COMPONENT 1

POLICIES AND MARKET INCENTIVES IN SUPPORT OF NATURAL CAPITAL

THE INTEGRATION OF NATURAL CAPITAL ACCOUNTING IN PUBLIC AND PRIVATE SECTOR POLICY AND DECISION-MAKING FOR SUSTAINABLE LANDSCAPES

NATURAL CAPITAL

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TDRI THAILAND DEVELOPMENT RESEARCH INSTITUTE

COMPONENT 1

POLICIES AND MARKET INCENTIVES IN SUPPORT OF NATURAL CAPITAL

OUTPUT 1.1.2

Draft the 'National framework for NC accounting in Thailand'

OUTPUT 1.1.3

Raise funding to co-finance development of national water resource and tourism sector NCAs

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EXECUTIVE SUMMARY

Thailand is in Southeast Asia with a population of 71.6 million in 2025 and has a land area of 51.3 million hectares. Thailand is an upper-middle-income country with per capita income of USD7,172. As percentage to GDP, the economic structure comprises of 8.4 percent agriculture, 39.2 percent manufacturing and 24.9 percent services. With the exporting sector takes up as much as 65 percent of GDP, Thailand is considered a small open economy that is vulnerable to global disturbances may they be economic, political or environmental. With these challenges, three development agenda for Thailand include: 1) income enhancing strategies to move Thailand out of the middle-income trap, 2) sustaining long-term growth momentum through capacity building and rehabilitating the natural habitat and resources, and 3) enhancing Thailand's resilience from uncertain events, both economic and climate change.

SDG goals indicate that Thailand is still finding challenges with goal 14 life under water and goal 15 life on land while work progress in these two areas are stagnating. This implies that water resource management as well as biodiversity and ecosystem management will continue to require additional attention. A challenge Thailand is facing is to integrate ecosystem management with the overall economic management. Adopting a holistic management mechanism, such as the Natural Capital Account will enable Thailand to integrate ecosystems management with the overall economic development of the country.

Natural Capital Account (NCA) based on the United Nations System of Environmental Economic Accounting (UN-SEEA). The UN-SEEA have two parts: the SEEA Central Framework (SEEA CF) and the SEEA Ecosystem Accounting (SEEA EA). The SEEA CF is an international statistical standard that documents links between the environment and the economy by quantifying stocks of environmental assets, environmental flows into and out of the economy, and economic activity related to the environment. The SEEA CF is designed to be compatible with the System of National Accounts (SNA), the internationally recognized standard for measuring and reporting on economic activity. The SEEA EA complements the SEEA CF and was adopted by the UN Statistical Commission in 2021. The SEEA EA quantifies ecosystems into four accounts (1) extent and (2) condition based on selected indicators plus the (3) supply and use of ecosystem services in both physical and (4) monetary terms, and finally (5) asset accounts that quantify the net present value of stocks of ecosystem assets.

When the UN-SEEA is able to quantify the values of economic flows from the ecosystem, this NCA will enable Thailand to integrate ecosystem management with the overall economic management of the country. NCA will inform policy makers of the economic significant of ecological changes, answer policy questions, such as will the economic benefits of development projects outweigh the value of environmental loss, help local government, provincial government and central government allocate optimal budget and funding for environmental conservation to achieve most effective outcomes.

This report develops the NCA based on the UN-SEEA guideline for Krabi province. Krabi province is chosen because Krabi is endowed with valuable natural resources, such as marine ecology, mountain terrains, mangroves, endanger species such as Dugong, or corals reefs. These resources are considered as valuable

natural capital of Krabi province as they can attract as many as five million visitors each year. For these reasons, the focus of this report will be on the water resource sector and the tourism sector of Krabi province.

Once, the NCA is developed, it will be integrated with the National Income Accounts of the the National Economic and Social Development Council (NESDC) or the Budget Bureau. The NCA statistics will be used for improving funding and budget allocation at all levels: the municipality, Krabi province and central government agencies of the NESDC or the Budget Bureau where sufficient budgeting can be allocated for environmental conservation. Furthermore, the NCA will become a policy tool for decision makers at all government levels. The central public agency can use NCA to test whether the economic benefits of investment project outweigh the environmental costs. The local government can use NCA to select the most cost-effective wastewater management technologies.

NCA is thus a tool that will ensure that integrate environmental management with the overall development of Thailand to ensure that Thailand growth path trajectory is a sustainable one.

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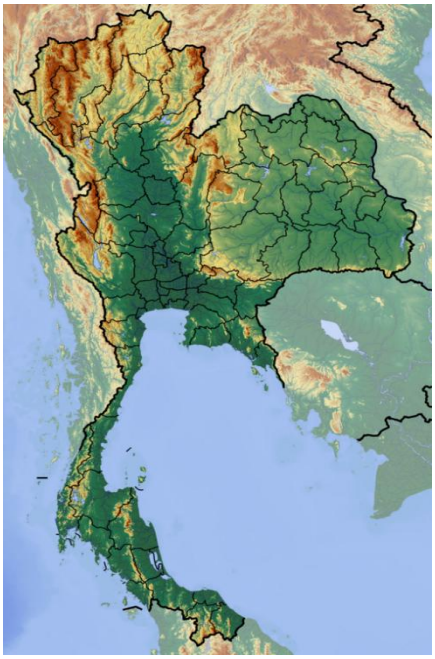
1. Introduction

1.1 State of development in Thailand

Thailand is situated in Southeast Asia with an area of 51.3 million hectare and a population of 71.6 million in 2025. Thailand is bordered by Myanmar on the northwest, Lao PDR on the northeast, Cambodia on the east and Malaysia on the south. Thailand is divided into four geographical regions: the northern region is characterized by mountain terrains, the northeastern region is elevated flat plateau, the central region is the flood plain and the southern region is mostly flat with mountain terrains towards the far south. Thailand is also bordered by the Gulf of Thailand on the eastern peninsular and the Andaman Ocean on the western peninsular. Administratively, Thailand comprises of 77 provinces with Bangkok being the capital of the country. Most Thai population are Buddhists with small percentage of Muslims and Christians. Thai people of different regions have their distinct cultures and speak in different Thai dialects.

Figure 1 Map of Thailand



The geographical characteristic of and the diverse cultures enable the Thailand to benefit from the diversification of economic activities. Thailand was predominantly agrarian with rice production dominating the farming areas, followed by maize, sugar cane, rubber and palm oil. Since 1950's, the Thai economic transition began to shift towards manufacturing and services. In 2024, while the agriculture sector occupies much of land use in Thailand, its contribution to GDP was only 8.4 percent while the manufacturing sector expanded to as much as 39.2 percent and the service sector contributes 24.9 percent to GDP. The tourism sector has been fast growing and contributes 18 percent to GDP. This economic structure enables the Thais to earn per capita income of USD7,172 in 2023 and the World Bank classifies Thailand as an upper-middle-income country.

Thailand is considered a small-opened economy where export earning plays a crucial role maintaining economic momentum. In 2023, Thai export earning accounts for as much as 65 percent to GDP. This high degree of openness while generates income, it inevitably exposes Thailand to external shocks and disturbances, such as financial disruptions, international disputes or oil price crisis. Climate change and weather variability and extreme events, such as floods and droughts have posed increasing pressure on the livelihood of the Thai people. With these challenges, three development agenda for Thailand include: 1) income enhancing strategies to move Thailand out of the middle-income trap, 2) sustaining long-term growth momentum through capacity building and rehabilitating the natural habitat and resources, and 3) enhancing Thailand's resilience from uncertain events, both economic and natural.

Thailand's development models conform to international sustainable development concepts, such as the World Bank infrastructure projects, the IMF economic prescription, the UN Sustainable Development Goals (SDGs) or

the UNFCCC Climate Change goals. Two notable Thailand indigenous development models are the Sufficiency Economy Philosophy (SEP) bestowed by King Rama IX of Thailand and the One Tambon (Sub-district) One Product (OTOP). Among the various development concepts, the 17 SDGs best provides an overall accounting of the state of development for Thailand.

Figure 2 SDGs tracking for Thailand

The SDGs tracking shows that Thailand has been successful in poverty reduction and education attainment. The continued economic expansion enabled the Thai families to obtain some form of employment and earn income above the poverty line of USD2.15/day. Following the 13-year free education policy, as high as 99 percent of the Thai children are able to attend school with the literacy rate of 98 percent. Areas where SDG goals have not been achieved as there challenges ahead but show signs of moderate improvement are gender equality, clean water and sanitation, affordable and clean energy, and industry innovation and infrastructure. It is reported that decent work and economic growth, reduced inequality, responsible consumption and production, climate action, and partnerships for the goals are areas that have stagnating. The major challenges for Thailand are areas, such as zero hunger, good health and well-being, sustainable cities and communities, life below water, life on land, and peace, justice and strong institutions.

In this regard, the development of Natural Capital Account for Krabi province that explores the contribution of natural resource to the well-being of the people will be instrumental in building a strong intuitional setting for natural capital finance leading to sustainable use of water resources including ocean resources and sustainable tourism.

1.2 Integration of NCA Information into the System of National Accounts

Thailand SDGs goals show how goal 14 life under water and goal 15 life on land are areas where major challenges exist and improvements are stagnating. For SDG goal 14 life under water, the challenges include marine biodiversity threats, overfishing, or ocean health. For SDG goal 15 life on land, the challenges are terrestrial and freshwater sites that are important to biodiversity, and loss of species. A reason that has prevented Thailand from maintaining a healthy resource sector is the inability to recognize the importance of the natural resource sector in relation to the importance of the rest of economic activities. The lack of the

natural resource accounting system together with the lack of information on the contribution of natural resources to the economy has prevented the Thai government from allocating sufficient fund and budget for natural resource protection and conservation. This is one of the major challenges facing Thailand and has become a major obstacle preventing Thailand to expand on a sustainable development path.

Insufficient allocation of fund and budget for natural resource protection and conservation can be seen in forest protection, watershed conservation, air and water pollution control, or biodiversity conservation. This together with a heavier and more intense utilization of natural resources, such as an increase of the number of tourists will add pressure on resource sustainability. Maya Bay in Krabi province, for example, accommodated as many as five million visitors per year before it was close for rehabilitation during the early 2020s.

The Natural Capital Account (NCA) is an attempt to make a full account of the ecosystem and its contribution to the economic wellbeing. NCA captures how ecosystems are inter-connected and captures the changes of the ecosystems over the years. With information on the stock and flow of benefits of the ecosystem, policy makers can measure the economic values of these natural resources and the contribution these natural resources make to the economy. With this information, the policy makers will be able to make decisions on how they can best allocate sufficient budget for natural resource protection and conservation, hence preventing any long-term deterioration of the ecosystem and biodiversity irreversibility.

NCA information when integrated with the National Income Accounts will be useful for governments at all levels, namely, municipalities and provincial governments can use this information for allocating appropriate level of funding for air or water pollution control. For instance, the central government agencies, such as the National Parks, Wildlife and Animal Conservation (DNP) can establish guidelines for controlling the visitation rates at some fragile ecosystems. The planning agencies, such as the National Economic and Social Development Council (NESDC) and the Budget Bureau can use the NCA information for budget allocation as investments in natural resource protection and conservation will yield economic returns like those in other economic investments.

The NCA information when integrated into National Accounts will also help improve decision making of the government agencies particularly with large scale investment decisions. As natural capitals are systematically recorded, it will reflect the interdependency of ecosystems following impact of a development projects. This type of simulation analysis, when presented in economic values, will inform the policy makers whether the economic benefits will outweigh the opportunity cost of the development projects. Moreover, when negative impacts are identified, the government agencies can prepare appropriate mitigation or prevention measures to prevent any foreseen environmental impacts. On the other hand, when positive impacts are identified, the government agencies can use this information to design market-base instruments that will tap income from the beneficiaries of the development projects. While appropriate fees are imposed, it will provide the needed price signal and adjust the level of economic activities to be within the carrying capacity of the ecosystems. Furthermore, this revenue earned can be used to finance such investment without the need to impose a burden on the central budget.

NCA information when integrated into the National Accounts is, thus, a tool enabling governments at all levels to recognize the interdependencies of ecosystems and the flow of economic values across the sectors. This will

improve the accuracy and the transparency of public decision makings and will ensure that the development trajectory is on a sustainable growth path.

2. Concept and Methodology of National Capital Accounts

2.1 Natural Capital Account Under the UN SEEA Standards

Natural capital accounts measure the stocks, flows, and values of natural resources—such as land, water, forests, minerals, and ecosystems—and their contributions to the economy and human well-being. These accounts track both the quantity and condition of resources (stocks) and the services they provide over time (flows).

Box 1 What is Natural Capital?

'Natural' capital the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people. [UN SEEA, n.d.[1]]

One of the most popular frameworks on natural capital accounting is the **United Nations System of Environmental-Economic Accounting (UN SEEA)**. The UN SEEA integrates environmental data into economic statistics, similar to standards for GDP or employment. It measures ecosystems, services, and environmental stocks and flows as part of official statistics. Developed by the UN Statistics Division with global partners, SEEA supports policy decisions on natural resources.

UN SEEA consists of two parts:

- The SEEA Central Framework (SEEA CF) was adopted by the UN Statistical Commission as the first international standard for environmental-economic accounting in 2012. It is an international statistical standard that documents links between the environment and the economy by quantifying stocks of environmental assets, environmental flows into and out of the economy, and economic activity related to the environment. The SEEA CF is designed to be compatible with the System of National Accounts (SNA), the internationally recognized standard for measuring and reporting on economic activity.
- The SEEA Ecosystem Accounting (SEEA EA) complements the Central Framework and was adopted by the UN Statistical Commission in 2021. The SEEA EA quantifies ecosystems' (1) extent and (2) condition based on selected indicators plus the (3) supply and use of ecosystem services in both physical and (4) monetary terms, and finally (5) asset accounts that quantify the net present value of stocks of ecosystem assets.

[1]UN SEEA. (n.d.). *Natural Capital and Ecosystem Services - System of environmental economic accounting*. United Nations. https://seea.un.org/content/natural-capital-and-ecosystem-services-faq#What%20is%20natural%20capital?

SEEA EA also includes thematic accounts covering specific topics that aid in the interpretation of ecosystem accounts, which include accounts for land, water, carbon, and biodiversity; the recent SEEA EA revision also describes thematic accounting approaches for oceans and urban areas.

Box 2 Core areas of SEEA-CF

The SEEA-CF comprises measurements in three core areas (UN, n.d.):

1. *Environmental flows* are the flows of natural inputs between the economy and the environment, and within the economy. These flows can be measured in both physical and monetary terms.
2. *Stocks of environmental assets* are the stocks of individual assets such as land and forest in both physical and monetary terms. These accounts also reflect the changes in these assets over time due to economic activity and natural processes.
3. *Economic activity related to the environment* are monetary flows due to economic activities related to the environment. Examples include expenditures on environmental protection and resource management, as well as the production of environmental goods and services.

Box 3 Five core types of ecosystem accounts (SEEA EA)

SEEA Ecosystem Accounting is an integrated statistical framework for organizing biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this information to economic and other human activity. It comprises a set of accounts that collectively present a coherent and comprehensive view of ecosystems:

1. **Ecosystem extent (size) account**: This account serves as a common starting point for ecosystem accounting. It organizes information on the extent of different ecosystem types (e.g. forests, wetlands, agricultural areas, marine areas) within a country in terms of area.
2. **Ecosystem condition (quality/health) account**: This account organizes biophysical information on the condition of different ecosystem types. The ecosystem condition account organizes data on selected ecosystem characteristics and the distance to a reference condition to provide insight into the ecological integrity of ecosystems.
3. **Ecosystem services flow account (physical and monetary terms)**: This set of ecosystem accounts measures the supply of ecosystem services and the use of those services by economic units, including households, enterprises and government.
4. **Monetary ecosystem asset account**: This account records information on stocks and changes in stocks (additions and reductions) of assets. The ecosystem monetary asset account records this information in monetary terms for ecosystem assets based on the monetary valuation of ecosystem services and applying the net present value approach to obtain opening and closing values in monetary terms for ecosystem assets at the beginning and end of each accounting period.
5. **Thematic accounts**: These accounts organize data on themes of specific policy relevance. Examples of relevant themes include biodiversity, climate change, oceans and urban areas.

The SEEA Central Framework and Ecosystem Accounts are complementary to each other. The Central Framework focuses on individual resources at the national level, while the Ecosystem Accounts address entire ecosystems, often at sub-national or spatial scales.

2.2 Conceptual and Methodology of NCA

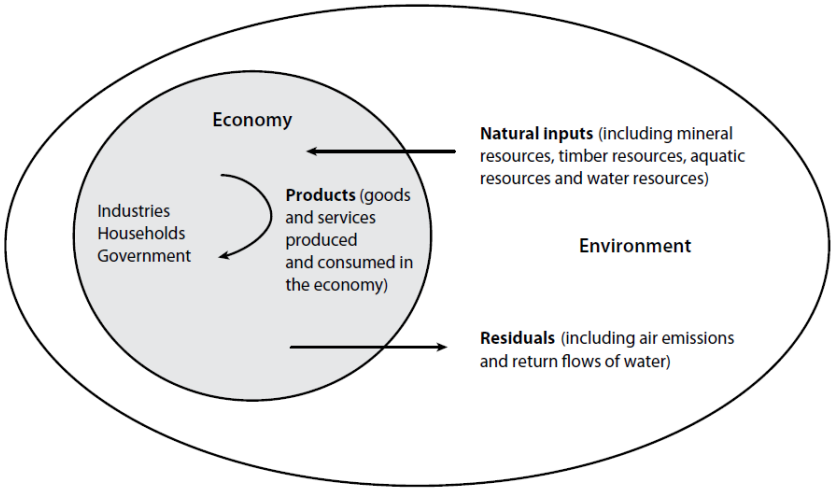
2.2.1 The SEEA Central Framework

The SEEA CF is an integrated statistical framework that extends the System of National Accounts (SNA) to include the environment and its interaction with the economy. Using the same concepts and classifications as the SNA, it expands the asset boundary to cover natural resources like forests and water.

SEEA CF measures **stocks** and **flows**, emphasizing production, consumption, and accumulation. The **production boundary** determines which goods and services are considered part of the economy, and flows between the economy and environment are measured based on whether they cross this boundary.

Environmental flows in the SEEA CF comprise physical flows and monetary flows. The **physical flows** are defined as "the use of physical units to record flows of materials and energy that enter and leave the economy and flows of materials and energy within the economy itself" (UN, 2014). These flows are categorized into three types: natural inputs, product flows, and residuals. Natural inputs, such as water and fish, represent the flows from the environment to the economy. In contrast, product flows occur within the economy, such as the production and consumption of goods and services. Residuals, such as air and water pollution, refer to the flows from the economy to the environment, which are often recorded as environmental losses. These environmental flows are presented in the SEEA CF in the supply and use tables format.

Figure 3 Physical flows: natural inputs, products, and residuals



Source: Figure 2.1 in UN (2014)

In addition to environmental flows, the SEEA CF also documents **environmental assets**, defined as "the naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity" (UN, 2014). The SEEA CF focuses on individual assets instead of entire ecosystems. It mainly captures material benefits from the direct use of environmental assets as natural inputs by economic units rather than non-direct uses such as carbon sequestration from forests. These environmental assets are recorded in the asset accounts.

Lastly, the SEEA CF tracks the flows associated with **economic activities related to the environment**. These activities include expenditures on resource management and environmental protection, as well as the production of environmental goods and services, such as environmental taxes and subsidies. These activities are recorded in both the sequence of economic accounts and functional accounts.

Box 4 Main accounts and tables in the SEEA CF

1. *Supply and use tables* record flows of natural inputs, products, and residuals in physical and monetary terms
2. *Asset accounts* comprise the stock of individual environmental assets at the beginning and the end of each accounting period in both physical and monetary terms
3. *A sequence of economic accounts* shows depletion-adjusted economic aggregates
4. *Functional accounts* document economic activities carried out for environmental aims

Source: Adapted from UN (2014)

(1) Supply and Use Tables

The supply and use tables in the SEEA CF document all input, product, and residual flows within an economy among various economic units and the environment. The tables are recorded in both physical and monetary terms. Regardless of the types, the tables are divided into two parts—supply and use—which must be equal to each other. The flows are classified by types of products and residuals in the rows and by economic units and sources in the columns.

(2) Asset Accounts

Asset accounts in the SEEA CF document the opening and closing stocks of individual natural assets and track various types of changes that occur to these assets over an accounting period.

Asset accounts are recorded in both physical and monetary terms. Typically, an asset account in physical terms begins with an opening stock and track changes to the stock, which are categorized as either additions or reductions. These changes may result from natural causes such as catastrophic losses or human-induced causes such as extractions. An asset account in monetary terms also contains similar items but includes an additional row that reflects changes in the value of an asset—the revaluation of the stock.

(3) The Sequence of Economic Accounts

Although the supply and use tables and asset accounts document much of the interactions between the environment and the economy, there are numerous other transactions and flows that policymakers may consider relevant to their policies. For instance, taxes, grants, and subsidies linked to the environment may be of interest. As these flows are not based on physical flows of products and services, they are instead recorded in **the sequence of economic accounts** in monetary terms. There accounts, therefore, include balancing items that link different accounts together and provide insight into economic performance.

(4) Functional Accounts

Frequently, when working with data from the SEEA CF, it becomes necessary to break down the monetary supply and use tables in order to pinpoint specific environmental activities or products. This is where functional accounts come into play, serving as a means of organization. One such example is the environmental protection expenditure account, which compiles pertinent information from other accounts within the SEEA CF and enables a streamlined analysis of all expenditures related to environmental protection.

(5) Key Accounting Concepts in the SEEA CF

As the SEEA CF serves as a satellite account in the SNA, the accounting principles in the SNA also apply to the SEEA CF. One notable example is the utilization of double- and quadruple-entry accounting. In double-entry accounting, two entries are made for each transaction, one for the flow of product and one for the flow of money. For example, when a household purchases water, their consumption of water increases while their cash balance decreases. This transaction must also be recorded for the water producer, whose inventory decreases while their cash increases. This results in a total of four entries, known as quadruple-entry accounting.

Another common accounting principle in the SEEA CF, which is also aligned with the SNA, is the valuation of transactions at market prices. Market prices are defined as "amounts of money that willing buyers pay to acquire something from willing sellers" (UN, 2014). When market prices are not available, they can be approximated using market price equivalents.

2.2.2 The SEEA Ecosystem Accounting

While the SEEA CF focuses on individual natural assets without specifying where those assets are from, the SEEA EA evaluates entire ecosystems and provides information on the sources and characteristics of multiple natural assets or ecosystem assets.

(1) Ecosystem Assets and Services

According to the UN SEEA, ecosystem assets are defined as "contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions." These assets supply ecosystem services to humans and the economy and hence could be characterized as producing units.

Box 5 Ecosystem services

Ecosystem services are defined as "the contribution of ecosystems to the benefits that are used in economic and other human activity" (UN, 2021). These services can be categorized into three categories as follows:

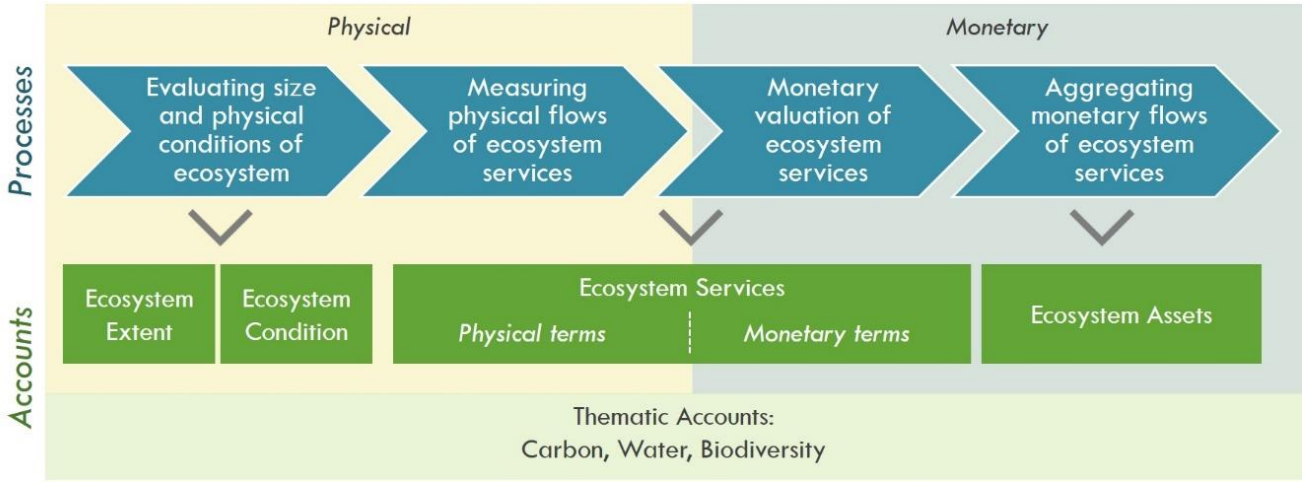
1. *Provisioning services* include the direct-use services through extraction and harvest such as timber from logging and fish from fishing.
2. *Regulating and maintenance services* include indirect services derived from the ecosystem's ability to regulate biological process and to influence hydrological and biochemical cycles. Examples of these services include flood and climate controls.
3. *Cultural services* include non-consumptive services, usually cultural benefits, derived through the existence and functioning of ecosystem assets. These services are usually intangible and experiential such as recreational and aesthetic benefits.

While the SEEA CF mostly captures the provisioning services of individual ecosystem assets, the SEEA EA focuses more on the regulating and cultural services. For instance, fish in a marine ecosystem are accounted for in the SEEA CF as they are caught and consumed. The same marine ecosystem also provides numerous regulating and cultural services, such as carbon sequestration and recreational activities, which are recorded in the SEEA EA.

As illustrated in

Figure ***4***, ecosystem accounting usually starts with the physical evaluation of an ecosystem resulting in the first two ecosystem accounts: the extent and condition accounts. Then, the flows of ecosystem services are measured in physical and monetary terms as shown in the ecosystem service accounts. Finally, the monetary ecosystem services are aggregated using the net present value (NPV) approach to form the ecosystem asset accounts. These processes and accounts will be further elaborated on in the next subsections.

Figure 4 Overview of the SEEA EA processes and accounts



Source: Author

(2) Physical Accounting

Effective physical accounting of ecosystem and natural capital requires a three-pronged approach. First, it is necessary to identify the types and extents of ecosystems under consideration. Second, the physical conditions and qualities of these ecosystems must be carefully assessed. Finally, the physical flows of ecosystem services must be measured. This process typically relies on a combination of physical and GIS tools and data to generate detailed maps and tables as outputs.

The first step in physical accounting of ecosystem capital involves identifying the various types of ecosystems and measuring their **extent or size**. In addition to the size or extent of an ecosystem, physical accounting of ecosystem capital also involves assessing the ecosystem's qualities or conditions. **Ecosystem condition** is defined as "the quality of an ecosystem measured in terms of its abiotic and biotic characteristics" (UN, 2021). The condition is evaluated based on composition, structure, and function. These factors are essential for maintaining the integrity of the ecosystem and enabling it to continuously provide ecosystem services.

Because ecosystem assets are usually not traded and hence do not have market prices, the ecosystem condition is assessed in physical terms. This assessment usually involves

1. Organizing biophysical information on the condition of different ecosystem types,
2. Measuring the distance of the ecosystem toward a reference state, such as a historical state, and
3. Evaluating the ecosystem's capacity of supplying ecosystem services into the future.

In addition to measuring the extent and condition of ecosystems, physical accounting of natural capital also quantifies **flows of ecosystem services** generated by the capital and records them in the supply and use tables format. As per the definition of ecosystem services, the ecosystem service flow account mainly focuses on the services that are considered final—those whose end users are economic units such as households and firms.

(3) Monetary Valuation and Accounting

The **ecosystem service flow accounts** are measured not only in physical terms but also in monetary terms. Valuation methods are usually applied to physical flows of ecosystem services to determine their monetary values. These monetary flows of services are then aggregated to derive the monetary value of ecosystem assets.

The SNA framework focuses on exchange value, which is the product of price and quantity, rather than the changes in welfare or consumer surplus. The SEEA EA also follows this approach and relies on exchange values for valuing ecosystem services. Essentially, the monetary value of an ecosystem service is estimated based on economic transactions when the service is traded. If a service is not traded, non-market approaches should be used to value it, as described in the box below.

Box 6 Valuation methods for the SEEA EA

The most straightforward approach for valuing an ecosystem service is to use **the actual price or value observed** when that service is traded or exchanged. Direct observation is the most preferred method for valuation. However, since ecosystem services are usually not traded, their prices are not readily observable. In such cases, the value of an ecosystem service can be estimated from prices in similar markets, embedded values in market transactions, revealed expenditures in related goods and services, or expected expenditures.

1. **Prices from similar markets:** Prices from similar markets may be used when there is no appropriate market for an ecosystem service. These prices are usually adjusted to reflect differences in qualities, contexts, costs, etc.

2. **Methods based on values embodied in market transactions:**

   a) *Residual value and resource rent methods* calculate the value of an ecosystem service by subtracting the total costs of all other inputs, such as labor and capital, from the gross value of the final marketed good that utilizes the service. The formula from the SEEA CF is as follows:

Output
less intermediate consumption
less compensation of employees
less other taxes on production
plus other subsidies on production
Equals gross operating surplus
less consumption of fixed capital (depreciation)
less return on produced assets
less labour of self-employed persons
Equals resource rent
= depletion + net return on environmental assets

b) Production change method involves incorporating an ecosystem service as an input in the production function of a final marketed good. When the service changes, the output of the good also changes. The value of the service is then calculated as the resulting change in revenue.

c) Hedonic pricing method estimates the premium on property or rental values that arises from the presence of ecosystem services, such as clean air or nearby parks.

3. **Methods based on revealed expenditures:**

a) *Averting behavior method* derives the value of an ecosystem service from the expenses incurred in preventing or mitigating the damages caused by negative environmental impacts associated with that ecosystem.

b) Travel cost method estimates the value of recreational areas using the travel costs incurred by visitors.

4. **Methods based on expected expenditures:**

a) *Replacement cost method* estimates the value of an ecosystem service using the cost of replacing the service by a substitute that yields equivalent benefits. This substitute can be either a consumption good or an input factor.

b) *Avoided damage costs method* evaluates the value of ecosystem services using the costs of the damages that would result from the loss of those services. Similar to replacement costs, the emphasis is typically on the services provided by ecosystems that would be lost if the ecosystem were not present or in a state of significant deterioration.

In addition to the approaches described above, the *Simulated Exchange Value (SEV) method* is sometimes used to determine the exchange value required for accounting entries. This method estimates the price and quantity that would arise if an ecosystem service were to be traded in a market. The price and quantity are determined based on an estimated demand function from other valuation techniques, a supply function, and a market structure.

It is important to acknowledge that some commonly-used valuation techniques may not be suitable for valuing ecosystem services within the SEEA EA framework. For instance, stated preference methods rely on information from hypothetical questions in surveys to determine the value of a non-traded good. Since these methods do not directly reveal exchange values, any estimates from these methods should be adjusted prior to their incorporation into SEEA accounting.

For cultural services the ecosystem in Krabi, a hedonic pricing model was applied to value sea views, and expenditure methods were applied to recreational activity services.

Once ecosystem services have been valued, the resulting monetary flows are included in the ecosystem service flow accounts using the supply and use table format. The monetary service flows are then aggregated to form the **ecosystem asset accounts** using an NPV approach. By utilizing the NPV approach, the value of an ecosystem asset is linked to its capacity, or its ability to deliver ecosystem services into the future, and how this capacity is projected to evolve over time. The asset's capacity and expected changes in capacity also provide insight into its expected lifespan. If the consumption of ecosystem services from an ecosystem asset is sustainable, i.e., the asset condition is not expected to deteriorate, then the asset will last perpetually (UN, 2021).

Box 7 Net present value (NPV)

The net present value (NPV) is "the value of as asset determined by estimating the stream of income expected to be earned in the future then discounting the future income back to the present account period" (UN, 2021).

Structure-wise, the ecosystem asset account comprises the monetary values of all ecosystem assets in a given ecosystem accounting area at the beginning and end of each accounting period. The account also illustrates the changes in the value of those assets over the period. These changes in monetary value are broadly categorized into five types: ecosystem enhancement, ecosystem degradation, ecosystem conversions, other modifications in the volume of ecosystem assets, and revaluations arising from price fluctuations.

Box 8 Five types of changes in ecosystem asset accounts

According to the SEEA EA framework, the five types of changes in ecosystem asset accounts are defined as follows (UN, 2021):

- *Ecosystem enhancement* is the increase in the value of an ecosystem asset that is associated with an improvement in the condition of the ecosystem asset.
- *Ecosystem degradation* is the decrease in the value of an ecosystem asset that is associated with a decline in the condition of an ecosystem asset.
- *Ecosystem conversions* are distinct and persistent changes in ecosystem types due to alterations in ecological structure, composition, and function. Such changes are reflected in the supply of a different set of ecosystem services and expected future returns.
- *Other changes in the volume of ecosystem assets* are changes in the value of an ecosystem asset, other than (i) those due to ecosystem enhancement, ecosystem degradation and ecosystem conversion, and (ii) those that are solely the result of changes in unit prices of ecosystem services.
- *Revaluations* are changes in the value of ecosystem assets due solely to movements in the unit prices of ecosystem services which underpin the derivation of the net present value of ecosystem assets.

Ecosystem enhancement should focus only on growth in asset value arising from ecosystem condition improvements that are likely to lead to a rise in future flows of ecosystem services in physical terms. Any increases in value that result from shifts in the expected demand for ecosystem services should be treated as upward reappraisals.

Table 1 Examples of ecosystem condition improvements and shifts in expected demand relevant to water resources and the tourism sector in Southern Thailand

Ecosystem condition improvements	Shifts in expected demand
• Restorations of mangroves and wetlands to improve water filtration • Improved watershed management • Coral reef restoration • Beach erosion control • Improved waste management	• Rising demand for freshwater • Rising demand for pristine beaches and marine parks • Higher willingness to pay for diving or access to pristine beaches

Deterioration in ecosystem conditions may stem from various factors, including the extraction and harvesting of natural resources, as well as both short and long-term effects of pollution and emission. Resource extraction or harvesting from an ecosystem, such as fishing or grazing, should be evaluated relative to the regeneration rate in an appropriate scale and time frame. Only extraction rates that exceed the rate of regeneration should be regarded as degradation.

2.3 Standardizing the National Definition of Natural Capital and Natural Capital Accounts

2.3.1 Natural Capital

UN SEEA defines **natural capital** as "the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people." Across various organizations around the world, the term has been similarly defined as outline in Table 2.

Table 2 International Definitions of "Natural Capital"

Source	Definition
UN SEEA	"The stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.
United Nations Glossary of Environmental Statistics[2] and OECD[3] Glossary of Statistical Terms	"Natural assets in their role of providing natural resource inputs and environmental services for economic production."
EIB[4]	"The value of everything that comes from nature — soil, air, water and all living creatures"

[2] UN Statistics Division. (1997). Glossary of Environmental Statistics. Retrieved February 2, 2026, from https://unstats.un.org/unsd/publication/SeriesF/SeriesF_67E.pdf.
[3] OECD. (2008). *OECD Glossary of Statistical Terms*. https://doi.org/10.1787/9789264055087-en
[4] Knight, C. (2023, July 11). *What is natural capital?*. European Investment Bank. https://www.eib.org/en/stories/nature-environment-pollution

In Thailand, agencies have defined "natural capital" as follows.

Table 3 Definitions of "Natural Capital" in Thailand

Source	Definition
NESDC[5]	"Things that occur naturally, whether they are exhaustible, renewable, or abundant. These resources provide direct benefits as factors of production, goods, and services—such as water, air, sunlight, soil, forests, biodiversity, and minerals—as well as indirect benefits, such as a healthy environment that supports human well-being and quality of life. They also include human-made environments, such as works of art and historical sites.
Community Organizations Development Institute (CODI[6])	"Natural resources and various environmental elements that determine the potential for sustaining life and livelihoods within communities. These include natural water sources, forests, soil, water, mountains, seas, islands, wildlife, minerals, energy, springs, and agricultural crops."

We propose to adopt UN SEEA's definition of "natural capital" as the national one as we are following the UN SEEA framework to NCA.

2.3.2 Natural Capital Accounting

The UN SEEA defines Natural Capital Accounting (NCA) as "an umbrella term covering efforts to use of an accounting framework to provide a systematic way to measure and report on stocks and flows of natural capital." Similar to the various definitions of natural capital, there are also alternative definitions of NCA as outlined in Table 4.

Table 4 Definitions of "Natural Capital Accounting" (NCA)

Source	Definition
UN SEEA	NCA is an umbrella term covering efforts to use of an accounting framework to provide a systematic way to measure and report on stocks and flows of natural capital.
World Bank[7]	NCA integrates natural resources, economic valuation and analysis, providing a better understanding of development progress and its impacts on society and environment than standard measures such as GDP.

[5] NESDC. (n.d.). *Natural Resource and Environmental Capital for Sustainable Development in the 10th Development Plan (2007 - 2011).* Retrieved from https://www.nesdc.go.th/wp-content/themes/plant3-child/assets/pdf/10/2_3.pdf.
[6] Community Organizations Development Institute. (2015). *Manual on Supporting the Development of Economic Systems and Community Capital*.
[7] World Bank. (2025, April 21). *Natural capital*. https://www.worldbank.org/en/topic/natural-capital

European[8] Commission (EC)	NCA is a tool to measure the changes in the stock and condition of natural capital (ecosystems) at a variety of scales and to integrate the flow and value of ecosystem services into accounting and reporting systems in a standard way.
NSO[9]	NCA applies accounting principles to collect and record data on natural resources, which are mostly physical data and information on the use of natural resources, in order to show the relationship between natural resources and production within the economic system.

The definitions of NCA presented in Table 4 share significant similarities, particularly in emphasizing the use of accounting principles to systematically measure and report on natural capital. Given the similarities and considering that Thailand is piloting NCA based on the UN SEEA Framework, we propose adopting the UN SEEA definition as the national standard to ensure alignment, compliance, and consistency with international best practices.

2.4 Global and Regional Best Practices

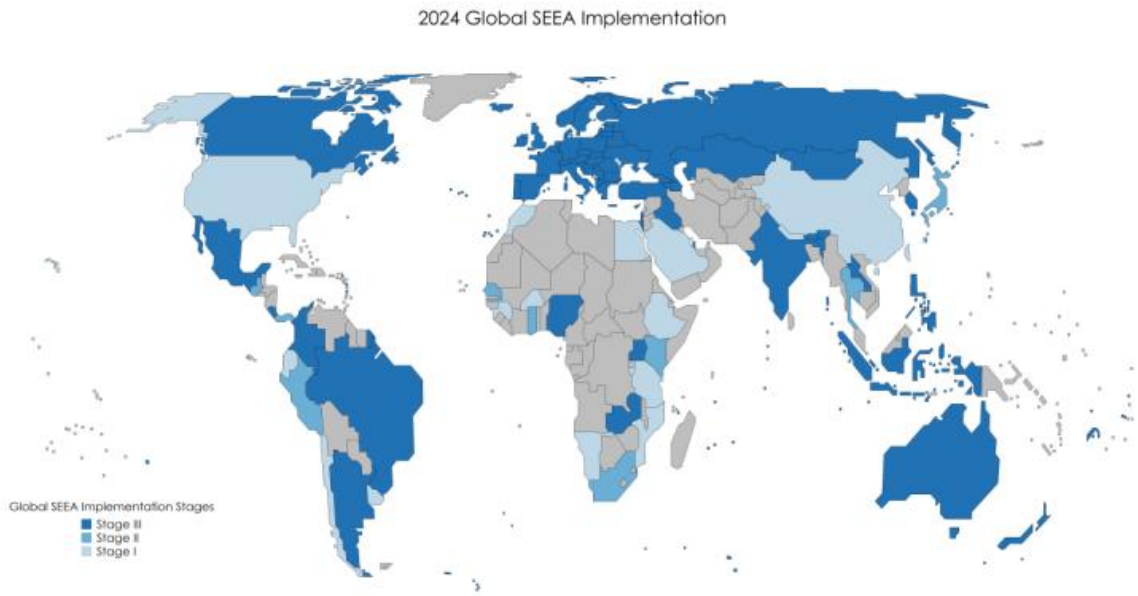
The global gold standard for natural capital accounting is the System of Environmental-Economic Accounting (SEEA). As noted earlier, this framework includes two main components: the SEEA Central Framework (SEEA CF) (adopted by the UN in 2012) and the SEEA Ecosystem Accounting (SEEA EA) (adopted in 2021). In addition to implementation efforts by UN agencies, the Wealth Accounting and Valuation of Ecosystem Services (WAVES) partnership, led by the World Bank, also supports parts of these efforts.

As of 2024, 94 countries worldwide have adopted the SEEA. All of these countries have implemented the SEEA CF, and 53 of them also prepared SEEA EA and/or thematic accounts. Figure 5 illustrates that 71% of the countries regularly report at least one account (Stage III); 11%, including Thailand, report their accounts occasionally (Stage II); and 18% prepare accounts but have not yet publish them (UN, 2025).

[8] European Commission. (n.d.). Natural Capital Accounting. Environment European Commission. https://environment.ec.europa.eu/topics/nature-and-biodiversity/natural-capital-accounting_en#:~:text=Overview,Aligning%20Accounting%20Approaches%20for%20Nature

[9] National Statistics Office. (2021). *Guidelines for Establishing Thailand's Environmental-Economic Accounting System*. NSO. February 2, 2026, https://catalogapi.nso.go.th/api/doc/department/D08/SD08_08/SD08_08_55_7.pdf

Figure 5 Global adoption of SEEA



Source: SEEA Around the World (UN, 2025)

Within Asia, 22 countries compiled at least one account between 2020-2024. Notably, within Southeast Asia, Lao PDR, Indonesia, and the Philippines have reached Stage III of SEEA adoption (UN Statistics, 2025). Thailand falls in the middle at Stage II; the rest of the ASEAN countries either have not yet adopted SEEA or did not report their progress.

Regional Success Case: The Philippines

One notable example of SEEA adoption in Southeast Asia is the Philippines, which has regularly compiled and published both their CF and EA accounts. The Philippines Statistics Authority compiles CF accounts such as those on mineral and energy resources. Environmental accounts such as material flow and water assets are also being developed (UN, 2024)

Implementation-wise, the Philippines is part of WAVES and followed a pilot-to-scale approach. The country started with focused pilot accounts. For example, preliminary physical and monetary asset accounts for minerals were produced from 2000 to 2012 (World Bank, 2020). Then, a national asset account for mangroves and site-specific EA accounts such as one for Southern Palawan followed (Vinculado, C.P.E. (n.d.)).

Institutionally, the Philippines prepared its NCA Roadmap as early as 2017, and with that the country started institutional arrangements along with key policy documents to facilitate smooth SEEA implementation[10]. The current strategic guidance is based on the Roadmap to Institutionalize Natural Capital Accounting (NCA), which

[10] National Economic and Development Authority, Philippine Statistics Authority, & Department of Environment and Natural Resources. (n.d.). Roadmap to Institutionalize Natural Capital Accounting in the Philippines (Abridged). FAOLEX Database. https://faolex.fao.org/

covers the national implementation of NCA from 2022 to 2040. In May 2024, the Philippine Ecosystem and Natural Capital Accounting System (PENCAS) Act was passed, mandating the creation and regular use of NC accounts in policymaking (SEADS, 2024). This marks an important step towards fully integrating natural capital accounting into national development planning.

Several lessons can be learned from the Philippines. First, strong institutional and legal frameworks, such as the PENCAS Act, provide clear policy direction and enable smooth, stable implementation of SEEA. Second, interagency collaboration is essential for the sustainable adoption of SEEA. In the Philippines, several government bodies are involved throughout the NCA process—from data collection to account compilation and the integration of NCA into policymaking. This collaboration is made possible thanks to the mentioned strong institutional and legal frameworks. Last but not least, capacity building is critical to developing technical skills and familiarity with the SEEA frameworks. Several workshops and other training initiatives have been conducted over the past several years to strengthen these capabilities.

2.5 Scope of NCA and the Interdependencies of the Tourism and Water Resource Sectors

This report aims to construct a Natural Capital Account based on the United Nations System of Environmental-Economic Accounting (SEEA). The geographical area understudied is Krabi province located in the southern region of Thailand (Figure 6). Krabi province is chosen as it is endowed with valuable ecosystems comprising of mountainous terrains, agricultural flat plane, urban dwellings along the coast and marine ecosystems that are home to the endanger specie dugongs. Krabi province has inland area of about 50 million hectare and an ocean area of another 50 million hectare.

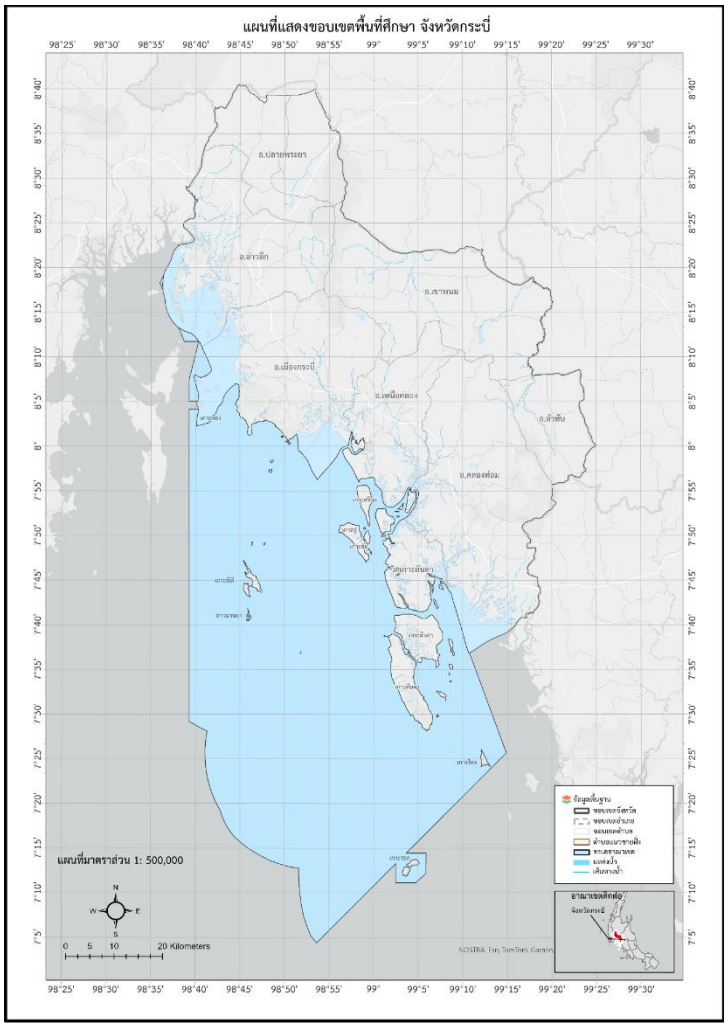
Given the natural beauty of Krabi ocean, beautiful Krabi has been an attractive tourist destination for both international and local tourists. The main marine attractions include the Phi Phi islands, Ao Nang beach, Hong Island, Railay beach and Maya Bay. Snorkeling and scuba diving are popular among the international tourists. A notable destination among the tourists is migratory bird watching at Krabi river and its mangrove forests located within the Khao Pra-Bang Khram Wildlife Sanctuary, Klong Prasong Subdistrict, Krabi province.

water pollution, destructions to corrals and seagrass areas that are the habitat of dugongs. High rate of visitation has led the Department of National Parks, Wildlife and Plant Species to close Maya Bay for three years during 2018-2021 for rehabilitation.

For this reason, Krabi ecosystems has been under pressure from visitations and the natural capital of Krabi province has been under threat. Should this development trend continue, Krabi tourism will not be able to sustain. During the pre-Covid 19, Krabi attracted about five million tourists each year. This high level of visitation rate has imposed several negative environmental impacts on Krabi ecosystems, such as fresh water pollution from untreated wastewater discharge from restaurants, hotels and laundry services; beach destruction from tourist activities and littering; seawater disruption from long-tail and jet boats; wastewater discharge from jetty, ports cleaning and fresh markets.

The scope of this report is, therefore, to construct a Natural Capital Account (NCA) based on the UN-SEEA for Krabi province focusing on two sectors, they are, the tourism sector and the water resource sector (water quality of both freshwater and seawater) covering five-year period from 2016 to 2020.

Figure 6 The scope of study area: Krabi province



When focus on the tourism and water resource sectors, the ecosystem of Krabi province that are relevant includes the freshwater ecosystem, terrestrial ecosystem, and marine ecosystem. These three ecosystems are inter-dependent as the forest coverage on the highlands serves as water retention during the raining seasons and provides water to the flat plane during the dry seasons. The abundance of freshwater supply thus depends not only on rainfall pattern, but also the condition of the forest coverage as well. As expansion of the urban areas and tourism activities translate into an increase in water demand as well as wastewater discharge into public waterways. The quality of freshwater when drain into the ocean will affect marine lifeforms, such as seagrass, corals and tourism activities. To understand this inter-dependency, consultants will carry out tourism assessment and water resource assessment, and to identify the inter-dependency of the ecosystems in Krabi province. The analysis will utilize land use information, GIS maps, environmental quality indicators, services derived from the ecosystems (both physical and monetary) to construct SEEA for Krabi province.

2.6 Data sources

In constructing the five SEEA account as described in section 2.2 above (ecosystem extents, ecosystem conditions, ecosystem services (physical terms), ecosystem service (monetary terms) and ecosystem asset accounts) requires extensive data. Table 5 shows the types of data requirement and the sources where these data can be obtained. Most of the data can be obtained from government agencies, some primary data may be collected at the study site. Some data, especially when constructing the monetary terms of the ecosystem services account, valuation data is obtained from academic publications. After the data is tabulated, units must

be standardized and normalized. This information will enable the report to construct the National Framework for Natural Capital Accounting for Thailand.

Table 5 Data flow and data sources

Stock Account

(and change in stocks)

Extent Account

Information/Data Type	*Department*
Land (use) Benefits	Land Development
Maritime Zones	Royal Thai Navy
Administrative Jurisdictions	Department of Provincial Administration
Data of Seagrass and Coral Reef	Department of Marine and Coastal Resources
Areas & Locations of Mooring Sites	Department of National Parks, Wildlife and Plant Conservation
Boundaries of Koh Rok, Krabi	Geo-Informatics and Space Technology Development Agency (GISTDA)

Condtion Account

Information/Data Type	*Department*
Quality of Surface Water and Seawater	Pollution Control & Regional Environmental Office 15
Species Richness of Fish	Department of Fisheries
Species Richness of Trees and Birds & Protected Forest Areas and Their Density in Relation to the Total Area of Krabi Province	Department of National Parks, Wildlife and Plant Conservation
Crop Diversity	Office of Agricultural Economics
Vegetation water content (NDWI) and Vegetation index (NDVI)	Geo-Informatics and Space Technology Development Agency (GISTDA)
Soil Organic Carbon Content	Land Development

Monetary Asset Account [in progress]

Flow Accounts

Service Accounts (Physical and Monetary)

Information/Data Type	*Department*
Agricultural Yields and Agricultural Commodity Prices	Office of Agricultural Economics
Data on Fisheries and Aquaculture in Freshwater and Marine Environments	Department of Fisheries
Quantity of Natural Water Bodies and Reservoirs & the Water usage for various purposes	Department of Water Resource, Department of Groundwater Resource, Metropolitan Waterworks Authority, and Royal Irrigation
Forests	Royal Forest & Forest Industry Organization (Southern Region)
Quantity and Price of Electricity Generated from Biomass Power Plants	Electricity Generating Authority of Thailand & Office of Energy Regulatory Commission
Mangrove Forests	Department of Marine and Coastal Resources
Number of Accommodation Rooms and the Number of Tourists	Office of the Permanent Secretary, Ministry of Tourism and Sports
Carbon Price	Excise Department

2.7 Policy scenario analysis for the water and tourism sectors

The construction of NCA based on the UN-SEEA system will be instrumental in decision makings when initiate development projects, preparation of budgets and work plans of government agencies, assessing the environmental and economic impacts of large-scale development project (both public and private alike), designing of market-base instruments as well as providing environmental justice, such as determining compensations or fines in case of environmental damages.

After reviewing the situations of water resources and tourism at Krabi province, it is learned that Krabi has been expanding steadily owing largely to the inflow of foreign income in the tourism sector. Krabi province is one of the world well-known tourist destinations. Each year, about 5-6 million visitors come to Krabi province. Before the COVID-19, the well-known Maya Beach in Krabi province alone accommodates as many as 5 million visitors each year until the area became deteriorated to the point national park authority had to close Maya Beach for rehabilitation.

Such incidence shows that the volume of tourism at Krabi province has begun to exceed the carrying capacity of nature and the existing facilities. In addition to the closing of Maya beach there are other warning signs that tourism activities begins to exceed the carrying capacity. Wastewater and water pollution at Ao Nang area is becoming critical.

It is therefore useful to use the SEEA accounts developed earlier to analyze what may be suitable policy responses to the pressure Krabi province.

Three policy responses to be tested are:

1) The net benefit of periodical wastewater discharge monitoring.

2) The net benefit investment in wastewater treatment plant.

3) The impact of forest rehabilitation and the net benefit of forest rehabilitation.

These policy responses will aid the annual budget preparation of Krabi province and enable Krabi province as well as the Budget Bureau (central government) to determine the optimum level of budget allocation to various activities for Krabi Province.

2.8 Co-Finance Source Committed for the Development of NCA

Thailand has placed significant emphasis on the state of natural resources and environment. Several reports on the state of natural resources and environment have been produced periodically in Thailand, for instance, the annual State of Environment Reports by The Office of Natural Resources and Environmental Policy and Planning (ONEP) or the annual Pollution Reports by the Pollution Control Department.

On standardizing the reporting structure of state of natural resources and environment the National Statistical Office provided “An SEEA Guideline for Constructing the Water Resource Satellite Accounts for Thailand” (2001). This guideline became useful for water resource management particularly for preparing long-term planning and strategies to prevent flooding and droughts. National Center for Genetic Engineering and Biotechnology (BioTec), on the other hand, produced “The System of Environmental Economics Accounting (SEEA) and the Tourism Satellite Account for Tourism in Andama Ocean”2020.

In 2025, the Office of Natural Resources and Environmental Policy and Planning (ONEP) and National Center for Genetic Engineering and Biotechnology (BioTec) produced the “Report on System of Environmental Economics Accounts under the System of National Accounts: SNA” for the forestry sector and the “Guideline for Report on System of Environmental Economics Accounts” under the System of National Accounts: SNA” for the forestry sector”.

In 2026, the Ministry of Tourism and Sports, National Statistical Office (NSO), completed the “(Draft) The System of Environmental Economics Accounts, Central Framework”.

Finally, the National Economic and Social Development Council (NESDC), the key central planning agencies in Thailand began work on stocktaking of the state of knowledge of the Natural Capital Account (NCA) in Thailand. NESDC envisions that NCA will play an important role in the preparation of the National Economic and social Development in the future.

3. Thailand Policy Framework NCA

3.1 National Level Legal Structure, Public Administration and Plans

Thailand is governed under constitutional monarchy or constitutional democracy. The current Thai Constitution B.E.2560 outlines the legal structure, public administration structure and layers of national plans. The Constitution B.E.2560 stipulates that the Thai public affair governed under three bodies: the legislative body comprising of the lower house or

the house of representatives and the upper house or senators; the administrative bodies comprising of the cabinet, ministers and director generals, and the judiciary body comprising of the administrative court, the constitutional court and the court of justice. These three governing bodies serve as check and balance of public administration. (See Figure 7)

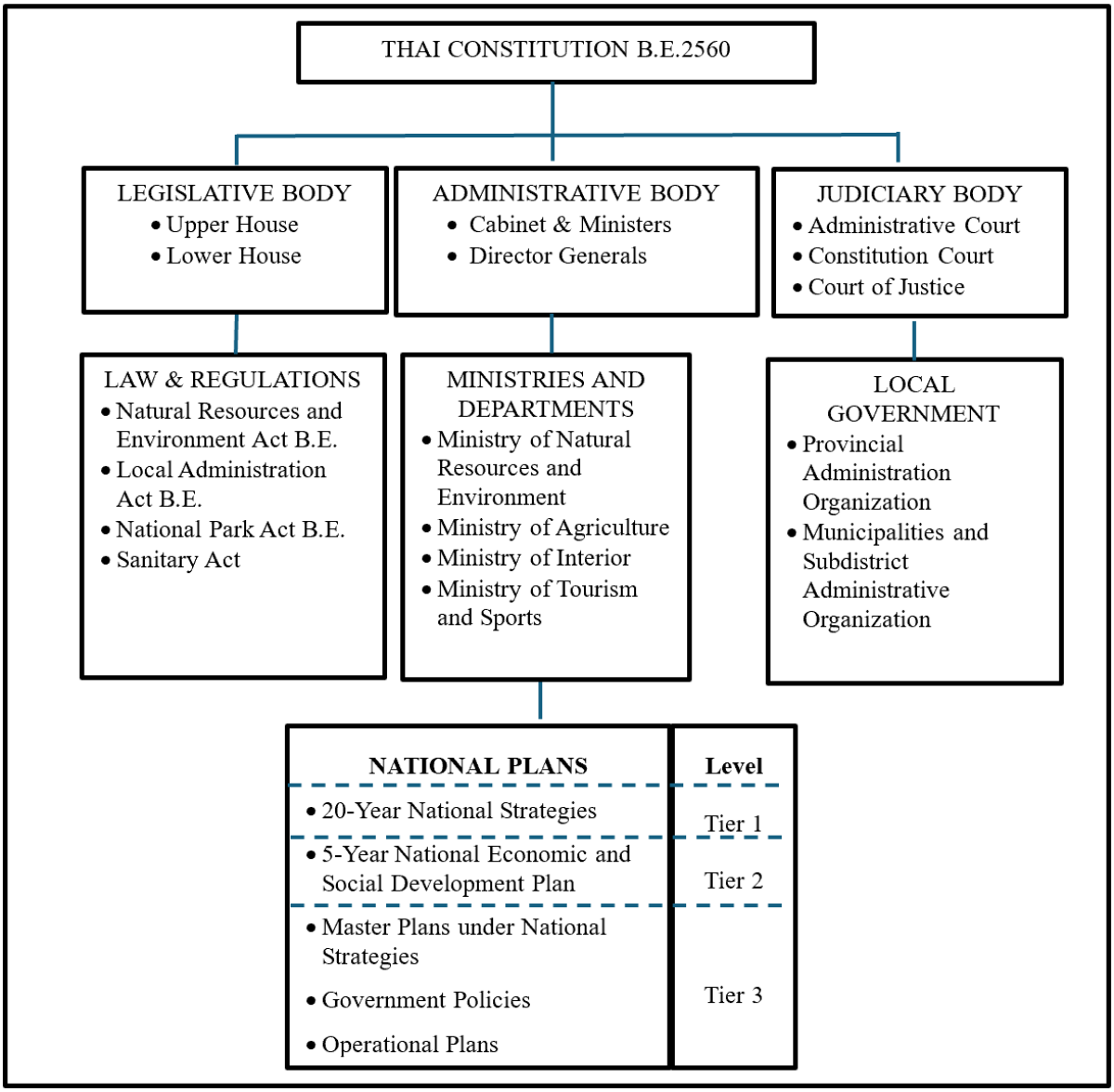
The legislative body is responsible for promulgating laws and regulations which provide guiding principles, responsibility and obligations of for public administration. Currently, several laws and regulations are used to govern national affairs, including natural resource management, environmental management and pollution control, such as the Natural Resources and Environmental Act, the National Park Act or the Sanitary Act.

The administrative body on the other hand, led by the elected prime ministers and the cabinets provide policy directions of his/her administration, for instance, the Ministry of Natural Resources and Environment, the Ministry of Interior, or the Ministry of Tourism and Sports.

In terms of national plans, all the national development plans are categorized into Tier 1, Tier 2 and Tier 3 plans. All the development plans are guided under the directions of the 20-year National Strategies. Under Tier 1 is the Tier 2 plans that include the 5-year National Economic and Social Development Plan. Below Tier 2 is Tier 3 plans which are the various master plans of each ministry, departments and organizations. Therefore, it can be surmised that all the master plans governing the economic sectors, such as natural resource and environment must conform to the directions of the Tier 2, and hence Tier 1 directives.

Parallel to the public administration of the central government is local government administration. Local government is quasi-independent from the central government. Although the local governments are elected from their electorates and their responsibilities are geared towards providing local public services, such as residency registration, birth and death records, sanitation, waste treatment, etc., local government is linked with the central government only via the ministry of interior. Work plans and development plans of the local government still need to conform to laws and regulations and Tier 1, 2, and 3 national plans. There are two types of local government in Thailand: the Provincial Administration Organizations who oversee the welfare at the province level and the Municipalities and the Subdistrict Organizations who oversee the welfare at the subdistrict level.

Figure 7 National level legal structure, public administration and plans



3.2 Local Level Public Administration

The Thai public administration at the local level is based on the national level public administration as shown in Figure 7 above. Although Thailand has expanded role of the local governments in many services, the role of central governments including central government agencies and state enterprise at the local level are still important in the public administration. The role of central governments at the local level is known as “function base” whereas the role of local governments is known as “area base”. Therefore, at the local level, there is a degree of integrating responsibilities between central government agencies who provide public services according to their functions. For instance, the Ministry of Natural Resources and Environment operates a local office at Krabi province called the Provincial Office of Natural Resources and Environment Krabi or the Ministry of Public Health operates a local office at Krabi province called the Provincial Office of Public Health Krabi.

In addition, there are also central governments who provides public utility or public services known as the state enterprises at the local level as well, for instance, the Provincial Electricity Authority, the Provincial Waterworks Authority, the Wastewater Management Authority or the Tourism Authority of Thailand.

The local governments in Thailand are categorized into different types depending on the size of population of each juristic. These local governments are generally responsible for providing public services, they are, the Provincial Administration Organization, City Municipalities, Town Municipality, Subdistrict Municipality and Subdistrict Administrative Organization. In 2026, here are altogether 7,850 local government offices throughout Thailand whose responsibilities are to provide local services to the residents of their jurisdictions.

Among the numerous types of government agencies operating at the local level, there exist a collaborative mechanism that coordinate activities of each agency, both the function base agencies and the area base agencies, that is the Provincial Office of the province lead by the Provincial Governor. The Provincial Governor of each province has a responsibility to oversee the wellbeing the people and the operation of all government agencies in the province. The Provincial Office prepares the provincial plans that provides the direction for provincial development. Therefore, the Provincial Governor has the authority to coordinate efforts from all the government agencies to overcome problems should they arise and to make sure that the provincial development plans are sufficiently funded.

With respect, it was learned that NCA information is best utilized at the Krabi provincial level. The outcome of NCA helped the Krabi Provincial Office allocate more budget for wastewater treatment and wastewater monitoring. Such investments will promote a healthier marine ecosystem.

4. Short-term work plan for Policy Interests

4.1 Aligning natural capital accounting to national water resources and tourism sector policy

Tourism plays a significant role in the Thai economy, with tourist spending accounting for 8.9% of the country’s GDP in 2024. The sector depends heavily on natural resources, particularly water resources such as rivers, waterfalls, shorelines, and marine ecosystems. However, there is growing concern that tourism may place unsustainable pressure on these resources. To address this, it is essential to incorporate the environmental impact of tourism into sector policymaking. One effective approach is to integrate natural capital into national

accounts and policies. Doing so will guide policy design and help ensure the long-term sustainability of both natural resources and the tourism industry.

This section will outline national policies related to tourism and water resources and discuss the implications of NCA for these policies. It will also briefly propose a work plan to better align these policies with NCA.

4.1.1 Relevant National Policies and NCA Implications

Thailand has several national plans and policies relevant to natural resources and the tourism sector, ranging from overarching frameworks such as the 20-Year National Strategy to the National Economic and Social Development Plans (NESCPs) and budgetary policies. These policies emphasize sustainable growth and often establish relevant objectives and strategies. However, they may not always provide sufficiently practical tools for effective implementation as will be discussed in this subsection.

(1) The 20-Year National Strategy

The most relevant strategy to tourism and water resources in the 20-Year National Strategy is Strategy 5: Eco-Friendly Development for Growth/Green Growth. This strategy aims to balance economic growth with its impact on quality of life and the environment.

Specifically, one of the KPIs in this strategy is to replenish degraded natural resources. The strategy also highlights conservation of water resources, sustainable growth based on the blue economy, and the enhancement of water productivity.

There are several ways in which NCA can contribute to achieving these objectives. First, NCA can help identify natural resource degradation, which is crucial for any replenishment efforts. In addition to identifying degradation, NCA enables return on investment calculation for replenishment or conservation initiatives, ensuring resources are allocated where they will deliver the greatest economic and environmental benefits.

For water productivity enhancement, ecosystem services tracking within NCA provides insights into water resource productivity and can inform decisions on viable improvements. Furthermore, by integrating water accounts into national statistics, governments can design pricing and incentives that reflect scarcity and encourage efficient use.

Last but not least, NCA offers a framework for assessing whether economic growth is truly sustainable, which is critical for balancing development objectives with long-term environmental stewardship and resilience.

(2) The 13th National Economic and Social Development Plan

Within the 13th NESDP, three milestones are related to tourism and water resources:

- Milestone 2: Thailand as a Sustainable Quality-Oriented Tourism Destination
- Milestone 10: Thailand as a Circular Economy and Low-Carbon Society
- Milestone 11: Coping with Natural Disasters and Climate Change

NCA can contribute to this Plan in a number of ways. For Milestone 2, NCA enables the identification of “high-value” tourism activities by incorporating environmental costs and benefits into economic assessments. This

approach helps policymakers prioritize tourism models that generate economic returns while minimizing ecological impacts. Additionally, NCA can inform destination management by tracking ecosystem services and water resource use, ensuring that tourism development aligns with sustainability objectives.

Second, satellite accounts for water and tourism allow us to set appropriate "prices" for water use and tourism activities and highlight the circular nature of water resources, corresponding to both Milestones 2 and 10. By tracking ecosystem service flows between water resources and the tourism sector, policymakers can set water charges such that they reflect water scarcity and account for environmental impacts such as those arising from wastewater discharge.

As for Milestone 11 on natural disasters and climate change, NCA can inform policymakers about vulnerable areas and assess if climate change mitigation measures are economically justified. For example, NCA can provide the economic justification to invest in green infrastructure, such as watershed restoration and mangrove rehabilitation, due to their ecosystem services in shoreline preservation, flood control, and water purification.

(3) Budgetary Policies

As mentioned earlier, NCA can play a crucial role in evaluating the costs and benefits of policies. When properly integrated, it becomes an essential tool for the budgetary process. With NCA, budgets can be allocated to projects and initiatives that deliver the highest economic returns while accounting for environmental impacts. For example, water and tourism satellite accounts may indicate that investing in wastewater treatment facilities for popular tourist destinations would not only reduce pollution and protect ecosystems but also enhance the long-term attractiveness of these destinations, thereby generating sustained economic benefits.

This kind of budgetary need highlights the importance of NCA at the local level, such as the provincial level. This is because many environmental impacts occur locally, and local administrative organizations often lack the tools to incorporate nature into their budgeting processes or to support their environmental budget requests.

Another practical use of NCA in the budgetary process is calculating the depreciation of natural capital. This information is valuable for allocating budgets for restoration and preservation. For example, if NCA shows that mangrove ecosystems are losing value due to coastal erosion, funds can be directed toward mangrove rehabilitation projects.

At the national level, NCA, particularly for tourism and water resources, can play an important role in the **Medium-Term Expenditure Framework (MTEF)**. MTEF aims to reduce Thailand's budget deficit as a percentage of GDP. On the revenues side, tourism contributes significantly to Thailand's GDP. Green policies, such as incentives for electric vehicles (EVs) and gasoline taxes, may also affect tax revenues. On the expenditures side, budgets are required to maintain natural resources to sustain tourism and economic growth. In addition, climate change is expected to increase budgetary needs for managing risks from extreme weather events and natural disasters. For these reasons, tourism and water resources, along with other natural resources and environmental factors, are closely linked to MTEF.

By linking NCA to MTEF, it can be evaluated if tourism growth is sustainable and how it may affect GDP in the future. NCA also supports identifying budgetary needs for environmental priorities such as natural resource replenishment and climate change risk mitigation. This makes the expenditure side of MTEF more robust and aligned with sustainable growth objectives. Altogether, NCA can strengthen MTEF by incorporating natural and environmental dimensions and ensuring that MTEF goals are consistent with long-term economic resilience and ecological sustainability.

4.1.2 NCA alignment and future work plan

In summary, NCA can be integrated into national policy frameworks as detailed in Table 6.

Table 6 NCA alignment and integration with national policy frameworks

National policy framework	Key elements from the policy framework	NCA alignment and integration
20-Year National Strategies	Strategy 5: Eco-Friendly Development for Growth	• Identifying natural resource degradation • Calculating ROI for conservation and replenishment efforts • Tracking ecosystem services for water productivity • Assessing sustainability
13th NESDP	• Milestone 2: Thailand as a Sustainable Quality-Oriented Tourism Destination • Milestone 10: Thailand as a Circular Economy and Low-Carbon Society • Milestone 11: Coping with Natural Disasters and Climate Change	• Identifying high-value tourism activities • Setting appropriate prices for natural capital • Providing justification for climate adaptation green investments
Budgetary policies and MTEF	-	• Evaluating environmental-relevant costs and benefits of budget requests • Calculating natural capital depreciation and allocating budgets for conservation and restoration • Linking economic activities and natural capital to fiscal planning to ensure long-term sustainability and economic resilience

Taking this integration as a medium- to long-term goal, steps are necessary to ensure that the integration is smooth and effective. With our project as a pilot case for NCA in Thailand, we can disseminate our findings to stakeholders, such as NESDB, MONRE, MOAC, and MOTS, to build awareness and understanding. From there, we can expand the scale of NCA to cover other geographical areas and sectors in the future.

4.2 Krabi provincial NCAs for the tourism sector and water resources

4.2.1 Institutional arrangements

The Krabi Provincial Governor (Mr. Phasakon Bunyalak) signed Krabi Provincial Order No. 1827/2023, dated May 8, 2023, appointing a working group to develop a natural capital accounting system for the tourism and water management sectors in Krabi Province. The working group consists of representatives from various relevant government agencies and stakeholders, such as from tourism, fisheries, and environmental sectors. Following this order, we established a provincial working group for Krabi and held two working group meetings in 2024 and 2025.

4.2.2 Krabi provincial NCAs for water resources and the tourism sector

Following the tourism sector and water resources situation assessment, we collected geographic information database of Krabi, performed spatial data analysis, and established natural capital accounts for water resources and the tourism sector as follows.

First, we established **ecosystem extent accounts** for Krabi between 2016-2020 as show in Table 7. For terrestrial resources, the biomes include forests, shrubland, grassland, and intensive land use. Freshwater biomes consist of rivers and streams, lakes, and artificial wetlands. Marine biomes comprise marine shelves, pelagic ocean waters, and anthropogenic marine biomes. Our extent accounts also cover transitional biomes, such as marine-freshwater terrestrial and marine terrestrial biomes. Between 2016 and 2020, we found net reductions in areas of forests, plantations, permanent upland streams, rice paddies, freshwater aquafarms, intertidal areas, and sandy shorelines.

Table 7 Ecosystem Extent Accounts of Krabi

Realms	Terrestrial							Freshwater						Marine				Marine-Freshwater-Terrestrial	Marine-Terrestrial	
Biomes	T1: Tropical-subtropical forests	T2: Temperate-boreal forests and woodlands	T3: Shrubland	T4: Grassland	T7: Intensive land use			F1: River and streams	F2: Lake Biome	F3: Artificial wetlands biome				M1: Marine shelf		M2: Pelagic ocean water	M4: Anthropogenic marine biome	MFT: Marine-Freshwater-Terrestrial	MT: Marine-Terrestrial	
Ecosystem Functional Group (EFG)	T1.3 Tropical-subtropical montane rainforests	T2.2 Deciduous temperate forests	T3.1 Seasonally dry tropical shrubland	T4.5 Temperate subhumid grassland	T7.1 Annual Cropland	T7.3 Plantations	T7.4 Urban and industrial ecosystem	F1.1 permanent upland stream	F2.1, F2.2, Small and large freshwater lakes	F3.1 Large Reservoir	F3.3 Rice paddies	F3.4 Fresh water aquafarm	F3.5 Canals/ Ditches, Drains	M1.1 Seagrass meadows	M1.3 Photic coral reefs	M2 Pelagic ocean water (Unable to categorize M2.1 -M2.5)	M4.1 Submerged artificial structures	MFT1.2 Intertidal forests and shrublands	MT1.3 Sandy shorelines	Total Ecosystem Accounting Area
Opening extent (2016)	63,487.50	11.75	2,489.75	1,392.00	908.75	351,152.75	19,148.75	7,558.50	156.50	984.75	1,310.00	4,395.50	556.75	5,404.50	2,249.00	457,861.00	1,022.75	39,832.50	845.00	960,768.00
Additions to extent	648.50	0.00	700.50	483.25	346.00	2,610.50	4,787.50	34.75	10.50	117.00	6.50	102.75	548.25	0.00	0.00	53.50	0.00	440.50	12.00	10,902.00
Reductions to extent	1,543.25	11.75	409.00	188.75	311.75	6,325.00	920.50	40.50	7.00	19.25	307.00	335.25	14.75	0.00	0.00	0.00	0.00	452.00	16.25	10,902.00
Net change in stock	(894.75)	(11.75)	291.50	294.50	34.25	(3,714.50)	3,867.00	(5.75)	3.50	97.75	(300.50)	(232.50)	533.50	0.00	0.00	53.50	0.00	(11.50)	(4.25)	0.00
Closing extent (2020)	62,592.75	0.00	2,781.25	1,686.50	943.00	347,438.25	23,015.75	7,552.75	160.00	1,082.50	1,009.50	4,163.00	1,090.25	5,404.50	2,249.00	457,914.50	1,022.75	39,821.00	840.75	960,768.00
Retained stock	61,944.25	0.00	2,080.75	1,203.25	597.00	344,827.75	18,228.25	7,518.00	149.50	965.50	1,003.00	4,060.25	542.00	5,404.50	2,249.00	457,861.00	1,022.75	39,380.50	828.75	949,866.00

Following the extent accounts, we evaluated conditions of water resources and formed the **ecosystem condition accounts** for the same period of time as shown in Tables 8-10. Table 8 illustrates our freshwater conditions and shows an improvement in freshwater conditions due to increases in both WQI and BOD.

Table 8 Ecosystem Condition Accounts for Krabi Water Resources

SEEA Ecosystem Condition Typology Class		Variables		Freshwater (F)										
				Variable values (observed)		Reference level values		Indicator values (rescale)			Indicator weight	Index Values		
		Descriptor	Measurement unit	Opening 2016	Closing 2020	Lower level	Upper level	Opening	Closing	Change in indicator (Closing-Opening)		Opening	Closing	Change
Abiotic characteristics	**A1.Physical state**	Data Not available												
	A2. Chemical state	WQI at Saphan Tha Nam Station	index (0-100)	62.0	73.2	0	100	0.62	0.73	0.11	0.20	0.12	0.15	0.02
		WQI at Khlong Yai Station	index (0-100)	58.0	77.1	0	100	0.58	0.77	0.19	0.20	0.10	0.15	0.06
	Total abiotic							**0.60**	**0.75**	**0.30**	**0.40**	**0.22**	**0.30**	**0.08**
Biotic characteristics	**B1.Compositional state**	Fish species richness[1]		54.00	54.00	0	176	0.31	0.31	0.00	0.20	0.06	0.06	0.00
	B2.Structural state	Data Not available												
	B3.Functional state	BOD at Saphan Tha Nam Station	(mg/l) rescaled 4.0 =0%, 1.5=100%	80	140	0.00	100.00	0.8	1.40	0.60	0.20	0.16	0.28	0.12
		BOD at Khlong Yai Station	(mg/l) rescaled 4.0 =0%, 1.5=100%	80	108	0.00	100.00	0.8	1.08	0.28	0.20	0.16	0.22	0.06
	Total biotic							**0.64**	**0.93**	**0.88**	**0.60**	**0.38**	**0.56**	**0.18**
Landscape/waterscape characteristics	**C1.Landscape/waterscape**	Data Not available												
	Total landscape/waterscape	Data Not available												
Total											**1.00**	**0.60**	**0.86**	**0.26**

Table 9 presents the ecosystem condition accounts for terrestrial resources. These accounts indicate that the physical, chemical, compositional and structural states of these resources remained relatively stable between 2016 and 2020. For example, the numbers of bird and tree species were similar in both years. In contrast, marine resources show mixed trends, with some improvements and some deteriorations, as illustrated in Table 10.

Table 9 Ecosystem Condition Accounts for Krabi Terrestrial Resources

SEEA Ecosystem Condition Typology Class		Variables		Terrestrial (T)										
				Variable values (observed)		Reference level values		Indicator values (rescale)			Indicator weight	Index Values		
		Descriptor	Measurement unit	Opening 2559	Closing 2563	Lower level	Upper level	Opening	Closing	Change in indicator (Closing-Opening)		Opening	Closing	Change
Abiotic characteristics	**A1.Physical state**	Normalized Difference Water Index (NDWI)	index (-1 to 1)	-0.31	-0.35	-1	1	0.35	0.33	-0.02	0.13	0.04	0.04	0.00
	A2. Chemical state	Soil organic carbon content (2021)	index (0 to 8)	4.66	4.66	0	8	0.58	0.58	0.00	0.13	0.07	0.07	0.00
	Total abiotic							**0.46**	**0.45**	**-0.02**	**0.25**	**0.12**	**0.11**	**0.00**
Biotic characteristics	**B1.Compositional state**	Tree species richness[1]	Number	423	423	0	100	4.23	4.23	0.00	0.13	0.53	0.53	0.00
		Bird species richness[2]	Number	348	348	0	1083	0.32	0.32	0.00	0.13	0.04	0.04	0.00
	B2.Structural state	Forest cover density[3]	%	6.34	6.34	0	100	0.06	0.06	0.00	0.13	0.01	0.01	0.00
		Crop diversity[4]	Number	10	10	0	27	0.37	0.37	0.00	0.13	0.05	0.05	0.00
	B3.Functional state	Normalized Difference Vegetation Index (NDVI)	index (-1 to 1)	0.36	0.40	-1	1	0.68	0.70	0.02	0.13	0.09	0.09	0.00
	Total biotic							**0.95**	**0.95**	**0.02**	**0.63**	**0.71**	**0.71**	**0.00**
Landscape/waterscape characteristics	**C1.Landscape/waterscape**	Forest area density	%	0.127	0.126	0	100	0.00	0.00	0.00	0.13	0.00	0.00	0.00
	Total landscape/waterscape							**0.00**	**0.00**	**0.00**	**0.13**	**0.00**	**0.00**	**0.00**
Total											**1.00**	**0.82**	**0.82**	**0.00**

Table 10 Ecosystem Condition Accounts for Krabi Marine Resources

SEEA Ecosystem Condition Typology Class		Variables		Marine (M) + Marine-Freshwater-Terrestrial (MFT) + Marine-Terrestrial (MT)										
				Variable values (observed)		Reference level values		Indicator values (rescale)			Indicator weight	Index Values		
		Descriptor	Measurement unit	Opening 2559	Closing 2563	Lower level	Upper level	Opening	Closing	Change in indicator (Closing-Opening)		Opening	Closing	Change
Abiotic characteristics	A1.Physical state	**Transparency**												
		Noppharat Thara Beach	Meter	0.55	0.40	0.36	0.44	2.38	0.50	-1.88	0.02	0.04	0.01	-0.03
		Ao Nang	Meter	0.65	0.50	0.45	0.55	2.00	0.50	-1.50	0.02	0.04	0.01	-0.03
		Noppharat Thara Beach (Pak Khlong Haeng)	Meter	1.25	1.50	1.35	1.65	-0.33	0.50	0.83	0.02	-0.01	0.01	0.01
		Bilae Beach (Koh Hong)	Meter	0.70	1.00	0.9	1.1	-1.00	0.50	1.50	0.02	-0.02	0.01	0.03
		Ban Saladan (Koh Lanta)	Meter	0.70	0.40	0.36	0.44	4.25	0.50	-3.75	0.02	0.08	0.01	-0.07
		Loh Ba Gao Bay, Koh Phi Phi (Eastern)	Meter	0.65	0.60	0.54	0.66	0.92	0.50	-0.42	0.02	0.02	0.01	-0.01
		Loh Dalum Beach, Koh Phi Phi (Central–Western)	Meter	0.50	0.60	0.35	0.70	0.43	0.71	0.29	0.02	0.01	0.01	0.01
		Loh Dalum Beach, Koh Phi Phi	Meter	1.50	6.00	1.10	6.00	0.08	1.00	0.92	0.02	0.00	0.02	0.02
		Loh Dalum Beach (Phi Phi Cabana), Koh Phi Phi	Meter	0.90	0.80	0.50	0.90	1.00	0.75	-0.25	0.02	0.02	0.01	0.00
		Ton Sai Beach (Ton Sai Village), Koh Phi Phi (Southern) – Point 1	Meter	0.95	1.20	0.80	1.20	0.38	1.00	0.63	0.02	0.01	0.02	0.01
		Ton Sai Beach (Ton Sai Village), Koh Phi Phi (Southern) – Point 2	Meter	8.00	9.50	7.00	11.00	0.25	0.63	0.38	0.02	0.00	0.01	0.01
		Long Beach, Ko Phi Phi (Southeastern)	Meter	1.15	0.60	0.60	1.15	1.00	0.00	-1.00	0.02	0.02	0.00	-0.02
		Maya Bay	Meter	1.10	1.80	1.10	4.00	0.00	0.24	0.24	0.02	0.00	0.00	0.00
		Railay Bay	Meter	0.90	0.80	0.30	0.90	1.00	0.83	-0.17	0.02	0.02	0.01	0.00
		Klong Dao Beach	Meter	0.65	0.40	0.30	0.65	1.00	0.29	-0.71	0.02	0.02	0.01	-0.01
		Baan Klong Nin (Koh Lanta)	Meter	1.10	0.40	0.25	1.10	1.00	0.18	-0.82	0.02	0.02	0.00	-0.01
		Baan Sriraya (Koh Lanta)	Meter	0.65	1.00	0.35	1.10	0.40	0.87	0.47	0.02	0.01	0.02	0.01
		baan bor maung (Bor Maung Bay)	Meter	2.25	1.50	1.35	2.25	1.00	0.17	-0.83	0.02	0.02	0.00	-0.01
		Thale Waek (Separated Sea)	Meter	1.15	0.20	0.20	1.25	0.90	0.00	-0.90	0.02	0.02	0.00	-0.02
		Laem Tong, Koh Phi Phi	Meter	0.55	0.80	0.50	0.85	0.14	0.86	0.71	0.02	0.00	0.02	0.01
		Koh Poda[1]	Meter	7.15	6.00	5.50	7.15	1.00	0.30	-0.70	0.02	0.02	0.01	-0.01
		Koh Kai (Chicken Island) [1]	Meter	7.00	2.70	2.70	7.00	1.00	0.00	-1.00	0.02	0.02	0.00	-0.02
		Loh Samah Bay[1]	Meter	11.50	8.00	3.00	11.50	1.00	0.59	-0.41	0.02	0.02	0.01	-0.01
		Koh Yung (Mosquito Island) [1]	Meter	6.00	1.00	1.00	6.00	1.00	0.00	-1.00	0.02	0.02	0.00	-0.02
	A2. Chemical state	**MWQI**												
		Noppharat Thara Beach	index (0-100)	82.30	81.67	0	100	0.82	0.82	-0.01	0.02	0.01	0.01	0.00
		Ao Nang	index (0-100)	60.40	83.83	0	100	0.60	0.84	0.23	0.02	0.01	0.01	0.00
		Noppharat Thara Beach (Pak Khlong Haeng)	index (0-100)	78.42	84.97	0	100	0.78	0.85	0.07	0.02	0.01	0.02	0.00
		Bilae Beach (Koh Hong)	index (0-100)	88.68	87.65	0	100	0.89	0.88	-0.01	0.02	0.02	0.02	0.00
		Ban Saladan (Koh Lanta)	index (0-100)	60.53	60.76	0	100	0.61	0.61	0.00	0.02	0.01	0.01	0.00
		Loh Ba Gao Bay, Koh Phi Phi (Eastern)	index (0-100)	85.57	89.02	0	100	0.86	0.89	0.03	0.02	0.02	0.02	0.00
		Loh Dalum Beach, Koh Phi Phi (Central–Western)	index (0-100)	78.63	88.12	0	100	0.79	0.88	0.09	0.02	0.01	0.02	0.00
		Loh Dalum Beach, Koh Phi Phi	index (0-100)	81.83	88.74	0	100	0.82	0.89	0.07	0.02	0.01	0.02	0.00

Table 10 Marine and Coastal ecosystem condition account *(Continued)*

SEEA Ecosystem Condition Typology Class		Variables		Marine (M) + Marine-Freshwater-Terrestrial (MFT) + Marine-Terrestrial (MT)										
				Variable values (observed)		Reference level values		Indicator values (rescale)			Indicator weight	Index Values		
		Descriptor	Measurement unit	Opening 2559	Closing 2563	Lower level	Upper level	Opening	Closing	Change in indicator (Closing-Opening)		Opening	Closing	Change
Abiotic characteristics *(Continued)*	**A2. Chemical state** *(Continued)*	Loh Dalum Beach (Phi Phi Cabana), Koh Phi Phi[1]	index (0-100)	88.38	85.70	0	100	0.88	0.86	-0.03	0.02	0.02	0.02	0.00
		Ton Sai Beach (Ton Sai Village), Koh Phi Phi (Southern) – Point 1	index (0-100)	82.14	87.64	0	100	0.82	0.88	0.06	0.02	0.01	0.02	0.00
		Ton Sai Beach (Ton Sai Village), Koh Phi Phi (Southern) – Point 2	index (0-100)	87.51	88.68	0	100	0.88	0.89	0.01	0.02	0.02	0.02	0.00
		Long Beach, Ko Phi Phi (Southeastern)	index (0-100)	86.52	87.24	0	100	0.87	0.87	0.01	0.02	0.02	0.02	0.00
		Maya Bay	index (0-100)	83.48	87.79	0	100	0.83	0.88	0.04	0.02	0.01	0.02	0.00
		Railay Bay	index (0-100)	88.41	85.16	0	100	0.88	0.85	-0.03	0.02	0.02	0.02	0.00
		Klong Dao Beach	index (0-100)	78.70	85.83	0	100	0.79	0.86	0.07	0.02	0.01	0.02	0.00
		Baan Klong Nin (Koh Lanta)	index (0-100)	80.97	86.29	0	100	0.81	0.86	0.05	0.02	0.01	0.02	0.00
		Baan Sriraya (Koh Lanta)	index (0-100)	84.35	87.23	0	100	0.84	0.87	0.03	0.02	0.02	0.02	0.00
		baan bor maung (Bor Maung Bay)	index (0-100)	85.30	83.95	0	100	0.85	0.84	-0.01	0.02	0.02	0.01	0.00
		Thale Waek (Separated Sea)	index (0-100)	89.21	87.79	0	100	0.89	0.88	-0.01	0.02	0.02	0.02	0.00
		Laem Tong, Koh Phi Phi	index (0-100)	84.49	66.73	0	100	0.84	0.67	-0.18	0.02	0.02	0.01	0.00
		Koh Poda[1]	index (0-100)	88.22	88.97	0	100	0.88	0.89	0.01	0.02	0.02	0.02	0.00
		Koh Kai (Chicken Island)	index (0-100)	86.68	89.00	0	100	0.87	0.89	0.02	0.02	0.02	0.02	0.00
		Loh Samah Bay (2017 and 2020)	index (0-100)	87.68	69.76	0	100	0.88	0.70	-0.18	0.02	0.02	0.01	0.00
		Koh Yung (Mosquito Island) (2017 and 2020)	index (0-100)	88.15	90.74	0	100	0.88	0.91	0.03	0.02	0.02	0.02	0.00
Total abiotic											**0.86**	**0.37**	**0.20**	**-0.17**
Biotic characteristics	**B1.Compositional state**	Fish species richness[1]	no.	57.00	57.00	0	631	0.09	0.09	0.00	0.02	0.00	0.00	0.00
		Coral species richness (2021)[2]	no.	38.00	38.00	0	270	0.14	0.14	0.00	0.02	0.00	0.00	0.00
		Bird species richness[3]	no.	222.00	222.00	0	1083	0.20	0.20	0.00	0.02	0.00	0.00	0.00
	B2.Structural state	coral cover: healthy coral reefs	%	0.95	26.67	0	100	0.01	0.27	0.26	0.02	0.00	0.00	0.00
		coral cover: moderate health coral reefs	%	13.30	40.53	0	100	0.13	0.41	0.27	0.02	0.00	0.01	0.00
		coral cover: damaged coral reefs	%	85.75	32.81	0	100	0.86	0.33	-0.53	0.02	0.02	0.01	-0.01
	B3.Functional state	Data Not available												
	Total biotic										**0.11**	**0.03**	**0.03**	**0.00**
Landscape/seascape characteristics	**C1.Landscape/waterscape**	Seagrass meadow cover	%	38.00	38.00	0	100	0.38	0.38	0.00	0.02	0.01	0.01	0.00
		Mangrove cover (2014 and 2022)	%	66.23	70.15	0	100	0.66	0.70	0.04	0.02	0.01	0.01	0.00
	Total landscape/waterscape										0.04	**0.02**	**0.02**	**0.00**
Total											**1.00**	**0.42**	**0.25**	**-0.17**

Remark:

1. There are 631 species of fish that inhabit the Krabi River estuary area (Janekarnkij, 2010).

2. Approximately 280 species of coral from 18 families and 71 genera are found in Thailand, with about 270 species in the Andaman Sea and about 240 species in the Gulf of Thailand (Department of Marine and Coastal Resources, 2021).

3. According to data compiled by the Bird Conservation Society of Thailand (BCST), more than 1,083 bird species have been recorded in Thailand (Bird Conservation Society of Thailand, n.d.). Of these, at least 222 species are found within the Krabi River Estuary wetlands (Krabi Provincial Administrative Organization, 2006

Ecosystem services flow accounts for Krabi were also established in both physical and monetary terms as shown in Tables 11-12. Provisioning services included those from biomass, such as crops and fishes, as well as water usage. These provisioning services exhibited mixed trends over time. For example, physical provisioning services from fish and aquaculture biomass peaked in 2018 before declining in 2019-2020. However, when monetary values are considered, provisioning services for these categories rose steadily over the same period. As another example, physical water usage by households increased, while industrial water usage fell during the study period.

Regulating and maintenance services include carbon sequestration by wood, seagrass, and mangrove; water flow and quality regulation; and habitat provisioning. Cultural services comprise benefits from sea views, recreation activities along shorelines and islands, coral reef and scuba diving experiences, and migration bird watching. Physical data for these services are not available. However, monetary flow data indicate that the carbon sequestration services have remained stable over time, while most cultural services monetary values declined sharply in 2020 during the COVID-19 Pandemic.

Table 11 Ecosystem service supply account in physical terms

Supply Table			Freshwater (F)					Terrestrial (T)					Marine (M) + (MFT) + (MT)				
			2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Provisioning Services																	
Biomass	Crops (ha)		1,310.00	1,234.88	1,159.75	1,084.63	1,009.50	351,152.75	350,224.13	349,295.50	348,366.88	347,438.25	Not Applicable				
	Wood (ha)		Not Applicable					417,141.75	416,059.38	414,977.00	413,894.63	412,812.25	39,832.50	39,829.63	39,826.75	39,823.88	39,821.00
	Wild fish and other natural aquatic biomass (ha)		9,256.50	9,413.75	9,571.00	9,728.25	9,885.50	Not Applicable					457,861.00	457,874.38	457,887.75	457,901.13	457,914.50
	Aquaculture (ha)		4,395.50	4,337.38	4,279.25	4,221.13	4,163.00	Not Applicable					457,861.00	457,874.38	457,887.75	457,901.13	457,914.50
	Biomass-based energy (ha)		Not Applicable					3.00	3.00	3.00	3.00	3.00	Not Applicable				
Water supply	Surface Water	Natural (ha)	8,271.75	8,404.56	8,537.38	8,670.19	8,803.00	Not Applicable					Not Applicable				
		Reservoir (ha)	984.75	1,009.19	1,033.63	1,058.06	1,082.50	Not Applicable					Not Applicable				
	Groundwater (MCM)		5,704.52	5,518.09	6,593.00	4,859.85	4,862.70	Not Applicable					Not Applicable				
Regulating and maintenance Services																	
Carbon sink	Wood (ha)		Not Applicable					417,141.75	416,059.38	414,977.00	413,894.63	412,812.25	Not Applicable				
	Seagrass (ha)		Not Applicable					Not Applicable					5,404.50	5,404.50	5,404.50	5,404.50	5,404.50
	Mangrove (ha)		Not Applicable					Not Applicable					39,832.50	39,829.63	39,826.75	39,823.88	39,821.00
Forest Benefit: Flood control/Water flow regulation (ha)			Not Applicable					19,148.75	20,115.50	21,082.25	22,049.00	23,015.75	Not Applicable				
Water Resource: Purification/Water quality regulation (ha)			10,566.50	10,648.63	10,730.75	10,812.88	10,895.0	417,141.75	416,059.38	414,977.00	413,894.63	412,812.25	39,832.50	39,829.63	39,826.75	39,823.88	39,821.00
Nursery and protective habitats /Provisioning of habitat (ha)			Not Available					Not Available					39,832.50	39,829.63	39,826.75	39,823.88	39,821.00
Cultural Services																	
Seaview (Rooms)			Not Applicable										18,904	21,647	21,853	22,405	22,405
Water, Shore, and Island recreation (Number of national park)													3	3	3	3	3
Coral and Scuba diving (ha)													2,249	2,249	2,249	2,249	2,249
Migratory bird watching (ha)													21,299	21,299	21,299	21,299	21,299

Source: Data from related organizations with evaluation by TDRI

Table 12 Ecosystem service use account in physical terms

Use Table			Freshwater (F)					Terrestrial (T)					Marine (M) + (MFT) + (MT)				
			2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Provisioning Services																	
Biomass	Crops	Rice (Tons)	1,729.00	1,309.00	1,403.00	2,517.00	2,626.00	Not Applicable					Not Applicable				
		Para Rubber (Tons)	Not Applicable					145,290	146,893	153,980	145,420.00	133,651	Not Applicable				
		Oil palm (Tons)	Not Applicable					2,675,684	3,349,672	3,383,122	3,504,487	3,345,467	Not Applicable				
	Wood	Acacia Species (Tons)	Not Applicable					0.00	0.00	6,129.85	6,129.85	0.00	Not Applicable				
		Mangrove (Tons)	Not Applicable					Not Applicable					3.94	3.96	3.99	4.01	4.02
	Wild fish and other natural aquatic biomass (Tons)		98.87	171.05	356.50	111.33	200.96	Not Applicable					10,431.00	10,396.00	8,952.00	12,241.00	27,731.41
	Aquaculture (Tons)		288.78	309.00	549.00	358.00	332.00	Not Applicable					13,286.39	13,203.83	14,078.37	15,039.26	14,632.17
	Biomass-based energy (Tons)		Not Applicable					306.60	306.60	306.60	306.60	306.60	Not Applicable				
Water use	Service sector (MCM)		6.38	7.94	9.43	10.84	15.36	Not Applicable					Not Applicable				
	Accommodation (MCM)		4.05	5.08	6.85	8.08	4.12	Not Applicable					Not Applicable				
	Household (MCM)		12.02	12.05	11.47	11.41	11.48	Not Applicable					Not Applicable				
	Wastewater Management (MCM)		1.11	1.25	1.29	1.34	1.42	Not Applicable					Not Applicable				
	Other Industries (MCM)		2.78	2.99	3.13	3.53	3.97	Not Applicable					Not Applicable				
	Agriculture (MCM)		4,377.57	4,227.61	4,080.94	13,541.98	5,085.76	Not Applicable					Not Applicable				
	Recirculation from Environment (MCM)		3,554.00	3,445.59	3,329.08	10,890.08	4,126.69	Not Applicable					Not Applicable				
Regulating and maintenance Services																	
Carbon sink	Wood (Million tCO2eq)		Not Applicable					159.61	159.20	158.78	158.37	157.96	Not Applicable				
	Seagrass (Million tCO2eq)		Not Applicable					Not Applicable					1.78	1.78	1.78	1.78	1.78
	Mangrove (Million tCO2eq)		Not Applicable					Not Applicable					3.73	3.73	3.73	3.73	3.73
Forest Benefit: Flood control/Water flow regulation (ha of area protected)			Not Applicable					19,148.75	20,115.50	21,082.25	22,049.00	23,015.75	Not Applicable				
Water Resource: Purification/Water quality regulation (MCM)			14.77	14.89	15.02	15.11	15.14	14.77	14.89	15.02	15.11	15.14	14.77	14.89	15.02	15.11	15.14
Nursery and protective habitats /Provisioning of habitat (ha of area protected)			Not Available					Not Available					39,832.50	39,829.63	39,826.75	39,823.88	39,821.00
Cultural Services																	
Seaview (Rooms)			Not Applicable										12,365	14,601	15,114	15,356	4,091
Water, Shore, and Island recreation	Than Bok Khorani National Park	Thai (person)											38,360	30,344	31,064	25,738	13,405
		Foreign (person)											132,508	104,818	107,304	88,906	46,305
	Mu Koh Lanta National Park	Thai (person)											29,988	21,946	21,966	17,057	7,129
		Foreign (person)											103,589	75,807	75,878	58,919	24,628
	Hat Noppharat Thara-Mu Ko Phi Phi National Park	Thai (person)											405,457	472,337	346,619	237,546	64,455
		Foreign (person)											1,400,588	1,631,613	1,197,339	820,566	222,649
Coral and Scuba diving (ha of area protected)													2,249	2,249	2,249	2,249	2,249
Migratory bird watching (number of persons)													480	480	480	480	480

Table 13 Ecosystem service supply account in monetary terms

Supply Price of supply			Freshwater (F)					Terrestrial (T)					Marine (M) + (MFT) + (MT)				
			2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Provisioning Services																	
Biomass	Crops	Rice (THB per ha)	2,506.27	2,506.27	2,506.27	2,506.27	2,506.27	Not Applicable					Not Applicable				
		Rubber (THB per ha)	Not Applicable					3,333.33	3,333.33	3,333.33	3,333.33	3,333.33	Not Applicable				
		Oil palm (THB per ha)	Not Applicable					250.00	250.00	250.00	250.00	250.00	Not Applicable				
	Wood	Acacia Species (THB per Ton)	Not Applicable					0.00	0.00	850.00	850.00	0.00	Not Applicable				
		Mangrove (THB per ha)	Not Applicable					Not Applicable					4,941.40	4,969.07	5,004.28	5,030.44	5,045.03
	Wild fish and other natural aquatic biomass (THB per ha)		21,418.71	21,262.50	21,779.36	19,565.68	24,439.65	Not Applicable					10,864.83	8,216.48	11,266.42	8,918.59	13,561.68
	Aquaculture (THB per ha)		13,871.55	12,299.35	18,573.77	16,178.07	14,970.63	Not Applicable					43,925.17	48,142.03	44,558.49	42,877.09	44,089.36
	Biomass-based energy (THB per Ton)		Not Applicable					780.00	780.00	780.00	780.00	780.00	Not Applicable				
Water	Surface water	Natural (THB)	1.49	1.49	1.49	1.49	1.49	Not Applicable					Not Applicable				
		Reservoir (THB)	1.49	1.49	1.49	1.49	1.49	Not Applicable					Not Applicable				
	Groundwater (THB)		1.49	1.49	1.49	1.49	1.49	Not Applicable					Not Applicable				
Regulating and maintenance Services																	
Carbon sink	Wood (THB per tCO2eq)		Not Applicable					6,146.50	6,146.50	6,146.50	6,146.50	6,146.50	Not Applicable				
	Seagrass (THB per tCO2eq)		Not Applicable					Not Applicable					6,146.50	6,146.50	6,146.50	6,146.50	6,146.50
	Mangrove (THB per tCO2eq)		Not Applicable					Not Applicable					6,146.50	6,146.50	6,146.50	6,146.50	6,146.50
Forest Benefit: Flood control/Water flow regulation (THB per ha)			Not Applicable					347.39	3,321.89	1,159.51	23.18	744.92	Not Applicable				
Water Resource: Purification /Water quality regulation (THB per m^3)			15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Nursery and protective habitats /Provisioning of habitat (THB per ha)			Not Available					Not Available					10,158.14	10,215.01	10,287.40	10,341.17	10,371.16
Cultural Services																	
Seaview (THB per Room)			Not Available										1,248.37	1,255.36	1,264.26	1,270.87	1,274.55
Water, Shore, and	Than Bok Khorani National Park	Thai (THB per visitor)											60.00	60.00	60.00	60.00	60.00
		Foreign (THB per visitor)											300.00	300.00	300.00	300.00	300.00
	Mu Koh Lanta National Park	Thai (THB per visitor)											40.00	40.00	40.00	40.00	40.00
		Foreign (THB per visitor)											400.00	400.00	400.00	400.00	400.00
	Hat Noppharat Thara-Mu Ko Phi Phi National Park	Thai (THB per visitor)											40.00	40.00	40.00	40.00	40.00
		Foreign (THB per visitor)											400.00	400.00	400.00	400.00	400.00
Coral and Scuba diving (Million THB)													45,763.89	52,122.88	59,365.47	67,614.43	77,009.60
Migratory bird watching (THB/person/visit)													728.00	728.00	728.00	728.00	728.00

Source: Data from related organizations with evaluation by TDRI

Table 14 Ecosystem service use account in monetary terms

Use			Freshwater (F)					Terrestrial (T)					Marine (M) + (MFT) + (MT)				
			2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Provisioning Services																	
Biomass	Crops	Rice (Million THB)	4.333	3.281	3.516	6.308	6.581	Not Applicable					Not Applicable				
		Para Rubber (Million THB)	Not Applicable					484.30	489.64	513.27	484.73	445.50	Not Applicable				
		Oil palm (Million THB)	Not Applicable					668.92	837.42	845.78	876.12	836.37	Not Applicable				
	Wood (Rai)	Acacia Species (Million THB)	Not Applicable					0.00	0.00	5.21	5.21	0.00	Not Applicable				
		Mangrove (Million THB)	Not Applicable					Not Applicable					196.83	197.92	199.30	200.33	200.90
	Wild fish and other natural aquatic biomass (Million THB)		2.12	3.64	7.76	2.18	4.91	Not Applicable					113.33	85.42	100.86	109.17	376.08
	Aquaculture (Million THB)		4.01	3.80	10.20	5.79	4.97	Not Applicable					583.61	635.66	627.31	644.84	645.12
	Biomass-based energy (Million THB)		Not Applicable					0.24	0.24	0.24	0.24	0.24	Not Applicable				
Water use	Service sector (Million THB)		132.64	165.12	196.05	225.40	319.51	Not Applicable					Not Applicable				
	Accommodation (Million THB)		108.59	136.22	183.89	216.83	110.56	Not Applicable					Not Applicable				
	Household (Million THB)		199.51	200.01	190.36	189.36	190.61	Not Applicable					Not Applicable				
	Wastewater Management (Million THB)		16.71	18.79	19.29	20.17	21.24	Not Applicable					Not Applicable				
	Other Industries (Million THB)		74.61	80.30	83.88	94.68	106.59	Not Applicable					Not Applicable				
	Agriculture (Million THB)		2,188.79	2,113.81	2,040.47	6,770.99	2,542.88	Not Applicable					Not Applicable				
	Recirculation from Environment (Million THB)		1,777.00	1,722.80	1,664.54	5,445.04	2,063.34	Not Applicable					Not Applicable				
Regulating and maintenance Services																	
Carbon sink	Wood (Million THB)		Not Applicable					0.98	0.98	0.98	0.97	0.97	Not Applicable				
	Seagrass (Million THB)		Not Applicable					Not Applicable					0.01	0.01	0.01	0.01	0.01
	Mangrove (Million THB)		Not Applicable					Not Applicable					0.02	0.02	0.02	0.02	0.02
Flood control/Water flow regulation (Million THB)			Not Applicable					6.65	66.82	24.45	0.51	17.14	Not Applicable				
Water purification /Water quality regulation (Million THB)			221.54	223.36	225.25	226.68	227.17	221.54	223.36	225.25	226.68	227.17	221.54	223.36	225.25	226.68	227.17
Nursery and protective habitats /Provisioning of habitat (Million THB)			Not Available					Not Available					404.62	404.60	404.57	404.54	404.51
Cultural Services																	
Seaview (Million THB)			Not Applicable										6.838	8.120	8.465	8.646	2.310
Water, Shore, and Island recreation (Million THB)	Than Bok Khorani National Park	Thai											2.302	1.821	1.864	1.544	0.804
		Foreign											39.752	31.445	32.191	26.672	13.892
	Mu Koh Lanta National Park	Thai											1.200	0.878	0.879	0.682	0.285
		Foreign											41.436	30.323	30.351	23.568	9.851
	Hat Noppharat Thara-Mu Ko Phi Phi National Park	Thai											16.218	18.893	13.865	9.502	2.578
		Foreign											560.235	652.645	478.936	328.226	89.060
Coral and Scuba diving (Million THB)													102.923	117.224	133.513	152.065	173.195
Migratory bird watching (Million THB)													0.349	0.349	0.349	0.349	0.349

Monetary values of cultural services were calculated as follows:

- The value of sea views was estimated using a hedonic pricing model based on hotel room price rates. The hedonic regression included variables such as a dummy indicator for whether a room has a sea view, room size, hotel star rating, inclusion of breakfast, availability of a pool, and room types.
- The value of recreational activities was estimated through expenditure data analysis, utilizing tourist spending patterns in Krabi Province as the primary basis for calculation.
- The valuation of coral and scuba diving activities, as well as migratory bird watching, was derived from the calculation of value added based on existing market values together with projected values that would be generated through the implementation of such activities.

Monetary ecosystem asset accounts were compiled and are presented in Table 15. In 2020, the combined value of marine, marine–freshwater terrestrial, and marine–terrestrial assets was the highest, exceeding 66 billion baht. Terrestrial assets were valued at more than 44 billion baht, while freshwater assets accounted for 7 billion baht. Taken together, ecosystem assets associated with the water and tourism sectors in Krabi Province were estimated at 118 billion baht in 2020. This represents a notable decline compared with the estimated 128 billion baht recorded in 2016, underscoring the reduction in asset value over the study period.

Table 15 Monetary ecosystem asset account (NPV)

Unit: Million THB

	Freshwater (F)	Terrestrial (T)	Marine (M+MFT+MT)	Total
Opening value (2016) (MB)	**5,214.14**	**1,524.20**	**2,503.52**	**9,241.86**
Ecosystem enhancement	8,692.95	217.71	88.88	8,999.55
Ecosystem degradation	(8,308.73)	(214.52)	(446.27)	(8,969.51)
Ecosystem conversions				
Additions	375.49	35.51	2.36	413.36
Reductions	(331.52)	(36.00)	(2.18)	(369.70)
Net change in value	428.20	2.70	(357.21)	73.69
Closing value (2020) (MB)	**5,642.34**	**1,526.90**	**2,146.31**	**9,315.55**

4.2.3 Short-Term Work Plan: Next Steps

To ensure the continued implementation and sustainability of NCA in Krabi, the following strategic actions are recommended:

1. Strengthening data systems and monitoring: continuous data collection, indicator expansion, and digital data platform development
2. Local capacity building: training programs, academic partnerships with local universities and government agencies, and private sector engagement
3. Institutionalizing NCA at the provincial level and integrating NCA into provincial development plans and policy making

5. Conclusion

The main in-country activities of the project *"Integration of Natural Capital Accounting in Public and Private Sector Policy and Decision-making for Sustainable Landscapes"* consists of developing policies and market

incentives for the implementation of the SEEA framework at the national level and compiling pilot accounts for the tourism sector and water resources in Krabi province.

As part of this project, this report reviews a conceptual framework for NCA, presents relevant policy frameworks and institutional arrangements in Thailand, reports on current project progress—such as on NCAs for the water and tourism sectors in Krabi and a viable market-based instrument suggestion—and proposes short-term plans for the next steps.

The findings highlight the importance of integrating natural capital considerations into Thailand's development planning and sectoral policies. By aligning NCA with the System of National Accounts and incorporating ecosystem services into economic decision-making, Thailand can better capture the value of its natural resources and ensure sustainable growth. This approach supports evidence-based policymaking, enabling both public and private sectors to recognize the economic benefits of conservation and resource efficiency.

Pilot implementation in Krabi demonstrates the practical application of NCA in a tourism-dependent region where water resources are critical. These accounts provide insights into resource interdependencies and help identify policy levers for balancing economic development with environmental sustainability. Lessons learned from Krabi can inform national-scale strategies and guide replication in other provinces.

Looking ahead, the report emphasizes the need for capacity building and inter-agency coordination to institutionalize NCA in Thailand. Strengthening collaboration between government agencies, local authorities, and private stakeholders will be essential for scaling up NCA practices.

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