SUMMARY FOR POLICY MAKERS
NATIONAL ECOSYSTEM ASSESSMENT REPORT OF VIETNAM

Support to developing capacities to address science-policy-practice interface' project

Hanoi, May 2022

The report has been produced by the Center for Biodiversity Conservation under the Vietnam Union of Science and Technology Associations and the Institute of Strategy and Policy for Natural Resources and Environment of the Ministry of Natural Resources and Environment, as part of the initiative on Building capacity for national ecosystem assessments: linking science and policy and the Biodiversity and Ecosystem Services Network (BES-Net). Financial support was provided by the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of the Federal Republic of Germany.

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ASEAN	Association of South East Asian Nations
DARD	Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSO	General Statistics Office
ISPONRE	Institute of Strategy and Policy for Natural Resources and Environment
IPBES	Intergovernmental Science-Policy Platform on Biodiversity & Ecosystem Services
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
MPA	Marine Protected Area
NP	National Park
PAs	Protected Areas
TCMT	Vietnam Environment Administration
VFD	Vietnam Forest and Delta Program Project
VND	Vietnamese Dong (currency with exchange rate fluctuates from 20,000 VND to 23,000 VND = 1 USD during 2010-2021)

ACKNOWLEDGEMENTS

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We are immensely grateful to the International Climate Initiative of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of the Federal Republic of Germany (BMUB) for financial support to the "Support to developing capacities to address Science-Policy-Practice interface' project". We sincerely thank the United Nations Environment Programme World Conservation Monitoring Centre (UNEP WCMC) and the United Nations Development Programme - the Biodiversity and Ecosystem Services Network (UNDP BES-Net) for technical support during the implementation process of the project. Many thanks also go to colleagues of the project implementing countries who have regularly exchanged information and shared experiences in the project's activities.

We very highly appreciate and express our deep thanks to the authors who dedicated their high expertise and experience for their efforts and inputs. They have all tried their best to research and study the ecosystem assessment processes for developing and completing the project's outputs. As the first ecosystem assessment implemented in Vietnam, the project's outputs have been recognized and highly evaluated by international and national experts during the project implementation process.

We also would like to convey our sincere thanks to Dr. Claire Brown, Dr. Shaenandhoa Garcia Rangel, Mrs. Nadine Bowles-Newark, Ms. Charlotte Hicks and all colleagues from UNEP WCMC; Ms.Yuko Kurauchi and Ms. Pippa Heylings from UNDP BES-Net; Ms Makiko Yashiro, UNEP Regional Office for Asia and the Pacific; and Dr. Michael Parsons, Policy Adviser to the Minister of MONRE Vietnam for their trainings, guidances, peer reviews, and everything they have done for the NEA in Vietnam during the whole of the NEA process. Most especially, our heartfelt thanks go to all the reviewers for their comments and approval of the NEA report.

The authors are grateful for the friendly cooperation and support of the World Wide Fund for Nature (WWF), the Centre for Marine Life Conservation and Community Development (MCD), the Department of Special Use and Protection Forests Management of the Vietnam Administration of Forestry, the Nature and Biodiversity Conservation Agency (BCA) of the Vietnam Environment Administration, the Department of Planning Management and the General Statistics Office of the Ministry of Planning and Investment, the Institute of Ecology and Biological Resources, UNDP Vietnam, GIZ, CIAT-Vietnam and relevant agencies for assisting staff and providing information, data helping us to develop and complete this report.

INTRODUCTION

An ecosystem assessment plays an important role in synthesizing and communicating complex information and can both inform and influence decision-making processes, e.g. ecosystem assessments can: respond to decision makers' need for credible and robust information; highlight trade-offs between decision options; model future prospects to avoid unforeseen, long-term consequences; and provide critical judgement of options and uncertainty enabling decision makers to choose policies that sustain the appropriate mix of services.

Ecosystem assessments equally provide an opportunity to inform decision-making processes towards attaining national development goals and national biodiversity related strategic plans; to meet the information needs for policy makers at different sectors; to strengthen capacity through the science-policy interface and to promote an integration of biodiversity and ecosystem services into action plans.

Since 2017, the National Ecosystem Assessment Initiative at UNEP WCMC has supported countries to conduct national ecosystem assessments (NEA). This support is delivered in collaboration with the United Nations Development Programme (UNDP) and the United Nations Educational, Scientific and Cultural Organisation (UNESCO) through the Biodiversity and Ecosystem Services Network (BES-Net). Financial support for the NEA Initiative is provided by the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of the Federal Republic of Germany.

In Vietnam, the Center for Biodiversity Conservation (CBC) under the Vietnam Union of Science and Technology Associations (VUSTA) in collaboration with Institute of Strategy and Policy for Natural Resources and Environment (ISPONRE)/Ministry of Natural Resources and Environment (MONRE) and relevant institutions are implementing the National Ecosystem Assessment project from April 2017 to April 2022 to support and advise the Government on which policies should be developed or revised to maintain the benefits from ecosystem services in Vietnam.

The summary for policy makers is a brief of a national ecosystem assessment report, and is one of the important outputs of the project. It presents background information on the selected three key ecosystems (forest ecosystem; wetland ecosystem; and marine and coastal ecosystem) in Vietnam for the decision making process with the purpose of promoting an integration of biodiversity and ecosystem services into policy, planning development of relevant sectors.

The report provides 21 key messages and background information on five issues (i) the status of biodiversity and trends in ecosystems; (ii) contribution of the key ecosystems to socio-economy; (iii) drivers, pressures to changes in ecosystem services and its impacts on the socio-economy; (iv) the four future plausible scenarios for ecosystems and their services; and (v) the legal and institutional framework on biodiversity and ecosystem services including impacts, gaps and some recommendations to enhance ecosystems and their services.

The summary for policy makers will provide a valuable and useful reference for policy makers as well as officials, experts and scientists in the field of biodiversity conservation and relevant areas in the policy development processes.

PART I. KEY MESSAGES

1. Vietnam has high biodiversity with an abundance of natural ecosystems, species, and rich and endemic genetic resources

The geographical location and topographical and climatic factors of Vietnam have created natural landscapes and diverse ecosystems in the mainland part of the territory as well as in the sea. In Vietnam, ecosystems are divided into three groups: (i) terrestrial ecosystems (including: forest, rocky mountain (no forest cover), agricultural and urban ecosystems); (ii) wetland ecosystems (including inland wetland, coastal wetland and artificial wetlands ecosystems); and (iii) marine ecosystems. In addition, there are other groups of ecosystems, mainly artificial ecosystems on the mainland (*MONRE, 2020*).

In Vietnam to date, approximately 61,700 natural species of organisms have been identified, including: some 7,500 species/varieties of microorganisms; 2,200 species of fungi, 16,977 species of terrestrial and aquatic plants; 1,932 species of terrestrial vertebrates; 20,000 species of insects; 1,500 species of terrestrial invertebrates; and nearly 2,000 species of freshwater invertebrates and fish. In the ocean, there are over 11,000 marine species including microalgae, seaweed, sea grass, zooplankton, crustacean, molluscs, echinoderms, coelenterates, sponges, marine fish, marine reptiles, and marine mammals, etc. (*MONRE, 2021*).

Vietnam is one of the world's most diverse centers of cultivated plant and animal genetic resources, including about 800 plant species, more than 6,000 rice varieties, and 887 livestock varieties of which 30 varieties are widely used (*MONRE, 2021*).

2. Most of important ecosystems are located in a system of 176 protected areas

In Vietnam, most important ecosystems have the highest levels of biodiversity and biological productivity, making great contributions to the economy and social welfare. Most of the important ecosystems in Vietnam are located in a system of 176 protected areas (PA) of Vietnam, covering a total area of about 2,512,530 ha (7.6% of the national area) (*MONRE, 2021*).

Forest ecosystem

Wetland ecosystem

Marine ecosystem

3. Ecosystems which provide the most services and are high in biodiversity and biological productivity tend to be degraded

Erythrorchis ochobiensis

Vietnam's forest cover area is tending to increase mainly by new plantations; the ecosystems of rivers, streams, lakes, reservoirs and estuarine areas are degraded and biodiversity has been reduced; the peat swamp is reduced in area and in the thickness of the peat layer; natural tidal flats are affected; lagoons are degraded in varying degrees; seagrass beds are decreasing in area; coral reefs in the sea of Vietnam are declining in area and coverage of live coral; the number of threatened species increases; and the number of individuals of endangered species has been reduced or has not appeared for a long time.

In the period 2014-2017, scientists have proposed to be included in the Vietnam Red Book for the next period 1,211 species, including: 600 species of plants and fungi; 611 animal species. Thus, compared with the 2007 Vietnam Red Book (the total number of threatened species is listed as 882 species, consisting of 418 animal species and 464 plant species), the number of species proposed to the Red Book of Vietnam in this new period will be markedly increased (*MONRE, 2019*).

The results of multi-year monitoring of some important bird areas show that the number of individuals of rare and precious species, especially globally endangered migratory birds in the protected areas has decreased, such as the Spoonbill (*Platalea minor*) in Xuan Thuy National Park (NP) and crested cranes (*Grus antigone*) in Dong Thap NP and Phu My Wetlands Nature Reserve (Kien Giang), even some species have not been seen for many years such as sea dugong (*Dugong dugon*) in Phu Quoc) (*MONRE, 2019*).

Platalea minor

4. Traditional and indigenous knowledge on conservation and sustainable use of biodiversity are extremely diverse and abundant

Due to the diversity of ethnic minority communities and languages, along with indigenous cultures and customs, traditional and indigenous knowledge on the conservation and sustainable use of natural resources in general, and biological resources in particular in Vietnam are extremely diverse and rich. The people of ethnic communities in the mountainous regions of Vietnam for a long time have accumulated many traditional remedies from hundreds of medicinal plants in the forest. The Institute of Medicinal Materials has collected 1,296 folk remedies of ethnic communities that have served for screening research, and research and development to create disease prevention products (*MONRE, 2019*).

Knowledge of using materials from forest trees for community housing, daily tools, weaving and other purposes. Knowledge and experience in cultivation and breeding: many generations have drawn upon indigenous knowledge in agricultural and forestry production of ethnic communities is building experience through production practice. That experience has been gathered by word of mouth from generation to generation, in every family and in each community. It is knowledge of trees, wildlife in the forest, experiences with farming and livestock, weather cycles and other features of nature. Regarding the issue of management, protection and development of forest resources, indigenous knowledge of the people is really effective, such as knowledge of land use in cultivation, identification of forest trees, forest animals, and knowledge about exploitation and use of forest products. This is a favorable factor for community participation in local forest management, protection and development activities. Forests are of great importance to the life of the communities (*Pham Quoc Hung and Hoang Ngoc Y, 2009*).

5. Ecosystems which provide the most services and are high in biodiversity and biological productivity contribute significant benefits to the socio-economy

All three key ecosystems make substantial contributions to the economy and human welfare through four groups such as provisioning services; regulating services; cultural services; and supporting services. If these ecosystems and their related ecosystem services are degraded, the economy and people will suffer great damage in both physical and non-physical aspects.

According to the Statistical Yearbook (2021), the agriculture, forestry and fishery sectors contributed significantly to the gross domestic product (GDP), their export value increased from 19 billion USD in 2010 to 41.25 billion USD in 2020, accounting for 14.6% of the country's export turnover and 14.85% of GDP in 2020, and 12.36% of GDP in 2021.

About 20 million Vietnamese people derive either their main or partial income from aquatic resources; about 25 million people live in or near forests and 20-50% of their income comes from non-timber forest products, including hundreds of species of medicinal plants, oil crops, dyes (*MARD, 2020*).

6. Forest ecosystems in Vietnam contribute to the socio-economy in a range of ways, including to local livelihoods through payments for forest environmental services

Thanks to the policy on payment for forest environmental services (PFES), in the period 2011-2020, the total amount of money collected from parties using forest environmental services is more than 16,746 billion VND (equivalent to 728.09 million USD) or 1,674 billion VND/year on average (equivalent to 72.78 million USD/year on average). This money has been used to pay for more than 250,000 households (with an average payment of 15% of the total income of households) and 10,000 communities (with an average payment of about 50 million VND/community/year), contributing to increased income for people living in and around forests, especially ethnic minority communities living in remote and mountainous areas (*VFD, 2021*).

According to the Winrock International (2021), PFES has always been and will be an extremely important policy of the forestry sector. However, this policy has revealed some shortcomings and limitations such as some unclear and inappropriate regulations, making them difficult to apply especially those related to the monitoring and evaluation system. Thus, the Decree no.147/2016/ND-CP dated 2 November 2016 on PFES should be revised, adjusted for higher implementation efficiency.

7. Evaluation studies of ecosystems in Vietnam show how significant these services are in the socio-economy

The forest ecosystem services in Cat Tien NP were estimated to have generated goods and services worth 51.60 million USD/year in 2012 *(Emerton et al., 2014).* The total direct use value of wetland ecosystem services in Xuan Thuy NP in 2010 was estimated at 81.709 billion VND/year (equivalent to 4.09 million USD/year); the total indirect use value was estimated at 6,511 billion VND/year (equivalent to 325,550 USD/year); and the biodiversity conservation value was estimated at 399 million VND/year (equivalent to 19,950 USD/year) (*Dinh Duc Truong, 2010).*

The total economic value of marine ecosystem services ranged from 94 million VND to 307 million VND (equivalent to 4,200 USD to 13,650 USD)/ha/year. The total economic value of marine ecosystems services around selected islands in Vietnam was estimated to fluctuate between 267.5 billion VND (equivalent to 12 million USD) to 599 billion VND (equivalent to 26.62 million USD). The total economic value of marine ecosystems in the island Bach Long Vi island (Hai Phong city) was estimated to reach 599 billion VND/year (equivalent to 26.62 million USD/year), with an average of 94 million VND/ha/year (equivalent to 4,200 USD/ha/year); in Con Co island (Quang Tri province) it reached 267.50 billion VND/year (equivalent to 12 million USD/year), with an average of 307 million VND/ha/year (equivalent to 13,650 USD/ha/year); and in Tho Chu island (Kien Giang province) it reached 565.20 billion VND/year (equivalent to 25 million USD/year), with an average of 125.47 million VND/ha/year (equivalent to 5,576 USD/ha/year) *(Tran Dinh Lan et al., 2015).*

If key ecosystems and their associated ecosystem services are degraded, the people and economy will suffer great material and immaterial loss. Meanwhile, most of the studies on the evaluation of system services are small research projects. As a result, existing information on the value of ecosystem services is fragmentary, non-representative, and cannot be easily transferred from one

place to another when needed. In order to conserve and enhance ecosystems, thereby maintaining the valuable services they provide to the economy and human welfare, Vietnam needs to continue to promote research on ecosystem services and soon develop a database on the value of major ecosystem services so that it can be easily integrated into the decision-making process related to the management and use of these ecosystem services.

8. The services provided by Vietnam's ecosystems are on a declining trend

Most of Vietnam's important ecosystems such as primary/natural forests, mangroves, coral reefs, seagrass beds, etc., are reduced in area, experiencing ecosystem degradation, and biodiversity levels are decreased, such as the number of threatened species increased, number of individuals of endangered species decreased, or some species have not been seen for a long time. In addition, population growth has led to an increased demand for resources and energy resulting in an increase in resource extraction activities. The increasing demand leads to overexploitation of valuable products provided by ecosystems, resulting to a decline in goods and services of the ecosystem overall.

According to the report of the Government in 2018, in the 3 years 2016-2018, the area of degraded forest averages 2,430 ha/year. Statistics from MARD show that the natural forest area decreased from 10,304,816 ha in 2010 to 10,279,185 ha in 2020, while the area of planted forests increased from 3,083,300 in 2010 to 4,398,030 ha in 2020.

The fluctuations of mangroves in Vietnam from 1943 (408,500 ha) to 2009 showed a very strong downward trend, to an extremely low area in 2003 (83,288 ha), i.e. after 60 years, lost 4/5 of the country’s mangrove areas. Thanks to the policy on mangroves planting, the area of mangroves from 2007 to 2017 showed an increasing trend.

Nguyen Thi Thu, Cao Van Luong el at. (2011) reported that in 10 years an average of 40-50% of coastal seagrass has been lost. Over the past two decades, the area of seagrass has decreased by 45.4% and the average annual reduction rate was 4.4% (*Nguyen Thi Thien Huong et al., 2017*). The Institute of Oceanography report showed that only about 1% of coral reefs have a high coverage while the number of coral reefs with low coverage accounts for over 31%, and the number of coral reefs with average or slight coverage was 41% and 26% respectively.

9. Societal awareness on the value of the benefits of ecosystem services is still low

In Vietnam, management agencies from central to local levels, ecosystems have been mainly seen as biodiversity with their main value coming from biological resources (e.g. tree and animal resources) and along with precious and rare genetic resources. Even in laws on biodiversity in Vietnam, the concept of *ecosystem services* is not mentioned. From the above-mentioned biodiversity-centred approach, the common perception of society about the contribution of ecosystem services to the national economy and human welfare can be said to be superficial. Among some local leaders, biodiversity conservation is also a notion of luxury, or even an obstacle to socio-economic development.

10. Seven factors as drivers of change in the status and trends of ecosystems affecting their services were identified by Vietnam’s national ecosystem assessment

According to Grant et al. (2008) and MA (2005), drivers are exogenous factors, human-induced factors in an ecosystem. Therefore, the drivers of change in the status and trends of ecosystems services in Vietnam NEA include demographic changes resulting in an increased need for resources; economic development; the overlap of functions and management of biodiversity among relevant agencies; policy and governance of biodiversity conservation; communication,

awareness and education; science and technology developed; and limited resources for biodiversity conservation/investment. Drivers are fundamental factors that create pressures affecting the ability of the ecosystems to provide other products and services: e.g. according to Vietnam's voluntary national review on the implementation of the sustainable development goals (2018), as of June 2017, the proportion of urban population supplied with water through centralized water supply systems was estimated at about 84.5% (an increase of 1% compared to the end of 2016); the adjusted Electricity Planning VII, approved by the Government in March 2016, total power production in 2015 was 159 billion kWh, in 2020 it was forecasted to be 265 billion, in 2025, 400 billion, and in 2030, 572 billion kWh; inadequate coordination between MONRE and line ministries; the inconsistency in policy documents; over-use pesticides and uncontrolled, excessive agricultural intensification leaves a lot of consequences for the environment and public health such as soil degradation; etc.

11. Five factors as pressures to change in the status and trends of ecosystems affecting their services were identified by Vietnam's national ecosystem assessment

According to Grant et al. (2008), pressures are endogenous factors. The pressures are resulting from the key underlying drivers. Pressures to change the status and trends of ecosystem services in Vietnam NEA include land/waters conversion includes infrastructure development without proper scientific basis; illegal and excessive exploitation of biological resources and illegal trade in wild animals and their products are tending to increase; environmental pollution; climate change; and the introduction of invasive alien species. These pressures degrade terrestrial and aquatic ecosystems and degrade biodiversity and thereby degrade ecosystem services: e.g. from 2003 to 2009, there were about 25,000 ha of forest land converted each year to other uses (*VNFOREST, 2010*); from 2006 to 2016, there were 2,991 projects, with 386,290 ha of forest transferred to other purposes, of which: natural forest was 300,120 ha (accounting for 78.0%), and planted forest was 86,170 ha (accounting for 22.0%) (*MARD, 2016*); in 2018 and 2019, the national forest protection force detected and handled 466 cases of violations of regulations governing the management and protection of endangered wildlife (in 2018 was 239 cases, in 2019 it was 227) (*DFP, 2020*); Vietnam is also seen as a transshipment country for the transboundary and transnational wildlife trade (*MARD, 2018*); the phenomenon of algal bloom, mainly blue-green algae (*Microcystis* spp.) exhausts dissolved oxygen in lakes in Hanoi city, killing many fish. Red tide phenomenon is increasing in coastal waters (*MONRE, 2019*); According to climate change and sea level rise scenarios for Vietnam (*MONRE, 2016*), a sea level rise of 100cm results in a corresponding risk of flooding of 78 out of 286 "critical habitats", 46 protected areas, 09 biodiversity areas of national and international value and 23 other biodiversity areas in Vietnam would be severely affected; etc.

12. The impact of changes in ecosystem services on the socio-economy shows a trade-off between increased production outputs and ecosystem degradation, leading to reduction in ecosystem services overall

The drivers and pressures on different scenarios affecting ecosystem services (provisioning capacity of ecosystem services), and changing in ecosystem services all have certain impacts on the socio-economy in Vietnam. In the recent decades, the drivers and pressures affecting ecosystem services, that denote "positive" impacts registered as continuously increasing output, quantity or revenue of a number of economic sectors such as agriculture, fisheries, industry and trade, and tourism meeting the increasing needs of people.

The downside of achieving such economically significant figures is the trade-off in ecosystem degradation, biodiversity loss and consequent reduction in ecosystem services: e.g. natural forests

area and seagrass beds area are reduced; coral reefs with lower coverage; endangered species with reduced number of individuals; the yield of natural seafood exploitation is critical; exploitation rates in some species, mainly in sea areas are high, signaling over-exploitation; environmental pollution, together with the unhealthy eating habits of a part of the population, have led to dangerous epidemics for humans at global level such as the SARS, respiratory syndrome epidemic in 2002-2003 and Covid-19 in 2019 to now; etc.

13. The first future plausible scenarios for ecosystems and their services were developed in Vietnam, examining the potential effects of changes in drivers and pressures

Four various plausible scenarios have been developed through the NEA and applied to better understand likely future pathways for ecosystems and their services in Vietnam such as: (i) development as usual scenario; (ii) feasible base scenario; (iii) higher growth scenario; and (iv) sustainable development scenario associated with conservation.

In the four scenarios above, the sustainable development scenario associated with conservation is considered the most positive trend, as the goals of the Government's 2030 Agenda Implementation Plan can be achieved, which include: sustainable economic growth with respect to social justice, and protection of the ecological environment, effective management and use of natural resources, proactive response to climate change; ensuring that all people are promoted to their full potential, participate and equally enjoy the fruits of development; building a peaceful, prosperous, inclusive, democratic, equitable, civilized and sustainable Vietnam society.

14. The movement of drivers and pressures according to the scenarios developed under Vietnam's NEA shows that some factors (such as population growth) will become less important while others (such as population distribution) will be more important

In the four plausible future scenarios, the drivers and pressures affecting the ecosystem are predicted to be basically the same as in the past, but the relative importance of the different drivers and pressures is different. Some factors (such as population growth) tend to decrease in importance in some scenarios, while others (population distribution, environment, climate change, and land/water use change, etc.) will more important.

15. The scenarios developed by Vietnam's NEA predict changes in the quality of ecosystems and their services due to clear changes between the scenarios in provisioning and regulating services

In the four scenarios above, predicted changes in the quality of provisioning services and regulating services shows clear changes between the scenarios. The scenario of *sustainable development associated with conservation* is considered to show a positive trend, with an important goal of harmonizing conservation and development, not trading off economic development at all costs and harming the environment and biodiversity. This scenario would also help Vietnam to meet the Aichi biodiversity targets and the Sustainable Development Goals.

16. Seven sets of measures proposed in Vietnam's NEA show ways to improve proactive management of ecosystems and their services

For active management of ecosystems and sustainable use of their services, based on the lessons learned from the scenarios, some solutions are proposed as follows: (i) complete the legal framework (revise, amend the Biodiversity Law to be consistent in some regulations to accord with the current situation); (ii) improve effective decision-making processes (tools as facilitating transparency, stakeholder engagement, developing plans; data collection and feedback, etc.); (iii) institutional and governance changes; (iv) integrate the conservation and sustainable use of

biodiversity and the contribution of nature to people into sectoral policies, plans, programs and strategies (integrated approaches across sectors); (v) economics and incentives for regulating the use of ecosystem's goods and services; (vi) other necessary responses (social and customary responses, modern technology development, knowledge and awareness raising, strengthening biodiversity conservation management capacity); and (vii) develop and apply sustainable livelihood models to communities in agriculture, forestry and fishery areas, especially in the buffer zones of nature reserves (ecotourism development in association with biodiversity conservation, combined model of agriculture-forestry-fishery, integrated model of climate change adaptation solutions based on ecosystems, community-based conservation, etc.).

17. The legal framework on conservation and sustainable use of biodiversity and ecosystems is gradually being improved in Vietnam but it is still inconsistent or conflictive resulting in obstacles or difficulties in implementation

The three key specialized laws on conservation and sustainable use of biodiversity and ecosystems have been issued and gradually improved such as: the Law on Forestry (2017); the Fisheries Law (2017); and the Biodiversity Law (2008) are to create a legal corridor for overall comprehensive conservation and sustainable use of biodiversity and ecosystems in Vietnam. The Government and ministries and agencies have issued more than 193 policy documents guiding the implementation of these laws. However, the concept of ecosystem services has not been mentioned and institutionalized in the laws on biodiversity in Vietnam. Ecosystem services have only been regulated in some limited policy documents and there is lack of policies with regulations on ecosystem assessment. Besides, the percentage of policy documents for marine and wetland ecosystems is very limited, account for only 17.8% and 4.5% respectively of the total of policy documents on biodiversity conservation, while these ecosystems play an important role in supporting on socio-economic wellbeing in Vietnam. In addition, the quality of some policies is not high, some regulations are not in accordance with the practical situation due to these policies haven't been developed on the basis of science-policy-practice interface, resulting in difficulties to apply and enforce the laws and documents under laws on biodiversity and ecosystem conservation.

Though many policies have been issued, numerous regulations stemming from these policy documents are inconsistent or conflictive resulting in obstacles or difficulties in implementation. The biggest challenge to management and conservation of biodiversity and ecosystems is the inadequate coordination between MONRE and MARD in developing and issuing policies. This existence stems from the inconsistency between the three key laws in promulgating regulations on biodiversity conservation in Vietnam.

According to the Law on Forestry (2017), forests are classified into five categories: (i) national park; (ii) nature reserve; (iii) species - habitat reserve; (iv) landscape protection forest; and (v) scientific research or experiment forest, while the Biodiversity Law classified PA system into four categories: (i) national park; (ii) nature reserve; (iii) species/habitat PA); and (iv) landscape PA.

Due to the inconsistency in names, classifications, criteria and standards of PA system between the two these laws, leading to overlap and contradiction in rankings system of PAs. In addition, there is inconsistency in functional sub-zones and buffer zones of PAs and shortcomings in the management of PAs with mixed ecosystems, e.g. the PAs have all forest, wetland and marine ecosystems, resulting in degradation of biodiversity, ecosystems and their services.

18. The institutional framework on management of biodiversity and ecosystems in Vietnam has been reorganized, there are still overlaps in functions and missions

The Government performs unified state management of biodiversity; the Ministry of Natural Resources and Environment is responsible to the Government for performing state management of biodiversity; Ministries and ministerial-level agencies shall, within the scope of their tasks and powers, perform the state management of biodiversity according to the Government's assignment; People's Committees at all levels shall, within the scope of their tasks and powers, perform the state management of biodiversity according to the Government's decentralization.

Though the Government has made every effort to restructure the organization of biodiversity management at central and local levels, the system is still very unwieldy with many focal agencies resulting in some shortcomings and overlaps in function and missions. Besides, interdisciplinary coordination in management is not strict and still limited due to passivity and lack of continuity, resulting in low biodiversity management efficiency.

The assignment of state management responsibility for biodiversity is unclear between MONRE and MARD as well as between local management agencies leading to overlap and conflict. Human resources for local conservation are still inadequate and have not been trained in professional skills in biodiversity conservation. In particular, at most local DONREs, there are no functional units and specialized officials for biodiversity and ecosystem conservation.

Overlapping functions of state management on biodiversity and different ecosystems can negatively affect the use and sustainable exploitation of ecosystem services while reducing the provisioning services of the ecosystems.

19. Policy documents have had significant impacts on Vietnam's conservation and sustainable use of biodiversity and ecosystems

Though some policies are inconsistent or conflicting, however, the results of the implementation of policies and laws are to reduce drivers and pressures affecting biodiversity and ecosystems. Each group of key drivers and pressures affecting biodiversity and ecosystem services in Vietnam has corresponding policy documents developed and promulgated. These are feedbacks to effectively manage biodiversity and ecosystem services in order to minimize the impact of motivational and pressure groups. There have been basic results when implementing those legal bases.

20. Existing policy measures have made significant contributions to maintain and enhance ecosystems and their services

There are two basic groups of policies related to forest protection and benefit sharing from forest ecosystem services: (i) forest protection and development policy and; (ii) policy on payment for forest environmental services with many incentive measures to mobilize the communities to participate in forest protection.

After 10 years of implementation, the PFES policy has achieved many successes in the fields of economy, society, and environment and was recognized as one of the ten greatest achievements of the forestry sector in the period 2011-2015 (*MARD, 2017*). Thanks to this policy, many jobs have been created and a positive change in the awareness and responsibility of stakeholders for forest management and protection has been created. Therefore, in the three years of 2016-2018 implementation of the *Target Program for Sustainable Forestry Development for the period of 2016-2020,* a number of targets have been achieved or exceeded (*Government Report, 2018*).

A first basis on a policy on payment for wetland ecosystem services has been initially institutionalized in the Decree no.66/2019/ND-CP dated July 29, 2019. However, the provisions

on the payment price of the entities used for each type of service have not been mentioned. Therefore, it is necessary to have separate policy documents to implement the policy of payment for wetland ecosystem services.

Regarding activities of payment for marine ecosystem services, until now, payments have been done from a spontaneous perspective as collection of fees from tourist services in Ha Long Bay, some NPs and PAs, etc. Thus, it is necessary to have a legal basis for a policy on payment for wetland and marine ecosystems services.

21. Specific recommendations to maintain and enhance ecosystem services are proposed by the national ecosystems assessment

The legal framework on biodiversity and ecosystems still has certain shortcomings and overlaps; the existing laws as the Biodiversity Law, the Law on Forestry and the Fisheries Law that are inconsistent in some regulations or still lacks a number of regulations or is incomplete. Therefore, it is necessary to revise, adjust and supplement some regulations to complete the legal framework in accordance with the current situation such as (i) unifying the concepts, classifications, criteria and functional sub-zones and buffer zones of PAs between the Law on Forestry and the Biodiversity Law; (ii) introduction of contents of ecosystem services into the revising of the Biodiversity Law to create a legal basis for developing policies, guidelines on ecosystem services, ecosystem assessment, evaluation of ecosystem services; (iii) development of a pilot policy on payments for wetland, marine and coastal ecosystem services; and (iv) review and revise the Decree no.147/2016/ND-CP dated 2 November 2016 on PFES for a higher implementation efficiency.

PART II. BACKGROUND

I. STATUS OF BIODIVERSITY AND TRENDS OF ECOSYSTEMS

1.1. Status of biodiversity

1.1.1. Status of ecosystems

The geographical location and topographical and climatic factors of Vietnam have created the natural landscape and diversity of ecosystems on the mainland as well as in the sea.

1.1.1.1. The ecosystem in Vietnam is very diverse

In Vietnam, ecosystems are divided into three groups such as terrestrial ecosystems; wetland ecosystems; and marine ecosystems. In addition, there is another group of ecosystems that are mainly man-made ecosystems on the mainland *(MONRE, 2020).*

Forest ecosystems including forest types: (i) evergreen closed tropical humid forest; (ii) semi-deciduous closed tropical humid forest; (iii) evergreen broad leaved forests on limestone; (iv) natural needle leaf forests; (v) dry dipterocarp forest (deciduous dipterocarp forest); (vi) naturally dry forest (with thorny plants); (vii) cajuput forests; (viii) bamboo forest; and(ix) mangrove forest (*Nguyen Ngoc Lung et al., 2010*). In addition to the forest ecosystem types, forestry scientists have also classified into 14 types of forest vegetation according to ecological factors (*Thai Van Trung, 1999*).

According to MARD (2021), by 2020, Vietnam has 14,677,215 ha of forest land. Of which, 10,279,185 ha is natural forest and 4,398,030 ha is planted forest. The area of forested land eligible for calculation of the national coverage rate is 13,919,557 ha, the coverage rate is 42.01 %.

Table 1. Forest area by ecological region in 2020

Region	Natural forest area (ha)	Planted area (ha)	Total area of forested land (ha)	Coverage rate (%)
Northwest	1,574,797	207,414	1,782,210	46.41
Northeast	2,364,934	1,584,315	3,949,249	56.30
Red River Delta	46,269	37,059	83,328	6.18
North Central	2,205,433	921,271	3,126,704	57.35
Central Coast	1,570,943	872,242	2,443,185	50.43
Central Highland	2,179,794	382,411	2,562,205	45.94
Southeast	257,122	222,985	480,107	19.42
Southwest	79,893	170,334	250,227	5.45
Whole country	**10,279,185**	**4,398,030**	**14,677,215**	**42.01**

(Source: MARD, 2021)

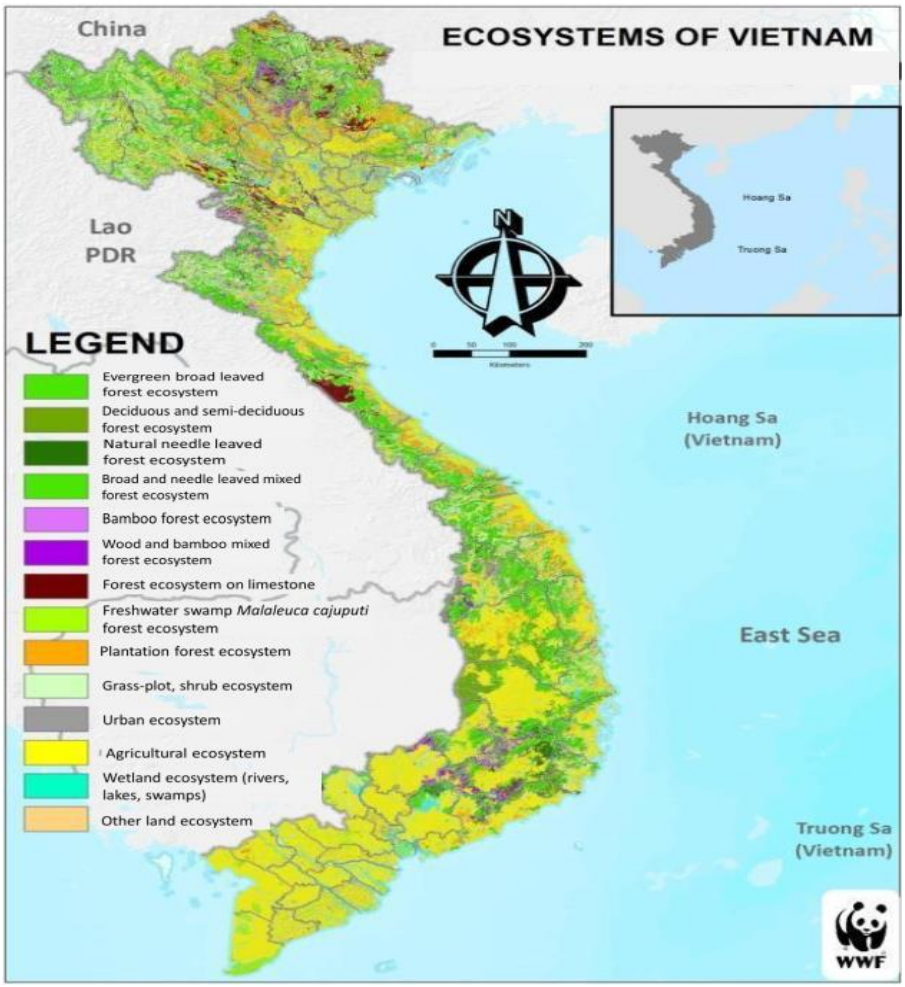


Figure 1. Map of ecosystems on the mainland in Vietnam

(*Source: MONRE & WWF, 2013*)

Wetland ecosystems: The total wetland area of Vietnam is 11,847,975 ha (not including the area of seasonal rivers and streams, hot springs, mineral water), accounting for 37% of the total land area of the country (*Nguyen Thi Thu Ha et al., 2016*). Wetlands in Vietnam are classified into 3 groups with 26 types: (i) Marine and coastal wetlands that are salty or brackish wetlands in coastal areas, around islands, influenced by tides. There are 9 types of marine and coastal wetlands; (ii) inland wetlands (also called fresh wetlands) are wetlands located on the mainland or near the coast. There are 8 types of inland wetlands; and (iii) artificial wetlands are waters formed by human action. There are 9 types of artificial wetlands (*Decision 1093/2016/QD-TCMT*).

Wetland ecosystems in Vietnam

Marine and coastal ecosystems: Vietnam has a coastline of more than 3,260 km (excluding islands) with more than 3,000 large and small islands along the coast and two archipelagos of Hoang Sa and Truong Sa. Vietnam's exclusive economic zone is over one million km^2, divided into six ecological regions with specific characteristics of biodiversity: (i) Gulf of Tonkin (to the south of Con Co island, Quang Tri province); (ii) central coastal waters (from Con Co island to Mui Dinh in Phan Rang-Varellacape); (iii) South Central coastal waters (from Dinh Cape to Vung Tau); (iv) Southeast coastal waters (from Vung Tau to Ca Mau); (v) South West Coast Sea (from Ca Mau to Phu Quoc Island in the Gulf of Thailand) and; (vi) offshore-sea (waters of the Hoang Sa and Truong Sa archipelagos).

Among the six marine ecoregions in Vietnam mentioned above, 20 types of marine ecosystems have been distinguished. Typical marine ecosystems in the coastal zone (also types of coastal and marine wetlands) include tidal flats, mangroves, estuaries, lagoons, bays, island salt-lakes, mangroves, coral reefs, and seagrass beds. In addition, there are also aquatic ecosystems around coastal islands and offshore waters (including the Hoang Sa and Truong Sa archipelagos) (*MONRE, 2019*).

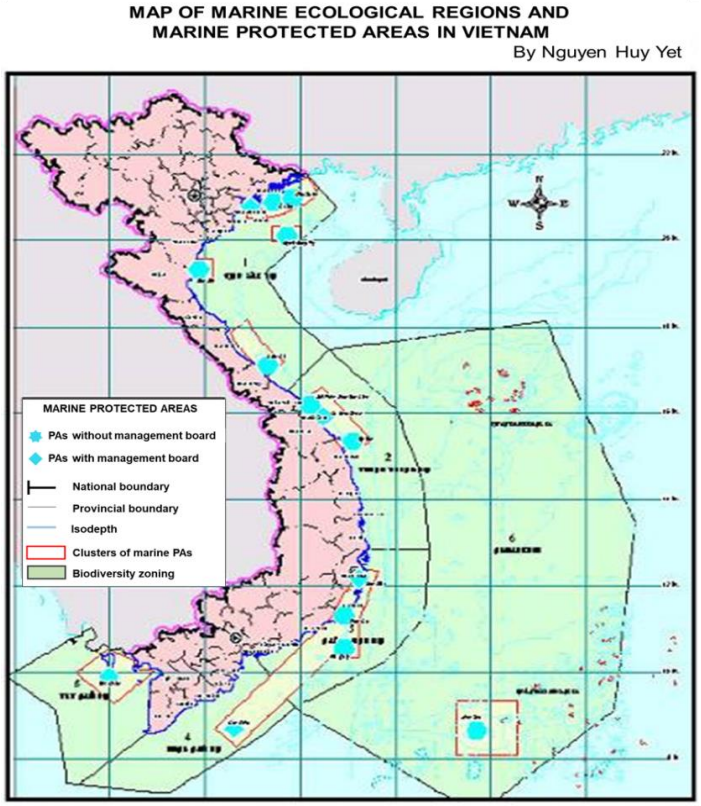


Figure 2. Map of marine ecological regions and marine protected areas in Vietnam

(*Source: Nguyen Huy Yet, 2000*)

1.1.1.2. Key important ecosystems in Vietnam

Based on the level of contribution to the economy and social welfare, the following ecosystems are considered as the main and important ecosystems of Vietnam, having the highest biodiversity and having the highest biological productivity:

Key forest ecosystems: Evergreen closed tropical humid forest; semi-deciduous closed tropical humid forest; evergreen broad-leaved forests on limestone and natural needle leaf forests.

Key inland wetland ecosystems: coral reefs, and seagrass beds (at a depth of below 6m during low tide), rivers, streams, natural lakes, reservoirs, peat swamps, estuaries, tidal flat, mangroves.

Key marine and coastal ecosystems: coral reefs, sea grass beds (at a depth of over 6m during low tide), lagoons, bays, coastal islands and offshore waters (including archipelagos of Hoang Sa and Truong Sa).

There are three PA systems such as forest PA system; marine PA system, and wetland PA system in Vietnam (*MARD, 2017*). Most of the key ecosystems are located in the three systems of 176 PAs, covering a total area of about 2,512,530.78 ha (7.6% of the national area) (*MONRE, 2021*).

In addition, some nature reserves (NR) and other territories with high biodiversity value are recognized by international or regional organizations as of international importance with the following titles: 06 global priority ecological zones recognized by WWF; 09 Ramsar sites with a total area of 120,549 ha; 11 World Biosphere Reserves with a total area of 4,900,872 ha; 06 World Natural Heritage sites with a total area of 1,537,952 ha; 10 ASEAN Heritage Parks with a total area of 355,710 ha; 63 important bird areas with a total area 1,689,900 ha; 104 key biodiversity areas, with a total area of 3.35 million ha; and 07 biodiversity conservation corridors.

According to the Law on Forestry (2017), forests are classified into five categories: (i) national park; (ii) nature reserve; (iii) species - habitat reserve; (iv) landscape protection forest; and (v) scientific research or experiment forest, while the Biodiversity Law classified PA system into four categories: (i) national park; (ii) nature reserve; (iii) species/habitat PA); and (iv) landscape PA.

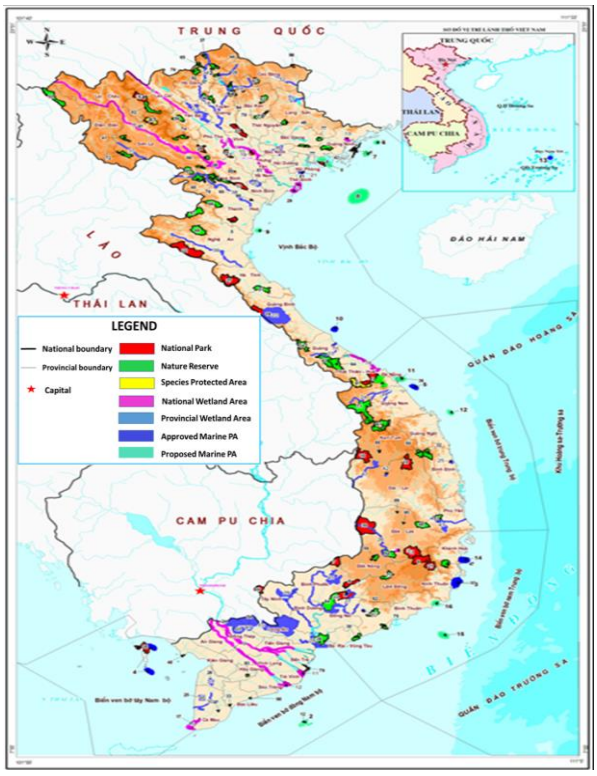


Figure 3. Map of protected areas systems in Vietnam

(*Source: MARD, 2017*)

1.1.2. Status of species and genetic resources

Vietnam is recognized as one of the countries with high biodiversity in the world. Up to now, Vietnam has about 61,700 natural species of organisms have been identified, including: about 7,500 species/varieties of microorganisms; 2,200 species of fungi, about 16,977 species of terrestrial and aquatic plants; 1,932 species of terrestrial vertebrates; about 20,000 species of insects; about 1,500 species of terrestrial invertebrates; and nearly 2,000 species of freshwater invertebrates and fish. Under the sea, there are over 11,000 marine species including microalgae, seaweed, sea grass, zooplankton, crustacean, molluscs, echinoderms, coelenterates, sponges, marine fish, marine reptiles, marine mammals, etc. (*MONRE, 2021*).

In the known species composition, the number of endemic species in Vietnam is high e.g. about 30% of terrestrial vascular plant species, 4.6% of species and subspecies of birds, 27% number of freshwater snails and mussels, and about 58% of freshwater shrimps and crabs). In addition to having a diversity of natural organisms, Vietnam has a high diversity of cultivated plant and animal genetic resources, including about 800 plant species, more than 6,000 rice varieties, 887 livestock varieties and around 30 varieties of them are widely used. Livestock and crops have been developed for hundreds of years and have valuable genetic traits. These are the precious indigenous genomes of Vietnam that need to be protected, preserved and developed (*MONRE, 2021*).

Cervus unicolor

Trachypithecus poliocephalus

Panthera tigris corbetti

1.1.3. Traditional and indigenous knowledge on conservation and use of biological resources

Vietnam has 54 ethnic minority communities (Kinh people accounts for about 86.5% of Vietnam population). Due to the diversity of ethnic communities and languages together with indigenous cultures and customs, traditional and indigenous knowledge on the conservation and use of natural biological resources in Vietnam is extremely diverse and rich. Ethnic people in the mountainous regions of Vietnam have long accumulated many traditional remedies from hundreds of medicinal plants in the forest. The Institute of Medicinal Materials has collected and collected 1,296 folk remedies for diseases of ethnic minority communities, these remedies have served for research, screening, and development to create disease prevention products (*MONRE, 2019*). Ethnic communities have had knowledge about tree species, wild animals in the forest, experience in cultivation and husbandry, the cycle of weather and other characteristics of nature.

The community of ethnic minorities in Vietnam has proposed many customary laws to preserve and protect the living environment, and to conserve and sustainably use forest and aquatic resources. For example, the Ede customary law in the Central Highlands has 236 articles with over 8,000 sentences, defining the responsibilities of each individual and the individual to the community in protecting forests, birds, animals, land, and water sources. The customary law of the M'nong in Dak Nong has 215 articles with about 7,000 sentences, in which the forest protection issue is regulated: "The deep forest is not the deer's, that forest belongs to the ancestors, that forest is children and grandchildren, that forest belongs to grandparents, that forest

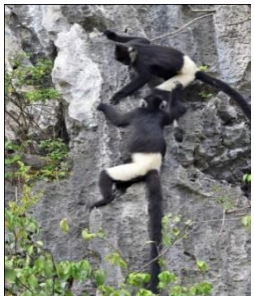
is ours". Therefore, anyone who destroys the forest will be condemned. The Thai customary law regulates the ecological balance between people and forests. The customary law on the protection of aquatic resources in rivers and streams is a customary law of the Muong ethnic community, raised into a custom by Lang, Dao, and dignitaries. This can be considered as a natural response of ethnic minorities, safeguarding sustainable use of biological resources in order to prevent the degradation of ecosystems and biodiversity.

Rhinopithecus avunculus

Paphiopedilum armeniacum

Leiothrix lutea

Paphiopedilum callosum



Trachypithecus delacouri

To support local ethnic communities in conservation, exploitation and use of genetic resources of biodiversity, specific legal documents have been issued. The Biodiversity Law 2008 and the Nagoya Protocol fundamentally protect access to genetic resources, copyright of traditional knowledge about genetic resources and a fair and reasonable sharing of benefits from genetic resources within the framework of the Convention on Biological Diversity to which Vietnam is a party.

The Law on Forestry (2017) stipulates that the State shall allocate and land to ethnic minority people and communities whose income mainly comes from forest for combined forestry-agricultural-fishery production; facilitate cooperation in forest protection and development with forest owners and benefits sharing arising from forests; facilitate practice in culture and beliefs associated with forests according to the Government's regulations (Article 4, Clause 6).

1.2. Ecosystem services in Vietnam

Ecosystem services in Vietnam can be classified into four categories including provisioning, regulating, cultural and supporting services.

1.2.1. Provisioning services

Forest ecosystems provide a range of goods and products that can be classified into two groups: timber and non-timber forest products (NTFPs). Timber can be used as raw material for production of wooden products (e.g. medium density fibreboard (MDF), plywood, paper, pulp, furniture, woodchips, mine pole, scaffold). It is also an important source of energy for home consumption (e.g. heat for cooking and agricultural processing) and electricity generation (in thermal electricity plans) (*FSIV, 2009*).

Rivers, streams, reservoirs and lakes are not only critical for the entire country's agriculture and crop land, however, are also vital for the survival of people there (i.e. provision of drinking water). Rivers and streams are home to many aquatic species that contribute a huge number of fisheries resources (*Truong Hong et al., 2013*). Reservoirs also provide an opportunity to develop fisheries resources that can provide additional livelihood and subsistence support to local communities.

Estuarine ecosystems supply plants (e.g. reeds, sedges, mangroves) and animals (e.g. fish, crabs, worms, prawns) that are consumed or traded by coastal communities. They also provide water for

industrial uses (e.g. cooling, rinsing, chemical reactions) and finite raw materials (e.g. sand from dynamic environments that only naturally renews after a few centuries). A valuation study in Van Uc Estuary (Tien Lang district, Hai Phong city) showed that the ecosystem provides a value of up to 108 USD/ha for clam collection, 622 USD/ha for aquaculture and 10 USD/ha for timber and fuelwood (*USAID, 2015*).

Peatland ecosystems consist of five typical ecological units: (i) *Melaleuca cajuputi* (Myrtaceae) forests; (ii) mixed *Melaleuca cajuputi* forests; (iii) water surface with aquatic plants; (iv) reeds and low brushes; and (v) bold land. According to the Vietnam Environment Administration (VEA) (2014), the average income of households from harvesting timber and non-timber forest products in U Minh Thuong peatland was around 5.40 million VND/year (equivalent to 270 USD/year).

Mangrove, coral reef, and seagrass bed ecosystems provide necessary provisioning services under food and nutrition; fiber, biomass, raw materials, and medicines; fresh water; and energy production. Examples of goods and services provided by marine and coastal ecosystems are found in table 2.

Table 2. Goods and provisioning services provided by marine and coastal ecosystems

Ecosystem type	Use values	Examples
Mangrove forests	Wood supply	In Thua Thien Hue and Quang Nam provinces, wood is supplied for domestic and international timber and furniture industries and international pulp and study manufacturers
	Fruits and leaves	
	Bark (tannin & dye)	
	Medicinal herbs	
	Sugar and honey	
	Seafood and aquaculture production (fish, shrimp, crab, soft body, worms)	
Coral reefs	Building material	In 2015, fisheries and sea food production in the coral reefs surrounding Nha Trang were valued annually to be 2.70 million USD.
	Raw material for the fine arts/craft and product development	
	Seafood production (fish, shellfish, molluscs)	
Seagrass beds	Raw material for the fine arts/craft and product development	Decline of seagrass distribution in Van Phong Bay, Vietnam started in 2004. Findings by Trong-Thach et al., (2020) revealed that the distribution of seagrass meadows had declined by 22.1% with a decreasing annual trend of 12.2 ha. The
	Medicinal herb	
	Alternative fertilizer and food source	

	Supplies fish, shrimp, and molluscs	main causes of seagrass bed loss were related to the conversion of the seagrass meadows into shrimp ponds. This is an example of when a provisioning service such as shrimp cultivation in seagrass meadows, harms the ecosystem, despite the economic benefits of developing aquaculture

(Source: Adapted from Xun (2018), Paudyal et al. (2020), Trong Thach et al. (2020).

Table 3. Annual aquaculture value associated with coral reefs in Nha Trang Bay, 2015

Species group	Quantity (tons)	Total revenue (million USD)	Value added (million USD)
Lobster	220	13.08	4.97
Grouper	37	0.41	0.13
Total aquaculture value		**13.49**	**5.10**

(Source: Quach Thi Khanh Ngoc, 2019)

1.2.2. Regulating services

Forest ecosystems play an important role in the protection of watershed areas in Vietnam by retaining soil, controlling erosion and preventing sedimentation and accumulation of mud and sand from runoff. Forest ecosystems help regulate water flows, reduce surface flow, increase the absorption of water into soil, reduce flooding and improve water quality (*FSIV, 2009; Thai Phien, Tran Duc Toan, 1996*). Natural forest ecosystems provide shelter for many animals such as birds, bees, bats and other insect and reptile species that help to control pests and facilitate pollination in the surrounding area. A study by Emerton et al. (2014) estimated the economic value of pollination and seed dispersal services provided by forest ecosystems in Cat Tien NP by examining the value added to farm crops that are dependent on insect pollination. The results showed a baseline value of 304.16 billion VND (equivalent to 14.38 million USD) for wild insect crop pollination, pest control and seed dispersal services.

Inland freshwater ecosystems provide provisioning services, and less obvious, yet fundamentally crucial regulating services such as water purification, groundwater stock balancing and feeding, salinity stabilization, flood mitigation and sediment transport and retention.

Estuarine ecosystems the process of water exchange through the river mouths of estuarine ecosystems enhances the circulation of water inside estuaries and lagoons, cleans the environment, mitigates pollution and floods for coastal areas and lagoons, maintains water flow by scattering sediment (e.g. from agricultural processes) to the sea and contributes to improving the micro-climate in the region. River mouths are the only natural way to maintain and stabilize water salinity in estuaries and lagoons, maintain ecological balance and community structure and maintain biodiversity in the water area. Species sensitive to water salinity spawn and breed in lagoons and coastal waters, enriching food and coastal resources (*Le Duc An et al., 2011*).

Peatland ecosystems also provide various regulating services, including water supply and storage, flood control and carbon sequestration and storage. A study carried out by Tran Triet (2016) shows that the U Minh peatlands absorb a large amount of rainwater in the wet season and gradually release it during the dry season, providing potable freshwater for local people as well as

for wildlife and agriculture. In addition, peatland ecosystems play an important role in regulating the global climate. According to Truong Hoang Dan, Quach Truong Xuan and Bui Truong Tho (2014), 10-year-old *Malaleuca* forests on peatlands in U Minh Thuong NP have stored about 26.05 to 26.92 tons of carbon/ha.

Marine and coastal ecosystems can help governments save money. Natural benefits of healthy marine and coastal ecosystems include savings in damages during storms and floods, reductions in erosion, water purification, climate regulation, and reductions in the costs of engineering for coastal protection, as depicted in figure 4 below. Scheme shows general mechanics of wave height reduction through habitats, using the example of coral reefs, seagrass beds and mangroves.

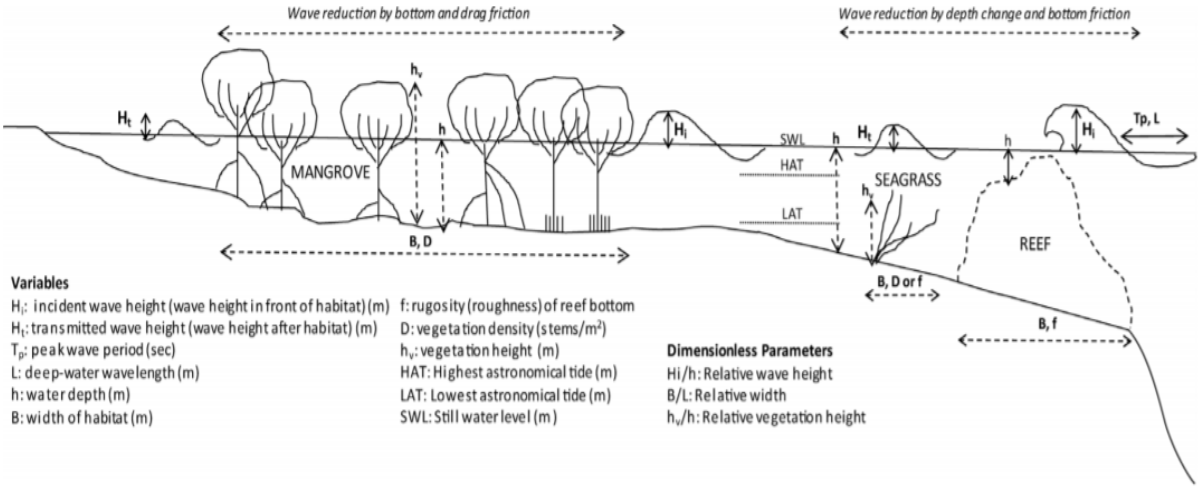


Figure 4. Scheme of wave height reduction across coastal habitats

(Source: Narayan et al., 2016)

1.2.3. Cultural services

Forest ecosystems play an important role in supporting local livelihoods, especially for ethnic groups (53%) who mostly live in remote, mountainous forest areas *(Bann et al., 2017)*. Forest ecosystems also promote tourism sector development, especially ecotourism, through the system of national parks, nature reserves, cultural and historic areas, and a wide range of natural beauty spots throughout the country. Ecotourism is taking off in Vietnam with a high and stable economic value. Especially in national parks, nature reserves and beauty spots, ecotourism has brought many local benefits.

Marine and coastal ecosystems support living organisms both cultural and biotical. A list of all the cultural services provided by key marine and coastal ecosystems of Vietnam, on the other hand is listed in the table 4 below:

Table 4. Goods and cultural services provided by marine and coastal ecosystems

Ecosystem type	Use values	Examples
	Existing values of genes, species, and populations	Research indicates that ecosystem services have greatly contributed to the economic development of the country, to livelihoods, and human life. It has been estimated that the economic value of mangrove ecosystems fluctuates depending on the geographic location from 0.204 to 1.67

Mangrove forests		billion VND/ha/year (equivalent to 9,700 to 79,500 USD/ha/year); coral reef ecosystems: 1.71 to 11.42 billion VND/ha/year (equivalent to 81,500 to 543,800 USD/ha/year); seagrass ecosystem: 0.656 billion VND/ha/year (equivalent to 31,240 USD/ha/year) (*ISPONRE, 2016*).
	Species migration	
	Rare species	
	Existing value of ecosystem	
	Spiritual thought & faith	
	Historical value	
	Local activity	
	Aesthetics	
	Education and scientific research	
Coral reefs	Reserve for biodiversity	In 2015, fisheries and sea food production in the coral reefs surrounding Nha Trang were valued annually to be 2.70 million USD.
	Secondary productivity	
	Food sources for other organisms	
	Existing value of ecosystem	
	Aesthetics	
	Tourism	
	Education and scientific activity	
Coral reefs	Reserve for biodiversity	Seagrass research in Vietnam is increasing according to Fortes et al. (2018), based on the number of research papers that have been produced in the last decade. This shows drastic improvement for the understanding Vietnam has about it is ecosystem and how to better manage it. Opportunities for scientific activity and research also provide opportunity for international funding. For example, between 2011 and 2015, 18.65% of Official Development Aid was directed to environmental and urban development. This is equivalent to 3.58 billion USD. The increase in research and scientific studies in seagrass areas and communities is allowing for the increasing awareness, action, protection, and sustainable development of these areas.
	Species migration	
	Rare species	
	Aesthetics	

	Tourism	
	Education and scientific research	

(Source: Adapted by Xun (2018), Quach Thi Khanh Ngoc (2019), Fortes et al. (2018), Open Development Vietnam (2018), ISPONRE, (2016)).

1.2.4. Supporting services

Supporting services differ from the other services in that their impacts on people are either direct (via provisioning, regulating or cultural services) or occur over a long period time (it is indirect and difficult to see). Therefore, this part will be focused on the three first ecosystems services, including: provisioning, regulating and cultural services. Supporting services will be described in details in item II "Contribution of key ecosystems to the socio-economy".

1.3. Trends of ecosystems

1.3.1. Vietnam's forest cover area is tending to increase mainly by new plantations

In 1990, Vietnam's forest area was only 9,175,000 ha, forest coverage was only 27.8%, but due to afforestation development programs by 2020, the area of forested land qualified for calculating the national coverage rate was 13,919,557 ha, and the forest coverage rate was 42.01% (*MARD, 2021*). According to the report of the Government in 2018, in the 3 years 2016-2018, the area of damaged forest averages 2,430 ha/year. Statistics from MARD, from 2010 to 2020 showed the natural forest area was tending to decrease from 10,304,816 ha in 2010 to 10,279,185 ha in 2020, while the area of planted forests was increasing from 3,083,300 in 2010 to 4,398,030 ha in 2020.

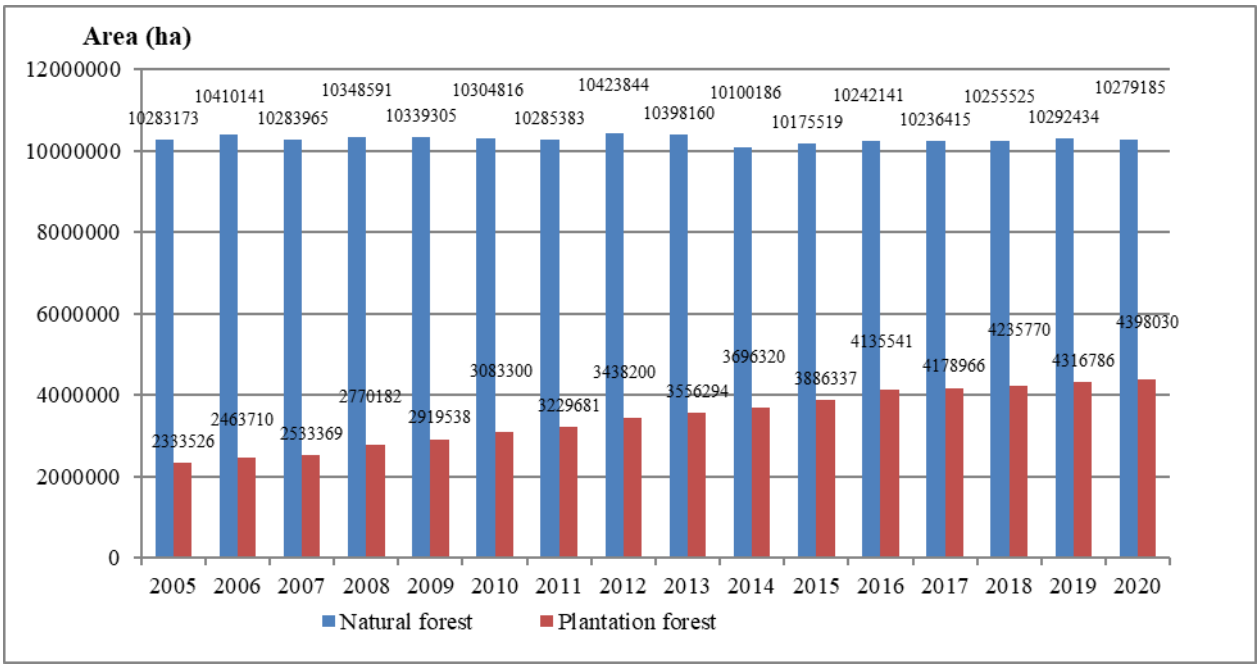


Figure 5. Area (ha) of natural and planted forests from 2005-2020

(Source: MARD, 2006-2021)

The fluctuations of mangroves in Vietnam from 1943 (408,500 ha) to 2009 showed a very strong downward trend to extremely low in 2003 (83,288 ha), i.e. after 60 years, lost 4/5 mangrove

areas. Thanks to the policy on mangroves planting, the area of mangroves from 2007 to 2017 showed an increasing trend.

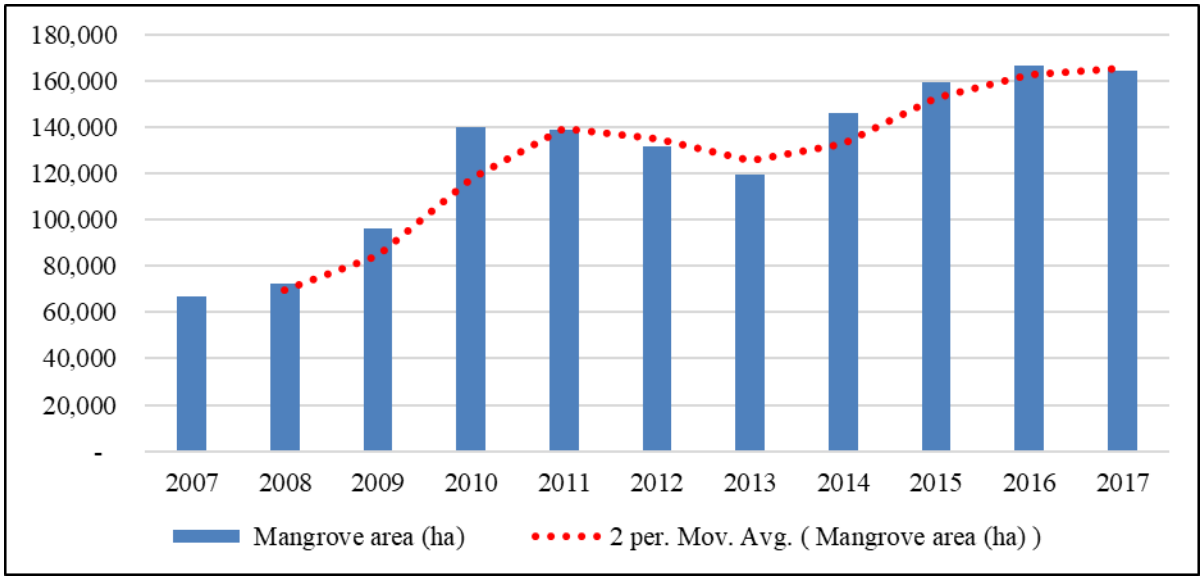


Figure 6. Evolution of mangrove area in the period 2007-2017

(Source: VNFOREST, 2008-2018)

1.3.2. The ecosystems of rivers, streams, lakes, reservoirs and estuarine areas are degraded and biodiversity reduced

Rivers, streams, lakes and reservoirs are inland wetland ecosystems with high biodiversity, with rivers and streams dispersing aquatic animal populations to other inland waters in the basin. Vietnam currently has about 3,450 rivers and streams with a length of over 10 km, distributed in 108 river basins, with 15 basins having an area of over 2,500 km^2 and 10 river basins being wider than 10,000 km^2 (*MONRE, 2015*). The two most important river systems are the Red River system and the Cuu Long River system (Mekong River). The system of rivers and streams is supplemented with a flow of up to 310 billion m^3 of water every year.

Vietnam currently has over 100 natural lakes with an area of 10 ha or more each, and about 7,000 reservoirs for irrigation and hydropower. In particular, hydroelectric reservoirs with a total capacity of about 56 billion m^3, account for about 86% of the total capacity of the reservoirs in the country. The area of natural lakes is reduced due to urbanization and industrialization. At the beginning of the nineteenth century, according to statistics, there were 602 large and small lakes in the (old) Hanoi city. However, over time, this number has decreased significantly.

A remarkable feature occurring in reservoirs is ecological succession. The basic feature affecting the morphology of the reservoir is the process of sediment deposition, a process that gradually filling the reservoir bed. Over time, the volume of water and surface area of the reservoir decreases, and the reservoir becomes a swamp, even a terrestrial ecosystem (*Dang Ngoc Thanh, Ho Thanh Hai et al., 2002*). Another example of succession occurs at Tra O lagoon (Binh Dinh province): during the river-sea interaction and the sand dune displacement, the morphology and position of the lagoon's mouth are changed. More recently, due to the human impacts of the rehabilitation of the lagoon, the succession rate of Tra O lagoon becoming a peat swamp has been accelerated and in the future it will become a lowland area. Currently, local people have been exploiting peat in the eastern part of the lagoon.

Vietnam has 114 estuaries, which are evenly distributed (approximately every 25 km of the coast there is an estuary) throughout the territory of 24 coastal provinces and cities, creating rich and diverse estuarine biota populations with an abundance of fresh, brackish and saltwater ecological adaptation groups. The two largest delta estuaries of Vietnam are the Red River Delta estuary and the Mekong Delta estuary. Ba Lat - the main delta river mouth of the Red River - is the habitat of many species of animals and plants and is a stop for many waterfowl of international importance on their migration path. Dinh An - the largest estuary of the Cuu Long River system - is also an important habitat and breeding ground for many aquatic species migrating from the upper Mekong (*Le Duc An et al., 2011*).

The process of rapid urbanization and industrialization in river basins, estuarine areas and coastal areas has seriously affected the hydrological regime, water flow, and sediment quality of downstream rivers. It is especially evident that due to the large number of hydroelectric dams built on the Mekong mainstream in the middle and upstream areas, the amount of water in the Mekong River including the sediment flows to the Mekong River Delta has been significantly reduced, including a decrease in flood levels and duration. Erosion of the river banks of the Cuu Long River system has also recently increased to a serious level (*MONRE, 2019*).

Untreated domestic and industrial wastewater discharged into free-flowing rivers, lakes, and seas has polluted the environment, degraded aquatic ecosystems, and reduced biodiversity: causing algal blooms in inland freshwater lakes and red tides in some coastal areas, killing many aquatic animals, especially fish (*MONRE 2019*).

1.3.3. The peat swamp is reduced in area and in thickness of the peat layer

Peat swamps are scatteredly distributed in Vietnam. U Minh Thuong (Kien Giang province) and U Minh Ha (Ca Mau province) are considered as two places to keep the largest remaining area of cajeput forest on remnant peatland in Vietnam. According to previous data, in 1950 the cajeput forest area in U Minh had up to 400,000 ha, but by 1970 there were only 200,000 ha. In 1976, the Vietnam Geological Survey recorded 12,400 ha of peatland in U Minh Thuong and 20,200 ha of peatland in U Minh Ha. Currently, the area of peatland is only 2,800 ha in U Minh Thuong and 7,500 ha in U Minh Ha with the thickness of peat layers ranging from 0.4 to 1.2 m (*Tran Triet, 2016*).

1.3.4. The natural tidal flats are affected

A large area of tidal flats is used for coastal aquaculture. The indiscriminate exploitation of aquaculture has caused many serious ecological consequences such as imbalances of different ecosystems in the tidal zone. Environmental pollution in the tidal zone comes from intensive or unmanaged industrial farming and other human activities that occur on a large scale in the coastal zone.

1.3.5. Lagoons are degraded in different degrees

All 12 ecosystems of lagoons in the Central Coast have been degraded to different degrees in both structure and function, and the distribution area and volume of lagoon water have been reduced in terms of space and time. There have been manifestations of local environmental pollution in some lagoons such as Tam Giang - Cau Hai and Nai lagoons, with heavy metal elements such as As, Cu exceeding the permitted standard for ISQG at the top of the lagoon and along the sluice gates, transported by canals from the inland into the lagoon (*Nguyen Van Quan et al., 2015*).

1.3.6. Coral reefs in the sea of Vietnam are declining in area and coverage of live coral

Within Vietnam's sea, four main coral distribution areas can be distinguished: coral areas in the archipelago of the Hoang Sa and Truong Sa; coral areas of Central coastal and Southeastern islands; coral areas of the western coast of Tonkin Gulf; and coral areas of the Southwest coast. Among key marine ecosystems, the coral reef ecosystem is considered to be the most vulnerable to climate change.

In the period of 2008-2010, the total area of Vietnam's coral reef was about 14,130 ha (*Institute of Marine Resources and Environment*). According to data from Nguyen Van Long and Vo Si Tuan (2014), there were 403 hard coral species with the total area of coral reefs in Vietnam's waters was 13,355 ha including 9,179 ha within existing MPAs. The live coral coverage of coral reefs in coastal areas is decreasing over time. Only about 1% of the coral reefs had a high coverage (with a coverage > 75%) while the number of coral reefs with a low cover accounted for over 31% (with a coverage < 25%), and the number of coral reefs with medium to fair coverage were 41% and 26% respectively (*Institute of Oceanography, 2008*).

Identified threats to coral reefs include: overexploitation, destructive fishing, sediment deposition, pollution, outbreaks of predatory organisms such as sea starfish, black prickles, invasions of seaweed, and natural disasters such as: algal blooms on a large scale in Ca Na Bay in 2002; outbreaks of starfish in the bays of Nha Trang, Van Phong and Cu Lao Cham (2002-2004); cumulative effects of high temperature and low salinity in a short period in Con Dao (2005); flood waters from the mainland affecting coral reefs in Cu Lao Cham waters (2006); and mass bleaching of corals in Phu Quoc waters (2010) (*Vo Si Tuan et al., 2005, 2013*). Studies on the status of animals living in reefs in coastal areas of Vietnam also reflect the poor status of species composition of groups such as fish, mollusks, echinoderms and crustaceans (*Vo Si Tuan et al., 2008*). This shows the fact that coastal coral reefs in Vietnam are in a serious decline due to over-exploitation, inappropriate use and environmental pollution.

1.3.7. Seagrass beds are decreasing in area

According to Nguyen Van Tien (2013), Vietnam's seagrass area was 8,130 ha. According to the statistics using newly published remote sensing technology of Cao Van Luong et al. (2012), the area of coastal seagrass in Vietnam was about 17,000 ha, scattered in the bays and coastal waters around islands and in lagoons. The largest area of seagrass was in the shallow waters of the Phu Quoc island (over 10,000 ha) with 9 species (*Tien et al., 2006*).

Seagrass species play an important role in coastal ecosystems and human life. The area of seagrass in Vietnam is tending to decrease over time. Over the past two decades, the area of seagrass has decreased by 45.4% and the average annual reduction rate was 4.4% (*Nguyen Thi Thien Huong et al., 2017*). Cao Van Luong et al. (2012) have shown that the seagrass area has decreased by 50% compared to 1999, while the area of seagrass beds in Tam Giang-Cau Hai lagoon have decreased by 60% of compared to 1999. The decline in seagrass beds is mainly due to human activities such as fishing, anchoring, and aquaculture causing environmental pollution, and increasing water turbidity; and activities of building ports and constructions for tourism. (*MONRE, 2019*).

1.3.8. The number of threatened species increases

In the Viet Nam Red Book (2007), the total number of threatened species is listed as 882 species, consisting of 418 animal species and 464 plant species. Of the latter figure, nine species are considered extinct in the wild in Viet Nam, namely *Dicerorhynus sumatrensis*, *Bos sauveli*,

Tapirus indicus, *Cynogale lowei*, *Procypris merus*, *Anguilla japonica*, *Cyprinus multitaeniata*, *Cervus nippon*, and *Crocodylus porosus*.

The number of endangered species is increasing according to the project: "*Survey and assessment of endangered species that should be given priority for protection aiming at amending the Vietnam Red Book*" conducted in 2014-2017. The Institute of Ecology and Biological Resources of the Vietnam Academy of Science and Technology was the lead agency in coordination with a number of other research institutes that have proposed to list 1,211 species with new ranking levels in the next edition of the Vietnam Red Book including: 600 plant and fungi species and 611 animals. Thus, compared with the Vietnam Red Book 2007, the number of species proposed for the next version of the Red Data Book of Vietnam is much higher (*MONRE, 2019*).

1.3.9. The number of individuals of endangered species has either declined or not been seen for a long time

Notably, in 2011, the subspecies of Vietnam Rhino (*Rhinoceros sondaicusannamiticus*) became officially extinct in Vietnam (*Gersmann, 2011*). In the world of flora, the spectacular Vietnamese orchid (*Paphiopedilum vietnamense*) became extinct in nature.

The results of multi-year monitoring in some important bird areas show that the number of individuals of rare and precious species, especially globally endangered migratory birds in the PAs has decreased, such as the spoonbill (*Platalea minor*) in Xuan Thuy NP and cranes (*Grus antigone*) in Dong Thap NP and Phu My Wetlands NR (Kien Giang province), and even some species have not been seen again for many years.

According to a survey conducted by WWF in 2003, Phu Quoc and Con Dao are two of Vietnam's last marine areas to have *Dugong dugon*, but the population numbers no more than 100. However, according to the management board of Phu Quoc Marine MPA (2016), *Dugong dugon* has not been seen recently in the reserve's seagrass beds due to hunting and degradation of habitat.

II. CONTRIBUTION OF KEY ECOSYSTEMS TO THE SOCIO-ECONOMY

2.1. Benefits from ecosystem services in Vietnam

Vietnam has three key ecosystems such as forests, wetlands, and marine and coastal ecosystems, which, besides having the highest levels of biodiversity, also provide many important goods and services to the economy (especially for agriculture, forestry, fisheries, industry, tourism), to the environment and to human well-being through their four groups of ecosystem services.

Ecosystem services are divided into four groups: (i) provisioning services: products obtained from forest, wetland and marine ecosystems (food, firewood, fibers, construction materials, etc.); (ii) regulating services: climate regulation, water regulation, carbon storage and sequestration, etc.; (iii) cultural services: non-material benefits (spiritual and religious, recreational and ecotourism, aesthetics, etc.); and (iv) support services: nutrient cycle, soil formation, photosynthesis, etc. (*MA, 2005*).

Although not often recognized, the exploitation and use of ecosystem services in Vietnam has contributed significantly to the national economy, especially in the fields of agriculture and forestry, fisheries, tourism and health. According to the Statistical Yearbook (2021), the agriculture, forestry and fishery sectors contributed significantly to the gross domestic product (GDP), their export value increased from 19 billion USD in 2010 to 41.25 billion USD in 2020, accounting for 14.6% of the country's export turnover and 14.85% of GDP in 2020, and 12.36% of GDP in 2021.

About 20 million Vietnamese people derive either their main or partial income from aquatic resources and are exploiting and using more than 300 species of seafood and more than 50 species of economically valuable freshwater fish; about 25 million people live in or near forests and 20-50% of their income comes from non-timber forest products, including hundreds of species of medicinal plants, oil crops, dyes (*MARD, 2020*). Natural ecosystems with high biodiversity are also the foundation for ecotourism that is becoming a popular service in PAs, providing a means for exploring and educating on nature protection, as well as a source of benefit sharing for local people that join in providing the service. In addition to socio-economic and cultural values, ecosystems also provide many other important services: types of forest vegetation on land as well as in coastal waters help regulate the climate and respond to climate change through carbon storage, air and water filtration, waste decomposition, and reduction of the negative impacts of natural disasters such as landslides and floods.

2.1.1. Contribution of provisioning services

The forest ecosystem provides timber and non-timber forest products, and is also home to the highest level of biodiversity among terrestrial ecosystems with many endangered, endemic and economic species. In 2019, the forest provided nearly 30 million m^3 of timber harvested from planted forests and natural forests. The whole country has planted 239,152 ha of forest, of which 11,830 ha were protection and special-use forests and 227,322 ha were production forests. In 2019, Vietnam's export value of wood products reached 10.50 billion USD, accounting for 4.3% of the country's export turnover. Non-timber forest products are significant for the livelihoods of 25 million forest-dependent people (with 20-25% of total income coming from non-timber forest products) and are significant for the national economy, with a total export value in 2019 of 600 million USD (*MARD, 2020*).

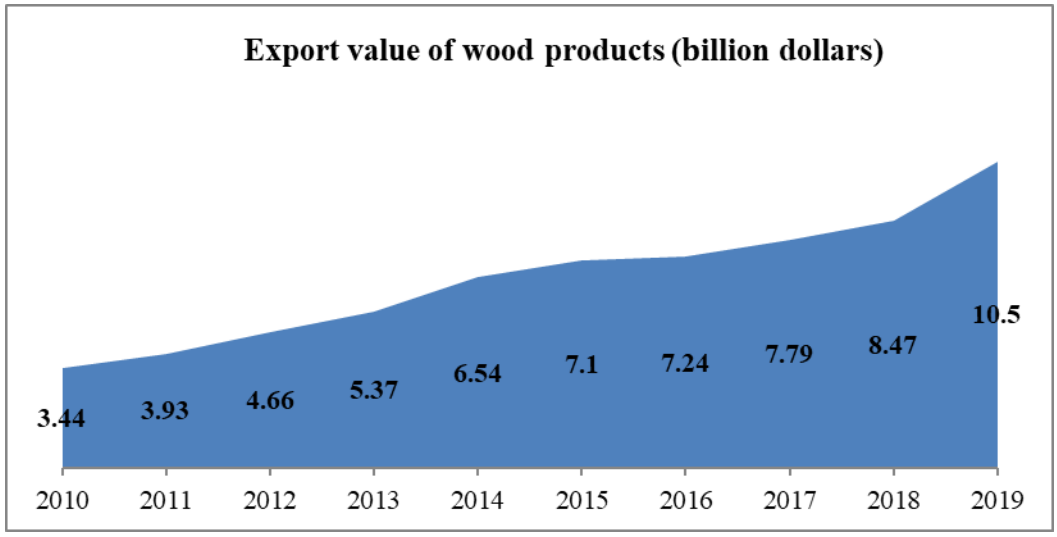


Figure 7. Export value of wood products of Vietnam, 2010-2019

(*Source: MARD, 2011-2020*)

Recent inventory and evaluation results show that about 20% of firewood traded in the market is the remainder of the forest after being harvested. In addition, the forest ecosystems provided over 60,000 tons of valuable non-timber forest products (NTFPs) to local communities and to the economy. As of 2017, these products include about 3,830 medicinal species (of which, 1,800 species of pharmacological value), 500 essential oil species, 620 fungus species, 820 algae

species, 40 rattan species, 76 balsamic species, 600 tannins species, and 823 fatty oil species (*MARD, 2018*).

Wetlands in Vietnam cover an area of 11,847,975 ha (accounting for 37% of the natural area and distributed in most ecological regions), inland water ecosystems are important for the economy and human well-being in Vietnam. They are habitats to 1,028 species of fish and about 800 species of invertebrates, while about 300 other vertebrates (frogs, water birds, and mammals) have a life associated with the inland water environment.

Inland water ecosystems make a substantial contribution through the provision of aquatic products for human food, meeting the needs of domestic use and export. In 2019, the catch of aquatic products in domestic freshwater ecosystems reached 208.50 thousand tons. The total area of aquaculture including both brackish-salty and freshwater farming in 2019 was about 730 thousand ha, with an estimated output of 4,432 thousand tons, making a major contribution to seafood export turnover in 2019 (about 8.60 billion USD) (*Directorate of Fisheries, 2020*). In addition, wetland ecosystems play an important role in the development of many sectors, such as aquaculture, forestry, transportation, energy, tourism, and mining.

The Mekong River Delta is the largest wetland area with an area of over 4 million ha, accounting for 41% of the country's total wetland area. The region is home to nearly 20 million people and is one of the most fertile and productive deltas in the world. By providing 55% of the country's rice (22-24 million tons of rice that feed 145 million people worldwide), 65% of the country's fruit (4 million tons) and 74% of the country's aquaculture output (3.5 million tons), the Mekong River Delta is the most important agricultural region in Vietnam, contributing 20% of the country's GDP (*Unique, 2018*).

Vietnam's exclusive economic marine waters of over 1 million km^2 have more than 3,000 islands, large and small, and 2 archipelagos of Hoang Sa and Truong Sa, with a coastline of over 3,260 km. There are about 20 types of marine and coastal ecosystems, home to nearly 12,000 known marine species. The important marine and coastal ecosystems are coral reefs, seagrass beds, lagoons, bays, coastal islands, and seas (*MONRE, 2019*). The average total reserves of major marine resources groups in Vietnam are estimated at 4.36 million tons. In 2019, seafood exploitation was estimated at 3,560 thousand tons; Aquaculture production was estimated at 4,432 thousand tons. Export turnover of the fishery sector in 2019 reached 8.54 billion USD, lower than in year 2018's total of 8.80 billion USD (*Directorate of Fisheries, 2020*).

In marine ecosystems, coral reef and seagrass ecosystems are areas with the highest biodiversity and biological productivity, providing people with many valuable resources, such as coral reefs with coral fish of high economic value, ornamental fish species, crustaceans, molluscs, echinoderms, and sea turtles. Many species of coral reefs include: group of sponges, groups of soft corals and echinoderm groups that contains valuable biologically active ingredients, raw materials for the manufacture of important pharmaceuticals. Compounds of the saponin class, steroid, diterpene, glycolipid, and several other compounds have been isolated and their structures elucidated. Among the compounds obtained, there are those that show antibiotic and cytotoxic activity on some experimental cancer cell lines. In addition, a number of compounds were assessed for their anti-inflammatory, anti-osteoporosis and antioxidant properties (*Chau Van Minh et al., 2012*). Seagrass beds provide food for many species of marine animals, especially the dugong. Out of nearly 12,000 marine species, there are 124 species living in corals, crustaceans, molluscs, sea fish, sea turtles and marine mammals listed in the Red Data Book of Vietnam (2007) with different levels of threat.

In the offshore waters, besides biological resources, oil and gas resources are valuable, making an important contribution to the national economy.

2.1.2. Contribution of regulating services

Forest ecosystems play an important role in watershed and coastal protection, including: reducing soil erosion and sedimentation, controlling runoff, flooding; and regulating water quality. The loss of forest cover due to unplanned harvesting or land use conversion will result in serious consequences for the watershed-related functions of forests. Forests are very important in reducing surface water flow and increasing infiltration. Watershed forests, especially natural forests with a multilayered canopy are very important in maintaining water flow rates during rainy seasons and in supplying water during dry seasons for local use, hydropower generation and irrigation. Over the past few years, floods have occurred in many provinces in the central and the northern areas of the country. One of the main causes is forest destruction (*MARD, 2021*).

Wetland ecosystems provide water regulation, groundwater regeneration, flood control and wind storm mitigation services. In addition to the ability to store carbon, the coastal mangrove ecosystems also have the value of protecting and developing the shoreline, by keeping and increasing the amount of sediments, filtering water, and reducing the impact of storms on coastal areas.

Marine and coastal ecosystems such as coral reefs and seagrass beds are compared to submarine barrier that protect coastlines and islands from landslides. Wave energy is reduced as it passes through the reef, and the reduction is proportional to the width and magnitude of the reef. Air-conditioning is undertaken by seagrass with each square meter of seagrass able to produce 10 liters of dissolved oxygen, contributing to the balance of the concentration of O_2 and CO_2 in the water environment. This assists in minimizing the impact of greenhouse gases by increasing the CO_2 absorption capacity of seawater (*Nguyen Van Tien et al., 2004*). Seagrass ecosystem is capable of filtering water and treating waste.

2.1.3. Contribution of cultural services

Forest ecosystems are a very important part of Vietnamese culture both mentally and recreationally. Anthropological studies in Vietnam have shown a close relationship between natural ecosystems and the livelihoods and cultures of indigenous peoples. Many sacred forests are protected by ethnic minority communities whose cultural rituals are all related to forests and natural resources (*Bann et al., 2017*). The tropical and sub-tropical forest ecosystems in Vietnam with high biodiversity and tangible and attractive beauty are planned to be PAs, which are the basis for scientific research, education and development of the ecotourism industry. There are models of ecotourism associated with biodiversity conservation and with the participation of local communities that promote economic growth, help diversify livelihoods, and alleviate poverty.

Vietnam's wetland ecosystems are closely linked to the cultural and religious formation of many local communities. Wetlands are the source of wet rice civilization of all ethnic communities in Vietnam. Nature reserves with wetlands such as Ba Be NP (Ba Be Lake), Phong Nha-Ke Bang NP (river and lake systems underground in caves) or PAs of mangrove forests have been developed for ecotourism, scientific research and education.

Vietnam's marine and coastal ecosystems have beautiful natural landscapes such as lagoons, bays, coastal islands with coral reefs, seagrass beds, and sandy beaches, which are important conditions for the development of the ecotourism industry, entertainment and relaxation. The coastal area of Central Vietnam is considered as the region where the ecotourism industry has the fastest growth rate. In 2017, about 310,000 visitors visited the famous coastal landmarks of Quy Nhon (Binh Dinh province), and in 2018, the number of visitors increased by 6.2%, to 329,000

people. According to statistics from the Ministry of Culture, Sports and Tourism, 974,000 international visitors (with average daily spending of 97.83 USD/person) and 3,097,000 domestic visitors (with average spending per a day was 52.81 USD/person) visited the coastal city of Nha Trang in 2015 and contributed 321 million USD to total revenue for the city (*Quach Thi Khanh Ngoc, 2015*).

2.1.4. Contribution of supporting services

Forest ecosystems, including mangroves with 41.89% coverage, are suppliers of oxygen through the fixation of carbon dioxide (CO_2) during photosynthesis and the creation of a giant natural biomass. At the same time, they form a nutritional cycle and food chain with different links for groups of organisms to grow and develop.

Wetland ecosystems of over 11 million ha play an important role in providing water through hydrological cycles. Biological-geo-hydrological processes take place in the water environment to form a rich and diverse aquatic system.

Vietnam's marine and coastal ecosystems with an area three times the land area play an important role in creating vast resources for human use including biologically and abiotic products through hydrological cycles, and the marine geology development cycle.

2.2. Forest ecosystems in Vietnam contribute to the socio-economy through payments for forest environmental services

Payment for forest environmental services is a breakthrough policy in the forestry sector in Vietnam. After 10 years of implementation, this policy has achieved many successes in the fields of economy, society, and environment and was recognized as one of the ten greatest achievements of the forestry sector in the period 2011-2015 (*MARD, 2017*). Revenue from PFES currently accounts for 18.5% of the total annual investment of the whole society in the forestry sector.

By the end of 2020, three out of the five types of PFES have generated payments, including: (i) soil protection and erosion control services; (ii) services for regulating and maintaining water sources for production; and (iii) natural landscape protection and biodiversity conservation services for tourism. Two out of five types of PFES have still not yet yielded payments, including: (i) storing and absorbing carbon and (ii) providing spawning grounds, food sources, natural seed, and water sources for aquaculture activities. However, according to the evaluation report of the Vietnam Forest and Delta Program Project (VFD) (2021), the policy of payment for forest environmental services has recorded many remarkable achievements.

Since its implementation, PFES mechanism has generated a total revenue of 16,746 billion VND (equivalent to 728.09 million USD) or 1,674 billion VND/year on average (equivalent to 72.78 million USD/year on average), equivalent to 95.3% of the total state budget and 18.5% of social budget for forestry sector. These figures grew quickly and then stabilised over 2018-2020, providing a sustainable funding source for forest protection and development in Vietnam, and greatly contributing to the reduction of presure on the state budget.

Figure 8 below presents PFES revenues collected from forest environmental service users per year from 2011-2020 (Unit: billion VND).

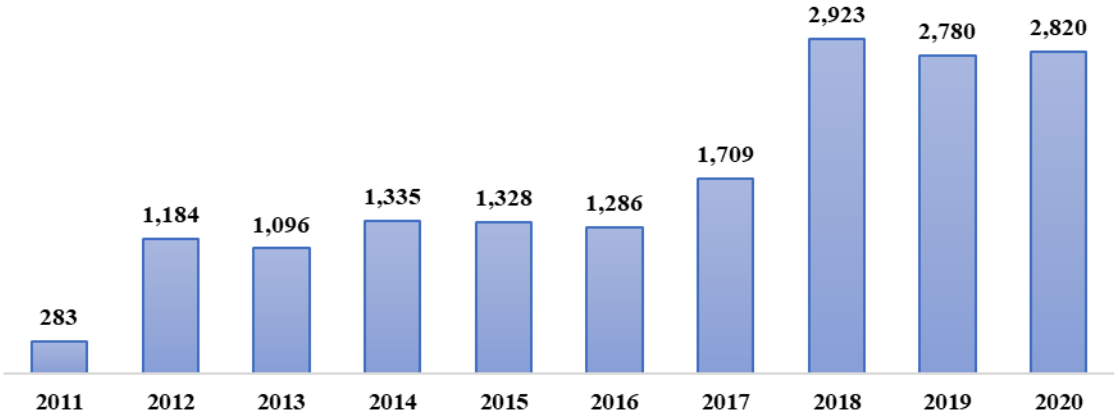


Figure 8. Revenue generated through PFES during 2011-2020

(Source: VFD, 2021)

From the environmental aspect, PFES revenue has supported to the management and protection of over 6.5 million ha of forests (equivalent to 45% of total forest area of the country), helping to maintain forest cover, improving forest quality and the ecological environment, and mitigating negative impacts caused by climate change.

From the social aspect, PFES revenue has been paid to more than 250,000 households (with an average amount that accounts for 15% of the total household's income) and 10.000 communities (with an average amount of 50 million VND per community per year), contributing to raising incomes for forestry workers, especially for ethnic minority communities living in remote mountainous areas. In addition, PFES policy has created jobs and positive changes in the awareness and responsibility of stakeholders towards forest protection and management.

According to a recent study implemented by the Vietnam Forest and Delta Program (VFD), PFES policy will still be an important policy in the period of 2021-2030. The expected PFES revenues are 3,500 billion VND in 2025 and over 4,000 billion VND in 2030 (equivalent to 30-35% of social investment in the forestry sector). Approximately, 300.000 individuals and households will be paid at the rate that is equivalent to 20% of their total income, and 7 million ha of forests will be well managed and protected.

According to the thematic report "Summary of 10 years implementation of PFES policy in the period 2011-2020 and development orientation in the period of 2021-2030" carried out by Winrock International (2021), PFES has always been and will be an extremely important policy of the forestry sector. However, this policy has some shortcomings and limitations as follows: (i) PFES potential has not been fully realised, especially in the areas of ecotourism, aquaculture and carbon sequestration; (ii) the direct payment mode is limited because there are too many service providers; (iii) there has been a large difference in payment levels among different watersheds, localities, communities and households; (iv) PFES income is still low; (v) awareness of PFES and the forest protection fund is limited and inconsistent; and (vi) some regulations are still unclear and inappropriate, making them difficult to apply, especially those related to the monitoring and evaluation system to adjust the quality of paid services.

2.3. Studies on evaluation of ecosystem services in Vietnam

2.3.1. An overview on evaluation research of ecosystem services in Vietnam

Ecosystem service evaluation studies that have been conducted for the first time in Vietnam since the 1990s have focused on mangrove ecosystems in Nam Dinh and Can Gio (Ho Chi Minh City) by Nguyen Hoang Tri et al. (1996, 2000). Nguyen Duc Thanh (1996) studied the ecotourism value of Cuc Phuong NP. Pham Khanh Nam (2003) estimated ecotourism values of Hon Mun Nature Reserve (now Nha Trang Bay NP).

In the early 2000s, the Department of Science, Technology and Environment (DOSTE) of several provinces started to explore the values of their important ecosystem services. From 2005-2007, the Vietnam Academy of Forest Sciences has conducted estimates of the economic value of goods (such as timber, fuelwood, non-timber products) and services (i.e. watershed protection, coastal protection, carbon sequestration and recreational values) of plantations and natural forests of different forest types in Northern, Central and Southern regions of Vietnam.

Also in this period, Nguyen Minh Huyen et al. (2010) and Nguyen Quang Hung et al. (2013) estimated the economic value of mangrove ecosystems in Quang Ninh, Hai Phong, Nghe An and Ca Mau provinces.

In 2013, in Lam Dong province, the value of goods and services of Bidoup-Nui Ba NP was estimated. Tran Dinh Lan et al. (2015) estimated the value of groups of goods and services of the marine ecosystems of Bach Long Vi, Con Co and Tho Chu archipelagoes.

ISPONRE (2017) estimated the economic value of coastal wetland ESs in Thai Thuy district (Thai Binh province) and in Tam Giang-Cau Hai lagoon (Thua Thien Hue province).

By the end of 2017, there have been hundreds of studies evaluating ecosystem services across the country conducted by institutes and international organizations. The quality of the evaluation studies has been greatly improved by adopting standardized evaluation methods at an international level as well as the use of updated input information.

Most studies on the economic value of ecosystem services in Vietnam often focus on terrestrial natural forest and mangrove ecosystems. Some studies of the on economic values of a number of other important coastal ecosystems such as coral reefs and seagrass beds have also been undertaken. Other ecosystems such as inland wetlands, lagoons and coastal bays have had little research on the evaluation of ecosystem services. Especially, the ecosystem services for offshore islands, continental slopes and deep sea areas have not been studied (*MONRE, 2019*).

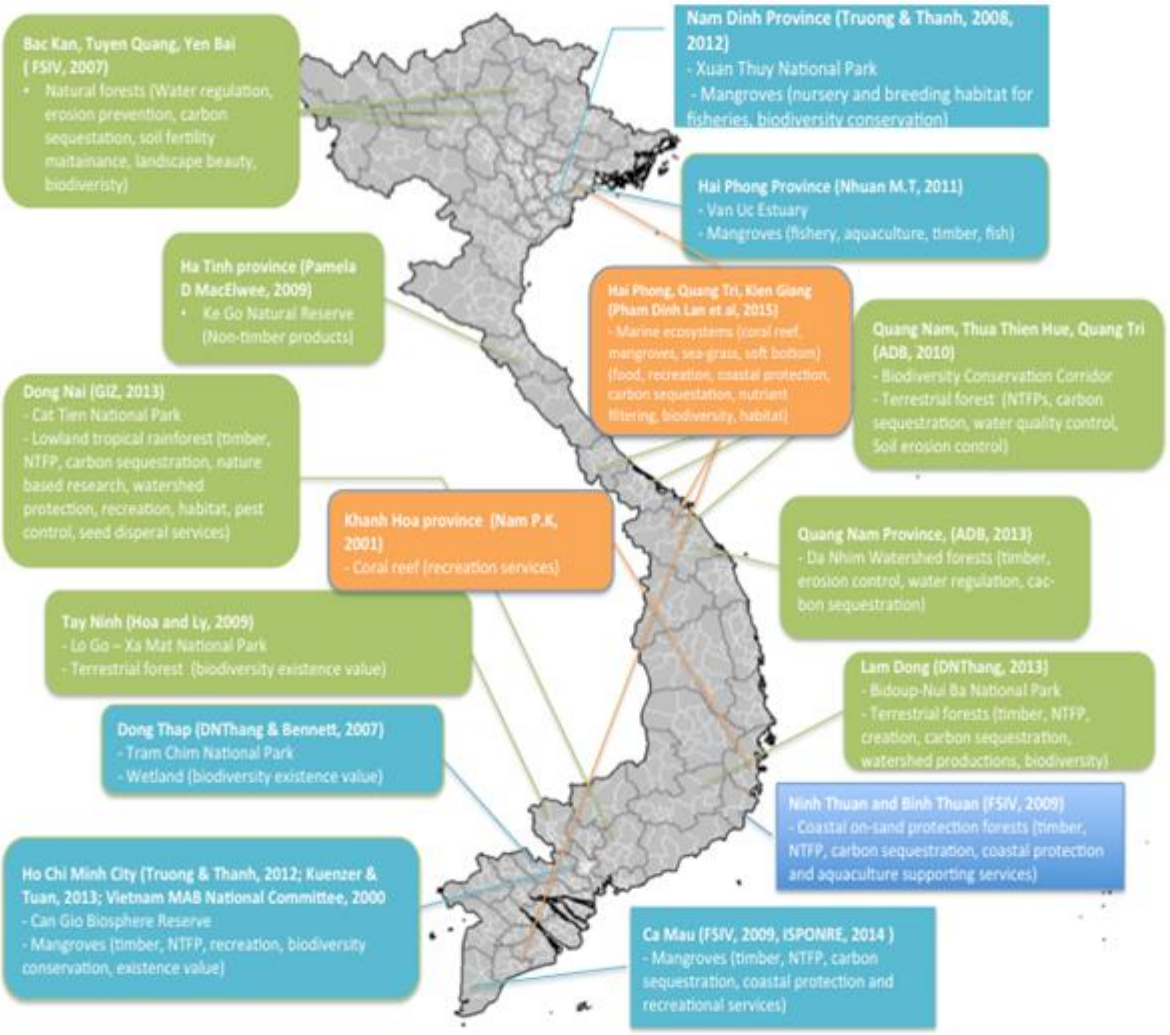


Figure 9. Some studies on ecosystem service valuation in Vietnam

(Source: Mark Fenn and Tran Thi Thu Ha, 2017)

2.3.2. Economic value of ecosystem services in Vietnam

Economic value of forest ecosystem services: The economic value studies of Cat Tien NP have been carried out within the framework of the project "ValuES of GIZ and MARD. The study found that ecosystem services of Cat Tien NP generated an amount of goods and services worth up to 51.60 million USD in 2012. However, over time, these values will begin to decrease and deplete as ecosystems are transformed and Cat Tien NP's ability to provide ecosystem services deteriorates. Cumulative losses will amount to 2,255 billion VND (equivalent to 107 million USD) over the next twenty-five years if Cat Tien NP is not preserved.

Table 5. Economic value of forest ecosystem services of Cat Tien National Park

Ecosystem service	Billion VND	Million USD
Wood products	8.79	0.42
Plant-based non-timber forest products	34.4	1.63

Animal-based non-timber forest products	15.45	0.73
Water flow & quality regulation	536.01	25.34
Carbon sequestration	175.54	8.30
Pollination and seed dispersal	304.16	14.38
Nature-based recreation and education	16.33	0.77
Total	**1,091**	**51.60**

(Source: Emerton et al., 2014)

Economic value of wetland ecosystem services: Dinh Duc Truong (2010) conducted a partial and a full evaluation of ecosystem services in Xuan Thuy NP. The total direct use value was 81,710 million VND/year (equivalent to 4.09 million USD/year); the total indirect use value was 6,510 million VND/year (equivalent to 325,550 USD/year); the biodiversity conservation value was 399 million VND/year (equivalent to 19,950 USD/year).

Table 6. Economic values of goods and services provided by wetland ecosystem in Xuan Thuy NP

No.	**Ecosystem service**	**Economic value** (million VND/year**)**	**Economic value (**USD/ year**)**	**Economic value** (million VND/ha/ year)	**Economic value (**USD/ha/ year**)**	**Share of economic value of service in the total value**
DIRECT USE VALUE						
1	Shrimp cultivation support	7,388	369,400	4.20	210	7.42
2	Clam cultivation support	38,100	1,905,000	84.00	4200	42.50
3	Clam larvae supply	12,000	600,000	60.00	3000	13.40
4	Crab cultivation support	7,000	350,000	11.60	580	7.81
5	Seaweed supply	3,600	180,000	6.00	300	4.02
6	Honey	2,100	105,000	0.60	30	2.34
7	Aquatic products supply in the core zone	9,100	455,000	2.90	145	10.20
8	Recreation	2,421				2.70
Total use value		**81,710**	**4,090,000**			**90.40**
NON-DIRECT USE VALUE						
1	Aquaculture production support	3,071	153,550	16.60	830.00	3.43
2	Coastal protection service	1,520	76,000	0.49	24.50	1.70
3	Carbon sequestration	1,920	96,000	0.62	31.00	2.15
Total non-direct use value		**6,510**	**325,550**			**7.28**
NON-USE VALUE						
1	Biodiversity conservation	399	19,950			0.45

(Source: Dinh Duc Truong, 2010)

Economic value of coastal and marine ecosystem services: Tran Dinh Lan et al. (2015) assessed the value of groups of goods and services of marine ecosystems in Bach Long Vi, Con Co and Tho Chu archipelago, and identified: the total economic value of marine ecosystems services around selected islands in Vietnam was estimated to fluctuate between 267.5 billion VND

(equivalent to 12 million USD) to 599 billion VND (equivalent to 26.62 million USD). The total economic value of marine ecosystems in the island Bach Long Vi island (Hai Phong city) was estimated to reach 599 billion VND/year (equivalent to 26.62 million USD), with an average of 94 million VND/ha/year (equivalent to 4,200 USD); in Con Co island (Quang Tri province) it reached 267.50 billion VND/year (equivalent to 12 million USD), with an average of 307 million VND/1ha/year (equivalent to 13,650 USD); and in Tho Chu island (Kien Giang province) it reached 565.20 billion VND/year (equivalent to 25 million USD), with an average of 125.47 million VND/ha/year (equivalent to 5,576 USD).

Table 7. Economic values of ecosystem services of Bach Long Vi, Con Co and Tho Chu islands

Value type	Ecosystem	Ecosystem service	Valuation method	Value (VND million/year)		
				Bach Long Vi	Con Co	Tho Chu
Direct use value	Tidal ecosystem	Food (fish, crab, shrimp, clam)	Market price	309	6,399	5,742
	Coral reef and soft bed ecosystem	Food (fish, crab, shrimp, clam)	Market price	378,341	144,994	324,978
	Marine ecosystem as a whole (including tidal and coral reef and soft bed ecosystems)	Recreation (tourism)	Travel cost method (zonal approach)	11,750	14,980	24,600
In-direct use value	Coral reef and soft bed ecosystem	Storm protection, soil erosion prevention	Avoided cost from sea dyke construction to protect the island	17,236	23,012	44,108
	Marine ecosystem as a whole (including tidal and coral reef and soft bed ecosystems)	Carbon sequestration	Market price (carbon credit price)	107	12	3.34
		Nutrient filter	Cost of water treatment/ Avoided cost from water pollution treatment	113,595	45,418	99,216
		Biodiversity, breeding ground, habitat	Benefit transfer (Alan White, 1998)/ Contingent valuation	75,730	30,279	66,144
Non-use value	Marine ecosystem as a whole (including tidal and coral reef and soft bed ecosystems)	Non-use value, option value, and bequest value	Contingent valuation	1,950	2,425	444

(Source: Tran Dinh Lan, et al., 2015)

2.4. Trends of ecosystem services

2.4.1. Ecosystems are changing and being degraded

Most of Vietnam's important ecosystems such as primary/natural forests, wetlands, coral reefs, seagrass beds, etc. have been reduced in area and become degraded while biodiversity levels have decreased, threatened species have increased, and the number of individuals of endangered species has decreased with some species not being seen for a long time. Over the past 50 years, humans have changed their ecosystems faster and more broadly than at any other period in human history in response to the rapidly growing demand for food, fresh water, wood, fiber and fuels (*MA, 2005*).

2.4.2. Ecosystem services are tending to decline

In Vietnam, population growth leads to increased demand for resources and energy, leading to increased resource exploitation activities. Some economic sectors such as agriculture, industry and trade, and tourism, tend to increase output in order to meet the increasing needs of people. The increasing demand for valuable products of the provisioning services leads to the decline in other ecosystem services. This can be seen as the downside of achieving a significant high level of development of a number of economic sectors in Vietnam over the years, such as agriculture, forestry, fisheries, tourism and mining, which have made trade-offs with ecosystem degradation, biodiversity degradation, and consequently, degradation of ecosystem services.14 of the 18 categories of the contributions of nature that were assessed, mostly regulating and non-material services of ecosystems, have declined (*IPBES, 2019*). Especially, human infectious diseases such as the pandemic caused by the Corona virus from late 2019 until now have not been controlled. The declining trends suggest over-exploitation of biological and non-biological resources; combining these human use factors with the rapid manifestation of climate change impacts leads to declining ecosystem services.

2.5. Public awareness on benefits of ecosystem services

In Vietnam, management agencies from central to local levels, ecosystems have been mainly seen as biodiversity with their main value coming from biological resources (e.g. tree and animal resources) and along with precious and rare genetic resources. Even in laws on biodiversity in Vietnam, the concept of *ecosystem services* has not been mentioned.

From the above-mentioned biodiversity approach, the common perception of society about the contribution of ecosystem services to the national economy and human welfare can be said to be superficial. For some local leaders, biodiversity conservation is a notion of luxury, or even an obstacle to socio-economic development.

III. DRIVERS AND PRESSURES TO CHANGES IN ECOSYSTEM SERVICES AND ITS IMPACTS ON THE SOCIO-ECONOMY

3.1. The drivers of change in the status and trends of ecosystems services

Drivers are the basic factors that create pressures that affect the ecosystem's ability to provide goods and services.

3.1.1. Demographic changes have increased the need for resources

As of the census of 2019, Vietnam has 96.48 million people. The population of Vietnam in 2049 will increase to 108.5 million people under the medium variant. With such population growth, the increasing demand for natural resources is considered to increase the unsustainable use of biological resources as well as ecosystem services, putting pressure on biodiversity conservation.

Moreover, the majority of the population is concentrated mainly in the Northern Delta, the Southern Delta and the coastal areas in the central region. Most of the terrestrial protected areas are located in mountainous areas where many places are facing special difficulties, with a high poverty rate. That poses challenges for the management and protection of biodiversity and ecosystem services in protected areas.

Increasing demand for land use for agriculture and aquaculture: The National Assembly's Resolution no.134/2016/QH13 on adjusting land use planning to 2020 and land use plan for the previous period (2016-2020) at the national level shows that the land area used for agriculture in general, and land for production forests and aquaculture in particular (artificial ecosystems) has been increasing gradually from 2015 to 2020, while the land area of protection forest is tending to decrease. This shows the need to increase land uses to meet the need to use wood and fishery resources for people.

Increasing demand for water resources: Vietnam's surface water resources are globally rated as low to average. The water supply system has not yet met the urban domestic water needs. On the other hand, according to the Ministry of Planning and Investment (2016), although urban water supply capacity has increased 1.6 times compared to 10 years ago, however, due to the increasing urbanization process, many new industrial zones and urban areas are formed and the urban population also increased rapidly. Therefore, the water supply system has not yet fully met the urban water demand.

Increasing energy use and production: In Vietnam, according to the revised Electricity Planning VII in 2016, the total electricity production in 2015 in kWh was 159 billion; in 2020 it was forecasted to be 265 billion; 400 billion in 2025; and 572 billion in 2030, with coal-fired thermal power still having a large proportion, over 53%, of total electricity production, hydroelectricity being reduced to just over 12%, electricity from gas nearly 17%, and renewable electricity increasing by 6.5-6.9% in the period 2020-2025 to 10.7% by 2030. Energy production is also one of the main sources of greenhouse gas emissions, which is an important determinant of climate change and changes in ecosystem services.

Increasing demand for biological resources: About 20 million people in Vietnam obtain their main or partial income from aquatic resources and are unsustainably using over 300 species of seafood and over 50 species of freshwater aquatic species of economic value. About 25 million people live in or near forests and 20-50% of their income come from non-timber forest products, including hundreds of medicinal plants, oil crops, dyes and wildlife *(MARD, 2020).*

In general, people's perception and practices are outdated about the medicinal value of some products derived from wild animals (rhino horn, bear bile, tiger extract, etc.) and super profit from the illegal trade of these products also contribute to the loss of biodiversity. Similarly, the habit of using furniture from precious and rare natural wood as a symbol of power and wealth will also reduce forest resources.

3.1.2. Economic development

Vietnam's labor productivity has improved significantly over the years and the country now enjoys a high labor productivity growth rate in the ASEAN region. Labor productivity of the whole economy at current prices in 2019 was estimated at 110.40 million VND/laborer (equivalent to 4,791 USD). At constant prices, labor productivity in 2019 increased by 6.2% compared to 2018 (*GSO, 2019*). As a result, people's lives have been improved. However, patterns of consumption of ecosystem services are not sustainable. There is a conflict between

development and conservation. In particular, the establishment of many economic/industrial zones in coastal areas is a challenge to environmental protection and biodiversity conservation.

3.1.3. Overlapping in functions and management of biodiversity between relevant authorities

The institutional framework for biodiversity in Vietnam currently involves many ministries, though the state management of biodiversity is the main responsibility of both MONRE and MARD, and is overlapping (*MONRE, 2018*). Specifically, MONRE is assigned by the Government to be the focal point for the state management of biodiversity, while MARD manages the system of special-use forests and marine PAs and MONRE manages the wetland protected areas.

The biggest challenge to biodiversity management and conservation is the inadequate coordination between MONRE and MARD in issuing policies. Although the institutional framework of biodiversity management has been formed from the central to local levels, but the assignment of state management responsibility for biodiversity is unclear between MONRE and MARD as well as between local management agencies leading to overlap and conflict. Overlapping functions of state management on biodiversity and different ecosystems can negatively affect the use and sustainable exploitation of ecosystem services while reducing the provisioning services of the ecosystem.

3.1.4. Policy and governance on biodiversity conservation

So far in Vietnam, the Government, ministries and agencies have issued around 193 policy documents guiding the implementation of the Biodiversity Law (2008) and other specialized laws related to biodiversity conservation. These policy documents include decrees, decisions, directives, circulars, official letters, technical guidelines.

Inadequate enforcement of biodiversity management continues with management still having many shortcomings, and some protected areas having been seriously encroached by illegal wildlife and timber harvesting activities (*MONRE, 2018*).

3.1.5. Communication, awareness and education

Communications, education and awareness raising on biodiversity conservation are currently only conducted at the community level by various relevant management officials. The provisions of the Gender Equality Law (2006) and the requirements for gender mainstreaming have not been clearly reflected in biodiversity legislation. Public education to raise biodiversity conservation awareness is a process that needs to be carried out regularly and for a long time but at present there is not enough funding to conduct these activities every year (*MONRE, 2018*).

3.1.6. Science and technology development

In Vietnam, in the process of socio-economic development, there has been increased investment and development of science and technology. In the agricultural and fishery sectors, intensive cultivation and industrial shrimp farming has been widely deployed. In addition to the positive aspects of having a high level of food production for the people, and limiting the exploitation of natural biological resources, there are disadvantages from these models including the use of many chemicals such as chemical fertilizers, pesticides, antibiotics, growth and developmental preparations and high animal density, leading to problems of disease, environmental pollution, and biological product safety.

3.1.7. Limited resources for biodiversity conservation/investment

Currently enforcement of biodiversity laws is still limited due to lack of resources, including human resources, and technical and financial equipment. Reasons for the poor implementation of biodiversity law include an overlapping legal framework for managing biodiversity, insufficient resources, weak capacity for conservation work, and lack of necessary equipment. The coordination between forces implementing environmental protection and biodiversity is not strict. The inefficient sanctioning of illegal acts on conservation is also the cause of an increasing illegal exploitation and trade in wild plants and animals and their products (*MONRE, 2019*).

Investing in the implementation of biodiversity conservation from the budget has increased but it is still spread out, lacking focus and with low investment efficiency. Most funding of non-governmental organizations depends on short-term and funding-based projects, so it is difficult to implement long-term commitments for conservation (*MONRE, 2019*).

3.2. The pressures to change in the status and trends of ecosystems services

3.2.1. Land/waters conversion includes infrastructure development without a proper scientific basis

According to the report of MARD (2016), from 2006 to 2016, there were 2,991 projects, with 386,290 ha of forest transferred to other purposes, of which: natural forest was 300,120 ha (accounting for 78%), and planted forest was 86,170 ha (accounting for 22%).

The leveling of tens of thousands of ha of natural tidal flats in the coastal area of Bac Bo to cultivate white clams (*Meretrix serata*) changes the mechanics of tidal soil while also reducing the biodiversity of the tidal flats, especially the population of indigenous clams (*Meretrix meretric*) that are gradually decreasing. High-density clam farming leads to environmental pollution from organic substances excreted from the cultured species to the outside environment while at the same time the raising with high density leads to environmental pollution from organic substances excreted to the outside environment from cultured objects (*MONRE, 2019*).

From 1943 to 2005, at least 220,000 ha of mangroves disappeared either due to war-related destruction or destruction for the development of aquaculture. Primary mangroves have almost disappeared in many coastal provinces (*MONRE, 2019*).

Many hydropower reservoirs fail to properly operate processes, such as flood discharge regimes ensuring environmental flow, causing human and economic damage, and strongly affecting ecosystems in downstream regions (*MONRE, 2019*).

3.2.2. Excessive and illegal exploitation of biological resources

Illegal exploitation of biological resources includes wild animals, timber, and even illegal logging within some national parks and protected areas. In many northern mountainous provinces, the eradication of precious medicinal plants for smuggling across borders is quite common. In Cao Bang, Chinese traders have set up many stations to buy and process local medicinal herbs such as white *Stephania glabra*, yellow *Stephania glabra*, *Gynostemma pentaphyllum*, arrowroot, *Sargentodoxa cuneata*, *Zoysia tenuifolia,* etc. Many medicinal plants whose economic value as well as therapeutic use remain unclear are illegally exported to China (*MONRE, 2019*).

Illegal exploitation of aquatic products continues with destructive tools such as mines, chemicals, and bottom trawling with small netting. Overexploitation and illegal exploitation of wildlife resources in the forest, including wood from forests, and wild animals with traps or shotguns is leading to degraded ecosystems, reduced biodiversity, and depleted biological resources. Sizes of fish species that dominate production volumes in mostly coastal regions of Vietnam are relatively

small, with animals not reaching sexual maturity. Although total fisheries outputs have been continuously increasing, the average yield (ton/year) shows a declining trend (*Research Institute for Marine Fisheries-RIMF, 2016*).

Illegal trade in wildlife animals: The trade in wildlife and their products is tending to increase. From 2010 to 2016, forest rangers across the country have discovered and handled over 174,000 violations of the forestry law. Particularly in 2016, the whole customs sector detected and arrested 26 cases of transporting ivory and ivory products with a total volume of nearly five tons, along with tons of pangolins, pangolin scales, turtles, bear limbs, rhino horn, etc. smuggled for consumption in Vietnam, or transferred to a third country (*MARD, 2017*).

3.2.3. Environmental pollution

The rapid urbanization and industrialization process has seriously affected air quality as well as the quality of inland and coastal waters environments. Currently, 70% to 80% of marine waste originating from mainland is caused by, factories, industrial parks, and residential areas discharging waste water and untreated solid waste into rivers and canals in coastal plains or directly discharging to the sea. The phenomenon of algal bloom, mainly blue-green algae (*Microcystis* spp.) exhausts dissolved oxygen in lakes in Hanoi city, killing many fish. Red tide phenomenon is increasing in coastal waters (*MONRE, 2019*).

3.2.4. Climate change

Vietnam is one of the five countries most affected by global climate change. According to climate change and sea level rise scenarios for Vietnam (*MONRE, 2016*), a sea level rise of 100cm results in a corresponding risk of flooding of: about 16.8% of the Red River Delta area; approximately 17.8% of Ho Chi Minh City; and 38.9% of the Mekong Delta region. 78 out of 286 "critical habitats" (equivalent to 27%), 46 protected areas (equivalent to 33%), 09 biodiversity areas of national and international value (23%) and 23 other biodiversity areas in Vietnam would be severely affected. The main factors of climate change such as rising temperatures, sea level rise, precipitation, and natural disasters, will impact on all ecosystems and living things. Many wild plants and animals will suffer increasing pressure due to changes in habitat, food sources and natural disasters such as floods, droughts and storms. Some species of plants and vertebrates may be at risk of extinction in the next century due to climate change effects (*MONRE, 2019*).

3.2.5. The introduction of invasive alien species

Invasive alien species when introduced will develop populations rapidly, crowding out native species in terms of food and habitat, even eroding native species genetic resources due to hybridization. Concerns about the risk of harm to biodiversity, human health and the economy of invasive alien species are increasing, especially the golden apple snail (*Pomacea canaliculata, P. insunarum*) were introduced into Viet Nam in the late 80s and have now spread to the whole country. According to existing information, 94 exotic species have been imported into Viet Nam, including 42 species that are known to be invasive and 12 of which are fast-growing invasive species such as *Mimosa pigra* and *Eichhornia crassipes*. Mimosa was first discovered in Tram Chim National Park (Dong Thap province) in 1995 but is now widespread and has become a major threat in many wetlands throughout the country (*MONRE, 2019*).

In 2013, MONRE and MARD issued a joint circular no.27/2013/TTLT-BTNMT-BNNPTNT providing criteria for identifying invasive alien species and promulgating the list of invasive alien species. Accordingly, with respect to the list of 25 invasive alien species, 15 potential invasive alien species have appeared in the territory of Vietnam and 41 potential invasive alien species

have not appeared in the territory of Vietnam. Despite efforts in the management and control of invasive alien species of MONRE, MARD, etc., there are still shortcomings in this area (*MONRE, 2019*).

3.3. Impacts of changes in ecosystem services on the socio-economy

According to the Statistical Yearbook (2021), the agriculture, forestry and fishery sectors contributed significantly to the gross domestic product (GDP), their export value increased from 19 billion USD in 2010 to 41.250 billion USD in 2020, accounting for 14.6% of the country's export turnover and 14.85% of the GDP in 2020, and 12.36% of GDP in 2021. If calculating the products from the resources of agro-forestry, agricultural and marine ecosystem services, the gross domestic product at current prices in 2018 of agriculture and forestry sectors, aquatic products and minerals was 1,221,952 billion VND (equivalent to 55.54 billion USD), accounting for 22.04% of GDP.

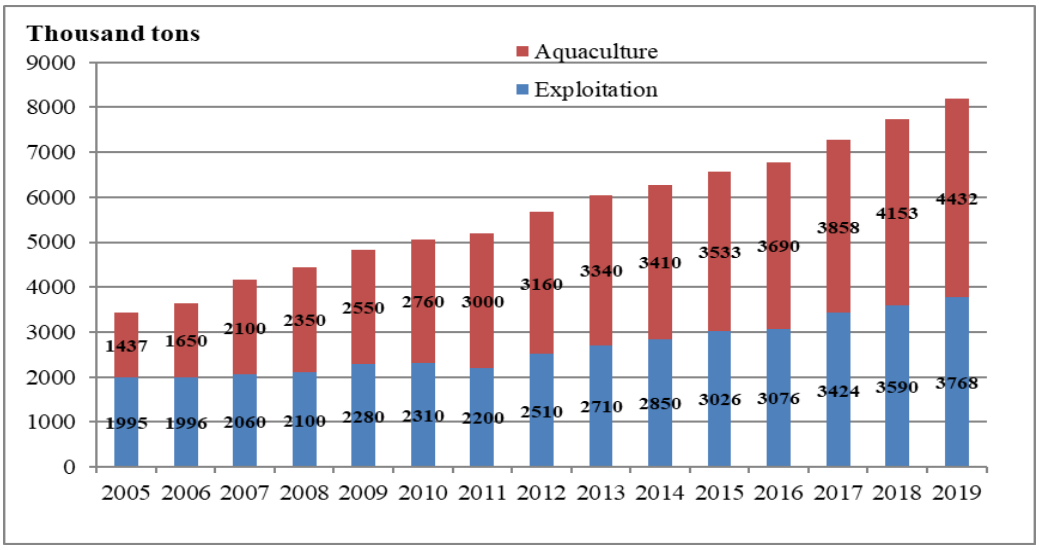


Figure 10. Growth of Vietnam's Fisheries Sector

(Source: Directorate of Fisheries, 2006-2020)

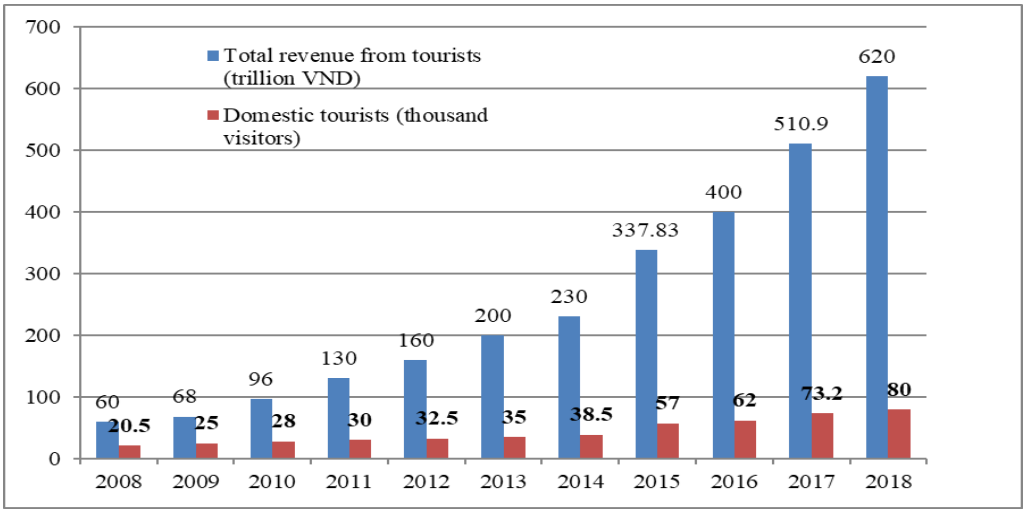


Figure 11. Growth of Vietnam's tourism industry

(Source: Vietnam National Administration of Tourism, 2019)

The downside of achieving these significant economic development numbers has been the trade-off of ecosystem degradation and biodiversity loss and consequently, ecosystem services degradation. Due to dynamics and pressures such as exploitation and use of products and services, this degradation is tending to increase, exceeding the supply capacity of ecosystem services, resulting in: reduced natural forest area; reduced seagrass beds area; lower coral reef coverage; reduced number of endangered species individuals; increased number of endangered species; critical levels of natural marine catch; increased environmental pollution from economic development.

IV. PLAUSIBLE FUTURE SCENARIOS FOR ECOSYSTEMS AND THEIR SERVICES

4.1. Context with background information

4.1.1. An overview of scenarios on biodiversity and ecosystem services

MA (2005) has developed four global scenarios to explore a plausible future for ecosystems and human well-being as follows: (i) global orchestration; (ii) order from strength; (iii) adapting mosaic; and (iv) techno-garden.

The secretariat of the Convention on Biological Diversity (CBD) in 2017 published documents on: Scenarios for the 2050 vision on Biodiversity. Of them, the "business as usual scenarios", predicted for 2050 shows unsustainable results, with biodiversity continuing to be lost.

In 2019, at the 7th plenary meeting, the IPBES Assessment Report described three scenarios: (i) "global Sustainability"; (ii) "regional competition"; and (iii) "economic optimism".

A reasonable future version for Europe and Central Asia involving six plausible scenarios has been developed as (i) business-as-usual; (ii) economic optimism; (iii) regional competition; (iv) regional sustainability; (v) global sustainable development; and (vi) inequality.

Scenarios were developed with the main purpose of informing policy making and discussing policy impacts on issues related to the environment, climate change, biodiversity and human well-being.

4.1.2. An overview of Vietnam's policy documents on biodiversity and ecosystem services

Many important laws in the field of natural resource management, relating to biodiversity and ecosystem services, have been developed and gradually improved. To implement the laws, numerous strategies, master plans, and plans have been formulated related to the development of future scenarios on development in Vietnam, such as: the "*Report on the implementation of strategy of socio-economic development 10 years from 2011 to 2020 and development of a strategy of socio-economic development 10 years from 2021 to 2030"* developed on October 15, 2020, by the 12th Party Central Committee, in which, there are notable specific targets such as achieving an average gross domestic product (GDP) growth rate of about 7%/year; GDP per capita at current prices by 2030 to reach about 7,500 USD/person; reducing energy consumption per GDP unit by 1%-1.5%/year; reducing at least 8% of greenhouse gas emissions; and 100% of production and business establishments to meet environmental standards. The Ministry of Planning and Investment also held a seminar with the title: *towards high-quality growth in the period of 2021-2030: policy priority orientations* to discuss the development of Vietnam's socio-economic development strategy for 2021-2030.

In 2019, the National Center for Socio-Economic Information and Forecasts (NCIF) developed two scenarios predicting economic growth for the period of 2021-2025: (i) feasible baseline scenario: growth Vietnam's GDP will reach about 7%; and (ii) higher growth scenario: expected GDP growth of 7.5%/year.

CSIRO has collaborated with the research team of the Ministry of Science and Technology to develop the four future scenarios for Vietnam's digital economy in the period of 2021-2045: (i) traditional scenario; (ii) digital export scenario; (iii) digital consumption scenario; and (iv) digital conversion scenario. Each scenario has its own development criteria.

MONRE has developed and published a scenario of climate change and sea level rise for Vietnam (2016 version) with the two scenarios: *the RCP4.5 scenario* (the scenario of low average greenhouse gas concentration) and *RCP8.5 scenario* (high greenhouse gas concentration scenario).

In Vietnam, except for the climate change scenario, only future scenarios for the socio-economic sector have been developed, while no future scenarios for the ecosystem and their services are available.

4.2. Development of the plausible future scenarios for ecosystem and their services

4.2.1. Four plausible future scenarios proposed

Four plausible future scenarios for ecosystem and their services in Vietnam are proposed to be: (i) development as usual scenario; (ii) feasible base scenario; (iii) higher growth scenario; and (iv) sustainable development scenario associated with conservation.

4.2.2. Description of the scenarios characters

(1) The *"development as usual scenario"* assumes trends that have occurred in the past and present under the effects of driver and pressure factors will continue unchanged. With this scenario, the economy has a growth rate of 6.76% to about 7%, and inflation is 3.2%.

Under this scenario, important ecosystems continue to be degraded, especially coral reefs and seagrass beds. Biodiversity continues to decline, with the number of individuals of many endangered species being reduced, as is already evident in species of globally threatened migratory birds such as the Black faced-spoonbill (*Platalea minor)*, the Chinese white stork (*Egretta eulophotes)*, red-necked cranes (*Grus antigone*), as well as sea dugongs (*Dugong dugon*). There is no solution to the control of invasive alien species.

Provisioning services of ecosystems are heavily exploited, even excessively or illegally. The downside of achieving meaningful figures on economic development in sectors such as agriculture, forestry, fisheries, tourism, etc. must be a trade-off with ecosystem degradation, biodiversity loss and thereby degradation of ecosystem services. Coral reefs have lower coverage, and the seagrass area is reduced.

Environmental pollution and climate change continues to lead to the loss of biodiversity and degradation of important ecosystems, while increasing extreme weather patterns, give rise to increased saline intrusion, and scarcity of freshwater in the Mekong River Delta, resulting in reduced water flows for the vulnerable freshwater ecosystems in this region. Environmental incidents and epidemics affect a large number of people.

(2) The *"feasible baseline scenario"*: Vietnam's GDP growth will reach about 7%. In this scenario, the macro-economy is basically stable, with inflation is at 3.5-4.5%/year; labor productivity is improved, with an increase of about 6.3% /year; by 2025, Vietnam's GDP per capita will be about 4,688 USD, lifting Vietnam into the group of high middle-income countries. Increased income levels bring changes in consumption patterns, driving demand for ecosystem services, including agro-forestry products such as timber, meat, fish and vegetables. The increase in provisioning services leads to a decline in other services. With trade barriers removed, along with a major highlight is poverty reduction.

Under this scenario, ecosystems continue to decline with a loss of biodiversity. Increased land use conversion leads to pressures on natural terrestrial land, underwater and marine habitats and biodiversity degradation.

(3) The *"higher growth scenario"* expects GDP growth to be 7.5%/year. Economic growth is the highest in this scenario. Science and innovation are increasingly playing an important role in socio-economic development, contributing to increasing the competitiveness of enterprises as well as national competitiveness.

Increased income levels bring changes in consumption patterns, driving demand for ecosystem services, including agro-forestry products such as timber, meat, fish and vegetables, in major urban centers in the Red River and Mekong River regions. The increasing demand for these services leads to a decline in other services. Rapid economic growth requires large amounts of energy and raw materials, along with low environmental regulation with high greenhouse gas emissions (the trend is that of the RCP8.5 scenario - i.e. high concentration of greenhouse gases). Reliance on technology solutions sometimes creates new problems and vulnerabilities. The cost of environmental management continues to increase. Environmental incidents and epidemics affecting large numbers of people become more common.

Under the high growth scenario, there is continued loss of biodiversity and increased land use conversion, resulting in pressures on natural, terrestrial and marine natural habitats and declining biodiversity, increasing the use of provisioning ecosystem services while reducing regulating services of the ecosystem. Agriculture, fisheries and forestry are important sectors for socio-economic development, contributing significantly to GDP. However, products from these industries come at an increasing cost in the form of a decline in many other ecosystem services.

(4) The *"sustainable development scenario associated with conservation"*: this scenario is similar to the feasible baseline scenario, in that GDP growth is about 7%/year or more. However, in this scenario, the perspective of sustainable development associated with conservation is mentioned as a key factor, involving: quality growth to ensure sustainability (efficient growth, green growth, inclusive growth); efficient use of natural capital, ensuring green growth to achieve the goals of growth and sustainable growth; addressing climate change issues; combining proactive environmental policy and sustainable production and consumption with low greenhouse gas emissions; and seeking harmony between development and conservation.

Under this scenario, the goals of the Government's 2030 Agenda Implementation Plan must be achieved including: sustainable economic growth with respect to progress, social justice and protection of the ecological environment, effective management and use of resources, proactively responding to climate change; ensuring all people are promoted to their full potential, and can participate and equally enjoy the fruits of development; and building a peaceful, prosperous, inclusive, democratic, equitable, civilized and sustainable Vietnamese society. Accordingly, significant progress has been made in developing modern, environmentally friendly technologies to increase production of services, to create alternative products and to reduce harmful trade-offs, and combining proactive management policies and sustainable production and consumption with low greenhouse gas emissions (the trend is that of the RCP4.5 scenario - i.e. low average greenhouse gas concentration).

The most important aspect of this scenario is that to implement sustainable development associated with conservation, the system of legal mechanisms and policies related to biodiversity conservation should be prioritized for renovation and improvement, in accordance with the actual conditions, and especially they are effectively enforced to harmonize development with environmental protection and biodiversity conservation. Resources for biodiversity conservation,

both from the Government as well as from international organisations and NGOs, are guaranteed; an active management and ecosystem adaptation approach is applied with the consent of stakeholders from central and local levels, businesses and the community; many livelihood models for the community based on the exploitation and sustainable use of natural resources are developed and popularized; and modern environmentally friendly technologies are developed.

4.3. The movement of driver and pressure factors according to the scenarios

In the four plausible future scenarios, the drivers and pressures affecting the ecosystem are predicted to be basically the same as in the past, but the relative importance of the different drivers and pressures will change across the scenarios. Some factors (such as population growth) tend to decrease in importance while others (population distribution, environment, climate change, and land / water use change, etc.) will become more important.

Table 8. Assumption of the evolution of driver and pressure factors according to the scenarios

	Development as usual scenario	**Feasible base scenario**	**Higher growth scenario**	**Sustainable development scenario associated with conservation**
Drivers				
Demographics / Population	Average fertility; population with average fertility option: 102. 321 million people (2029); migration at a high level leads to population distribution in the plains	Average fertility; population with average fertility option: 102. 321 million people (2029); migration at a high level leads to high population distribution in the plains	Low fertility; population with low fertility options: 101. 152 million people (2029); migration at a high level leads to high population distribution in the plains	Average fertility; population with average fertility option: 102. 321 million people (2029); migration at a moderate level
Demand for resources	Similar to nowadays	High	High	High
Energy demand	Similar to nowadays	High	High	High
Energy supply	The current energy structure	Changing energy structure; recycled energy; changing modern technology	Changing energy structure; recycled energy; changing modern technology	Changing energy structure; recycled energy; changing modern technology friendly to the environment
GDP growth	6.8-7%	About 7%	7.5%	About 7%; Green growth
Science, Technology	Medium	High	High	High Environmentally friendly technology; modern and effective environmental

				treatment technology
Legal mechanisms and policies on biodiversity conservation	Similar to nowadays	Similar to nowadays	Similar to nowadays	Innovation, more complete and more feasible
Conservation management	Similar to nowadays	Similar to nowadays	Similar to nowadays	Proactive management and adaptation of ecosystems; effective management of the PA
Conservation resources	Not guaranteed	Not guaranteed	Not guaranteed	Guaranteed
Approach to sustainable development	Similar to nowadays	Approach to sustainable development	Approach to sustainable development	Green technology; ecological efficiency; approach to sustainable development
Pressures				
Land / waters use conversion	High level of conversion; area of natural forest decreased; planted area increased slightly	Planted area increased slightly	Planted area increased slightly	Increasing forest area; increase forest cover
Environmental pollution	Environmental pollution	There is still environmental pollution	High risk of environmental pollution	Reduced pollution levels
Climate changes	Greenhouse gas emissions as today; saline intrusion increases; RCP8.5 scenario trend	Average greenhouse gas emissions; saline intrusion increases; trends in RCP4.5-RCP8.5 scenarios	High greenhouse gas emissions; saline intrusion increases; RCP8.5 scenario trend	Lower greenhouse gas emissions; saline intrusion is under control; trends in RCP4.5 scenario
Invasive alien species	Uncontrolled	Uncontrolled	Uncontrolled	Proceed to control

4.4. Predicted changes in the quality of ecosystems and their services

The change of ecosystems and the provision of basic ecosystem services according to the four plausible future scenarios developed for this assessment are shown in the tables below.

4.4.1. Predicted changes in the quality of ecosystems

Predicted changes in the quality of three key ecosystems under the plausible future scenarios with different development characteristics can be described below.

The decrease in ecosystems is reflected in the indicators of reduced area (primary/natural forests; coral reefs; seagrass beds); live coral cover; reduction of wildlife community indicators (forest ecosystems); animal communities living in coral reefs, seagrass beds); the flow of fresh water and sediments across rivers and estuaries are reduced; pollution level (rivers, lakes, reservoirs); reduced peat layer thickness (peat swamp); hydrological regime, and impact of land use conversion (seasonal wetlands).

The increase shown in the above indicators assume a positive increase or a decrease in pollution levels due to environmental control. The continental slope and the deep sea area are indeterminate because there are no comprehensive research data.

Table 9. Predicted changes in the quality of ecosystems according to the scenarios

Ecosystems	Development as usual scenario	Feasible base scenario	Higher growth scenario	Sustainable development scenario associated with conservation
Forest ecosystems				
Area of natural forest	↓	↓	↓	↔
New planted forest area	↑	↑	↔	↑
Forest ecosystem (wildlife community)	↓	↔	↓	↑
Inland wetland ecosystems				
Rivers and streams (water flow, water quality)	↓	↔	↓	↑
Estuarine areas (freshwater flow, sediment flowing through, salinity intrusion)	↓	↔	↓	↑
Natural lakes, reservoirs (water reserves, water quality, water regulation	↓	↔	↓	↑
Swamp, peat swamp (reduced peat layer thickness)	↓	↓	↓	↔
Costal and marine ecosystems				
Quality of tidal flats (due to pollution, clam aquaculture)	↓	↓	↓	↑

Area of mangroves (natural forest, regenerated forest, new planted forest)	↑	↑	↓	↑
Lagoon, gulf (pollution)	↓	↔	↓	↑
Area and coverage of coral reefs (animal communities in the reef)	↓	↓	↓	↑
Area of seagrass beds (animal communities in grass)	↓	↓	↓	↑
Offshore island waters	↓	↔	↓	↑
Continental slope and deep sea	●	●	●	↑

increase ↑ ↓ decrease ↔ as before 2020 ● Not determined

4.4.2. Predicted changes in the quality of ecosystem services

For provisioning services, determining increases means increasing service output through changes in the area in which the service is provided (for example, agricultural expansion) or increasing output product per unit area. The rating goes down if the current use of biological resources exceeds sustainability. For regulating services, the increase refers to changes in services that result in greater benefits for everyone (e.g. disease correction services can be improved by deleting a vector known to spread the disease to everyone). Regression of regulating services means reducing the benefits gained from services, through service changes (for example, loss of mangroves reduces storm protection benefits of ecosystems) or pressure of humans for services that exceed its limits (e.g., excessive pollution beyond the ability of ecosystems to maintain water quality). For cultural services, degradation refers to a change in ecosystem features that reduce the cultural benefits (recreational, aesthetic, spiritual, etc.) provided by the ecosystem, while the increase refers to a change that increases them. For supporting services, increased assessment means increased primary productivity and ensured the balance of nutrient cycles in ecosystems. Ecosystem degradation leads to reduced primary productivity and imbalance in nutrient cycles or food webs in ecosystems.

Table 10. Predicted changes in the quality of ecosystem services according to scenarios

Ecosystem services	Development as usual scenario	Feasible base scenario	Higher growth scenario	Sustainable development scenario associated with conservation
Provisioning services				
Products made from wood and non-wood for materials, fuel and food	↔	↔	↔	↑

Fishery products for food	↓	↔	↔	↑
Biologically active products and pharmaceuticals	↑	↑	↑	↑
Products are jewelry, decoration	↑	↑	↑	↑
Fresh water resource	↓	↓	↓	↑
Genetic resources and bio-diversity	↓	↔	↔	↑
Regulating services				
Regulating water source	↓	↔	↓	↑
Climate regulation, carbon sequestration & storage	↓	↓	↓	↑
Control erosion, protect coastlines, reduce storm damage	↓	↓	↓	↑
Disease control: human	↓	↔	↔	↑
Pest control	↓	↔	↔	↑
Cultural services				
Cultural and historical values	↑	↔	↓	↑
Tourism, relaxation, sports	↑	↑	↑	↑
Educations, training	↑	↑	↑	↑
Supporting services				
Land formation	↓	↔	↓	↑
Nutrition cycle of ecosystems; Primary productivity	↓	↔	↓	↑

increase ↑ ↓ disease ↔ As before 2020

In the four scenarios above, provisioning service and regulating services have clear changes between the scenarios. The scenario of sustainable development associated with conservation is considered the most positive trend, with an important goal of harmonizing conservation and development, without the trade-off of development at all costs, which harms the environment and biological resources. This scenario also reflects Vietnam's determination to implement the Aichi Biodiversity Goals and the Sustainable Development Goals.

4.5. Proactive management of ecosystems: benefits and measures

4.5.1. Benefits of proactive management

A proactive ecosystem management approach is beneficial largely because it involves prevention, and the restoration of ecosystems or ecosystem services following their degradation or collapse is generally more costly and time-consuming than preventing degradation, if that is possible at all.

4.5.2. Proposed measures for proactive management of Vietnam's ecosystems and their services

Complete the system of legal framework on biodiversity and ecosystem services: make amendments to the Biodiversity Law and the relevant laws in accordance with the current Vietnam's context.

Improve effective decision-making processes: legal decisions affecting ecosystems and their services can be improved by changing the processes used to make appropriate decisions.

Institutional and governance changes: institutional and governance changes within the framework of environmental governance and facilitates effective management of ecosystems.

Integrating conservation, sustainable use of biodiversity and ecosystem and contributions of nature into people into policies, plans, programs and strategies of line sectors: policymakers and organizations develop integrated cross-sectoral approaches that will allow for a more systematic review of biodiversity and the natural contributions to human. Especially integrate biodiversity and ecosystem services into strategic environmental assessments and environmental impact assessments.

Economy and incentives: economic and financial interventions provide powerful tools to regulate the use of ecosystem goods and services such as eliminating subsidies harmful to biodiversity including economic incentives; economic reform towards sustainable development and green growth. However, market mechanisms can only work if there are support organizations, and therefore institutional capacity needs to be built to allow wider use of them and to improve the sustainability of the economic and financial system.

Other necessary responses: social responses; modern technology development; knowledge and awareness raising; strengthening biodiversity conservation management capacity; increase resources for biodiversity conservation; promote the full and effective participation of local people and segments of society in decision-making regarding biodiversity conservation and sustainable use of ecosystem services.

Development and application of sustainable livelihood models to the community in agriculture, forestry and fishery areas, especially in buffer zones of protected areas such as model of ecotourism development associated with biodiversity conservation; combined model of agriculture-forestry-fishery; integrated model of climate change adaptation solutions based on ecosystem; community-based conservation model; model of coral reef restoration, mangrove planting; model of organic agriculture; sustainable aquaculture model.

V. THE LEGAL AND INSTITUTIONAL FRAMEWORK ON CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY AND ECOSYSTEMS - IMPACTS, GAPS AND SOME RECOMMENDATIONS TO ENHANCE ECOSYSTEMS

5.1. The legal and institutional framework on conservation and sustainable use of biodiversity and ecosystems

5.1.1. The legal framework on conservation and sustainable use of biodiversity and ecosystems

At the highest level, the need for conservation and sustainable use of biodiversity in Vietnam has been identified in the Constitution (approved by the National Assembly on November 21, 2013).

Many important laws in the field of natural resource management have been developed and gradually improved, in chronological order such as the Law on Forest Protection and Development (1991, revised in 2004 and changed to the Forestry Law in 2017); Law on Land

(1993, revised in 1998, 2003 and 2013); Law on Environmental Protection (1993, revised in 2005, 2014 and 2020); Law on Water Resources (1998, revised in 2012); Law on Natural Resources and Environment of Sea and Islands (2015); Law on Fisheries (2003, revised in 2017); and the Planning Law (2017). In particular, the Biodiversity Law passed by the National Assembly in 2008 and in force in 2009 has opened a turning point for biodiversity conservation.

To create a legal framework for conservation and sustainable use of biodiversity, the Government and ministries and sectors have developed and issued more than 193 policy documents guiding the implementation of the Biodiversity Law and other laws related to conservation, including decrees, decisions (approving strategies, master plans, plans, etc.), resolutions, directives, circulars, official letters, technical guidelines, etc.

The policy documents on conservation and sustainable use of biodiversity and ecosystems, and are developed according to the system of 3 specialized laws: (i) the Biodiversity Law (2008); (ii) the Law on Forest Protection and Development (1991, 2004) revised to the Law on Forestry (2017); and (iii) the Law on Fisheries (2003) revised to the Fisheries Law (2017). These laws have some inconsistent or conflictive contents, e.g. according to the Law on Forestry (2017), forests are classified into five categories: (i) national park; (ii) nature reserves; (iii) species - habitat reserves; (iv) landscape protection forest; and (v) scientific research or experiment forest, while the Biodiversity Law classified PA system into four categories: (i) national park; (ii) nature reserve; (iii) species/habitat PA); and (iv) landscape PA. Due to the inconsistency in names, classifications, criteria and standards of PA system between the two these laws, leading to overlap and contradiction in rankings system of PAs. In addition, there is inconsistency on functional sub-zones and buffer zones of PAs and shortcomings in the management of PAs with mixed ecosystems, e.g. the PAs have all forest, wetland and marine ecosystems, resulting in degradation of biodiversity, ecosystems and their services.

Therefore, there has overlap and heterogeneity related to the management of biodiversity from the decrees guiding the implementation of these laws to the next set of policy documents, leading to difficulties and shortcomings in implementing biodiversity conservation and management, especially in localities. From the inconsistency between the system of major policy documents on biodiversity between the two sectors of natural resources, environment and agriculture, rural development, it has led to overlap in the management system of biodiversity conservation by central and local authorities making it difficult to apply and enforce the laws on biodiversity conservation.

In addition, the quality of some policies is not high, some regulations are not in accordance with the practical situation due to these policies haven’t been developed on the basis of science-policy-practice interface, resulting in difficulties to apply and enforce the laws and documents under laws on biodiversity and ecosystem conservation.

5.1.2. The institutional framework on management of biodiversity and ecosystems

Article 6 of the Biodiversity Law (2008) stipulates: The Government unifies the state management of biodiversity; the Ministry of Natural Resources and Environment (MONRE) is responsible to the Government for the implementation of the state management of biodiversity; Ministries and ministerial-level agencies shall, within the scope of their respective tasks and powers, perform the state management of biodiversity as assigned by the Government such as the Ministry of Agriculture and Rural Development (MARD), the Ministry of Science and Technology (MOST), the Ministry of Health (MOH); Provincial People's Committees (PPC) within the scope of their duties and powers are to perform the state management of biodiversity as decentralized by the Government.

The agencies are responsible for direct management of biodiversity in Vietnam are presented in figure 12. The management of special-use forests, marine PAs is under the authority of MARD. Management of wetland protected areas, including wetlands listed under the Ramsar Convention, is covered by responsibility of the MONRE. The provincial agencies are responsible for the implementation of national biodiversity policies, laws and plans.

To date, management of PAs has been decentralized to local responsibilities at appropriate levels (Provincial and District People's Committees). Currently, there are six NPs directly managed by VNFOREST under MARD, and the rest of the PAs at the provincial level are managed by PPCs. The assignment and decentralization of the management of the PAs has revealed overlaps and shortcomings, so it is necessary to establish a unified management agency for the PA system in Vietnam.

In terms of genetic resources conservation, there are many ministries involved in genetic resources management: MONRE is assigned to be the focal point for management of genetic resources and biosafety. However, in reality, MARD is being assigned to preside over the conservation of genetic resources of plants, animals and fisheries, while the assigned MOST is the focal point to carry out the tasks of the gene fund and traditional knowledge copyright on genetic resources. In addition, the implementation of the task of managing genetic resources also includes the Ministry of Industry and Trade and the Ministry of Health.

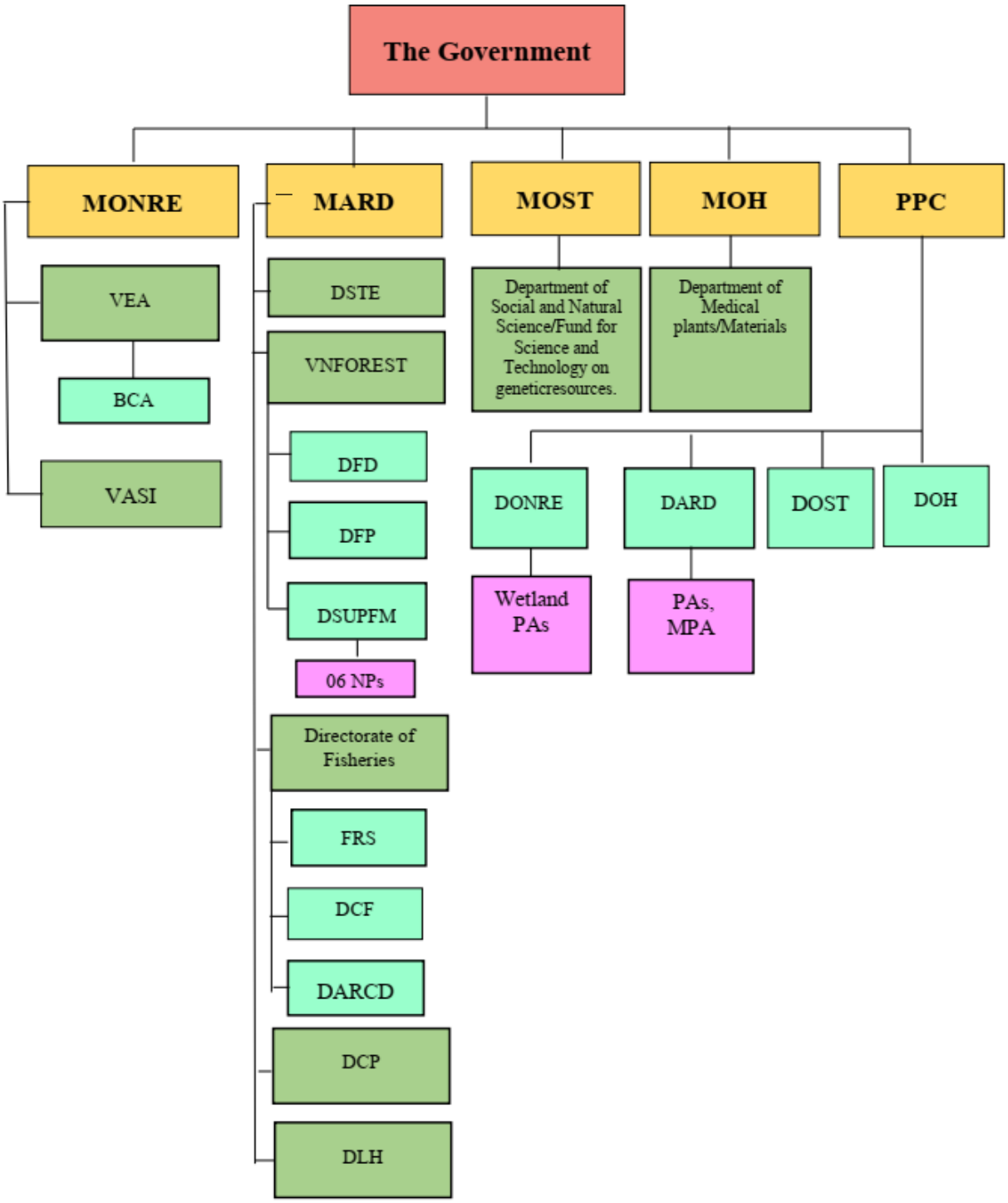


Figure 12. Diagram of the institutional framework on biodiversity in Vietnam

A list of above acronyms is explained in below table.

The Ministry of Natural Resources and Environment (MONRE)	
Vietnam Environment Administration	VEA
Nature and Biodiversity Conservation Agency	BCA
Vietnam Administration of Seas and Islands	VASI
The Ministry of Agriculture and Rural Development (MARD)	

Department of Science, Technology & Environment	DSTE
Vietnam Administration of Forestry	VNFOREST
Department of Forest Development	DFD
Department of Forest Protection	DFP
Department of Special Use and Protection Forests Management	DSUPFM
National Parks	NPs
Fisheries Resources Surveillance	FRS
Department of Capture Fisheries	DCF
Department of Aquatic Resource Conservation and Development	DARCD
Department of Crop Production	DCP
Department of Livestock Husbandry	DLH
The Ministry of Science and Technology (MOST)	
The Ministry of Health (MOH)	
Provincial People's Committees (PPC)	
Department of Natural Resources and Environment	DONRE
Department of Agriculture and Rural Development	DARD
Department of Science and Technology	DOST
Department of Health	DOH

In addition to the state management role, many national and international non-governmental organizations and development organizations are also actively involved in biodiversity conservation, such as the Vietnam Association for Conservation of Nature and Environment (VACNE), the Vietnam Forestry Association (VIFA), the Research Institute of Resources and Environment (CRES), the Center for Biodiversity Conservation (CBC), the Education for Nature-Vietnam (ENV), the Center for People and Nature (PanNature), the Centre for Marine Life Conservation and Community Development (MCD), IUCN, BirdLife International, WWF, Winrock International, Wildlife Conservation Society (WCS), Fauna & Flora International (FFI), GIZ, USAID, Asian Turtle Conservation Program (ATP), and People Resources Conservation Foundation (PRCF).

Though the Government has made every effort to restructure the organization of biodiversity management at central and local levels, the system is still very unwieldy with many focal agencies, the assignment of state management responsibility for biodiversity is unclear between MONRE and MARD as well as between local management agencies leading to overlaps and conflicts in function and missions. Besides, interdisciplinary coordination in management is not strict and still limited due to passivity and lack of continuity. Human resources for local conservation are still inadequate and have not been trained in professional skills in biodiversity conservation. In particular, at most local DONREs, there are no functional units and specialized officials for biodiversity conservation, etc. leading to low biodiversity management efficiency.

Overlapping functions of state management on biodiversity and different ecosystems can negatively affect the use and sustainable exploitation of ecosystem services while reducing the provisioning services of the ecosystem.

5.2. Impacts of policy documents on management of biodiversity and ecosystems

The policies and organizations that manage biodiversity in Vietnam mentioned above have been developed to respond to the drivers affecting biodiversity and ecosystem services including (i) demographic change and increased consumption of natural resources; (ii) unsustainable economic growth model; (iii) overlapping biodiversity management functions among relevant agencies; (iv) lack of uniformity and consistency in biodiversity conservation policy; (v) ineffectiveness in education and communication to raise awareness on biodiversity conservation; (vi) scientific and technological development and (vii) limited resources for biodiversity conservation and development. Pressures on biodiversity such as (i) land/water conversion for infrastructure development that lacks a scientific basis; (ii) excessive and illegal exploitation of biological resources; (iii) environmental pollution; (iv) climate change; and (v) the introduction of invasive alien species.

Each group of key drivers and pressures identified with impacts on biodiversity and ecosystem services in Vietnam has corresponding policy documents developed and promulgated. These are responses from regulators and policy makers to effectively manage biodiversity and ecosystem services.

5.3. Impact of the policy on payments for forest environmental services on sustainable development

The PFES policy can be considered as a mechanism for the sustainable use of forest ecosystems and the equitable sharing of benefits between providers and users of forest ecosystem services. This policy has been started from the regulation of Article 74 (environmental services related to biodiversity) of the Biodiversity Law (2008) and has been recorded in task 3 of the National Strategy on Biodiversity to 2020 (2013), with a vision to 2030, which the Government has approved in Decision no.1250/2013 /QD-TTg.

Thanks to the actions taken in accordance with policy documents, especially the policy on PFES as mentioned above has created many jobs and a positive change in awareness and responsibility of stakeholders for forest management and protection. Therefore, in three years 2016-2018 in implementing the Target Program for Sustainable Forestry Development for the period 2016-2020, according to the Government Report (2018), a number of targets have been met exceeding the plan as follows: (i) the number of cases of violating the Law on Forest Protection and Development (2004) was averaged 17,665 cases/year, an average decrease of 9,600 cases /year compared to the period 2011-2015. It was estimated that in the period 2016-2020, the number of violations reduced by 39% compared to the period 2011-2015; (ii) the damaged forest area has averaged 2,430 ha/year, a decrease of 270 ha/year, corresponding to a decrease of 10% compared to the period 2011-2015. It was estimated that in the period of 2016-2020 it reduced by 30% compared to the period 2011-2015; (iii) the forest area contracted to households, individuals and communities increased from 4,944 million ha/year in the period 2011-2015 to 6,143 million ha/year in 2016-2018; (iv) the concentrated afforestation was 675,000 ha, an average of 225,000 ha/year; planting production forests: 627,000 ha, an average of 209,000 ha/year; planting 47,400 ha of special-use and protection forests, an average of 15,800 ha/year; and (v) regarding sustainable forest management: as of August 2018, the total forest area certified for sustainability under the FSC system was 229,281 ha (plantation forest 147,677 ha, natural forest 81,604 ha) in 17 provinces with 36 units certified, namely 04 households (Tuyen Quang, Yen Bai, Quang Tri and Quang Nam provinces) and 32 forestry companies. The output of exploited timber from certified planted forests was 2.0 million m^3, with certified timber having a selling price of 10-15% more than that of non-certified wood.

Significantly, so far, the policy on PFES in the Law on Forestry (2017) has been legalized. This is one of the important provisions that serves as the legal basis for forest development and protection in general, and in particular for the sustainable use and fair sharing of benefits from forest ecosystem services in the next stages.

5.4. Existing policy measures have made significant contributions to maintain and enhance ecosystems and their services

Between the three key ecosystems as forest, wetland, marine and coastal ecosystems, there are different laws and policies to manage biodiversity conservation and maintain ecosystem services. However, the percentage of policy documents for these 3 ecosystem groups is different.

The number of policy documents on biodiversity conservation in general accounts for 43.3%; forest ecosystems and the forestry sector account for 34.4%; marine ecosystems and the fishery sector account for 17.8%; and wetland ecosystems and water resources account for only 4.4% of the total policy documents.

5.4.1. Policy measures to maintain and enhance forest ecosystems

There are two basic groups of policies related to forest protection and benefit sharing from forest ecosystem services: (i) forest protection and development policy and; (ii) policy on payment for forest environmental services with many incentive measures to mobilize the communities to participate in forest protection.

Forest protection and development policy: The Decision no.661/QD-TTg of the Prime Minister signed on July 29, 1998 approving the objectives, tasks, policies and implementation of planting 5 million ha of forest. After more than 10 years of implementation, the forest coverage increased from 32% in 1998 to 39.5% in 2010. The whole country has allocated 9,999,892 ha out of the total 16.24 million ha planned for forestry land. By 2010, the country's timber reserve reached 935.3 million m^3, an increase of 24.4% compared to 1998.

By 2012, the Prime Minister signed Decision no.57/QD-TTg dated in 01/2012 approving the National Plan for Forest Protection and Development for the period 2011-2020, in which there were the following objectives: (i) well protect the existing forest area; ensure efficient and sustainable use of forest resources and planned land funds; (ii) increase forest coverage to 42-43% by 2015 and 44-45% by 2020; increase productivity, quality and value of forests; restructure the industry in the direction of increasing added value; basically meeting the demand for wood and forest products for domestic consumption and export; (iii) create more jobs, increasing income for people with a life associated with forestry, contributing to hunger eradication, poverty reduction, security and defense. Accordingly, the target of the rate of forest cover only needs to reach 42% by 2020 to suit the reality. The results of the national target program on sustainable forest development were clear: by 2020, Vietnam had 14,677,215 ha of forest land, of which 10,279,165 ha was natural forest and 4,398,030 ha was planted forest. The area of forested land eligible to calculate the national coverage rate was 13,919,557 ha, the coverage rate was 42.01% (*MARD, 2021*).

On April 1st, 2021, the Prime Minister approved the Strategy for Vietnam forestry development for the period 2021-2030, with a vision to 2050 with specific goals: (i) afforestation, with about 340,000 ha/year by 2030; (ii) planting protection forests and special-use forests at an average of 4,000-6,000 ha/year; (iii) restoration of protection and special-use forests on average 15,000 ha/year; (iv) total PFES collection increasing by 5%/year on average; (v) the national forest coverage rate is stable at 42%-43%.

Policy on payment for forest environmental services: Policy on PFES has already been presented in item 2.2 of Part II.

5.4.2. Policy measures to maintain and enhance wetland ecosystems

In Decision no.1479/2008/QD-TTg, the Government approved "Planning the system of protected inland waters to 2020" with 45 protected inland waters. This can be considered as the first plan of a wetland reserve.

Decision no.1250 /2013/QD-TTg, approving the National strategy on biodiversity to 2020, with a vision to 2030, implements conservation and sustainable use plans for wetlands nationwide, giving priority to important river basins.

Decision no.45/2014/QD-TTG, approving the National master plan for biodiversity conservation to 2020, with a vision to 2030, includes 60 protected wetlands and MPAs.

In 2019, the Government issued Decree no. 66/2019/ND-CP on the conservation and sustainable use of wetlands. This Decree stated that there be sharing of benefits from ecosystem services of important wetlands (outside the protected area), with declaring that stakeholders are to share in benefits from an important wetland ecosystem service; and specifying benefit-sharing activities on important wetlands.

Although it has been mentioned in the National master plan on biodiversity conservation (2014), the conservation system has progressed very slowly, so far only four wetland PAs have been established in accordance with the Biodiversity Law such as: Dong Xuyen Bird Garden Species-Habitat Conservation Area (Bac Ninh Province); Phu My Species-Habitat Conservation Area (Kien Giang Province); Thai Thuy wetland protected area in 2019 (Thai Binh Province); and Tam Giang-Cau Hai wetland protected area in 2020 (Thua Thien-Hue province). In addition, some NRs with high wetland biodiversity were recognized such as: 09 Ramsar sites; 06 inland and coastal wetland areas of 11 world Biosphere Reserves; 03 inland and coastal wetlands 0f 10 ASEAN Heritage sites (*MONRE, 2020*).

Thus, it can be seen that a first basis for a policy on payment for wetland ecosystem services has been initially institutionalized in the above provisions of the Decree 66. However, the provisions on the payment price of the entities used for each type of service have not been mentioned. Therefore, it is necessary to have separate policy documents to develop, pilot and implement the policy of payment for wetland ecosystem services in Vietnam.

5.4.3. Policy measures to maintain and enhance marine and coastal ecosystems

In 2008, the Government issued Decree no.57/2008/ND-CP on the regulation of management of Vietnam's MPAs of national and international importance. In 2010, the Prime Minister issued Decision no.742/2010/QD-TTg on approving the planning of Vietnam's MPA system to 2020, including 16 MPAs (accounting for 0.24% of the sea area). By 2020, 12/16 MPAs with a total area of 213,400 ha have been established and put into operation (*Directorate of Fisheries, 2021*).

Decision no.1570/QD-TTg dated September 6, 2013 approving the Strategy for sustainable exploitation and use of natural resources and protection of the marine environment by 2020, with a vision to 2030 aims to improve adaptive capacity to climate change, maintain ecological function and biological productivity of marine ecosystems in order to protect marine biodiversity and marine resources.

Regarding a policy of payment for marine ecosystem services, until now, payments have been done from a spontaneous perspective. Typical examples include fees for tourism services in Nha

Trang Bay MPA, Ha Long Bay and at Con Dao NP. Therefore, it is necessary to have a policy to develop, pilot and implement the policy of payment for marine and coastal ecosystem services in Vietnam.

5.5. Existing policy gaps and some recommendations to maintain and enhance ecosystems

5.5.1. The legal framework on management of biodiversity and ecosystems still has certain inadequacies and overlaps

There are some key shortcomings and overlaps in the legal framework on biodiversity and ecosystems in Vietnam as follow:

1. Inconsistency in the concepts, classifications, criteria, functional sub-zones and buffer zones of PAs between the Biodiversity Law (2008) and the Law on Forestry (2017).
2. For the management of genetic resources and biosafety, there are many ministries involved in management such as: MONRE, MARD, MOST, MOH and Ministry of Industry and Trade. Therefore, the reality of implementing biosafety management activities for genetically modified organisms, management of genetic resources, as well as the management of access to genetic resources in Vietnam is lacking in linkages sharing and exchange of information. The assignment, decentralization and regulations of responsibility among management agencies in controlling invasive alien organisms are unclear and overlapping. There has been no consensus about the management and licensing of alien species imported into Vietnam.
3. The concept of *ecosystem services* has not been mentioned and institutionalized in the laws on biodiversity in Vietnam. ecosystem services have only been regulated in some limited policy documents and there is lack of policies with regulations on ecosystem assessment.
4. Currently the policy on PFES is quite comprehensive, but it only applies to water supply services for hydropower plants, water companies and tourist companies. For other forest areas that do not benefit from PFES, it is necessary to consider other programs such as investments from the private sector and the community to improve the local landscape, providing revenue through sales and carbon sequestration credits.
5. At present, there is still no policy on payment for wetland ecosystem services and marine ecosystem services while these ecosystems have many important services provided to people such as food, fisheries, tourism, relaxation and environmental and climate regulation. To soon implement, it is necessary to have a mechanism and policy for the payment for wetland and marine ecosystem services in the form of a Government Decree as is available with payments for forest environmental services.
6. The Biodiversity Finance Report, Policy and Institutional Review (*UNDP, 2018*) emphasizes that PFES has the potential to become an important source of finance for forest development, including biodiversity conservation, but lacks a comprehensive and reliable enough monitoring system.
7. The process of operating reservoirs and inter-reservoirs has not been fully and effectively implemented (between the Ministries of Industry and Trade, MARD and MONRE).
8. The planning on the system of aquatic resource protection zones and areas where fishing is prohibited for a definite period has not been implemented under the Fisheries Law (2017).

5.5.2. Specific recommendations to improve the legal framework on conservation and sustainable use of biodiversity and ecosystems

5.5.2.1. Recommendations to improve the Biodiversity Law 2008

Through many assessments by ministries and branches during the implementation of the Law, it is necessary to adjust and supplement a number of contents related to biodiversity and ecosystem conservation to be consistent with relevant laws and suited to the current situation:

1. Introduction of the concept of ecosystem services into the revising of the Biodiversity Law;
2. Adopt a landscape and ecosystem-based approach to biodiversity conservation;
3. Conduct economic valuation and assessment of ecosystem services as a basis for harmonization between conservation and development, as currently economic values from ecosystem services have not been included in Vietnam's national accounting system;
4. Environmental products/services have not been fully assessed and accounted for in the current accounting system, leading to incorrect perception of growth. Currently, the United Nations has issued a unified green GDP calculation framework for worldwide application and implementation;
5. Ensure benefits from biodiversity and ecosystem services are shared fairly and reasonably among stakeholders with community participation and in particular, legislate different ecosystem service payment policies;
6. Investigate, inventory, monitor and report on biodiversity, especially for protected areas, areas of high biodiversity value (outside of PAs), and important wetlands;
7. Establish the national database system on biodiversity and ecosystems, and the mechanism for managing and using information on biodiversity and ecosystem services;
8. Unifying names, classifications, criteria and standards of PA types between the revised Biodiversity Law and the Law on Forestry (2017); as well as on viewpoints and measures in the organization and management of NRs and PAs between ministries and branches at the central level, and between central and local governments and protected areas;
9. Develop and implement mechanisms to promote community participation in biodiversity and ecosystems conservation, especially in PAs;
10. Develop and implement mechanisms and policies for the socialization of conservation work of biodiversity and ecosystem services;
11. Mechanisms and policies to promote the conservation, restoration and development of biodiversity and ecosystems are implemented as an action to adapt to climate change;
12. Apply the provisions of the Law on Gender Equality 2006 and integration of the gender issues into biodiversity conservation;
13. Increase the ability of the Biodiversity Law to reference other relevant laws.

5.5.2.2. Recommendations to develop and improve some policies under the relevant laws

Some policy documents on biodiversity and ecosystems should also be reviewed, adjusted and supplemented or newly developed with contents and regulations to consist with the revising of the Biodiversity Law and suit to the current actual conditions in Vietnam.

(i) Development of some new policies related to ecosystems and their services

In order to maintain and increase the quality of important ecosystem services and to contribute many practical benefits to socio-economic development, it is necessary to develop a number of mechanisms, policies, and technical guidance for ensuring consistency among relevant laws,

resolve conflicting and overlapping issues in the management and conservation of biodiversity and ecosystem services at the national level and implement international commitments to which Vietnam has joined. In order to ensure the quality of policies after promulgation, and ease and appropriateness in the implementation process, it is necessary to mobilize information and knowledge from the linkage between groups of scientists - policy makers - practitioners as well as consult with relevant partners in the process of formulating and perfecting mechanisms and policies. Some of the proposed policies to develop are as follows:

1. Pilot policy on payments for wetland, marine and coastal ecosystem services. In which, it is necessary to develop appropriate benefit-sharing mechanisms between service users and service providers; a support mechanism; and payment rates of users for each type of service. After the successful implementation of the pilot policy, it is recommended that the Government issue a higher legal document to mobilize organizations and individuals to participate in the conservation and sustainable development of ecosystems and their services through mechanisms and policies to pay for ecosystem services.
2. Coordination mechanism in the management of protected area systems. Currently, with the PAs established under the Law on Biodiversity (2008) and the Law on Fisheries (2017) and the PAs established under the Law on Forest Protection and Development (2004) and the Law on Forestry (2017) there have been many disagreements regarding the rating of the PA, functional zoning and buffer zones, criteria, etc. Therefore, a coordination mechanism is required to unify management in order to minimize the conflicts and differences that form the driving forces for biodiversity loss and the degradation of ecosystems and their services.
3. Technical guidance on ecosystem assessment and piloting in a PA or NP will then be scaled up at provincial, regional and national levels. In particular, attention should be paid to strengthening the capacity to evaluate and integrate ecosystem services into policies of relevant sectors through the activities of the phase 2 project implemented by MONRE and UNDP Vietnam.
4. Coordination mechanism on genetic resource management and biosafety among the Ministries: MONRE, MARD, MOST and MOH aimed at unifying and clarifying the responsibilities of each ministry in managing these areas as well as enhancing coordination in the management of natural resources and ecosystem services.

(ii) Adjusting and supplementing some policies related to ecosystems and their services

Some policy documents under laws such as the Biodiversity Law, the Law on Forest Protection and Development, now the Law on Forestry, and the Fisheries Law have remained unchanged for many years and are no longer suited to current conditions. They need to be adjusted and supplemented to be consistent, and synchronized as follows:

1. Strategy for management of the system of special-use forests, marine conservation zones, and inland water conservation zones in Vietnam to 2020, with a vision to 2030 (2014);
2. Strategy for exploitation and sustainable use of natural resources and marine environment protection up to 2020, with a vision to 2030 (2013);
3. Strategy for integrated coastal zone management of Vietnam to 2020, with a vision to 2030 (2014);
4. National master plan on biodiversity conservation to 2020, with a vision to 2030 (2014);
5. Decree no.147/2016/ND-CP dated November 2, 2016 amending and supplementing a number of articles of the Government's Decree no.99/2010/ND-CP dated September 24, 2010 on policy on payment for forest environmental services (2016).

(iii) Other recommendations to maintain and improve ecosystems and their services

In order to maintain and enhance ecosystems for improving the important ecosystem services contributing to the socio-economy, it is necessary to implement various measures at the same time to reduce drivers and pressures to change the status and trends of ecosystems and biological lifeforms in the context of global climate change such as:

1. The ecosystem approach has become very popular over the past decade as a harmonious way to conceptualize management issues related to natural ecosystems. The application of this approach to forest, wetland, marine and coastal ecosystems constitutes a comprehensive integrated management of human activities based on the best scientific knowledge of ecosystems and dynamics, in order to identify and take measures for sustainable exploitation and use of ecosystem services and maintenance of ecosystems.
2. Continue to promote research on the values of ecosystem services (especially for wetland ecosystems and marine and coastal ecosystems) that include provisioning services, regulating services, cultural services and supporting services. Vietnam needs to soon develop a database on the values of major ecosystem services so that it can be easily integrated ecosystems and their services into the decision-making process as well as the strategic environmental assessment and environmental impact assessment related to the management and use of these services.
3. In terms of management viewpoint, it is necessary to think of legalization of the value of ESs so that they can be fully accounted for in the national accounting system.
4. Further research is needed on the drivers and pressures of change in ecosystem services according to specific scenarios in Vietnam and their impact on the socio-economy in order to respond through suitable measures for sustainable exploitation and use of ecosystem services and for biodiversity conservation in Vietnam.
5. Support and facilitate ethnic minority communities to preserve and develop traditional and indigenous knowledge of the conservation and sustainable use of natural biological resources.
6. Focus on the development and application of sustainable livelihood models to improve and enhance the living standards of communities in agriculture, forestry and fishery areas living in or around buffer zones of protected areas, in order to reduce pressures on ecosystems and their services. Models must be suitable for the natural conditions as well as the practices of each different ecological region.
7. Continue to restructure the organization of biodiversity management at central level to minimize focal agencies in ministries and improve capacity for human resource at local level.
8. Strengthen enforcement measures for biodiversity conservation laws.
9. Increase the search for sources of investment capital for biodiversity and ecosystem conservation.
10. Develop and implement a comprehensive programme on communication, education and awareness raising for all walks of life about the important role of biodiversity and ecosystem services.

Supported by:

Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection

based on a decision of
the German Bundestag

In partnership with:

UN environment programme WCMC

NEA NATIONAL ECOSYSTEM ASSESSMENT INITIATIVE

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