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Environmental Sustainability in Vietnam

Piloting the Environmental Sustainability Gap Framework (ESGAP) and Strong Environmental Sustainability Index (SESI)

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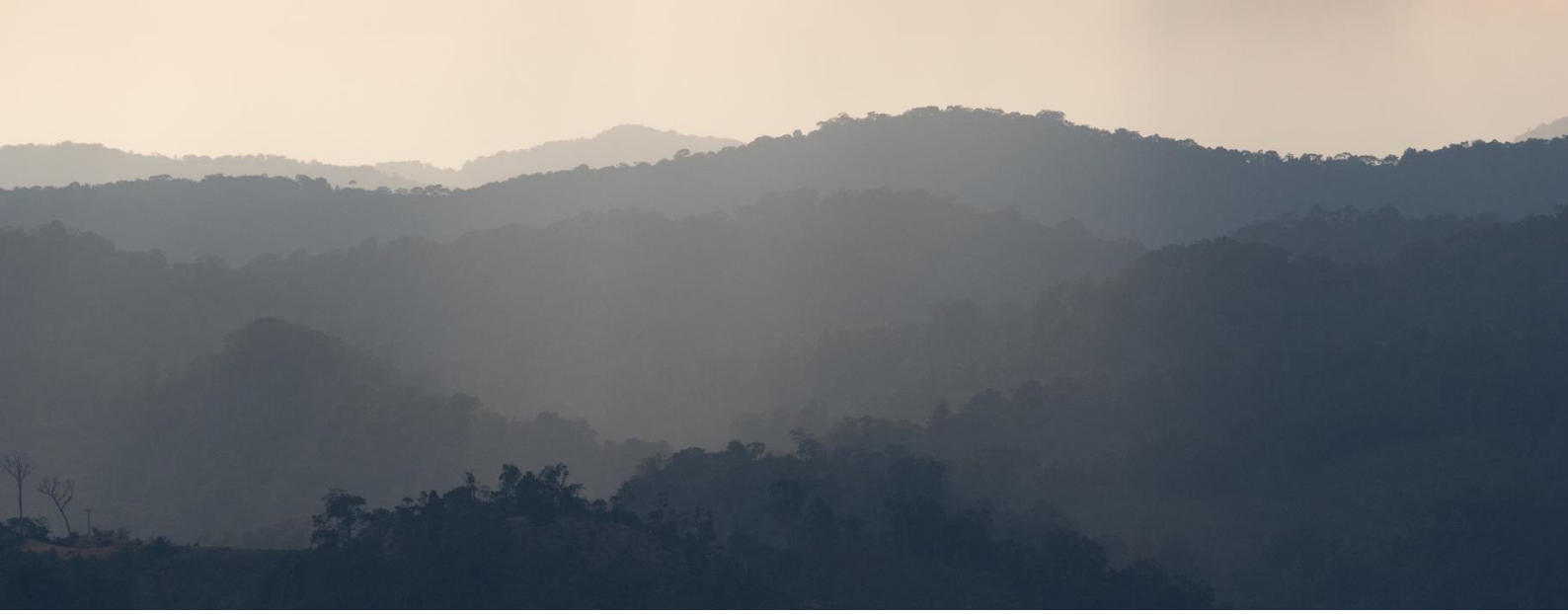

Environmental Sustainability in Vietnam – Piloting the Environmental Sustainability Gap Framework (ESGAP) and Strong Environmental Sustainability Index (SESI)

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ACRONYMS AND ABBREVIATIONS

CBD	Convention on Biological Diversity
DWRM	Department of Water Resource Management
ESGAP	Environmental Sustainability Gap
FAO	Food and Agriculture Organization
FFI	Fauna & Flora International
GHG	Greenhouse Gas
GSO	General Statistics Organization of Vietnam
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment
IUCN	International Union for Conservation of Nature
MARD	Ministry of Agriculture and Rural Development
MOIT	Ministry of Industry and Trade
MOH	Ministry of Health
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
MPI	Ministry of Planning and Investment
NDC	Nationally Determined Contribution
OECD	The Organization for Economic Co-operation and Development
SDGs	Sustainable Development Goals
VSDGs	Vietnam's Sustainable Development Goals
SESI	Strong Environmental Sustainability Index
SDIs	Sustainable development indicators
MDGIs	the Millennium development goals indicators
TAC	Total Allowable Catch
TFWW	Total freshwater withdrawal
UCL	University of College London
UN	United Nations
UNIDO	United Nations Industrial Development Organization
UNEP	United Nations Environment Programme
UNEP-WCMC	The UN Environment Programme World Conservation Monitoring Centre
UNFCC	United Nations Framework Convention on Climate Change

VBCSD	Vietnam's Business Council for Sustainable Development
WEI	Water Exploitation Index
WHO	World Health Organization
WWF	World Wildlfe Fund

EXECUTIVE SUMMARY

The Prime Minister of Vietnam issued a National Action Plan for the implementation of the Agenda 2030 on Sustainable Development adopting 17 global Sustainable Development Goals (SDGs) into 17 Vietnamese SDGs and 115 targets to 2030. Nevertheless, the limited number of indicators and data, and the lack of a nation-wide monitoring system jeopardizes the country's ability to effectively measure and monitor the state of the environment in a robust way. Better monitoring, better data and better co-ordination between agencies and Government Ministries are still major challenges to effectively monitor performance towards achieving the Vietnam's SDG targets.

This study pilots the assessment of strong environmental sustainability in Vietnam using the Environmental Sustainability Gap framework (ESGAP), and the Strong Environmental Sustainability Index (SESI), which measures countries' performance on maintaining four essential environmental functions (i.e., source, sink, life support and human health and welfare).

Most of the topics covered in the ESGAP framework are also environmental concerns for Vietnam. Nevertheless, the ESGAP framework also highlighted major gaps in Vietnamese policies related to the use of non-renewables resources, and the ecological and chemical conditions of ecosystems. In particular, some of these include the lack of regulations for impacts of tropospheric ozone pollution on ecosystems, overfishing, the lack of standards for maintaining quality and functioning of ecosystems and biodiversity, as well as major remaining environmental challenges for Vietnam that the Government must address such as air pollution in major cities and weak protection and management of its world natural heritage.

Our results also showed that five out of 22 strong environmental sustainability indicators used in the European version of the ESGAP framework have data available in Vietnam (including soil erosion, Greenhouse Gas (GHG) emissions, ozone depleting substances, clean fuels and technologies for cooking, and natural and mixed world heritage sites). Eight out of 22 indicators had insufficient data sources and were replaced by proxy indicators for Vietnam. The remaining 9 indicators (related to groundwater resources, ozone pollution and ecological quality of ecosystems) represent major data gaps on the environment for Vietnam.

Currently, Vietnam has defined a total of 41 national technical regulations and standards on environment quality to limit wastewater, exhaust gas, noise pollution, solid waste, and hazardous waste. In Vietnam, these technical standards were developed by the government by assessing the suitability of standards used in developed countries and adjusting these to the national Vietnamese context. Additionally, further national technical regulations on the environment are currently under development, especially on air quality and emission regulations for specific industry sectors.

Some of the main remaining challenge to address are the differences between the two environmental standards systems used in Europe and Vietnam, the scientific underpinning of the proxy indicators used in Vietnam and their relevance or suitability for the ESGAP framework, as well as the availability of environmental data and indicators to fill the data gaps highlighted on this study.

There are a number of lessons to be learned from this study, which include: i) the relevance of the ESGAP framework to identify Vietnam's remaining environmental challenges to achieve strong environmental sustainability and data gaps in the country, and ii) the potential of the Vietnam ESGAP framework to be leveraged as an effective communication tool which provides an overall picture of the gap (i.e., how far the country is) to achieve environmental sustainability.

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INTRODUCTION

In September 2015, the United Nations Sustainable Development Summit adopted an international framework to guide development efforts, entitled 'Transforming our world: the 2030 Agenda for sustainable development'. The Agenda is built around 17 Sustainable Development Goals (SDGs), divided into 169 targets, which are informed by 244 indicators. The importance of improving the availability of and access to data and statistics related to the environment was recognized through the adoption of a wide range of environmental SDG targets and indicators.

In March 2019, UN Environment launched a report called 'Measuring Progress towards monitoring the environmental dimension of the SDGs', which analyses the environmental dimensions of sustainable development based on the Sustainable Development Goal (SDG) indicators, including the availability of statistical and spatial data. This report highlighted the profile of the environmental dimension of the SDGs and its role as a fundamental pillar to achieve sustainable development. It provided a framework to monitor performance on achieving the environmental dimension of sustainable development and it also highlighted that whereas many environmental SDG indicators focus on mechanisms to address environmental problems, production and consumption features and links between human and the environment, only a few capture the actual state of the environment or its trends.

A question still remaining is if existing environmental indicators and indicator sets are capable of showing whether countries are making progress towards environmental sustainability. For an indicator to reflect if countries are close or not to environmental sustainability, it needs to meet four criteria: (i) it needs to be linked to the environmental functions of natural capital; (ii) it needs a reference point against which performance can be compared; (iii) the reference point needs to represent the conditions under which the provision of critical functions of natural capital are maintained; and (iv) the indicator needs to be defined at the national level, as this is the level at which most environmental policy is implemented.

Not all the environmental sustainability performance indices meet these criteria, and this is precisely the gap that the Environmental Sustainability Gap (ESGAP) framework aims to fill. The ESGAP framework was developed in the 1990s. and sets the basis to measure countries' environmental sustainability performance, based on standards meant to represent the situation at which the environment can maintain its functions over time.

It is composed of four functions of the environment including: (i) Source function - maintain the capacity to supply resources); (ii) Sink function - maintain the capacity to neutralize wastes, without incurring ecosystem change or damage); (iii) Life support - maintain the capacity to sustain ecosystem health and function and (iv) Human health and welfare - maintain the capacity to maintain human health and generate human welfare in other ways. An initial case study developed by University College London (UCL) identified 22 indicators, all supported by scientific standards of environmental sustainability, that can ultimately be aggregated into two single indices that represent absolute environmental sustainability performance at a given point in time, and progress over time towards environmental sustainability respectively. The former refers to the Strong Environmental Sustainability Index (SESI), while the latter is referred to as the Strong Environmental Sustainability Progress Index (SESPI).

Currently the SESI is being calculated for the 27 Member States of the European Union (EU) plus UK in preliminary work, using environmental data made available by the European Environment Agency, the European Commission, Eurostat and academic sources. This work illustrates the feasibility of implementing the ESGAP framework for countries for which a wide range of high-quality environmental datasets are available.

To achieve global relevance alongside the numerous existing environmental indicator initiatives such as the SDGs, the Convention on Biological Diversity (CBD), and The Paris Agreement, the implementation of the ESGAP framework needs to be feasible in all countries, at different stages of development. A recent feasibility assessment of the application of the ESGAP framework in all countries (Fairbrass et al. 2020) concluded that there is considerable global data available to support its implementation in countries at different stages of development.

In Vietnam, the Government of Vietnam has issued an action plan to implement the SDGs (Decision No. 622/QD-TTg dated May 10, 2017). Shortly thereafter, the Ministry of Planning and Investment also issued a set of 158 indicators for Vietnam (03/2019/TT-BKHDT dated January 22, 2019). In the area of natural resources and environment, the Ministry of Natural Resources and the Environment (MONRE) also issued an action plan to achieve the Sustainable Development Goals with 17 specific objectives and 40 monitoring indicators. Nevertheless, data collection has just started to be implemented by different ministries involved.

Road-testing the ESGAP framework in Vietnam is a great opportunity to self-assess how the country performs against science-based environmental standards and consider how this compares to other related indicator systems such as the SDGs. In addition, the ESGAP indicator framework also represents an opportunity for

Vietnam to supplement data sources to support the assessment of progress towards achieving the environmental dimension of the SDGs in Vietnam.

Objectives of the study

The present study aims to analyze the feasibility of implementing the ESGAP framework in Vietnam and calculating the Strong Environmental Sustainability Index (SESI) for the country by selecting suitable indicators relevant to the Vietnamese context through data collection and analyses via peer review desk research and broad national stakeholder consultation for Vietnam. This work is intended to serve as a country-owned document to inform policymaking and provide recommendations on the challenges and opportunities related to measuring progress towards strong environmental sustainability in Vietnam.

Methodology of the study

The following methods have been used in this study: (i) Desk review; (ii) Collection of data and calculation; (iii) Consultation with relevant stakeholders.

A desk review was implemented to analyze the linkages between the ESGAP framework and the environmental policy framework in Vietnam, as well as to identify indicators, data sources and standards. A number of national and international publications on natural resources management, environmental protection and climate change were used to inform this work.

Data was collected from official publications or directly provided by different departments of MONRE such as the General Land use Administration (GLA), Vietnam Environment Administration (VEA), Vietnam Administration of Sea and Island (VASI), Department of Climate Change (DCC), Ministry of Agriculture and Rural Development (MARD), Ministry of Industry and Trade (MOIT) and the Food and Agriculture Organization (FAO) in Vietnam. Some additional data has been collected from global data sources including publications by international organizations such as UNEP and FAO.

Calculation of the Vietnam SESI followed the guidelines developed by the ESGAP team from UCL (Usubiaga-Liaño, A. & Ekins, P.,2020) based on an internal methodological report and additional exchanges. This report describes the indicator selection process and calculates the SESI at the level of environmental function using the following normalization, weighting and aggregation methods.

- Normalization: Environmental sustainability is represented by normalizing the indicators with the goalpost method, which in this case uses environmental standards as reference points to measure absolute (not relative) performance. A minimum score of 5 is used to avoid zero values when using the geometric mean to aggregate the information.
- Weighting: In absence of a credible weighting scheme that represents the

relevance of each environmental function, equal weights are used.

- Aggregation: A geometric mean is used to represent the limited substitution capacity between the functions of natural capital.

Consultations on the framework, indicators and results produced were conducted through two workshops with relevant stakeholders including line ministries and Vietnamese scientists and experts.

In October 2020, ISPONRE hosted a face-to-face consultation workshop with representatives of relevant management agencies (i.e., Department of Environmental Quality Management, Department of Information Technology and Natural Resources Data, Department of Climate Change, Chemical Department, Ministry of Industry and Trade, Center for Planning and Investigation national source, Northern Center for environmental monitoring; research institutes (i.e., Institute for Marine and Island Studies, Institute of Hydrometeorology and Climate Change, Academy of Social Sciences, Institute of Ecology and Resources, University of Natural Resources and Environment, Regional Development Research Institute, Institute for Environment and Sustainable Development); non-governmental organizations (Pannature, WWF - Viet Nam, French Development Agency, Association for the Protection of Nature and Environment); experts in the related fields and academics (Institute of Strategy and Policy on natural resources and environment). The objectives were to introduce the ESGAP framework, context, methods and achieved results to date and to propose stakeholders' commitments on data sources and ability to provide data.

In March 2021, ISPONRE hosted a virtual stakeholders meeting with 24 national participants and experts from over 14 institutions (Forest Inventory and Planning Institute (FIPI), Vietnam Institute of Fishery Economics and Planning (MARD), Department of Water Resources Management (MONRE), Department of Climate Change (MONRE), Vietnam Environment Administration (MONRE), Centre for Environmental Information and Data, Chemical Department of the Ministry of Industry and Trade, General Statistics Organization of Vietnam (GSO), Institute for Environment and Sustainable Development, Department of Science, Education, Natural Resources and Environment of the Ministry of Planning and Investment, Central institute for Natural Resources and Environmental Studies of the Hanoi National University, PanNature, UNEP Vietnam, FAO Vietnam, WWF Vietnam, Institute of Ecosystems and Ecological Resources) to discuss the results of the proposed ESGAP framework for Vietnam. Participants provided valuable specific technical input in both meetings and also proposed additional indicators and data sources that could improve the current assessment in the future (see Appendices 4 & 5 for summary of input from participants).

1. ENVIRONMENTAL POLICY CONTEXT IN VIETNAM AND LINKAGES WITH THE ESGAP FRAMEWORK

1.1. Policy framework on environment and natural resources in Vietnam

Vietnam is a country with high economic growth among the ASEAN nations. Nevertheless, Vietnam's environment and natural resources continue to be strongly affected by unsustainable socio-economic development. The process of urbanization and expansion of administrative boundaries has been continuous, with the urban population growing rapidly, and the standards of living for rural communities also increasing. Nevertheless, this continuous growth has put an unprecedented pressure on the natural environment through an increasing demand for natural resources and negative pressures related to, for example, waste management, which are detrimental for both the environment and the Vietnamese socio-economic system.

Fully aware of serious impacts on the country's sustainability, The Communist Party of Vietnam adopted and affirmed the vision for in-country sustainable development throughout the Party congresses and the socio-economic development strategy 2001-2010. Hence, sustainable development has been mainstreamed into the Socio-Economic Development Strategy 2011 - 2020 and the Socio-Economic Development Plan 2011 - 2015 and 2016 - 2020 (detailed policies provided in Annex 1). Based on Vietnam's development context and priorities and building on the successful implementation of the Vietnam Millennium Development Goals, in 2017, the Prime Minister issued Vietnam's National Action Plan for Implementation of Agenda 2030 for Sustainable Development (Decision 622/QĐ-TTg) internalizing 17 global SDGs into 17 Vietnam SDG (VSDG) and 115 targets to 2030. Accordingly, the Ministry of Investment and Planning (MPI) of Vietnam also issued a set of sustainable development indicators (Circular No. 03/2019/TT-BKHDT) with 158 monitoring indicators and their roadmap to 2025 and 2030 (Decision 681/QĐ-TTg)[1]. Out of 158 indicators, there are 47 indicators relating to the field of natural resources and environment. Among the 115 targets to 2030, 17 targets related to natural resources and the environment have been assigned to the Ministry of Natural Resources and Environment (MONRE). Following up, a ministerial Action Plan for implementation (Decision No.

[1] Among these 158 indicators, there are: (1) 38 indicators belonging to the National Statistical Indicator System promulgated together with the 2015 Statistical Law. (2) 103 indicators are developed based on the global Sustainable Development Goals (indicators). The remaining indicators are not specified in the Statistical Indicators for Sustainable Development of Vietnam because: they are qualitative indicators, the indicators are only calculated on a global scale and calculated by international organizations, the indicators are not suitable for the current situation. socio-economic situation in Vietnam, the indicators are only applicable in specific areas ...) (3) 18 statistical indicators with roadmap B - are the indicators that will be collected and aggregated from 2025.

3756/QD-BTNMT dated December 13, 2018) which also defined 40 monitoring indicators with roadmaps until 2030. Although the system of sustainable development indicators has been issued and is quite complete in terms of environmental sustainability, the monitoring and evaluation of the implementation of the indicators is still in the formative stage, currently 60/158 only Sustainable development targets equivalent to 38% are not yet available for assessment (MIP, 2020).

Regarding on the field of sustainable management of natural resources, the strategy for natural resources management and environmental protection of the Government of Vietnam is defined by different policies issued by the Party and the Government of Vietnam such as: (i) The socio-economic development strategy for the period 2011-2020 which mandates to "exploit and use resources in a rational, efficient and sustainable manner" and to "evaluate the potential and value of important natural resources" and "planning, managing and exploiting natural resources in economical, effective and sustainable manners"; (ii) Resolution 24-NQ/TW of the Central Committee of the Communist Party of Vietnam on proactively responding to climate change, enhancing natural resource management and protecting the environment. Additionally, the National Assembly has issued different laws to regulate the management and protection of natural resources, such as the Laws on Land, Water Resources, Environmental Protection, Minerals, Natural Resources and Environment of Seas and Islands, Forestry, Fisheries or the Biodiversity Law. The Government of Vietnam has also issued by-law documents and sectoral strategies and plans for implementation (see Annex 1 for further details).

Recognizing environmental protection as one of the three main pillars of the country's sustainable development, the Government of Vietnam has determined not to trade off the environment for the benefit of economic growth. The Government issues sector strategies for each area, including targets and monitoring targets for the 10-year period 2010-2020; 2020-2030 such as National Strategy for environmental protection until 2030, vision to 2050; National Strategy for integrated solid waste management to 2025, vision to 2050 (Amendment); Planning for the national natural resources and environment monitoring network 2016 - 2025, with a vision to 2030, etc. (detailed policies provided in Annex 1).In addition to these orientation documents, there are the Law on Environmental Protection, Biodiversity Law and guidance documents such as decrees and circulars. These legislations provide regulations on specific areas such as pollution control, waste management, strategic environmental assessment, environmental impact assessment, environmental management of river basins, environmental management of industrial zones and trade villages, sea and island environmental

management, biodiversity conservations, environmental monitoring, financial incentives and supports for technological development.

A system of national standards and technical regulations on the environment is being completed with standards equivalent to the those applying in ASEAN countries including Japan and Korea. Additionally, in the period of 2013-2018, the Ministry of Natural Resources and Environment issued national technical regulations on the environment and quality of wastewater and emissions.

Specific databases with information on areas such as land, water resources or sea islands are also under development and managed by the MONRE. In particular, for example, a system to monitor changes in surface water, underground water, exploitation and use of water and wastewater discharge into water sources is under current development. On land resources, a national database on rice land has currently been completed, aiming to integrate the commune-level rice land database into the district level and district level into the province level. The localities have established a synchronous digital cadastral record system between cadastral maps with registration information, and some localities have also built and operated cadastral databases[2].

Regarding to climate change policies, Vietnam is considered as one of most vulnerable countries to climate change, and climate change has become a major challenge to achieve the SDGs in Vietnam. Furthermore, economic development and industrialization have increased energy demand and consumption and its consequent emissions of greenhouse gases and other pollutants. From 2000 to 2010, carbon emissions per capita in Vietnam tripled and carbon emissions per GDP unit increased by 48%, ranking 31st in the world in 2011 in terms of total emissions of greenhouse gases. With the current rate of increasing emissions, Vietnam must strongly transform towards a low carbon economy. The Government of Vietnam signed the United Nations Framework Convention on Climate Change (UNFCCC) (June 11, 1992), ratified on November 16, 1994 and signed the Kyoto Protocol (December 3, 1998), ratified on September 25, 2002. Vietnam's policy framework to respond to climate change continues to be developed with the issuance of the National Strategy on Climate Change, the National Strategy on Green Growth, the National Target Program to Respond to Climate Change and the Green Growth 2016-2020. Scenarios of climate change and sea level rise for Vietnam were issued in 2009 and updated in 2012, 2016 and 2020. Climate change has been mainstreamed into the strategies and plans for

2 By the end of 2017, 237/700 district-level administrative units in 63 provinces and cities have developed a land database, of which 117 districts in 32 provinces and cities have basically been completed and put into operation. By May 2018, 132/713 district-level units built and operated cadastral databases (accounting for 18.5% of the total number of districts).

socio-economic and sectoral development. Many models of adaptation with climate change and low-carbon livelihoods have been developed and replicated (detailed Vietnamese policies to respond to climate change provided in Annex 1).

An inventory on GHG emissions activities has been institutionalized by the Law on Environmental Protection 2014 (Article 41), and Decision 2359/QD-TTg approving the National GHG Inventory System. National GHG inventory activities have been implemented for the years 1994, 2000, 2010, 2013 and different plans, schemes, and programs to reduce GHG emissions have been implemented by different ministries such as the biogas program, the development of public transport in urban areas, mandatory regulations on energy consumption, the development of E5 biofuel and policies to support developing renewable energy sources.

1.2. Linkages between Vietnamese environmental policies and the ESGAP framework

The following table evaluates the linkages between the ESGAP framework and the policy system of Vietnam:

Table 1. Comparative analyses between the Vietnam legal framework on environmental sustainability and the ESGAP framework

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
Source (Maintain the capacity to supply resources)	Renew renewable resources	Forest resources	Annual fellings	Forest utilization rate	VSDG15.2.1: Existing forest area VSDG15.2.2: Forest cover rate	(1) Forestry development strategy in Vietnam for the period 2006 - 2020 (2) National Strategy on Biodiversity to 2020, Vision to 2030 (3) The Strategy for management of special-use forests, marine protected areas and inland water conservation zones of Vietnam to 2020, with a vision to 2030.	Vietnam aims to increase forest coverage and forest quality through sustainable forest management and forest protection.
		Fish resources	Condition of fish stocks	Fish stocks within safe biological limits	VSDG 2.4.2: Percentage of aquaculture area applying good and sustainable aquaculture practices VSDG 14.4.1: Proportion of fishery resources within ecological sustainability limits VSDG 14.4.2: Number of illegal fishing cases VSDG 14.4.3: Ratio of catches to reserves of aquatic resources in Vietnam's coastal waters	(1) Fisheries Development Strategy of Vietnam to 2020 (2) Strategy for sustainable exploitation and use of marine resources and environmental protection to 2020, with a vision to 2030	Vietnam aims to limit the decline in fisheries, especially in coastal areas
		Water resources	Blue water consumpt	Surface water bodies	VSDG 6.3.1: Percentage of urban wastewater that is collected and treated to	(1) The National Action Plan to improve efficiency of management, protection	Vietnam's objectives are to improve efficiency of water resources use; limit the

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
			ion	are not under water stress	meet given standards and regulations. VSDG 6.3.2: Proportion of industrial parks and export processing zones that have a centralized wastewater treatment system meeting environmental standards. VSDG 6.4.1: The proportion of large reservoirs is controlled and monitored to ensure that the minimum flow of the river basin is maintained. VSDG 6.5.1: The proportion of large and important river basins has an automatic, online monitoring system. VSDG 6.5.2: Proportion of large, important reservoirs in river basins operated under inter-reservoir coordination regulation.	and general use of water resources for the period 2014-2020 (2) National strategy on water resources to 2020	decline in surface water area in urban centers and residential areas; protect water quality in river basins; and overcome local and seasonal water shortages caused by overexploitation
			Status of groundwater body	Groundwater bodies in good quantitative status			
	Use non renewables prudently	Soil erosion	Soil erosion rate	Area with tolerable soil erosion	VSDG 15.3.1. Rate of degraded land area VSDG 12.2.2: Ratio of the land area of Vietnam as	(1) Resolution of the XI Central Executive Committee to Continuing to renovate land policies	Vietnam's policy mandates the sustainable exploitation and use of mineral resources and limits the use

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
					measured from the gamma spectrum 1:50,000 VSDG 12.4.3: Percentage of residual contaminated land areas treated and improved VSDG 2.4.1. Percentage of agricultural planted area applying safe production processes	and laws in the new era (2) National action program to combat desertification in the 2006-2010 period with a vision to 2020 (3) Adjustment of land use planning to 2020 and land use plan for the final period (2016-2020) at the national level	of fossil fuels. Vietnamese law also regulates soil quality protection through policies on sustainable agricultural cultivation or conservation of genetic resources in agriculture.
Sink Function (Maintain the capacity to neutralize wastes, without incurring ecosystem change or damage)	Prevent global warming, ozone depletion	Greenhouse gases	Greenhouse gas emissions	Emissions / Sustainable emissions	VSDG 11.6.4 GHGs emissions per capita	(1) National Target Program to Respond to Climate Change and Green Growth for the 2016-2020 period (2) Regulation on the management of import, export and temporary import - re-export of ozone depleting substances in accordance with the Montreal Protocol on ozone depleting substances (3) Mechanism to encourage development of solar power projects in Vietnam. (4) The Plan to implement the Paris agreement on climate change in Vietnam. (5) Vietnam's Renewable Energy Development Strategy to 2030, with a	Vietnam has committed to a 9% reduction in gas emissions by 2030 compared to the normal emission scenario, and even to a 27% reduction under international support.
		Stratospheric ozone depleting substances	Consumption of ozone depleting substances	Consumption / Sustainable consumption			

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
						Vision to 2050	
	Respect critical loads for ecosystems	Load of pollutants	in terrestrial	ecosystems		Ozone pollution	Cropland area exposed to safe ozone levels
				Forest area exposed to safe ozone levels			
			Critical loads of heavy metals	Ecosystems not exceeding the critical loads of cadmium/lead/mercury		No relevant policies	
			Eutrophication	Ecosystems not exceeding the critical load of eutrophication		No relevant policies	
			Acidification	Ecosystems not exceeding the critical loads of		No relevant policies	

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
				acidification			
		Freshwater ecosystems	Surface water pollution	Surface water bodies in good chemical status (fresh water and coastal water bodies)	VSDG 6.3.1: Percentage of urban wastewater collected and treated to meet given standards and regulations. VSDG 6.3.2: Percentage of industrial parks and export processing zones that have been put into operation with a centralized wastewater treatment plant meeting environmental standards	(1) National Strategy on Water Resources to 2020 (2) National technical regulation on surface water quality QCVN 08-MT:2015/BTNMT national technical regulation on surface water quality	Vietnam has a system of national technical regulations on land, water, and air, including technical regulations for wastewater. Vietnam also has regulations on assessment of the carrying capacity of river basins and rivers but has not yet assessed the carrying capacity of pollutants for air, soil and ecosystems.
			Groundwater pollution	Groundwater bodies in good chemical status		National technical regulation on ground water quality (QCVN 09-MT:2015/BTNMT)	
		Marine ecosystems	Marine pollution	Coastal water bodies in good chemical status	- Percentage of coastal water quality monitoring points meeting the requirements of the national technical regulation QCVN 10-MT:2015/BTNMT for the following parameters: Organic matter pollution (N-NH4+) (%); Total grease (%) - The sea and island environment pollution risk zoning map has been	National technical regulation on marine water quality (QCVN 09-MT:2015/BTNMT)	

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
					developed and promulgated - Ratio of sea area under basic investigation of marine resources and environment at map scale 1:500,000 - Percentage of offshore monitoring points with average acidity (pH) meeting technical standards (pH = 7.5-8.5 according to QCVN: 2015/BTNMT for offshore seawater) (%) VSDG 14.1.1: Concentration of substances in seawater environment in estuary, coastal and offshore areas VSDG 14.3.1: D14.3.1: substances in the environment VSDG14.3.1: Substances in the marine environment in estuaries and coastal areas		
Life support-Maintain the capacity to sustain ecosystem	Maintain biodiversity (especially species and ecosystems)	Terrestrial ecosystems	Functional diversity	Terrestrial area with acceptable biodiversity levels	VSDG 6.6.1: Ratio of protected areas	(1) National strategy for biodiversity conservation to 2020, vision to 2030 (2) National Strategy for Forestry development in Vietnam for the period 2006 – 2020 (3) The Strategy for	Biodiversity state is reported at the provincial level and there are not yet national technical regulations or standards on biodiversity and ecosystems quality.
		Freshwate	Ecologica	Surface			

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
health and function		r ecosystems	l status	water bodies in good ecological status		management of special-use forests, marine protected areas and inland water conservation zones of Vietnam to 2020, with a vision to 2030. (4) Planning on the system of marine protected areas in Vietnam to 2020	
		Marine ecosystems	Ecological status	Coastal water bodies in good ecological status	VSDG 14.5.1: Area of Marine protected sites		
Human health and welfare - Maintain the capacity to maintain human health and generate human welfare in other ways	Respect standards for human health	Outdoor air pollution	Concentration of air pollutants	Population exposed to safe levels of $PM_{2.5}$	VSDG 11.6.3: Concentration of substances in the air environment (Monitoring parameters TSP/PM10/PM2,5/CO/SO2/NO2/O3/Pb)	(1) The National Action Plan for Air Quality Management to 2020, with a Vision to 2025 (2) National strategy of environmental protection to 2020 with a vision to 2030 (3) National technical regulation on ambient air quality (QCVN 05: 2013/BTNMT)	Vietnam has developed national technical regulations on ambient air and drinking water quality, based on the World Health Organization (WHO)'s standards on safety for human health.
		Indoor air pollution	Concentration of air pollutants	Population using clean fuels and technologies for cooking	VSDG 7.1.1: Percentage of households accessing electricity VSDG 7.1.2 Percentage of households using clean fuel VSDG 7.1.3 Renewable energy share in total final energy consumption		
		Drinking water	Concentration of pollutants	Samples that meet the drinking water criteria	VSDG 7.1.3 Percentage of communes recognized as meeting new rural standards VSDG 4.8.1 Percentage of schools with: Drinking water; Convenient and separate toilet system for each	(1) National Program to ensure a safe water supply 2016-2025 (2) Circular 04/2009 / TT-BYT issuing "National technical regulation on drinking water quality"	

Function	Principle	Topic	Pressure/State	ESGAP indicator	VSDG on field of Natural Resources and Environment	Other policies	Notes
					gender; Convenient hand washing place VSDG 6.1.1: Percentage of urban population supplied with clean water through a centralized water supply system VSDG 6.1.2: Percentage of households using hygienic water sources		
	Conserve landscape and amenity	Bathing water	Concentration of bacteria	Recreational water bodies in excellent status	VSDG 11.7.1: Area of public green land per capita in inner city and inner city VSDG 6.2.1: Percentage of households using hygienic latrines	(1) National technical regulation on surface water quality (QCVN 08-MT:2015/BTNMT) (2) National technical regulation on marine water quality (QCVN 09-MT:2015/BTNMT)	Vietnam has national technical regulations for surface water and coastal water quality that specify separate criteria for recreational areas.
		Natural and mixed world heritage sites	Conservation outlook	Natural and mixed world heritage sites in good conservation outlook	Number of Ramsar sites established and recognized Number of ASEAN Heritage Parks (APHs) built and recognized	(1) Decree 109/2017 / ND-CP on regulations on the protection and management of world cultural and natural heritage in Vietnam (2) National strategy of environmental protection to 2020 with a vision to 2030	Vietnam has designated ASEAN Heritage Gardens (APH), biosphere reserves, and geological parks.

The given table illustrates that although most of the environmental functions defined in the ESGAP framework are reflected in the Vietnamese environmental policy scenario. There are a few indicators of sustainable development in Vietnam directly assess the level of sustainability of the environment including:

- VSDG 14.4.1: Proportion of fishery resource reserves within ecological sustainability limits
- VSDG 15.3.1: Rate of degraded land area
- VSDG 14.6.4: GHG emissions per capita
- Rate of coastal water quality monitoring points meeting the requirements of national technical regulation QCVN 10-MT: 2015/BTNMT for the following parameters: Organic matter pollution (N-NH4+) (%); Total grease (%)
- Percentage of offshore monitoring points with average acidity (pH) meeting technical standards (pH = 7.5-8.5 according to QCVN: 2015/BTNMT for offshore seawater) (%)
- VSDG 14.1.1: Concentration of substances in seawater environment in estuary, coastal and offshore areas.
- VSDG 14.3.1: Acidity (pH) of seawater
- VSDG 11.6.3: Concentration of substances in the air environment (Monitoring parameters: TSP/PM10/PM2,5/CO/SO2/NO2/O3/Pb)
- VSDG 7.1.2 Percentage of households using clean fuel
- VSDG 11.7.1: Area of public green land per capita of cities
- VSDG 6.2.1: Percentage of households using hygienic latrines

Meanwhile, the remaining indicators are indirect indicators (response indicators) that evaluate the implementation of environmental management agencies of Vietnam towards environmental sustainability such as the rate of industrial parks and export processing zones with systematic centralized wastewater treatment system which is automatically monitored and connected online with environmental management agency (%); The number of illegal fishing cases...

Additionally, we identify three gaps in terms of both environmental issues that the Government of Vietnam is concerned about but are not reflected directly in the ESGAP framework, as well as important environmental functions considered in the ESGAP framework that are not considered in the environmental policy scenario in Vietnam.

1) Use non renewables prudently. The ESGAP framework mainly refers to soil resources, whilst Vietnam's policy also regulates the sustainable use of mineral resources and fossil fuels. Nevertheless, the absence of science-based standards that applies to extraction makes it challenging to include a relevant indicator in the framework.

2) Maintain biodiversity. Vietnam currently faces many challenges to monitor the state of biodiversity and ecosystem health nationwide. Some of these challenges include: i) the lack of a unified coordinating institution for biodiversity conservation in Vietnam (state management of biodiversity conservation is shared between the Ministry of Agriculture and Rural Development (MARD), MONRE, and the Provincial People's Committees (PPC), and there are overlaps and conflicts within it), ii) the lack of a long-term, systematic and comprehensive national biodiversity monitoring system, iii) low and unfocused funding from the state budget for biodiversity conservation, and iv) overall ineffective legislation enforcement related to biodiversity conservation in Vietnam (Soto-Navarro et al., 2020). Immediate policy goals focus on implementation actions such as the development of action plans and prioritization criteria for the conservation of wild and rare species, the protection of genetic resources, and the designation of protected areas.

3) Respect critical loads for ecosystems: Currently, Vietnam has regulations on assessing the load capacity of river basins and rivers, but not on the carrying capacity of pollutants to the air and soil environment.

1.3. National data availability

In this section, we review national data sources in Vietnam to inform the implementation of the ESGAP framework. This review included policy documents and published literature as well as the identification of focal agencies managing data sources at the national level.

We assessed the availability of indicators based on four criteria (

Table 2) according to Fairbrass et al. (2020). These criteria include:

Update frequency. Regularly updated data enables environmental changes to be tracked over time. Data that is updated at least annually is preferable as this aligns to the normal frequency that national reporting occurs.

Most recent update. Data that is produced more recently is preferable over older datasets, as this enables reporting that more accurately reflects the current state of the environment. Datasets that do not have a recent update are likely to also not be frequently updated, so there is some overlap with the update frequency criteria.

Spatial coverage. Data that is available for the entire footprint of the country is preferable to data that is only available for certain regions or sites. Whole country datasets tend to be produced by satellite or modelling activities, whereas more localized data is produced by in-situ monitoring.

Spatial resolution. Fine-scale resolution data is preferable to data that is only available at the country scale. Many of the environmental measures in the

ESGAP, such as water quality and biodiversity, can vary spatially at local scales. High resolution data allows spatial differences in the state of the environment to be tracked and inform spatial environmental policies.

Table 2. Data assessment criteria and scores

Criteria		Score			
		0	1	2	3
Temporal	**Update frequency**	Data is not regularly updated	Less than every 5 years	At least every 5 years	Annual
	Most recent update	Older than 10 years	Data from last 10 years	Data from last 5 years	Data from last 3 years
Spatial	**Coverage**	No data available	Only certain sites	Only certain regions	Whole country
	Resolution	Coarser than country scale	Country scale	Region (km) scale	Site (m) scale
Overall score aggregated across the four criteria		**0**	**1-4**	**5-8**	**9-12**
		No data. Nationally derived datasets will be required	Low quality. Considerable work required to use global datasets, or alternative datasets will be required	Moderate quality. Some work may be required to use global datasets, and alternative datasets may be preferable	High quality. Global datasets have potential to support SES indicators

Results of data assessment as follow:

(i) Indicators with available national data and standards for Vietnam (10 of which are the same indicators used to implement the ESGAP framework in European countries), include,

1) **Forest Resources**

EU ESGAP indicator: Forest utilization rate

Vietnam's ESGAP indicator: Forest cover change

The forest utilization rate is the ratio between the annual volume felled and the volume of annual growth in the stock of living trees. Vietnam does not have data on the annual growth of wood stock. Also, while annual volume of wood felled is an official indicator in the Statistical Yearbook of Vietnam

and updated annually by the General Statistics Office (GSO), it may not completely account for illegal logging or forest clearing.

We suggest using as a proxy indicator Forest cover change. This indicator is also used to monitor the Vietnamese 15.2.2 SDG target as the data for this indicator is updated annually. Some other indicators related to forest quality such as the coverage of rich forest areas could improve quality of the indicator but there are not clearly defined standards for this type of indicator. We suggest using the Vietnam's national target (VSDG's target) as standard for the 'Forest cover change' indicator.

2) **Fish resources**

EU ESGAP indicator: Fish stocks within safe biological limits

Vietnam's ESGAP indicator: Proportion of fish stock within total allowable catch (TAC)

We suggest using the proportion of fish stock within total allowable catch as a proxy indicator for the Vietnamese ESGAP.

The EU's indicator is the same indicator proposed to assess Vietnam's 14.4.1 SDG target, but data for this indicator is not expected to be available until 2025. Currently, the only data available for Vietnam is annual fishery production (capture) from FAO and the total allowable catch calculated for Vietnam's fish stocks in 1997.

3) **Surface Water resources**

EU ESGAP indicator: Freshwater bodies not under water stress

Vietnam's ESGAP indicator: Freshwater bodies not under water stress (measured by the Water Exploitation Index)

In this case we used the same European indicator. For Vietnam, this indicator is reported annually on nine major river basins of Vietnam and it is calculated as the proportion of the river basin not under water stress. Nevertheless, the data do not cover total water abstraction but only total water withdrawal by large users for whom a permit is required (over 0.1 m^3/s for agricultural use or over 10.000m^3/day for other uses[3]). Hence, we use the Water Exploitation Index (WEI) calculated by the Water Resources Group for Vietnam in the dry season of 2016 (2030 Water Resources Group. , 2017), with the contribution from MONRE and MARD as a proxy indicator. We considered the threshold of 20% as the upper limit for a full and unconditional safety of water stress.

4) **Soil resources**

EU ESGAP indicator: Area with tolerable soil erosion

Vietnam's ESGAP indicator: Same as EU ESGAP indicator

3 Decree no. 201/2013/NĐ-CP detailing the Implementation of a number of articles of the Law on Water Resources

We propose adopting the same indicator used in the European context. Soil erosion in Vietnam is classified according to the TCVN 5299:2009 regulations on Soil quality (MOIT, 2009). The Vietnam official standard for area with no erosion is up to 1 t/ha/year, which is the same scientific standard used in the European context for the application of the ESGAP framework.

This indicator is on regulations on the statistics reporting regime of the natural resources and environment sector.

5) **Greenhouse Gas**

EU ESGAP indicator: Per capita greenhouse gas emissions

Vietnam's ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context. Vietnam has data available for 2010 and 2014 from greenhouse gas inventories and also data estimated which is updated every two years. In addition, national population data is released annually from national statistical data sources.

6) **Ozone depleting substances**

EU ESGAP indicator: Consumption of ozone depleting substances

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context. National data is estimated and released annually by the Ozone secretariat of the UN Environment Programme. In addition, national population data is released annually from national statistical data sources.

7) **Heavy metal pollution**

EU ESGAP indicator: Ecosystems not exceeding the critical loads of cadmium/lead/ mercury

Vietnam ESGAP indicator: Per capita mercury emissions

We suggest using per capita mercury emissions as a pressure proxy indicator for the Vietnamese ESGAP. Vietnam is member of the Minamata Convention on Mercury. UNEP provides data sources estimated for more than 200 countries in 2018. Zero emission can be used as the indicator's standard as suggested by the European Environmental Bureau (EEB).

8) **Surface water pollution**

EU ESGAP indicator: Proportion of surface water monitoring points in major river basins that meet the technical standard of surface water quality

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context.

This indicator has annual data for Vietnam collected from surface water monitoring stations on main river basins. Water quality parameters regularly monitored include dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD5), nitrate nitrogen (N-NO3-), ammonium nitrogen (N-NH4+) and lead (Pb). We compare the annual average value of these parameters with the Vietnam's national technical standard on surface water quality (QCVN 08-MT: 2015/BTNMT)(MONRE,2015).

9) Groundwater pollution

EU ESGAP indicator: Proportion of monitoring points showing that groundwater quality meets the technical standards

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context.

This indicator has annual data collected from groundwater monitoring stations in different regions across the country. Data is collected on parameters which include iron (mg/l), ammonium ion (mg/l), chloride ion (mg/l), sulphate ion (mg/l), nitrogen dioxide (mg/l), nitrate (mg/l), total hardness (mg/l), pH and total dissolved solids (TDS) (mg/l). We use as standards for these parameters the Vietnam's national technical standards on groundwater quality (QCVN 09-MT: 2015/BTNMT) (MONRE, 2015).

10) Marine pollution

EU ESGAP indicator: Proportion of monitoring stations showing that coastal water quality meets the technical standards

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context.

The indicator has data available annually collected from monitoring stations in 13-15 provinces out of 28 provinces having coastal line over the country. The parameters having data available include: Iron (Fe) mg/l); ammonium (NH4+) (mg/l); Clorua (Cl-) (mg/l); Sulfate (SO4) (mg/l); Nitrogen dioxide (NO2) (mg/l); Nitrate (NO3) (mg/l); Total hardness (mg/l); The power of Hydrogen (pH); Total Dissolved Solids (TDS) 105 (mg/l).The applicable standards are Vietnam's national technical standards on coastal water quality: QCVN 10-MT: 2015/BTNMT (MONRE,2015).

11) Indoor air pollution

EU ESGAP indicator: Proportion of population using clean fuels for cooking

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context.

This indicator only has one data point for Vietnam corresponding to the population and housing census implemented in 2019. This census is conducted in Vietnam every 10 years.

12) Outdoor air pollution

EU ESGAP indcator indicator: Population exposed to safe levels of PM2.5

Vietnam ESGAP indicator: Same as EU ESGAP indicator

This indicator has limited data annually available collected from monitoring stations in six cities in Vietnam. Nevertheless, we propose using the same indicator used in the European ESGAP using data provided by the World Bank.

13) Drinking water

EU ESGAP indicator: Samples that meet the drinking water criteria

Vietnam ESGAP indicator: Proportion of clean water plants with water quality meeting technical standards of drinking water quality

We suggest using the proportion of clean water plants with water quality meeting technical standards of drinking water quality as a proxy indicator for the Vietnamese ESGAP.

This indicator assesses tap water quality. Nevertheless, an important caveat for this indicator is related to representativeness as a high percentage of the population uses other drinking water sources.

Another indicator considered is the proportion of population using clean water for drinking and cooking. This indicator only has one data point corresponding to the population and housing census implemented in 2019 in Vietnam. Data for urban population using clean water for drinking is available annually but it does not include rural population, which may be misleading.

The Vietnam's technical standard defined in the National technical regulation on clean water quality for domestic use QCVN 01-1: 2018/ BYT (Vietnam's Ministry of Health (MOH), 2018) can be used as the indicator standard.

14) Natural world heritage sites

EU ESGAP indicator: The proportion of natural and mixed world heritage sites in good conservation outlook

Vietnam ESGAP indicator: Same as EU ESGAP indicator

We propose adopting the same indicator used in the European context.

The status of the Vietnamese World Heritage Sites was reported in the 2014, 2017 and the 2020 report of International Union for Conservation of Nature (IUCN) (Osipova et al, 2017, 2020) that assesses all-natural World Heritage sites.

(ii) Indicators with limited national data available for Vietnam but which are not currently included in the Vietnamese ESGAP framework are,

1) **Groundwater resources**

   EU ESGAP indicator: Groundwater bodies in good quantitative status. We considered using the groundwater level change as a proxy indicator for Vietnam with standard of zero change. Nevertheless, given the lack of criteria to accept this standard we decided not to include in the indicator framework.

2) **Terrestrial ecosystems**

   EU ESGAP indicator: Terrestrial area with acceptable biodiversity levels. There is data available for the ratio of rich forest over the total forest area in Vietnam. Nevertheless, there is neither scientific information nor a policy target that can inform the definition of a standard for this indicator. One possibility could be to use the Ecosystem Intactness Index (Beyer et al. 2019), a globally standardized measure of the relative integrity, or intactness, of the world's terrestrial ecosystems using global datasets on anthropogenic pressures.

(iii) Indicators that currently lack data for Vietnam, and which therefore are not included in the Vietnamese ESGAP framework include,

1) **Ozone Pollution.** ***EU ESGAP indicator: Cropland and forested area exposed to safe ozone levels.*** In Vietnam, air quality is not monitored in most forested areas and agricultural lands.
2) **Eutrophication.** ***EU ESGAP indicator: Ecosystems not exceeding the critical loads of eutrophication.*** There is no data available in Vietnam for this indicator.
3) **Acidification**. ***EU ESGAP indicator: Ecosystems not exceeding the critical loads of acidification.*** There is no data available in Vietnam for this indicator but data on deposition of inorganic nitrogen/Sulphur dioxide and sulphate may be available.
4) **Freshwater ecosystems.** ***EU ESGAP indicator: Surface water bodies in good ecological status.*** There are no data sources for this indicator in Vietnam.
5) **Marine ecosystems.** ***EU ESGAP indicator: Coastal water bodies in good ecological status.*** There are no sources for this indicator in Vietnam. A potential proxy indicator could be coastal water bodies in good ecological status in terms of phytoplankton, current and wave parameters but currently, Vietnam has no comprehensive data available.

6) **Recreational water.** ***EU ESGAP indicator: Recreational water bodies that meet the 'excellent' quality criteria.*** There are no data sources on quality of recreational water bodies in Vietnam.

To sum up, after assessing the indicators in the European Strong Environmental Sustainability Index (SESI), we found that 5 out of 22 indicators of SESI that had available data for Vietnam (on land erosion, GHG emission, ozone depleting substances, clean fuels and technologies for cooking and natural and mixed world heritage sites). Another 9 out of 22 indicators had insufficient data sources for Vietnam and therefore needed to be replaced by proxy indicators. The remaining 8 out of 22 indicators (those related to groundwater resources, ozone pollution, critical loads of eutrophication and acidification and ecological quality of ecosystems) have no data and no suitable indicators for Vietnam to apply (Table 3). See Appendix 2 for further details on the data assessment.

Table 3. Comparison between the European ESGAP indicator framework and the Vietnamese ESGAP framework. Blue represents same indicators used in the European ESGAP framework, orange represents proxy indicators used in the Vietnamese ESGAP framework, and red represents data gaps for Vietnam.

Function	Principle	Topic	Subtopic	European ESGAP Indicator	Vietnam ESGAP indicator
Source	Renew renewable resources	Biomass	Forest resources	Forest utilization rate	Forest coverage
			Fish resources	Fish stocks within safe biological limits	Fish stocks within Total Allowable Catch
		Freshwater	Surface water resources	Freshwater bodies not under water stress	Proportion of main river basin not under water stress
			Groundwater resources	Groundwater bodies in good quantitative status	
	Use non-renewables prudently	Soil	Soil erosion	Area with tolerable soil erosion	Area with tolerable soil erosion
Sink	Prevent global warming, ozone depletion	Earth System	Greenhouse gases	Emissions / sustainable emissions	Per capita GHG emissions
			Stratospheric ozone depleting substances	Consumption / sustainable consumption	Consumption of HCFCs
	Respect critical levels and critical loads for ecosystems	Terrestrial ecosystems	Ozone pollution	Cropland and forest area exposed to safe ozone	
			Pollution by heavy metals	Ecosystems not exceeding the critical loads of	Per capita mercury emissions
			Eutrophication	Ecosystems not exceeding the critical loads of	

			Acidification	Ecosystems not exceeding the critical loads of	
		Freshwater ecosystems	Surface water pollution	Surface water bodies in good chemical status	Proportion of monitoring stations with good surface water quality according
			Groundwater pollution	Groundwater bodies in good chemical status	Proportion of monitoring stations with good groundwater quality according
		Marine ecosystems	Marine pollution	Coastal water bodies in good chemical status	Proportion of monitoring stations with good coastal water quality according
Life support	Maintain biodiversity (especially species and ecosystems)	Terrestrial ecosystems	Functional diversity	Terrestrial area with acceptable biodiversity	
		Freshwater ecosystems	Ecological status	Surface water bodies in good ecological status	
		Marine ecosystems	Ecological status	Coastal water bodies in good ecological status	
Human health & welfare	Respect standards for human health	Human health	Outdoor air pollution	Population exposed to safe levels of $PM_{2.5}$	Population exposed to safe levels of $PM_{2.5}$ (under Vietnamese technical
			Indoor air pollution	Population using clean fuels and technologies for	Proportion of population using clean fuels for cooking
			Drinking water pollution	Samples that meet the drinking water criteria	Proportion of clean water plants that meet clean water quality standards
	Conserve landscape and amenity	Amenity	Bathing waters	Recreational water bodies in excellent status	
			Natural and mixed world heritage sites	Natural and mixed world heritage sites in good	Natural and mixed world heritage sites with good conservation outlook

1.4. Vietnamese ESGAP indicator framework

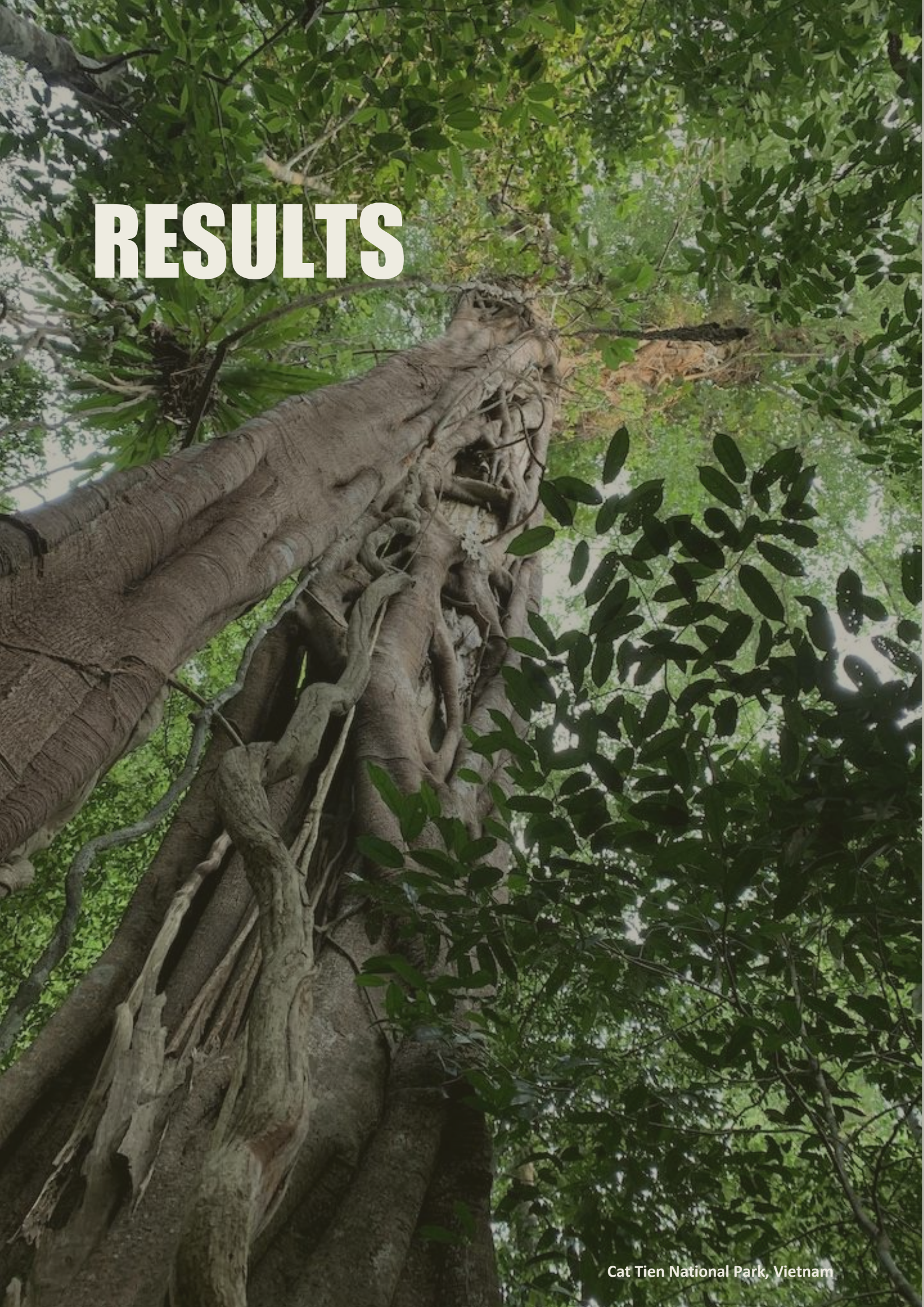
Based on our data assessment above, we selected 14 indicators to implement the Vietnamese ESGAP framework (Table 4).

Table 4. Indicators in the Vietnamese ESGAP framework

Source: Synthesized by the authors, 2020.

Function	Principle	Topic	Subtopic	Indicator
Source	Renew renewable resources	Biomass	Forest resources	Forest coverage
			Fish resources	Fish stocks within TAC
		Freshwater	Surface water resources	Proportion of main river basin not under water stress
	Use non-renewables prudently	Soil	Soil erosion	Area with tolerable soil erosion
Sink	Prevent global warming, ozone depletion	Earth System	Greenhouse gases	Per capita GHG emissions
			Stratospheric ozone depleting substances	Consumption of HCFCs
	Respect critical levels and critical loads for ecosystems	Terrestrial ecosystems	Pollution by heavy metals	Per capita mercury emissions
		Freshwater ecosystems	Surface water pollution	Proportion of monitoring stations with good surface water quality according to Vietnamese technical standards
			Groundwater pollution	Proportion of monitoring stations with good groundwater quality according to Vietnamese technical standards
		Marine ecosystems	Marine pollution	Proportion of monitoring stations with good coastal water quality according to Vietnamese technical standards
Human health and welfare	Respect standards for human health	Human health	Outdoor air pollution	Population exposed to safe levels of $PM_{2.5}$
			Indoor air pollution	Proportion of population using clean fuels for cooking
			Drinking water pollution	Proportion of clean water plants with good drinking water quality according to Vietnamese technical standards
	Conserve landscape and amenity	Amenity	Natural and mixed world heritage sites	Natural and mixed world heritage sites with good conservation outlook

RESULTS



Cat Tien National Park, Vietnam

2. RESULTS AND DISCUSSIONS

2.1. Data analyses

In this section, we present data sources and results on the scores calculated for each indicator of the Vietnamese ESGAP framework after collecting and standardizing all data collected. Once main data gaps were identified for Vietnam, we supplemented national data with international data sources where available.

As part of the construction of the index, all the indicators have been normalized using the following formula:

$$\text{if } \; 100\frac{\mathrm{I}-\mathrm{gp_{min}}}{\mathrm{gp_{max}}-\mathrm{gp_{min}}} \geq 100 \qquad \mathrm{NI} = 100$$

$$\text{if } \; 5 < 100\frac{\mathrm{I}-\mathrm{gp_{min}}}{\mathrm{gp_{max}}-\mathrm{gp_{min}}} \leq 100 \qquad \mathrm{NI} = 100\frac{\mathrm{I}-\mathrm{gp_{min}}}{\mathrm{gp_{max}}-\mathrm{gp_{min}}}$$

$$\text{if } \; 100\frac{\mathrm{I}-\mathrm{gp_{min}}}{\mathrm{gp_{max}}-\mathrm{gp_{min}}} \leq 5 \qquad \mathrm{NI} = 5$$

Where gp_{max} and gp_{min} indicate the goalpost values that lead to the highest and lowest possible scores in the normalization process. Values higher than 100 and lower than five have been constrained to these values. The latter is used to avoid zeros and small values which cause problems when using the geometric mean for aggregation. In the aggregation process equal weights and the geometric mean have been used.

2.1.1. Source function

Indicator 1.1. Forest utilization rate

Proxy Indicator: Forest coverage

Forest coverage is the percentage of forest area to total natural land area. Forest area is calculated when the forest has a continuous area of over 0.3 ha and a forest canopy cover over 10%.

Standard: Based on demand for land use in Vietnam, the National Assembly and the Government of Vietnam set a target of national forest coverage from 2020 to 2030 from a current 42% of coverage to 43% by 2030. This policy target is used as the standard for this indicator. 0% coverage is used as lower bound.

Data profile: Forest coverage is a national statistic indicator, so data is released annually by the General Statistic Organization of Vietnam (GSO) (https://www.gso.gov.vn/)

ESGAP score calculation:

We normalized the indicator as follows:

Table 5. Score for forest cover

Source: calculated by the authors using data from MARD

Year	Forest coverage (%)	ESGAP score
2008	38.7	90.00
2009	39.1	90.93
2010	39.5	91.86
2011	39.7	92.33
2012	40.7	94.65
2013	41.0	95.35
2014	40.4	93.95
2015	40.8	94.88
2016	41.2	95.81
2018	41.7	96.98
2019	41.9	97.44

ESGAP score: 97.44 (2019)

Discussion:

- Country context: The ESGAP score for 2019 is 97.44 with a forest cover of 41.9% nationwide for 2019. This result reflects Vietnam's efforts in afforestation over the last 20 years, such as the implementation of 5 million ha of forest plantation under the programme on sustainable forestry and coastal forestry. Nevertheless, an important caveat is that these results do not reflect primary forest cover but mostly plantations. Hence, although forest coverage has increased and almost reached the 2020 target (42% coverage nationwide) quality of forests across Vietnam is decreasing. This is due to continuous deforestation and illegal logging of primary forests. Hence, this indicator does not fully reflect the sustainable management of forests in Vietnam.
- Recommendations: In the future, an alternative indicator for the Vietnamese ESGAP framework should better reflect the provision of forest products. Other indicators could be the "Area/ratio of forest with sustainable management certification" and/or "primary forest coverage". Nevertheless, we acknowledge that indicators referring to the quality of

forests in relation to biodiversity or ecosystem health could also be used as indicators of the Life Support function.

Indicator 1.2. Fish stocks within safe biological limits

Proxy Indicator: Fish stock within Total Allowable Catch

Standard: The Total Allowable Catch (TAC) used as standard is 1670.4 tons (policy standard) calculated according to data from FAO in 1997 for Vietnam (FAO,2020).

Data profile: The production of marine fish caught by locality is a national indicator produced in the Statistical Yearbook of Vietnam (GSOa,2020), an annual publication by the General Statistics Office (GSO) of Vietnam (Table 6).

Table 6. Production of caught sea fish and Total Allowable Catch (TAC) by province

Source: GSOa, 2020

Region/Province	Production of caught sea fish by province (Tons)					TAC (Tons)
	2015	2016	2017	2018	2019	2017
Total for country	**2076.7**	**2242.8**	**2453**	**2578.6**	**2728.2**	**1670.4**
Tonkin Gulf					**495.7**	**272.5**
Quảng Ninh	30.7	36.5	38.5	39.7	41.3	
Hải Phòng	40.5	40.3	44.3	50.8	53	
Thái Bình	40.6	43.2	46.6	49.3	53.2	
Nam Định	31	28.7	29.8	32.3	33.6	
Ninh Bình	2	1.9	2	2.5	1.8	
Thanh Hóa	63.1	69.3	74.7	78.3	79.2	
Nghệ An	82.5	93.7	107.6	119.3	134.3	
Hà Tĩnh	21.3	16.4	17.7	18.8	21.5	
Quảng Bình	45.2	39.5	47.7	51.5	55.7	
Quảng Trị	20.6	12.7	19.8	19.5	22.1	
Central Region					**608.7**	**242.6**
Thừa Thiên - Huế	30.6	23.4	29	31	32.3	
Đà Nẵng	28.4	28.1	29.4	29.8	31	
Quảng Nam	49.7	52.5	57.9	59.8	62.8	
Quảng Ngãi	117.6	130	199.3	214.1	222.7	

Bình Định	156.9	167.2	180.1	189.2	202.4	
Phú Yên	47.5	53	54.1	54.8	57.5	
South Eastern					**1200.7**	**830.5**
Khánh Hòa	79.7	83.6	85.6	87.4	87.7	
Ninh Thuận	73.5	81.2	96.4	102.6	109.6	
Bình Thuận	119.4	128.8	136.8	142.1	144.4	
Bà Rịa - Vũng Tàu	220.9	248.1	256.8	263.8	274	
TP. Hồ Chí Minh	9.9	9.2	10.3	10.2	10.4	
Long An	3	3.1	3.2	2.9	2.8	
Tiền Giang	58.9	59.4	66.9	74.7	94.3	
Bến Tre	127.6	149.3	145.3	147.2	154.2	
Trà Vinh	23	23.8	25.1	26.7	39.2	
Sóc Trăng	40.6	45.4	42.9	44.4	43.6	
Bạc Liêu	70	65.8	68.2	69.8	72.4	
Cà Mau	130.1	149.2	143.6	155.3	168.1	
South Western					**423.1**	**202.3**
Kiên Giang	311.9	359.5	393.4	410.8	423.1	

ESGAP score: 5.00 (2019)

Discussion:

- Country context: The indicator score for 2019 is 5 (0 before standardization). Sea fish caught nationwide increased from 2,077 tons in 2015 to 2,728 tons in 2019, which is way above the TAC defined for 1997 of 1,670 thousand tons. This result reflects that overfishing is still a major environmental issue in Vietnam. Nevertheless, Vietnam currently has many policies to protect marine resources which include, for example, the prohibition of using toxic chemicals, explosive materials or electric impulses, (Directive 01/1998 / CT-TTg and Directive 19 / CT-TTg dated July 30, 2014 by the Prime Minister); regulations on the construction of new offshore fishing vessels, and regulations on fishing nets (Fisheries Law 2017); and the National Action Plan to prevent, reduce and eliminate illegal, unreported and unregulated fishing until 2025 (Decision No. 78/QD/TTg dated 18/01/2018). However,

there is still a gap on specific regulations to end overfishing through annual catch limits.

- Suitability of proxy indicator: The use of this indicator for the Vietnamese ESGAP framework brings many caveats given that the most recent data on TAC by FAO dates from 1997. Additionally, for the normalization, this indicator would not only need a lower bound such as Total Allowable Catch, which represents a policy target, but also an upper bound aligned with a level of catch that allows stocks to recover to safe biological limits. Although the latter is missing, given that catch volumes are substantially higher than the Total Allowable Catch, it is reasonable to conclude that current levels of fishing pressure are unsustainable in Vietnam.
- Recommendations: The indicator suggested to report on Vietnam's SDG target 14.4.1, Proportion of fish stocks within safe biological limits, is the same indicator used for the European ESGAP, which will be reported for Vietnam by 2025. Hence, we propose to use this indicator in the future once data becomes available by 2025.

Indicator 1.3. Surface water bodies under water stress

Proxy Indicator: Proportion of main river basins not under water stress.

This indicator measures the number of water bodies which are or not under water stress exploitation levels. Water stress is determined using the Water Exploitation Index (WEI), which is defined as the mean annual total abstraction of freshwater in relation to the annual average of freshwater resources available. The WEI is calculated as a function of the total freshwater withdrawn (TFWW) and renewable freshwater resources (TRWR) expressed in km^3/year, as follows:

$$WEI\ (\%) = TFWW/TRWR * 100$$

Total freshwater withdrawal (TFWW) is the volume of freshwater extracted from its source (rivers, lakes, aquifers) for agriculture, industries and other services. It is estimated at the country level for the following three main sectors: agriculture, services (including domestic water withdrawal) and industries (including cooling of thermoelectric plants).

Total renewable freshwater resources (TRWR) is calculated as the sum of internal and external renewable water resources. The terms "water resources" and "water withdrawal" are understood here as freshwater resources and freshwater withdrawal. Internal renewable water resources are defined as the long-term average annual flow of rivers and recharge of groundwater for a given country

generated from endogenous precipitation. External renewable water resources refer to the flows of water entering the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through international agreements or treaties.

Standard:

Some authors suggest considering a withdrawal rate of 20% as the threshold of water stress (Raskin 1997, Rijsberman 2006). The OECD defines water stress as "a measure of the total annual average demand of a river basin (or a sub-basin) compared to the average water available annually (precipitation minus evapotranspiration) in that basin. Typically, these are grouped into four categories: < 10% = no stress, 10-20% Low stress; 20-40%= medium stress and > 40% = severe stress" (OECD, 2015).

For this indicator, we used a WEI of 20% as the indicator standard. In the normalization we use 0% and 100% of river area meeting the standard as lower and upper bounds respectively.

Data profile:

Data on the total amount of surface water available is collected from nine main river basins in Vietnam. This data is released annually by the Department of Water Resource Management (DWRM) in MONRE. However, Vietnam currently has not comprehensive data on environmental flow requirements and total freshwater abstraction from main river basins. Hence, it is not feasible to calculate the level of water stress periodically.

Table 7. Total seasonal and annual amount of surface water of main river basins

Source: DWRM, 2019

No.	River basin	Total surface water (billion m^3)		
		Wet season	Dry season	Total annual
1	Bang Giang -Ky Cung	5.77	1.77	7.55
2	Thai Binh	6.68	1.88	8.57
3	Hong	59.45	16.28	75.73
4	Ma	11.22	4.25	15.47
5	Ca	14.25	7.67	21.93
6	Vu Gia - Thu Bon	14.34	7.72	22.07
7	Ba	4.81	2.32	7.13
8	Dong Nai	22.65	7.55	30.2
9	Mekong	388.03	114.66	502.69

10	From outside Vietnam	349.37	101.43	450.8
11	Se San	7.86	2.98	10.84
12	Sre Pok	9.58	3.64	13.22
13	Mekong River Delta	16.28	4.73	21
14	Other	4.94	1.88	6.82

We used the WEI calculated by the 2030 Water Resources Group for Vietnam in the dry season of 2016 (2030 WRS,2017), with the contribution from MONRE & MARD (Table 8 and Figure 1).

Table 8. Water Exploitation Index in dry season of main river basins (2016)

Source: 2030 Water Resources Group, 2017

River basin	Dry Season (million m3)		WEI (%) Dry season
	Water demand	Water Availability	
Bang Giang -Ky Cung	220	18,117	1
Hong -Thai Binh	12,832	65,740	20
Ma	3,236	9,226	35
Ca	1,368	13,905	10
Gianh	64	3,345	2
Thach Han	94	2,035	5
Huong	1,162	5,144	23
Vu Gia - Thu Bon	1,327	11,777	11
Tra Khuc	675	5,243	13
Kone	877	4,754	18
Ba	1,346	6,915	19
Dong Nai	4,019	21,603	19
South East river cluster	1,881	4,628	41
Se San	54	12,344	0
Sre Pok	513	11,502	4
Mekong	20,458	110,510	19

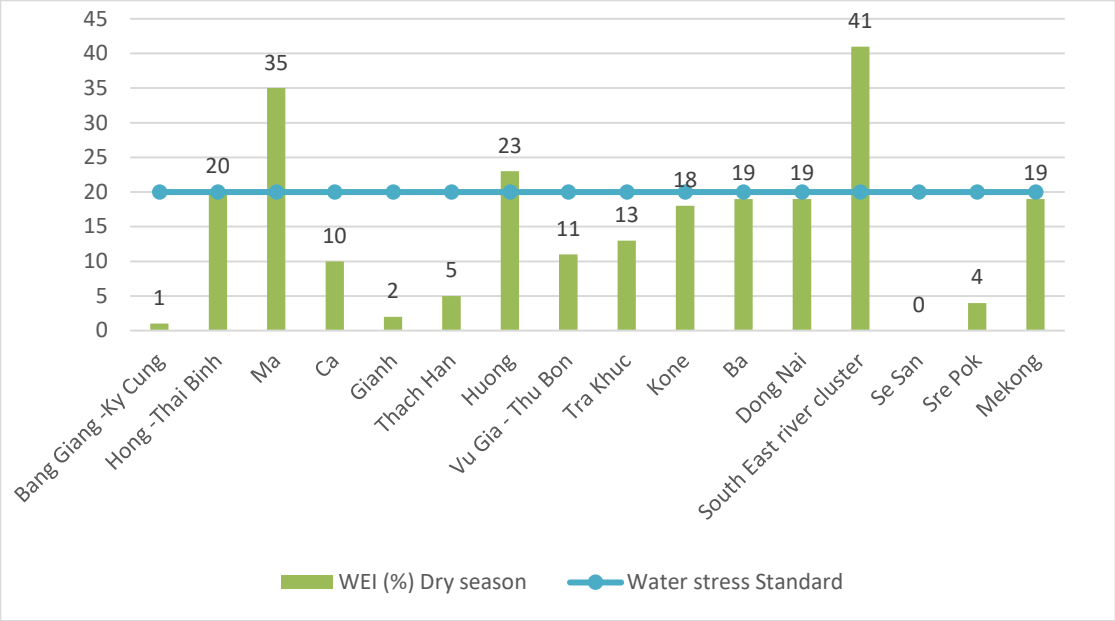


Figure 1. Water Exploitation Index in dry season of main river basins of Vietnam in 2016

ESGAP score calculation:

We calculated river basins not under water stress weighted by their area in Vietnam's territory. To do so, we used a threshold of WEI of 20 or lower to identify whether a river basin was not under water stress (1) or not (0) so only river basins not under water stress affected the final ESGAP score. Then, we weighted the water stress score of each river basin by their area.

Table 9. Water stress score and area of main river basins (2016)

No	River basin	Dry Season (million m3)		WEI (%)	Not under water stress (Yes/No: 1/0)	Area (km2)	ESGAP score
		Water demand	Water Availability	Dry season			
1	Bang Giang -Ky Cung	220	18.117	1	1	10.847	**87.98**
2	Hong -Thai Binh	12.832	65.74	20	1	88860	
3	Ma	3.236	9.226	35	0	17.653	
4	Ca	1.368	13.905	10	1	20.460	
5	Gianh	64	3.345	2	1	4680	
6	Thach Han	94	2.035	5	1	2550	
7	Huong	1.162	5.144	23	0	3.066	

8	Vu Gia - Thu Bon	1.327	11.777	11	1	10.035	
9	Tra Khuc	675	5.243	13	1	5200	
10	Kone	877	4.754	18	1	3640	
11	Ba	1.346	6.915	19	1	13900	
12	Dong Nai	4.019	21.603	19	1	36530	
13	South East river cluster	1.881	4.628	41	0	15760	
14	Se San	54	12.344	0	1	11510	
15	Sre Pok	513	11.502	4	1	18230	
16	Mekong	20.458	110.51	19	1	40.547	

Source: Calculated by authors, 2021

ESGAP score is 87.98.

Discussion

- Country Context**:** The indicator does not subtract environmental flow requirements and therefore does not correctly reflect the capacity to support freshwater-dependent ecosystems. For this reason, this indicator can only be considered a proxy of freshwater resource scarcity. However, this indicator could be used in future if no other data sources are available. Only three out of 16 river basins were subject to abstraction rates higher than 20%. Nevertheless, although the score is high (as most river basins were under the 20% standard) many of those river basins exhibit significant sustainability issues (such as saline intrusions and water conflicts) in the dry season, such as the Mekong River Basin.
- Recommendations: The Vietnamese ESGAP could continue using this indicator in the near future as there are very little data regarding environmental flow requirements in Vietnam. Water extraction/exploitation is not yet regularly calculated for Vietnam and most existing data are derived from international cooperation. However, Circular no. 04/2020/TT-BTNMT by MONRE, dated June 3, 2020 require inter-provincial river basin/water resource plans to estimate total water demand by all activities. Therefore, data on total water extraction might be periodically updated in the future. The SDG Indicator 6.4.2 on water stress, which includes environmental flow requirements, is planned to be available for Vietnam by 2025 and could provide an alternative indicator.

Indicator 1.4. Area with tolerable soil erosion

Indicator: Area with tolerable soil erosion

This indicator evaluates the protection and maintenance of soil functions by preventing soil degradation and erosion. The indicator is calculated as the percentage of land area that is not eroded over the total surveyed land area.

Standard: Currently, Vietnam is conducting a land assessment and classification following the Vietnamese national technical standard TCVN 5299:2009 on *Soil quality – Method for determination of soil erosion by rain*. According to this national standard, erosion grades are classified as follows:

Table 10. Assessment on soil erosion levels according to the Vietnam national standards

Source: MONRE, 2016

Grades	Erosion rate (tons/ha/yr.)	Assessment
I	Up to 1	No erosion
II	1 - 5	Weak erosion
III	5 - 10	Moderate erosion
IV	10 - 50	Severe erosion
V	>50	Very severe erosion

The Vietnam standard for area with no erosion is up to 1 t/ha/year, which is in line with the scientific standard used in the European ESGAP from Jones et al. (2004); Huber et al. (2008); Verheijen et al. (2009).

Data profile: The most recent data available for Vietnam was compiled by the General Department of Land Administration in 2016, following Circular no. 02/2014/TT-BTNMT of MONRE on regulations on the statistics reporting regime of the natural resources and environment sector. Table 11 and Figure 2 represent soil erosion levels in 2016 for Vietnam.

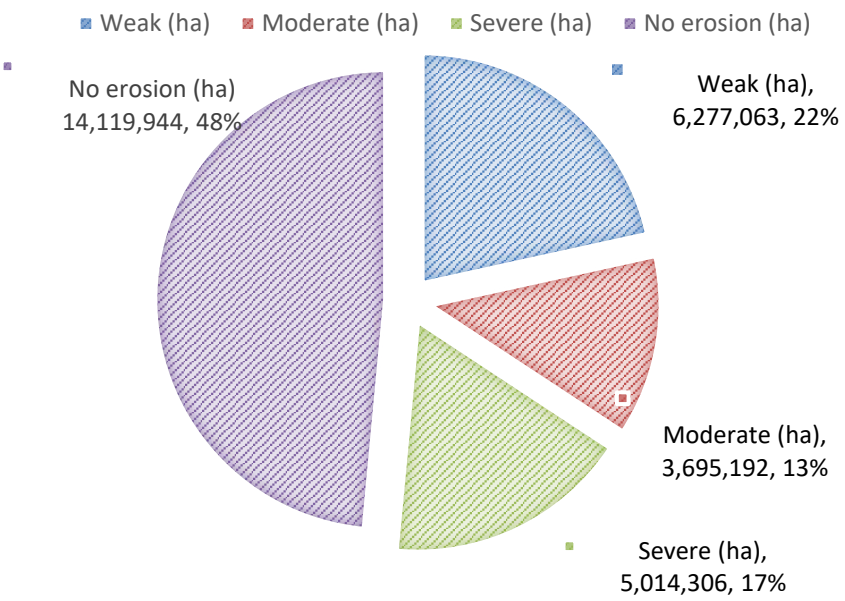
Table 31. Soil erosion levels of Vietnam in 2016

Source: MONRE, 2016

Unit	Total surveyed area	Area with soil erosion			No erosion
		Weak	Moderate	Severe	
ha	29,106,505	6,277,063	3,695,192	5,014,306	14,119,944
%	100	21.57	12.70	17.23	48.51

Figure 2. Soil erosion levels of Vietnam in 2016

Source: MONRE, 2019



ESGAP score calculation:

The indicator describes environmental state as the percentage of land area with no erosion. Values are constrained between 0 and 100 and are therefore implicitly normalized in a scale of 0 to 100, where 0 is the worst possible performance and 100 the best.

ESGAP score: 48.51 (2016)

Discussion

- Country context: This result indicates that 48.5% of surveyed Vietnam's land area has tolerable level of soil erosion. Nevertheless, this is not representative of the whole country. According to our data and results, the highest level of soil erosion is observed mainly in the Northern Mountainous region, Northern Central and Central deltas and the Central Highlands. The reason is mainly due to land-use (mainly agricultural lands) and deforestation for hydropower development.
- Suitability of the indicator: Whilst this indicator is suitable for Vietnam, the data currently reflects only the land erosion caused by heavy rain and flooding.
- Recommendations: Erosion levels should also be calculated for riverbanks and coastal areas caused by local human activities (such as illegal sand

exploitation), and other factors (upstream hydroelectricity, weather and sea level rise), particularly in the Mekong Delta region. Some provinces may lose as much as over 300 ha annually (Nguyen Thi Hong Diep et al. 2019). Nevertheless, this is currently an important data gap for Vietnam that needs to be filled in the future.

2.1.2. Sink functions

Indicator 2.1. Per capita CO2 emissions

Indicator: Per capita Greenhouse Gas Emissions

This indicator assesses the country's performance on reducing its CO_2 emissions to contribute to the IPCC's target of 1.5°-2°C during the 2010-2100 period (Clarke et al. 2014, Lucas et al. 2020).

Standard:

We used the gp_{max} and gp_{min} bounds used for the European ESGAP indicator. For the gp_{max}, which represents the maximum ambition (i.e. a normalised score of 100), is 0.5 tonnes CO_2 per capita (tpc) and gp_{min} (i.e. the lowest normalised score) is 2.5 tpc. This is what the IPCC estimates will deliver 1.5-2 degrees. The gp_{max} value of the science-based environmental standard shows the per-capita CO_2 emissions consistent with meeting the 1.5°C target with 67% of possibilities. The gp_{min} value is consistent with meeting the 2°C target with 33% of possibilities. Emissions have been allocated on an equal-per-capita basis.

Data profile:

GHG emissions for Vietnam were released by MONRE based on the national greenhouse gas inventory conducted in 2010 and 2014. However, the net cumulative contribution of the CO_2 emissions from land use, land-use change and forestry activities (LULUCFs) is considered to be close to zero in most 1.5°-2°C scenarios during the 2010-2100 period (Lucas et al. (2020) based on Clarke et al. (2014)). Hence, LULUCF emissions are excluded from the calculation of this indicator.

Table 42. Data on GHG emissions of Vietnam in 2010 and 2014

Year	Data sources	Total GHG emission	Total GHG emission excluding LULUCF	Population	GHG emission per capita (tons)
2010	Data Source: http://thongke.monre.gov.vn/ds-cong-bo.html	246,830,640	266,000,000	86,932,500	2.84

2014	National communication of Vietnam - The Third to the UNFCCC	283,970,000	321,470,000	90,728,900	3.13

ESGAP score calculation

We used a gp_{min} of 2.5 tons per capita and a gp_{max} of 0.5 tons per capita.

If the country value=> gp_{min}, the ESGAP score =5,

If the country value=< gp_{max}, the ESGAP score =100, otherwise

The score = [(Country value - - gp_{min})/(gm_{max}- gp_{min})] * 100

The indicator's score is calculated in Table 13.

Table 53. ESGAP's score for GHG emission indicator

Year	GHG emission per capita (tonnes)	ESGAP's Score
2010	3.06	5
2014	3.13	5

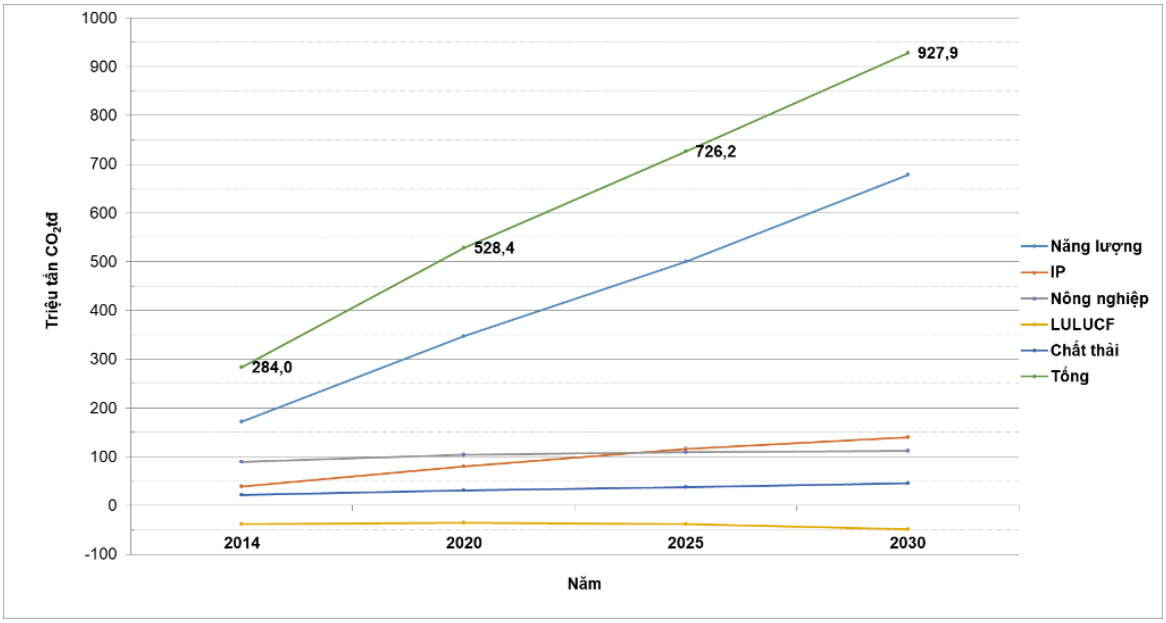


Figure 3. GHG emissions projections for Vietnam under business-as-usual scenarios for the period 2014-2030

Source: MONRE, Updated NDC, 2020[4]

ESGAP score: 5.00 (2014)

Discussion

[4] MONRE, Updated National Determined Contribution – Technical Report, 2020.

- Country context: The Vietnam ESGAP score for per capita GHG emissions reflects the current unsustainable situation for the country in relation to carbon emissions. GHG emissions in Vietnam have been increasing over the last 10 years (Figure 3) and according to the recently updated Vietnam's Nationally Determined Contribution (NDC), the country's GHG emissions will increase by 3.2 times from 2014 to 2030 (MONRE, 2020).
- Recommendations: The Government of Vietnam should invest more towards decreasing the GHG emissions rate and aim for net zero emissions. The ESGAP framework clearly highlights this element as crucial for the country.

Indicator 2.2. Per capita consumption of ozone depleting substances

Indicator: Consumption of HCFCs

This indicator aims to assess the country's performance on reducing the consumption of ozone depleting substances, typically the elimination of HCFCs in accordance with the regulations of the Montreal Protocol. Vietnam officially signed the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer in January 1994.

Standard: The Montreal Protocol limits the consumption of controlled ozone depleting substances by its signatories. We used therefore the control limits of the Montreal Protocol as gp_{min} of the indicator's standard, which represents the lowest normalized score, and zero consumption as gp_{max} of the indicator's standard, which represents the maximum ambition.

Table 64. Control limits of HCFC by the Montreal Protocol. Source: Ozone secretariat, 2020[5]

Year	Control limits of Montreal Protocol (tons)
2014	330.5
2015	199.1
2016	199.1
2017	199.1
2018	199.1
2019	199.1

[5] *Ozone secretariat, UN Environment Programme, 2020. Country profiles: Vietnam. https://ozone.unep.org/countries/profile/vnm Date of Access: 25/12/2020.*

Data profile

Data is retrieved from the website of the Ozone Secretariat, the secretariat for The Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.

ESGAP score calculation:

Using the gp_{max} of 0 ton of HCFCs consumption and the gp_{min} of control limits.

The formula for scoring is as follows:

If the country value=> gp_{min}, the ESGAP score =5,

If the country value= gp_{max}, the ESGAP score =100, otherwise

The score = [(Country value- gp_{min})/(gm_{max}- gp_{min})] * 100

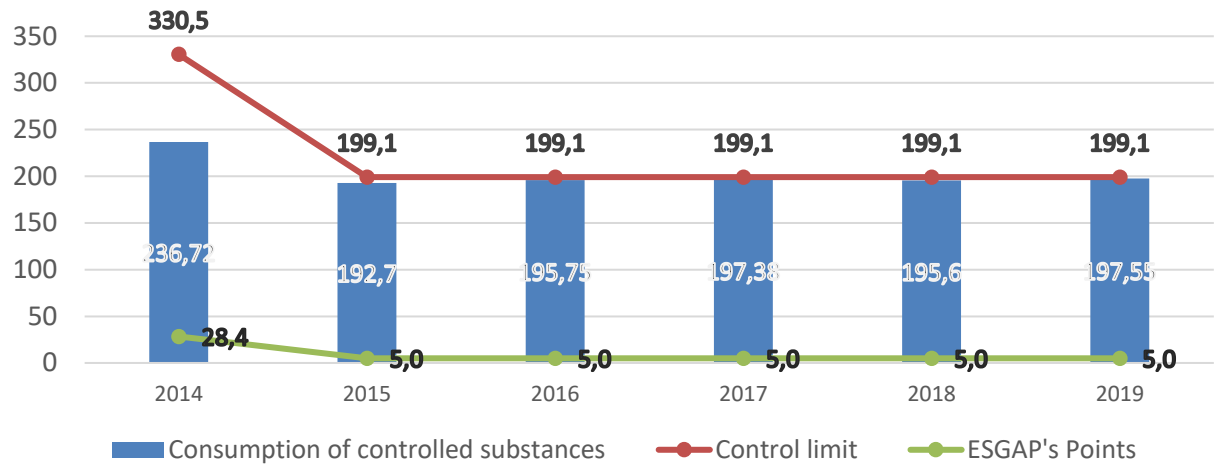
The indicator's score is calculated in Table 15.

Table 7. ESGAP score for Consumption of HCFCs indicator

Source: Calculated by authors from data of Ozone Secretariat, 2020

Year	Consumption of HCFCs (tons)	Control limits of Montreal Protocol (tons)	ESGAP score
2014	236.72	330.5	28.4
2015	192.7	199.1	5
2016	195.75	199.1	5
2017	197.38	199.1	5
2018	195.6	199.1	5
2019	197.55	199.1	5

Figure 4. Vietnam's ESGAP indicator: consumption of HCFCs



ESGAP score: 5.00 (2019)

Discussion

- Country context: Results for this indicator show that Vietnam is far from the target of zero consumption of HCFCs. However, Vietnam's Government efforts on regulating consumption of HCFCs are shown in the fact that the country has not exceeded the Montreal's control limit since 2015 particularly in 2014 to 2015, when Vietnam reduced approximately 46 tons of HFCs consumption.
- Suitability of indicator: This indicator is suitable for Vietnam. However, using control limits as lower bound to calculate the score seems to be over strict, since despite a recent unexpected increase in the emission of some ODS (Rigby,M., et al., 2019), the Montreal Protocol has led to signs of healing in the ozone layer (Solomon,S., et al. 2016). Thus, while the ambition of reducing ODS consumption to zero is justified, the lowest score should relate to the situation in which the ozone hole appeared. This could be the per capita average consumption of ODS in the 1980s.
- Recommendations: The lowest normalized score should be related to the appearance of the ozone hole.

Indicator 2.3. Ecosystems not exceeding the critical loads of cadmium, lead and mercury

Proxy Indicator: Per capita mercury emissions

This indicator aims to assess countries' efforts to reduce mercury emissions, typically in accordance with the regulations of the parties to the Minamata Convention on Mercury. Vietnam became a signatory to the Minamata Convention on Mercury in Japan on October 11, 2013.

Standard:

The European Environmental Bureau (EEB) aims to reduce mercury in the environment to a minimum both in the EU and globally. This indicator, therefore, uses zero-mercury emissions as the standard, with zero emissions as the upper bound which is equivalent to a score of 100 points. There is, however, no scientific base for the lower bound at which total mercury emissions into the environment exceeding the critical load. Instead, we used the available data on the total amount of mercury released into the air by countries around the world and used the 2.5th percentile of the per capita emissions. This is a method commonly used to define the minimum values in the min-max normalization. Nonetheless, it does not have a scientific basis, and therefore the results need to be interpreted with care.

Data profile:

We used two data sources to evaluate this indicator. One source was data from the Ministry of Industry and Trade of Vietnam (MOIT) in 2014[6]. This estimation includes estimates of mercury emissions into air, water, land, in products, in waste, and in sewage. We also used the UNEP report (UNEP, 2018)[7], which only includes mercury emissions into the air. Therefore, the two data sources have disparities in the number of national emissions estimates. Hence, in order to ensure inter-country comparability, we used the 2018 UNEP data to calculate the indicator (see Table 16).

Table 8. Mercury Emissions of Vietnam in 2014 and 2018

Year	Total Hg emission (kg)	Data sources
2014	49.131	MOIT, Vietnam
2018	18.054	UNEP

ESGAP score calculation:

We used the upper bound as gp_{max} of 0 kg of mercury consumption, which represents a normalized score of 100, and lower bound as gp_{min} of the 2.5th percentile of country per capita emissions.

[6] http://www.mercuryconvention.org/Portals/11/documents/MIAs/Viet-Nam-MIA-2016.pdf
[7] https://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/mercury/global-mercury-assessment

The formula for scoring is as follows:

If the country value=> gp_{min}, the ESGAP score =5,

If the country value=< gp_{max}, the ESGAP score =100, otherwise

The score = [(Country value- gp_{min})/(gm_{max}- gp_{min})] * 100

Results are shown in Table 17.

Table 9. ESGAP score on the mercury emissions indicator

Source: Calculated by authors from data of Ozone secretariat, 2020

Country	Mercury emission 2018 (kg)	Population 2018	Mercury emission per capita 2018 (kg)	2.5 percentile of countries in the world (kg/capita)	ESGAP score
Global	2,223,594				
Vietnam	18,054	95,540,395	0.000189	0.003737779	**95**

ESGAP score: 95.00 (2018)

Discussion:

- Country context: the ESGAP score for mercury emissions in Vietnam is 95. This assessment reflects that Vietnam has achieved good results for mercury emissions control compared with other countries in the world. However, towards the goal of zero mercury emission, calculations of MOIT suggested that actual mercury emissions may be much higher than UNEP estimates and Vietnam may need stronger commitment and efforts to achieve the goal.
- Suitability of indicator: Some participants of the research consultation workshop questioned the representativeness of this proxy indicator as mercury is not the only environmentally significant heavy metal being emitted in Vietnam (See Appendix 5). For the purpose of this exercise, however, mercury emissions is still chosen due to the fact that it is the Vietnam's environmental policy interest and target.
- Recommendations: This indicator lacks systematic monitoring data. Hence, a better network of mercury monitoring stations and comprehensive inventories of mercury emissions are needed in Vietnam. Nevertheless, in the future, instead of using mercury emissions, Vietnam should identify the most relevant pressures related to the sink function in terrestrial ecosystems and to propose adequate indicators for the ESGAP framework.

Indicator 2.4. Surface water bodies in good chemical status

Proxy Indicator: Proportion of surface water monitoring stations in major river basins that meet the technical standards of surface water quality.

Indicator profile:

This indicator is calculated as the percentage of monitoring stations in nine main river basins of Vietnam that show an annual average surface water quality which meets the technical standard for five parameters: Chemical oxygen demand (COD), biochemical oxygen demand (BOD5), nitrate nitrogen (N-NO3-), ammonium nitrogen (N-NH4+) and lead (Pb).

Standard:

We used as standards the regulations in Vietnam's national technical regulations on surface water quality QCVN 08-MT: 2015/BTNMT (Table 18).

Although the QCVN regulates threshold values for 36 different parameters, there are only six parameters with good data availability including dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD5), nitrate nitrogen (N-NO3-), ammonium nitrogen (N-NH4+) and lead (Pb). DO is excluded from the indicator because it is not considered to be representative of water quality of river basin because it shows the amount of alluvium in the river.

The QCVN regulations include different water quality standards for different types of water uses. This study used the A1 standard for domestic water supply purposes (after applying normal treatment), conservation of aquatic flora and fauna and other purposes. The water quality parameter thresholds for this water use are the highest in the regulations.

Table 10. Viet Nam's technical standards for five water quality parameters. The regulated thresholds for domestic water supply purposes (A1) for the surface water quality parameters are used as the standards for the ESGAP indicator

Source: MONRE, Technical standard, QCVN 08-MT: 2015/BTNMT, 2015

Parameter	A1	A2	B1	B2
COD	10	15	30	50
BOD5	4	6	15	25
$N\text{-}NO_3^-$	2	5	10	15
$N\text{-}NH_4^+$	0.3	0.3	0.9	0.9
Lead	0.02	0.02	0.05	0.05

Data profile:

We used data collected from 275 monitoring stations in 2018 and 257 stations in 2019 on surface water quality in nine main river basins, including some major dams, provided by the Vietnam Environment Administration (VEA). Monitoring stations with all five monitored parameters meeting the standards were evaluated as not polluted.

ESGAP score calculation:

This indicator describes environmental state as the percentage of surface water bodies that meet environmental standards. Values are constrained between 0 and 100 and therefore implicitly normalized in a 0-100 scale, where in all cases 0 is the worst possible performance and 100 the best. The minimum and maximum values assigned as goalposts (gp_{min} and gp_{max}) are 0% and 100% respectively.

Indicator results are shown in Table 19 and Figure 4.

Table 11. Number and percentage of monitoring stations showing surface water quality meeting the technical standards, and calculated ESGAP scores for 2018-2019.

Source: Calculated by authors

Year	Number of monitoring stations	Number of the stations meeting the standard 2018						ESGAP score
		COD	BOD_5	$N\text{-}NO_3^-$	$N\text{-}NH_4^+$	Lead	All	
2018	275	98	95	275	172	261	62	**23**
		36%	35%	100%	63%	95%	23%	
2019	257	78	50	255	169	250	37	**14**
		30%	19%	99%	66%	97%	14%	

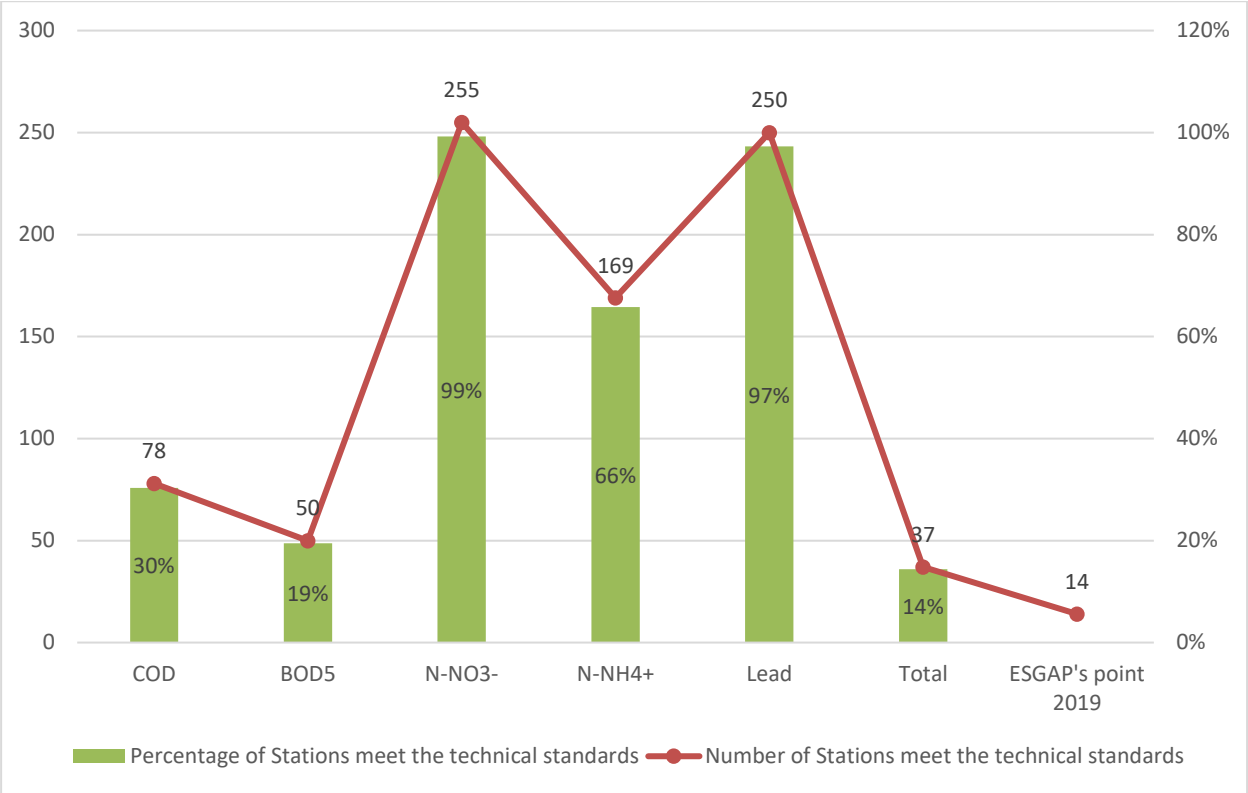


Figure 5. The proportion of monitoring stations that meet the technical standards of surface water quality in 2019

Source: Calculated by authors

ESGAP score: 14.00 (2019)

Discussion

- Country context: According to our results for 2019, only 37 (14%) out of 257 water quality monitoring stations across nine main river basins met all of the technical standards for the five water quality parameters included in the indicator (Table 19 and Figure 4). Most pollution issues were related to parameters of COD and BOD5 with only 30% and 19% of the monitoring stations meeting the parameter's standard, respectively. The indicator's score in 2019 is 14, which shows a slight decrease compared to 2018.

  These results are indicative of how surface water pollution in Vietnam remains an environmental and sustainability challenge. According to the National Report of Environmental State in 2019 (the theme on environment of river basins (MONRE, 2018)[8]), the environmental quality of many river basins in Vietnam is being degraded, especially at those parts flowing through urban and industrial areas. Socio-economic development as well as climate change effects have put a lot of pressure on the aquatic environment of Vietnam's river basins.

[8] MONRE, 2018, the National Report of Environmental State in 2019: Environment of river basins.

- Suitability of indicator: The indicator has a reliable and annual source of data; however, it lacks representativeness as there is not enough data for all water quality parameters, especially heavy metal parameters.
- Recommendations: In future, Vietnam should enhance its monitoring system to include a wider range of parameters indicative of surface water quality.

Indicator 2.5. Coastal water bodies in good chemical status

Proxy Indicator: Proportion of monitoring stations with coastal water quality within technical standards.

Indicator profile:

The indicator is calculated as the percentage of coastal water quality monitoring stations in Vietnam (less than 5.5 km from the coast) showing that the annual average of coastal water quality meets the technical standards for parameters on total suspended solids (TSS), dissolved oxygen (DO), orthophosphate phosphorus ($P\text{-}PO_4^{3-}$), ammonium nitrogen ($N\text{-}NH^{4+}$); Lead (Pb), Cadmium (Cd); Iron (Fe) and Cyanide (CN^-).

Standard:

We used as standard Vietnam's national technical standards on coastal water quality: QCVN 10-MT: 2015/BTNMT with thresholds for each parameter as shown in Table 20.

The QCVN regulations include different water quality standards for different coastal areas. This study used the standard for coastal water in farming and aquatic conservation areas and conservation of aquatic flora and fauna. The water quality parameter thresholds for this water use are the highest in the regulations.

Table 20. Viet Nam's technical standards for eight coastal water quality parameters. The regulated thresholds for areas of farming and aquatic conservation areas and conservation of aquatic flora and fauna parameters are used as the standards for the ESGAP indicator

Parameters	The areas of farming, aquatic conservation, conservation of aquatic flora and fauna	The area of coastal beach, water sport	Other areas
TSS	50	50	-
DO	>=5	>=4	

$P\text{-}PO_4^{3-}$	0.2	0.3	0.5
$N\text{-}NH_4^+$	0.1	0.5	0.5
Pb	0.05	0.05	0.1
Cadimi	0.005	0.005	0.01
Fe	0.5	0.5	0.5
Xyanua (CN-)	0.01	0.01	0.01

Data profile:

We used monitoring data collected from 72 monitoring stations in 2018 and 70 stations in 2019 assessing coastal water quality in 13 out of 28 coastal provinces in 2018 and 15 out of 28 in 2019 coastal provinces. Data was provided by the Vietnam Environment Administration (VEA). Monitoring stations with all eight parameters meeting the Vietnamese technical standards are evaluated as non-polluted.

ESGAP score calculation:

Similar to indicator 2.4, the normalized value of the indicator depends on the percentage value of the indicator, and the minimum and maximum values assigned as goalposts (gp_{min} and gp_{max}), which are 0% and 100% respectively.

Results for these indicators are presented in Table 21.

Table 21. Number and percentage of coastal water quality monitoring stations meeting the technical standards, and calculated ESGAP scores for 2018-2019

Source: Calculated by authors using MONRE data for 2021

Year	Number of monitoring stations	Number of stations meeting technical standards in 2018									ESGAP score
		TSS	DO	$N\text{-}NH_4^+$	$P\text{-}PO_4^{3-}$	Pb	Cadmium	Fe	Cyanide	All	
2018	71	40	69	27	70	71	-	60	71	23	32
		56%	97%	38%	99%	100%	-	85 %	100 %	32 %	
201	67	38	66	19	59	67	67	56	-	9	13

9		57%	99%	28%	88%	100%	100 %	84 %	-	13 %	

Our results show that in 2018, out of 71 coastal water monitoring stations across 15 coastal provinces, 23 (32%) met the technical standards for the parameters monitored. The indicator's score in 2018 is 32.1. In 2019, out of 67 monitoring stations in, nine stations (13%) met the technical standards for the parameters monitored. Hence, the ESGAP score for this indicator in 2019 is 13.

ESGAP score: 13.00 (2019)

Discussion:

- Country context: Indicator scores for 2018 and 2019 highlighted that water pollution is a crucial problem in coastal waters in Vietnam. According to MONRE's 5-year summary report on implementation of the Law on Environmental Protection (2015-2019), the reason for TSS and $N\text{-}NH4^+$ exceeding the threshold is due to transportation activities, seaports, fishing port areas and aquaculture activities (particularly in Tho Quang boat lock in Da Nang city and Tam Giang Lagoon in Thua Thien Hue province). One of the main reasons is oil and grease leakages from boats. For example, Tho Quang boat lock (Da Nang) is one of the hotspots for seawater pollution in recent years due to the influence of fishing port operations.
- Suitability of indicator: The indicator seems to be suitable, however, better representativeness is still an issue for this indicator (i.e., monitoring stations in a wider range of coastal areas in the country).
- Recommendations: There is a need for better monitoring data and better representativeness from different coastal regions throughout the country.

Indicator 2.6 Groundwater bodies in good chemical status

Proxy Indicator: Proportion of monitoring points with groundwater quality meeting the technical standards.

Indicator profile:

This indicator is calculated as the percentage of groundwater monitoring stations in Vietnam showing an annual average of groundwater quality meeting the technical standards for the parameters: Iron (Fe) (mg/l); ammonium (NH4+) (mg/l); Chloride (Cl-) (mg/l); Sulfate (SO4) (mg/l); Nitrogen dioxide (NO2) (mg/l); Nitrate (NO3) (mg/l); Total hardness (mg/l); and Total Dissolved Solids 105 (TDS 105) (mg/l).

Standard: We used Vietnam's national technical standards on groundwater quality: QCVN 09-MT: 2015/BTNMT with thresholds for each parameter shown in Table 22.

Table 22. The regulated thresholds for groundwater quality parameters

Source: QCVN 09-MT:2015/BTNMT

Groundwater parameters	Threshold (mg/l)
Fe	5
NH4+	1
Cl-	250
SO4	400
NO2	1
NO3	15
Total hardness	500
TDS 105	1500

We used the thresholds defined for groundwater in general as standards. The monitoring stations with all parameters meeting the standards were evaluated as non-polluted.

Data profile:

We used monitoring data collected from 668 monitoring stations in five regions including North, Northern Central, Central Highlands, Southern Central and South Vietnam, and provided by the National Center for Water Planning and Investigation. In each monitoring station, data was provided under the average of two seasons (dry season and rainy season).

ESGAP score calculation:

We used the same normalization method as defined for the indicators 2.4 and 2.5. The normalized value of the indicator depends on the percentage value of the indicator, and the minimum and maximum values assigned as goalposts (gp_{min} and gp_{max}), which are 0% and 100% respectively.

Results are presented in Table 23.

Table 23. Number and percentage of monitoring points showing groundwater quality meets the technical standards, and calculated ESGAP score for 2018

Source: Calculated by authors based on data from Department of Water Resource Management (DWRM), MONRE, 2019

Number of monitoring points	Number/percentage of monitoring points meeting the standard 2018								Total	ESGAP Score
	FE	NH4	Cl	SO4	NO2	NO3	Total hardness	TDS105		
1336	1253	687	943	1218	1193	1193	1045	1037	671	**50**
	94%	51%	71%	91%	89%	89%	78%	78%	50%	

Our results show that, in 2018, out of 668 monitoring points collecting data under two seasons (dry season and rainy season) equivalent to 1336 average seasonal monitoring results, 671 (50%) reached or exceeded the Vietnam's groundwater technical standards. Hence, the indicator score for 2018 is 50.

ESGAP score: 50 (2018)

Discussion:

- Country context: According to the Ministry of Natural Resources and Environment of Vietnam (MONRE, 2020[9]), the quality of groundwater in Vietnam is not a major environmental issue, but in some areas, particularly in the Northern Delta, there is local pollution of nutrients and heavy metals. Also, saline intrusion has affected groundwater quality in central coastal provinces, downstream of Dong Nai river and coastal provinces in the Mekong Delta. A report from the World Bank on Vietnam's water resources (2030 Water Resources Group, 2017)[10] also indicated that groundwater pollution is increasingly becoming a problem in Vietnam, particularly in industrial and craft villages, as well as in agricultural areas. In addition, groundwater quality faces major challenges associated with organic and coliform contamination, as well as phosphate pollution, which alarmingly exceeds the current standards. In Dong Nai River Basin, polluting land use activities and discharge of untreated wastewater and industrial effluent has impacted groundwater quality and is posing a significant risk to users.

[9] MONRE, 2020, Review report on 5 years implementation of the Law on Environmental Protection 2014 (2015-2019).
[10] 2030 Water Resources Group (2017) Vietnam: Hydro-Economic Framework for Assessing Water Sector Challenges.

- Suitability of indicator: The indicator has reliable and annually sourced data, however same as indicators 2.4 and 2.5, there is not enough data for all water quality parameters, especially some heavy metal parameters.
- Recommendations: In future, Vietnam should develop a better system of monitoring to assess a wider range of parameters on groundwater quality.

2.1.3. Life support function

According to our assessments, no indicators are available to calculate the ESGAP Life Support function in Vietnam.

2.1.4. Human Health and Welfare function

Indicator 4.1: Population exposed to safe levels of PM2.5

Proxy indicator: Population exposed to safe levels of PM2.5 (under Vietnamese technical regulation of air quality)

Standard: We used the 2005 WHO Air quality guidelines on thresholds and limits for key air pollutants that pose health risks (Table 24).

Table 24. WHO air quality guidelines and interim targets for particulate matter: annual mean concentration

Source: WHO, 2006[11]

	PM2.5(µg/m³)	Basis for the selected level
Interim target-1 (IT-1)	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG levels.
Interim target-2 (IT-2)	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to the IT-1 level.
Interim target-3 (IT-3)	15	In addition to other health benefits, these levels reduce mortality risk by approximately 6% [2-11%] relative to the -IT-2 level.
Air quality guideline (AQG)	10	These are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to PM2.5

Countries are encouraged to consider adopting an increasingly stringent set of standards, tracking progress through the monitoring of emissions reductions and declining concentrations of PM. Three interim target levels were set by the WHO as an achievable roadmap for attaining their air quality guideline of an annual

[11] WHO (2006) WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: Global update 2005.

average fine particulate matter (PM2.5) concentration of 10 µg/m^3. The interim targets are set at progressively lower concentrations: IT-1, 35 µg/m^3; IT-2, 25 µg/m^3; and IT-3, 15 µg/m^3.

The Vietnam National technical regulations on ambient air quality (QCVN 05: 2013 / BTNMT - Circular No. 32/2013/TT-BTNMT) uses the second interim target level (25 µg/m^3) as the standard for annual average fine particulate matter (PM2.5) concentration.

For this indicator, we propose to use the IT-2 as the threshold, given that IT-2 is the most policy-relevant among the scientific target values produced by WHO.

Data profile:

We used monitoring data from six air quality monitoring stations in six major cities in Vietnam (Table 25). Nevertheless, given that data is scarce and not representative enough of the air quality in Vietnam more widely, we used supplementary data sources from the World Bank (obtained from the Global Burden of Disease Study (2017)[12]) from 2010 to 2017 (Table 25).

Table 25. Air quality monitoring results from six cities in Vietnam for 2018-2019

Source: Vietnam Environment Administration (MONRE)

Monitoring station	2018		2019	
	PM10	PM2.5	PM10	PM2.5
Da Nang				
Le Duan St, Da Nang	13.2		34.11	21.3
Hanoi				
Nguyen Van Cu str, Hanoi	54.7		55	40.2
Khanh Hoa				
Dong De str, Khanh Hoa	9.6		21.6	16.8
Phu Tho				
Viet Tri City	51.8		56	35.9
Thua Thien Hue				
Hung Vuong str – Hue City	34.1		24.4	20.8

[12] Brauer, M. et al. 2017, for the Global Burden of Disease Study 2017. Available at https://data.worldbank.org/indicator/EN.ATM.PM25.MC.ZS

Quang Ninh				
Hong Ha, Ha Long city	29.8			

Table 26. Percentage of Vietnam's population exposed to PM2.5 levels exceeding WHO air quality guideline value and interim targets (%)

Source: The Global Burden of Disease Study (2017)

Year	Percentage of Vietnam's population exposed to PM2.5 levels (%)		
	IT-2 (25 mg/m3)	IT-3 (15 mg/m3)	AQG (10 mg/m3)
2010	85.66	100	100
2011	86.53	100	100
2012	83.54	100	100
2013	82.68	100.00	100
2014	81.57	99.98	100
2015	80.72	99.80	100
2016	76.59	99.29	100
2017	76.72	99.23	100

ESGAP score calculation:

We used the IT-2 as the threshold for safe levels of P.M2.5. We first calculated the population exposed to safe level of PM2.5. Then, we normalized the indicator's values in a scale of 0-100, where in all cases 0 is the worst possible performance and 100 the best.

Table 27. Percentage of Vietnam's population exposed to PM2.5 levels exceeding WHO air quality guideline value and interim targets (%), and ESGAP score for indicator of population exposed to safe level of PM2.5

Source: Calculated by authors, 2021

Year	Percentage of Vietnam's population exposed to PM2.5 pollution (%)	Percentage of the population exposed to safe level of PM2.5 (%)	ESGAP score
2010	85.66	14.34	14.34
2011	86.53	13.47	13.47
2012	83.54	16.46	16.46

2013	82.68	17.32	17.32
2014	81.57	18.43	18.43
2015	80.72	19.28	19.28
2016	76.59	23.41	23.41
2017	76.72	23.28	23.28

ESGAP score: 23.3 (2017)

Discussion

- Country context**:** According to a report by the Ministry of Natural Resources and Environment (MONRE, 2019)[13], in 2010 to 2017 dust pollution, especially fine dust (PM2.5) in some major cities in Vietnam increased. This is mainly due to a larger number of vehicles, construction activities and burning fossils for industrial production. However, the air quality in rural and mountainous areas of Vietnam is still in relatively good condition. Vietnam's urban population accounts for only 35.05% (GSO, 2019). Compared to the World Bank's assessment results with more than 76% of Vietnam's population being subject to fine dust pollution, it is, thus, not really consistent with the reality of Vietnam.
- Suitability of indicator: This indicator is suitable for Vietnam.
- Recommendations: In the future, Vietnam should attempt to produce data at better resolution (by investing in a better monitoring station network).

Indicator 4.2 Population using clean fuels and technologies for cooking

Indicator: Proportion of population using clean fuels for cooking

Standard:

Indoor air pollution is primarily caused by burning solid fuels, including biomass (such as wood and crop waste) and coal. Much of this fuel is used by the poor and burned in open fires and simple stoves with poor ventilation, which leads to high levels of smoke exposure. Improved technology can reduce indoor air pollution from burning solid fuel but is unlikely to reduce it to safe levels (WHO, 2014)[14].

Data profile:

We used data from the 2019 Population and Housing Census conducted according to Decision No. 772/QĐ-TTg dated June 26, 2018 of the Prime Minister (Table 28). This is the fifth Population and Housing Census in Vietnam since reunification in 1975. This census is conducted every 10 years.

[13] MONRE, 2020, Report 233/BC-CP dated 18/May/2020: Report on environment protection in 2019

[14] WHO (2014) WHO guidelines for indoor air quality: household fuel combustion. ISBN: 9789241548878 (print).

Table 28. Percentage of population using different types of fuels for cooking (%)

Source: GSO, 2019 Population and Housing Census, 2019

	Total	Electricity	Gas/Biogas	Coal	Wood	Other	None
National	100.0	9.2	79.5	0.3	10.9	0.0	0.1
Urban	100.0	16.5	81.4	0.3	1.6	0.0	0.2
Rural	100.0	5.2	78.3	0.4	16.0	0.0	0.1

ESGAP score calculation:

Since coal and wood are not considered clean fuels, the proportion of the population using clean fuels for cooking is:

National total - (National coal use + National wood use) = 100 - (0.3 + 10.9) = 88.8%

The normalized value of indicator depends on the percentage value of the indicator, and the minimum and maximum values assigned as goalposts (gp_{min} and gp_{max}), which are 0% and 100% respectively.

ESGAP score: 88.8 (2019)

Discussion

- Country context: The proportion of population using clean fuels for cooking of Vietnam in 2019 is 88.8%. This data is bit different from the result produced by the Global Health Observatory (GHO), WHO (66.92% in 2016)[15]. The difference might be resulted from differences between the years and the methods producing the data. Vietnam has primary data from the national 2019 Population and Housing Census, whereas WHO used modeling methodology to produce this data source. The data used in this research would be more convincing for Vietnam's side. This view is also supported by the comments made in the study's consultation workshop (see Table of Contents 4).

  In fact, Vietnam has included the indicator "the percentage of households using clean raw materials" as one of the indicators of VSDG monitoring and evaluation (VSDG indicator 7.1.2). Although the above survey results are available, according to the Draft National Report 2020 on the implementation of Vietnam's Sustainable Development Goals, this indicator has not yet been evaluated and will only begin to be reported from 2025 (MPI, 2020). This may reflect the complexity of data management and reporting in Vietnam.

[15] https://data.worldbank.org/indicator/EG.CFT.ACCS.ZS?locations=VN

Even so, the ESGAP score results seem to appropriately reflect the context of Vietnam. The National Environmental Report on Air Quality 2013 (MONRE, 2014) states that the source of air pollution from people's activities in urban areas has decreased significantly due to the improvement and changes of living conditions and habits. Even in rural areas, people have abandoned the habit of burning biomass such as firewood and straw in their daily life, instead, in many rural areas of Vietnam, people burn rice straw right in the field, causing local air pollution in some rural areas (MONRE, 2016)

- Suitability of indicator: This indicator is suitable for Vietnam.
- Recommendations: In the future, ESGAP can use directly the data reported from the report on Vietnam SDG indicators of "the percentage of households using clean raw materials" (VSDG indicator 7.1.2).

Indicator 4.3. Samples that meet the drinking water criteria

Proxy indicator: Proportion of clean water plants that meet clean water quality standards for domestic use.

This indicator is calculated as the percentage of clean water plants assessed that meet clean water quality standards for domestic use.

Standard:

We assigned a score of 100 if 100% inspected water plants had water samples meeting the technical standard on clean water quality. Currently, quality of clean waters in Vietnam is defined according to the National technical regulation on clean water quality for domestic use QCVN 01-1: 2018 / BYT. This regulation was compiled by the Department of Health Environment Management and submitted to the Legal Department for approval by the Ministry of Science and Technology and The Ministry of Health, which issued the regulation with the Circular No. 41/2018 / TT-BYT dated December 14, 2018.

These regulations apply to organizations and individuals that carry out part or all activities related to exploitation, production, transmission, wholesaling and retailing of clean water under the centralized water supply system (hereinafter referred to as water providers). These regulations do not apply to drinking water from tap, bottled natural mineral water, water produced from purifiers, water filtration systems and other water not intended for domestic use. These regulations define 99 clean water quality parameters and permissible limits (See appendix 2 for details). Accordingly, there is the sampling and testing of clean water quality parameters of group A including microbiological parameters (Coliform and E. coli or heat-resistant coliforms); sensory and inorganic parameters (including arsenic (As); free residual chlorine; turbidity; color; odor, taste and pH). There are also other parameters for group B depending on local regulations.

Data profile:

We collected data from reports and interviews with the Department of Environmental Health Management under the Ministry of Health.

These reports included results from inspection and monitoring of water providers for clean water quality in 2018 and 2019. These inspections were carried out in accordance with regulations defined in Circular No. 41/2018 / TT-BYT of the Minister of Health of Vietnam dated December 14, 2018.

ESGAP score calculation:

We normalized the indicator using gp_{min} and gp_{max} values of 0% and 100% respectively. The indicator's score is calculated in Table 29.

Table 29. ESGAP score for drinking water indicator

Source: The Ministry of Health, 2019[16]

Year	Number of clean water plants	Number of inspected clean water plants	Proportion of sample meeting technical standard of drinking water quality (%)	ESGAP score
2018	-	-	96	**96**
2019	8186	4698	76	**76**

ESGAP score: 76 (2019)

Discussion:

- Country context: According to our results shown in Table 29, the score for this indicator is 76 for 2019, which decreased from the score of 96 in 2018. This decrease, however, does not reflect the actual reduction of water quality but the changes of regulations on inspection and changes of Vietnam's clean water standards (The Ministry of Health, 2019).
- Suitability: According to 2019 Population and Housing Census of Vietnam (GSO, 2020[17]), only 52.2% of the national population is using tap water as the primary source of water for cooking and drinking. There is no data on the quality of water from other sources used by households (such as rainwater, well water, or natural water bodies). Hence, this score is not representative of the whole Vietnamese population.

[16] The Ministry of Health (MOH), 2019, report No 1245/BC-MT of Department of Environmental Management, Ministry of Health, dated on July 3, 2020: Report on the results of inspection and supervision of the quality of clean water and household latrines in 2019

[17] GSO, 2020, Results of 2019 Population and Housing Census.

- Recommendations: To improve this indicator, it is necessary to sample other water sources used by rural and remote populations. However, this presents many challenges due to the (in)accessibility of these areas, and the fact that the sources may vary from household to household and the water quality of these sources may also vary significantly with time. Therefore, we consider this indicator not suitable for Vietnam. The indicator of population with access to clean water in urban and/or rural areas might be a better indicator for a developing country such Vietnam, with clean water meaning tap water produced and supplied to people by factories producing tap water, meeting the standards set by the Ministry of Health. The proposed indicator has data available for Vietnam, however, within the scope of this study, in order to best match the SESI indicators (see section 1.3 on page 28 on indicator selection method), this indicator should still be considered experiment.

Indicator 2.4.2.2. Natural and mixed world heritage sites in good conservation outlook

Indicator: The proportion of natural and mixed world heritage sites in good conservation outlook

Standard:

The definition of 'good conservation outlook' is based on three elements:

- the current state and trend of values,
- the threats affecting those values,
- the effectiveness of protection and management.

The overall conservation outlook for a particular site is assessed against four categories (Osipova et al, 2020) (Table 30).

Table 30. Definition for ratings of conservation outlook

Source: Osipova et al. 2020.

Rating	Definition
Good	The site's values are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.
Good with some concerns	While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained in the long term.
Significant concerns	The site's values are threatened and/or are showing signs of deterioration. Significant additional conservation measures are needed to maintain and/or restore values over the medium to long term.
Critical	The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed

	to maintain and/or restore the site's values over the short to medium term, or the values may be lost.

Data profile:

Vietnam has three World Heritage Sites, which include Ha Long Bay, National Park Phong Nha - Ke Bang, and Trang An Cultural and Natural Heritage. The status of all these sites was reported in the 2014, 2017 and 2020 IUCN Outlook reports (Table 31)

Table 31. Conservation outlook of world heritage sites in Vietnam

Source: Osipova et al, 2017, 2020

Site	Type	Conservation outlook 2017	Conservation outlook 2020
Ha Long Bay	Natural	Good with some concerns	Good with some concerns
National Park Phong Nha - Ke Bang	Mixed	Good with some concerns	Significant concerns
Trang An Cultural and Natural Heritage	Mixed	Significant concerns	Good with some concerns

ESGAP score calculation:

We normalized the indicator based on gp_{min} and gp_{max} of 0% and 100% respectively.

The proportion of natural and mixed world heritage sites in good conservation outlook is zero so the ESGAP score for this indicator is 5.

ESGAP score: 5 (2019)

Discussion:

- Country context: The 2020 IUCN conservation outlook (Osipova et al, 2020) showed that for about two thirds (72%) of all natural and mixed sites in Asia the conservation status is either good or good with some concerns, which is slightly better than the overall global results (63%). However, for 30% of all sites the conservation outlook is of significant concern and for 7% it is critical. Vietnam follows this pattern. The main threats currently affecting natural World Heritage sites in Asia include commercial hunting, tourism impacts, logging and dams, road construction and water pollution. These are also significant general environmental issues for conservation in Vietnam.

- Limitation: The conservation sector is relatively underdeveloped in Vietnam, therefore using "Good" conservation outlook as the threshold may hinder comparison with its past performance.
- Recommendations: It is important to interpret these results within the context defined above (i.e., an underdeveloped conservation sector). Whilst a more partial scale (e.g., assigning a score of 100 for "Good", 50 for "Good with some concerns" and 0 for "Significant Concern" & "Critical") would be able to determine progress on the conservation natural heritage sites, the SES index aims to show the extent (but not severity) of unsustainability. Hence, it is not recommended to assign arbitrary scores on severity. Nevertheless, something to consider in the future could be the inclusion of the conservation status of other designations and recreational sites including, for example, national parks, national monuments, RAMSAR sites and Geoparks.

2.2. Vietnam SES sub-indices and overall index

We used 14 indicators on the Source, Sink and Human Health and Welfare functions to apply the ESGAP framework to the country context of Vietnam. Nevertheless, a major caveat of this study is that there are no indicators available in Vietnam to assess the Life Support function in the country, given the lack of monitoring data on the state of terrestrial and water ecosystems.

We show in Table 32 a summary on the performance for the different indicators used to calculate the SES index in Vietnam.

Table 32. ESGAP results for Vietnam

	Indices and indicators	ESGAP score
A	**Source function**	**59.7**
A1	**Renew renewable resources**	**63.5**
	Biomass	**22.1**
1	Forest coverage	97.4
2	Fish stocks exploited within Total Allowable Catch	5.0
	Freshwater	**88.0**
3	Proportion of main river basin not under water stress	88.0

A2	**Use non-renewables prudently**	**48.5**
4	Area with tolerable soil erosion	48.5
B	**Sink function**	**30.5**
B1	**Prevent global warming, ozone depletion**	**5.0**
5	GHG per capital	5.0
6	Consumption of HCFCs	5.0
B2	**Terrestrial ecosystems**	**94.9**
7	Mercury emission per capital	94.9
B3	**Freshwater ecosystems**	**13.9**
8	Proportion of surface water monitoring points in major river basins meet the technical	14.4
9	Proportion of monitoring points showing that coastal water quality meets the technical standards	13.4
B4	**Marine ecosystems**	**50.0**
10	Proportion of monitoring points showing that ground water quality meets the technical standards	50.0
C	**Life support**	**No data**
D	**Human health and welfare**	**48.4**
D1	**Human health**	**54.0**
11	Population exposed to safe levels of PM2.5	23.3
12	Proportion of population using clean fuels for cooking	89.0
13	Proportion of clean water plants having water quality meeting technical standard of drinking water quality	76.2
D2	**Other welfare**	**5.0**
14	Proportion of natural and mixed world heritage sites in good conservation outlook	5.0

The results of each specific component index are reflected as follows:

2.2.1 Source function in Vietnam

The Source function of the Vietnamese ESGAP framework (which assesses the (un)sustainable use of renewable and non-renewable resources in the country) showed a mid-performance for the country with a score of 59.7. This function was

calculated using four indicators on forest, fish, freshwater resources and soil resources. The forest indicator exhibited a high performance (97.4). Nevertheless, there are several caveats associated with the use of this indicator and its adequacy to assess the (un)sustainable use of forest resources in Vietnam. First, we used a policy standard, not a scientific standard for the indicator. Hence, a level of forest coverage of 43% is not necessarily indicative of a 'good enough' threshold to maintain the provision of forest resources into the future in Vietnam. Second, this high performance is not representative of a good quality of Vietnam's forests as the data available does not discern between plantations and primary forest coverage. Nevertheless, if an indicator on 'forest quality' becomes available in the future, this should be included under the life support function for the Vietnamese ESGAP framework.

Also, despite a relatively high performance on the sustainable use of surface water resources (proportion of main river basin not under water stress) which got 88/100 points, the freshwater resource indicator used in the Vietnamese ESGAP framework should only be considered a proxy of freshwater resource scarcity, so this performance should be reassessed in the future when better indicators and data become available.

Our results also highlighted overfishing as a critical and urgent environmental issue for Vietnam if the Government is committed to achieving environmental sustainability. There is still a gap on specific regulations to end overfishing through annual catch limits.

Last, in relation to the use of non-renewable resources, Vietnam achieved a relatively low performance although being assessed only through the use of an indicator on soil erosion. Nevertheless, data on erosion levels caused by human activities (such as illegal sand exploitation and other factors such as upstream hydroelectricity activities and sea level rise), should also be made available for riverbanks and coastal areas particularly in the Mekong Delta region. This is currently an important data gap for Vietnam that the Vietnamese ESGAP framework has highlighted and that needs to be filled in the future.

2.2.2. Sink function in Vietnam

Most of the indicators used to implement the Vietnamese ESGAP framework were under the Sink function category (six indicators). Nevertheless, the Sink function in Vietnam exhibited the lowest performance (30.5 points) in comparison to the Source and Human Health and Welfare functions. This means that, according to our results, the capacity of the natural capital in Vietnam to neutralise wastes without incurring ecosystem change or damage (which includes the regulation

of the chemical composition of the atmosphere and oceans and the assimilation of waste) is jeopardised in the country.

Particularly underperforming areas on environmental sustainability for the Sink function in Vietnam that the ESGAP framework has identified is the country's response to climate change (as defined by Vietnam's per-capita CO_2 emissions and consumption of ozone depleting substances). This reflects the current unsustainable situation for the country in relation to carbon emissions and the need for the Government of Vietnam to redirect investments towards decreasing GHG emissions and commit to a transition towards a carbon neutral economy.

Other critical areas that the Vietnamese ESGAP framework has identified as a priority towards achieving environmental sustainability, is the need to respect critical loads for ecosystems, so their capability to disperse, absorb, neutralise and recycle waste, without disturbing other functions, is maintained. Particularly, water pollution is a major concern in Vietnam (as shown by the results on surface water and coastal water pollution). The unsustainable socio-economic development path that Vietnam has followed since the economic reforms initiated in the 1980's (Đổi Mới), as well as climate change derived effects, have put a lot of pressure on the water environment of Vietnam's river basins. Similarly, international trade, the thriving of seaports for fishing operations and the unsustainable proliferation of aquaculture activities, as well as the derived environmental impacts (such as oil and grease spillovers) mean that coastal pollution is a crucial environmental problem in coastal waters in Vietnam.

2.2.3. Life Support function in Vietnam

The lack of data from biodiversity assessments points to a major policy gap that Vietnam's environmental decision makers should pay attention to. While the quality of the environment is declining, especially the water environment, and the environmental pressures are increasing, it is certain to cause damage to biodiversity. If this issue is not monitored and assessed soon, it will not be able to fully assess the country's environmental sustainability and also lose the opportunity to develop the proper policies for this issue.

2.2.4. Human health and welfare function in Vietnam

On relation to respecting standards for human health, according to our assessment Vietnam exhibits a mid-performance, which suggests that emissions may currently exceed dangerous levels for human health. Particularly, outdoor air pollution is one of the major environmental problems affecting the health of Vietnamese people, especially in urban areas.

Regarding the amenity topic (i.e., the conservation of landscapes of special human or ecological significance because of their rarity, aesthetic quality or

cultural or spiritual associations), our results show that Vietnam is neither conserving nor managing effectively its natural World Heritage sites. Some of the main threats currently affecting natural World Heritage sites in Asia (with Vietnam following the same pattern) include commercial hunting, tourism impacts, illegal logging, dams and road construction and water pollution.

2.3.4. The ESGAP composite index

As mentioned, the composite index cannot yet be calculated due to the lack of one of the four ESGAP pillars on the Life Support function. This shortcoming of the pilot study needs to be further researched to make it more complete.

In fact, there are a number of international environmental sustainability indicators and indices calculated for Vietnam such as the Index of Air Quality (https://www.iqair.com/en/vietnam) Environmental Performance Index (EPI) released by Yale University (https://epi.yale.edu/). Adopteing the results, the Government issued a Government Resolution (Resolution No. 19-2018/NQ-CP of the Government: On continuing to perform the main tasks and solutions to improve the business environment, enhance national competitiveness in 2018 and the following years) in which the Ministry of Natural Resources and Environment is assigned to track and evaluate the results of Vietnam's EPI indicators. However, there has been still an issue with the general acceptability of these international indicators for the scientific community and policy makers due to the problem of verifying published data sources. While EPI mainly uses data from studies and difficult-to-test models, Vietnamese scientists and policymakers have questions on the data sources and tend to be more confident with national officially published data. The scientists and policymakers, therefore, gave recommendations for the ESGAP's research that the data used should be national officially published (see comments in the minutes of the first scientific conference). As a result, the proposed ESGAP indicators for Vietnam are based on, on one hand, the ESGAP original framework with the solid foundation and scientific standards of ESGAP's indicators, and on the other hand, has used the data sources available and recognized in Vietnam. Thus, ESGAP, if capably applied in Vietnam, is likely to be more widely acceptable.

There are also some sets of sustainable development indicators (SDIs) at different regional scales, the Millennium Development Goals indicators (MDGIs) and Sustainable Development Goals indicators (SDGIs) that are employed in Vietnam (Tri, Ngo et al., 2017). Among these sets of indicators, environmental indicators always account for one of the three pillars of sustainable development and have a large number of indicators. For example, in 1998 the first draft set of SDIs in Vietnam promulgated by the Vietnam Environment Administration included 80

indicators of which the environmental pillar had 60/80 indicators. With the support of UNEP, these Sustainable Development Indicators of Vietnam have been tested and developed continuously for many years. By 2011, the set of SDIs for monitoring and verifying Vietnam's sustainable development was officially promulgated (Tran Van et al., 2016). However, this set of indicators could not be calculated in the end, although a technical manual for each indicator has been developed. (Tri, Ngo et al.,2017). Possible shortcomings include the lack of theoretical framework, thus there are too many indicators and the indicators are repeated; calculation of the composite indicator was too complicated (Lam, 2015); target values of indicators were not clear; the infeasibility of data for calculation was also a contribution. To overcome these difficulties, therefore, the proposed ESGAP framework and ESGAP indicators for Vietnam have been studied to ensure its scientific and logical framework, and also the indicators are simple and transparent. Data sources used must be available and completed.

Most recently, a set of statistical indicators of Vietnam's Sustainable Development Indicators including 158 indicators has also been issued (MPI, 2019). Compared with the SDGs' set of indicators proposed by the United Nations to use to evaluate countries, Vietnam only uses very few internationally proposed indicators and the remaining are alternatives which are mainly proposed by national ministries and sectors. Among the VSDG's environmental indicators, most of the indicators are aimed at monitoring and evaluating the implementation efforts of management agencies such as "The rate of urban solid waste collected and treated that meets the regulations"; "Percentage of urban construction solid waste collected, recycled or reused compared to the total amount of generated urban construction solid waste collected". Some indicators for direct assessment of environmental sustainability such as "Proportion of households using clean fuels", and "Concentrations of substances in the air environment" have been included in the set of ESGAP indicators proposed for Vietnam if data are available (see details in table 1 P.19). In fact, results of assessment of the implementation of Vietnam's Sustainable Development Goals (VSDGs) in 2020 (MPI, 2020) shows that the environmental indicators, especially the direct environmentally sustainable indicators (environmental quality) have not been yet evaluated or the data sources is lacking for evaluation. This is a common difficulty for environmental indicators to be implemented in Vietnam due to the lack of a synchronous environmental monitoring infrastructure system, a lack of a fully statistical environment database system being reported and updated. These difficulties are expected to be solved soon due to many data sources having been updated and planned to enhance in the national master plan, sectoral and provincial planning of Vietnam for the period 2021-2030 being implemented recently. This is

a very good prospect to be able to upgrade the data sources for calculating the ESGAP indicators for Vietnam.

The ESGAP index, thus, with its role as a direct assessment of environmental sustainability, can be a companion and supplementary set of indicators for Vietnam's Sustainable Development Indicators. The two sets of indicators aim to, on the one hand, both assess efforts to protect the environment towards the Sustainable Development Goals (VSDGs) and, on the other hand, properly assess the results achieved in terms of environmental sustainability. This idea has been supported by the commendations of many environmental scientists and state managers through two consultation seminars organized by the research team (see Appendix 3 and 4).

Mu Cang Chai, Vietnam

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The process of adjusting and designing the EPI framework to fit the Vietnamese context allowed the Vietnamese research team to assess the gaps in Vietnam's policies towards environmental sustainability and on the national environmental monitoring system that need urgent attention if the Government is committed to achieving environmental sustainability over the coming decade. These critical gaps include, for example, the lack of regulations on the critical load of ecosystems and the lack of environmental standards for ecosystems and biodiversity.

Combined with lessons learned from the results of the SESI index assessment in Europe, the process of researching the index framework and ESGAP indicators suitable for Vietnam also points out lessons about environmental databases of Vietnam, compared with some other countries in the world that are also piloting the design of national ESGAP frameworks such as Kenya, Japan and China.

The national environmental data assessment implemented for this work has revealed that five out of the 22 indicators of the ESGAP framework have available data for Vietnam (those related to land erosion, GHG emissions, ozone depleting substances, clean fuels and technologies for cooking, and natural and mixed world heritage sites); whilst nine out of 22 indicators had insufficient data for Vietnam and therefore needed to be replaced by proxy indicators to adapt the ESGAP framework to the Vietnamese context. The remaining eight indicators (specifically those related to groundwater resources, ozone pollution and ecological quality of ecosystems) had neither data nor suitable proxy indicators to adapt to the Vietnamese context, and therefore they represent major data gaps.

Nevertheless, for the indicators adopted, challenges on the differences between the environmental standards used in the European and Vietnamese contexts still remain, as well as caveats related to the scientific underpinning of the proxy indicators used and their relevance or complete alignment to the ESGAP framework.

In future, when applying the ESGAP in a developing country like Vietnam with many constraints on environmental data and statistics, these indicators might have to be adjusted to be consistent with the principles of the ESGAP framework but can also be produced using data that is available in the country. Thus, whenever possible, ESGAP indicators might have to rely on suitable indicators identified in international environmental conventions/agreements and international databases, for the framework to be implementable in as many countries as possible.

As we discussed in the previous section, one of the main shortcomings of this study is the lack of indicators to calculate the state of the Life Support function in Vietnam, which undermines the ability to calculate an overall score on strong environmental sustainability performance for the country.

The Source function seemed to perform better for Vietnam (59.7) than the Human Health and Welfare function (48.8) and the Sink function (30.5). Nonetheless, the absolute scores are low in all cases, suggesting that the three environmental functions are currently jeopardised in Vietnam (with only the Source function scoring slightly higher than 50 points). The Source function covers, for example, the provision of forest and fish biomass, freshwater resources and soil, and its low performance suggests that Vietnam is jeopardised in its capacity to sustain the supply of biotic and abiotic natural resources into the future if more sustainable practices are not prioritised and implementation enforced under the current Vietnam National Action Plan for the implementation of the Agenda 2030 on Sustainable Development.

One clear example is the issue of fisheries. The Vietnam ESGAP results highlight that overfishing is still a critical and urgent environmental issue for Vietnam. In fact, one of the main shortcomings in Vietnam on relation to fisheries has been the control of illegal fishing in international waters (and therefore applying the United Nations Convention on the Law of the Sea (UNCLOS)). In particular, the small-scale "Blue Boat" (small wooden-hulled fishing boats) vessels illegally fishing outside of Exclusive Economic Zones (EEZ) attract much negative attention, which probably was the tipping point (on top of already existing shortcomings in traceability and catch documentation) for Vietnam being issued a Yellow Card by the European Commission in 2018 for illegal, unreported and unregulated (IUU) fishing. Whilst the Yellow Card was a key catalyst in strengthening legal and management measures in Vietnam and recent years have seen unprecedented improvements in the legal/policy foundation, including the enforcement of measures for mandatory use of Vessel Monitoring Systems (VMS), and overall stronger Monitoring, Control and Surveillance (MCS) in the offshore fisheries, gaps still remain in implementing provisions in practice, and in evaluating the management systems, including for example the lack of enforced and stronger management of migratory stocks like tuna and swordfish; both important commercial fisheries in Vietnam.

Another example is Vietnamese forestry. Whilst the ESGAP indicator on forest resources performed highly, this result can be misleading in terms of what the actual forestry situation in Vietnam is. Overall, Vietnam's forests have improved in terms of quantity when the forest coverage of Vietnam has increased from 38.7% in 2008 to 41.9% in 2019 (GSO, 2020), , representing a great effort in the forestry

sector. Nevertheless, the quality of the forest has not increased even been worse due to the fact that the important natural forest areas has been declined, the planted forest areas has low quality in term of biodiversity and sustainability. Vietnam's forestry has faced and still faces many challenges from the pressures linked to the country's socio-economic growth trajectory, its population growth and limitations in the awareness on the benefits of sustainable forestry as well as the management capacity of forest owners. These challenges must be faced through coordinated objectives and achievable solutions developed to intensify the effectiveness of sustainable forest management which include the establishment of related legal frameworks and policies to encourage and attract all social stakeholders to participate in sustainable forest management; enhance management capacity and mechanisms of joint participation in forest protection and management; or promote socio-economic solutions such as long-term credit investments compatible with forestry development conditions (KEI, 2017).

The lack of information to assess the capacity of Vietnam's natural capital to maintain ecosystem health and function (i.e. the Life Support function) extends to the actual state and capacity to provide quality habitats, to the regulation of runoff and climate, and to the maintenance of the country's biodiversity. This highlights the lack of data and indicators in Vietnam for ecosystem condition but also for biodiversity. The Government should therefore invest more resources on developing capacity and generate data to derive indicators on biodiversity state and ecosystem condition that consider different parameters to determine whether ecosystems are in good condition or not.

In terms of monitoring, Vietnam still suffers from a severe lack of systematic monitoring data of the country's biodiversity (including, species population sizes, distribution and conservation status) but also on the state of terrestrial, freshwater and marine ecosystems. There is also a fundamental lack of information and assessments on how different economic sectors impact on natural capital, such as for example the conversion of natural ecosystems such as forested areas to other purposes such as cassava, coffee production or upland rice and maize cultivation by key provinces, or mangrove forests to shrimp farming. In terms of biodiversity, the latest Viet Nam NBSAP and the 6th National Report to the CBD identified a number of drawbacks which included, but were not limited to, the lack of unified coordination for biodiversity conservation in Viet Nam. State management of biodiversity conservation is shared between MARD, MONRE, and the Provincial People's Committees (PPCs), and there are overlaps and conflicts within it. PPCs and other natural resource management agencies are given incentives for economic development, but not for biodiversity conservation; this is an important obstacle to conservation and sustainable use. Also, the lack of

implementation guidance in the latest NBSAP remains a major obstacle to the implementation of the three goals of the Biodiversity Convention.

RECOMMENDATIONS

In general, whilst there are many caveats associated with the interpretation of Vietnam's ESGAP results given the lack of information for different indicators as well as due to the use of policy standards in some cases instead of science-based standards, the study results also provide policy recommendations. These are as follows:

(i) There is a need to strengthen natural resource management, especially on forest, marine, freshwater, groundwater and land resources

Actions should be conducted in investigation and assessment of potentials, economic values, current state and trends of national natural resources including forest, marine fish stock, water and land resources. Based on the inventory and assessment, the country should:

- Develop and implement, plan, manage, exploit and use national resources in a rational, efficient and sustainable manner, continue afforestation, protect natural forests, and prevent and cease destructive fishing activities so as to protect fishery resources, particularly in coastal areas.
- Enhance basin-wide water resource management and control water extraction and overexploitation to ensure economic, efficient and sustainable use.
- Prevent and combat erosion, desertification and land degradation.

(ii) Enhance Vietnam's natural capital sink function by, for example, reducing GHG emissions and environmental pollutants.

Reduction of GHG emissions to meet the Vietnam's NDC commitment and enhance energy efficiency and the use and investments on renewable energy are still a priority, as well as the reduction of consumption of ozone-depleting chemical substances and regulating discharge of heavy metals such as mercury, lead and cadmium. Reduce water pollutants by promoting the implementation of projects and programs for treating wastewater, especially wastewater containing heavy metals and radioactive elements, medical and industrial wastewater, wastewater from agro-fishery-forestry processing facilities, and urban domestic wastewater. There is also a need to develop and implement a plan for monitoring and responding to marine acidification.

(iii) Maintain the capacity to sustain ecosystem health and function by promoting biodiversity conservation.

Strengthen management and expand existing protected areas where possible and accelerate the establishment of new protected areas. Prioritize resources for the protection of scenery, ecology and natural heritage. Rigorously protect wildlife species, crop varieties, medicinal plants and herbs, high value livestock species, and rare species in danger of extinction. Prevent the introduction and invasion of harmful alien species.

(iv) Ensure human wellbeing and welfare through nature conservation and reduction of air pollution

There is an urgent need to control and reduce air pollutants especially in urban areas through the implementation of measures to reduce both outdoor but also indoor air pollution by regulating the rising and unrestrained private vehicle use and by promoting clean energy use and the development of a sustainable transport system. This may also include the development of walkable environments and the implementation of measures for improvement of the state and access to green and recreational spaces in both urban and residential areas.

Whilst Vietnam's environmental monitoring and database frameworks have been gradually improving, the Vietnam ESGAP framework has revealed the potentiality to enhance the current set of indicators in use to monitor performance on achieving sustainable development. These indicators would simultaneously evaluate efforts towards achieving sustainable development (VSDG indicators) but also would provide a snapshot of the country's absolute performance against environmental standards that are linked to different environmental and resource areas, as well as an assessment on whether the capacity of natural capital to function is compromised over the long term.

Our study has identified major gaps and challenges or issues that need to be addressed for future applicability of the Vietnam ESGAP framework and to potentially inform in-country decisions on environmental sustainability. These include:

(i) The gap on indicators and data for specific ESGAP indicators for Vietnam

Our results showed that eight out of 22 ESGAP indicators could not be applied or replaced with proxy indicators for Vietnam. Specifically, those were related to the state of groundwater sources (Source function); the state of croplands and forest areas exposed to ozone, and levels of eutrophication and acidification in ecosystems (Sink function); all indicators related to the Life Support function (ecological status of terrestrial areas, surface and coastal water bodies); and the state of recreational water bodies (Human Health and Welfare function).

(ii) The need to review and to identify standards for calculation of indicators

In the ESGAP framework, the standards used for the calculations of the ESGAP indicator scores are very important. In principle, these standards have to be science-based. In this pilot study, however, there are some constrains on standards of some indicators.

The main novelty of SESI is the use of science-based environmental standards to measure the absolute environmental sustainability performance of countries. Nevertheless, the application of the ESGAP framework to the Vietnamese context has demonstrated that, arguably, the implementation of the framework in data poor countries like Viet Nam, with many constraints on environmental data and statistics, may need to balance the need to follow and apply the fundamental principles defined by the framework, and the adaptation to the national context and use of indicators for which there is not national data available. Otherwise, the national ESGAP framework would need to rely on suitable indicators identified and available through international environmental conventions/agreements and international sources, which would allow for better inter-comparability between countries but which could also potentially undermine its relevance or ability to meet and adapt to the particular national context and specific in-country needs and priorities on environmental sustainability.

Specifically, these constraints include too old and not updated standards, as is the case with the fish stock standard, where the total allowable catch is estimated for the year 1997.

(iii) Wider data-related issues and capacity of national statistical agencies.

There is a need to strengthen monitoring for adequate environmental management in Vietnam. The biggest challenge for the country is the lack of an adequate environmental monitoring system and comprehensive nation-wide database. Data availability and accessibility are critical for ensuring transparency and accountability for monitoring and tracking the progress on environmental sustainability in the coming years. There is a lack of systematic monitoring and data, for example, on air quality, water quality, ecosystem health or fish stocks. In order to apply the ESGAP framework to the Vietnamese context and to effectively assess performance towards environmental sustainability in Vietnam, the country needs to invest in a better environmental monitoring system, particularly to monitor air, water and marine environmental quality. Importantly, a comprehensive biodiversity monitoring system must be developed linked to an environmental database that is systematically and periodically updated. In the future, an increased availability of relevant data, indicators and/or scientific evidence that supports changes in existing standards or the inclusion of different

ones will require the structure and indicator selection for the Vietnam ESGAP framework to be revisited.

Despite increasing policy interventions to address existing environmental issues, the policy gap in Vietnam is still widening due to an ineffective implementation, poor scientific base for policy formulation and newly emerging environmental issues. This is common to most of the countries in the Asia-Pacific region as there is still a lack of comprehensive governance and policy mechanisms to effectively address environmental sustainability challenges. This is due to a broad spectrum of reasons, such as lack of funding resources and human capacity, weak governance systems and challenges in prioritization of efforts.

Nevertheless, we hope that the experience of implementing the ESGAP framework in Vietnam, apart from bringing the provision of data and information and lessons learned as well as project development experience needed to overcome knowledge gaps and positively improve the benefits for new and developing projects in other pilot countries, will also create momentum for an in-country review of the evidence on and for relevant data to be generated to increase the robustness of the framework and to effectively assess environmental sustainability in Vietnam.

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APPENDICES

Appendix 1. Policy overview on sustainable development in Vietnam. Source: Reviewed by the authors, 2020.

Policies	Number of the document	Notes
General policies on sustainable development of Vietnam		
Orientation of Vietnam's Sustainable Development Strategy (referred to as Vietnam's Agenda 21 under Decision No.153/2004 /QD-TTg dated August 17, 2004)	Decision No.153/2004 /QD-TTg dated August 17, 2004	
Vietnam Sustainable Development Strategy 2011 - 2020	Decision No. 432/QD-TTg dated April 12, 2012 of the Prime Minister	
National Strategy on Green Growth 2011 - 2020 with a vision to 2050	Decision No. 432/QD-TTg dated September 25, 2012 of the Prime Minister	
Resolution of Central Party on proactively responding to climate change, strengthening resource management and environmental protection	Resolution No.24-NQ/TW dated June 3, 2013	
National Action Plan to implement the 2030 Agenda for Sustainable Development	Decision No.622 / QD-TTg	It includes 17 goals of sustainable development and 115 specific targets for Vietnam until 2030 in all socio- economic and environmental areas. More than 10 ministries and 30 localities have issued action plans to implement the Decision 622/QD-TTG of the Prime Minister so far.
Sustainable Development Statistical Indicators for Vietnam.	Circular No. 03/2019/TT-BKHDT dated January 22, 2019 of the Ministry of Planning and Investment	It provides guidance on methodology for collecting and calculating the SDG statistical indicators
Directive of the Prime Minister on sustainable development	Directive No. 13/CT-TTg dated May 20, 2019	
Roadmap for the implementation of Vietnam's Sustainable Development Goals up to 2030	Decision No. 681/QD-TTg dated June 4, 2019	It provides a roadmap for implementation of the specific Vietnam's Sustainable Development Targets

Policies	Number of the document	Notes
Resolution of the Government on sustainable development	Resolution No. 136 / NQ-CP dated September 25, 2020	
Vietnamese policies on the protection of specific natural resources.		
Land resources		
Resolution of the XI Central Executive Committee on Continuing to renovate land policies and laws in the new era	Resolution No. 19-NQ / TW dated October 31, 2012	
Land Use Plan up to 2020 and the National 5-Year Land Use Plan 2011 - 2015	Resolution No. 17/2011/QH13 dated 22 November 2011	Issued by the National Assembly
Adjustment of land use planning to 2020 and land use plan 2016-2020 at the national level	Resolution No. 34/2016/QH13	
National action program to combat desertification 2006-2010 with a vision to 2020	Decision No. 204/2006 / QD-TTg September 2, 2006 of Prime Minister	The goal until 2020 is to tackle human activities that lead to desertification; formulate solutions to prevent and limit desertification caused by natural events; and maximizing restoration of degraded land
National Action Plan to improve efficiency of management, protection and general use of water resources 2014-2020.	Decision No. 182 /QD-TTg dated January 23, 2014	
National Strategy on Water Resources to 2020	Decision 81/2006 /QD-TTg dated 14/4/2006	The objectives stated for the protection of water resources are: 1) Restoration of rivers, reservoirs, aquifers and wetlands polluted, degraded or depleted; 2) to ensure minimal flow to maintain aquatic ecosystems and to protect the integrity and effectively use of wetlands and estuaries for key rivers and important aquifers; 3) to stop the situation of exploration, exploitation, use of water resources and illegal discharge of wastewater into water sources; and 4) to control water pollution by controlling the use of toxic chemicals in industrial, agricultural and aquaculture production.

Policies	Number of the document	Notes
Water resources		
National Program to ensure safe water supply 2016-2025	Decision No. 1566 / QD-TTg dated August 9, 2016	The objective is to minimize human health issues related to consumption of polluted water sources for the period 2020-2025
National target program on building new rural communes 2016-2020	Decision No. 1600 / QD-48 TTg	The objective is to ensure environmental sanitation, remediation, pollution treatment and environmental improvement in rural areas
National set of criteria for new rural communes 2016-2020	Decision No. 1980 / QD-TTg dated October 17, 2016	The 19 criteria components include element for environment and food safety
Adjustment of the Orientation for Development of Urban and Industrial Water Drainage in Vietnam to 2025 with a vision to 2050.	Decision No. 589 / QD-TTg dated April 6, 2016	
Mineral resources		
Strategic orientation for minerals and development of the mining industry to 2020, with a vision to 2030	Resolution No. 02-NQ / TW April 25, 2011 of The Central Party	
Mineral strategy to 2020, vision to 2030	Decision No. 2427 / QD-TTg December 22, 2011 of The Prime Minister	
Planning on basic geological surveys of minerals to 2020, with an orientation to 2030	Decision No. 1388 / QD-TTg, dated August 13, 2013 of The Prime Minister	
Marine and island resources		
Fisheries development strategy of Vietnam to 2020	Decision No. 1690 / QD-TTg dated September 16, 2010 of The Prime Minister	
Strategy for sustainable exploitation and use of marine resources and environmental protection to 2020, with a vision to 2030	Decision No. 1570/ QD-TTg in 2013 of The Prime Minister	The goal of the strategy is "to better understand the sea, its potentials, advantages, and adverse impacts from the sea; promote the exploitation and use of marine natural resources in a sustainable direction; preserve environmental quality of

Policies	Number of the document	Notes
		sea water; and maintain the ecological functions and biological productivity of marine ecosystems"
Strategy for integrated coastal management of Vietnam to 2020, vision to 2030	Decision No. 2295 / QD-TTg dated December 17, 2014 of The Prime Minister	The objective is "Exploiting and rationally using marine natural resources and protecting the coastal environment of Vietnam"
National Action Plan to prevent, reduce and eliminate illegal, unreported and unregulated fishing until 2025.	Decision No. 78 / QD-TTg dated January 16, 2018 of The Prime Minister	
Planning on the system of marine protected areas in Vietnam to 2020	Decision No. 742 / QD-TTG 2010	The objectives is "By 2015, at least 0.24% of Vietnam's marine area is marine protected areas and about 30% of marine protected area's area is strictly protected"
Forest resources		
National Strategy for Forestry development in Vietnam for the period 2006 - 2020	Decision 18/2007 / QD-TTg	The targets to 2020 are: i) "To establish, manage, protect, develop and use sustainably 16.24 million ha of land planned for forestry; and ii) to increase the percentage of forested land to 42-43% by 2010 and 47% by 2020. This strategy is under revision for the new period 2021-2030
National Strategy on Biodiversity to 2020, Vision to 2030	Decision No. 1250 / QD-TTg dated July 31, 2013	The targets are "i) The area of terrestrial nature reserves reaches 9% of the territory, ii) the area of marine conservation areas reaches 0.24% of the area of the sea; iii) forest coverage reaches 45%; iv) primary forest remains at 0.57 million ha; v) 15% of important degraded natural ecosystems are restored; vi) the number of nature reserves of Vietnam recognized internationally are 10 Ramsar zones, 10 biosphere reserves and 10 ASEAN heritage gardens
Strategy for management of special-use forests, marine protected areas and inland water conservation zones of Vietnam to 2020, with a vision to 2030.	Decision No. 218 / QD-TTg dated February 7, 2014	

Policies	Number of the document	Notes
Project on protecting and developing coastal forests in response to climate change 2014-2020	Decision No. 120 / QD-TTg dated January 22, 2015	The objective is to protect coastal forests to respond to climate change and sea level rise, mitigate natural disasters, protect the system of sea dikes, infrastructure and conserve biodiversity
Vietnamese policies on environmental protection		
National Strategy for environmental protection until 2020, vision to 2030	Decision No. 1216/ QD-TTg Dated September 5th, 2012 of the Prime Minister	
National Strategy on Biodiversity to 2020, Vision to 2030	Decision No. 1250/ QD-TTg dated July 31, 2013	
National Action Plan for Air Quality Management to 2020, Vision 2025	Decision 985a/QD-TTg dated June 1, 2016	
Planning for the national natural resources and environment monitoring network 2016 - 2025, with a vision to 2030	Decision No. 90/QD-TTg dated 12/01/2016	
National Program to ensure a safe water supply 2016-2025	Decision 1566/QD-TTg dated August 9, 2016 of the Prime Minister	
National Strategy for integrated solid waste management to 2025, vision to 2050 (Amendment)	Decision No. 491/ QD-TTg dated May 7, 2018	
National action plan for marine plastic waste management until 2030	Decision No. 1746/ QD-TTg dated December 4, 2019 of the Prime Minister	
Roadmap for application of emission standards to imported cars and used cars.	Decision No. 16/2019/QD-TTg of the Prime Minister	
Vietnamese policies on climate change.		
National strategy on climate change and action plan to implement the strategy	Decision No. 2139/QD-TTg dated December 5, 2011 of the Prime Minister	Objectives: i) By 2015, to complete the building of the climate change and sea level rise monitoring system; ii) By 2020, to develop a hydro-meteorological observation network with a station density equivalent to that of developed countries and to automate over 90% of the number of stations; iii) to

Policies	Number of the document	Notes
		increase the storm forecast period, iv) to improve the quality of forests, afforestation, greening bare land and bare hills
Regulation on the management of import, export and temporary import - re-export of ozone depleting substances in accordance with the Montreal Protocol on ozone depleting substances	Joint Circular No. 47/2011/ TTLT-BCT-BTNMT dated December 30, 2011	
National Target Program to Respond to Climate Change in the 2012-2015 period	Decision No. 1138 / QD-TTg dated August 30, 2012 of the Prime Minister	
National strategy for green growth	Decision No. 1393 / QD-TTg dated September 25, 2012 of the Prime Minister	
National action plan on climate change for the period 2012-2020	Decision No. 1474 / QD-TTg dated October 5, 2012 of the Prime Minister	
Plan to implement Paris agreement on climate change	Decision No: 2053 / QD-TTg dated October 28, 2016 of the Prime Minister	
National Target Program to Respond to Climate Change and Green Growth for the 2016-2020 period	Decision No. 1670 / QD-TTg dated October 31, 2017 of the Prime Minister	
Vietnam's Renewable Energy Development Strategy to 2030, with a Vision to 2050	Decision No. 2068 / QD-TTg dated November 25, 2015 of the Prime Minister	
Vietnam Green Growth Urban Development Plan to 2030.	Decision No. 84 / QD-TTg dated January 19, 2018 of the Prime Minister	
Mechanism to encourage development of solar power projects in Vietnam.	Decision No. 02/2019 / QD-TTg dated January 8, 2019 of the Prime Minister	

Appendix 2. Overview of Vietnam's environmental indicators

Source: Synthesized by the authors, 2020.

Indicator type numbering corresponds to the indicator decision hierarchy: 1. Same indicator and standard as in the EU ESGAP framework, 2. Proxy state indicator supported by a science-based standard, 3. Proxy state indicator supported by an alternative non-science-based standard, and 4. Proxy pressure indicator supported by an upper (and perhaps lower) reference value(s).

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
Forest (Forest utilization rate)	Forest coverage (change)	Official National Accounting Indicators			x		43% by 2030 (Vietnam's policy goal)	Total: 12 Freq. of dissemination: Annual Timeliness: 2019 Time coverage :2016- 2019 Temporal comparability: all years	
	New planted forest area	Official National Accounting Indicators					NA		
	Total forest area	Official National Accounting Indicators					NA		
	Protected forest (special-use forests and protection forests)	Official National Accounting Indicators					NA		
	Rich forest area: (volume of standing trees ranges from 201-300 m3/ha)	Results of Forest Inventory			x		NA	Total: 7 Freq. of dissemination: 10 years Timeliness: 2016 Time coverage:2016	

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
								Temporal comparability: 1 year	
	Poor and exhausted forest area (volume of standing tree ranges from 10 to 100 m³/ha	Results of Forest Inventory			x		NA		
	Forest area lost18 - Illegal logging. - Fire. - Illegal deforestation & encroachment. - Other reasons	Statistical Indicators of the sector of Agricultural and Rural Development (Decision 3201/ QD/BNN-KH dated November 26, 2010 of the Ministry of Agriculture and Rural Development)			x		NA		Must collect data from provinces
Fish (Fish stocks within safe biological limits)	Fishery production (capture)	General Statistics Office		x			NA	Total: 12 Freq. of dissemination: Annual Timeliness: 2019 Time coverage:2015,2019 Temporal comparability: all years	

[18] Circular 12/2019 / TT-BNNPTNT providing for forestry sector statistics

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	Fish stock							Total: 0 Not available	
	VSDG 14.4.3 Proportion of fishing output on reserves of coastal aquatic resources in Vietnam	Report from 2025		x				Total: 0 Not available till 2025	
	VSDG 14.4.1 Proportion of fish stocks within safe biological limits (Vietnam's SDG 14.4.1)	Report from 2025	x				NA	Total: 0 Not available till 2025	
Surface Water resources (Surface water bodies under water stress)	Total amount of surface water in major river basins	Circular No. 02/2014 / TT-BTNMT dated 22 January 2014 of the Minister of Natural Resources and Environment regulating the reporting of statistics of the natural resources and environment sector Indicator 0203/ BTNMT		X (Total amount of water abstraction/ Total amount of freshwater of main river basin)			OECD standard: 20%	Total: 11 Freq. of dissemination: Annual Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	* Having data on 9 major river basins: 2019; 2020 * The data just includes licensed withdrawn water.
	Total volume of exploitation of	Circular No. 02/2014 / TT-BTNMT							

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	water resources, discharge of wastewater into water sources has been licensed in the main river basins	Indicator 0206/BTNM							
	Vietnam SDG 6.4.1: The proportion of large reservoirs is controlled and monitored to ensure a minimum flow of the river basin is maintained	Official document number: 721/TNNQG-KHCN&HTQT dated November, 11th 2020 on Report on the implementation of the sustainable development goals				x	Vietnam's Government has set milestones for this target is: To 2020:70%; 2025:85%; 2030: 90%	Total: 10 Freq. of dissemination: Annual Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	Having report 2020 is 90%
	Total change in surface water level in major river basins	Circular No. 02/2014 / TT-BTNMT Indicator 0205/BTNM		x			NA	Total: 8 Freq. of dissemination: Every 5 year Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	Water Exploitation Index (WEI)	2030 Water Resources Group (2017)		x			OECD (2015) suggested that the total annual average demand of a river basin (or a sub basin) compare with annual average water available <10% is not under water stress	Total: 6 Freq. of dissemination: a reseach Timeliness: 2019 Time coverage: 2019 Temporal comparability: Not comparability	
Groundwater resource (Groundwater bodies in good quantitative status) *Propose to cancel this topic*	Total natural area is assessed on groundwater resource	Circular No. 02/2014 / TT-BTNMT Indicator 1201/BTNMT				x	NA	Total: 8 Freq. of dissemination: annually Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	Survey to Vietnam Environment Administration to collect the data
	Groundwater level	Circular No. 02/2014 / TT-BTNMT Indicator 0202.1/BTNMT		x			NA	Total: 10 Freq. of dissemination: annually Timeliness: 2019 Time coverage: 2016,2018,2019 Temporal comparability: all years	
	Change in groundwater level	Circular No. 02/2014 / TT-BTNMT Indicator 0204/BTNMT		X			NA		
Soil	Land area being eroded	Circular No. 02/2014 / TT-BTNMT	X				Same as EU standard < 1 t/ha/y	Total: 8	Having data of 51/63 provinces

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
(Area with tolerable soil erosion)		Indicator 0109.2/BTNMT,						Freq. of dissemination: Every 5 years Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	
	Vietnam SDG 15.3.1: Propotion of degraded land over total natural land area	Circular No. 02/2014 / TT-BTNMT Indicator 0109.2/BTNMT,	X				Vietnam's standard of degraded land	Total: 6 Freq. of dissemination: Every 5 years Timeliness: 2016 Time coverage: 2016 Temporal comparability: all years	Having data 2016 of all 63 provinces
Greenhouse Gas (- Per-capita GHG/CO2 emissions & - Per-capita consumption of ozone depleting substances)	Greenhouse gas emissions	National Statistical Indicators - Circular No. 02/2014 / TT-BTNMT Indicator 0512/BTNMT	x				The IPCC estimate will deliver 1.5-2 degrees. The gp_{max} shows the per-capita CO2 emissions consistent with meeting the 1.5°C target with 67% of possibilities. The gp_{min} is consistent with meeting the 2°C target with 33% of possibilities.	Total: 8 Freq. of dissemination: Every 2 years Timeliness: 2014 Time coverage: 2005, 2010, 2014 Temporal comparability: all years	The implementation of the commitment starts from 2020 therefore we donot have data to assess the implementation of this commitment
	VSDG 11.6.4 Per-capita GHG emissions	National report on implementation of VSDG 2020		x					

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	Amount of consumption of HCFCs [19]				x		Control limits for countries' HCFCs emission in Montreal Protocol		
	Sea level	Circular No. 73/2017 / TT-BTNMT promulgating the system of statistical indicators for natural resources and environment sector					NA		
	Average sea level change						NA		
	Average temperature change						NA		
	Ultraviolet radiation intensity						NA		
	National GHG emissions reduction compared to the normal scenario (%)	Decision 3756/QĐ-BTNMT			x		Commitment of Vietnam in Paris Agreement: 9% reduction of total GHG by 2030	Total: 8 Freq. of dissemination: Every 2 years Timeliness: 2014 Time coverage: 2005,2010, 2014 Temporal comparability: all years	
Ozone pollution (cropland and forested area not exposed to	Ground ozone level	Circular No. 02/2014 / TT-BTNMT Indicator 0401.1/BTNMT						Total: 0 Not available	Not monitored for forest & croplands

[19] Decision No. 1888 / QD-BTNMT approving Document and Investment Decision of Vietnam's Phase II HCFCs Elimination Management Plan

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
critical levels of ozone) *Propose to cancel this topic*									
Heavy metal pollution	Mercury emission	National Inventory of Mercury[20] Decision 1811 / QD-TTg October 4, 2013 on the signing of the Minamata Convention on Mercury	Yes (Total mercury emissions (Kg Hg/n)				Use EU standard: 0 emission	Total: 3 Freq. of dissemination: Not disseminated regularly Timeliness: 2014 Time coverage: 2014 Temporal comparability: Not comparable	
Ecosystems not exceeding the critical loads of eutrophication	Content of substances in surface water	Circular No. 02/2014 / TT-BTNMT Indicator 0403.1/BTNMT,	X (Proportion of monitoring points showing that surface water quality meets the technical standards for the parameters				Use Vietnam's national technical standard on surface water quality QCVN 08-MT:2015/BTNMT	Total: 12 Freq. of dissemination: Annually Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	* Having data of mornitoring stations of 9 main river basins. Vietnam currently has 4 different surface water standards for 4 different water uses

[20] Vietnam Chemicals Agency, UNIDO (2015) Minamata Initial Assessment in Vietnam: National Inventory of Mercury.

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
			of pollution of N-NO_3^-, N-NH_4^+ -)						
	Concentration of substances in coastal marine water	Circular No. 02/2014 / TT-BTNMT Indicator 0404.1/BTNMT,	X (Proportion of monitoring points showing that coastal water quality meets the technical standards for the parameters of pollution of N-NO_3^-, P-PO_4^{3-})				Vietnam's national technical standard on coastal water quality QCVN 10-MT:2015/BTNMT	Total: 12 Freq. of dissemination: Annually Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	Having data of monitoring stations of 15/28 coastal provinces
	Vietnam SDG 14.1.2: Proportion of monitoring points showing that coastal seawater quality meets the national technical	Report 3987 / TCMT-VPTC dated December 10, 2020 of Vietnam Environment Administration on the implementation of sustainable development goals according to		X			used QCVN 10-MT:2015/BTNMT Vietnam's Government has set milestones for this target is: To 2020:100% sites; 2025:100% 2030: 100%	Total: 8 Freq. of dissemination: Monthly Timeliness: 8-9/2019 Time coverage: 2019 Temporal comparability: Not comparable	Having only data of monitoring stations of 5/28 coastal provinces in the country Data from report of 8-9/2020

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	standards for the parameters of pollution of organic matter (N-NH4+) (%); - Total grease (%)	Decision 3756 / QD-BTNMT							
Surface water pollution (Surface water bodies in good chemical status)	Content of substances in surface water	Circular No. 02/2014 / TT-BTNMT Indicator 0403.1/BTNMT,	X (Proportion of surface water monitoring points in major river basins meet the technical standards of surface water quality)				Vietnam's national technical standard on surface water quality QCVN 08-MT:2015/BTNMT	Total: 12 Freq. of dissemination: Annually Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	* Having only data of 06 parameters DO; COD; BOD5; N-NO3-; N-NH4+; And Lead)
Ground water pollution (Groundwater bodies in good chemical status) *Propose to cancel this topic*	Characteristics of physical properties and concentration of substances of groundwater r	Circular No. 02/2014 / TT-BTNMT Indicator 0202.3/BTNMT	X (Proportion of groundwater monitoring points having characteristics of physical properties				Use Vietnam's national technical standard on groundwater QCVN 09-MT:2015/BTNMT	Total: 12 Freq. of dissemination: Annually Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	* Data collected from 668 monitoring points collecting under 02 seasons (dry season and rainy season) * only having data of the parameters: Fe(mg/l); NH4+ (mg/l); Cl- (mg/l); SO4 (mg/l); NO2

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
			and concentration of substances meet the technical standards)						(mg/l); NO3 (mg/l); Total hardness (mg/l); pH; TDS 105 (mg/l)
	Concentration of substances in groundwater (N-NH4++, N-NO3-, coliform, heavy metals (As, Cu, Fe, Mn, Hg, Pb)	Circular No. 02/2014 / TT-BTNMT Indicator 0403.2/BTNMT	X (Proportion of groundwater monitoring points having concentration of substances meet the technical standards for parameters of (N-NH4++, N-NO3-, heavy metals (As, Cu, Fe, Mn, Hg, Pb)				Use Vietnam's national technical standard on groundwater QCVN 09-MT:2015/BTNMT	Total: 0 Having data of only 2 provinces Hà Giang, Vĩnh Phúc.	
Marine pollution	Concentration of substances in coastal marine water	Circular No. 02/2014 / TT-BTNMT Indicator 0404.1/BTNMT,	X (The proportion of coastal				Use Vietnam's national technical standard	Total: 12 Freq. of dissemination: Annually	* Having data of monitoring stations of 15/28 coastal provinces

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
			water bodies with coastal water quality exceeding the technical standards)				on coastal water quality QCVN 10-MT:2015/BTNMT	Timeliness: 2019 Time coverage: 2018,2019 Temporal comparability: all years	* Having data of parameters TSS; DO; $P\text{-}PO_4^{3-}$; $N\text{-}NH^{4+}$; Pb; Cadimi; Fe; Xyanua (CN-).
Acidification Propose to cancel this topic	Monitor acid deposition (dry and wet) in air environment	Circular No. 02/2014 / TT-BTNMT Indicator 0511/BTNMT					NA	Total: 0 Having data 2014, 2016, 2017 of 4-5 provinces. Does not have all data for 52 reporting periods	Not enough data, method and standard to calculate the indicators.
Biodiversity in terrestrial ecosystems (- Terrestrial area with acceptable biodiversity levels)	Vietnam SDG 14.1: Proportion of Terrestrial protected areas (per total natural inland areas)	Circular No. 02/2014 / TT-BTNMT Indicator 0406/BTNMT					NA	Total: 10 Freq. of dissemination: Every 5 years Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	
	Natural forest area	Official National Accounting Indicators			X (Ratio of natural forest over the total forest area)		NA	Total: 12 Freq. of dissemination: Annual Timeliness: 2019 Time coverage:2016,2019	

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
								Temporal comparability: all years	
	Rich forest area: (volume of standing trees ranges from 201-300 m3/ha)	Results of Forest Inventory [21]			X (Ratio of rich forest over the total forest area)		NA	Total: 7 Freq. of dissemination: 10 years Timeliness: 2016 Time coverage:2016 Temporal comparability: 1 year	
	Poor and exhausted forest area (volume of standing tree ranges from 10 to 100 m^3/ha				X (Ratio of poor and exhausted forest over the total forest area) poor		NA		
Biodiversity in freshwater ecosystems	VSDG the number of Ramsar sites established	Decision 681 / QD-TTg dated June, 4th2019 on the Roadmap for the realization of Vietnam's sustainable development goals up to 2030				x	Vietnam's Government has set milestones for this target is: To 2020:10 sites; 2025:13; 2030: 15	Total: 12 Freq. of dissemination: annually Timeliness: 2020 Time coverage:205-2020 Temporal comparability: all year	

[21] Decision 1157/QD-BNN-TCLN dated 26 May 2014 of the MARD Minister on approval of the survey, inventory and profile of forest management 2013-2016.

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
Biodiversity in marine ecosystems Propose to cancel this topic	VSDG 14.5.1: the ratio of marine protected areas to total marine areas	Decision 681 / QD-TTg dated June, 4th2019				x	Vietnam's Government has set milestones for this target is: To 2020:0,24%; 2025:13; 2030: 15	Total: 10 Freq. of dissemination: Every 5 years Timeliness: 2019 Time coverage: 2019 Temporal comparability: all years	2020: 0,134%
Outdoor air pollution (Population exposed to safe levels of particulate matter lower than 2.5/10 micrometers or less in diameter)	Vietnam SDG 11.6.3 Concentration of substances in the air environment (in main Cities)	Circular No. 02/2014 / TT-BTNMT Indicator 0401.1/BTNMT, 0401.2/BTNMT	X (The proportion of air quality monitoring points in big cities having air quality meeting and exceeding the technical standards)				Vietnam's national technical standard QCVN 05:2013/BTNMT	Total: 0 Data is not reliable Having data only a few monitoring points in Bac Ninh, Hanoi, Hai Duong have sampled and analyzed PM10 in the laboratory	
Indoor air pollution	Proportion of population using clean fuels for cooking	The 2019 Population and Housing Census (pg. 314)[22]	X				NA	Total: 5 Freq. of dissemination: Every 10 years Timeliness: 2019 Time coverage: 2019	

[22] http://tongdieutradanso.vn/uploads/data/6/files/files/2_%20Bieu%20so%20lieu%20va%20phu%20luc%20(duyet%20gui%20in).pdf

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
								Temporal comparability: Not comparable	
Drinking water (Samples that meet the drinking water criteria)	Vietnam's SDG indicator 6.1.1: Proportion of urban population provided with drinking water through the centralized water supply system (*)	National Statistical Indicators [23]				x	TCVN: (*) Clean water means tap water produced and supplied to people by factories producing tap water, meeting the standards set by the Ministry of Health	Total: 12 Freq. of dissemination: Annually Timeliness: 2019 Time coverage: 2015-2019 Temporal comparability: all Year	Having only data of urban population
	Proportion of population (urban and rural) provided with drinking water through the centralized water supply system				x			Total: 5 Freq. of dissemination: Every 10 years Timeliness: 2019 Time coverage: 2019 Temporal comparability: Not comparable	
	the Proportion of clean water plants having water quality meeting technical standard of			x				Total: 12 Freq. of dissemination: Annually Timeliness: 2018, 2019 Time coverage: 2019	

[23] https://www.gso.gov.vn/px-web-2/?pxid=V1149&theme=Y%20t%E1%BA%BF%2C%20v%C4%83n%20h%C3%B3a%20v%C3%A0%20C4%91%E1%BB%9Di%20s%E1%BB%91ng

Topic and EU's indicator	Vietnam indicators	References	1. Same as EU indicator	2. Proxy state indicator with science-based standards	3. Proxy state indicator with alternative reference point (non-science based)	4. Proxy pressure indicator with upper reference point	Standard to be used	Data availability' score	Note
	drinking water quality							Temporal comparability: all Year	
Recreational water (Recreational water bodies that meet the 'excellent' quality criteria-)	Proportion of monitoring points showing that coastal water quality meets the technical standards for the parameters of total coliform and E. coli	Circular No. 02/2014 / TT-BTNMT Indicator 0404.1/BTNMT,		X			QCVN 10-MT:2015/BTNMT Coliform: 1000 CFU/100ml (for swimming)	Total: 0 Data is not reliable Having data of only 2 provinces	Having data of only 2 provinces
Natural world heritage sites (Natural and mixed world heritage sites that have a good conservation outlook	Natural and mixed world heritage sites that have a good conservation outlook	+ UNESCO + Boards of management of National Park Phong Nha-Ke Bang, Ha Long Bay and Trang An Cultural and Natural Heritage	x				EU standard	Total: 10 Freq. of dissemination: Every four years Timeliness: 2019 Time coverage: 2015, 2019 Temporal comparability: all years	Available at UNESCO websites

Appendix 3. Detailed descriptions of indicators and data sources

1. Forest Resources

ESGAP Indicator: Forest resources

Vietnam's ESGAP indicator: Forest coverage

Range0 to 100

Unit %

Description Forest cover is the percentage of forest area to total natural land area; Forest area is calculated for forest coverage when the forest has a continuous area of over 0.3 ha and has a forest canopy cover of more than 10%.

Data provider: GSO

Data Source https://www.gso.gov.vn/

Time (to and t) 2016 - 2019

Standard: Policy-based environmental standard(s): "Vietnam's National Action Plan of implementation of Sustainable Development Goals (Decision No. 681/QĐ-TTg dated June 4, 2019) Target 15.2.2: Forest cover to 2030 is 43%

Normalisation bounds: 0 = 0%; 100 = 43%

2. Fish resources

ESGAP indicator: Fish stocks within safe biological limits

Vietnam indicator: Fish stocks exploited within Total Allowable Catch

Range: 0-100

Unit: %

Description: This indicator calculates the percentage of fish stocks of Vietnam exploited within total Allowable Catch

Data provider: General Statistics Office of Vietnam

Data source: Statistical yearbook of Vietnam 2019: indicator the production of sea fish caught by locality

Available at https://www.gso.gov.vn/

Standard: The total allowable catch (TAC) using to identify the acceptable level of exploiting fish stock for Vietnam was indicated by FAO (1997).

Available at http://www.fao.org/fi/oldsite/FCP/en/vnm/profile.htm

Normalisation bounds:

0=0%; 100 = 100%

Note: The TAC divided for 4 main sea regions in Vietnam including Tonkin Gulf, Central region, South Eastern and South Western.

3. Surface water resources

ESGAP indicator: Freshwater bodies not under water stress

Vietnam proposed indicator: Proportion of main river basin under water stress as measured by the Water Exploitation Index (WEI)

Range: 0 - 100

Unit: %

Description:

Data provider: Worldbank

Data source: Worldbank report

2030 WRG (World Bank)

Time (to and t): Dry season 2016

Standard: WEI ≥ 20% (OECD)

Normalisation bounds: 0=0%; 100 = 100%

4. Soil resources

EU indicator: Area with tolerable soil erosion

Vietnam proposed indicator: Percentage of area with tolerable soil erosion

Range: 0-100

Unit: %

Description: % area of the soil with no erosion to the total national natural land area

Data provider: General Department of Land Administration, MONRE

Data source: Circular No. 02/2014/TT-BTNMT dated 22 January 2014 of the Minister of Natural Resources and Environment regulating the reporting of statistics of the natural resources and environment sector: Indicator 0202.3

Available at: http://thongke.monre.gov.vn/ds-cong-bo.html

Time (to and t): 2016

Science-based standard: Soil erosion in Vietnam is classified according to TCVN 5299:2009 on Soil quality – Method for determination of soil erosion by rain.

Class	Erosion rate	Assessment

I	Up to 1	No erosion
II	1 to 5	Weak erosion
III	5 to 10	Moderate erosion
IV	10 to 50	Severe erosion
V	>50	Very severe erosion

Normalisation bound: 0=0%, 100 = 100%

5. Greenhouse gas

ESGAP indicator: Per-capita CO2 emissions

Vietnam indicator: per capita CO2 emission

Range: 0 - +∞

Unit: tonnes

Description:

Data provider: Vietnam Environment Administration

Data source:

The data gathered from various sources as follows:

2010	http://thongke.monre.gov.vn/ds-cong-bo.html
2013	The second biennial-updated-report-of-vietnam-to-the-united-nations-framework-convention-on-climate change (BUR 2)
2014	National communication of Vietnam - The Third to the United Nations Framework Convention on Climate change

Time (to and t): 2010;2013;2014

Science-based standard: The IPCC estimate will deliver 1.5-2 degrees. The gp_{max} value shows the per-capita CO2 emissions consistent with meeting the 1.5°C target with 67% of possibilities. The gp_{min} value is consistent with meeting the 2°C target with 33% of possibilities. Emissions have been allocated on an equal-per-capita basis.

Normalisation bounds: 100 = 0.5 tonnes per capita; 0 = 2.5 tonnes per capita

6. Stratospheric ozone depleting substances

EU indicator: Stratospheric ozone depleting substances

Vietnam proposed indicator: Consumption of HCFCs

Range: 0 - +∞

Unit: Tonnes ODP

Description: Consumption/annual allowance

Data provider: Ozone secretariat, UN Environment Programme

Data source: Ozone secretariat, UN Environment Programme, 2020. Country profiles: Vietnam. https://ozone.unep.org/countries/profile/vnm Date of Access: 25/12/2020

Time (to and t): 2014-2019

Policy-based environmental standard(s): The Montreal Protocol limits the per capita consumption of controlled ozone depleting substances by its signatories.

Year	Control limit
2014	330.5
2015	199.1
2016	199.1
2017	199.1
2018	199.1
2019	199.1

Normalisation bounds: 100 = 0; 0 = control limits

7. Mercury emission

ESGAP: Ecosystems not exceeding the critical loads of cadmium / lead / mercury

Vietnam proposed indicator: Per capita Mercury emission

Range: 0 - ~

Unit: Kg

Description: Consumption/annual allowance

Data provider: UNEP

Data source: available at https://www.unenvironment.org/explore-topics/chemicals-waste/what-we-do/mercury/global-mercury-assessment

Time (to and t): 2018

Science-based environmental standard(s): zero emission

Normalisation bounds: 0=2.5 percentile of countries in the world; 100 = 0 kg per capita

8. Surface water pollution

Vietnam's ESGAP indicator: Proportion of surface water monitoring points in major river basins meet the technical standard of surface water quality

Range: 0 – 100

Unit: %

Description: The percentage of monitoring stations in 9 main river basins of Vietnam showing that annual average surface water quality meeting the technical standard for 05 parameters; COD; BOD_5; N-NO3-; N-NH4+; And Lead

Data provider: the Vietnam Environment Administration.

Data source: Circular No. 02/2014 / TT-BTNMT dated 22 January 2014 of the Minister of Natural Resources and Environment regulating the reporting of statistics of the natural resources and environment sector: Indicator 0403.1

Available at: http://thongke.monre.gov.vn/ds-cong-bo.html

Time (to and t): 2018; 2019

Science-based environmental standard(s): Vietnam's national technical standard on coastal water quality QCVN 08-MT:2015/BTNMT as following

Threshold:	A1	A2	B1	B2
COD	10	15	30	50
BOD5	4	6	15	25
$N\text{-}NO_3^-$	2	5	10	15
$N\text{-}NH_4^+$	0.3	0.3	0.9	0.9
Lead	0.02	0.02	0.05	0.05

This study used the A1 standard: surface water use for domestic water supply purposes (after applying normal treatment), conservation of aquatic flora and fauna and other purposes.

Normalisation bounds: 0=0%, 100 = 100%

Note: The monitoring stations which have all 05 monitored parameters meeting the standards are evaluated as not being polluted

9. Coastal water pollution

Vietnam's ESGAP indicator: Proportion of monitoring points showing that coastal water quality meets the technical standards

Range: 0 -100

Unit: %

Description: the percentage of coastal water quality monitoring stations in Vietnam (less than 5.5 km from the coast) which show an annual average of coastal water quality that

meet the technical standards for the parameters TSS; DO; $P\text{-}PO_4^{3-}$; $N\text{-}NH^{4+}$; Pb; Cadimi; Fe; Xyanua (CN-).

Data provider: the Vietnam Environment Administration

Data source: Circular No. 02/2014 / TT-BTNMT dated 22 January 2014 of the Minister of Natural Resources and Environment regulating the reporting of statistics of the natural resources and environment sector: Indicator 0404.1

Available at: http://thongke.monre.gov.vn/ds-cong-bo.html

Time (to and t): 2018; 2019

Science-based environmental standard(s): Vietnam's national technical standard on coastal water quality QCVN 10-MT:2015/BTNMT as following:

Thresold: for water quality at coastal areas (<5.5 km2)	The areas of farming, aquatic conservation, conservation of aquatic flora and fauna	The area of coastal beach, water sport	Other areas
TSS	50	50	-
DO	>=5	>=4	
$P\text{-}PO_4^{3-}$	0.2	0.3	0.5
$N\text{-}NH_4^{+}$	0.1	0.5	0.5
Pb	0.05	0.05	0.1
Cadimi	0.005	0.005	0.01
Fe	0.5	0.5	0.5
Xyanua (CN-)	0.01	0.01	0.01

The study used standards for coastal water in the areas of farming, aquatic conservation, conservation of aquatic flora and fauna.

Normalisation bounds: 0=0%, 100 = 100%

Note: The monitoring points with all 08 of these parameters meeting the Vietnamese technical standards are evaluated as non-polluted water quality.

10. Ground water pollution

Vietnam's ESGAP indicator: Proportion of monitoring points showing that ground water quality meets the technical standards

Range: 0 -100

Unit: %

Description: the percentage of groundwater monitoring stations in Vietnam showing the annual average of groundwater quality meeting the technical standards for the parameters: Fe(mg/l); NH_4^+ (mg/l); Cl^- (mg/l); SO_4 (mg/l); NO_2 (mg/l); NO_3 (mg/l); Total hardness (mg/l); pH; TDS 105 (mg/l)

Data provider: National Center for Water Planning and Investigation

Data source: Circular No. 02/2014 / TT-BTNMT dated 22 January 2014 of the Minister of Natural Resources and Environment regulating the reporting of statistics of the natural resources and environment sector: Indicator 0202.3

Available at: http://thongke.monre.gov.vn/ds-cong-bo.html

Time (to and t): 2018; 2019

Science-based environmental standard(s): Vietnam's national technical standard on groundwater quality QCVN 09-MT:2015/BTNMT as follows

Threshold: for ground water quality	
Fe(mg/l)	5
NH4+ (mg/l)	1
Cl- (mg/l)	250
SO4 (mg/l)	400
NO2 (mg/l)	1
NO3 (mg/l)	15
Total of the hardness (mg/l)	500
PH	5.5-8.5
TDS 105 (mg/l)	1500
Permanganate indicator (mg/l)	4

Normalisation bounds: 0=0%, 100 = 100%

Note: The monitoring points with all of these parameters meeting the Vietnamese technical standards are evaluated as non-polluted groundwater quality.

11. Outdoor air pollution

Vietnam's ESGAP indicator: Population exposed to safe levels of PM2.5

Range: 0 – 100

Unit: %

Description: Percentage of Vietnam's population exposed to PM2.5 levels (%)

Time (to and t): 2010-2017

Data provider: WHO

Data source Brauer, M. et al. 2017, for the Global Burden of Disease Study 2017. Available at https://data.worldbank.org/indicator/EN.ATM.PM25.MC.ZS

Standard: WHO air quality guidelines and interim targets for particulate matter: annual mean concentrations

	PM2.5(μg/m^3)	Basis for the selected level
Interim target-1 (IT-1)	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level
Interim target-2 (IT-2)	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to the IT-1 level.
Interim target-3 (IT-3)	15	In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2-11%] relative to the -IT-2 level.
Air quality guideline (AQG)	10	These are the lowest levels at which total, cardiopul-monary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to PM2.5

For this indicator, we propose to use the IT-2 as the threshold as the IT-2 is the most policy-relevant among the scientific target values produced by WHO.

12. Indoor air pollution

Vietnam's ESGAP indicator: Proportion of population using clean fuels for cooking

Range: 0 – 100

Unit: %

Description: the percentage of households using clean fuels for cooking.

Data provider: General Office Statistics

Data source: 2019 Population and Housing Census - Decision No. 772/QĐ-TTg dated June 26, 2018

Time (to and t): 2019

Standard: non-solid fuels used indoor

Normalisation bounds: 100 = 100%

Note: there are 4 types of fuel for cooking in Vietnam: Electricity; Gas/ Biogas; Coal, Wood of which Electricity and Gas/ Biogas is considered as clean fuel.

13. Drinking water

Vietnam's ESGAP indicator: Proportion of clean water plants having water quality meeting technical standard of drinking water quality

Range: 0 – 100%

Unit: %

Data provider: Department of Environmental Health Management, Ministry of Health

Data source:

Data source: REPORT on: Results of inspection and monitoring of household clean water quality and latrines in 2018, 2019

Time (to and t): 2018;2019

Standard: 100% inspected clean water plants having water sample meeting technical standard of drinking water quality

The quality of drinking water in Vietnam is specified in QCVN 01: 2009 / BYT National technical regulations on drinking water quality

Normalisation bounds: 0=0%, 100 = 100%

14. Natural world heritage sites

EU indicator: the proportion of natural and mixed world heritage sites in good conservation outlook

Vietnam's indicator: the proportion of natural and mixed world heritage sites in good conservation outlook

Range: 0 – 100

Unit: %

Description: The percentage of natural and mixed world heritage sites that meet creteria of good conservation outlook over the total of the country's natural and mixed world heritage sites

Data provider: IUCN
Data source: Osipova et al, 2017
Time (to and t): 2017
Standard: Good conservation outlook as IUCN Assessment
Normalisation bounds: 0=0%, 100 = 100%.

Appendix 4. Stakeholders workshop March 20201

Assessing the national environmental sustainability performance by applying The Environmental Sustainability Gap (ESGAP) for Vietnam

Time: 14.00-17.00, 19th March 2021

Venue: Online meeting

Participation

Chairman: Dr Nguyen Trung Thang – Deputy General Director, Institute of Strategy and Policy on Natural resources and Environment (ISPONRE)

Prof. Paul Ekins and Dr Alison Fairbrass- University College London (UCL)

Dr Alison Fairbrass – University College London (UCL) – ESGAP researcher and Post-doctoral scientist

Dr. Carolina Soto-Navarro – International Scientific Advisor (UNEP-WCMC)

Dr. Hoang Hong Hanh, MSc. Duong Thi Phuong Anh, MSc. Vu Thi Thanh Nga, MSc. Nguyen The Thong, Mr. Tran Quy Trung – ISPONRE's research team

Mr. Nguyen Quoc Dung, Forest Inventory and Planning Institute (FIPI), MARD

Ms. Cao Le Quyen- Vietnam Institute of Fishery Economics and Planning, MARD

Ms. Le Thi Mai Van – Department of Water Resources Management, MONRE

Mr. Nguyen Thanh Cong - Department of Climate Change, MONRE

Mr. Truong Manh Tuan - Vietnam Environment Administration, MONRE

Ms. Le Hoang Anh - Centre for Environmental Information and Data

Mr. Le Viet Thang, Chemical Department, Ministry of Industry and Trade

Mr. Nguyen Đinh Khuyen -Vietnam GSO

Mr. Pham Van Loi - Institute for Environment and Sustainable Development.

Ms. Nguyen Thanh Nga, Department of Science, Education, Natural Resources and Environment - Ministry of Planning and Investment

Mr. Vo Thanh Son, Central institute for Natural Resources and Environmental Studies, Hanoi National University

Mr. Hoang Bich Hop- PanNature Viet nam

Ms. Le Ha Thu- PanNature Viet nam

Ms. Vu Xuan Nguyet Hong – Environmental economics Expert

Mr. Nguyen Phong – Statistics Expert

Prof. Truong Quang Hoc- Environmental Expert

Mr. Nguyen Thanh Phuong – UNEP Vietnam

Asso. Prof. Nguyen Danh Son- Environmental Expert

Mr. Nguyen Song Ha- FAO Vietnam

Mr. Nguyen Thai Anh- FAO Vietnam

Mr. Pham Manh Hoai- WWF Vietnam

Mr. Do Van Tu- Institute of Ecosystems and Ecological Resources

Mr Ho Huu Hung - Vietnam Environment Administration

Ms. Mac Thi Minh Tra - Vietnam Environment Administration

Workshop objective

The workshop aimed at i) Introduce the results of application of the ESGAP for Vietnam;

and ii) Collecting ideas to improve the results and implication of the ESGAP for Vietnam in the future

Content

Opening speech Dr Nguyen Trung Thang – Deputy General Director, Institute of Strategy and Policy on Natural resources and Environment (ISPONRE) introduces the objective and program of workshop; Prof. Paul Ekins, Dr Alison Fairbrass and Dr. Carolina Soto-Navarro, from University College London (UCL) and UN Environment Programme Wolrd Conservation Monitring Centre 9UNEP-WCMC), respectively, introduced the Environmental Sustainability Gap (ESGAP) framework and international experiences of application of ESGAP.

Ms. Vu Thanh Nga provided a presentation about the workplan for assessing the national environmental sustainability performance by applying the Environmental Sustainability Gap (ESGAP) for Vietnam.

Questions and discussion

1. Prof. Truong Quang Hoc – Environmental expert

- In my point of view the ESGAP framework are encouraging to internationalize their calculation methods and approaches so it is not easy to apply for Vietnam. I want to question that with such a methodology, should ESGAP indicator can be either localized or nationalized? I wonder whether ESGAP indicator set really suitable for Vietnam or not.

- Secondly, the total index contains 4 component indicators that reflect several areas with different levels of contribution, whether we apply weights to calculate the index. Currently, we are calculating the national climate resilience index and are applying weights to these indicators, as a result, this process are very effective and produces very interesting results.

- For the alternative indicators that the study proposed to apply to Vietnam, are these proposed indicators either international or just applied for Vietnam?

- The forest coverage indicator of Vietnam and the forest utilization indicator of ESGAP are completely different, it is better to develop a more compatible indicator for Vietnam.

2. Mr. Vo Thanh Son - Central institute for Natural Resources and Environmental Studies, Hanoi National University

- I appreciate the application of international approaches and methods to measure Vietnam's sustainability.

- I want to ask what basis does this study use to determine Gmin, Gmax; Scientific basis for calculating the standards of such indicators?

3. Ms. Vu Xuan Nguyet Hong - Environmental Economics Expert

I appreciate the team's efforts to calculate the results of the indicator set.

- For indicator 13, it is necessary to note the indicator on the proportion of the population using tap water for eating and drinking purposes. Currently, Vietnam has statistical indicators on the proportion of the population using hygienic water, including tap water and other types of clean water such as rain water, well water, etc. Thus, the typical proportion must be clearly distinguished between the population using clean water and the population using tap water. .

- The data year should be included in the report as the different time to collect data can produce different results

- After review a report, I do not clearly understand why Gmin value is greater than Gmax.

- I find it questionable that the data on greenhouse gas emissions mentioned in the report is quite high, compared with some international figures calculated for Vietnam.

4. Mr. Nguyen Trung Thang - ISPONRE

- The principle of the study is to try to apply as much as possible according to the conceptual framework and criteria proposed by the international research team. In case international indicators are not available and data are not available to calculate for Vietnam, then alternative indicators with scientific standards will be selected. Therefore, the indicators are highly scientific and can be completely applied to localize Vietnam. However, the problem is that the data source must be sufficient to evaluate and calculate ESGAP index.

- Currently, the index is applying an international approach in which environmental issues are assessed to be of equal importance, so there is no weight for each indicator.

- The forest coverage indicator was discussed from the previous workshop. However, due to data constraints related to Vietnam's forest use rate, we recommend using this indicator.

5. Ms. Vu Thi Thanh Nga - ISPONRE

- Regarding the indicator of forest cover, as we discussed in the previous workshop, Vietnam currently does not have complete data on forest use as in Europe. Currently, we only have data on the total logging output, but there is a lack of data on the amount lost due to illegal logging, fire, and felling. In addition, we only have the area of newly planted forest every year without the total wood biomass increase every year.

- Regarding the water use indicator of Vietnam, currently the statistical yearbook reports the indicators "*the proportion of the urban population provided with clean water through the centralized water supply system*" and "*The proportion of households using water sources hygienic*", however, since this study wants to assess the total population data providing with clean water supply through centralized water supply systems, so we use the annual census data source. In 2019, there are census results of the population provided with clean water through a centralized water supply system.

- Vietnam's data on GHG emissions are national report data provided by the Ministry of Natural Resources and Environment and are data on Vietnam's greenhouse gas inventory. When comparing with figures estimated by UNEP for countries, there may be discrepancies. For national calculation, the research team prioritizes the use of domestic data sources.

6. Prof. Truong Quang Hoc - Environmental Expert

- Does the study divide the evaluation interval with indicators? We should sort indicators score in sustainable level by low, medium and high.

- If assessing the environmental impact, does the study evaluate the threshold of environmental load and the tipping points for each assessment environmental problem?

7. Ms Vu Thi Thanh Nga - ISPONRE

- At present, although the study does not divide the assessment interval, the research takes 100 points equivalent to environmental sustainability. The gap from the identified score to maximum points (100) is defined as the distance to the sustainable environment.

- Under the ESGAP framework, each indicator must define the scientific standard at which the environment and resources are sustainably protected. This International Standard is mostly the load-bearing threshold of the environment in which the environment can neutralize waste without being altered. Hence, the threshold is usually much lower than the tipping point, in contrast, if the threshold is exceeded, the environmental structure can collapse. In our research, for the application to Vietnam, the standards used for the indicators are the national technical regulations on the quality of soil, water and air environments.

7. Dr. Vo Thanh Son

- In my opinion, the use of Vietnamese standards in the research is not really accurate. National standards often change over time and depend on the state of technological and economic development in each country. EU Standard is different from Vietnam, so there is a need to make a comparison.

- In terms of forest coverage indicators, I think we should not just use one indicator to replace the forest use indicator. About the theory of natural capital, the quantitative indicators can be multiplied by the quality indicators. For example, we have the rich, poor, average forest areas multiplied by the quality weight of each of these forest types.

8. Ms. Cao Le Quyen - Vietnam Institute of Fishery Economics and Planning, MARD

- In this study, the indicators of the protection of aquatic resources are evaluated very low. I appreciate the data sources used here, all of which are official data sources. However, the use of FAO assessment data in 1997 is quite different from the present time. According to our assessment, currently the most up-to-date data on allowable fishing limits for the whole country is only about 2.6

to 2.7 million (not officially announced). The catch of the whole country was at about 3.8 million tons and is still increasing every year. This result is also go to beyond the sustainability limit.

- To improve this indicator, I think that the research team should refer to the Circular No. 16 dated 28/12/2020 of the Ministry of Agriculture on the target of the catch (fishing) of aquatic products. The industry's goal is to reduce catching volume. If we achieve negative growth, it can be seen as success.

9. Mr. Nguyen Trung Thang - ISPONRE

- We try to collect the latest data sources, however, some indicators only have very limited data sources.

- For the fishery resource indicator, we use the FAO study (1997) on the allowable catch limit of Vietnam as the indicator standard. According to the current domestic assessments, Vietnam's fisheries resources are still in decline. Thus, the current allowable catch limit must be lower in comparison with data in 1997. Consequently, the study using the 1997 catch limit, which we have not yet to reach, demonstrates the fact that our problem of overfishing is more serious than currently assessed and will not soon be changed.

10. Mr Nguyen Quoc Dung - Forest Inventory and Planning Institute (FIPI), MARD

- Please reconsider Table 4. it is necessary to differentiate indicators and index

- For the indicator of forest resources: While the EU applies forest utilization, Vietnam proposes the forest coverage. At present, we have data for assessing annual net growth, it is important to consider what direction we aim for forest growth, the quality of either the forest or the economy?

- There are annual statistical indicators on economic growth in the forestry sector under Circular No. 12/2019/TT-BTNMT dated 25/10/2019 on statistical indicators of the Ministry of Agriculture and Rural Development. Regarding the current forest cover, we have targets for some types of forest such as coastal forest, rocky mountain forest, etc. (the indicator will be lower than FAO indicator). However, the forest coverage contains only area. In terms of volume, we have data on national forest resource monitoring with survey results on biomass.

- In terms of heavy metals, I see the EU indicator includes several different types of heavy metals, ISPONRE's team proposed indicator only concerned

mercury. In fact, Vietnam have sufficient ability to measure heavy metals. What is the reason why research only measure mercury?

- In terms of soil resource, the ESGAP indicator only cover soil erosion is insufficient. The mountainous area of Vietnam is quite large, with great erosion potential. We also need to mention other types of land such as agricultural land, aquaculture land. I suggest that research should consider replacing with criteria for soil degradation. Currently, Vietnam is participating in the convention to combat land degradation.

11. **Mr. Do Van Tu - Institute of Ecology and Biological Resources**

- I can see that the current method of data collection depends mainly on published data and statistics. However, in Vietnam, sometimes the data quality may not be guaranteed. To evaluate more convincing data sources, it is necessary to use data from scientific reports to be more convincing.

- Heavy metal pollution criteria: we should not use only mercury indicator; it may cause inaccurate results. Regarding the data, we can apply many other parameters being available and need to find more data for specific environmental problems.

- I think the conclusions of the research are very good and worthwhile, I wish the research team would develop, propose research's result to higher-level authorities.

12. Ms. Le Thi Mai Van – Department of Water Resources Management, MONRE

- I think the alternative indicators for Vietnam are quite appropriate. I agree with Prof. Truong Quong Hoc's opinion that we need to apply weights to indicators, even evaluate and weight for each ecological region to match with regional characteristics.

- I also wonder that within various parameters of water quality assessment, the study only considers a few parameters to specify each indicator. It should be considered, many parameters that are considered to have "sensitivity" in water quality for example for groundwater' parameters are arsenic, lead, cadmium concentration should be included in the calculation process?

- We should have a scientific basis for sustainable hierarchy level for each criterion.

13. Mr. Nguyen Phong – Statistics Expert

- This is a scientific research with high applicability, in order to be able to develop at a higher level, the study should allocate a chapter about the limitations of the data. I can clearly see the ratings and comments on the results of each indicator in the annex of the summary report. The study needs to separate the data section, data processing and data limitation, so that we can make recommendations about the data.

- Regarding the weight of the indicators, I think that there should be a composite index that should be included in the next stage.

14. Ms. Vu Thi Thanh Nga - ISPONRE

- Regarding water quality indicators, due to the limitation of data sources at some monitoring stations which only monitor some main parameters, many parameters do not have complete annual average data, so the research team prioritizes the parameters having the most sufficient data.

- Regarding the data collection timeline, we try to get the assessment data for 2019, but in case the data is not up-to-date for example of greenhouse gas emissions, we use the latest data source.

- Regarding scientific standards to calculate the criteria, we are currently using national technical regulations and standards. To explain whether these national standards are scientific, or develop based on political factors. We believe that the development of national technical regulations is scientific, with reference to international technical standards, assessment and selection in accordance with the scientific and technical level of Vietnam. All of standards are built and evaluated through state-level scientific councils.

- Regarding heavy metal pollution indicators, currently the assessment of heavy metal pollution has been assessed through the water pollution indicator. However, as mentioned about the limitations of the study, currently there is a lack of data to observe the quality of heavy metals in the soil and air environment. At the same time, we are also lacking the metal load capacity rating in these environments.

- We collect ideas about the separation of limited data to have lessons learned about building databases, environmental indicators.

- The study of weights and classification of evaluation results can be considered at the next research stage, when there is a more complete set of assessment indicators and data.

13. Mr Do Van Tu - Institute of Ecology and Biological Resources

- Data are inconsistent over time as with fisheries data obtained from FAO 1997 but reassessment data are updated in recent years.

14. Prof. Truong Quang Hoc – Environmental expert

- If there is a series of index scores and criteria from 0-100, it is recommended to separate each rating level. I think that environmental regulation is not a threshold.

15. Mr. Vo Thanh Son - Central institute for Natural Resources and Environmental Studies, Hanoi National University

- National standards depend on socioeconomic development conditions

16. Prof. Truong Quang Hoc – Environmental Expert

- For standard indicators, I agreed that it should use scientific standards.

- I would also like to refer to whether the study defines a common environmental threshold.

17. Ms. Mac Thi Minh Tra – Vietnam Environment Administration

- About the criteria of heavy metal pollution, I think that mercury is not a typical parameter reflecting this problem for the Vietnamese environment. In fact, heavy metal pollution is present in the water, air, and soil environments and therefore, it is sure that there are environmental quality monitoring data, for example, the water, air environment consist of data on lead, cadimi, mercury, etc… I propose to consider additional criteria on this issue.

- Regarding surface water pollution, the study has evaluated quite typical parameters reflecting water pollution problems in Vietnam such as organic pollution and nutritional pollution. I think that the selection of evaluation parameters should consider the typical parameters of water environment as stipulated in Decision 1460/TCMT, including pH, plant protection, heavy weight group, microorganism group

- Regarding seawater pollution, I suggest to add oil, grease and mineral parameters that are the current main marine pollution parameters. Regarding the parameters of Total Suspended Solids (TSS), it should be considered the natural factors affecting to the TSS. In Vietnam, some northern areas have high TSS due to alluvium, so it may not reflect the nature of this indicator in water pollution problem.

- Regarding air pollution, I think that the air quality monitoring data is inconsistent with the data source currently used by the World Bank (in the report). The reason is that while this is the pollution points, the World Bank data is based on population

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- The set of indicators aims to reach and compare with environmental sustainability of other countries in the world, now the research has calculated that three over four functions achieve good result, it is necessary to continue further research.

18. Ms. Do Van Tu - Institute of Ecology and Biological Resources

- In my opinion for the missing indicators, the research should be supplemented to ensure the completeness of the indicator set. To some extent we have to accept some indicators at a semi-quantitative level.

19. Ms. Vu Thi Thanh Nga – ISPONRE

- Regarding heavy metal pollution indicators, we agree that mercury emissions are not typical indicators. Currently, we have monitoring data for heavy metals in the water environment and are generally assessed for water pollution. However, in other environments such as soil and air, there is a lack of observational data. In addition, the methodology of calculating the number of polluted ecosystems according to EU norms is a challenge for Vietnam because this data is completely unavailable.

- Water environmental eutrophication indicators were evaluated in the parameters of surface water and seawater pollution. Currently, it is impossible to assess this indicators due to the lack of seawater-quality monitoring data of oil, grease and minerals. Hence, the collection of indicator data can improve if the data are widely available.

- Regarding air pollution data, the limited source of monitoring data is only available in 6 cities and 6 monitoring points, so it does not guarantee the quality and representativeness for the whole country. Therefore, the study has supplemented and used the estimated result from the WHO Global Burden of

Disease study to calculate and try to compare with the results of observed data in Vietnam. It is clearly that there is a mismatch in the data that is not entirely accurate. We will ignore this review in the report.

IV. Conclusion

Mr. Nguyen Trung Thang concluded the workshop:

The application of the ESGAP framework and indicators has shown meaningful lesson learnt for assessing the sustainability development of Vietnam.

Most of opinions agree with the methodology in selecting and calculation of the proposed ESGAP framework and indicators for Vietnam and agree in some extents with the assessment results.

The set of indicators still lacks many indicators that need to be added, such as indicators of biodiversity, indicators on heavy metals, indicators of bathing water ...

Many indicators are also facing difficulties in the lack of data and the quality of data in the country is not high. For example, indicators on forest resource use is not really representative; the data on surface water resources is not completed; water quality assessment parameters are not typical; air quality indicators ...

In the future, in order for the set of indicators to be applied in practice, it is necessary to consider researching and building a more complete set of data, considering additional indicators for the index completeness and using weights in the calculation of the indexes.

On behalf of the organizer, we would like to thank UNEP and UCL for their technical and financial supports for this research, many thanks the delegates for their contributions and comments.

Mr. Nguyen Trung Thang closed the workshop at 17.00

Appendix 5. Workshop Minutes 2

Assessing the national environmental sustainability performance by applying The Environmental Sustainability Gap (ESGAP) for Vietnam.

I. Workshop info:

1. Time: 14.00-17.00, 19th March 2021

2. Venue: Online meeting

3. Participations:

3.1. Chairman:

- Dr Nguyen Trung Thang – Deputy General Director, Institute of Strategy and Policy on Natural resources and Environment (ISPONRE)

3.2. Participants:

Prof. Paul Ekins and Dr Alison Fairbrass- University College London (UCL)

Dr. Carolina Soto-Navarro – International Scientific Advisor

Dr. Hoang Hong Hanh, MSc. Duong Thi Phuong Anh, MSc. Vu Thi Thanh Nga, MSc. Nguyen The Thong, Mr. Tran Quy Trung – ISPONRE's research team

Mr. Nguyen Quoc Dung, Forest Inventory and Planning Institute (FIPI), MARD

Ms. Cao Le Quyen- Vietnam Institute of Fishery Economics and Planning, MARD

Ms. Le Thi Mai Van – Department of Water Resources Management, MONRE

Mr. Nguyen Thanh Cong - Department of Climate Change, MONRE

Mr. Truong Manh Tuan - Vietnam Environment Administration, MONRE

Ms. Le Hoang Anh - Centre for Environmental Information and Data

Mr. Le Viet Thang, Chemical Department, Ministry of Industry and Trade

Mr. Nguyen Đinh Khuyen -Vietnam GSO

Mr. Pham Van Loi - Institute for Environment and Sustainable Development.

Ms. Nguyen Thanh Nga, Department of Science, Education, Natural Resources and Environment - Ministry of Planning and Investment

Mr. Vo Thanh Son, Central institute for Natural Resources and Environmental Studies, Hanoi National University

Mr. Hoang Bich Hop- PanNature Viet nam

Ms. Le Ha Thu- PanNature Viet nam

Ms. Vu Xuan Nguyet Hong – Environmental economics Expert

Mr. Nguyen Phong – Statistics Expert

Prof. Truong Quang Hoc- Environmental Expert

Mr. Nguyen Thanh Phuong – UNEP Vietnam

Asso.prof. Nguyen Danh Son- Environmental Expert

Mr. Nguyen Song Ha- FAO Vietnam

Mr. Nguyen Thai Anh- FAO Vietnam

Mr. Pham Manh Hoai- WWF Vietnam

Mr. Do Van Tu- Institute of Ecosystems and Ecological Resources

Mr Ho Huu Hung - Vietnam Environment Administration

Ms. Mac Thi Minh Tra - Vietnam Environment Administration

4. Workshop objective:

The workshop aimed at objectives as follows:

- Introduce the results of application of the ESGAP for Vietnam;

- Collecting ideas to improve the results and implication of the ESGAP for Vietnam in the future

II. Content

1. Opening speech

- Dr Nguyen Trung Thang – Deputy General Director, Institute of Strategy and Policy on Natural resources and Environment (ISPONRE) introduces the objective and program of workshop.

- Prof. Paul Ekins and Dr Alison Fairbrass, University College London (UCL) and UN Environment Programme (UNEP) introduce the Environmental Sustainability Gap (ESGAP) framework and international experiences of application of ESGAP.

2. Presentation

- Ms. Vu Thanh Nga: Assessing the national environmental sustainability performance by applying The Environmental Sustainability Gap (ESGAP) for Vietnam.

III. Questions and discussion

4. Prof. Truong Quang Hoc – Environmental expert

- In my point of view the ESGAP framework are encouraging to internationalize their calculation methods and approaches so it is not easy to

apply for Vietnam. I want to question that with such a methodology, should ESGAP indicator can be either localized or nationalized? I wonder whether ESGAP indicator set really suitable for Vietnam or not.

- Secondly, the total index contains 4 component indicators that reflect several areas with different levels of contribution, whether we apply weights to calculate the index. Currently, we are calculating the national climate resilience index and are applying weights to these indicators, as a result, this process are very effective and produces very interesting results.

- For the alternative indicators that the study proposed to apply to Vietnam, are these proposed indicators either international or just applied for Vietnam?

- The forest coverage indicator of Vietnam and the forest utilization indicator of ESGAP are completely different, it is better to develop a more compatible indicator for Vietnam.

5. Mr. Vo Thanh Son - Central institute for Natural Resources and Environmental Studies, Hanoi National University

- I appreciate the application of international approaches and methods to measure Vietnam's sustainability.

- I want to ask what basis does this study use to determine Gmin, Gmax; Scientific basis for calculating the standards of such indicators?

6. Ms. Vu Xuan Nguyet Hong - Environmental Economics Expert

I appreciate the team's efforts to calculate the results of the indicator set.

- For indicator 13, it is necessary to note the indicator on the proportion of the population using tap water for eating and drinking purposes. Currently, Vietnam has statistical indicators on the proportion of the population using hygienic water, including tap water and other types of clean water such as rain water, well water, etc. Thus, the typical proportion must be clearly distinguished between the population using clean water and the population using tap water. .

- The data year should be included in the report as the different time to collect data can produce different results

- After review a report, I do not clearly understand why Gmin value is greater than Gmax.

- I find it questionable that the data on greenhouse gas emissions mentioned in the report is quite high, compared with some international figures calculated for Vietnam.

4. Mr. Nguyen Trung Thang - ISPONRE

- The principle of the study is to try to apply as much as possible according to the conceptual framework and criteria proposed by the international research team. In case international indicators are not available and data are not available to calculate for Vietnam, then alternative indicators with scientific standards will be selected. Therefore, the indicators are highly scientific and can be completely applied to localize Vietnam. However, the problem is that the data source must be sufficient to evaluate and calculate ESGAP index.

- Currently, the index is applying an international approach in which environmental issues are assessed to be of equal importance, so there is no weight for each indicator.

- The forest coverage indicator was discussed from the previous workshop. However, due to data constraints related to Vietnam's forest use rate, we recommend using this indicator.

5. Ms. Vu Thi Thanh Nga - ISPONRE

- Regarding the indicator of forest cover, as we discussed in the previous workshop, Vietnam currently does not have complete data on forest use as in Europe. Currently, we only have data on the total logging output, but there is a lack of data on the amount lost due to illegal logging, fire, and felling. In addition, we only have the area of newly planted forest every year without the total wood biomass increase every year.

- Regarding the water use indicator of Vietnam, currently the statistical yearbook reports the indicators "*the proportion of the urban population provided with clean water through the centralized water supply system*" and "*The proportion of households using water sources hygienic*", however, since this study wants to assess the total population data providing with clean water supply through centralized water supply systems, so we use the annual census data source. In 2019, there are census results of the population provided with clean water through a centralized water supply system.

- Vietnam's data on GHG emissions are national report data provided by the Ministry of Natural Resources and Environment and are data on Vietnam's

greenhouse gas inventory. When comparing with figures estimated by UNEP for countries, there may be discrepancies. For national calculation, the research team prioritizes the use of domestic data sources.

6. Prof. Truong Quang Hoc - Environmental Expert

- Does the study divide the evaluation interval with indicators? We should sort indicators score in sustainable level by low, medium and high.

- If assessing the environmental impact, does the study evaluate the threshold of environmental load and the tipping points for each assessment environmental problem?

7. Ms Vu Thi Thanh Nga - ISPONRE

- At present, although the study does not divide the assessment interval, the research takes 100 points equivalent to environmental sustainability. The gap from the identified score to maximum points (100) is defined as the distance to the sustainable environment.

- Under the ESGAP framework, each indicator must define the scientific standard at which the environment and resources are sustainably protected. This International Standard is mostly the load-bearing threshold of the environment in which the environment can neutralize waste without being altered. Hence, the threshold is usually much lower than the tipping point, in contrast, if the threshold is exceeded, the environmental structure can collapse. In our research, for the application to Vietnam, the standards used for the indicators are the national technical regulations on the quality of soil, water and air environments.

7. Dr. Vo Thanh Son

- In my opinion, the use of Vietnamese standards in the research is not really accurate. National standards often change over time and depend on the state of technological and economic development in each country. EU Standard is different from Vietnam, so there is a need to make a comparison.

- In terms of forest coverage indicators, I think we should not just use one indicator to replace the forest use indicator. About the theory of natural capital, the quantitative indicators can be multiplied by the quality indicators. For example, we have the rich, poor, average forest areas multiplied by the quality weight of each of these forest types.

8. Ms. Cao Le Quyen - Vietnam Institute of Fishery Economics and Planning, MARD

- In this study, the indicators of the protection of aquatic resources are evaluated very low. I appreciate the data sources used here, all of which are official data sources. However, the use of FAO assessment data in 1997 is quite different from the present time. According to our assessment, currently the most up-to-date data on allowable fishing limits for the whole country is only about 2.6 to 2.7 million (not officially announced). The catch of the whole country was at about 3.8 million tons and is still increasing every year. This result is also go to beyond the sustainability limit.

- To improve this indicator, I think that the research team should refer to the Circular No. 16 dated 28/12/2020 of the Ministry of Agriculture on the target of the catch (fishing) of aquatic products. The industry's goal is to reduce catching volume. If we achieve negative growth, itcan be seen as success.

9. Mr. Nguyen Trung Thang - ISPONRE

- We try to collect the latest data sources, however, some indicators only have very limited data sources.

- For the fishery resource indicator, we use the FAO study (1997) on the allowable catch limit of Vietnam as the indicator standard. According to the current domestic assessments, Vietnam's fisheries resources are still in decline. Thus, the current allowable catch limit must be lower in comparision with data in 1997. Consequently, the study using the 1997 catch limit, which we have not yet to reach, demonstrates the fact that our problem of overfishing is more serious than currently assessed and will not soon be changed.

10. Mr Nguyen Quoc Dung - Forest Inventory and Planning Institute (FIPI), MARD

- Please reconsider Table 4. it is necessary to differentiate indicators and index

- For the indicator of forest resources: While the EU applies forest utilization, Vietnam proposes the forest coverage. At present, we have data for assessing annual net growth, it is important to consider what direction we aim for forest growth, the quality of either the forest or the economy?

- There are annual statistical indicators on economic growth in the forestry sector under Circular No. 12/2019/TT-BTNMT dated 25/10/2019 on statistical indicators of the Ministry of Agriculture and Rural Development. Regarding the current forest cover, we have targets for some types of forest such as coastal forest, rocky mountain forest, etc. (the indicator will be lower than FAO indicator).

However, the forest coverage contains only area. In terms of volume, we have data on national forest resource monitoring with survey results on biomass.

- In terms of heavy metals, I see the EU indicator includes several different types of heavy metals, ISPONRE's team proposed indicator only concerned mercury. In fact, Vietnam have sufficient ability to measure heavy metals. What is the reason why research only measure mercury?

- In terms of soil resource, the ESGAP indicator only cover soil erosion is insufficient. The mountainous area of Vietnam is quite large, with great erosion potential. We also need to mention other types of land such as agricultural land, aquaculture land. I suggest that research should consider replacing with criteria for soil degradation. Currently, Vietnam is participating in the convention to combat land degradation.

11. **Mr. Do Van Tu - Institute of Ecology and Biological Resources**

- I can see that the current method of data collection depends mainly on published data and statistics. However, in Vietnam, sometimes the data quality may not be guaranteed. To evaluate more convincing data sources, it is necessary to use data from scientific reports to be more convincing.

- Heavy metal pollution criteria: we should not use only mercury indicator; it may cause inaccurate results. Regarding the data, we can apply many other parameters being available and need to find more data for specific environmental problems.

- I think the conclusions of the research are very good and worthwhile, I wish the research team would develop, propose research's result to higher-level authorities.

12. Ms. Le Thi Mai Van – Department of Water Resources Management, MONRE

- I think the alternative indicators for Vietnam are quite appropriate. I agree with Prof. Truong Quong Hoc's opinion that we need to apply weights to indicators, even evaluate and weight for each ecological region to match with regional characteristics.

- I also wonder that within various parameters of water quality assessment, the study only considers a few parameters to specify each indicator. It should be considered, many parameters that are considered to have "sensitivity" in water quality for example for groundwater' parameters are arsenic, lead, cadmium concentration should be included in the calculation process?

- We should have a scientific basis for sustainable hierarchy level for each criterion.

13. Mr. Nguyen Phong – Statistics Expert

- This is a scientific research with high applicability, in order to be able to develop at a higher level, the study should allocate a chapter about the limitations of the data. I can clearly see the ratings and comments on the results of each indicator in the annex of the summary report. The study needs to separate the data section, data processing and data limitation, so that we can make recommendations about the data.

- Regarding the weight of the indicators, I think that there should be a composite index that should be included in the next stage.

14. Ms. Vu Thi Thanh Nga - ISPONRE

- Regarding water quality indicators, due to the limitation of data sources at some monitoring stations which only monitor some main parameters, many parameters do not have complete annual average data, so the research team prioritizes the parameters having the most sufficient data.

- Regarding the data collection timeline, we try to get the assessment data for 2019, but in case the data is not up-to-date for example of greenhouse gas emissions, we use the latest data source.

- Regarding scientific standards to calculate the criteria, we are currently using national technical regulations and standards. To explain whether these national standards are scientific, or develop based on political factors. We believe that the development of national technical regulations is scientific, with reference to international technical standards, assessment and selection in accordance with the scientific and technical level of Vietnam. All of standards are built and evaluated through state-level scientific councils.

- Regarding heavy metal pollution indicators, currently the assessment of heavy metal pollution has been assessed through the water pollution indicator. However, as mentioned about the limitations of the study, currently there is a lack of data to observe the quality of heavy metals in the soil and air environment. At the same time, we are also lacking the metal load capacity rating in these environments.

- We collect ideas about the separation of limited data to have lessons learned about building databases, environmental indicators.

- The study of weights and classification of evaluation results can be considered at the next research stage, when there is a more complete set of assessment indicators and data.

13. Mr Do Van Tu - Institute of Ecology and Biological Resources

- Data are inconsistent over time as with fisheries data obtained from FAO 1997 but reassessment data are updated in recent years.

14. Prof. Truong Quang Hoc – Environmental expert

- If there is a series of index scores and criteria from 0-100, it is recommended to separate each rating level. I think that environmental regulation is not a threshold.

15. Mr. Vo Thanh Son - Central institute for Natural Resources and Environmental Studies, Hanoi National University

- National standards depend on socioeconomic development conditions

16. Prof. Truong Quang Hoc – Environmental Expert

- For standard indicators, I agreed that it should use scientific standards.

- I would also like to refer to whether the study defines a common environmental threshold.

17. Ms. Mac Thi Minh Tra – Vietnam Environment Administration

- About the criteria of heavy metal pollution, I think that mercury is not a typical parameter reflecting this problem for the Vietnamese environment. In fact, heavy metal pollution is present in the water, air, and soil environments and therefore, it is sure that there are environmental quality monitoring data, for example, the water, air environment consist of data on lead, cadmium, mercury, etc… I propose to consider additional criteria on this issue.

- Regarding surface water pollution, the study has evaluated quite typical parameters reflecting water pollution problems in Vietnam such as organic pollution and nutritional pollution. I think that the selection of evaluation parameters should consider the typical parameters of water environment as stipulated in Decision 1460/TCMT, including pH, plant protection, heavy weight group, microorganism group

- Regarding seawater pollution, I suggest to add oil, grease and mineral parameters that are the current main marine pollution parameters. Regarding the parameters of Total Suspended Solids (TSS), it should be considered the natural

factors affecting to the TSS. In Vietnam, some northern areas have high TSS due to alluvium, so it may not reflect the nature of this indicator in water pollution problem.

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Mr. Nguyen Trung Thang closed the workshop at 17.00

About Agence française de developpement

AFD Group implements France's policy in the areas of development and international solidarity. The Group includes Agence Française de Développement (AFD), which finances the public sector and NGOs, as well as research and education in sustainable development; its subsidiary Proparco, which is dedicated to private sector financing; and Expertise France, a technical cooperation agency. The Group finances, supports and accelerates transitions towards a fairer, more resilient world.

With our partners, we are building shared solutions with and for the people of the Global South. Our teams are at work on more than 4,000 projects in the field, in the French Overseas Departments and Territories, in 115 countries and in regions in crisis. We strive to protect global public goods – promoting a stable climate, biodiversity and peace, as well as gender equality, education and healthcare. In this way, we contribute to the commitment of France and the French people to achieve the Sustainable Development Goals (SDGs). Towards a world in common.

ENVIRONMENTAL SUSTAINABILITY IN VIETNAM

Piloting the Environmental Sustainability Gap Framework (ESGAP) and Strong Environmental Sustainability Index (SESI)

The Prime Minister of Vietnam issued a National Action Plan for the implementation of the Agenda 2030 on Sustainable Development. Nevertheless, the limited number of indicators and data, and the lack of a nation-wide monitoring system jeopardizes the country's ability to effectively measure and monitor the state of the environment in a robust way. Better monitoring, better data and better co-ordination between agencies and Government Ministries are still major challenges to effectively monitor performance towards achieving the Vietnam's SDG targets.

This study pilots the assessment of strong environmental sustainability in Vietnam using the Environmental Sustainability Gap framework (ESGAP), and the Strong Environmental Sustainability Index (SESI), which measures countries' performance on maintaining four essential environmental functions (i.e., source, sink, life support and human health and welfare). The ESGAP framework is relevant to identify Vietnam's remaining environmental challenges to achieve strong environmental sustainability and data gaps in the country.

The study found that out of 22 strong environmental sustainability indicators present in the ESGAP framework, five have data available in Vietnam, eight have insufficient data sources and were replaced by proxy indicators for Vietnam, and the remaining nine represent major data gaps on the environment for Vietnam. The Vietnam ESGAP framework has the potential to be leveraged as an effective communication tool which provides an overall picture of the gap (i.e., how far the country is) to achieve environmental sustainability.

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