21st century, much of the world markets will likely be selling goods and services related to biological products. Products that are already circulating are genetically modified crops, which will likely be followed by genetically modified livestock. Furthermore, gene therapy through xenotransplantation of organs is also currently being developed. An example is the process of generating tissues with the use of pigs or other animals that have been inserted with human genes through genetic modification to produce spare organs and cells for transplantation into the human body.

Great biodiversity potential in Indonesia is continuing to be explored and identified. For example, currently, of the 30,000 species found in Indonesia there are 950 species that are found to have medicinal or pharmaceutical functions. (MoE, 2014). Furthermore, there is potential for the manufacturing of drugs such as Lipitor, which is a drug that uses enzyme-producing microbes to lower cholesterol levels by inhibiting HMG-CoA reductase enzymes, which plays an important role in the production of cholesterol in the liver. The source of the drug, can be worth up to $19 billion (according to Endang Sukara). Several leading pharmaceutical companies, are

Box 4.7. International Polio Vaccine

The polio vaccine is a necessity for all people. To manufacture the vaccine most Indonesians do not realize that the vaccine is made in Indonesia and to produce the vaccine, renewable biological resources from Indonesia is required. This biological resource is obtained from the breeding of the long-tailed macaque (*Macaca fascicularis*).

PT Bio Farma as an Indonesian company that has been producing the vaccine and has distributed it all over the world. Bio Farma has helped people in more than 100 countries. The polio vaccine has been helping children survive polio attacks. Thus, as a biological resource, the polio vaccine is a tangible example of the use of biodiversity. In addition to providing health benefits, it also generates reserves from the sale of the vaccine to various countries.

PT Bio Farma is a state-owned enterprise, shares of which, are entirely owned by the government and is the only manufacturer of the vaccine for people in Indonesia and the largest in Southeast Asia. In 2009, Bio Farma reaped a revenue of Rp 1.2 trillion from the sale of vaccines, both for export and domestic needs.

intensively searching for “blockbuster biodiversity”.

On the other hand, there are debates over whether the buying and selling of genetic resources is leading to the commodification and privatization of life; life has changed from something sacred and belonging to nature into a commercial commodity or property of a company / individual. This will lead to the extinction of living things that are viewed as not having economic value, leading to the erosion of biodiversity. Furthermore, a food product that is in great demand is inulin from the dahlia plant, which can be used as a mixture in probiotic milk, in addition to being a nutritious food product that prevents colon cancer. Inulin is in demand as a product that provides fiber to normalize digestion. Inulin has also been found to have physiological effects that are beneficial for health.

The physiological properties of inulin include among others, prebiotic properties, which cannot be hydrolyzed by the enzymes in the digestive system, however inulin can be fermented by the microflora present in the colon so as to increase the amount of bifidobacteria that our bodies need. Thus, it can maintain the stability and balance of microflora in the colon. Inulin also contains soluble dietary fiber that has been studied to inhibit the growth of HT29 colon cancer cells (Maryanto, et al., 2013).

• Genetically Modified Organisms (GMOs)

Genetic engineering research, especially on agricultural biotechnology in Indonesia started in the early 1990s. Studies were conducted by various institutions, including research institutes, universities and state-owned enterprises. Results of the studies have been placed in the greenhouse with Integrated Testing Facilities (FUT), while other results are under limited field trials.

There are concerns that genetically modified organisms (GMOs) can disrupt ecosystems, destroy biodiversity and hinder efforts to save the earth and every living thing on it. Actually adequate facts and scientific information are needed. Therefore, to conduct a reliable risk assessment of consequences of the release of GMOs, precautionary tests need to be conducted. For example, the monoculture planting of GMO products is considered dangerous, as it may cause environmental stress on distinct crop pests. It is also thought that these pests may develop and after several generations of pests, they will become more vulnerable. One concern about GMOs is the potential for transgenes from modified crops in other cultivars or their wild relatives.

Therefore, the release of GM crops should receive attention due to the ecological risks associated with the release. After the gene has been transferred to a non-plant, it is almost impossible to retract it. That is, Government Regulation No. 21 is still far from meeting the expectation where risk assessment and risk management is carried out thoroughly. All negative impacts should be anticipated in a comprehensive manner. The aim of genetic engineering is to increase food production and improve the life system without the exploitation of nature in order to achieve prosperity.

The Cartagena Protocol has been ratified by Indonesia through Law Number 21 Of 2004. There are some differences between the Government Regulation Number 21 of 2005 and the Joint Decree of Four Ministers of 1999 with the inclusion of the MoEF in making decisions on environmental safety from biotechnology products.

The decree on food safety and/or safety of biotechnology food products was established with the involving the National Agency of Drugs and Foods Control (BPOM) and the relevant ministries, namely: MoA, MoEF and the MoMAF. Furthermore, the new regulation sets the duration of each stage of assessment, so that the duration of the assessment process becomes certain. The Commission on Biosafety and Biosafety Technical Team (TTKH), which has been determined in the regulation, must be approved by the President through a presidential regulation. Unfortunately, a presidential regulation on this subject has not been issued.

Other research institutions have also conducted research in genetic engineering of crops, such as: PT Perkebunan Nusantara XI (PTPN) and the Bogor Agricultural Institute (IPB), which have conducted studies on sugarcane and tolerance to drought. The Center for Biotechnology and Agricultural Genetic Resources has conducted a study on resilience to explosion, leaf blight on rice crops and soybeans that are tolerant to aluminum. IPB conducted studies on potatoes resistant to wilting disease and virus-resistant chilies. The Bandung Institute of Technology (ITB) has conducted studies on improving the quality of teak (Deswina 2014).

Transgenic rice crop studies were also conducted at the Indonesian Institute of Sciences (LIPI). The rice was tested in an integrated test in collaboration with the Rice Crop Research Center in Sukamandi. The researchers have been able to incorporate the 1Ab cry genes derived from *Bacillus thuringiensis* into the paddy genome. Molecular biology techniques applied to rice crops can be used for characterization and improving resistance against biotic and abiotic attacks (Deswina 2014).

The nature of engineered rice crops is their resistance to stemborer pests, introduced by cry genes with the application of DNA technology and expressed in the plant tissues, although to date there are no varieties of Bt rice crops that are ready to be marketed to farmers (Maria, et al., 2013). However, through DNA technology, the Biotechnology Research Center - LIPI, has managed to insert cry 1Ab genes from *Bacillus thuringiensis* bacteria into the rojolele rice crop genome. So far, the Biotechnology Research Center - LIPI has successfully obtained a cry generation strain that is resistant to rice crop borers that contains the 1Ab coding for crystal disease, which is being tested in limited field trials.

• Development of Biodiversity Ecosystem Tourism

Nature tourism development while preserving the biodiversity of ecosystems. Biodiversity ecosystems as stated above have attracted has many domestic and international visitors. Coral reef ecosystems in Raja Ampat, Wakatobi and Bunaken have already attracted millions of tourists, which means the generation of revenue for the region and community. Karst ecosystems that need to be maintained in some areas, also need to be utilized economically while preserving their existence because of the multi-beneficial function of karst ecososytems (see box 4.8).

Tourism of beautiful and unique beaches in Indonesia can be developed while showing that their preservation adds to the beauty of the area and can create economic enterprises with a value chain for the region and community. These efforts are in line with development decentralization, in which local governments compete to beautify their regions to become tourist destinations. This step can be greatly utilized in line with biodiversity preservation efforts for ecosystems and the species that exist in them.

Box 4.8. Utilization of karst ecosystem services in Maros regency

The province of South Sulawesi has a karst area located in the districts of Maros and Pangkep regencies. This area is known as the Maros-Pangkep karst ecosystem covering an area of approximately 40,000 ha. Currently, almost half of the area has become part of the 43,750 ha of the Bantimurung-Bulusaraung National Park (TN Babul) (DEPHUT 2004) conservation area. As a karst area, it is economically known as an area that has potential for minerals to be used as construction material and raw material for cement and marble products, which have been exported to Singapore and Malaysia (Adhisumarta 2003). At the same time, karst areas also have environmental services value such as water resources, biodiversity, uniqueness of the landscape, natural attractions, archaeological sites and areas of worship (Kasri, et al., 1999).

The world's oldest rock art is found in Maros district, namely in Leang Timpuseng. A good karst ecosystem is proven to be able to preserve images of handprints dating 39,000 years ago, and an image of a pig-deer (35,400 years old) (Pindi, 2015). This area is also the habitat of 284 species of plants and hundreds of species of butterflies in Bantimurung, including the tarsier, possum and two species of bats, which are keystone species that serve to pollinate some 100 species of plants. (Mapong 2006).*

Figure 4.4 The Maros-Pangkep karst ecosystem (left: epikarst-perikarst; right: subkarst)

Source: Pindi Setiawan, 2015.

4.5 CHALLENGES

According to LIPI study results (2014), biodiversity has not yet to provide benefits for the prosperity and economies of the community, when there is abundant biological wealth in Indonesia that can be used as food, pharmaceuticals, medicine and cosmetics, that are still not excavated and mapped optimally. The economic potential of modern biotechnology products, according to Deswina (2009), can provide benefits for all parties, not only consumers but also producers, and will also be able to improve the overall economy. From the various challenges of globalization of the biodiversity business, there are two important aspects that require attention. First, the commercialization of biological material in the form of direct use from nature or in cultured, extracted, or modified forms and secondly, is bioprospecting and biopiracy.

Irresponsible utilization of biodiversity will disrupt the existence of biodiversity and pose detriments to its benefits that should be beneficial to the welfare of the surrounding communities. There are three types of irresponsible utilization that pose a challenge namely: (i) "mining" of biodiversity from its habitat that exceeds its regenerating ability; (ii) irresponsible trade of biodiversity; and (iii) utilization patterns that "erode" community activities that are based on local wisdoms.

Utilization of biodiversity is not a new practice in community life. Indigenous peoples have long preserved the biodiversity present in their surroundings. They utilize biodiversity in accordance with the cycles of nature, both in volume, time of utilization and method of utilization. Irresponsible utilization occurs when benefits are already known and developed into a necessity for the wider community, so that the demand is no longer in balance with the biodiversity regeneration ability. This development of usage promotes large-scale "mining," in a more continuous duration and implementation of exploitative methods. These methods of utilization are inconsistent with the regeneration ability and life cycles of biodiversity and often damage the habitats of the biodiversity itself. These practices that are continuously being implemented in turn promote the extinction of biodiversity. These methods of utilization pose a large challenge, considering the value of biodiversity that is highly beneficial to our lives in various aspects. One challenge is to create responsible methods of utilization. One method that will encourage the formation of responsible utilization patterns is growing biodiversity plantations. Development of biodiversity plantations is the cultivation of biodiversity so that it becomes a bioresource that can be grown according to the scale of demand and harvested at times that can be set in accordance with the patterns of utilization. Development of biodiversity plantations will facilitate the community so that it will be able to utilize the benefits and develop broader benefits in accordance with its needs. This utilization method needs to be promoted so that biodiversity that contains benefits for our lives will be more useful and its existence will be protected.

Another challenge is irresponsible trading. Irresponsible trading occurs because of the demand for irresponsible utilization of biodiversity that is carried out in an inefficient way. Irresponsible trading occurs in the following forms: (i) "Mining" of biodiversity that exceeds the regeneration ability as mentioned above thus disruption the ecosystem cycles. An example of a practice that is developing within the community is the trade of cicak (common house geckos), geckos and others. The capture of large quantities can disrupt their faunal function in the food chain, leading to infestations of insects that should be the prey of the cicak and gecko. This must be prevented by establishing requirements that animals used for trade cannot be taken from the wild, but must be cultivated; (Ii) In optimal trading of biodiversity, such as the pangolin with known benefits, that are traded, even exported in volume and per head, although the benefits of the pangolin (as known today) is contained in its scales. Pangolin trade should use farmed pangolin, and research on the utilization of other parts of the pangolin should be done to find benefits from other parts of the pangolin. Similarly with sharks that are captured and taken only for their fins. The processing industry

Development of biodiversity plantations will facilitate the community so that they will be able to utilize its benefits and develop broader benefits in accordance with their needs

needs to be developed, so that exports are in the form that has already been processed, semi-finished or ready for consumption / use and not in its raw form. Thus, the added value can be enjoyed by the Indonesian people. In this regard, it is very important to encourage and support biodiversity utilization industries with the right policies.

Considering that biological resources have a very high value, many parties are interested in prospecting biological resources in a similar manner when prospecting or exploring for minerals, oil or wood. Bioprospectors are mostly multinational companies, although there are also other actors such as universities and government agencies. Many developing countries that are rich in biological resources are not yet ready to face this, in legal, economic and social terms. Indonesia, for example, does not have regulations on bioprospecting. The existing policies, namely Presidential Decree Number 100 Of 1993 on Research Permit For Foreigners is only govern permissions general research for foreigners, but not special for the germplasm research. Based on this presidential decree, LIPI has formed a coordination team for the issuing of research permits for foreigners. The latter policy was renewed, with the issuance of Presidential Regulation Number 41 Of 2006 On Licensing for Conducting Research and Development Activities For Foreign Higher Education, Research and Development of Foreign Institution, Foreign Corporations Agency, and Foreigner. That regulation requires the applicant to submit the research license to the Minister, in this case, the Ministry of Research, Technology and Higher Education by attaching the files of requirements, including proposal of research, curriculum vitae and recommendations from the Indonesian research partners.

Weakness of Polices allow the occurrence of biological encroachment or biopiracy, namely the encroachment of biological resources and knowledge on biological resources without the consent of the community or developing country after the parties have obtained adequate information. Biopiracy cases include patent applications from large companies in several developed countries for several drugs where their efficacy is already known and has been used by people for a long time. Among the plants are turmeric and neem from India, as well as the Swartzia mad-agascariensis medicinal tree from Africa (Jhamtani 2002).

Biopiracy is a form of practice that exploits natural resources and environmental knowledge without permission and benefit sharing. The benefits not only include those of an economic nature but also naming benefits and intellectual rights. In other words, biopiracy is a form of theft or deprivation of rights over natural resources, whether it concerns species or genetics. An important case that involved Indonesian researchers was the *"theft"* of an LIPI publication that involved the discovery by LIPI researchers of the Megalara garuda wasp in a collaborative project with the University of California, Davis. The foreign researchers did not include the names of the Indonesian researchers in their publication on the discovery of the new species.

Relevant policies that have been issued by the government is Law Number 4 Of 2006 on the Ratification of the International Treaty on Plant Genetic Resources for Food and Agriculture (an Agreement Regarding Plant Genetic Resources for Food and Agriculture) that contains a provision regarding Material Transfer Agreement which allows the exchange of samples and / or specimens between the countries for research purposes. Utilization of biodiversity is also regulated by the ratification of the Nagoya Protocol on ABS, thus the management of bioprospecting should be clearer and carried out through better and equitable methods. The Nagoya Protocol is also important to prevent the theft of germplasm (biopiracy) and profit sharing from engineering or utilization of genetic resources from countries rich in biodiversity such as Indonesia. In efforts to prevent the theft of germplasm, monitoring and caution needs to be heightened on a cooperative level in two sectors: (1) collaborative collection or exploration between conducting institutions and institutions from countries that are not signatories of biodiversity conventions, such

Biopiracy is a form of practice that exploits natural resources and environmental knowledge without permission and benefit sharing.

as the United States and (2) partnerships between public or private universities, particularly in areas that are directly cooperating with foreign institutions.

In relation to the irresponsible use of biodiversity, bioprospecting and biopiracy, efforts to protect community activities based on local wisdoms are needed. Protection of local wisdoms is crucial because the utilization of biodiversity in general is rooted in local traditions and even the traditions of indigenous peoples. Formulas for traditional herbal medicines used by the people usually originate from practices that have been handed down for generations. Industrial utilization of biodiversity (large scale), that is processed using modern / industrial technology (standardized) and commercialized normally promote the emergence of trademarks, patents and intellectual property rights. These occurrences will certainly endanger the customs that exist within the community and the development possibilities by the community.

Protection of local wisdom is crucial because the utilization of biodiversity in general is rooted in local traditions and even the traditions of the indigenous people.

Traditional knowledge of plants and animals used in traditional medicine is often used as a screening shortcut in bioprospecting to obtain ingredients used in modern medicine, and to be able to market them profitably. The use and collection of information as well as genetic resources from a country without authorization and compensation from the concerned country is categorized as biopiracy. Biopiracy can involve the exploitation of traditional knowledge of medicines for commercial purposes without proper compensation. Biopiracy can occur very easily, especially in countries that lack the capacity for monitoring and law enforcement. Thus, policy frameworks, laws, regulations, and institutions associated with bioprospecting, biopiracy and the determination and assertion of rights and regulation of access to biodiversity and genetic information as well as active ingredients of the medicines needs to be developed effectively.

Matters that need special attention, include the following: (i)

Economic evaluation of genetic material and information on genetic resources that are still in the raw form; (ii) Determination of ownership of biodiversity material in nature, genetic information contained in it, as well as ex-situ biodiversity collection; (iii) Resolution of conflicts among biodiversity stakeholders; (iv) Scope of regulations on access to genetic material and information; and (v) Regulation of equal profit sharing from the use of genetic resources and information. Another policy that is needed is a platform for the protection / recognition / regulation of property rights to local wisdom in the utilization of biodiversity before major industries develop their patents.***

Buffalo shepherd in Savana Lombok, NTB

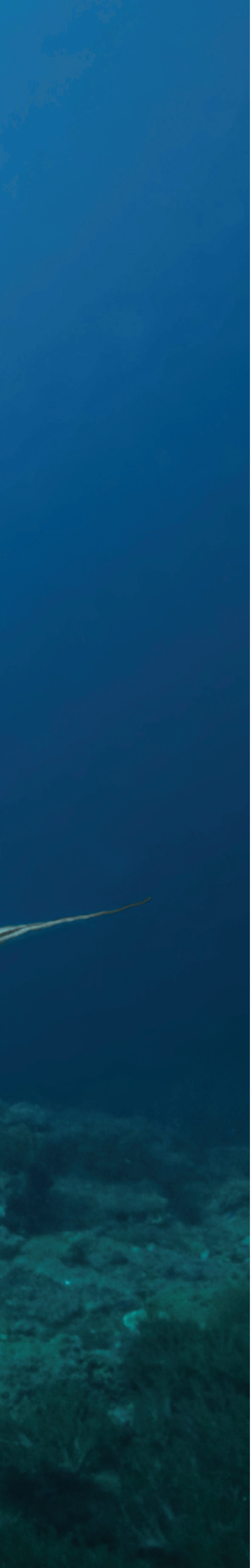
Genetic diversity in living things (plants, animals, and microbes) is the basic material used in developing cultivars, varieties and species that can be utilized by humans. Erosion of sources of genetic diversity results in a serious threat to food security, shelter, and energy for the long term

Foto : Wawan Setiawan, Klik Club KPC Sangatta Kaltim

Manta (Manta spp)

Indonesia is the migration track and simultaneously home for Manta Samudera (Manta Birostris) and Manta Karang (Manta Alfredi). Its population declined drastically due to the gill industry in East Asia, which is not balancing with its reproduction speed. Indonesia has provided full protection to manta from extinction

Courtesy photograph: Tobias Zimmer, Coral Reef Alliance.



5

Management of Biodiversity

Biodiversity wealth, as previously described, requires preservation policies both ex-situ and both ex-situ and in-situ. Especially in-situ, considering that there are still many that has not been identified. Besides there are still many benefit of biodiversity that we have not known. The ecosystem biodiversity wealth has a unique characteristic with a type content of matual dependency. Meanwhile, biodiversity type also have benefical values for humans and life. Genetics, that we are still limited in our knowledge, should also be continually studied, because it contains genes that are little known and need to be futher reviewed.

In this regard, we need to review the conservation measures we have already undertaken and the need for improvements that need to be made in line with the various challenges in managingthe dynamic biodiversity. The part of the conservation that equally important is the management of data and information on biodiversity. The variety of data that identifies the richness of our diversity, both the conditions and the development of expanding utilization are very necessary to be properly managed.

Therefore, data management needs to be well managed so that biodiversity information can provide a reason for continuous research, both basic research and research on its utilization. With the data available it can be used as a basis to recognize the benefits contained in biodiversity so that the information system of the benefits of biodiversity that we have and can be developed into economic value for everydaylife. Given the value of biodiversity, biodiversity conservation has an important value to be done to benefit today, and provides a basis for whay biodiversity conservation is necessary, as there are still many potential benefits to biodiversity that are not known .

5.1 MAINTENANCE AND PRESERVATION OF BIODIVERSITY WEALTH

Maintenance and preservation of biodiversity is important to reduce the pressure on the existence of biodiversity through conservation and recovery programs (rehabilitation and restoration). In accordance with the mandate of Law Number 5 Of 1990 on the Preservation of Biological Resources and Its Ecosystem, which regulate conservation of ecosystem and species in protected areas, it has intensively conducted by a number of existing conservation institutions. Indonesia is among countries that possess a protected area management system that functions as an in-situ conservation effort, i.e. efforts to protect the ecosystems and natural habitats for the conservation of species and genetics diversity. In addition, Indonesia also has an ex-situ preservation site. At present, there are biodiversity institutions as stated in the technical implementing unit (UPT), among others the management of in-situ and ex-situ conservation areas.

5.1.1. In-Situ Preservation

Management of the in-situ collection is very much needed, in particular for biodiversity groups/ ecosystems. In-situ preservation, in particular for the ecosystem, is very important because: (i) the existence of biodiversity in the ecosystem have specific characteristics, in particular geographical locations and specific natural characteristics. Accordingly, in-situ preservation is important to preserve Indonesian endemic types; (ii) species that live in particular ecosystems are interdependent, either between various species, as well as the species and the environment. Together, the ecosystem has shared values, part of which have already been identified, therefore it should be maintained in original form and location; (iii) Together, the ecosystem also has roles and functions within the macro environment, part of which have also not been identified, and accordingly their presence in nature is important to be maintained.

• Management of In-Situ Conservation Areas by the MoEF

Up until 2014, the government had established 528 conservation areas managed by technical implementing unit (UPT). At present there are 528 conservation areas in Indonesia, either in the form of nature reserves, wildlife sanctuaries, national parks, excursion parks, hunting parks as well as forest parks (see Table 5.1).

Amendments in natural resource conservation policies that are quite significant in Indonesia, according to Santosa (2008) are among others:

1. The Durban Accord and Action Plan (2003) as a result of The Fifth World Congress on National Parks on September 8 to 17 2003, serve as umbrella for conservation efforts to more emphasizes the conservation of cultural and spiritual values, good governance, conflict resolution, collaborative management, indigenous.

Table 5.1 Size and number of conservation areas in Indonesia

NO	SECTOR	AREA (HA)	TOTAL
1	Nature Reserve	3.923.001,66	216
2	Marine Reserve	152.610,00	5
3	Wildlife Reserve	5.024.138,29	71
4	Marine Wildlife Reserve	5.588,25	4
5	National Park	16.375.000,00	50
6	Marine National Park	4.043.541,30	7
7	Nature Park	257.323,85	101
8	Marine Nature Park	491.248,00	14
9	Forest Park	351.680,41	23
10	Hunting Park	220.951,44	13
11	KSA/KPA (Other conservation areas)	309.880,30	24
	Jumlah	**31.154.963,50**	**528**

Source: Partono, 2014 in LIPI, 2014.

people and community conserved areas

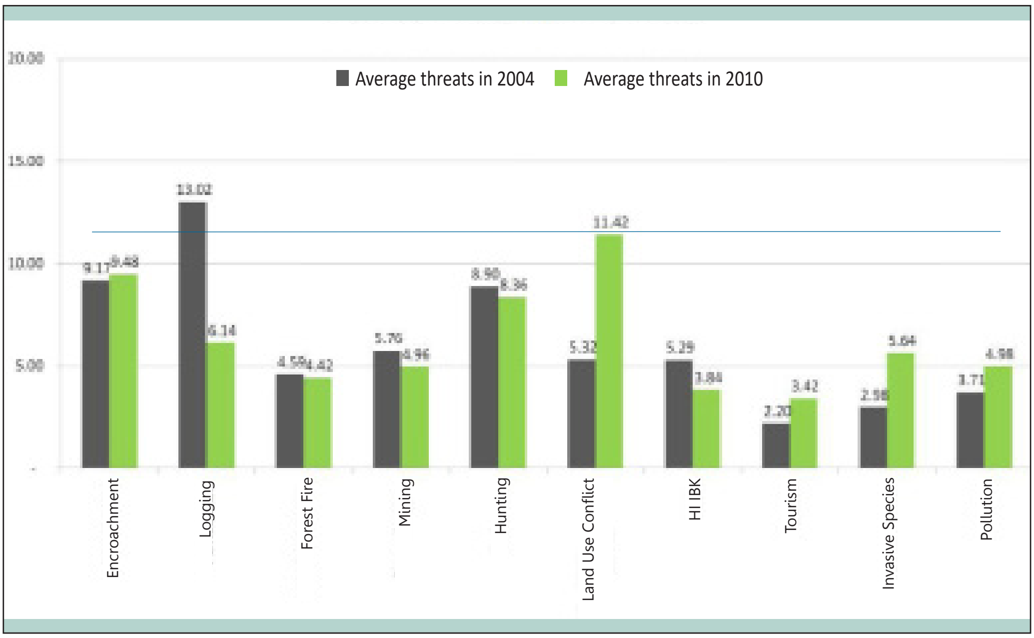
2. Publication of Forest Ministry Regulation P.19 Of 2004, which led to the change from government-based management into a multi-stakeholder management or collaborative management.

3. Approval of Regulation No. P.56 Of 2006 on Guidelines for the National Park Zoning change the policy that is usually top-down to bottom-up (participatory); and

4. According to the survey RAPPAM-METT analysis (Rapid Assessment and Prioritization of Protected Areas Management-Management Effectiveness Tracking Tool) in 2010-2011 (Ministry of Forestry, 2011)

Unfortunately, the policy levels are not yet accompanied by adequate implementation. According to the survey analysis of RAPPAM-METT (Rapid Assessment and Prioritization of Protected Areas Management - Management Effectiveness Tracking Tool) in 2010-2011 (Ministry of Forestry 2011), nearly the entire management of national parks in Indonesia has been declared not yet effective. The various causes are among others: institutional issues, poor legal

Figure 5.1 Comparison of Average Threats in Indonesian National Parks



Source: RAPPAM 2004 and 2010 in the Ministry of Forestry (2011) aspects related to the area certainty, poor control of regional conflicts, poor management planning, which is closely related to limited human resources and limited financing from the government, as well as the threat of population pressures that encourage the emergence of regional conflicts.

- **Management of In-Situ Conservation Areas by the Ministry of Marine Affairs and Fisheries and Regional Governments**

The issuance of Government Regulation Number 60 Of 2007 on Conservation of Fish Resources, which is generated from Law Number 31 Of 2004 junto Law Number 45 Of 2009 on Fisheries, has mandated the government (MoMAF) and regional governments to undertake the conservation efforts for fish resources that includes the conservation of ecosystems, species and fish genetics.

The mandate of conservation of the biodiversity of the sea, coasts and small islands strengthened by the issuance of Law Number 27 Of 2007 junto Law Number 1 Of 2014 on Management of Coastal Areas and Small Islands. Until 2014, the Ministry of Marine Affairs and Fisheries and regional governments (Provincial/Regency / City) has initiated the establishment of 113 conservation areas with total area of 11.756.129.41 ha, that its management is carried out by the Ministry of Marine Affairs and Fisheries and regional governments. Table 5.2 illustrates in detail the size, number of areas and conservation area categories of initiation results by the Ministry of Marine Affairs and Fisheries and regional government.

According to IUCN meeting outcomes (WCC 2008) in Barcelona, conservation area management can be implemented jointly, meaning that it is not solely managed by the government. There were four patterns agreed upon in the meeting, namely: (1) Governance by the government (fully managed by the government). This is the present pattern implemented in Indonesia (2) Shared governance (jointly managed by the government and non-government entities) (3) Private governance (managed by individuals, companies or NGOs) (4) Governance by native peoples and local communities, included in this case are Community Conserved Areas (CCA).

Table 5.2 Size and number of water protected areas by 2014

No	Category	Area (ha)	Total
1	Marine National Park	3.355.352.80	1
2	Water Nature Sanctuary	445.630,00	3
3	Water Excursion Park	1.541.040,20	6
4	Regional Water Conservation Area	6.44.106,39	103
Total		11.756.129,41	113

Source: Table of Conservation Area Sizes, KKP

5.1.2. Management of Ex-Situ Biodiversity.

Management of biodiversity outside of the original natural habitat (ex-situ) may be conducted by conservation institution, which govern based on Government Regulation Number 7 Of 1999 on Preservation of Plant and Animal and Government Regulation Number 8 of 1999 on the Utilization of Plants and Wildlife as well as Ministerial Regulation of Forestry Number P.53/ Menhut-II/2006 of Conservation Institution. Conservation Institutions (LK) are institutions engaged in the conservation of plants and/or animals outside their habitats (ex-situ), either in the form of government institutions and non-government institutions. Conservation organizations can be in the form of :

a. Animal rescue centers

b. Special animal training centers

c. Wildlife rehabilitation centers

d. Zoos

e. Safari parks

f. Wildlife parks

g. Specific wildlife parks

h. Zoology museums

i. Botanical gardens

j. Specific plant gardens

k. Herbarium.

The main function of conservation institutions is to develop controlled breeding and/or rescue of plants and animals while maintaining the purity of the species. In addition, conservation institutions also have the function as a place for education, demonstration, temporary custody, source of broodstock and genetic reserves to support in-situ populations, healthy recreation facilities as well as research and development of science. According to Ministry of Forestry (2014), there are 58 units of total Conservation Institution (LK) by December 31, 2012. Three units of LK permit issued in 2013, are Taman Safari PT. Safari Lagoi Bintan, Tourism Region International Bintan, Riau Islands Province; Taman Satwa PT. Mirah Megah Travel, Somba Opu Tourism and Fortress Culture Region, South Sulawesi; Animal Park Nature Conservation Foundation Yogyakarta. Accordingly, compared to the previous year, the number of LKs issued increased by 5.45 percent. Realized LK locations in 2013 did not meet the target (Decree of the Director General of PHKA Number: SK.173/ IV-SET/ 2013). The additional LK targets in 2013 were in the East Java province (one unit) and the Central Java province (two units). As of the end of 2013, the third licensing process of targeted LKs had not been completed.

Ex-situ conservation is also done in the Botanical Garden based on Presidential Regulation Number 93 Of 2011 on Botanical Gardens. Botanical Gardens are ex-situ plant conservation areas that have documented collections of plants and are arranged based on the pattern of taxonomic classification, bioregion, thematic, or a combination of the patterns for the purpose of conservation, research, education, tourism and environmental services. Other types of conservation conducted in Biodiversity Park (Taman Kehati) has governed by Ministerial Regulation of Environment Number 03 Of 2012 on Biodiversity Park.

Biodiversity Parks are reserve areas of local biological natural resources outside forest areas that have in-situ and/or ex-situ conservation functions, in particular for plant pollination and/or seed dispersion that are assisted by animals, while the vegetation structure and composition can support the preservation of animal pollinators and seed dispersion.

1. Botanical Gardens

Ex-situ conservation is conducted to preserve species outside their habitats. LIPI (2014) defined ex-situ conservation as a national reference collection that could be found in museum collections, such as the Bogor Zoological Museum (MZB) and Herbarium Bogoriense– a reference for flora and fauna (generally in the form of dead specimens), as well as a collection in the form of life such as microbial cultures and plant collections at the Bogor Botanical Gardens and its branches. The collection is a reference of the repertoire of wealth owned by Indonesia. Reference in life form can be seen in the botanical gardens. Botanical gardens are ex-situ plant conservation areas that possess documented plant collections and are organized based on the classification pattern of taxonomy, bioregion, thematic, or a combination of the patterns for the purpose of conservation, research, education, tourism and environmental services. Indonesia has four national and regional botanical gardens, in the framework to increase the preservation of flora and simultaneously as an awareness means and for science. The expansion of botanical gardens is regulated under Presidential Regulation Number 93 Of 2011 on Botanical Gardens. Botanical Garden management is supported by research conducted by the Bogor Botanical Garden Plant Conservation. This institution implements identification of island-based eco-regions for the development of botanical gardens.

Botanical gardens managed by the Government, in this regard LIPI, are the Bogor Botanical Garden, Purwodadi Botanical Garden, Bedugul Botanical Garden and the Wildlife Biodiversity

Table 5.3 National and Regional Botanical Gardens

Botanical Garden	Size and Scope of Management
NATIONAL BOTANICAL GARDENS	**451.5 ha**
Bogor Botanical Garden (since 1817)	Managing wet lowland plants
Cibodas Botanical Garden (sejak year 1862)	Managing wet highland plants
Purwodadi-Pasuruan Botanical Garden (since 1941)	Managing dry lowland plants
Ekakarya Bali Botanical Garden (since 1959)	Managing dry highland plants
REGIONAL BOTANICAL GARDENS	**3,600 ha**

Park with a total of 451.5 ha. The botanical gardens preserve approximately 65,000 specimens of plants/ flora covering at least 3,000 Indonesian native plant species, including 20 percent Indonesian plant species threatened by extinction.

Up until 2013, there were 21 regional botanical gardens (new) with an area of more than 3,600 ha and a collection of approximately 10,000 specimens (LIPI 2014). All developed regional botanical gardens are focused on native plant species, in particular species that are endemic, endangered and have the potential to restore ecosystem functions. Accordingly, Indonesia has 25 botanical gardens representing 15 eco-regions (see Table 5.3).

2. Reference Center

In addition to the botanical garden collections, Indonesia also has a collection of fauna and flora specimens, as well as a microbial culture collection.

- ### Reference collection of fauna specimen

  The reference collection of the Indonesian fauna is stored at the Bogor Zoological Museum (MZB). Specimens stored as the Indonesian fauna are divided into two types of specimens, namely the type specimen and the general specimen. A large part of the type specimen collection that existed before independence has been moved to the Netherlands or museums in Europe or the United States. The type specimen collection collected after the colonial era was almost entirely stored at MZB. The number of specimen and number of types owned by MZB is the largest in Southeast Asia. This is not surprising because it is in line with Indonesian biodiversity wealth. The collection at MZB consists of more than 3 million specimens.

  Insect collection is the largest collection with a total of more than 2 million specimens, or approximately 85 percent of the total MZB collection. It is followed by the collection of mollusks, crustaceans and fish. Other vertebrate collections, namely birds, herpetofauna (reptiles and amphibians) and mammals total only to approximately 1 percent of the

Hornbill/ rangkong (Buceros/ Rhinoplax vigil)

Kalimantan endemic, it has the ability to cruise high and far. In the forest ecosystem conservation, the rangkong is among animal chains that disperse seeds. The Dayak tradition refers to it as the "commander bird", a symbol of the "nature above".

Photo courtecy : Fahrul Arnama, Indonesian Birds total MZB collection. Specimens of the MZB collection are collected from all over the archipelago so that in general the fauna collection at MZB (especially vertebrata) represents nearly the entire animal species in Indonesia.

Although the collection nearly covers the entire archipelago and expedition activities were conducted before the establishment of MZB; it does not mean that the collection in MZB is already complete. Bird specimen collection, which began in 1866 (preceding the establishment of MZB), has been ongoing for 148 years. However, evidently the number of species collected make up for only approximately 1, 210 of 1,605, or around 75 percent. Such condition also occurs with other taxa, in particular of the vertebrate groups, so that the average number of species at MZB only account for 70 to 80 percent of the total species in Indonesia. The invertebrate group has considerable differences between the number of collected species and estimated actual number of species in Indonesia.

- ## A reference collection of flora specimen

Herbarium specimens are used as a reference in expressing new species. The referenced species are stored in a herbarium are also used as research material when stating new species, list of species or when preparing flora.

Based on the Index Herbarium Indonesianum (Gir-mansyah dkk., 2006), there are 30 herbaria in Indonesia and a number of them are under universities. In general, each herbarium in the regions are managed for the respective areas or based on the expertise of researchers. Apart from the Herbarium Bogoriense (BO), there are a number of herbariums registered with the International Association Plant Taxonomy, such as SEAMEO Biotrop Herbarium (BIOT), Celebense Herbarium (Tandulako University, Palu CEB), Andalas Herbarium (ANDA, Andalas University, Padang), Papua University (MAN, Papua State University), Forest Botany Herbarium (BZF) and Bogor Botanical Garden Herbarium (KRB).

Herbarium collections are also divided into general collections and type collections. Based on the division, general collections contain more than type collections. The general collections consist of algae plant specimens, spore plants and seed plants. The fungus collection is the largest collection in terms of the tribes compared to Musci and Hepaticae. The Angiospermae (Dicotil) collection (74 percent) has more tribes compared to Monocothyle (15 percent) and Gymnospermae (3 percent).

The type collection in the Bogoriense Herbarium total 17,037 sheets, consisting of the collections of Cryptogamae, Pterydophyta, Gymnospermae, Monocotyl and Dicotyl, from 19,289 species and 1, 657 genera. The herbarium specimen consists of algae, fungi, lichens, hepaticae, musci, ferns, gymnosperms, angio-spermae (monocots and dicots). For spore plants and fungi collections, musci and hepaticae are the largest collections because research in these groups actively collect, Many KB Boedijn collections are stored in the Bogoriense Herbarium. The wet collection (totaling 37,985 bottles) is the largest collection in Southeast Asia and in the world. The wet collection consists of flower and fruit collections to complement the dry collection and is very important in taxonomic research, as it does not need boiling of flower specimens for further research.

- **Reference collection of microbial cultures**

Up until now, microbe wealth has been not optimally utilized to increase the dignity, prestige and welfare of the Indonesian people. Whereas, considered from the development of science, research outcomes indicate that microbes play an important role in developing products of high economic value. Research of Indonesian microbial for agriculture (such as for producing natural herbicide, biological fertilizer, biological control for various types of pests and plant diseases), for the health sector (among others as source of antibiotics, new bioactive compounds, ion-blocker for the treatment of diseases and virus infection antidote molecules, including avian influenza, etc.) and in the environmental sector for bioremediator, including to handle oil pollution, have been largely conducted by researchers in various research institutions, universities and private companies in Indonesia.

Developed countries are very interested in accessing the microbial wealth of Indonesia that have not undergone data collection and have not been optimally explored. Exploration activities of Indonesian microbial wealth have been largely carried out by Indonesian researchers. Many exploration and research activities discovered various microbial species that have potential for further development. Therefore, to maintain Indonesian microbial wealth, document systems, storage, maintenance and internationally standard testing, are required. Indonesian microbial wealth stored in an internationally standard storage system will continually grow along with exploration activities that are being conducted.

There are 18 microbial culture collections in Indonesia that are engaged in the preservation of microbial culture consisting of the LIPI Microbial Collection (LIPIMC), Biotechnology Culture Collection (BTCC), Balitvet Culture Collection (BCC), Biofarma Culture Collection (BFCC), Biogen Culture Collection (BiogenCC), Biotek Microbial Culture Collection (BioMCC), Biotechnology Lemigas Culture Collection (BLCC), BPPT Culture Collection (BPPTCC), Diponegoro University Culture Collection (DUCC), Food and Nutrition Culture Collection (FNCC), IPB Culture Collection (IPBCC), ITB Culture Collection (ITBCC), Department of Microbiology, Faculty of Medicine, University of Indonesia Culture Collection (MUICC), National Center for Fish Quality Control Culture Collection (NCQCCC), Center for Isotope and Radiation Application Culture Collection (PAIRCC), Dr. H. A. Rotinsulu Lung Hospital (RSPRCC), University of Indonesia Culture Collection (UICC) and Udayana University Culture Collection (UNUDCC) (Sjamsuridzal dkk., 2008).

LIPIMC and BTCC have been joined together to become the Indonesia Culture Collection (InaCC), as storage and conservation of microbial with international standards, complying with the guidelines of the OECD Biological Resource Center (BRC), which is internationally recognized. InaCC is an ex-situ conservation of microbes that can be used to support the food sector, agriculture, health and energy.

The BRC microbial collection covers the provision and storage of living cells, genome of organisms and information related to heredity and functions in a biological system. Long-term storage can be carried out in cold temperatures and frozen in dry form. As BRC, up till now InaCC has stored various microbial species as a national asset and result of exploration activities. Research records of microbiology, in particular taxonomy from 2000 to 2010 show a rapid growth.

A number of acetic acid bacteria species and new type of actinomycetes (new genus and new types) were discovered and published in international scientific journals (Lisdiyanti et al., 2000, 2001, 2002, 2010; Nampiah et al., 2009). Utilization of new isolates has been conducted to produce fertilizers, enzymes, foodstuff, feed materials, etc. Various opportunities are wide open to seek new microbial and obtain potential genes, and use them for economic development and the welfare of the nation. Approximately 10, 000 microbial collected by LIPI researchers still need to be validated and preserved based on international standard methods. .

At present, the collection of microbial life that is saved in the Indonesian Culture Collection (InaCC), LIPI Biological Research Center consists of 1,939 collections. Microbial collections that can be accessed by academics, researchers and the industry are divided into collections of mold bacteria (901 isolates), actinomycetes (136 isolates), mold (529 isolates), yeast (348 isolates) and microalgae (25 isolates).

The InaCC collection culture started from the collection by LIPI researchers in the 1970s who stored multiple isolates, in particular tempeh mold and Rhizobium. The InaCC collection mainly originates from various regions in Indonesia, among others Java, Sulawesi, Sumatra, Papua, Kalimantan and Nusa Tenggara.

InaCC also stores a microbial collection originating from abroad, such as Germany, China and Taiwan. Efforts to expand the microbial culture collection are periodically carried out by Indonesian researchers apart from research cooperation with foreign countries such as Japan and the United States that in the near future will be registered as part of the InaCC collection. Arranging the international standard microbial collection management with ISO 9001 is being conducted at the LIPI Biology Research Center to complement the flora and fauna collection as a reference organism.

- **Indonesian Institute of Sciences (LIPI)**

The collection system managed by LIPI is supported by research activities aimed to implement inventory and identification of biodiversity, namely by the Biology Research Center, the Biotechnology Research Center, Plant Conservation Center of the Bogor Botanical Gardens, and the Oceanographic Research Center. The Biological Research Center implements its research activities at the ecosystem, species and genetic levels. Collected data are the terrestrial ecosystem types, plant reference collections (herbarium and living collections), zoological museum reference specimens, a collection of microorganisms, and the collection of genetic diversity in the form of DNA.

The Biotechnology Research Center has a collection of research outcomes at the species and genetic levels in the form of living plants collections (tissue culture results), microorganisms, local superior breeding stock, and the collection of genetic diversity in the form of DNA. The Oceanographic Research Center conducts research related to the marine biological resources at the ecosystem and species levels. Data collected are in the form of the marine ecosystem types, coral cover reefs, seagrass beds and reference specimens of plants and marine animals.

- **Ministry of Agriculture**

  Preservation of genetic diversity, in particular for agricultural crops and livestock, are implemented to manage the collection that is used to renew seeds and seedlings, as well as efforts to develop seeds and seedlings with a better productivity and quality/ endurance(living collection).

- **Ministry of Marine Affairs and Fisheries**

  The Directorate for Regional Conservation and Fish Types and the Directorate General of Marine, Coast and Small Islands hold the duties and functions related to the management and development of the ecosystem, species and genetic levels, including encouraging the strengthening of functions of the Conservation of Fish Resources management authority.

  The Research Center for Management and Restoration of Fish Resources, Research and Development of Marine Affairs and Fisheries Agency conduct researchs on the ecosystem and species levels consisting of areas with important conservation values for mangroves, refugia fisheries, coral reefs and rare marine life, among others: turtles, shrimps, lobster, sharks, dolphins, pari manta, sidat, arowana and napoleon.

3. Captive Breeding of Plants and Wild Animal and Biodiversity Park

• Captive Breeding of Plants and Wild Animal

Apart from the collection for preservation, collection for the economic use of biodiversity has also been developed. The government has since long encouraged the breeding of endangered flora and fauna, to preserve them in their natural habitat, as well as for production (cultivated) to meet market demand. Captivity of TSL aims to maintain the species' purity.

Technically, the policy of protected Plants and Wild Animal captive breeding provisions is based on Ministerial Regulation of Forestry Number P.19/Menhut-II /2005 on the Captive Breeding of Plants and Wild Animal. According to the statistics of PHKA (MoF 2014), until 2013, there are 776 units of Plants and Wild Animal captive breeding throughout Indonesia.

Captivity of animals and plants takes place in 26 provinces, consisting of mammals, aves, pisces, reptiles, arthozoa, anthopoda, ram pets, plants, insects, crocodiles, sea horses, crustaceans, leeches, and mollusk species. Various TSL captivity results are also distributed by 234 TSL dealers.

The development of cultivation efforts include, among others, the delegation of TSL cultivation licensing authority generation 2 etc. to UPT KSDA, increased public awareness on captivity and distribution of TSL, improvement of legislation related to TSL captivity. The number of cultivation units as of Dec. 31, 2012 stood at 724. During 2013 there was an increase in the number of cultivators to 52 units, bringing the number of cultivation units to 776 in December 2013.

When compared to 2012, there was an increase by 7.18 percent. Based on available data, the number of TSL dealer permits in 2012 stood at 205 units. In 2013 there was an increase in distribution permits to 13 units, bringing the total to 218 units. The increase in TSL dealers in 2013 was 6.34 percent from 2012 (Ministry of Forestry 2014).

- **Biodiversity Park**

Furthermore, in order to develop the use of biodiversity and encourage biodiversity is well-recognized both in its original form as well as the development of its benefits, the Ministry of Environment in 2008 developed and encouraged the local government to build Biodiversity Park (Taman Kehati). Biodiversity parks are local biodiversity reserve areas outside forest areas that have the in-situ and/or ex-situ conservation function, in particular for plants pollination and/or seed dispersion assisted by animals with a vegetation structure and composition that can support the preservation of animal pollinators and seed dispersers.

Biodiversity parks are used for the collection of plants, multiplying plants and seed provider animal supporters; planting genetic sources and local plants; a means of education, research development of science and ecotourism; source of seeds and seedlings; green open spaces; and/or additional vegetation covers. The management of Biodiversity Park is based on Ministerial Regulation of Environment Number 3 of 2012 on Biodiversity Park.

At this time there are as many as 78 Biodiversity Parks have been built (MOE, 2014), which is 9 (nine) Biodiversity Parks was built by using State Revenues and Expenditures Budget, 27 Biodiversity Parks in 15 province using Special Allocation Fund for Environment, 29 Biodiversity Park in 10 Provinces using Provincial Revenues and Expenditures Budget, and 9 Biodiversity Parks was built on private sector initiatives. In addition, there are 4 Biodiversity Parks in Southeast Sulawesi province were still under construction (see Table 5.4).

5.2. PROTECTION AND BREEDING OF BIODIVERSITY

One of the threats to the preservation of biodiversity is the presence of Invasive Alien Species (IAS). The IAS influence to a very large ecosystem because it can alter the natural ecosystem and cause degradation and loss of a species, even their habitat. (Anonymous, 2000, LIPI 2014). The International Union for Conservation of Nature (IUCN) defines (IAS) as a biota population that is growing

Table 5.4 Distribution of Biodiversity Parks

Province		Government Funding Source	Private Initiative
Java	Central Java	5	
	West Java	2	1
	East Java	5	3
	Banten	7	
		1	
Sumatera	West Sumatra	5	
	Lampung	2	
	NAD	6	
	North Sumatra	1	
	Bengkulu	1	
	Bangka Belitung	2	1
	South Sumatra	1	
	Riau	1	1
Sulawesi	North Sulawesi	5	1
	Central Sulawesi	5	
	Southeast Sulawesi	15	
Balinusra	Bali	1	1
	NTT	1	
	Maluku	1	
Kalimantan	South Kalimantan	1	
	West Kalimantan	1	
	East Kalimantan		1
Total		**69**	**9**

and breeding in their habitat or natural, as well as not in their original ecosystem. While CBD (2014) defines IAS as an introduction type that spreads out from its original habitat so that its presence threatens biodiversity.

The IAS introduction into an ecosystem in Indonesia may occur, either natural as well as unnatural, that is through human activities, including trade and transportation nationally and internationally. Most plant and animal species were intentionally introduced for various purposes, such as horticultural crops, ornamental plants, pets and ornamental fish. However, the displacement of a number of species is unintentionally entrained on other goods. The invasion process is conducted in phases through various levels, namely migration, introduction, colonization, naturalization and spread that cause a negative impact.

Based on extracting information about IAS, 2,809 foreign and/or invasive types are identified, i.e ranging from fungi, bacteria, viruses, arachnids, insects, fish, mollusks, birds, mammals and plants (Arida et al., 2014, in LIPI, 2014). Based on a compilation of Ministry of Environment of the Republic of Indonesia and SEAMEO BIOTROP 2003, it is stated that there are more than 1,619 foreign plant species and 331 invasive plant species, while from validation results in accordance with the latest nomenclature conducted by Arida et al., (2014) there are 2,085 species, 17 sub-species, 21 varieties, and one forma. Among the 2,085 species, 1,731 are foreign species, 350 invasive species, and four species with an unknown status.

According to Ministerial Regulation of Agriculture Number 93 Of 2011, disturber organisms of quarantine plants are divided into two categories, namely::

a. **Category I** (quarantine plant disturber organism that cannot be released from the carrier media of the quarantine plant disturber organism), and

b. **Category II** (quarantine plant disturber organism that can be released from the carrier media of the quarantine plant disturber organism). Every category is further divided into two categories, namely category A1 (quarantine plant disturber organism that do not yet exist in Indonesia) and category A2 (quarantine plant disturber organism that exist in Indonesia but are still limited and are being controlled).

Based on reports of IAS in Indonesia which issued by the Invasive Species Specialist Group (ISSG), there were 190 IAS of different species of animals and plants are recorded. Of this total, 98 species, i.e. 53 plant species, 43 animal species and two microbes are foreign organisms, whereas the unknown status consists of 10 plant species, six animal species and four microbe species. The original Indonesian species consist of 42 plant species, 29 animal species and one microbe species.

JAI existence has negative impacts on biodiversity, i.e. pushing aside the existence of the original strain by way of competition, predation, or transmission of diseases so that the function of the ecosystem becomes disrupted.

The number of foreign species are likely to rise as many new species are reported, such as papaya mealybug (*Paracoccus marginatus, Hemiptera: Pseudococcidae*) (Mani et al., 2012); dadap warts (*Erythrina sp., Quadrastichus erythrinaee, Hymenoptera, Eulophidae*) (Anonymous 2006); pengorok potato leaves (*Lyriomyza spp., Diptera: agromyzidae*) (Braun 1997); and the Japanese beetle (*Popillia japonica*). From LIPI survey results, the species recorded have already spread in Indonesia in a number of highland and lowland agricultural areas, which according to laboratory study results are capable of destroying a wide range of vegetable crops (Erniwati dkk., 2013, in LIPI, 2014). Meanwhile, invasive microbe studies have not been largely conducted compared to invasive plants and animals. Microbial invasion by bacteria, fungi, and virus occur worldwide, however its detection is more difficult than other higher organisms. Invasive microbes have the significant potential to change socioeconomic conditions through changes of the ecosystem diversity function, either the terrestrial as well as aquatic ecosystems. In general, invasive microbes are pathogenic to other organisms.

IAS exixtence has a negative impact on biodiversity, i.e. pushing aside the existence of the original strain by way of competition, predation or transmission of diseases so that the function of the ecosystem becomes disrupted. IAS directly affects local biodiversity and is one of the largest threats to the destruction of habitats and ecosystems (CBD 2002). The spread of invasive foreign species are able to change the structure and composition of species in the natural ecosystem. Local species lose the competition and are threatened by extinction.

Knowledge regarding the dangers of the rapidly growing foreign invasive plants shows how great the impact of the invasive plant species is on the production system, environment, health and even the welfare of the community in general. For example vegetable leafminer *Liriomyza sativae, L. trifolii, L. huidobrensis and L. bryoniae* (Tokumaru and Abe, 2006) that destroy vegetables and nuts crops.

The introductions of timor deer (*Rusa timorensis*) to Merauke caused depressed population of wallaby saham (*Macropus agilis*). The existence of invasive plants, such as *Acacia nilotica* have disturbed and caused declines in the existence of native Indonesian plants and animals such as bison and wild buffalo in the Baluran National Park.

According to the latest report of IAS, there are more than 2,000 plant species in Indonesia (Setyawati and Soekisman 2003), 100 species of which are categorized as dangerous while 27 species have garnered worldwide attention. Of these harmful invasive plants, 60 percent are foreign species, 40 percent native to Indonesia with parts recognized as agricultural pests and weeds (LIPI, 2014).

To date, Indonesia has no regulation yet on the management of IAS to protect biodiversity. Regulation with respect to IAS was still in a draft prepared by Ministry of Environment and Forestry, which will be stipulated into a Presidential Decree/Presidential Instruction. Regulations and national policies that have been developed and related to IAS, among others:

1. Law Number 5 Of 1990 on Conservation of Natural Resources and Its Ecosystem;
2. Law Number 16 Of 1992 on quarantine of animals, fish and plants;

3. Law Number 32 Of 2009 on Environmental Protection and Management;
4. Government Regulation Number 27 Of 1999 on Environmental Impact Assessment;
5. Government Regulation Number 14 Of 2002 on Plant Quarantine
6. Government Regulation Number 15 Of 2002 Fish Quarantine;
7. Ministerial Decree of Forestry Number 447 Of 2003 on Administration of Collecting or Capture and Distribution of Plant and Wild Animal;
8. Ministerial Regulation of Marine Affairs and Fisheries Number PER.17/MEN/2009 on Prohibition of Entry of Several Dangerous Fish Species from Abroad into the Territory of the Republic of Indonesia;
9. Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2003–2020.

Considering that IAS is a cross-sector issue, prevailing legislation is not sufficiently regulate yet, neither in relation to the introduction nor the spread and its control.

Therefore, it is necessary to implement laws and related to the management of IAS. In addition, it is also necessary to formulate a comprehensive reference for the related sector on a national scope in the form of a national strategy and action plan for the management of IAS. It is expected that the management of IAS will be implemented more exact, effective and efficient by the respective sectors in accordance with their authorities, but remaining nationally coordinated and integrated, which will in turn have positive impacts on the environment, health, social and economic sectors, at the national and local levels (MoE, 2014).

5.3 BIODIVERSITY AND CLIMATE CHANGE

Biodiversity and climate change are like two sides of a coin that cannot be separated. Preserving or protecting biodiversity in the framework of the ecosystem also means maintaining the existing carbon stocks on timber or land in the regions. Ironically, it is estimated that at least 1.7 billion tons of carbon is released annually due to transfer of land-use, whereas the greatest part is caused by deforestation in tropical forest areas. Deforestation represents approximately 20 percent of current global carbon emissions, which is greater than the percentage emitted by the global transport sector with an intensive use of fossil fuel.

Ironically, climate change and global warning originate from the emission of uncontrolled greenhouse gases. On the other side, forest deforestation and degradation in Indonesia are the largest contributors to national emissions

Climate change is a great challenge to the implementation of IBSAP 2015-2020, because of climate anomalies, not only the causal factors of disasters and extinction of the existing biodiversity, such as forest fires, but also the fact that climate change alters the natural patterns of living creatures that survived for thousands of years. Global temperature changes affect biodiversity with various damage impacts and scale, either against genes, species, communities and ecosystems (Parme¬san, 2006; Bellard dkk., 2012). Ironically, climate change and global warning originate from the emission of uncontrolled greenhouse gases. On the other side, forest deforestation and degradation in Indonesia are the largest contributors to national emissions. Meanwhile, the important emission sources in the last 10 to 15 years originate from forest and land fires, as well as peatland drainage with annual emissions of no less than 0.5 billion tons of carbon. The study of Mora, et al., (2013) predicts that in the agricultural and food sectors there will be a decrease of 10 percent of rice harvest for each temperature increase of an average one degree Celsius. In addition, fish catching in Indonesia will decrease to 40 percent in the exclusive economic zone areas as a result of many species seeking a cooler climate, adapting to warmer temperatures or going extinct due to climate change. Further, in the study simulation conducted, it was predicted that undesired affects will be encountered earlier in tropical areas and low-income countries. Therefore, the study encourages increased responsiveness to promote an increased capacity of these countries to have resilience and undertake mitigation to reduce emissions of greenhouse gases that are harmful to biodiversity and humans.

Biodiversity will also experience crucial challenges based on the observations the Corlett study (2011) that states that long dry seasons are the high predictors of species wealth. Dry years may affect the death and growth of plants. In addition, dry weather will affect the frequency of fires. To overcome this, it is recommended that real action be parallel to the implementation of IBSAP 2015-2020 in the national targets, as follows:

a. Reduce non-climate pressures on tropical rain forests, including clearing of forests and land.

b. Restore connectivity to enable connectivity of genes and species in separate populations and restore forest cover to reduce high temperatures.

Climate change has indeed received serious attention from the Indonesian government, at the policy level and through activity implementation. Biodiversity conservation efforts can be complementary to climate change mitigation through REDD + schemes. In addition, activities will be found that cannot be separated in terms of biodiversity and sustainable use with climate change mitigation, for example in ecosystem restoration efforts.

Another important challenge will be encountered in the agriculture and food crop sector. Stigter and Winarto (2012) recommend a new planting pattern referred to as smart farmer by empowering farmers in an effort to handle climate change, among others by manufacturing appropriate products that are beneficial for farmers. In the meantime, the industry is recommended to create products that attract users on account of intense sales competition. In addition, farmers should also increase capacity, which can be done through the training of trainers (TOT) as the field school for farmers.

Apart from that, research on the response of species and populations against climate change as an affect of global warming indicates a tendency of phenological changes needs to be carried out. Phenological shifts as a result of global warming are among others encountered during mating seasons, budding and flowering of plants. Obviously, the phenomenon of phenological shift is correlated with the changes in temperatures and rainfall.Shifts in the flowering of plants will in the end also affect the availability of fruit, including feed fruits that are largely used by animals, including orangutans and living creatures that depend on fruits in the forest.

WWF survey outcomes and the Sebangau National Park Office (2006-2007) conclude that the orangutan spread in the Sebangau National Park indicates fluctuations depending on two main factors, namely:

1. Human activity and habitat degradation; decrease of orangutan abundance in degraded habitats, such as forests in the south side of the Sebangau area. Habitat destruction and human activities (negative) will result in the decrease of orangutans.

2. Type of habitat: orangutans are more frequently found in the tall standing forest (sub) type and mixed swamp forests compared to low standing forests. The existence of orangutans in TN Sebangau also indicates the tendency of orangutan concentration in areas near bodies of water.

Accordingly, strategic efforts to prevent forest clearing as a result of human activities should be reduced and even eliminated. These efforts are in line with the various types of studies suggesting that maintaining forests will be an important factor in mitigation efforts in dealing with climate change.

Although national regulations do not yet regulate the integration between climate change and biodiversity, programs implemented by various institutions indicate synergy, for example the efforts in developing REDD+ and initiatives prepared by UKP4, but the initiatives should be developed. Until now, the implementation and coordination for UNFCCC are MoEF and the National Council on Climate Change (DNPI) with the focal point: DNPI, while the implementation of UNCBD and the focal point is MoEF. Therefore, it is necessary to synchronize the issue of climate change and biodiversity that is implemented in the scope of Moef with the active participation of DNPI.

5.4 BIODIVERSITY DATA AND INFORMATION MANAGEMENT

• Data on Preservation/ Collection of Biodiversity

The previous description has shown the long history of efforts to preserve the biodiversity of Indonesia and the country's seriousness in the management of biodiversity. Similarly, measures of identification are still being conducted by LIPI and the above mentioned technical ministry to continue to identify, classify and document outcomes of research implemented.

Starting from the government's concern over the preservation of biodiversity in Indonesia, ideas emerged to establish an information network covering the biodiversity sector on a national scope that is referred to as NBIN (National Biodiversity Information Network). The information network is under LIPI and in its capacity has the following functions:

a. Reference center for conservation, research and the use of biodiversity. The connecting door to the global biodiversity information network.

b. A mechanism to facilitate the flow of information regarding biodiversity.

c. A structured way to respond to the needs of users in the biodiversity sector.

In addition, the objective to establish NBIN is as follows:

a. Establish a practical mechanism for the exchange of data and information on biodiversity.

b. Increase the comprehension on the requests of information users.

c. Establish NBIN independence in the long term.

Institutional NBIN as a distribution network consists of institutions that work together. The structure of the relationship between institutions involved in NBIN is more a rational relationship than a hierarchy. The main role of the NBIN association is to promote cooperation between NBIN members and disseminate information regarding NBIN.

The NBIN association has core members who directly contribute data, information or services for the network and interested members in general. It can also contribute in the framework to build, enlarge and expand the institutional NBIN but do not provide data, information and services related to biodiversity.

Data and information on diversity available to the respective potential NBIN members vary greatly in terms of quantity, quality and ease of access. NBIN is expected to facilitate and support the network so that access to data integration, user and information communication on biodiversity in Indonesia can be easily conducted.

National Biodiversity Information Network (NBIN) is expected to facilitate and support the network so that access to data integration, user and information communication on biodiversity in Indonesia can be easily conducted.

Furthermore, LIPI in cooperation with Ministry of Research, Technology and Higher Education and Global Biodiversity Information Facility (GBIF) developed a portal of Indonesia Biodiversity Information Facility (InaBIF). InaBIF is expected to become the portal of knowledge management for genetic resources and traditional knowledge of Indonesia that will store, manage and integrate data and information on the Genetic Resources and Traditional Knowledge (SDGPT) of Indonesia.

InaBIF is expected to function as a medium to facilitate information among research institutions, universities, regional governments, policymakers and security (customs and the police). This portal is also expected to accommodate the flora and fauna trade that is permitted by CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora). InaBIF it is expected to:

a. Increase public awareness to access information regarding SDGPT Indonesia and its potentials.

b. Provide public facilities to access information regarding SDGPT and optimize the utilization and protection.

c. Provide convenience for the Indonesian people to protect SDGPT and fight for their rights for all profits earned from SDGPT for the prosperity of Indonesian people.

The InaBIF portal is still in the prototype phase for plants and integrates only five databases i.e. Prosea (Plant Resources of South Asia), IBIS (Indonesian Biodiversity Information System), Lintrad (Protection of Medicinal Plants and Traditional Medicine Program), ISJD (Indonesian Scientific Journal Database), and ISTDL (Indonesian Science and Technology Digital Library).

Further, LIPI is expected to be the focal point of data management and utilization of biodiversity preservation. Systems that are part and connected to InaBIF are expected to be established in the respective technical ministries transparently and kept up to date (Figure 5.2).

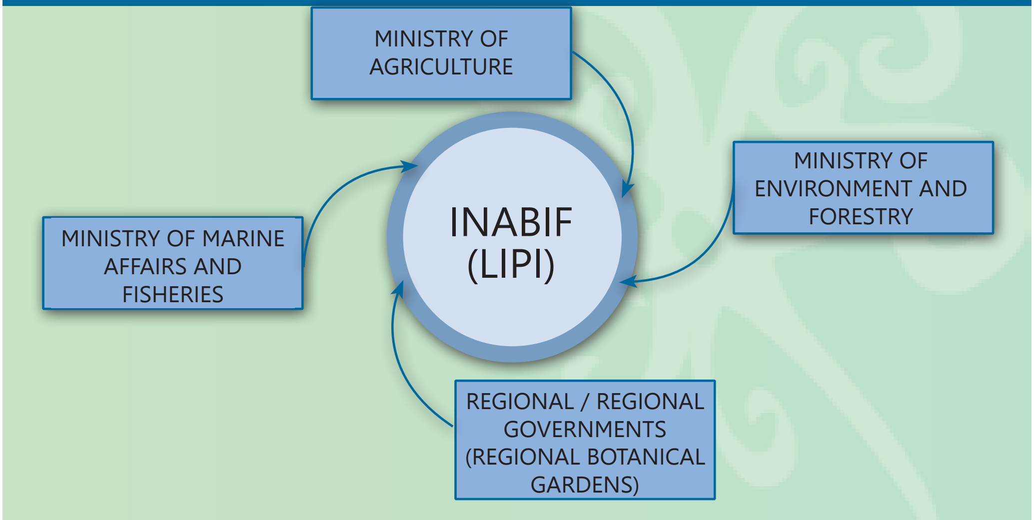
• Data on Biodiversity Utilization

In the past, utilization did not need to be regulated because:

a. Utilization patterns were still or only implemented by the local community and were very much based on local wisdoms.

b. Utilization was previously very low and lower than the growing power of the natural habitat,so as to not disturb biodiversity.

Figure 5.2 Preservation Data and Biodiversity Collection System (InaBIF).



c. At present, the total population is very large, with biodiversity needs driven due to the industry and overseas trade. Accordingly, biodiversity utilization level is beyond the biodiversity re-growth power and damages the power of growth.

In addition, the reduced biodiversity habitat should also be recognized and monitored due to the decrease of land/ forest as well as damaged habitat due to natural processes and climate change.

In regard to the utilization of biodiversity, it supports the improvement of public welfare and national economic growth. Utilization should be further regulated, not prohibited as biodiversity utilization also encourages the awareness of biodiversity use that further encourages the preservation of biodiversity.

However, the economic utilization of biodiversity needs to be based on "responsible utilization", as defined in chapter IV. In this way, utilization/ bioresource/ bioprospecting are highly recommended but should be carried out in a way that does not disturb the existence of biodiversity in their natural habitat.

In addition, utilization of biodiversity should also be accompanied by reporting/ data and information on the biodiversity benefits, which are essential to:

a. Provide information regarding the knowledge of the benefits of biodiversity that continuously grows.

b. Provide information to control/ monitor the utilization and enforcement of regulations concerning the preservation of biodiversity.

c. Provide information on the economic value of biodiversity for the prosperity of the community and its contribution to the national economy.

Furthermore, data on the utilization of biodiversity should be properly managed to distinguish between biodiversity that is sustainably used (does not disturb the habitat) and biodiversity that is cultivated or "produced" outside the habitat. In this regard, increased cultivation is highly encouraged because along with the progress of science and technology, to recognize the utilization of biodiversity and develop it into material for the needs of life (food, health, energy, materials, etc.) and accordingly the needs of "life material" will be highly developed. Progress in science and technology is capable of developing the benefits contained in biodiversity. However, the utilization should be properly regulated and should not disturb the habitat so that preservation is maintained for future generations.

Certainly, monitoring the utilization of biodiversity in each sector is implemented by the respective K/L according to the principal duties and functions. Licensing for the use of biodiversity for utilization (traded, development benefits) are regulated under Government Regulation Number 7 Of 1999 on Preservation of Plants and Animal, Ministry Regulation of Forestry Number P.19/Menhut-II/2005 on Captive Breeding of Plants and Wild Animal and Ministerial Decree of Forestry Number 447 Of 2003 on Administration of Harvest or capture and distribution of plants and wild life trade, the realization of non-tax revenues (PNBP) from the income of dues for catching, taking, transporting of wildlife in 2013 is recorded to amount to Rp.5.124.495.667- (MOF 2014).

5.5 CHALLENGES

Updates of biodiversity preservation activities and data collection in every authorized K/L. The awareness to update research outcomes into databases should be improved. Updates are implemented because:

a. New discoveries due to basic research that are continually conducted.

b. Updates due to the monitoring of biodiversity stock conditions that are poorly maintained and other damages.

c. Updates on the development of knowledge regarding the benefits of biodiversity.

Updating data is important as the basis of the "recognition" from the international world on the ownership of biodiversity, so that it can also serve as a basis for determining the mechanisms and sharing of benefits.

This measure is important as the existence of biodiversity does not stand alone but is attached to community culture, local wisdoms of the people and in particular its relation to endemic biodiversity. For this purpose, the updating of NBIN into InaBIF needs to be intensified and supported by SOP data maintenance between K/Ls (in the InaBIF system) and in each K/L.

The mechanism and data collection on the utilization of biodiversity should be transparent and structured. In relation to the utilization, there should be :

a. Improved "obligation" on inventory data management (new) and monitoring of existing biodiversity (update condition of damaged / not).

b. There should be rules on the "official" utilization patterns and the reporting system. For example: the use of biodiversity for the purposes of economic/ industrial/ trade is permitted, however the concerned party should own a biodiversity garden.

c. Data collection needs to be organized, whether separated from InaBIF or incorporated or simply connected.

The use of preservation data, biodiversity conditions, cause of damage and utilization as the basis of law enforcement. At present, the destruction of flora and its habitat, killing endemic fauna as well as the near extinction of fauna are flourishing for momentary interests. Repression and updating data on damage/ killing results are not connected to biodiversity data, so that there is no continuity between preservation efforts, proper utilization and poor utilization that is illegal / criminal.

Therefore, an integrated data management system between the preservation of utilization and its use to prevent and reduce steps that endanger the existence of biodiversity in Indonesia, is needed. With the progress of technology and supported by increased protective measures, the integrated system should be well constructed. Only this way can the measures to maintain the wealth we borrow from future generations be carried out well. ***

A number of fish species and marine biota newly discovered in coral reefs in the waters of Bali


Grallenia, *New Goby_CI_Gerry Allen*


Siphamia, *New Cardinalfish_CI_MarkErdmann*

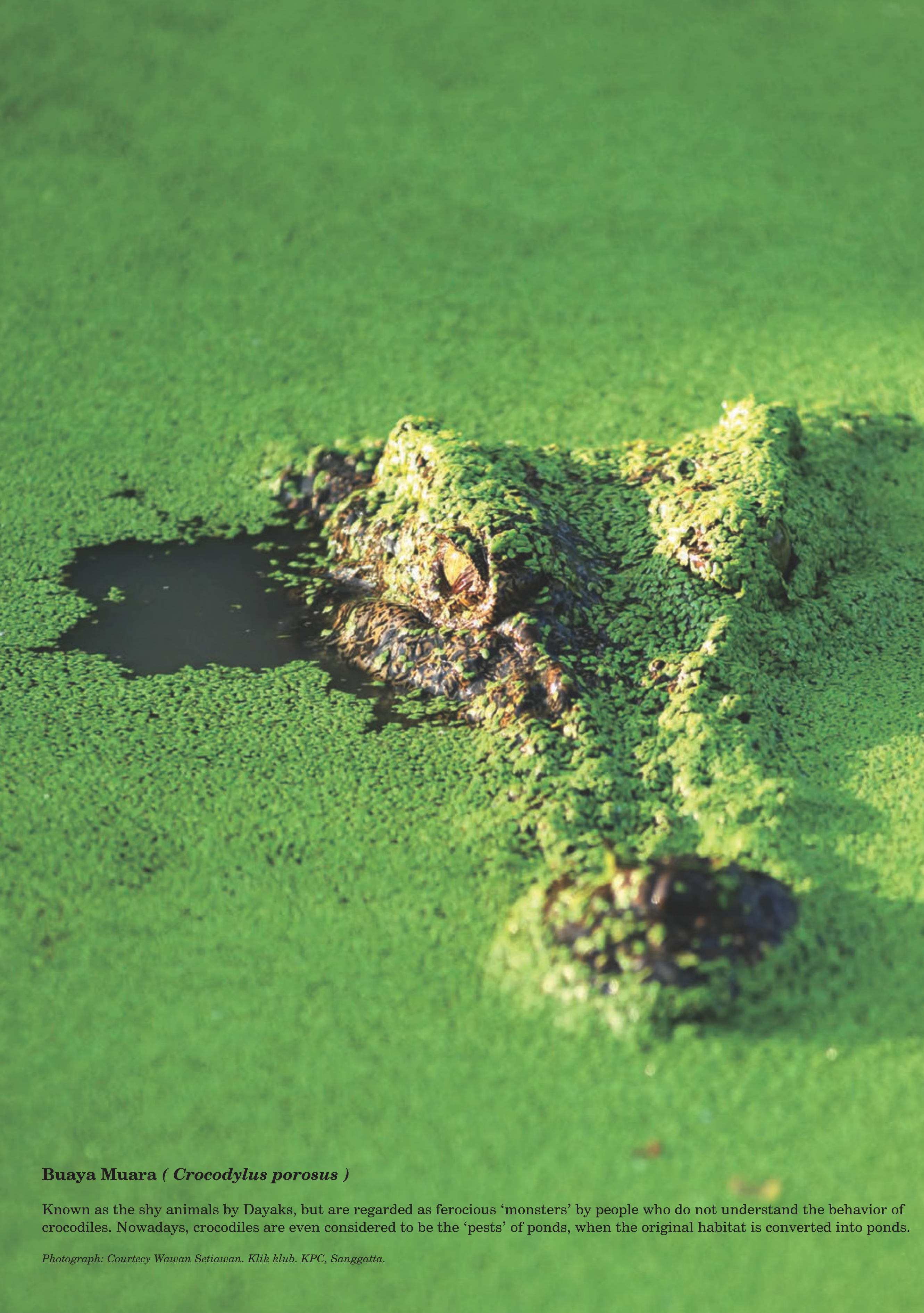

Grallenia, *New Goby_CI_Gerry Allen*


Heteroconger, *New Garden Eel_CI_Gerry Allen*


Manonichthys Adult, *New Dottyback_CI_Gerry Allen*


Euphyllia Baliensis, *New Bubble Coral_CI_Mark_Erdmann*

Indonesia has a high biodiversity of coral reefs, it has been recorded that there are approximately 590 species of hard coral, 210 species of soft corals and 350 species of gorgonian. In addition, there are approximately 2,057 species of fauna that inhibit the coral reef habitat, 97 species among it are endemic fauna, native to Indonesian waters. A number of coral reef biota have been recently discovered in the marine ecosystems of Indonesia (photos above were recently found on coral reefs in the waters of Bali)



Buaya Muara ***(Crocodylus porosus)***

Known as the shy animals by Dayaks, but are regarded as ferocious ‘monsters’ by people who do not understand the behavior of crocodiles. Nowadays, crocodiles are even considered to be the ‘pests’ of ponds, when the original habitat is converted into ponds.

Photograph: Courtecy Wawan Setiawan. Klik klub. KPC, Sanggatta.

6

Institutional and Resource Management of Biodiversity.

Since Indonesia ratified the Convention on Biological Diversity into Law Number 5 Of 1994, several Ministries/Institutions (M/I) have been established for the improvement of utilization and management of biodiversity, namely Ministry of Environment, Ministry of Forestry, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture and the Indonesian Insitute of Seciences. The fourth national report review in 2009 identified several ministries/institutions relevant to biodiversity and those that had included the issue in their strategic plans. Many regulations on biodiversity have been issued but remain sector-based and only focus on commodities. Therefore, conservation functions, utilization and benefits sharing as the objectives of CBD cannot be optimally reached, and have yet to be accommodated at the genetics, types and ecosystem level. In addition, the implementation of regulations that are not in line with prevailing regulations and the poor implementation of laws have made biodiversity a challenge to manage.

In 2009, the Environment Ministry reported through the fourth biodiversity national report the results of the initial review of the implementation of the 2003-2020 IBSAP. The results of a preliminary review mentioned institutional weakness and mandated the establishment of an ad hoc team in 2003-2020 as a minimum prerequisite of the IBSAP. This was caused by several things:

(i) poor legal framework for IBSAP implementation, making it voluntary based; (ii) lack of monitoring and coordination mechanism; and (iii) unavailability of assigned institution responsible for the coordination, monitoring and implementation of the IBSAP.

Moreover, some institutions mandated by the 2013-2020 IBSAP to be established for the management of biodiversity management have yet to be established. Similarly, international institution communications are still conducted partially and are not centralized; therefore strategic communications and improved positioning in Indonesia have yet to be accomplished in the world biodiversity domain. It also enervates biodiversity preservation and sustainable use of biodiversity for the overall prosperity of the people. In connection with that, institutional issues associated with the review of regulations, the institutional order of biodiversity and human resource organizers, as well as resource mobilization will be described as follows.

6.1 REGULATION MANAGEMENT FOR BIODIVERSITY

The Indonesian government has issued various regulations on the management and utilization of biodiversity, both pertaining to the management and preservation of ecosystems (conservation of natural resources and its ecosystem; water resources, forestry, coastal and small islands), type and results of cultivation (fishing, food, livestock and animal health, cultivation of plant system) as well as safeguard measures (spatial planning, quarantine and protection). In addition, Indonesia has also ratified several international conventions such as the UNCED and UNFCCC, Validation Genetic Resources and Ratification of the Nagoya Protocol.

As presented in Figure 6.1, there are 17 UN laws pertaining to environmental management and/or biodiversity. Laws that are strongly linked and need to be considered for the development of future biodiversity management are presented in Table 6.1.

Nevertheless, the prevailing regulations do not meet all aspects to support biodiversity management, as expected. Support requires regulations that are more operational and technical and manage biodiversity in a sustainable manner.

Figure 6.1 Development of Laws and Legislations on Biodiversity Management.

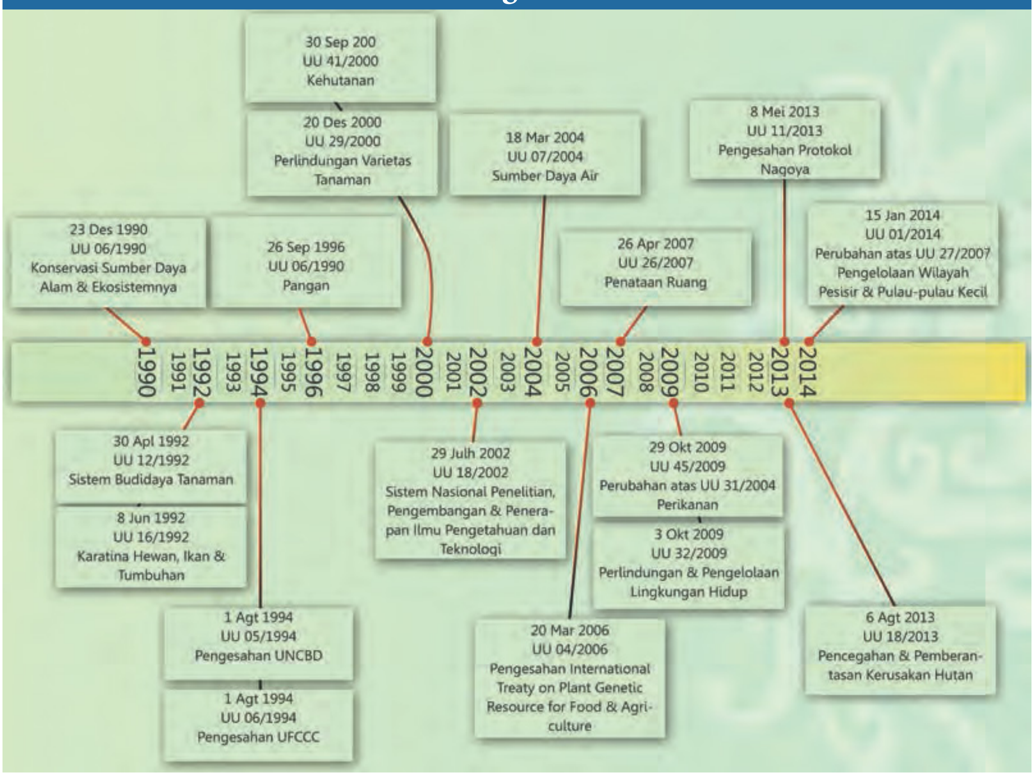


Table 6.1 Regulations related to Biodiversity Management

No	Regulations	Substance regulated/relevant with Biodiversity
1	Law Number 5 Of 1990 on Conservation of Natural Resources and Its Ecosystem.	This law covers the conservation of type, preservation of type, and sustainable use of type and ecosystem, but does not include a binding arrangement for genetics and derivatives, therefore not ensuring the protection against the genetic component of an individual type. This law became the basis of the setting of conservation areas in the form of KPA and KSA.
2	Law Number 12 Of 1992 on Plants Cultivation System.	This law regulates cultivation system, including efforts to increase agricultural production through plasmanutfahan conservation farming, breeding and supply of plant seeds. This is limited to the regulation of agricultural SDGs.
3	Law Number 41 Of 1999 on Forestry	The law regulates SDA derived from indigenous forests. The issuance of permits providing access to such forests shall consider indigenous peoples and the government.
4	Law Number 29 Of 2000 on Plant Variety Protection	The law regulates special protections given by the state to plant varieties resulting from plant breeding, including breeding activities of the plants and the distribution of profits through a royalty system.
5	Law Number 18 Of 2002 on National System of Research, Development and Application of Science and Technology	The law regulates research and development activities conducted by foreign entities, including universities, research institutes, enterprises and individual foreigners not residing in Indonesia.
6	Law Number 31 Of 2004 on Fish as amended by Law Number 45 Of 2009 on Fishery.	The law regulates the use of marine genetic resources
7	Law Number 21 Of 2004 on Ratification of Cartagena Protocol on Biosafety.	Ratification of the Cartagena Protocol arranges adequate protection in terms of transit, handling and use of living trans boundary movements on biosafety of Genetically Modified Organism(OHMG). With this protocol, each state party shall regulate traffic genetically engineered products (PRG) from the threat of pollution of the existing biodiversity within the national jurisdiction. As a rule derivatives have been issued under Government Regulation Number 21 Of 2005 on Genetically Modified Safety Products.
8	Law Number 4 Of 2006 on Ratification of International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)	ITPGRFA is an international instrument in the field of utilization of agricultural genetic resources that arranges the exchange of agriculture genetic materials through a genetic material transfer agreement (MTA).
9	Law Number 27 Of 2007 as amended by Law Number 1 Of 2014 on Management of Coastal Areas and Small Islands	The law regulates the management of coastal areas and small islands covering planning, utilization, supervision and control by the principles of environmental management and utilization using environmentally friendly technology.

No	Regulations	Substance regulated/relevant with Biodiversity
10	Law Number 32 Of 2009 on Environmental Protection and Management	This law regulates the protection of the environment based on the principle of state responsibility, preservation and sustainability, harmony and balance, alignment, benefits, prudence, justice, eco region, biodiversity, the polluter pays, participative, local knowledge, governance reign of good, and regional autonomy as well as the setting of genetic resources and biological safety of genetically modified products. In addition, this law stipulates that the preservation of the environment is conducted through conservation, provisioning the resources or the preservation of nature and functions of the atmosphere. Conservation of natural resources is an activity meant to protect and preserve.
11	Law Number 11 Of 2013 on Ratification on Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from the Utilization to the Convention on Biological Diversity	The Nagoya Protocol regulates access to genetic resources and associated traditional knowledge related to SDGs based on prior informed consent and agreement. With the mechanism of the Nagoya Protocol is expected to prevent the theft of genetic resources (bio piracy) and push a study on Bio resources basis.

6.2 INSTITUTIONS FOR MANAGEMENT AND UTILIZATION OF BIODIVERSITY

Biodiversity management involves ministries, with the Ministry of Environment and Forestry as a focal point in a variety of international biodiversity forums. In addition, Indonesia also has the Commission on Biosafety of Genetically Modified Products and the Commission on National Genetic Resources.

The Roles of Ministries and Institutions

Four ministries and one agency have been assigned the duties and functions directly related to biodiversity, including research, conservation and biodiversity utilization. Those related Ministries and Institutions (M/I) are: Ministry of Research, Technology and Higher Education, Indonesian Institutions of Sciences, Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, and Ministry of Agriculture. Various agencies related to the management of biodiversity have been established, among others, the Commission on Biosafety for Genetically Modified Products and the National Commission on Genetic Resources.

In addition, various parties have roles in the management of biodiversity, including universities, research institutes and civil society organizations (CSOs). However, the relationship between the various parties related to the management and utilization of biodiversity is not clearly visible, although the coordination mechanism aims to support the tasks and functions of each party.

- **The Roles of Ministries/ Institutions Related to Biodiversity Research**

  a. Ministry of Research, Technology and Higher Education has duties in formulating national policy in the field of research, science and technology and coordinating the implementation of policies in the field of research and science and technology. The ministry formulates the main directions and priorities in the development of science and technology, and oversees the preparation of strategic policies in science and technology, supported by the National Research Council (DRN). The ministry coordinates and manages various research institutions, namely LIPI, LAPAN, BPPT, BATAN, BAPETEN, BAKOSURTANAL (currently BIG), BSN, PUSPIPTEK, LBME, PUSPA IPTEK, ATP, BTC, Bio-Island and Agro Business. The ministry also has a role in issuing permits to foreign scientists to carry out research in Indonesia.

  b. LIPI carries out science and technology research and development, including coaching and providing input on policy formulation. It also serves as a scientific authority to provide recommendations pertaining to plants and wildlife trade in accordance with CITES. The LIPI also serves the function of a national focal point (NFP) for Global Strategic for Plant Conservation (GSPC), the subsidiary body of the Scientific, Technical and Technological Advice (SBSSTA), Taxonomy Global Initiative (GTI) in the implementation of the Convention on Biodiversity (CBD).

• The Roles of Ministries/Institutions Related to Biodiversity Conservation and Utilization

a. The Ministry of Environment and the Ministry of Forestry were merged and became the Ministry of Environment and Forestry. The Ministry has duties in the field of environment and forestry includes, among others: forest management; management of resources and ecosystems; watersheds (DAS); sustainable forest management; control printing of defilement; controlling the impacts of climate change; controlling land and forest fires. The ministry is the NFP-law of several international conventions such as the CBD, the Convention on Desertification (UNCCD Ramsar Convention, the Cartagena Protocol and the Nagoya Protocol.

   The ministry also acts as the management authority for the trade of plants and wildlife within the framework of CITES. Among its duties is to preserve biodiversity by securing conservation areas and preserving the integrity of ecosystems, as well as issuing permits for the conversion of forests. Meanwhile, its functions are carried out through trade quotas for animals and plants.

b. Ministry of Marine Affairs and Fisheries performs the duties and functions to formulate, adopt and implement policies pertaining to fisheries, aquaculture, processing and marketing of fishery products, management of marine areas, coastal and small islands, marine resources and fisheries surveillance, research development of marine and fisheries, human resource development of marine and fisheries, fish quarantine, as well as quality control and safety of fishery products.

   The ministry also oversees the protection and preservation of biodiversity in the conservation area of marine waters, coastal and small islands through the management of marine conservation, coastal and small islands as well as the conservation of fish species and genetic resources.

c. Ministry of Agriculture is an institution in charge of agriculture include food crops, horticulture, plantation, animal husbandry, food security, quarantine, protection of plant varieties, including research and their development. The Ministry is also the National Focal Point of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRA) which is an international treaty on genetic resources (SDG) crops for food and agriculture. It also implements biodiversity conservation through the collection of garden crops, both local and non-local.

d. In addition to the key institutions above, there are also other institutions that have promising roles in the management and utilization of biodiversity, namely: Ministry of Research, Technology and Higher Education, Ministry of Health, Ministry of Energy and Mineral Resources, the Ministry of Tourism, Geospatial Information Agency (BIG), the National Institute of Aeronautics and Space (LAPAN), universities, research institutes, as well as CSOs national and international level.

• The roles of Ministries/ Institutions related to natural resources preservation

a. Mandate of the Ministry of Environment and Forestry

Forestry, based on mandate of the Law Number 32 Of 2009 on Environmental Protection and Management, is mandated to preserve natural resources. In order to preserve the biological natural resources, the government, the provincial government, or the district / city and individual can build: a. biodiversity park outside the forest area; b. green open space (RTH) at least 30 percent of the area of the island / archipelago; and / or c. plant and maintain trees outside forests, particularly rare plants.

b. Biosafety Commission for Genetically Modified Products

The Biosafety Commission for Genetically Modified Products (KKH PRG) is a non-structural institution under and or has responsible to the President. The Biosafety Commission was established through Presidential Decree (Perpres) Number 39 Of 2010 on Biosafety Commission for Genetically Modified Products, as renewed by Presidential Decree Number 53 Of 2014 on the Amendment of Presidential Decree Number 39 Of 2010. The establishment of the Biosafety Commission for Genetically Modified Products is a mandate of Article 29 of Government Regulation Number 21 Of 2005 on Biosafety of Genetically Modified Products. KKH PRG membership consist of 19 members, which is comprise of 11 government representatives, 3 university representatives, and 5 community representatives. The membership of KKH PRG appointed by the President through Presidential Decree Number 181/M/2014.

Biosafety Commission for Genetically Modified Products (KKH PRG) has the following duties:

- Provides recommendations to the Minister of Environment and Forestry/Head of non-ministerial government institutions (LPNK) as a basis consideration in issuing letter for releasing and distributing of PRG.
- Provides result test certificate on environment safety, food safety and/or feed safety to the Minister of Environment and Forestry, the Minister/Head of LPNK as the basis consideration in issuing letter for releasing and distributing of PRG.
- Provides advice and consideration to the Minister of Environment and Forestry, the Minister/ Head of LPNK in determining the guideline on impact monitoring, risk management and PRG recall from distributions.
- Provide assistance to the Minister of Environment and Forestry, the Minister/ Head of LPNK in monitoring

to PRGs import and utilization; inspection and verification of the report on negative impact of PRGs.

In carrying out its duties and functions, assisted by the PRG KKH Biosafety Clearing-House (BKKH), PRG Biosafety Technical Team (TTKH PRG) and the Secretariat of the CBD PRG. the BKKH, domiciled in the KLH, is the organizer and presenter of information to the public.

Clearing House for Biodiversity (BKKH) has the following duties:

- Manage and provide information to the public about the procedures, receipt of applications, process and summarize the assessment results.
- Receive and deliver community input.
- Share information regarding the formulation of recommendations to be submitted to the Environment and Forestry Ministry, the minister and authorized heads of LPNK.
- Share the detailed recommendation which will be submitted to the Minister of Environment and Forestry, the Minister/Head of LPNK .
- Manage and present information that must be provided by the BPKH according to the mandate of the Cartagena Protocol on Biosafety.

TTKH PRG has been set by decree (SK) Chairman KKH PRG No. 01 / KKH- PRG / 11/2011 on Nov. 4, 2011. There are three fields in the TTKH PRG, namely the TTKH PRG Environmental Safety Division, TTKH PRG on Food Security and TTKH PRG on Feed Safety Division. Until the year 2014, it has produced the following recommendations issued by the Commission for the Biosafety: 16 on food safety and food security and three recommendations on environmental safety.

The KKH- PRG has also approved the implementation of biosafety assessment and testing PRG in a limited test facility and limited test field. Up to 2014, Biodiversity Technical Team on Genetically Modified Products (TTKH PRG) on Environmental Safety Division has been conducting assessments on the biological safety of:

- One proposal on PRG research in a laboratory;
- One proposal on PRG research Limited Test in the Field;
- Eighteen environmental safety assessments which consists of three assessments on environmental safety of Genetically Modified Products plants and fifteen assessments on environmental safety of Genetically Modified Products microorganism.

c. National Commission on Genetic Resources

The National Commission on Genetic Resources (KNSDG) was formed under Agricultural Ministerial Decree No. 734 / Kits / OT.140 / 12/2006. The KNSDG is tasked with providing input on SDG policies pertaining to agriculture and livestock to the agriculture minister through the IAARD. The National Commission on Genetic Resources (KNSDG) has networks in the regional areas, known as Regional Commission of Genetic Resources (Komda SDG), currently there are 20 Komda SDGs at the provincial level.

The scope of KNSDG activities:

- Following the development of the germplasm program at the national level (collection, institutional, labor, financing, preservation and utilization) associated with the development of the international community.
- Provide material for the formulation of national policy regarding germplasm.

- Develop a national strategy for backing up, evaluating, exploiting and preserving germplasm in Indonesia, in particular, and other economic commodities.
- Determine the priority commodities that will be handled by the threat of erosion germplasm genetics, as well as the potential value of its interest in diversification, particularly in the direction of utilization research for recovery.
- Develop a national germplasm system;
- Coordinate national activities relevant to handling germplasm.
- Monitor utilization and conservation of germplasm stored or managed by government agencies or NGOs.
- Identifying a qualified workforce and types of training and education needed, and finding a way to meet the shortfall.
- Hold regular technical meetings to further expand the involvement of the scientific community in achieving the goals of national germplasm counsel activities, especially in the effort of coaching members of the national germplasm commission in respective regions.
- Increase public awareness on germplasm to increase active participation in efforts to conserve and utilize germplasm.
- Produce bulletins on germplasm (scientific), Warta plasmanutfah Indonesia, leaflets, technical writing, as well as other forms of information dissemination through the mass media, both traditional and electronic.
- Coordinate regional and international cooperation with regard to germplasm to raise national interest..

d. Non-Governmental Organizations

Various biodiversity management efforts undertaken by NGOs consist of self-reliant community development institutions or CSOs, the private sector and community groups. CSOs in the environmental field began developing in the 1980s and raised the issue of uniformity of biodiversity since 1990. Its activities primarily revolve around policy advocacy, community education and community assistance in protected areas. In the 90s, CSOs were increasingly formed for activities devoted to biodiversity, with development as follows:

- The Kehati Foundation (networks of NGOs) has a wide network comprising NGOs and the government, with activities related to local wisdoms/community in the utilization of sustainable biodiversity. For example, the Indonesian Biodiversity Foundation was formed in 1994 to provide funding and technical support for activities related to the conservation of biodiversity.

- Since 2000, the Kehati Foundation has shown appreciation to CSO, individuals, scientists and entrepreneurs who have made strides in the preservation of biodiversity. There are six award categories set by the foundation, namely Prakarsa Lestari Kehati, Pendorong Lestari Kehati, Peduli Lestari Kehati, Cipta Lestari Kehati, Citra Lestari Kehati and Tunas Lestari Kehati. These awards are given to teenagers, either individuals or groups that have shown consistency, innovation and creativity in the filed of environment.

- International Agency. International CSO started acitivities in the last decade. NGOs such as Conservation International (CI), World Wild Fund (WWF), Wetlands International, The Nature Conservancy (TNC), WCS, Flora Fauna Indonesia

(FFI) and others work in the conservation region. In addition, Indonesia is also host for two international research agencies, namely CIFOR (Center for International Forestry Research) and ICRAF (International Center for Research in Agroforestry). CSO can also contribute to build knowledge center and communication center for biodiversity data and information to strengthen the biodiversity clearing house (BK Kehati). However, there are also activities focused on policy and efforts to increase the capacity of protection through awareness education, both at schools and for policymakers. CSO Agencies can also contribute to building the knowledge center and personalized communications system data, as well as biodiversity information to strengthen the Biodiversity Clearing House (BK Biodiversity Foundation).

According to Indrawan, et al. (2007), in Indonesia there are now no fewer than 600 non-government agencies or CSOs working in the field of conservation, 400 of which are networking as members of the Indonesia Forum for the Environment (WALHI) engaged in the field of conservation and community empowerment.

Activities undertaken by CSOs and the conservative environment, generally obtained financing, either multilateral or bilateral grants, through funding partnerships and funding in the development of conservation from developed countries such as the United States (USAID), Germany (GTZ), Japan (JICA), Canada (CIDA), the British (DfID), Australia (AusAID), the Netherlands, Sweden, Norwegian and other EU societies.

New initiatives in support of funding for conservation within the last five years have been undertaken by CSOs to facilitate debt relief for the natural conservation (debt for nature swap), so that the activities of conservation and community empowerment receive assistance that is meaningful.

6.3 BIODIVERSITY CLEARING HOUSE

The mandate to establish the Biodiversity Clearing House was set out in Law Number 5 Of 1994 on Ratification of Biological Diversity Convention, while at the national level, it was mandated under the Ministerial Regulation of Environment Number 29 Of 2009 on Guidelines for Biodiversity Conservation. However, until now, the Indonesian Biodiversity Clearing House has not been established.

Since 2002, the Ministry of Environment has developed a Biodiversity Clearing House. Some of the challenges in developing biodiversity clearing house are:

a. In carrying out its functions, a biodiversity clearing house is not equipped with a mandate and special task, thus, operationally it has not achieved its expectation.

b. Lack of human resources managers for a biodiversity clearing house, in quantity and quality, resulting in difficulties in obtaining data from the partners of Ministries/Institutions at the center so that the available data is sourced from the environment agency (BLH) at the Province and Regency / City level in the form of a biodiversity profile

In connection with that, based on the results of a review of existing institutions, interest in biodiversity management is growing. An overview of the initial thoughts on the Biodiversity Clearing House, as displayed in Figure 6.2.

A Biodiversity Clearing House is center to communicate the overall biodiversity management both for biodiversity exploration research, updating of biodiversity identification and condition, biodiversity development, cooperation on biodiversity management (research, preservation and utilization), and a place to facilitate sharing information on updating policy management of biodiversity as a whole.

All matters relating to biodiversity should be communicated through this clearing house. The Ministry of Environment and Forestry

(MOEF) is a managing institution of the clearing-house and as focal point of biodiversity communication as well.

The biodiversity clearing house has the following functions:

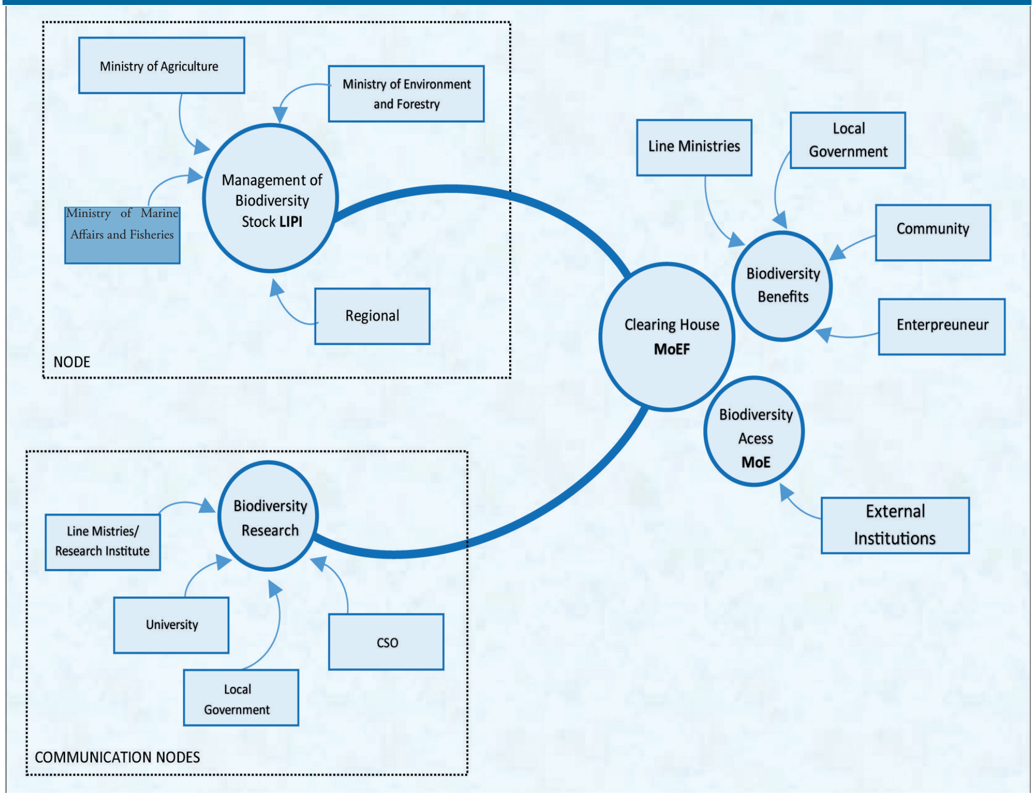
a. Reconciling between users and providers of biodiversity data and information
b. Monitoring the implementation of biodiversity convention, including IBSAP implementation.
c. Facilitating access to data and information exchange among stakeholders in the field of biodiversity at the national, regional and international level.
d. Providing assistance to familiarize and efforts to implement IBSAP with national targets
e. Serving as a reference in the formation of bridging the scientific and technical cooperation at the local, national and global level.

The substancial framework of Convention on Biological Diversity required the government of Indonesia to establish and operationalize the Biosafety Clearing House (BCH) and Access and Benefit Sharing (ABS) Clearing House. Biosafety Clearing House is one of the mandates of Law Number 21 Of 2004 and Government Regulation Number 21 Of 2005 to establish the Biosafety Clearing House with the aim to facilitate the exchange of scientific and technical information, as well as information on environmental issues, law, experience in handling of genetically modified products (PRG) and assist the parties in implementing the Cartagena Protocol.

Referring to Article 20 of the Cartagena Protocol, the biosafety clearing house was established as part of the Biodiversity Clearing House (Clearing House Mechanism/CHM). However, based on the first meeting of the Intergovernmental Committee for the Cartagena Protocol on Biosafety (ICCP) held in 2000 in Montpellier-France, it was agreed that although BK Care was part of the mechanism CHM, the clearing house must have different operational mechanisms.

In the framework of its operation, the secretariat of the biodiversity clearing house conducted a coordination meeting with components

Figure 6.2 Initial Framework of Biodiversity Clearing House



in the clearing house Care organization in carrying out its duties and functions related to each other. In addition, in carrying out its duties and functions, the Biodiversity Clearing House Secretariat is directed by a steering committee consisting of Echelon II (or equivalent) from key institutions. The secretariat of the biodiversity clearing house was also accompanied by the Technical Advisory Group (TAG) and the Technical Working Group (TWG) with members of Echelon III (or equivalent), which is representative of key institutions. The third group will be instrumental in providing advice, input and technical guidance on the implementation of the work of the biodiversity clearing house and identification of user needs.

By taking into consideration of the complexity of Biodiversity issues and there are already several focal points for various aspects of Biodiversity management, then clearing-house function is not performed entirely by MOEF itself, but "decentralized" to the institutions that have authorities in the field of biodiversity.

- **Biodiversity Management in Technical Sector**

  Ministries/Institutions such as Ministry of Agriculture, Ministry of Marine Affairs and Fisheries and the Ministry of Environment and Forestry, have the duties and functions to manage biodiversity in their respective sectors, both with regard to research, conservation, management and development of biodiversity utilization. Therefore, these ministries will continue to perform the duties and functions. One challenge is to build and nourish a biodiversity information system in accordance with current national systems, namely the NBIN (now the InaBIF). Management of biodiversity systems are linked in one integrated InaBIF, which still needs to be refined. Each relevant ministry needs to establish a mechanism of communication between the relevant institutions.

  It is important to be on agenda to adapt with the existing global biodiversity communication system.

- **Management of data and references**

  Management of data and information on biodiversity, in various forms, such as data and information for the preservation/ collection in the form of in-situ, ex-situ and in the form of references, according to the plan will be updated the InaBIF form. The LIPI as manager of the InaBIF simultaneously becomes the focal point of communication on biodiversity data. To that end, the node data and biodiversity information is collected as a sub-hub of the clearing-house. In connection with this, the LIPI will be in charge and manage the updating of data and information circumspection which are connected with the technical/sector of Ministries/ Institutions.

- **Coordination of biodiversity research**

  Implementing biodiversity research can also be done by the relevant ministries to identify the use of biodiversity. However, the research plan and greater development / advancement of research results need to be communicated among the relevant ministries to assess progress. Research results must be communicated so that there is no repetition or overlapping to ensure efficiency. In regard to research, a special communication node has been formed as part of the Biodiversity Clearing House system. In this respect, the focal point of research can be coordinated by the Research and Technology and Higher Education Ministry, which is connected to the system then a clearing house.

- **Coordination of biodiversity utilization**

Utilization of biodiversity is still an important focus in the management of biodiversity. But over time, the economic use of biodiversity has grown in importance, evidenced by the National Medium Term Development Plan 2015-2019 including a program of activities for the economic use of biodiversity developed and managed in a structured way. In line with this, the LIPI received a request "quota" for trade/utilization of wildlife. With developing bio prospecting and the economic use of biodiversity and environmental services associated with it, the arrangement of data and information system utilization of biodiversity needs to be organized and managed better. In connection with this, measures and efforts to prevent bio piracy, among others through cooperation, quarantine and other forms of protection are needed.

Cooperation among entrepreneurs in the use of biodiversity needs to be developed and regulated by emphasizing national biodiversity safety and in consideration of public welfare, especially the indigenous and local people. When rules and mechanisms have yet to be implemented, there needs to be structure so that the use of biodiversity brings prosperity to the Indonesian people.

- **World access to Indonesian biodiversity**

The world community has access to Indonesian biodiversity, either through research institutes or universities. Access has also been obtained through cooperation between local and international CSOs. With biodiversity utilization prospects and potential in the future, collaboration with foreign parties needs to be regulated. Data and information on cooperation needs to be documented and managed so that its implementation:

a. Involve domestic experts who master the knowledge of prudence.

b. In line with the utilization of research and development in the country (domestic).

c. Protects national biodiversity, with local communities maintaining ownership.

d. Anticipating the need for management of "benefit sharing" as mandated by the Nagoya Protocol.

With regard to the authority, the management of utilize access permit may be prepared centrally by the "Ministries/Institutions" or performed by each technical ministries/institutions, but using similar mechanism which is jointly arranged and transparently managed in Indonesia CHM. License issuance procedures and benefit sharing need to be finalized and reported through the clearing house mechanism. This step needs to be drafted within the framework of the "access benefit sharing", mandated by the Nagoya Protocol, and should be immediately reported to the secretariat of the CBD.

6.4 HUMAN RESOURCES FOR BIODIVERSITY MANAGEMENT

Human resources is an essential element for Indonesia to achieve a mastery of biodiversity. With a wealth and variety of biodiversity in the country, Indonesians must take ownership of it under the management of experts. In connection with that, it is necessary to carry out the following steps.

Management of Experts and Professionals of Indonesian Biodiversity. Indonesia has many experts in Ministeries/ Institutions in managing Biodiversity, such as Ministry of Agriculture, Ministry of Environment and Forestry, the Ministry of Marine Affairs and Fisheries and LIPI . Experts are essential for the maintenance, utilization and restoration of biodiversity where it has become extinct.

Experts are already involved in various measures and the development of biodiversity policies and/or associated with the survival of biodiversity. However, the experts have not been managed properly. For example, there is a need for taxonomists to support biodiversity (Box 6.1).

The following steps need to be taken:

First, record and categorize experts in Indonesia in terms of specialty, location and affiliated institution. This data collection is necessary for policy-making and to ensure prudent management. **Second**, this collection requires further analysis to determine the level of expertise required in the future. **Third**, it is necessary to establish a standardization system / certification to ensure the right experts are assisting in the management of Indonesian biodiversity. **Fourth,** the list of experts should be monitored and linked to human resource development to ensure Indonesian biodiversity remains in the country.

It is important to raise awareness on the importance of biodiversity for the sustainability of human life and the planetary supporters, as well as to increase interest in this field. Policies and measures to achieve these goals are necessary not only at the central level but also at the regional level. This step may not be new, but can be part of the Adiwiyata program, which has been developed over the years by adding content on biodiversity.

Increasing awareness among locals in areas concerned on biodiversity is also necessary. Thus, in addition to efforts to preserve local biodiversity, local educational institutions should be equipped with information to enrich curriculum; however, curriculum should not place new demands on the students. Recommended steps include carrying out activities related to biodiversity and providing concrete examples in the field.

- **Human Resources Managers of Biodiversity in Region and Communities**

  Besides the human resources in schools, it also plays an important role at local government level, because local government is the front guard to "maintain" the public awareness, both general community and private sector. In addition, the local government who became a "compulsory" driving force at the time where the awareness and attention of the general community was went down or undirected.

  The availability of documenting data of local biodiversity in local government is very necessary, followed by each local biodiversity wealth preservation, mainly ecosystem and endemic. Local Governments need to ensure that such property remains local and helps generate revenue for locals, providing benefits to the community while at the same time preserving local ecosystem and biodiversity.

  In this regard, the management of biodiversity needs to be incorporated into various aspects of regional development. Biodiversity can be a symbol of the regions and communities as well as be used for economic development, including creative economic activity, especially among young people. To that end, increasing awareness on biodiversity is necessary at the central and regional levels.

  As an example, biodiversity parks in the regions have become icons of society, while the existence of village biodiversity can be a "conservationist in-situ". Such an agenda overseen by local governments would greatly aid in the preservation of biodiversity.

6.5 FUNDING RESOURCE

The result study conducted by KemenPPN/Bappenas (2012)

Box 6.1. Taxonomy experts: Primary HR supporting Indonesian Biodiversity

From the 3 million types of biota worldwide, more than 1.7 million have been identified. However, there is a lack of expertise available to identify and describe the types of biodiversity at the international, regional and national level. Information on the various biodiversity that has been identified is difficult to obtain, owing to a lack of experts in the field of taxonomy. As a consequence, efforts to identify biodiversity up to the species level are hampered. These limitations are obstacles to the implementation of the CBD on a global scale.

During the sixth convention meeting of the Conference of the Parties (COP), it was decided that the Global Taxonomy Initiative (GTI) would immediately solve the problem surrounding the lack of data on types of flora, fauna and microbes. The decision shows the importance of taxonomy for the implementation of this convention. The following needs to be carried out in Indonesia:

- Increased taxonomic information to identify biodiversity
- Strengthening taxonomic activities, including materials, databases and taxonomists.

To support the GTI program at the national level a study was carried out in 2007 - 2009 on taxonomists in Indonesia, with a book entitled "Directory of Indonesian Taxonomist", containing information on taxonomic experts and their respective expertise, candidate taxonomists, para-taxonomy (technicians and laboratory assistants) and teaching in the field of taxonomy in Indonesia.

The book recorded approximately 52 taxonomists specializing in fauna, and six candidate taxonomists specializing in fauna. Of the 52 taxonomists, seven of them retired in the period of 2010-2014, while the six candidate fauna experts went on to study either abroad or inside the country .

Ninety-seven lecturers in the field of taxonomy fauna were recorded. There is still a low number of microbial taxonomy experts in Indonesia, with only 15 supported by 21 para-taxonomy experts on microbes and 15 prospective microbial taxonomy researchers. In the field of plant taxonomy, 69 researchers were recorded; 47 para-taxonomy and 91 teachers of plant taxonomy. The number of experts on flora taxonomy outnumbered fauna and microbe experts.

The directory's numbers have changed; therefore information on taxonomic experts in Indonesia needs to be updated. Among efforts in the 2015 GTI was to update the status of taxonomists in Indonesia.

As described above, there is imbalance between the number of taxonomists in Indonesia and the wealth of Indonesian biodiversity. Therefore, human resources need to be mapped to speed up information gathering on flora, fauna and microbes. The mapping of human resources has been carried out at the Biology Research Center, which is equipped with the ability to map Indonesian biodiversity.

The mapping of human resources, planned for 2015 – 2019, is estimated to require 112 researchers in the field of flora, 43 in fauna and 38 in microbiology. The number of researchers available, however, is subject to the internal operations of the research center, which is primarily concerned with the identification of biodiversity in Indonesia. The required number of researchers will increase when combined with data from universities on the development of experts on taxonomy. The number of MIPA Biology students in Indonesia in a single generation is limited.

Mapping and capacity building of human resources with expertise in the field of taxonomy is expected to accelerate the identification of biodiversity. Data analysis on biodiversity in Indonesia (LIPI, 2014) said that about 50 percent of gymnosperms had been identified. To resolve this takes time and must be done in light of the erosion of natural resources in Indonesia.***

showed that the financing of conservation efforts and sustainable use of biological diversity-oriented, is still too low. It can be seen from

Table 6.2 Financing needs for biodiversity management 2010-2014

PROGRAM AND LINE MINISTRIES	BUDGET YEAR (RP)					AVERAGE	TOTAL
	2010	2011	2012	2013	2014		
Development of Conservation areas and Ecosystem	24.320.000	24.806.364	25.301.818	25.555.455	25.586.364	25.114.000	125.570.000
Development of type and genetics of conservation	8.182.727	8.409.091	8.473.636	8.503.636	8.507.273	8.415.273	42.076.364
Investigation and protection of forest	14.729.091	15.023.636	15.324.545	15.477.273	15.495.455	15.210.000	76.050.000
Technical assistance Directorate General of Forest Protection and Nature Conservation	40.423.636	41.231.818	42.036.364	42.442.727	42.511.818	41.729.273	208.646.364
Development of the use of environmental services and natural tourism	8.181.818	8.345.455	8.512.727	8.597.273	8.608.182	8.449.091	42.245.455
Management and development of conservation areas and type	5.690.909	5.972.727	6.272.727	6.590.909	6.918.182	6.289.091	31.445.455
Technical assistance management of Directorate General for Marine, Coast and Small Islands	6.681.818	9.981.818	13.745.455	17.290.909	20.063.636	13.552.727	67.763.636
					TOTAL	**118.759.455**	**593.797.273**

the number of government budget allocations for the Biodiversity development and management is approximately 0.38% from the total average of state expenditures budget. This low budget may be shown from the indetification results of the funding needs, funding gap and the availability of funding sources for management of conservation area, are as follows:

- ## The needs and funding gaps

Based on the review of the government's budget and plan for 2010-2014 of Ministry of Forestry and Ministry of Marine Affairs and Fisheries, the average needs of fund for biodiversity management covers factors of the in-situ type protection, management, administration, ex-situ protection and mainstreaming. The calculation of average expenditure for biodiversity are per year is estimated at US$118,7 million (Jefferson, 2014).

Program and estimation of funding needs annualy are presented in Table 6.2. as bellows:

Table 6.3 Minimum requirements for financing Indonesian conservation 2010-2020

BUDGET ESTIMATION YEAR 2010-2020	VALUE	UNIT
Average requirement of conservation	18,62	US$ per 1 ha
Average requirement of Indonesian conservation	718.829.917	US$ per year
Average requirement of conservation staff	49	people per 100,000 ha
Average requirement of Indonesian conservation staff	18.912	people

Source: Jefferson analysis results (2014)

Jefferson calculated in 2014 the funding needs for conservation areas. Of the total conservation area of 39 million ha, the average budget obtained at this time is $5.1 / ha / year (reference 1999). In the period of 2010-2020, by including the assumption of inflation and economic growth, the budget is expected to increase to $18.6 / ha / per year to obtain the minimum required funding for conservation management of $725.4 million / year. Based on the minimal requirements with minimal increase in funding, and relying on the average inflation of 2010-2020, which amounted to 5.44 percent, while the assumption of GDP growth in 2012-2017 was 5.9 percent, and 5.1 percent for the years 2018-2030 (OECD 2012), the minimum conservation funding for the period of 2010-2020 is expected to be revised as presented in Table 6.3. as bellows:

• Gap of Funding Availability

Based on calculations of funding requirements in the table above, the lack of financing for protected area management for the period 2010-2020 is estimated to stand at approximately $ 13.5 / ha / year, with the accumulated amount of $ 521.9 million / year (Jefferson 2014). The estimation of minimum needs of conservation management in 2010-2020 is presented in Table 6.4 below

Table 6.4 Conservation fund deficiency 2010-2020

DESCRIPTION	VALUE	UNIT
Lack of conservation cost per Ha	13,52	US $ per 1 Ha
Lack of conservation cost	521.930.462	US$

Resource: Jefferson analysis results (2014)

• Availability of Funding Sources

Resources of funding related to the management of biological resources in Indonesia that came from the government, private, public and foreign grants. The following are descriptions of the sources and the approximate amount of funding that can be allocated for biodiversity management.

a. Government.

Funding from government sources can be identified from the allocation of State Revenues and Expenditures Budget or Regional Revenues and Expenditures Budget in development programs associated with the biodiversity management listed in the planning document (the government work plan / RKP; and / or National/Regional Medium-Term Development Plan (RPJMN/D). The government has allocated $452 million in the form of local public funds and grants for safe biodiversity management.

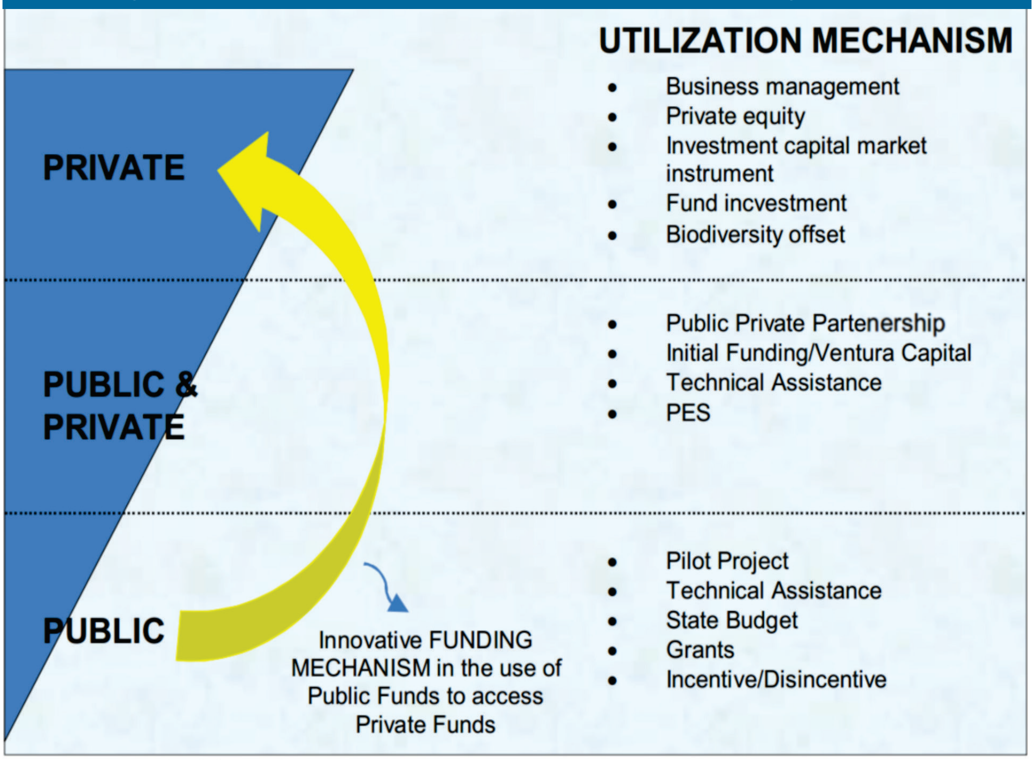
b. Private and National Communities Fund

The relative availability of private funds and the mechanism of private funding are presented in the following Figure 6.3.

Local private funds are generally obtained in the form of investments or loans. Funding through grants or funding for social development can be done through corporate social responsibility (CSR) programs.

Up until now, biodiversity funding that derives from a company or industry's CSR funds is still very limited to those involved in agriculture, livestock, food and beverage processing, cosmetic manufacturers and renewable energy. Based on the consumer price index report / CPI, in developing countries, the private sector accounted for $85 billion in investment related to climate change. In Indonesia, there is a lack of clear information on a CSR company that specializes in developing biodiversity information or data investment or local companies that invest in the management of biodiversity and the rules of the Indonesian capital market.

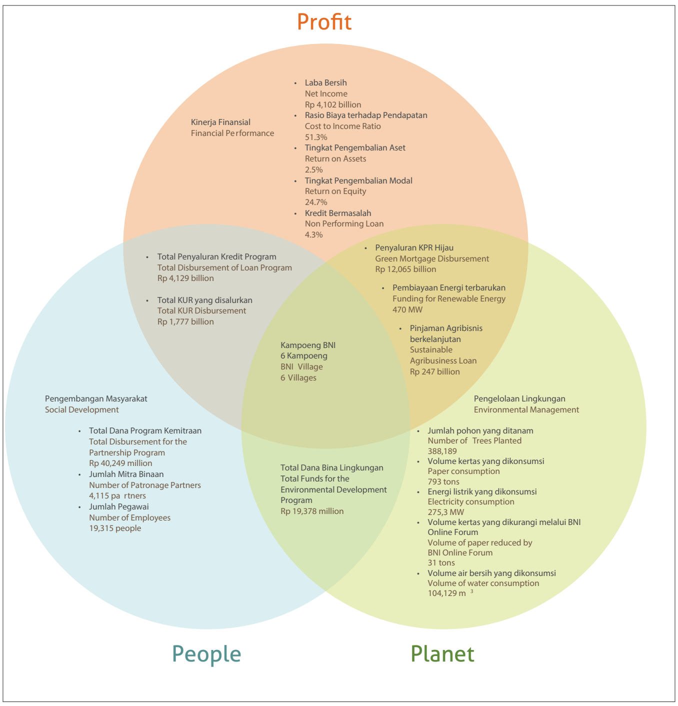
Figure 6.3 Relative amount of available funds and funding mechanisms



Sumber : Hasil analisis Jefferson 2014

Local private funds are not limited to CSR programs or investment but also include funds from independent institutions. Biodiversity Foundation activities for 2009-2013 cost $11.7 million, while overall budget per year is equal to CSR funds of $2.3 million. Based on reports, CSR funds in Indonesia totaled approximately $ 1 billion in 2012, of which 60 percent came from the private sector and the rest from state-owned enterprises. Growth of CSR in Indonesia ranges between 5 percent and 10 percent per year. BNI, a 66-year-old bank in Indonesia, currently has more than 1,600 branches across Indonesia with a total annual net profit of $580 million in 2012. As a pioneer bank dedicated to green biodiversity in Indonesia, BNI integrates business, social and environmental development. This integration resulted in many social and environmental-themed programs (see Figure 6.4).

Figure 6.4.BNI Triple Bottom Line



Source: Sustainability Report 2010., BNI, 2010.

BNI allocates each year approximately 4 percent of its net profit for CSR, including the development of social and environmental management beyond loans. BNI budgets $20 million for environmental management annually. Associated with the development of biodiversity, the environmental CSR funds, BNI activism cavity, among others: the creation of parks and urban forests in Aceh, Solo and Bali; rehabilitation of orangutans in Kalimantan; calculating and critical land conservation with the minimum planting of 1.5 million trees per year throughout Indonesia.

Another example of private sector involvement in the financing of biodiversity management is Sidomuncul. This company is among herbal companies that have long stood in Indonesia, producing popular products such as Tolak Angin herbs.

As a one of herbs based medicine industry, Sidomuncul uses natural ingredients and provides added value for the use and development of biodiversity in Indonesia. Contribution from Sidomuncul economically from product sales amounted to approximately $250 million in 2012 with a net profit of $40 million. Total sales accounted for 20 percent of the country's herbal industry sales of $1.2 billion in the same year.

Aside from economic contribution, Sidomuncul as contributes $10-15 million every year to biodiversity related activities, including the following: :

a. Research and technology development of raw material resources.

b. Development and training of 163 farms, totaling more than 6,000 farmers in particular to cultivate raw materials used by Sidomuncul.

c. Establishment of raw material factory to increase the added value; and provide health services, including cataract surgeries each year.

d. Owning and managing a 1.5-ha herb garden in Semarang with conservation status. Four hundred species of plants and 14 Sumatran tigers and orangutans are present there.

- **Private and International Community Funds**

International private funds are not usually allocated in the form of grants, but rather in the form of investments or loans. In Indonesia, many have not found use of bonds or investment fund management. According to a Climate Initiative (CPI) report, there are private funds in developed areas such as the United States, Europe, Africa and some Asian countries. For example, international private funding in Thailand has reached $143 billion, with an allocation of $68-70 billion in investment assets. At present there are few international private funds that specify funding in the form of biodiversity investment and securitization / capital market instruments related to biodiversity, as presented in Table 6.5

International resources are usually in the form of foreign grants. Foreign grants globally come from bilateral and multilateral funding. For bilateral funds, some developed countries have made contributions in the form of grants to assist in the management of biological diversity (Table 6.6).

Based on an Organisation for Economic Cooperation and Development (OECD) report (2013), Indonesia received in the sreng period of 2010-2011, $126 million for conservation areas (2% of the total bilateral funds amounting to $63 billion) lower than India 10 percent, China 7 percent, and Brazil 5 percent.

For multilateral funding sources, international public funds that played a role in financing biodiversity management for the Indonesian government, among others, are summarized in Table 6.7.

- ***Innovative Financing***

With limited roles and government funds, preserving and

Tabel 6.5 Private and international biodiversity funds

Institution	Function of Fund	Mode of Funding	Target of Funding
Asian Conservation Company	Forming a bridge of cooperation between private sector investment and the conservation of biodiversity in Asia.	Establishment of private equity investment portfolio of conservation advantage. Asian Conservation Foundation manages conservation areas included in the investment portfolio.	• Ecotourism • Sustainable fisheries • Transportation company serves ecotourism.
Verde Ventures	Provide funding to small medium and enterprises (SMEs) around the area of conservation and ecotourism operations.	Provide funding in the form of loan and equity financing (equity financing) for the conservation area.	• SMEs • Ecotourism
EcoEnterprise Fund	Support entrepreneurship ecosystem based in Latin America	Provide funding in the form of loans and equity investments (equity investment)	$ 38 million in the form of specialty ecotourism, non-timber SME, sustainable agriculture
Lignum Investment Fund	Support SMEs in the forestry area for increased revenue.	Funding in the form of private equity fund. Fund use forestry based securitization to obtain funding from capital markets. Revenue from plantation crops serves as dividend.	$40 million for sustainable plantations around conservation area.
Canopy Capital	Provide a guarantee of payment for five years with the marketing of their products / services forest conservation.	Forest-backed bond	• Product/service • Ecosystem • Forestry

Source: WWF, 2009

maintaining biodiversity for current and future benefits requires innovative steps for the development of biodiversity fund management. At the international level, at least two types of financing (loans) have been formed, namely Finance Alliance for Sustainable Trade (FAST) and Root Capital.

FAST is an institution established for serving as an intermediary or bridge between a creditor and producer. FAST also provides assistance by setting up instruments to mitigate risks.

Since 2008, FAST has welcomed 120 institutions as members, including in the financial sector, agricultural sector and others.

Table 6.6 Contributions of developed countries in the management and development of biodiversity globally

BILATERAL CONTRIBUTION (COMMITMENT USD)			
Country	**Year 2010**	**Year 2011**	**%**
Australia	501.5	392.7	6.46
Austria	17.6	18.3	0.30
Belgium	191.4	170.4	2.81
Canada	53.2	103.5	1.70
Czech		0.4	0.01
Denmark	266.7	163.5	2.69
EU	719.9	540	8.89
Finland	128.7	193.8	3.19
France	478.4	328.3	5.40
Germany	618	1220.4	20.09
Greece	4.7	0	0.00
Ireland	43.4	17.5	0.29
Italy	9.3	89.1	1.47
Japan	1167.3	1476.4	24.31
Korea	4.3	15.3	0.25
Luxembourg	3.7	0.01	0.00
Netherlands	105.4	116	1.91
New Zealand	12.8	14.7	0.24
Norway	669.5	337.3	5.55
Portugal	4.5	4.6	0.08
Spain	312.3	98.2	1.62
Sweden	222.4	200.6	3.30
Switzerland	64.6	133.7	2.20
UK	637.3	147.6	2.43
US	260.4	292	4.81
TOTAL	**6,497.3**	**6,074.31**	**100.00**

Source: OECD, 2013

Among FAST activities in Indonesia include the purchasing of cinnamon from farmers in the area of Kerinci Seblat at a premium price with the requirements that local farmers in the region conduct conservation and employ sustainable harvesting

Table 6.7 Fund of International Institution to Support Indonesian Biodiversity

INSTITUTION	DESCRIPTION
Global Environment Facility (GEF).	Since 1991, GEF has provided financing of $ 2.2 billion for 2,400 conservation areas amounting to 634 million-ha, with the support of $ 7.35 billion in co-financing. Per year in total GEF has provided grants of $ 200 million.
World Bank (WB).	As of 2012 the World Bank had financed $275 million per year - $ 60 million from GEF, $100 million in funding was sourced from the World Bank, while $115 million from co-financing.
United Nation Development Program (UNDP).	From 2003-2012, UNDP GEF managed funds for the management of 700 protected areas with funding of $456 million and $ 1.4 billion from co-financing.
United Nation Environmental Program (UNEP).	Since 2006, theUNDP has provided $135 million for conservation areas.
CBD Lifeweb Initiative (CBD LI).	Established in 2008 and at the time carried on COP 9. This program was established to assist the establishment of new funding for conservation areas based on NBSAP and used to support the Aichi targets. Since 2008, CBD LI has supported 62 activities by employing the counterpart funding budget / matching fund for conservation areas with $200 million.

Sumber: OECD, 2013

methods.

Root Capital this institution provides loans to small farmers and associations relevant to coffee plantations and tourism in developing countries. Industries that obtain financing from Root Capital generally do not obtain financing from banks.

Root Capital serves as a cooperation link between the biodiversity management sector and many large companies such as Marks & Spencer, Starbucks and others. Until now Root Capital has provided 500 loans to 340,000 farmers, amounting more than $100 million.

Table 6.8 Mechanism options for financing from other countries

FUNDING MECHANISM	FUNCTION	FORM AND AMOUNT OF FUNDING	FUND SOURCE
Watershed			
Payment for watershed protection, Costa Rica	Payment for land users adopting biodiversity management and certification	Government contracts and farmer for 20 years. Amount: • Deforestation $ 816 per ha; and • Forestry protection $320 per ha	• Gasoline tax • International donation
Payment from Hydropower, Philippines	Watershed payment for the use of hydropower	35% for village development 25% per Kwh of total sales	1% from the sale of hydropower electricity
Recreation cost			
Gorilla Visit Fee, Rwanda	Payment for gorilla maintenance	100% for area management	Fee of $500 non-national, $36 national
Dive Fees, Mabini & Tingloy	Payment for conservation management	100% for area management	$ 2 per day
Green Safari			
Photo Safaris Polar Bear, Manitoba	Payment for polar bear conservation Education and media on polar bear	Managed by private, Polar Bear International $40,000 per year	$15,000 for research per year USD 2,000 per year
Tourism in conservation area			
Conservation concession fees, New Zealand	Payment for conservation area management	3,500 conservation concessions rented to private sector managed for restaurant, shop, tour, lodging, plantation & movie business	Revenue sharing 3-7.5%
Namibrand Nature Reserve, Namibia	Payment for conservation area management	• Conservation area of 172,200 ha managed by private sector • $2 million in 2007. 12% net profit	Profit sharing.
Hotel and Transportation Tax			
Airport and cruise taxes Belize	Used for conservation management	Tax revenues incorporated into conservation trust fund of $600,000 per year	• Airport tax $ 3.75 • 20% commission from the cruise ticket sales
Hotel tax, Caicos, Karibia	Used for conservation management	Tax revenues incorporated into conservation trust fund $300,000 per year	1-9% hotel tax

FUNDING MECHANISM	FUNCTION	FORM AND AMOUNT OF FUNDING	FUND SOURCE
Mandatory Compensation			
Hydroelectric revenue, Costa Rica	Used for conservation management	Revenue contract for 99 years	20% from electricity sale
Environmental Tax, Brazil	Management and development conservation area	$200 million in the type of compensation	0.5% of total project cost
Biodiversity Offset			
Biodiversity Offset, Australia	Offset of land use near conservation areas	$43 million within 30 years	Gorgon (Shell, Chevron, Exxon)
Biodiversity Offset, Madagascar	Offset mining that removes part of the coast	Build 31,000 ha new conservation area	
Malua Biobank, Malaysia	34,000 ha of orangutan conservation in Malua	$10 million for 6 years Giving conservation rights to private sector, Malua Biobank sells certificates to the capital market and the proceeds put into Malua Trust $10 million for 6 years	Sabah government Ecoproducts Fund

Sumber: analysis result, jefferson (2014)

Some developing countries such as Costa Rica, the Philippines and Belize have already developed a mechanism of funding. Forms of funding mechanisms are developed in accordance with the function or purpose management. Examples of this funding mechanism are presented in Table 6.8. as bellows:

• Management Support, International Cooperation and Strategy of Funding Mobilization

Biodiversity management funding requires enhancement in line with efforts to update the IBSAP 2015-2020 and to create clear and measurable policies, as well as to provide ease in the implementation of action plans.

Funding measures for biodiversity management can be carried out as follows:

First, funding and mobilization of funds should be guided by the IBSAP and action plan that has been mutually agreed upon. This step is important to align policy, cooperation and financing biodiversity management to achieve specific purposes/goals.

The use of the document as guidance also provides a space for each of the parties to freely and flexibly manage biodiversity in accordance with the agreed policies and maintaining transparency and accountability and prudent management principles that have been agreed upon nationally and internationally.

Second, the government needs to develop a mechanism, standard criteria and indicators of cooperation and financing activities that are suitable to achieve the objectives of national biodiversity management. Some types of financing that can be adopted by Indonesia include:

a. Incentives from the manufacturer to the conservation of drinking water as a form of PES.

b. Impose biodiversity offset to oil and gas or mining companies to open new conservation areas.

c. Impose a public-private partnership for conservation areas, in particular for the management of natural tourism.

d. Impose a tax related to the tobacco industry or the extractive industries to develop protected areas.

e. Impose tax incentives for renewable energy (mini hydro) companies that perform activities in a sustainable manner

Third, the government needs to establish institutions of biodiversity financing to serve as "hub" to facilitate the contributions and participation in the management of biodiversity in Indonesia. One mechanism is the establishment of for a trust fund institution/agency the development and management of protected areas. This step has been challenged in the past owing to a lack of legal basis for a trust fund institution.

However, with the issuance of Government Regulation Number 10 of 2011 on Procedures for Procurement of Foreign Loans and Grants, as well as Presidential Decree Number 80 of 2011 on Trust Fund. The establishment of trustees will provide space for the management and mobilization of funds, as well as improved cooperation in accordance with the dynamics of biodiversity management.

6.6 CHALLENGES

• Biodiversity Regulations

In general, implemented regulations related to biodiversity have been proportional, but many have been initiated owing to "necessity" derived from international agreements, so many regulations are not equipped with sufficient instruments and resources to be able to "position biodiversity in the mastery of Indonesia".

a. There is a need for rules derived from prevailing regulations on biodiversity. Derivative regulations need to be formulated in the context of present prudential management and in accordance with the challenges of today and the future. Some derivative regulations still use the adjustment pattern sectors that are tangible, short-term and tangible results / concrete in the short term.

b. Instruments should be in place to measure the benefits felt by the people and decisionmakers following regulation implementation. This is necessary because biodiversity awareness is still low. During this time, the preservation of biodiversity is still a cost center rather than investment.

c. Regulations need to promote the availability of space to maintain the ecosystem and deem it as or even more important than the use of the space for the short term and long term.

   An ecosystem is of no value if it is destroyed, with the effects potentially putting people and the planet in danger. Measurement of the importance of biodiversity and its relationship with the regulations to support the conservation of biodiversity is vital. To that end, there needs to be efforts to increase understanding among policymakers with regard to biodiversity.

• Institution and Clearing House

Awareness among various institutions remains low and serious biodiversity management lacks consistency and has not been deemed a priority in short-and medium-term development targets.

Awareness of the importance of respecting expertise in biodiversity is still low and there is a need to build adequate human resources for the "mastery" of biodiversity by the people of Indonesia

The following are challenges in the development of a clearing house:

a. The need to strengthen the capacity of relevant ministries to perform their roles in the management of biodiversity, with clear SOP and performance indicators.

b. Each institution should document the process and outcome/output of biodiversity management and the benefits/outcomes in the medium term for biodiversity management. The management must be carried outtransparently and should be aligned with other ministry subsystems and integrated/connected with the clearing system on Biodiversity Clearing House.

c. The coordinator in the clearing system needs to be consistent and continually perform its function as a focal point in the international system to realize and assert control over Indonesian biodiversity and strengthen its national biodiversity ownership.

d. The clearing house needs to be strengthened and equipped with a system that can serve as a corridor and provide clearing mechanisms for all parties, especially for relevant ministries in Indonesia. The biodiversity clearing-house mechanism, which has been established, needs to provide access to foreign and domestic stakeholders.

Indonesia's ownership and control over its biodiversity is a priority, but at the same time access to the international community remains available in line with global agreements.

- ## Human Resources

Awareness of the importance of respecting biodiversity expertise is still low, while there is a need to build adequate human resources for the "mastery" of biodiversity by Indonesian people.

a. A system to measure local expertise should be established nationally to erase the perception that foreign experts are superior to Indonesian experts.

b. Mastery of biodiversity in various aspects, understanding, management and utilization must be carried out thoroughly, although it will take time to convince various relevant parties.

International funds are being mobilized before domestic funds

- ## Cooperation of Biodiversity Management, Funding and Mobilization

Cooperation in the management of biodiversity lacks focus on the interests of ownership and control by Indonesia. Therefore, many areas of concern still depend on international cooperation and support.

As a result international funds are being mobilized before domestic funds. :

a. Require policy-making management of biodiversity that is in line with prevailing requirements and promotes long-term preservation.

b. National biodiversity management policies should become the reference and the basis of biodiversity conservation cooperation and utilization with foreign and domestic stakeholders. Thus, biodiversity should be managed with consideration of the welfare of the people of Indonesia and with the goal of bringing benefits to generations to come and the world community in the future.

Funding and mobilization is still "conservative" and in line with the funding patterns of other development sectors, with a lack of exploration of various funding models, though this is also connected with the existence of a dichotomy/separation of biodiversity management with development and other life aspects.

a. Funding the field of biodiversity needs to be associated with patterns of funding in other areas of development, due to the use of space.

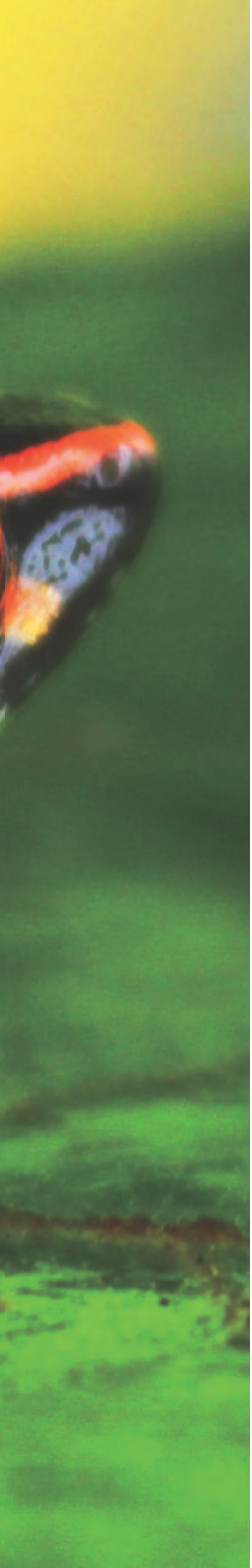
b. Biodiversity funding patterns must be creative with the support of institutions and mechanisms that can give attention to the utilization of biodiversity by future generations. ***

Maros – Pangkep Karsts Area, Sulawesi

The Maros-Pangkep karsts area is the 'barn' of water for the irrigated rice fields in this area. This area is also the main source of PDAM (Regional Water Company) in providing clean water. Even the cement factory also 'expects' water from the karsts area during the dry season. Water and carbon absorption is the main environmental service with the largest contribution.

Courtesy photograph: Pindt Setiawan, ITB. 2015

Frog (Hylarana signata). Photo : Fahrul Amama, Burung Indonesia



7

Policy, Strategy and Action Plan on Biodiversity Management

Management of Indonesian biodiversity requires appropriate policy supported by its framework which in line with biodiversity preservation practices and provide huge benefit to people's welfare. Of all efforts in biodiversity research being continuously conducted, it is known that many biodiversity resources have been identified, documented and preserved (see Chapter III) but still believed many have not yet been identified.

In terms of benefits, our biodiversity has long been known about and developed to meet the need for food, drugs and other health products as well as other types of materials. At the same time, our level of biodiversity has worsened due to environmental degradation, a growing need for accommodation due to population growth and people's socio-economic activities.

7.1 FORMULATION PROCESS OF POLICY DIRECTIONS

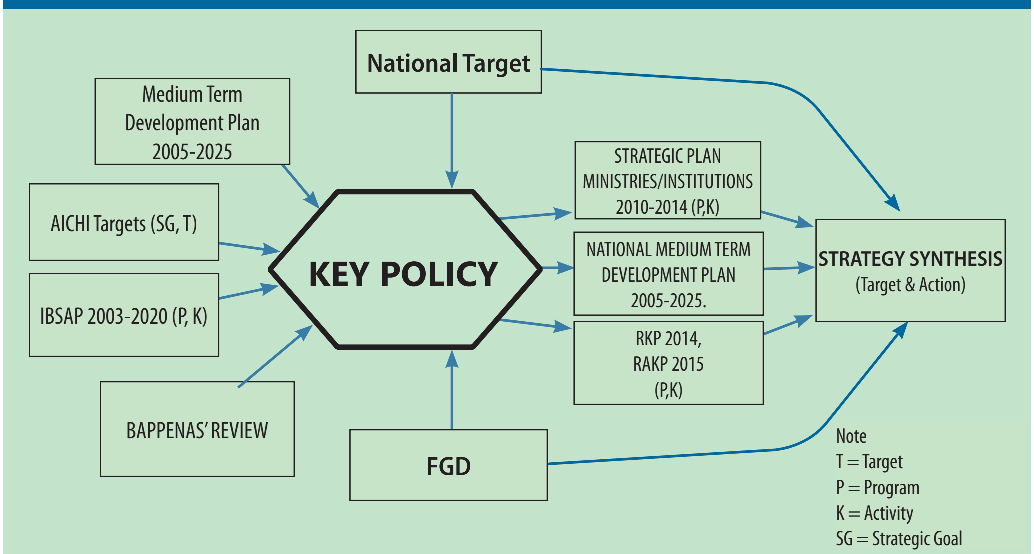
The above mentioned conditions suggest the need for improvement of current policy, specifically in its implementation, and development of new policy in accordance with biodiversity principles and dynamics, either in country or outside the country.

Policy improvement and biodiversity management are necessary because of new challenges related to the continued existence of biodiversity and the sustainability of biodiversity utilization (based on challenges and threats to existing biodiversity).

Biodiversity policy development is made based on the following references:

1. Development Plan Documents: National Long Term Development Plan 2005-2025, National Medium Term Development Plan 2010-2014, Strategic Plan and work Plan related M/I (Ministry of Environment and Forestry, Ministry of Agriculture, Ministry of Marine Affairs and Fisheries, Indonesian Institute of Sciences), Aichi Targets and IBSAP 2003-2020. In addition, the policy directions are also adapted to the preparation of National Medium Term Development Plan and Strategic Plan

Figure 7.1 The Formulation Process of Policy Directions, Strategies and Action Plans of the updated IBSAP 2015-20200



of Ministeries/ Institutions in 2015-2019.

2. Other processes treated as inputs are the various results of reviews conducted by the National Development Planning Ministry on biodiversity management, the national target development process, focused group discussions and a series of meetings on updating IBSAP 2015-2020 (Figure 7.1). Results of this policy development process will form the basis for the development of strategy, targets and action plans on an updated IBSAP 2015-2020.

7.2 VISION AND MISSION OF BIODIVERSITY MANAGEMENT

Indonesia as an independent country needs to play an active role in any dynamic initiatives and efforts to create a prosperous world. Therefore, as a nation, Indonesia is actively involved in regional and global efforts through bilateral or multilateral forums aimed at achieving its national goals, and with the application of free and active political values toward the realization of a new world with freedom, peace and social justice as its foundation.

These activities have been conducted to improve international cooperation, therefore, the ratification of the Biodiversity Convention into Law Number 5 Of 1994 has been a way for Indonesia to preserve its biodiversity, using every element of biodiversity sustainably and improving international cooperation in science and technology for the sake of current and future generations.

Given the importance of the above activities, a strategy and action plan is required, which should be in line with the National Medium-Term Development Plan 2015-2020 for implementation of IBSAP 2015-2020.

Strategic plan development requires a vision and mission in accordance with a set of goals. Commitment to biodiversity management on the national level needs to be improved through the following biodiversity management vision 2015-2020:

"Indonesian biodiversity preservation and development that contributes to national competitiveness and a fair and sustainable use of resources to improve the welfare of current and future generations"

This vision is supported by the ability to manage biodiversity well and use it as source of sustainable welfare and livelihoods for the people of the country. Biodiversity preservation is carried out through improvement in knowledge, technology and its overall and integrated use. To achieve this goal, human resource capacity building is required to support research and maintenance of data and information as well as sustainable utilization of biodiversity.

In addition, it requires regulations and appropriate management agencies as well as adequate funding. Good biodiversity management will improve its development, either in terms of knowledge or technology, human resources and their sustainable utilization. This will contribute to biodiversity competitiveness and its utilization for the prosperity of the nation for current and future generations.

In carrying out the missions, it requires appropriate organizations and mobilization of resources supporting implementation of missions and policies in order to achive the intended condition

Policy Framework. Efforts to reach intended future conditions as described in the vision must be equipped with missions that describe policies and stategies for the implementation of activities.

Appropriate organizations and mobilization of resources is required to support the implementation of missions and policies in order to achieve the intended future conditions. Three missions were formulated to support the realization of the vision and achieve the biodiversity management goals for the 2015-2010 period.

1. **To improve Indonesia's biodiversity ownership**.

   This mission seeks to place biodiversity as a part of Indonesia's national identity and something that belongs to Indonesia. Therefore, biodiversity should be owned and managed by Indonesia for the prosperity of its people.

2. **To treat biodiversity as source of sustainable welfare and livelihood for Indonesians**.

   This mission aims to improve the real utilization of biodiversity and its economic value and function as a source of people's welfare. This can be achieved through the scaling up of ecosystem function to ensure important services are also improved (water, health, livelihood, tourism). Ecosystem preservation and recovery in areas experiencing degradation, and implementation of access to and benefit sharing of genetic resources.

3. **Fully responsible biodiversity management for the sustainability of all creatures in the world**.

   This mission aims to provide a balanced understanding between the first and second missions. Although biodiversity is owned and managed by Indonesians, it still belongs to and is part of the world and is simply used by current and future generations. Therefore, biodiversity should also be managed in consideration with sustainability, with full responsibility and open access to the international community as part of international interaction so that the entire world community can benefit from it.

7.3 POLICY AND STRATEGY ON SUSTAINABLE BIODIVERSITY MANAGEMENT

Policy framework is illustrated in Figure 7.2:

The biggest problem in Indonesia is over-exploitation of natural resources, which threatens production sustainability in the future. This exploitation has threatened ecosystems, reduced natural resources' supportive values and eliminated biodiversity. Rapid population growth has put more pressure on biodiverse ecosystems. In order to fulfill people's needs, land conversion is inevitable, although this causes environmental degradation, natural disasters and climate change. All of these factors threaten Indonesia's biodiversity.

Figure 7.2 Sustainable Biodiversity Management Policy Framework

VISION		
"Indonesian biodiversity preservation and development that contributes to national competitiveness and a fair and sustainable use of resources to improve the welfare of current and future generations"		
MISSION 1 To improve ownership and utilization of Indonesian Biodiversity	**MISSION 2** To use biodiversity as a source of improving welfare and sustainability of life for the Indonesian people	**MISSION 3** To manage biodiversity with full of responsibility for the sustainability of life of the world
Human Resources	Data and information system	Appropriate institution and regulation
Funding: public, private and community		

Updated biodiversity data provided by LIPI (2014), generally indicates that many species in biodiverse ecosystems have become extinct or are endangered and a lot of biodiversity data still needs to be collected and explored further. Biodiversity in all types of ecosystems has not yet been sufficiently identified and much of it remains unknown. We are now in a race with time to discover our biodiversity and prevent it from being lost. In order to improve biodiversity management and conservation and sustainable use of biodiverse ecosystems that produces optimal benefit for the welfare and prosperity of Indonesian people, development of policy, strategy and an action plan, as well as setting up the national target of IBSAP 2015-2020 are important, as mandated by Law Number 5 Of 1994 on Ratification of Biodiversity Convention, the Law on the ratification of the Cartagena Protocol and Law on the ratification of the Nagoya Protocol. All of those document policies are drawn up based on the vision and mission of national biodiversity management.

To implement the mission, the policies for biodiversity management are as follows:

1. **To conduct research on biodiversity, data management and documentation of biodiversity as well as management of its**

ownership (patent/intellectual property rights) in support of Indonesia's needs. Among others, these strategies include:

a. Consistent, continuous and integrated biodiversity research to strengthen indentification of, stock (basic research) and extraction of benefit from biodiversity (applied research/ benefit use/benefit development) for Indonesia.

   In relation to this, biodiversity research requires a structured plan in accordance with Indonesian ownership of its biodiversity resources. Research on our biodiversity stock and its current condition needs to be properly documented, so that information on knowledge improvement, data and documentation is transparent and can form the basis for recognition and ownership of national biodiversity.

   Coordination is important among basic research, development research and applied research to support the application and development of putting an economic value on biodiversity for the prosperity of people.

b. Biodiversity data management and documentation follows global standards by showing the identity of a country, area and Indonesian people.

   All research must be saved in a certain data and reporting system for communication purposes about current biodiversity condition. Data and documentation on biodiversity require an appropriate, transparent and accountable management system that is in line with the global system. The documentation system is a basis to fulfill the registration requirements of international organization, therefore, recognition of Indonesian rights, including the local wisdom of Indonesian people, can be documented well globally.

   Data and documentation management is important to monitor ownership of biodiversity, to distinguish biodiversity already identified, domestication and cultured so that development is continuous and hopefully contributes to the prosperity of the community and country. Biodiversity resources are part of the national and local identity and should be appropriately promoted and communicated to others so that they will always belong to the people.

c. Efficient management of a patent/intellectual property rights system and establishment of a partnership model (research or other forms of cooperation) serving the country's needs.

   An inventory system is required to record current biodiversity and utilization patterns in Indonesia. All data and information available needs support from a good system and a recognition mechanism at the national or international level so that all data is recorded and documented. To support this effort, a national patent/intellectual property rights system needs to be established for the sake of the people of Indonesia. In addition, this body needs support from good partnerships in basic and development research, and benefit sharing for both national and local entities.

2. **Management of biodiversity to secure its existence for Indonesia and support the development of optimal benefit for the country.**

   The strategies are:

   a. Appropriate management of in-situ and ex-situ biodiversity to preserve current and future existence. In-situ management is conducted based on basic research and valid information so that biodiversity can be used as Indonesia's national identity. Existence of biodiversity (ecosystem and species) needs to be balanced with its benefit review for in-situ conservation and its economic value, especially for people living close to conservation areas.

   b. Management of biodiversity in all aspects of social life to secure the existence of biodiversity in the daily lives of the Indonesian people.

      Knowledge about biodiversity needs to be realized by maintaining biodiversity in daily activities such as:

      - Replanting trees and maintaining open space using local biodiversity (ex-situ);

- Promoting biodiversity as a national and local symbol when carrying out any relevant activities;
- Building biodiversity parks or similar (ex-situ) to reflect the original state of specific biodiverse ecosystems in areas and also as a source of the sustainable utilization of biodiversity.

c. Capacity development for researchers and other personnel who maintain and develop the benefit value of Indonesian biodiversity.

In accordance with biodiversity resources owned by Indonesia, the following activities should be conducted:

- The creation of a human resource capacity development plan based on our biodiversity;
- The creation of a human resources capacity development concept in line with sustainable biodiversity management;
- Development of professions related to biodiversity, that meet the global system so their expertise in biodiversity is relevant to biodiversity that we have; and
- Mainstreaming biodiversity in national and local educational systems.

3. Development of sustainable utilization of biodiversity.

The strategies are:

a. Improvement of efforts in biodiversity domestication and culture to increase benefits for the Indonesian people and other communities.

Sustainable biodiversity should be realized only as a collection of resources with potential benefits but also as something that brings real benefit for people's welfare and national economic growth. Therefore, the following steps are required:

- Conducting research that raised the status of biodiversity from asset/identified to bioresources that can be cultured and domesticated;

- Conducting research with a development purpose (cooperation with community, mainly with the private sector) to improve the real contribution to people's welfare and supported with mutual benefit sharing.

b. Drawing up regulations to support biodiversity benefit sharing and protect local wisdom. The following steps are required:

- A review of regulations to improve biodiversity management that balances the values of biodiversity conservation and resource utilization;
- Development of regulations that give room for the improvement of national utilization of resources and protect local wisdom following the global standard;
- Development of regulations that support economic value utilization of biodiversity, at the industry level or local level for the strengthening of national biodiversity ownership that still follows the global standard.

In order to make biodiversity a source of welfare and sustainable livelihoods for Indonesians, the following policies should be implemented:

1. Improvement of the economic value of biodiversity to support economic growth, national competitiveness and the welfare of people. The strategies are.

The strategies are:

a. Support from central and local governments for national biodiversity mainstreaming toward economic value utilization and the raising of people's welfare.

b. Human resources and science and technology improvements that support utilization of biodiversity as a source of people's welfare.

c. Development of regulations and organizations supporting utilization of biodiversity for people's welfare.

d. Development of a cooperation model between government and the community, especially the private sector, to increase people's welfare.

2. **Increase utilization of biodiversity in the daily life and activities of communities.** The strategies are:
   a. Support for biodiversity industries that are considerate of biodiversity conservation:
      - Development of an industry with sustainable biodiversity parks as its basis;
      - Development of a pattern for a sustainable biodiversity industry;
      - Development of an incentives/disincentives system in line with sustainable utilization of biodiversity.
   b. Support of a trading system on biodiversity benefits and use for Indonesia:
      - Development of a standard on the sustainable trading of biodiversity products;
      - Appropriate trading diplomacy (to ensure balance between benefits derived from and conservation of biodiversity).
   c. A monitoring system for the biodiversity industry and sustainable trading on biodiversity:
      - Setting the indicators;
      - Development of a transparent and accountable monitoring and supervision system;
      - Human resources for monitoring/supervision work in an adequate number as well as their capacity development..
3. **Protection of biodiversity resources and their ecosystems from any disturbance that may put Indonesian biodiversity and ecosystems in danger.** The strategies are:
   a. Development of policy that protects biodiversity utilization by relying on local wisdom, including recent data and supportive information and policy analysis of biodiversity protection;

b. Development of a biodiversity protection system to act as a buffer against "invasive" disturbances (data/information, procedure, protection instruments, organization and human resources).

To be able to manage biodiversity well to ensure the long life of the world, the following policies are implemented

1. **Quality management of biodiversity related organizations according to global standards.** The strategies are:
   a. Development of organizations dealing with biodiversity management that put Indonesian biodiversity as a top priority by following the global standard;
   b. Development of professions related to biodiversity in line with Indonesian biodiversity resources. .
2. **Development of a cooperation system for participatory and inclusive biodiversity management.** The strategies are:
   a. Mainstreaming biodiversity management through national and local development plan documents as well as a strategic plan among ministries/institutions with direct responsibility for its implementation;
   b. Development of cooperation with non governmental and community organizations in biodiversity management;
   c. Establishment of appropriate and sustainable communication.
   d. Monitoring and management of biodiversity to secure responsible biodiversity management.
3. **Application of mutual cooperation system by considering the existential security and identity of Indonesian biodiversity and the utilization of all resources for the sake of the Indonesian people**. The strategies are:
   a. Development of a cooperation model between government and private national parties; and between government and international parties; between private national parties and international parties in line with sustainable management principles;

b. Facilities to implement the cooperation, including its reporting, monitoring and supervision system.

7.4 THE NATIONAL TARGET OF BIODIVERSITY MANAGEMENT

The national target of biodiversity management for the period of 2015-2020 is prepared following the framework of Aichi Targets (AT) adjusted to national conditions and requirements. The national targets of biodiversity management in 2015-2020 are:

1. Awareness and participation of various parties established through formal and informal educational programs (to support AT-1);
2. Implementation of sustainable management of biodiversity resources in the planning and implementation of national and regional development to improve community economies (AT-2);
3. Realization of an incentives and disincentives system in business and the sustainable management of biodiversity (AT-3);
4. Establishment of increased availability and implementation of policies supporting sustainable production and consumption (SCP) in the utilization of bioiversity resources (AT-4);
5. Development of ex-situ conservation areas to protect local ecosystems (AT-5);
6. Implementation of a policy for sustainable management and harvesting (AT-6);
7. Realization of improved land for sustainably managed agriculture, plantations and animal husbandry (AT-7);
8. Reduction of pollution that damages biodiverse ecosystems (AT-8);
9. Implementation of prevention and eradication programs for invasive alien species (JAI) (AT-9);

10. Reduced level of anthropogenic pressure on coral reefs and other vulnerable ecosystems affected by climate change (AT-10);
11. Realization of sustainable maintenance and improvement of conservation areas (AT-11);
12. Realization of efforts to maintain the populations of endangered species as a national conservation priority (AT-12);
13. Implementation of system development in nurseries, genetic breeding and domestication of wildlife as well as the breeding of wild animals (AT-13);
14. Improved functionality of integrated ecosystems to ensure the improvement of essential services (water, health, livelihoods, tourism (AT-14);
15. Realization of conservation and restoration of degraded ecosystems in the region (AT-15);
16. Implementation of the Nagoya Protocol and its derivative instruments through legislation and the formation of implementation organizations at the central and local levels (AT-16);
17. Implementation of the new IBSAP at various levels (AT-17);
18. Development of local wisdom and innovations as well as bioprospecting capacity building for the conservation and sustainable utilization of biodiversity (AT-18);
19. Implementation of science and technology capacity building for the sustainable management of biodiversity (AT- 19);
20. Identification of resources and budget effectiveness in the implementation of sustainable management of biodiversity (AT-20);
21. Implementation of comprehensive and integrated data gathering and information mapping on biodiversity;
22. Implementation of various conflict settlement processes related to biodiversity.

7.5 BIODIVERSITY MANAGEMENT ACTION PLAN

The action plan aims to achieve the aforementioned vision, mission and target of biodiversity management. The action plan consists of four groups to support the mission and policies of biodiversity management in terms of research, conservation and utilization, as well as capacity building in biodiversity management for the 2015-2020 period.

1. Action plan for research, data management and documentation of biodiversity as well as management of ownership that promotes the interests of the nation and state of Indonesia (see table 7.1).

Table 7.1 Action plan on research, data management and documentation of biodiversity

NO.	ACTIVITIES	INDICATORS	INSTITUTIONS	PERIOD	BUDGET INDICATION	TARGETS
1	Improvement of biodiversity documentation	Human resources and science and technology improvements that support utilization of biodiversity as a source of people's welfare.	LIPI	2015-2020	APBN	TN-21
2	Improvement of biodiversity identification	Number of biodiversity identified	LIPI	2015-2020	APBN	TN-21
3	Improvement of biodiversity data and information compilation	Development of regulations and organizations supporting utilization of biodiversity for people's welfare.	LIPI, Ministry of Environment and Forestry	2015-2020	APBN	TN-21
4	Biodiversity data maintenance	a. Number of biodiversity database b. Biodiversity mapping selected	LIPI, Ministry of Environment and Forestry	2015-2020	APBN	TN-21
5	Development of a cooperation model between government and the community, especially the private sector, to increase people's welfare	Number of biodiversity newly identified	LIPI	2015-2020	APBN	TN-21

NO.	ACTIVITIES	INDICATORS	INSTITUTIONS	PERIOD	BUDGET INDICATION	TARGETS
6	Research, Ownership and Usage of Biodiversity resources and Science and Technology Program of	a. Number of research on biodiversity resources b. Number of users on methodology/ technology developed by Ministries/ Institutions	LIPI, MORT, Agency for the Assessment and Application of Technology (AAAT), MOI, MOEF, MOMAF, MOA	2015-2020	APBN	TN-19, TN-21
7	Improvement on basic research of biodiversity	a. Number of basic research b. Number of publications on basic research	LIPI, AAAT, MORT	2015-2020	APBN	TN-21
8	Improvement on applied research on biodiversity	Number of publications of basic reseach on biodiversity	LIPI, AAAT, MORT	2015-2020	APBN	TN-21
9	Development of strategy to use results of biodiversity research	a. Number of users of methodology/ technology developed by Ministries/ Institutions b. Number of science and technology used	LIPI, AAAT, MORT	2015-2020	APBN	TN-21
10	Improvement on patents of biodiversity research	Number of patents registered	LIPI, AAAT, MORT	2015-2020	APBN	TN-21

Note: AT = Aichi Target; TN = Target Nasional (National Target)

Table 7.2 Biodiversity Utilization Action Plan

NO.	ACTIVITIES	INDICATORS	INSTITUTIONS	PERIOD	BUDGET INDICATION	TARGETS
1	Human resources and science and technology improvements that support utilization of biodiversity as a source of people's welfare.	Number of biodiversity resources based commodity with sustainable standard/ criteria	Ministry of Environment and Forestry, Ministry of Agriculture and Ministry of Marine Affairs and Fisheries	2015-2020	APBN	AT 4, TN-4
2	Formulation of policies on standardization, technology and net production in environmental management;	Amount of biodiversity identified Percentage of production and consumption of commodities with sustainable standard/ criteria Number of/total area of protected biodiversity resources with application of sustainable standard/ criteria	Ministry of Environment and Forestry, Ministry of Agriculture and Ministry of Marine Affairs and Fisheries.	2015-2020	APBN	AT 4, TN-4

NO.	ACTIVITIES	INDICATORS	INSTITUTIONS	PERIOD	BUDGET INDICATION	TARGETS
3	Use of services within conservation area;	Number of initiatives and non-tax revenue	Ministry of Environment and Forestry	2015-2020	APBN	AT 14, TN 14
4	Development of eco-tourism attractions	Number of eco-tourism destinations	Ministry of Tourism	2015-2020	APBN	AT 14, TN 14
5	Management & conservation of reservoirs, watersheds, situ and other water container buildings;	Number of protected sources of water	Ministry of Public of Works and Housing	2015-2020	APBN	AT 14, TN 14
6	Conservation area management and development of essential ecosystem areas;	Total areas and number of plans for essential area management	Ministry of Environment and Forestry, NGO/CSO (i.e ZSL, Walestra, Gita Buana)	2015-2020	APBN	AT 14, TN 14
7	Empowerment of coastal and marine areas and small islands	Number of areas facilitated	Ministry of Maritime and Fisheries Affairs	2015-2020	APBN	AT 14, TN 14
8	Improvement of production and productivity of environmentally friendly agricultural products;	Total area and registered lands	Ministry of Agriculture	2015-2020	APBN	AT 14, TN 14
9	Improvement of production and productivity of sustainable plantation crops;	Total areas of development	Ministry of Agriculture	2015-2020	APBN	AT 14, TN 14
10	Development of products and businesses in marine and fisheries industry;	Number of locations, certifications and processed products	Ministry of Maritime and Fisheries Affairs	2015-2020	APBN	AT 14, TN 14
11	Ecosystem conservation recovery with total area of 250,000 ha;	Total area for ecosystem conservation recovery (250,000 ha)	MOEF, NGO/CSO (i.e ZSL)	2015-2020	APBN	AT 15, TN 15
12	Ecosystem recovery outside conservation areas;	Total area recovered	Ministry of Environment and Forestry, NGO/CSO (i.e BI)	2015-2020	APBN	AT 15, TN 15
13	Development of regulations related to Nagoya Protocol;	Number of relevant regulations	Ministry of Environment and Forestry,	2015-2020	APBN	AT 16, TN 16
14	Setting up of organization for Nagoya Protocol implementation;	Effective organization to implement Nagoya Protocol	Ministry of Environment and Forestry	2015-2020	APBN	AT 16, TN 16
15	Empowerment of Remote Indigenous Community;	Number of patented local innovations	Ministry of Environment and Forestry	2015-2020	APBN	AT 18, TN 18

NO.	ACTIVITIES	INDICATORS	INSTITUTIONS	PERIOD	BUDGET INDICATION	TARGETS
16	Use of local wisdom to support sustainable biodiversity management;	Amount of local wisdom used to support sustainable biodiversity management	Ministry of Environment and Forestry	2015-2020	APBN	AT 18, TN 18
17	Preservation of history and traditional values;	Number of documents and participants of cultural technical assistance	Ministry of Education and Culture	2015-2020	APBN	AT 18, TN 18
18	Development of public-private cooperation	Number of MOUs-MOAs among stakeholders	Ministry of Environment and Forestry	2015-2020	APBN	AT-19 TN-19
19	Improvement of support to biodiversity industry focusing on conservation values:	Improved support to sustainable biodiversity plantation industry	Ministry of Environment and Forestry	2015-2020	APBN	AT-19 TN-19
20	Improvement of support to biodiversity benefit trading system	Improved standard on sustainable biodiversity trading	National Development Planning Agency	2015-2020	APBN	AT-20 TN-20
21	Setting up cooperative model among stakeholders	Number of MOUs-MOAs among stakeholders	Ministry of Environment and Forestry	2015-2020	APBN	AT-20 TN-20

Note: AT = Aichi Target; TN = Target Nasional (National Target)

Table 7.3 Maintenance and Preservation Biodiversity Action Plan

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
1	Development of ex-situ conservation area;	Number of ex-situ built (biodiversity park, botanical garden, local marine conservation area (KKLD), tahura, Arboretum, germplasm garden, city garden)	Ministry of Environment and Forestry, LIPI, Regional Government, NGO/CSO (i.e WCS)	2015-2020	APBN	AT 5, TN 5
2	Management & harvesting of biodiverse areas that are protected and sustainably managed;	Number of area supervision activities and types of biota protected and managed	Ministry of Marine Affairs and Fisheries	2015-2020	APBN	AT 6, TN 6
3	Development of national and local regulations to support the biodiversity management target and permanent sustainability;	Number of national and local regulations to support the biodiversity management target and permanent sustainability	Ministry of Agriculture, NGO/CSO (i.e Burung Indonesia)	2015-2020	APBN	AT 7, TN 7
4	Pollution control from many types of activities;	Decreased pollution at 32% from marine activities	Ministry of Marine Affairs and Fisheries, NGO/CSO (i.e Burung Indonesia)	2015-2020	APBN	AT 8, TN 8
		Number of pollution control programs	Ministry of Environment and Forestry	2015-2020	APBN	AT 8, TN 8

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
5	IAS control through mapping of distribution, regulation, implementation and eradication	Number of invasive alien species (IAS) prohibited in Indonesia Number of regulations supporting IAS prevention in Indonesia IAS distribution map in Indonesia Number of IAS prioritized for eradication	Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture, Indonesian Institute of Sciences	2015-2020	APBN	AT 9, TN 9
6	Capacity building of IAS managing	Number of organizations managing IAS		2015-2020	APBN	AT 9, TN 9
7	Development of friendly horticultural plants protection system;	Number of recommendations and target groups	Ministry of Agriculture	2015-2020	APBN	AT 9, TN 9
8	Improvement of system and quality of quarantine for agricultural, animal, and fisheries products and security of biodiversity;	Number of policies, certifications and effectiveness of IAS and	Ministry Agriculture, Ministry of Marine Affairs and Fisheries.	2015-2020	APBN	AT 9, TN 9
9	More reviews on climate change mitigation and adaptation;	Number of reviews on climate change mitigation and adaptation	Ministry of Environment and Forestry	2015-2020	APBN	AT 10, TN 10
10	Improvement of activities dealing with climate change adaptation and mitigation at national and local levels;	Number of programs on climate change adaptation and mitigation at national and local levels	Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, NGO/SCO (i.e BI, ZSL and WCS)	2015-2020	APBN	AT 10, TN 10
11	Expansion of marine conservation area into 20 million ha;	Total marine conservation area reaches 20 million ha	Ministry of Marine Affairs and Fisheries, NGO/CSO (i.e WCS)	2015-2020	APBN	AT 11, TN 11
12	Recovery of land conservation area	Total land conservation recovery area is 250,000 ha	Ministry of Environment and Forestry	2015-2020	APBN	AT 11, TN 11
13	Sustainable management of protected forest;	Number of documents on conservation area management	Ministry of Environment and Forestry	2015-2020	APBN	AT 11, TN 11
14	Integrated management of watersheds;	Amount of integrated management of watersheds (180 KLHK-priority watersheds)	Ministry of Environment and Forestry, Ministry of Home Affairs	2015-2020	APBN	AT 11, TN 11
15	Essential ecosystem technical assistance	Number of essential ecosystem units formed (34 units)	Ministry of Agriculture	2015-2020	APBN	AT 11, TN 11

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
16	Expansion and sustainable management of lands for agriculture, plantations and animal husbandry	Total area of land used for agriculture, plantations and animal husbandry	Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Indonesian Institute of Sciences, NGO/CSO (i.e BI, ZSL and WCS).	2015-2020	APBN	AT 11, TN 11
17	Increased populations of protected, endangered species in biodiverse ecosystems	Number of priority protected endangered biodiverse species (25 types-KLHK, 15 types -KKP);	Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Indonesian Institute of Sciences	2015-2020	APBN	AT 12, TN 12
18	Improved quantity and quality of biodiversity seedlings and seeds of biological sources;	Number of seedlings and seeds	Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Indonesian Institute of Sciences.	2015-2020	APBN	AT 13, TN 13

Note: AT = Aichi Target; TN = Target Nasional (National Target)

Tabel 7.4 Capacity Building of Biodiversity Management Action Plan

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
1	Development of germplasm organizational system;	Number of organizations at local level	Ministry of Environment and Forestry, Ministry of Agriculture	2015-2020	APBN	AT 2, TN 2
2	Setting up and determination of IBSAP 2015-2020 organization;	New IBSAP organization is functional	Ministry of Environment and Forestry, NGO/CSO (i.e WCS)	2015-2020	APBN	AT 17, TN 17
3	Monev and reporting of implementation of IBSAP 2015-2020;	Monev and reporting documents	Ministry of Environment and Forestry, National Development Planning Agency, Ministry of Finance	2015-2020	APBN	AT 17, TN 17

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
4	Settlement of biodiversity conflicts	Number of conflicts settled	Ministry of Environment and Forestry, NGO/CSO (i.e WCS)	2015-2020	APBN	TN 22
5	Utilization, development, socialization and cooperation in non-urban technology;	Number of facilitations	Ministry of Home Affairs	2015-2020	APBN	AT 19, TN 19
6	Improvement in biodiversity resources research dissemination;	Number of information-dissemination events regarding biodiversity resources research results	LIPI, Ministry of Marine Affairs and Fisheries, BPOM	2015-2020	APBN	AT 19, TN 19
7	Development of a CHM (Clearing House Mechanism);	Functioning of CHM.	Ministry of Environment and Forestry	2015-2020		AT 19, TN 19
8	Development of environmental economic instrument;	Incentive scheme for sustainable biodiversity resources management	Ministry of Environment and Forestry	2015-2020	APBN	AT 3, TN 3
9	Financial management, distribution and return of revolving funds for forestry development activities;	Total amount of funding distributed	Ministry of Environment and Forestry	2015-2020	APBN	AT 3, TN 3
10	Development of laws, regulations and organizations to encourage funding-resource improvement	Number of laws and regulations issued	Ministry of Environment and Forestry, National Development Planning Agency, Ministry of Finance	2015-2020	APBN	AT 20, TN 20
11	Identification of needs, funding sources and location priority for biodiversity management	Needs, funding sources and location priority for biodiversity management are identified	National Development Planning Agency, Ministry of Finance, Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture, LIPI	2015-2018	APBN	AT 20, TN 20
12	Development of funding mobilization mechanism for priority locations	Guidelines for funding mobilization mechanism of biodiversity management	National Development Planning Agency, Ministry of Finance, Ministry of Environment and Forestry	2017-2020	APBN	AT 20, TN 20

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
13	Review of impact of subsidy on biodiversity utilization and conservation;	Number of subsidies withdrawn and subsidy roadmap to regions	National Development Planning Agency, Ministry of Finance, Ministry of Environment and Forestry,	2015-2020	APBN	AT 20, TN 20
14	Development of National Biodi- versity Conservation Fund (NBCF) to support IBSAP 2015-2020	• Document is written • Funding mobilization strategy is developed • Document is defined	National Development Planning Agency, Ministry of Finance, Ministry of Environment and Forestry	2016-2017	APBN	AT 20, TN 20
15	Improvement in investment and business expansion post harvesting of marine and fisheries resources;	Number of policies and business entities	Ministry of Marine Affairs and Fisheries	2015-2020	APBN	AT 20, TN 20
16	Development of forestry plan and improvement of forestry areas;	Number of plans to manage conservation areas	Ministry of Environment and Forestry, NGO/CSOs (i.e BI. ZSL, Forum Dangku, WCS)	2015-2020	APBN	AT 2, TN 2
17	Preparation and determination of updated IBSAP;	IBSAP document is defined	Bappenas, Ministry of Environment and Forestry, LIPI	2015-2020	APBN, donor	AT 2, TN 2
18	Human resources capacity development through formal and informal education and training;	Number of educational community improved its role in increasing awareness and level of knowledge on biodiversity	Ministry of Environment and Forestry, Ministry of Communication and Information, NGO/CSO (i.e BI, ZSL, Relawan Kawan Imau)	2015-2020	APBN	AT 1, TN1
19	Development of CEPA (Ca- pacity, Education and Public Awareness) strategy;	Number of thematic issues and cross sectoral issues with CEPA strategy	Ministry of Environment and Forestry, Ministry of Communication and Information	2015-2020	APBN	AT 1, TN1
20	Community participation improvement in biodiversity management;	Number of series of facilitation meetings to develop strategy and community participation models	Ministry of Environment and Forestry	2015-2020	APBN	AT 1, TN1
21	Awareness improvement through law enforcement on enviromental criminal law;	Capacity and number of personnel and environmental-related case management	Ministry of Environment and Forestry	2015-2020	APBN	AT 1, TN1

NO.	ACTIVITIES	INDICATORS	INSTITUTION	PERIOD	BUDGET INDICATION	TARGETS
22	Information broadcast and dissemination on biodiversity management;	Improved broadcast on forestry-related news in 20 mass media outlets	Ministry of Environment and Forestry	2015-2020	APBN	AT 1, TN1
23	Improvement in people's awareness about poverty reduction at the village level and development of biodiversity potential in left-behind areas;	Number of people and amount of support available for potential development of biodiversity resources	Ministry of Social Affairs, Ministry of Village, Development of Disadvantaged Regions, and Transmigration	2015-2020	APBN	AT 1, TN1
24	Improvement in people's awareness through KUMKM business empowerment in forestry, agricultural, marine and fisheries sectors;	Number of facilities and institutions receiving support	Ministry Cooperatives and Small and Medium Enterprises	2015-2020	APBN	AT 1, TN1

2. Action plan for the development of biodiversity to support economic growth, national competitiveness and community welfare (see Table 7.2).
3. Action plan for the maintenance and preservation of biodiversity for the people of Indonesia and to support the realization of optimal benefits to the nation and country of Indonesia (table 7.3).
4. Action plan for improvement of capacity to manage biodiversity with a participatory and integrated approach (see description in table 7.4).

7.6 POST-2020 BIODIVERSITY MANAGEMENT

The implementation of IBSAP for 2015-2020 is an important step toward sustainability and long-term programs. Therefore, we need a road map to carry the vision and mission of biodiversity management following the updates of IBSAP 2015-2020. Biodiversity target management after 2020 can be in line with the global vision for 2050. As with the alignment of a global vision for 2050, the vision of biodiversity management of Indonesia after 2020 includes:

"**By 2050, biodiversity management should be fully established to support efforts to conserve the earth that provide important benefits to everyone, through biodiversity that is valued, conserved, restored and wisely used, as well as the implementation of maintenance of ecosystem services**".

After 2020, the management of biodiversity is expected to begin to have a value that is understood and implemented by all parties, and one that can be used as a modality of nations to improve economic benefits that can encourage employment creation and poverty reduction. This can also promote policies in favor of the sustainable utilization of biodiversity. As a result it facilitates the sustainable utilization of biodiversity, which also encourages preservation and restoration, as well as the maintenance of ecosystem services. By maintaining biodiversity, a nation gains an advantage in climate change mitigation and adaptation efforts.

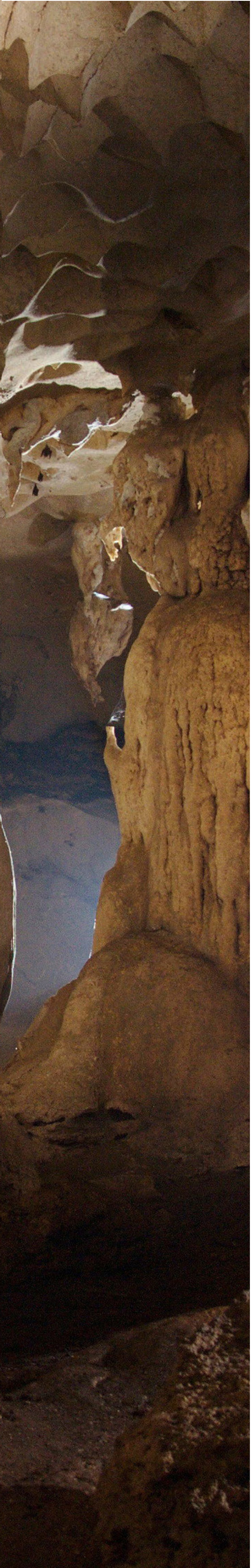
In line with this, sustainable biodiversity management can be used as a medium to reach the Sustainable Development Goals (SDGs).

In addition, the sustainable utilization of biodiversity in the future will still refer to national efforts through research activities and the development of applications based on biodiversity and bio industries. As such, for long-term benefits, it will support the development of food industries, medicine and industry development based on sustainable natural resources. ****

Merabu Karst

The Merabu Karst cave ecosystem is an interesting and challenging place for higher educational academics to learn about biodiversity

Courtesy photograph: Achmad Zona. ASC



8

Implementation Support to IBSAP 2015 - 2020

Communication is a key factor in implementing biodiversity policies and action plans for they involve multiple institutions and communities in the effort of attaining the desired biodiversity management aims.Biodiversity management, linked in its entirety in a clearing system, and the presence of a clearing house as a biodiversity management center, involves multiple nodes of biodiversity management, namely preservation of, research on, utilization of, and access to biodiversity by stakeholders, notably foreign/ overseas stakeholders,

In the meantime, monitoring and evaluation are key steps in the implementation of policies and action plans under the IBSAP to identify inroads made into the implementation process, the purposes attainment process, and the feedback process designed to improve implementation.

A communication, education, and public awareness (CEPA) strategy will be rolled out to create two-way communication and collaboration among the pertinent stakeholders to build awareness, trust, understanding, and consensus, to take action and to reduce conflict as part of the biodiversity preservation effort. The goal achieved under this strategy is the changed behavior and mental attitude of all the stakeholders towards the management and preservation of biodiversity.

8.1. MAINSTREAMING

Mainstreaming is a key element of the National Development Plan. The principle of mainstreaming is one of the keys to implementing development as set forth in the National Development Plan and is reflected in the 2015-2019 RPJMN and the RKP annually. Inter-sector mainstreaming in the National Development Plan takes place among the national government, sub-national governments and other stakeholders outside the government.

Mainstreaming biodiversity management is defined as a strategy to integrate biodiversity policies, programs, and activities into planning, budgeting, implementation, monitoring, and evaluation processes with the participation of multiple stakeholders to make sure biodiversity management development actually takes place (Kurniawan, 2014).

A biodiversity management mainstreaming mechanism must support the five aims of national development planning system implementation:

1. To support coordination among development stakeholders;
2. To ensure the bringing about of integrity, synchronization, and synergy among sub-national regions, spatial zones, time-frames and governmental functions, and between national and sub-national governments;
3. To ensure interrelationships and consistency among planning, budgeting, implementation, and supervisory activities;
4. To optimize community participation; and
5. To ensure that efficient, effective, equitable, and sustainable utilization of resources is attained.

Synergism among development sectors is imperative to the smooth proceedings of implementation and to the attainment of a wide range of goals under the National Development Plan. In principle, successful development cannot be achieved if each individual sector is treated separately; rather, they have to be seen as a collective as each sector interlinks with other sectors. As financing is restricted, to achieve effectiveness, efficiency, and maximum results with regard to the development goals, there is a need to synchronize the development of each sector to ensure that activities will mutually connect, support and reinforce each other.

For that reason, each ministry/institution assigned with biodiversity development duties should be strongly committed to achieving such synergy by virtue of communication, consultation, coordination, monitoring, and evaluation processes with stakeholders at the national and sub-national levels, and by advancing collective success with regard to the attainment of development goals.

Mainstreaming biodiversity management should take place in a structured fashion and meet the following criteria:

1. Mainstreaming is not to be seen as a separate effort to sectoral development activities;
2. Mainstreaming does not imply significant sums of additional funding (investment); and
3. Mainstreaming should take place at all the pertinent sectors by prioritizing those key sectors that have direct linkage ti mainstreaming issues.

Integration of a broad range of cross-sector development issues has likewise called for the need of multistakeholder participation in the implementation process. The role a broad range of stakeholders play in the implementation of cross-sector issues should accommodate the role each play in attaining the national goal concerning biodiversity management in relation to identified cross-sector issues. For that reason, that role is reflected in the action plan for biodiversity management, which is supportive to national goals relating to cross-sector issues.

Some of main Ministries/Institutions (Ministry of Environment and Forestry, Ministry of Marine Affairs and Fisheries, Ministry of Agriculture, Indonesian Institute of Sciences) still are the most important role in cross-cutting issues related to disaster management and climate change adaptation and mitigation. While the issue of poverty reduction and trade and international cooperation involving M/I and other stakeholders, such as the Ministry of Home Affairs, Ministry of Trade, Ministry of Industry, Ministry of Foreign Affairs, Ministry of Finance, research institutions, and industrial sectors.

In terms of operations, biodiversity management is understood as a management effort as set forth in the 2015-2020 IBSAP document. The 2015-2020 IBSAP document is an update of the 2003-2020 IBSAP document. Thus mainstreaming of biodiversity management is equivalent to the mainstreaming of the 2015-2020 IBSAP in the national development plan.

For that reason, programs and activities under the 2015-2020 IBSAP shall on a yearly basis be aligned with programs and activities of ministries/institutions under the 2015-2020 RPJMN and RKP. Outcome indicators as well as funding needs have also been prepared, in addition to regulations that need to be passed or fine-tuned to ensure improved implementation of biodiversity policies and action plans.

Successful integration of biodiversity management into the RPN should become protocol in the drafting of local development plans (RPJMD, RKPD). It is hoped that this will strengthen biodiversity management. Moreover, support in the form of regulations and other technical policies (guidelines) that can serve as a basis for the implementation and budgeting of local biodiversity management would significantly benefit the implementation of biodiversity management by local stakeholders.

The Ministry of PPN/National Development Planning Agency, Ministry of Finance, Ministry of Home Affairs, and Ministry of Environment and Forestry play an important roles in biodiversity management in local level of biodiversity management in birthing such local policies, very much influences the validity and implementation of biodiversity management in the sub-national regions..

8.2 COMMUNICATION, EDUCATION AND PUBLIC AWARENESS

Communication, education and public awareness are a series of activities that cannot be separated from one another and that have the purpose of encouraging the community to be cognizant of the importance of biodiversity, of implementing policy and action plan processes under the IBSAP according to respective roles, and of collectively attaining the IBSAP aims of the utilization of biodiversity for the community's well-being and in a sustainable fashion for future generations.

A communication, education, and public awareness strategy must be prepared in accordance with the correct methods and with the correct targets in mind. There are two dimensions to a communication, education and public awareness strategy:

1. Strategy based on communication methods: Direct communication and indirect communication/ communication through media; and
2. Strategy based on different communication targets. Based on the dimensions, a number of communication methods can be devised as is depicted in Table 8.1.

The many communication, education, and public awareness methods that are available call for the drafting of as many communication materials:

1. **Drafting of materials by biodiversity researchers and experts.**

   There is a need for researchers to present biodiversity documents and research results as interesting products. In general, biodiversity publications/ research reports are scientific documents. In this regard, there is a need for researchers and experts to write communication materials that are easy to understand by laypersons.

Table 8.1 Education and public awareness methods

GOALS AND METHODS	DIRECT	INDIRECT
1. INSTITUTION		
a. Government/Local	• Coordination meetings, workshops and seminars • Local government: local biodiversity villages, biodiversity tokens • Local wildlife reserves	Use of local biodiversity as local symbols and activities
b. International	Workshops, seminars, and collaborations	
c. Education		
• ECE and Kindergarten	• Stories, fairy tales; • Trips to the zoo;	Visual aids, movies
• Elementary schools	• Lessons; • Trips to museums, botanic gardens, biodiversity gardens.	Comics, movies.
• Junior/ senior high schools	• Trips, museums, botanic gardens, eco-tourism/ marine tourism, forests, mangroves; • Projects, joint events	• Essay contests; • School radio/television programs
• Higher education institutions	• Eco-tourism/ marine tourism, forests, mangroves; • Seminars, projects, joint events	• Essay contests; • School radio, television programs
d. Private sector	Joint projects, CSR	Sponsorships for the above-mentioned activities
2. INDIVIDUALS		
a. General Public	• Events, biodiversity ambassadors • Greening plants from local flora	Use of biodiversity as local symbols
b. Family	PKK (Fostering of Family Welfare): one of PKK program is to plant local plants in their home yards	• Comics; movies; • PKK enterprises: handicrafts featuring local biodiversity symbols (as souvenirs)

2. Drafting of materials by communication experts/ consultants.

Biodiversity materials can also be handed over to commu nication experts who will then produce straightforward, interesting, and easy to understand materials in the proper form/ media: brochures, comics, movies, etc.

3. Drafting Using Contests

Contests can be held to engage broader participation wherein participants would be asked to share their knowledge about community biodiversity using drawings, comics, storytelling/ radio programming and film making. They can be held at schools for school students and at higher education institutions for college students. They can also be held thematically for the public, e.g. by age group or for specific groups (homemakers, etc.).

A broad based engagement could also be achieved by forging cooperative ties with the private sector as part of utilizing CSR funds, or through collaborations with foreign agencies that share the same degree of concern toward biodiversity, and through collaborations with local governments, local institutions and local communities.

One of the effort to increase public awareness concerning the importance of biodiversity is by the designation of national wildlife and flowers by stipulated Presidential Decree Number 4 Of 1993 on National Wildlife and Flowers, with the hope, they are able to represent the characteristic of Indonesian state and nation. Those Species of flowers designated as national flowers are:

a. Bunga melati/Jasmine (*Jasminum sambac*) as the national flower;
b. Bunga anggrek bulan/Month orchid (*Phalaenopsis amabilis*) as the flower of charm;
c. Bunga padma raksasa/Corpse flower (*Rafflesia arnoldii*) as the endangered flower.

The three national wildlife fauna known as national identity are:

a. Komodo/dragon Komodo as the national animal;
b. Siluk merah/red dragon fish as the animal of charm; and
c. Elang Jawa/Javan hawk-eagle as the endangered animal

In 1989 and 2010, the Ministry of Home Affairs has issued Ministerial Decrees of Home Affairs Number 48 Of 1989 and Number 522.53-958 Of 2010 on Designation of Flora and Fauna as Provincial Identities. They were picked by taking into account their endemicity to, characterization of, or mainstay commodity of a given province (see Table 8.2).

In order to preserve biodiversity, most notably species that have been designated as local symbols/ icons, those specimens that have been designated as local symbols may be used for a wide range of

Table 8.2 List of provincial identities flora in Indonesia

Province	SPECIES	SCIENTIFIC NAME
Aceh	Joy Perfume Tree	*Michelia champaca*
North Sumatra	Ylang-Ylang	*Cananga odorata*
West Sumatra	King White Mulberry	*Morus macroura*
Riau	Nibong Palm	*Oncosperma tigillarium*
Riau Islands	Piper betle	*Piper betle*
Jambi	Red Sealing Wax Palm	*Cyrtostachys renda*
South Sumatra	Langsat	*Lansium domesticum*
Bangka Belitung	Nyatoh	*Palaquium rostratum*
Bengkulu	Titan Arum	*Amorphophallus titanum*
Lampung	Four O'clock Flower	*Mirabilis jalapa*
Banten	Kokoleceran	*Vatica bantamensis*
Jakarta Special Region	Snake fruit	*Salacca edulis*
West Java	Marian Plum	*Bouea macrophylla*
Central Java	White Sandalwood	*Michelia alba*
Yogyakarta Special Region	Burahol	*Stelechocarpus burahol*
East Java	Tuberose	*Polyanthes tuberosa*
Bali	Rosewood	*Dysoxylum densiflorum*
West Nusa Tenggara	Ajan Kelicung	*Diospyros macrophylla*
East Nusa Tenggara	Indian Sandalwood	*Santalum album*
West Kalimantan	Light Red Meranti	*Shorea stenoptera*
Central Kalimantan	Rambutan	*Nephelium lappaceum*
South Kalimantan	Kalimantan Mango	*Mangifera casturi*
East Kalimantan	Lute-Shaped Coelogyne	*Coelogyne pandurata*
South Sulawesi	Doub Palm	*Borassus flabellifer*
West Sulawesi	Rough Forest Chrysolite	*Elmerrillia ovalis*
Southeast Sulawesi	Fiber Orchid	*Dendrobium utile*
Central Sulawesi	Macassar Ebony	*Diospyros celebica*
Gorontalo	New Guinea Teak	*Vitex cofassus*
North Sulawesi	Hagimit Tree	*Ficus minahasae*
North Maluku	Clove	*Syzygium aromaticum*
Maluku	Cooktown Orchid	*Dendrobium phalaenopsis*
West Papua	Matoa	*Pometia pinnata*
Papua	Red Fruit	*Pandanus conoideus*

Decrees of the Minister of the Interior 48/1989 and 522.53-958 of 2010 Concerning the Designation of Provincial Flora and Fauna as Provincial Identities purposes, including: establishment of biodiversity villages, notably in zones/villages where species are endemic or live in local habitats, and as symbols on products such as souvenirs and local specialties in support of tourism.

Flora and fauna designated as local symbols can also be used as greening plants alongside roads, notably in strategic zones such as protocol roads, local parks, roads leading to local tourism spots, etc.

8.3 MONITORING AND EVALUATION

With the 2003-2020 IBSAP finalized, it is important that its constituent policies and action plans are mainstreamed into national and sub-national development plans. This constitutes an important step in the creation of a "corridor" for ministries/institutions tasked with implementing policies and action plans, as it will allow them to assimilate the activities into their annual strategic and work plans, and thus receive the funding needed to implement the activities.

The monitoring of IBSAP implementation is also important to be done, in order to:

1. Monitors the implementation process of IBSAP continuously to identify the constraints and problems in the implementation of IBSAP, and then discussed it to find the best solution.

   Monitoring of Biodiversity development activities which stated in IBSAP is in accordance with Law Number 25 Of 2004 on National Development Planning System, which is further regulated in Government Regulation Number 39 Of 2006 on Procedures of Control and Evaluation of Development Plan Implementation.

   Technically, it set in a Joint Decision between the Ministry of Finance Number Kep-102 / Mk.2 / 2002 and the State Ministry of National Development Planning / Head of Bappenas Number Kep.292 / M.PPN / 09/2002 on the Monitoring and Reporting System of Implementation Development Project. Monitoring is conducted for the presence/absence of IBSAP activities, the inclusion of which is mandated in planning or funding documents of national and sub-national governments;

2. Compiles data and information regarding biodiversity development, reports inroads made by IBSAP activities as part of the national clearing system, evaluates outcomes in relation to the purpose/ vision statement of biodiversity management for the IBSAP period, implementation improvements, IBSAP document improvements, and IBSAP policy improvements in connection with biodiversity policies and activities in other sectors.
3. Monitors IBSAP implementation outcomes in an integrated, cohesive, and continuous fashion. Monitoring can be implemented at multiple interlinked levels.

   Monitoring and evaluation of biodiversity is carried out in accordance with Law Number 32 Of 2009 on Environmental Protection and Management. Monitoring is conducted for expected activity outcomes, obstacles faced, and implementation improvements that need to be made.

However, before monitoring and evaluation can be conducted, biodiversity development policies and programs need be mainstreamed into development plans. This step is necessary to ensure that policies and programs are implemented and that they receive support from existing development programs (of the proper nomenclature) and that the policy and program implementation agencies receive the funding they need to implement them, so that national biodiversity development goals and objectives are attained.

Monitoring, evaluation, and reporting (MER) are conducted to ensure that implementation of the 2015-2020 IBSAP proceeds according to plan and that the goals and objectives are attained. In addition, MER under the implementation of IBSAP can be fed back into the National Report on Implementation of the Convention on Biodiversity Convention (CBD), which is published once every four years. This national report provides information about the implementation of the CBD and 2015-2020 IBSAP, and serves as a tool to monitor CBD implementation at the national and local levels.

Monitoring and evaluation of the implementation of the 2015-2020 IBSAP serve to manage program and activity implementation under it to ensure that they remain on track as planned and that national biodiversity management targets are met. The purposes of M & E and reporting of 2015-2020 IBSAP implementation are as follows:

1. To monitor the 2015-2020 IBSAP implementation process on an ongoing basis;
2. To anticipate issues and obstacles to the implementation of the 2015-2020 IBSAP from as early a stage as possible;
3. To achieve a minimum standard of and to strengthen the capacity of ministries/institutions for biodiversity management;
4. To rapidly, properly and accurately compile information and reports on activity outcomes under the 2015-2020 IBSAP in a periodic and gradual fashion; and
5. To make recommendations on improving 2015-2020 IBSAP implementation and planning in a comprehensive, cohesive and continuous fashion.

In general, the implementation of monitoring, evaluation and reporting of IBSAP 2015-2020 refers to several relevants regulations. The main regulations which is the basis of the implementation of monitoring, evaluation and of IBSAP among others:

1. Law Number 25 Of 2004 on National Development Planning Systems;
2. Law Number 32 Of 2009 on Environmental Protection and Management;
3. Law Number 39 Of 2006 on Control and Evaluation Procedures for Development Plan Implementation;
4. Joint Decree between the Ministry of Finance Number Kep-102/Mk.2/2002 and Ministry of National Development Planning / Head Bappenas Number Kep.292/M.Ppn/09/2002 on Monitoring and Reporting Systems for Development Project Implementation;

5. Ministerial Regulation of Finance Number 249/PMK.02/2011 on Measurement and Performance Evaluation of Work Plans and Budget Implementations of Ministries/Institutions; and many other technical regulations.

IBSAP M & E and reporting are conducted through indicators that measure the progress made by agreed national targets. According to Law Number 32 of 2009, monitoring is also recognized as part of supervision efforts to protect and manage the environment. Meanwhile, IBSAP evaluation is conducted to assess the degree of efficiency, effectiveness, and benefits of programs and activities. M & E results are expressed in the form of reports, which present information rapidly, appropriately and accurately to stakeholders to inform decision making in accordance with facts on the ground and assist in the creation of relevant policies (Government Regulation Number 39 Of 2006).

IBSAP M & E and reporting mechanisms concern all stakeholders involved in the 2015-2020 IBSAP implementation process from both government institutions (ministries/institutions) and non-governmental organizations under the coordination of the CBD National Focal Point (NFP) and with support from Ministry of Environment and Forestry (MoEF). Coordinators may form task clusters to assist the implementation of the 2015-2020 IBSAP made up of representatives of government institutions, non-governmental organizations, higher education institutions, and practitioners. Task clusters can be set up as dedicated units or form part of the same team as the Clearing House Secretariat for Biodiversity. Coordinators should have the proper competence to run Monitoring and Evalution duties and compile reports.

1. Approaches taken toward implementation of IBSAP Monitoring and Evalution and reporting:
2. Self-assessments conducted through Monitoring and Evalution tools are carried out by stakeholders involved in the implementation of the 2015-2020 IBSAP;
3. Report assessments will serve as written inputs that will inform a

wide range of documents filed by stakeholders with regard to the implementation of the 2015-2020 IBSAP; and

4. Field assessments are Monitoring and Evalution exercises conducted to verify a wide range of programs and activities implemented under the 2015-2020 IBSAP. Monitoring and Evalution and reporting are conducted in a systematic fashion by each institution as per their respective duties and competences.

Monitoring is also conducted by task clusters to the implementation of the 2015-2020 IBSAP on a regular basis at least once every year through either the compilation of reports or the filling out of tools by each institution implementing the 2015-2020 IBSAP, who also carry out field verification duties. Meanwhile, the task cluster will evaluate implementation of the 2015-2020 IBSAP on a regular basis at least twice a year based on yearly Monitoring and Evalution compilations. Monitoring and Evalution tool frameworks may use:

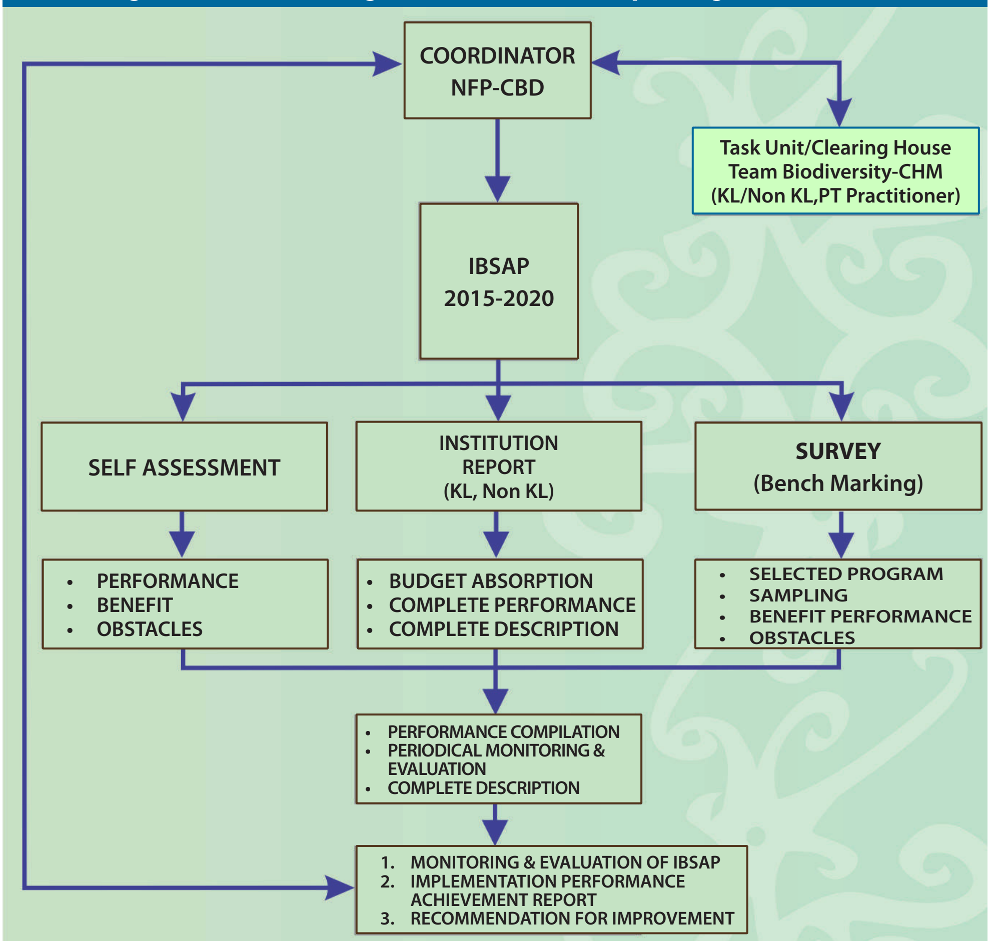
1. Biodiversity Clearing House (BK Kehati)
2. CBD National Report;
3. Annual evaluations will be conducted against the implementation of the 2015-2020 IBSAP;
4. Reporting documents from the relevant institutions; and
5. Self-assessment tools (SATs) for the implementation of the 2015-2020 IBSAP.

The Biodiversity Clearing House will serve as a medium to disseminate information, including monitoring results, evaluation results, and implementation reports for the 2015-2020 IBSAP. The Biodiversity Clearing House may also be used to prepare online reports and to analyze evaluations of the implementation of the 2015-2020 IBSAP by specific themes.

Monitoring and Evalution are conducted against performances of a wide range of institutions implementing programs and activities under the 2015-2020 IBSAP. Monitoring is conducted to keep tabs on ongoing programs and activity outcomes, and on obstacles and hindrances to the implementation process.

Program and activity outcomes in terms of the extent of resource inputs utilized (budgets, human resources, time frames, etc.), and outputs and results that may be in the form of impacts or benefits to the community and/or government due to the implementation of programs and activities under the 2015-2020 IBSAP.

Figure 8.1 Monitoring, Evaluation, and Reporting Mechanisms



Dipterocarp Forest

Dipterocarp forests contain a variety of tall vegetation, up to 200 – 300 types of trees per hectare, several of these have a high economic value such as: meranti (Shorea spp.), keruing (Dipterocarpus spp.) and kamper (Dryobalapnops spp). Dipterocarp forests grow at a height of 0 – 1.000 meters above sea level. Currently, at least 371 types of dipterocarps have been officially recorded in Indonesia.

Photo: Courtesy of Pindi Setiawan (ITB)

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ACRONYMS

ABS	:	Access and Benefit Sharing
AMAN	:	*Aliansi Masyarakat Adat Nusantara* *(*Indigenous Peoples Alliance of the Archipelago*)*
APBD	:	*Anggaran Pendapatan dan Belanja Daerah* (Regional Revenues and Expenditures Budget)
APBN	:	*Anggaran Pendapatan dan Belanja Negara (*State Revenues and Expenditures Budget)
AUSAID	:	Australian Agency for International Development
BAPI	:	Biodiversity Action Plan for Indonesia
BAPPENAS	:	*Badan Perencanaan Pembangunan Nasional* (National Development Planning Agency)
BATAN	:	*Badan Tenaga Nuklir Nasional* (National Nuclear Energy Agency)
BIG	:	*Badan Informasi Geospasial* (Geospatial Information Agency)
BK Kehati	:	*Balai Kliring Keanekaragaman Hayati* (Biodiversity Clearing House)
BLHD	:	*Badan Lingkungan Hidup Daerah* (Regional Environmental Agency)
BMKG	:	*Badan Meteorologi Klimatologi dan Geofisika* (Indonesian Agency for Meteorological, Climatological and Geophysics)
BNI	:	*Bank Negara Indonesia* (Indonesia State Bank)
BPOM	:	*Badan Pengawasan Obat dan Makanan* (The National Agency of Drug and Food Control)
BPPT	:	*Badan Pengkajian dan Penerapan Teknologi* (Agency for the Assessment and Application of Technology)
BPS	:	*Badan Pusat Statistik* (Statistic Indonesia)
BUMN	:	*Badan Usaha Milik Negara* (State-Owned Enterprises/ Business)
CBD LI	:	CBD Lifeweb Initiative
CBD	:	Convention on Biological Diversity
CEPA	:	Communication, Education and Public Awareness
CHM	:	Clearing House Mechanism
CI	:	Conservation International
CIDA	:	Canadian International Development Agency
CIFOR	:	Center for International Forestry Research
CITES	:	the Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP	:	Conference of the Parties
CPI	:	Climate Policy Initiative
CRITC	:	Coral Reef Information and Training Centers

CSO	:	Civil Society Organization
CSR	:	Corporate Social Responsibility
DAK-LH	:	*Dana Alokasi Khusus-LH.* (Special Allocation Fund for Environment)
DAS	:	*Daerah Aliran Sungai* (Watershed)
DEPHUT	:	*Departemen Kehutanan* (Department of Forestry)
DFID	:	Department for International Development
DNPI	:	*Dewan Nasional Perubahan Iklim* (National Board for Climate Change)
DNS	:	Debt for Nature Swap
DPR	:	*Dewan Perwakilan Rakyat* (House of Representatives)
DPRD	:	*Dewan Perwakilan Rakyat Daerah* (Regional House of Representatives)
ESDM	:	*Energi Sumber Daya Mineral* (Energy and Mineral Resources)
FAO	:	Food and Agriculture Organization
FAST	:	Finance Alliance for Sustainable Trade
FFI	:	Flora and Fauna International
FGD	:	Focus Group Discussion
FUT	:	*Fasilitasi Uji Terpadu* (Integrated Test Facilitation)
GDP	:	Gross Domestic Product
GEF	:	Global Environment Facility
GMO	:	Genetically Modified Organism
GNP	:	Gross National Product
GSPC	:	Global Strategy for Plant Conservation
GTI	:	Global Taxonomy Initiative
GTZ	:	German Technical Cooperation Agency, now GIZ (German International Cooperation Agency)
IBIS	:	Indonesian Biodiversity Information System
IBSAP	:	Indonesian Biodiversity Strategy and Action Plan
ICRAF	:	International Center for Research in Agroforestry
ICSR	:	Indonesia Corporate Social Responsibility
IIUPH	:	*Iuran Izin Usaha Pemanfaatan Hutan* (Contribution of Forest Utilization Business Permit)
InaBIF	:	Indonesian Biodiversity Information Facility
InaCC	:	Indonesian Culture Collection
INFORM	:	Indonesia Forest and Media Campaign
IPB	:	*Institut Pertanian Bogor* (Bogor Agricultural Institute)
IPBES	:	Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services
IPTEK	:	*Ilmu Pengetahuan dan Teknologi* (Science and Technology)
ITC	:	Information Technology and Communication

ITPGRFA	:	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	:	International Union for Conservation of Nature and Natural Resources-The World Conservation Union
IUPHHK	:	*Izin Usaha Pemanfaatan Hasil Hutan Kayu* (Business Permit of Utilization Timber Forest Product)
IAS	:	Invasive alien species
JICA	:	Japan International Cooperation Agency
K/L	:	*Kementerian/Lembaga* (Ministries/Institutions)
KAT	:	*Komunitas Adat Terpencil* (Remote Traditional Community)
KEHATI	:	*Keanekaragaman Hayati* (Biological Diversity / Biodiversity)
KEMEN ESDM	:	*Kementerian Energi Sumber Daya Mineral (Ministry of Energy and Mineral Resources)*
KEMEN PU	:	*Kementerian Pekerjaan Umum (Ministry of Public Works)*
KEMENDAG	:	*Kementerian Perdagangan (Ministry of Trade)*
KEMENDAGRI	:	*Kementerian Dalam Negeri (Ministry of Home Affairs)*
KEMENKEU	:	*Kementerian Keuangan (Ministry of Finance)*
KEMENKOMINFO	:	*Kementerian Keuangan* (Ministry of Communication and Information)
KEMENPAR	:	*Kementerian Pariwisata (Ministry of Tourism)*
KEMENPPN	:	*Kementerian Perencanaan Pembangunan Nasional (Ministry of National Development Planning)*
KEMENRISTEK	:	*Kementerian Riset dan Teknologi (Ministry of Research and Technology)*
KEMENRISTEKDIK	:	*Kementerian Riset, Teknologi dan Pendidikan Tinggi (Ministry of Research, Technology and Higher Education)*
KEMENTAN	:	*Kementerian Pertanian (Ministry of Agriculture)*
KKH PRG	:	*Komisi Keamanan Hayati Produk Rekayasa Genetik (Commission for the Biological Safety of Genetically Modified Products)*
KKH	:	*Konvensi Keanekaragaman Hayati (Convention on Biological Diversity)*
KKLD	:	*Kawasan Konservasi Laut Daerah (Regional Marine Conservation Area)*
KKP	:	*Kementerian Kelautan dan Perikanan (Ministry of Marine Affairs and Fisheries)*
KLHK	:	*Kementerian Lingkungan Hidup dan Kehutanan (Ministry of Environment and Forestry)*
KMNLH	:	*Kantor Menteri Negara Lingkungan Hidup* (State Ministry of Environment's office)
KNPN	:	*Komisi Nasional Plasma Nutfah* (National Committee for Germ Plasma)
KNSDG	:	*Komisi Nasional Sumberdaya Genetik* (National Committee for Genetic Resources)
KOMDASDG	:	*Komisi Daerah Sumberdaya Genetik* (Regional Committee for Genetic Resources)

KPPN	:	*Komisi Pelestarian dan Pemanfaatan Plasma Nutfah* (Committee for Conservation and Utilization of Germ Plasm)
LAPAN	:	*Lembaga Penerbangan dan Antariksa Nasional* (National Institute of Aeronautics and Space)
LIPI	:	*Lembaga Ilmu Pengetahuan Indonesia* (Indonesian Institute of Sciences)
LMO	:	Living Modified Organism
LPNK	:	*Lembaga Pemerintah Non Kementerian* (Non-Ministry Government Institution)
LSM	:	lembaga swadaya masyarakat (Non-Government Organization)
MAB	:	Man and Biosphere Program
MCA	:	Marine Conservation Area
MZB	:	Museum Zoologi Bogor (Bogor Zoology Museum)
NATREP	:	National Report
NBIN	:	National Biodiversity Information Network
NBSAP	:	National Biodiversity Strategy and Action Plan
NFP	:	National Focal Point
NGO	:	Non Governmental Organization
OECD	:	Organisation for Economic Co-operation and Development
OMS	:	*Organisasi Masyarakat Sipil* (Civil Society Organization)
OPT	:	*Organisme Pengganggu tanaman (*Organism of plant disturber) (TBC LIPI)
ORNOP	:	*Organisasi Non Pemerintah* (Non-Governmental Organization)
PADIA	:	Advanced Informed Agreement
PEMDA	:	*Pemerintah Daerah* (Regional Government)
PERDA	:	*Peraturan Daerah* (Regional Regulation)
PERMEN	:	*Peraturan Menteri* (Ministerial Regulation)
PERPRES	:	*Peraturan Presiden* (Presidential Regulation)
PES	:	Payment for Environmental Services
PHKA	:	*Pelestarian Hutan dan Konservasi Alam* (Forest Preservation and Nature Conservation)
PHT	:	*Pengendalian Hama Terpadu* (Integrated Pest Control)
PI	:	*Perubahan Iklim* (Climate Change)
PIKA	:	*Pusat Informasi Konservasi Alam* (Nature Conservation Information Center)
PNBP	:	*Penerimaan Negara Bukan Pajak* (Non-Tax State Revenue)
POM	:	*Pengawas Obat dan Makanan* (Drug and Food Controller)
PPN	:	*Kementerian Perencanaan Pembangunan Nasional (National Development Planning Ministry)*
PROSEA	:	Plant Resources of South East Asia
PSDG	:	*Pemanfaatan Sumber Daya Genetik* (Use of Genetic Resources)
PT	:	*Perseroan Terbatas* (Limited Liability Company)

PVT	:	*Perlindungan Varietas Tanaman* (Protection of Plant Varieties)
REDD	:	Reduce Emissions from Deforestation and Forest Degradation
REKI	:	*Restorasi Ekosistem Indonesi*a (Restoration of Indonesian Ecosystems)
RENSTRA	:	*Rencana Strategis* (Strategic Plan)
RIP	:	*Rencana Induk Pengelolaan* (Management Master Plan)
RKP	:	*Rencana Kerja Pemerintah* (Government Work Plan)
RPJMD	:	*Rencana Pembangunan Jangka Menengah Daerah* (Regional Medium-Term Development Plan)
RPJMN	:	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-Term Development Plan)
RPJPN	:	*Rencana Pembangunan Jangka Panjang Nasional* (National Long-Term Development Plan)
RPN	:	*Rencana Pembangunan Nasional* (National Development Plan)
RUU	:	*Rancangan Undang-undang* (Draft Law or Bill)
SAT	:	Self Assessment Tools
SBSTTA	:	Subsidiary Body on Scientific, Technical and Technological Advice
SCP	:	Sustainable Consumption and Production
SDG	:	*Sumber Daya Genetik* (Genetic Resources)
SDGs	:	Sustainable Development Goals
SDH	:	*Sumber Daya Hayati* (Biological Resources)
SDM	:	*Sumber Daya Manusia* (Human Resources)
SK	:	*Surat Keputusan* (Letter of Decision)
SKPD	:	*Satuan Kerja Perangkat Daerah* (Regional Apparatus Work Unit)
SKPD	:	*Satuan Kerja Perangkat Daerah atau Dinas* (Regional Apparatus Work Unit or Service Office)
TEEB	:	The Initiative on Economics of Ecosystems and Biodiversity
TFCA	:	Tropical Forest Conservation Action
TN	:	*Taman Nasional* (National Park)
TNC	:	The Nature Conservancy
TOT	:	Training Of Trainers
TTKH	:	*Tim Teknis Keamanan Hayati* (Biosafety Technical Team)
UI	:	*Universitas Indonesia* (University of Indonesia)
UKP4	:	*Unit Kerja Presiden bidang Pengawasan dan Pengendalian Pembangunan* (Presidential Work Unit for Development Supervision and Control)
UMKM	:	*Usaha Mikro Kecil dan Menengah* (Micro, Small and Medium Enterprises)
UNCBD	:	United Nations Convention on Biological Diversity
UNCCD	:	United Nations Convention to Combat Desertification
UNDP	:	United Nations Development Programe
UNEP	:	United Nations Environment Programe
UNFCCC	:	United Nations Framework Convention on Climate Change

USAID	:	United States Agency for International Development
UU	:	*Undang – Undang* (Law)
VIC	:	Village Information Center
WALHI	:	*Wahana Lingkungan Hidup Indonesia* (Indonesian Environmental Organization)
WB	:	World Bank
WCS	:	World Conservation Strategy
WEF	:	World Economic Forum
WEHAB	:	Water, Energy, Health, Agriculture, and Biodiversity
WSSD	:	World Summit on Sustainable Development
WWF	:	World Wildlife Fund
WWG	:	WEHAB Working Group
ZSL	:	Zoological Society of London

TERMINOLOGY

Agroecosystem	An ecosystem within the agricultural environment.
Agroforestry	Systems and technology for land use where long-life trees (including shrubs, palms, bamboo, timber, etc.) and short-life food crops and or plants for livestock food are grown in the same field with a certain arrangement of spacing or time of planting.
Aichi Targets	A global agreement regarding the strategy for biodiversity management that was signed at the COP 10 CBD of 2010 in Nagoya, Japan. The Aichi Targets contain the five goals of the strategy and its 20 targets. The period for implementation of the targets is up to the year 2020.
Arboretum	A collection garden planted with various different types of trees; a vast garden consisting only of a collection of various species of trees.
Bioactive	Substances or material that have an effect on living tissue or organs.
Biodiversity Convention	A convention signed by 150 countries at the UN Summit for Environment and Development in Rio de Janeiro in 1992.
Biodiversity Park	An initiative to save the original and endemic plant species outside of a forest area, with the intention of preserving plants whose pollination and spreading of seeds is done by a pollinating creature.
Biogeography	A study on the geographical spread of living creatures, their habitats and the underlying historical and biological factors.
Biogeography Line	An imaginary line that indicates the boundary of a certain geographic area based on the uniqueness of the organism communities or ecosystems.
Bioindicator	The biological reaction of an organism that regularly gives or shows a certain response to changes in the condition of the environment and the ecosystem.
Biological Diversity	All the diversity of living creatures that are found in an area, from genetic diversity, diversity of species to diversity of ecosystems.
Biopiracy	Activity related to the exploitation or utilization of bioresources without formal permission and or compensation to the country of origin or the indigenous community that by tradition owns or uses the said bioresources.

Bioprospecting	An evaluation of genetic resources and biological resources. In practice this activity is usually accompanied by the emergence of issues related to intellectual property rights, fair and equitable divisions of profit and the negative effects of using genetically modified products.
Bioresources	Sources of biological diversity that can be used or have the potential to be used to meet food, energy and industrial needs.
Biosphere	1. The part of the earth that is inhabited by living creatures, including the lithosphere, hydrosphere and atmosphere; 2. living creatures and their environment; 3. global ecosystem.
Botanical Garden	An area of land (usually with greenhouses) used to grow groups of wild plant species and cultivated plant species from faraway places to be used for scientific needs, tourism and for the conservation of ex-situ plant species.
Center of Origin	A geographical area where the specific traits of a species of plant, that is a domesticated plant or a wild plant, developed or emerged for the first time.
CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora is an international convention that regulates the trade of flora and fauna in order to prevent their extinction in nature.
Clearing House	A center of data and information about biological diversity.
Conservation Area	Areas set aside for nature conservation are national parks, nature recreation parks and forest parks; wildlife sanctuaries are nature preserves, wildlife reserves, protected forests and hunting parks. The term conservation is not found in Law No. 5/1990. Whereas in Law No. 41/1999 there is a grouping of forests based on their function, namely conservation forests, protection forests and producton forests. Conservation forests can be further divided into wildlife reserve forests, nature conservation forests and hunting parks.
Contamination	Pollution; contamination of the natural ecosystem particularly in connection with human activities.
COP	A conference of the parties that constitute the highest body in a convention. Its task is to hold meetings between the parties to review the progress of the convention and improve coordination among the convention.
Critically Endangered	The category IUCN Red List for any species that has a very high risk of becoming extinct.
Cultivar (cultivated variety)	A variety of plants produced and grown by humans through reproduction, selection or breeding and maintained through cultivation.
Data Deficient	Category IUCN Red List regarding the lack of data on population and status of a species.
Debt For Nature Swap	Fund for nature conservation that is defined as the cancellation of foreign debt by exchanging it with the mobilisation of domestic natural resources for nature conservation.

Deforestation	The felling of trees in a forest so that the land which originally was a forest will experience a change in its function, for example to become land for farming, plantations, or other use.
Economic Valuation	A method of evaluating the economic value of natural resources by determining or measuring the monetary value.
Ecoregion	A unit of land or water restricted geographically by a composition of unique species, natural communities and environmental conditions.
Ecosystem	1. A community of living creatures and their physical environment that interacts as one ecological unit, thus constituting the total biological, physical and chemical biotop content; 2. Any place where there is interaction between the living creatures and the physical and chemical environments; 3. The total biome and its habitat."
Endangered	Critical. Category of IUCN Red List on a species that has a high risk of extinction.
Endemic	A living creature that is native to, or whose spreading is restricted to only a certain region.
Endemicity	The ratio of the number of species that are found only on the island and the total number of species existing.
Eradication	1. The total eradication of pathogens from the host and its environment; 2. Destruction of a host for the purpose of controlling a disease; elimination."
Ex Situ	Outside of the original natural habitat or the normal position.
Family	One of the levels of biological classification consisting of several genus.
Fungi	A plant species that has no real leaves and lives off vegetative material.
Genetic Material	Material from plants, including material for reproductive and vegetative propagation, that contains functional units of inherited characteristics (heredity).
Genetic Variation	Varied appearance of the individuals in a population that is due to the difference in genetics.
Genome	A number of chromosomes forming one complete set, which is the set found in the sex cells (gamet), with a fixed number of chromosomes (n) that is half the number of chromosomes found in body cells (2n).
Germ Plasma	Source material that regulates successive immortality from generation to generation, passed on from the older generation to the descendents through gamets, it is a substance found in every group of creatures and is the source of traits that can be utilized and developed or assembled to create a superior species or new cultivar; included in this group are the high-quality cultivars of today or of the past, primitive cultivar, species already utilized but not yet cultivated, and the wild types related to the cultivated species or species maintained by humans.

Germ plasma plot	A plot of land on which to grow a group of cultivated plants and their wild family, to show the variation in their genetics. Such a plot serves as a place to conserve ex-situ germ plasma and provides the material for new cultivation.
Habitat	The location, plot, or special type of environment where living creatures usually grow and live naturally.
Herbarium	A collection of sample plants that have been preserved by drying and then given a label with their name, to be stored and arranged in accordance with the classification system.
In Situ	inside the original natural habitat or normal position.
Introduction	The entry or moving of a species in a habitat from one place to another place, which is intentional or unintentional.
IUCN	The International Union for the Conservation of Nature (IUCN) is the international authority for determining the status of conserving a species.
Limestone structure	An area of irregular layers of limestone that has absorbed water from, and is passed through by a river, with caves and underground tunnels.
Mangrove	Mangrove forests are usually found at beaches and along coastlines.
Mitigation	Efforts made to prevent invasive species from entering, and controlling those that have entered Indonesian territory.
Near Threatened	Category of IUCN Red List where a species is at risk of becoming reduced in population over a certain period of time.
Primary Forest	A primary forest is a forest that has not been disturbed or has experienced very little disturbance from humans.
Restoration	The effort to build an area within a natural forest that contains an important ecosystem.
Sago Flour	Flour made from the sago palm (Metroxylon sagu); the soft core of the trunk is cut up, squeezed in water and left to soak overnight. The supernatant liquid is disposed of, and the sediment is then dried in the sun, to become sago flour.
Seagrass Bed	A bed of seagrass formed by one type of seagrass (single vegetation) and or more than 1 type of seagrass (mixed vegetation);
Secondary Forest	A secondary forest is a forest that grows through natural secondary succession on forest land that had been seriously disturbed, such as land formerly used for mining, raising livestock and fixed farming.
Taxonomy	A branch of biology that studies the basic principles, methods and laws of classification by analyzing the giving of names, traits and grouping of living creatures based on the similarities and differences in characteristics; A science about taxonomy (naming, arranging, grouping) of living creatures with attention to the familial relationship and their evolution, through experiments (biosystematics).

Our place on earth, Indonesia, is extremely rich. From deep within the earth to the depths of the ocean, it is a heaven of priceless value for the millions of biologically diverse species.

We, the Indonesian people, are born with so many blessings from nature.

We are able to enjoy a natural environment that pampers us with its riches.

Respecting nature means respecting life. Utilizing these blessings wisely and preserving nature for our future generations will make us become a truly great nation

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.***

Three-way intersection in Pelanyau Cave, Merabu, Berau

Limestone structures/caves provide a very important environmental service. However, the specific landscape formed from the natural dissolving by water over millions of years has formed a limestone ecosystem that is extremely sensitive to changes within the environment as well as changes in topography. Lime ecosystems have a vulnerable support system, and are very difficult to restore after damage occurs.

Photo: Courtesy of Pindi Setiawan (ITB)

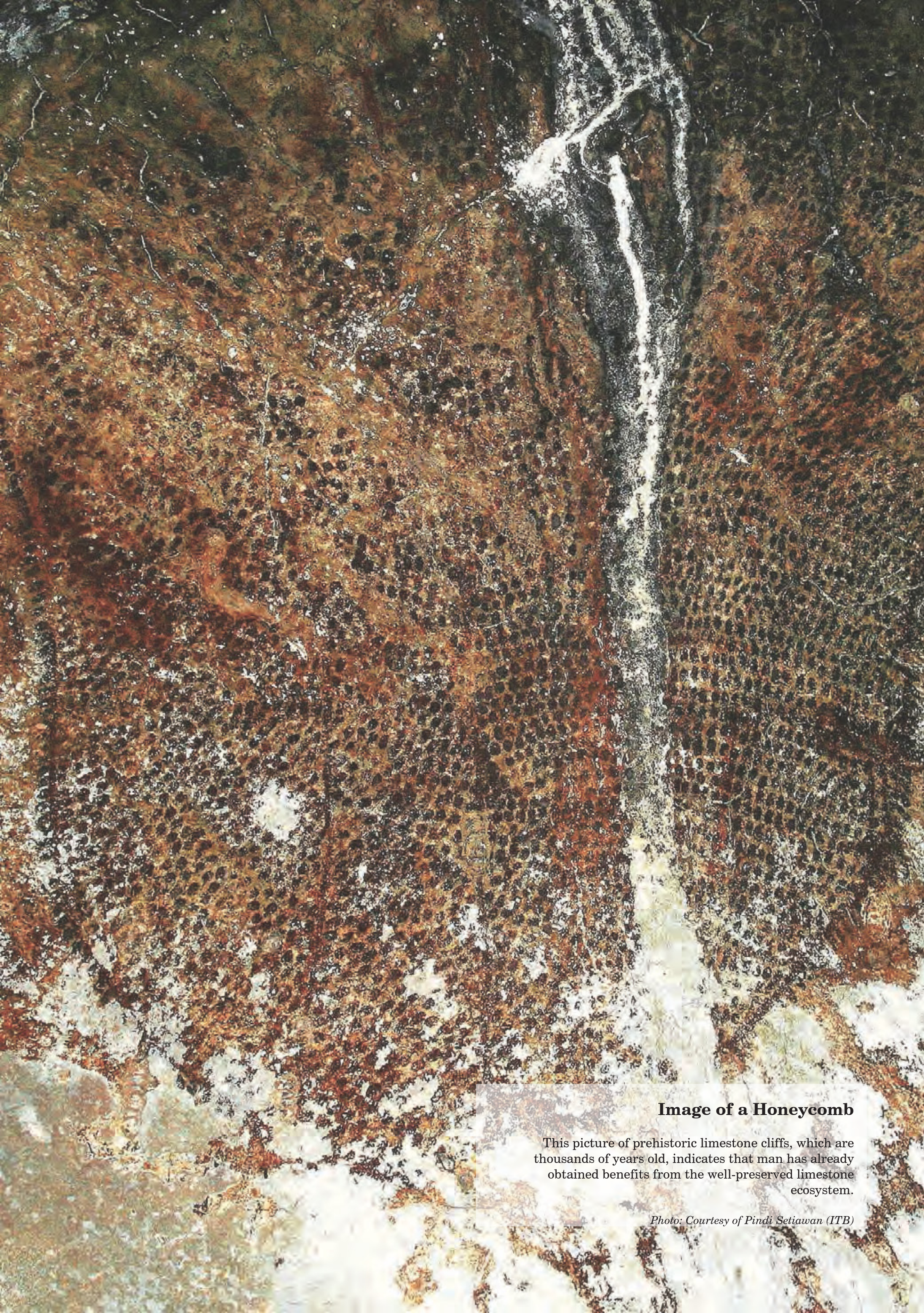

Image of a Honeycomb

This picture of prehistoric limestone cliffs, which are thousands of years old, indicates that man has already obtained benefits from the well-preserved limestone ecosystem.

Photo: Courtesy of Pindi Setiawan (ITB)

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