# The SEEA Ecosystem Accounts for Mexico

# POLICY BRIEF

## CONTEXT

Mexico, with its vast territory, dense population, and considerable biological and cultural diversity, faces, like many other countries, numerous environmental challenges, such as water scarcity, loss of biodiversity, and increasing pressure from climate change. Failure to address these challenges will hinder the country's sustainable development as they could become serious constraints to further improvements in economic performance and social equity.

Natural capital accounting (NCA), in particular, the System of Environmental Economic Accounting (SEEA), the accepted international statistical standard for environmental-economic accounting, brings together environmental, social, and economic data into an integrated measurement framework. It has been designed to shed light on the interactions between the economy, society, and the environment, and to foster full adoption of the sustainability paradigm. Recognising the importance of better understanding the role of ecosystems to support the wellbeing of Mexicans, and drawing on its long-standing experience in environmental-economic accounting (Figure 1 shows a timeline of the SEEA in Mexico), the National Institute of Statistics and Geography (INEGI) in collaboration with the Secretariat of the Environment and National Resources (SEMARNAT), agreed in 2017 to participate in the Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project.

## THE NCAVES PROJECT

The NCAVES project started in 2017 with the objective of improving the measurement of ecosystems and their services and mainstreaming biodiversity into national and subnational policy planning in five megadiverse countries: Mexico, Brazil, China, India and South Africa. NCAVES included piloting and testing of ecosystem accounting; the SEEA Ecosystem Accounting (SEEA EA).

The project was funded by the European Union (EU) and implemented by the United Nations Statistics Division (UNSD), the UN Environment Programme (UNEP), and the Secretariat at the Convention on Biological Diversity (CBD). Project countries were selected on the basis of being important strategic partners of the EU, for their richness in biodiversity along with their adherence to the commitments to the Convention on Biological Diversity. In Mexico, NCAVES was implemented by INEGI, in collaboration with SEMARNAT.

In particular, the NCAVES project set out to partner with Mexico in:

- Compiling national ecosystem extent and ecosystem condition accounts in physical terms;
- Testing the development of monetary ecosystem service accounts;
- Contributing to the development of the SEEA EA guidelines and methodologies; and
- Developing a roadmap towards the institutionalisation of the production and use of the SEEA EA within the SNIEG (Mexico's National System of Statistical and Geographical Information).

The NCAVES project is set to conclude in 2021.

INEGI MEDIO AMBIENTE SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES System of Environmental Economic Accounting United Nations UN environment programme

Funded by the European Union

*Figure 1:* *History of the SEEA in Mexico*

## 1991: PIONEERING ACCOUNTS

Mexico becomes one of the first countries to compile environmental economic accounts. Mexico's National Institute of Statistics and Geography (INEGI) takes part in a pilot project launched by the World Bank with technical support from the UN Statistical Office, to explore environmentally adjusted national product aggregates for Mexico.

## 1996: SEEA-MEXICO


INEGI begins compiling and publishing recurrent updates of the Mexico's System of Environmental and Economic Accounts (SCEEM, for its acronym in Spanish), which includes the Ecologically-Adjusted Net Domestic Product (PINE).

## 2000: ENVIRONMENTALLY-ADJUSTED GDP

The PINE is included in Mexico's landmark law for protection of the environment, Ley General del Equilibrio Ecológico y la Protección al Ambiente [General Law of Ecological Equilibrium and Environmental Protection] (LGEEPA), as a principle to be observed in support of environmental policy. A year after, it is selected as one of the indicators to assess the sustainability of Mexico's economic growth in the country's National Development Plan 2001-2006 and in the subsequent 6-year plans.

## 2017: ECOSYSTEM ACCOUNTS

Building on its decades of leadership, Mexico joins four other countries in the EU funded Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project to develop pilot ecosystem accounts under the framework of the SEEA Ecosystem Accounting. The project finalizes in 2021.

### What can ecosystem accounting tell us?

Ecosystem accounting can help policy makers answer the following types of questions:

- What do ecosystems and their services contribute to the economy, social welfare, employment, and livelihoods?
- What and where are the trade-offs from changes in land uses and how can a balance be struck to achieve long-term sustainability and equity?
- How is the condition of ecosystems and biodiversity changing over time? Where are the main areas of degradation and recovery?
- Can natural resources and ecosystems be better managed to ensure continued services and benefits, including food supply, water provision, flood control, carbon storage, and recreational opportunities?

## THE SEEA ECOSYSTEM ACCOUNTING

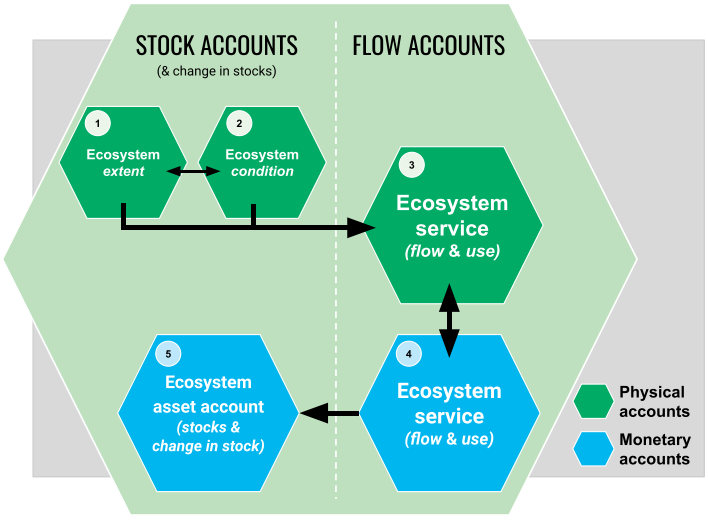
The SEEA provides the measurement framework for NCA. It consists of two complementary volumes: the SEEA Central Framework (SEEA CF), which was adopted as a statistical standard in 2013, and the SEEA EA, which was adopted in March 2021 by the United Nations Statistical Commission (UNSC).

Whilst the SEEA CF measures how the economy as-a-whole 'uses' the environment as input into production and consumption activities, the SEEA EA takes an ecosystem perspective and measures, using a spatial approach, the extent and condition of ecosystems, as well as the flow of ecosystem services to society and the economy in both physical and monetary terms. Figure 2 shows these five ecosystem accounts and the relationship between them.

Monetary estimates of the value of ecosystem services are derived by applying a range of established economic valuation techniques, such as: the resource rent approach, replacement cost, or hedonic pricing. Further, the valuation of ecosystem assets may be undertaken by applying the net present value approach to the monetary valuation of ecosystem services.

To make it consistent with the System of National Accounts and allow full integration of ecosystem accounting with the economic accounts, the SEEA EA's primary focus is on instrumental values, or how nature is used. The SEEA EA recommends that when accounts in monetary terms are compiled, associated data in physical terms are also released to aid contextualisation and interpretation of both types of data in policy and decision making.

*Figure 2:* *The relationship between the different accounts in the SEEA EA*



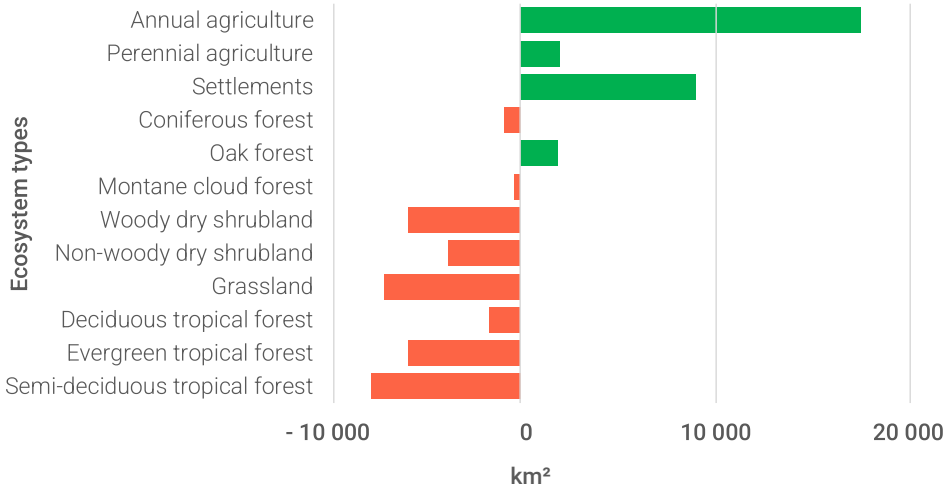
# THE SEEA EA IN MEXICO

## Ecosystem extent accounts

Ecosystem extent accounts determine the spatial distribution of different ecosystem types based on their ecological characteristics and their changes over time. Using geospatial data, ecosystem extent accounts are compiled according to a classification based on numerous ecological characteristics. Ecosystem extent accounts support the derivation of coherent indicators for key processes, such as deforestation, agricultural conversion, urban expansion, and other forms of ecosystem change.

As a proxy to the classification of ecosystem types, the NCAVES project used a hierarchical classification system, called CONAFOR-IPCC-N3, that aligns with how Mexico already reports on its greenhouse gas emissions to the IPCC. The extent account was compiled for the 2002-2014 period.

***Figure 3:*** *Net changes in extent, 2002-2014*




### *Findings – 2002-2014*

In general, natural ecosystems lost an area equivalent to 3% of the extent of the country and were transformed into human modified land covers, such as annual and perennial agriculture, settlements and urbanised areas, aquaculture, and plantation forest.

The ecosystems that lost the greatest extent are the tropical forests (*semi-deciduous*: -16%; and *evergreen*: -5%) and *dry shrublands* (-4%). Only 50% of the original extent of Mexican tropical forests remains. The process of urbanization has consolidated human settlements, which have almost doubled in extent. Figure 3 shows the net changes in extent from 2002 to 2014 for the ecosystem types that reported the largest changes in extent.

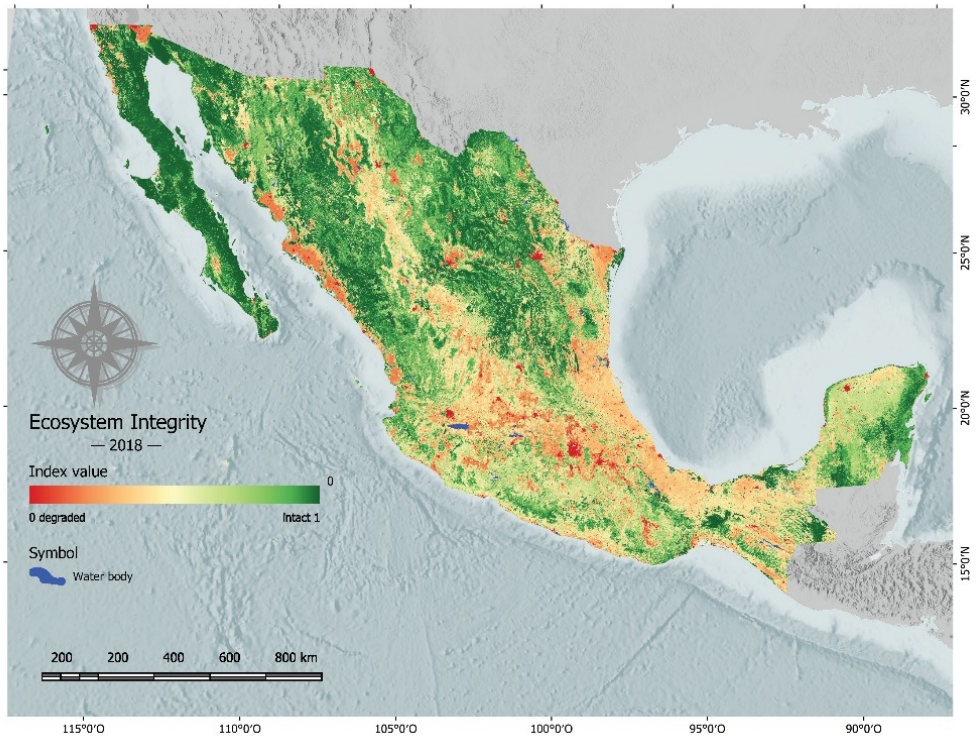
## Ecosystem condition accounts

Ecosystem condition accounts present structural and functional data and aggregate it in a structured way to describe the quality of ecosystem assets and how they change over time and under pressure.

Measurement of ecosystem condition is of significant interest in supporting environmental policy and decision making, which is often focused on identifying ecosystems of particular concern and then protecting, maintaining, and restoring their condition.

Supported by the NCAVES project, Mexico took a highly innovative, data-driven approach to understand, measure, and report the *condition* of the country's ecosystems using an Ecosystem Integrity Index. Figure 4 shows the spatial distribution of EII across Mexico.

***Figure 4:*** *Ecosystem Integrity Index for the terrestrial ecosystems of Mexico in 2018 (250 X 250 m or 6.25 ha grids).*



### *Ecosystem Integrity Index*

The Ecosystem Integrity Index (EII) is a proxy for how effectively an ecosystem can self-organize and sustain itself. It is a measure between 0 and 1. For example, ecosystem integrity is 1 where there is no evidence of human disturbance, whereas, at the other extreme, urban environments have very low indices of ecosystem integrity.

The data to construct the index cover a variety of biophysical data that is compiled by CONAFOR, CONANP and CONABIO and is broadly aligned with the methodology presented in the SEEA EA. The index shows a range of integrity values for each of the 250 x 250 m pixels that make up the total Mexican surface area.

The index has the potential to be strengthened by integrating more variables that affect the integrity of ecosystems and establish a correlation with other indices (such as the human footprint index) thus identifying the effect of the impacts of human activity on ecosystems condition.

### *Natural Capital Index*

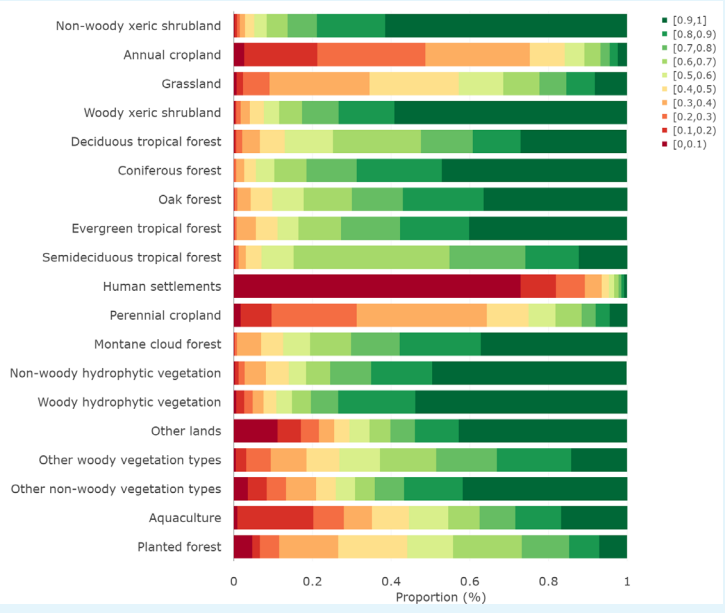
The Natural Capital Index (NCI) was generated by combining the Ecosystem Integrity Index with the ecosystem extent account. The Natural Capital Index represents, on a scale of 0 to 100%, the remaining natural capital in the ecosystem accounting area by taking into account both the remaining extent and condition, as measured by the EII, of all the ecosystems.

**The Ecosystem Integrity Index** (EII) revealed that:

- Only approximately 25% of the *deciduous tropical forest* and 10% of the *semi-deciduous tropical forest* have high integrity values;
- 40% of the *non-woody dry shrubland* and 60% of the *woody dry shrubland* have a high integrity;
- 70% of the *human-settlement* areas has very low ecosystem integrity. The remaining extent has low integrity (~0.25) and moderate to good integrity (~0.50); and
- Approximately 20% of *annual* and *perennial cropland* area has extremely low ecosystem integrity (values between 0 and 0.2) and 50% has low ecosystem integrity (values between 0.3 and 0.5).

Figure 5 shows the distribution of each habitat in terms of its EII.

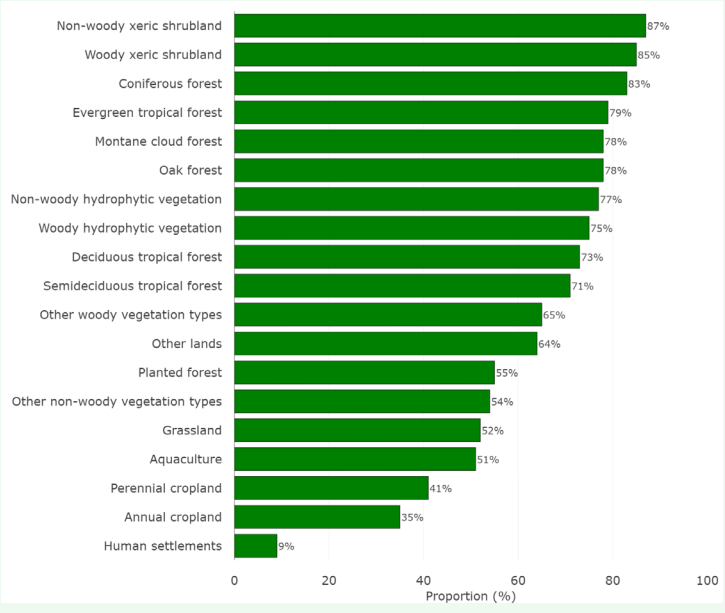
***Figure 5:*** *Proportional distribution of aggregated ecosystem integrity according to CONAFOR-IPCC-N3 categories for 2018*




**The Natural Capital Index** (NCI) revelead that Mexico preserves 65% of its original natural capital.

- Ecosystems with greatest NCI are the dry shrublands (non-woody, 87% and; woody 85%), and coniferous forest (83%);
- Ecosystems with the lowest NCI are *tropical forests* (semi-deciduous, 71% and *deciduous tropical forests*, 73%); *special other non-woody vegetation types* (65%); and *other lands* (64%). The NCI of *pastureland* is at 52%;
- Modified land areas that conserve the most natural capital are *planted forests* (55%); *aquaculture* (51%) and *perennial croplands* (41%). *Human settlements* only retain within them 9% of their original natural capital; and
- *Annual croplands* retain 35%, and perennial croplands, 41%.

***Figure 6:*** *Remaining Natural Capital (in percentage) for terrestrial ecosystems in 2018.*



## Valuation of ecosystem services

A key innovation of the SEEA EA is making explicit contribution of nature to the economy and well being by extending the production boundary to include ecosystem services. These services are usually not exchanged in the market and, as such, are not reflected in conventional accounts of these services as there is either no market price associated with their use or they are under-priced. Making these values explicit contributes to a better understanding of the contribution of nature and to a more efficient allocation of resources to avoid over-exploitation of the services.

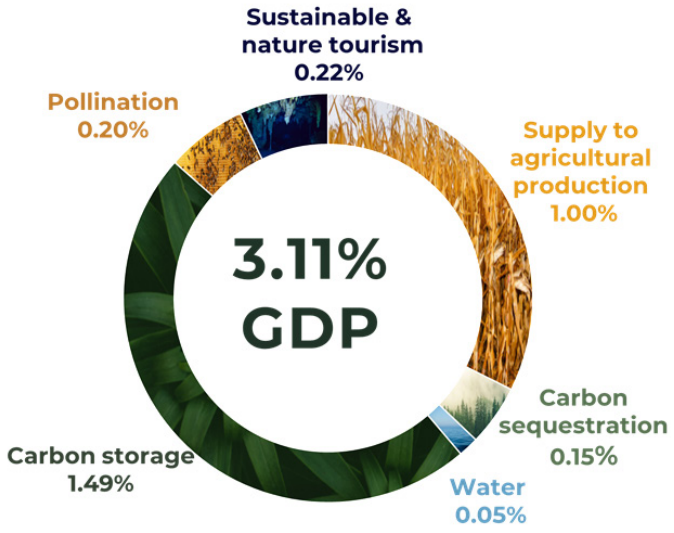
In line with the recommendations of the SEEA EA, the NCAVES project focused on the identification of exchange values for ecosystem services to ensure consistency with the market valuation principles of national accounts. The application of such methods requires making various assumptions and inferences; thus, these valuations should be seen as being experimental.

### *Classification of ecosystem services*

The first step in valuing ecosystem services is to make sure that they are clearly defined to avoid possible double counting.

The SEEA EA contains a reference list of ecosystem services based on agreed definitions, classified into 3 overarching types: provisioning, regulating and cultural services.

***Figure 7:*** *: Gross monetary contribution of pilot ecosystem services (% of 2013 GDP)*




**Valuation of ecosystem services in context**

Overall, the monetary valuation of Mexico's ecosystem services that were assessed amount to 3.11% of Mexico's 2013 GDP.

Mexico focused on generating monetary accounts for the following ecosystem services:

**1. Provisioning services for:**

- Selected crops (rice, beans, maize, wheat, sorghum, and soy)
- Residential and municipal water supply

**2. Regulating services for:**

- Carbon storage and sequestration (in biomass and soil)
- Pollination regulating services for agricultural crops

**3. Cultural services for:**

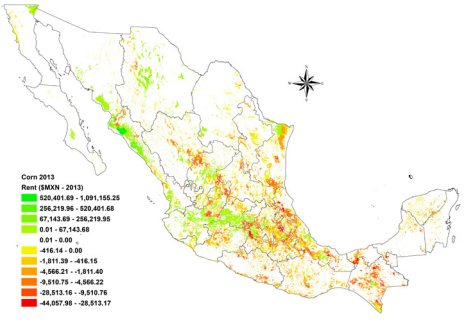
- Nature-based tourism

### Crop provisioning services

The resource rent, or residual value method, was used to calculate the economic contribution of ecosystem services to agricultural production. In simple terms, this approach values the ecosystem service as the difference between the sales of crops, and all required human inputs, such as energy, labour, and capital inputs; the remainder, or 'residual', is assumed to be the value of the of ecosystem services, such as soil, water, nutrients, and pollination.

The value of the final ecosystem services for Mexico was estimated to be approximately 39% of the agricultural sector's total value added. It should be noted that this contribution differed between crops and across regions, and is volatile over time. This suggests that ecosystem services are different depending on the crop types and producers, and their value is closely linked to the prices at which the crops are traded in markets.

***Figure 8:*** *Total rent value of maize 2013 (thousands of pesos)*




**>> LOOKING AHEAD : Accounts**

The SEEA EA accounts can be compiled with existing capacity and information. However, a more holistic approach to the development of ecosystem accounting is needed. Firstly, there needs to be developed an agreed classification of ecosystem types that reflects the ecological characteristics of the different ecosystems. Secondly, the ecosystem services provided by the various ecosystems needs to be spatially modelled in physical and then in monetary terms. This requires close collaboration among experts working on specific parts of the accounts to ensure that physical and monetary data apply to the same spatial area.

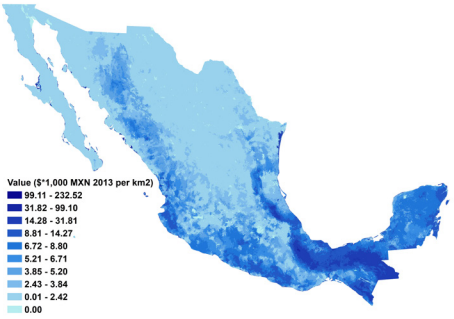
### Water

The valuation of water is a complex matter. Several approaches to value water provisioning services were used. The project estimated the monetary value by comparing resource rent and annual replacement costs.

Using the different methods, the economic values of water were estimated to be:

- Between 1.72 pesos and 1.95 pesos per $m^3$ for all water bodies (rivers and lakes) depending on the data sources used using the resource rent methods;
- Between 0.04%-0.05% of GDP in 2013 to household consumption;
- Between 0.01%-0.014% of GDP 2013 for municipal water provision; and
- Between 0.28% and 0.54% of 2013 GDP using annual replacement cost.

***Figure 9**: Monetary value of water ecosystem service per ecosystem type, 2013 (thousands of pesos per $km^2$)*




### Carbon storage and sequestration

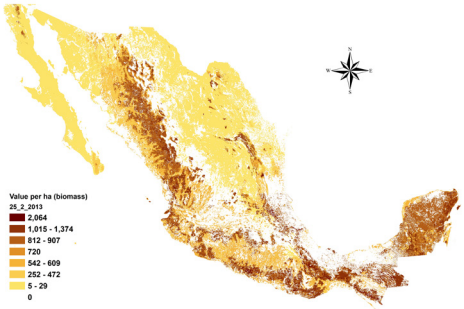
The Paris Agreement on Climate Change and the commitment Mexico has made in its Nationally Determined Contribution to measure and reduce greenhouse gas emissions make the compilation of carbon accounts particularly relevant.

**>> LOOKING AHEAD : Communication**

INEGI and SEMARNAT, in partnership with other agencies, should continue to communicate activities and results of the compilation of SEEA EA accounts with the objective of fostering transformative outcomes and generating interest at the national, subnational and regional levels.

The NCAVES project considered absorption and storage of carbon in biomass and soils across all Mexico's ecosystems. The economic valuation used a social cost of carbon of US$25 per $CO_2$-equivalent, derived from the literature, and applied a discount rate of 2% per year. The monetary value of the annual service of carbon storage and sequestration in biomass and soils, between 2007-2014, amounted to 1.63% of Mexico's GDP in 2013. This rate is highly sensitive to both the value of carbon used and the discount rate applied.

***Figure 10:** Value of annual biomass carbon storage and sequestration service, 2013 (pesos per ha) US$25 and 2% discount rate*




### Pollination services

There is evidence that the increasing intensification of agriculture and the reduction of natural habitat is decreasing the 'supply' of pollination services, especially when placed in the context of policies for the expansion of cropping, which requires pollination.

The NCAVES project estimated the proportion of the crop provisioning services due to pollination. The 'demand' for pollination by the sector was based on the estimated pollination dependency of various types of crop, with the potential 'supply' of pollinators based on the proximity of the pollinator habitats to the cropping areas.

Using this method, the monetary value, of the potential pollination services represents 12.09% of the agricultural gross value added in 2013, and on average 0.33% of national GDP between 2003-2018, underlining the importance of natural pollinators to the Mexican agricultural sector. Estimates of the valuation of pollination services support monitoring achievement of the objectives set in the Mexican Strategy for the Conservation and Sustainable Use of Pollinators (ENSCUP).

### Nature-based tourism

Nature-based tourism in Mexico's Natural Protected Areas (NPAs) is a sector of growing importance. The NCAVES project selected 15 key highly touristic areas, out of the 182 NPAs.

The value of nature-based tourism was estimated using two different methods that yield significantly different results. The first method calculated tourism expenditures based on economic census and amounted to 36 million pesos, 0.22% of 2013 GDP. The second method was based on a regression analysis of estimates from previous studies and amounted to 222.7 million pesos, 1.36% of 2013 GDP.

# NCA IN MEXICO: THE ROAD AHEAD

The NCAVES project showed that Mexico has the necessary capacity and data to compile ecosystem accounts and that there is demand for such data to support national policies and international reporting. The pilot compilation of the SEEA Ecosystem Accounts in Mexico was a result of collaboration across institutions, integration of data from several data sources and bringing together expertise from government and academia. Nevertheless, the results remain experimental and further work is needed to institutionalise the accounts as part of regular production processes, obtain the acceptance on the methodology tested, and to mainstream the ecosystem accounts data into policy and decision making. The project was instrumental in generating interest amongst the various stakeholders on the importance of obtaining integrated information on biodiversity and ecosystems, which will support integrated policies that take nature into account.

In particular, the following next steps have been identified:

**Institutionalisation of the accounts** within the National System of Statistical and Geographical Information (SNIEG), through the establishment of a multi-disciplinary mechanism with the participation of government, academia and private sector. The engagement and participation of the institutional users and decision-makers in the development of the accounts will ensure their mainstreaming in the use and application into policy and decision making. A roadmap is being developed that will outline the modalities of the inter-institutional mechanism as well as the role and responsibility of each stakeholder.

**Harnessing the potential of geospatial and earth observation data and technology,** including the Geospatial Data Cube, to integrate the accounts in a spatially-explicit manner. Geospatial data also could improve the analysis at the national and subnational level by applying different layers of information to improve the ecosystem accounts.

**In-depth analysis of existing data** that can be used for compiling ecosystem extent, condition and services accounts and defining their periodicity and alignment with the SEEA EA concepts, definitions, and classifications. The project has used available data but has also highlighted that a lot of data is available but is compiled by different institutions for their own purposes. It would be important that the data compiled by these agencies is made inter-operable for ecosystem accounting purposes.

**Development of a national classification of ecosystems types** which can be mapped to the internationally agreed IUCN Global Ecosystem Typology. The project has used a proxy for generating ecosystem extent accounts, which has also been used as the reference for ecosystem condition accounts. However, the need for an agreed classification was identified as high priority.

**Further the discussion on measurement of ecosystem condition.** The Ecological Integrity Index represents an innovative measure of ecosystem condition. Due to its data-driven approach the index could be further strengthened by adding more data that could include more variables to estimate, for example, ecosystem fragmentation and connectivity. Nevertheless, it needs to be further validated with a discussion among experts at interinstitutional level. In addition, an analysis of the data needed to compile the index on a regular basis would need to be developed to ensure that time series are compiled.

**Strengthen the linkages between ecosystem extent and condition accounts with ecosystem services** to highlight the relationship between ecological integrity and the provision of ecosystem services. This would entail the estimation of ecosystem services spatially by ecosystem types, in physical and monetary terms and expansion of the coverage of ecosystem services. In addition, the models used for the estimation of ecosystem services and the valuation methods should be further vetted and validated.

**Strengthen communication with different stakeholders, both data users and producers.** Natural capital accounting is a new transformative concept which potentially impacts and has implications on the economy, the environment, and society especially in addressing the twin crises of climate change and biodiversity loss and in the context of green recovery after the pandemic. Being a new concept, it needs to be clearly communicated to ensure its uptake in the policy discussions.

## NCA AND GLOBAL INITIATIVES

- The SEEA has been recognised as an useful framework to report on several global commitments. Several **Sustainable Development Goals** (SDG) indicators, in particular related to clean water and sanitation (Goal 6), climate action (Goal 13), life below water (Goal 14) and life on land (Goal 15) can be directly derived from the SEEA.
- The Convention of Biodiversity (CBD) will adopt **Global Biodiversity Framework** and its associated monitoring framework in April 2022, in Kunming China. The CBD calls for the use of the SEEA EA as the reference framework for a number of indicators and for the involvement of national statistical offices to work together with Parties and the scientific community to develop and maintain the national indicators.
- Developing integrated information to support mitigation and adaptation policies is increasingly an urgent request to support evidence-based policy making to address **climate change.** The SEEA CF and the SEEA EA together provide the necessary framework to support climate change policies that take nature into account. For example, the SEEA EA provides indicators of carbon sequestration and retention by ecosystem types, in addition to indicators of emissions by economic activities and expenditures for the protection of the environment.
- In a similar vein, the SEEA EA supports the informational needs of the United Nations Convention to Combat Desertification by providing an integrated framework to measure progress towards achieving **land degradation neutrality.**

### // LOOKING AHEAD : Inter-institutional collaboration

For the compilation of ecosystem accounts, INEGI needs to collaborate with different stakeholders in the government, academia, and private sector with different expertise including statistics and accounting, biophysical modelling, geospatial information systems, and economic valuation. The institutionalisation of the accounts in the National System of Statistical and Geographical Information (SNIEG) will support collaboration and data sharing as part of a common programme of work.

## NCA AND NATIONAL POLICY

In the Mexican context, ecosystem accounts can support the evaluation, and improvement, of national policy instruments such as ecological zoning, protected natural areas, wildlife use, environmental impact statements and land use change authorizations. Monetary accounts can be useful for assessing policy instruments for the conservation, protection, and restoration of ecosystems, as well as the contribution of ecosystems to the economy and the people.

Policy planning and design of policy instruments used for comprehensive management of water resources, sustainable forestry development, urban and tourism development, and agriculture and climate change mitigation and adaptation could be informed by ecosystem accounting.



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