System of Environmental Economic Accounting

DRAFT

HOW NATURAL CAPITAL ACCOUNTING CONTRIBUTES TO INTEGRATED POLICIES FOR SUSTAINABILITY

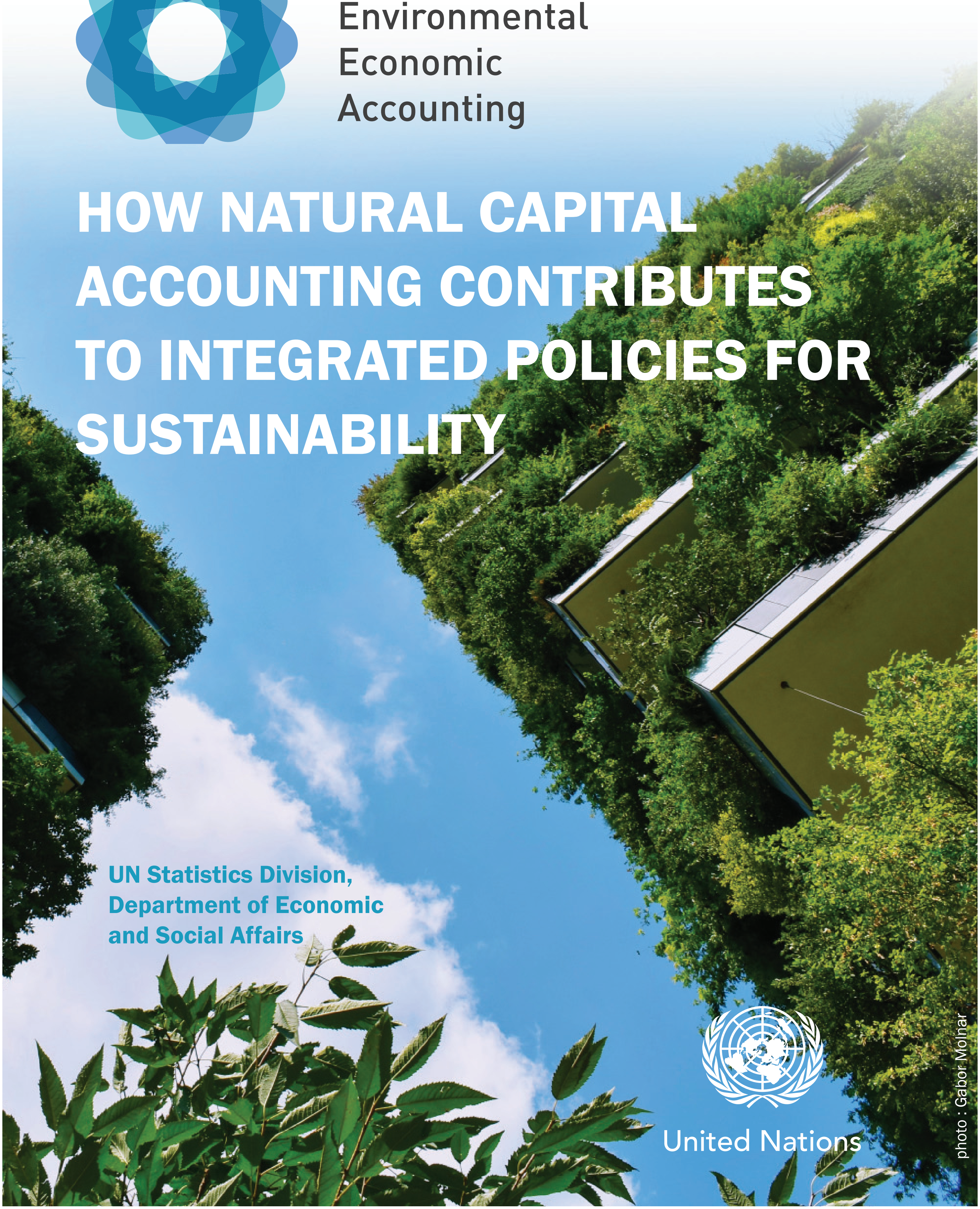


photo : Gabor Molnar

UN Statistics Division, Department of Economic and Social Affairs

United Nations

CONTENTS

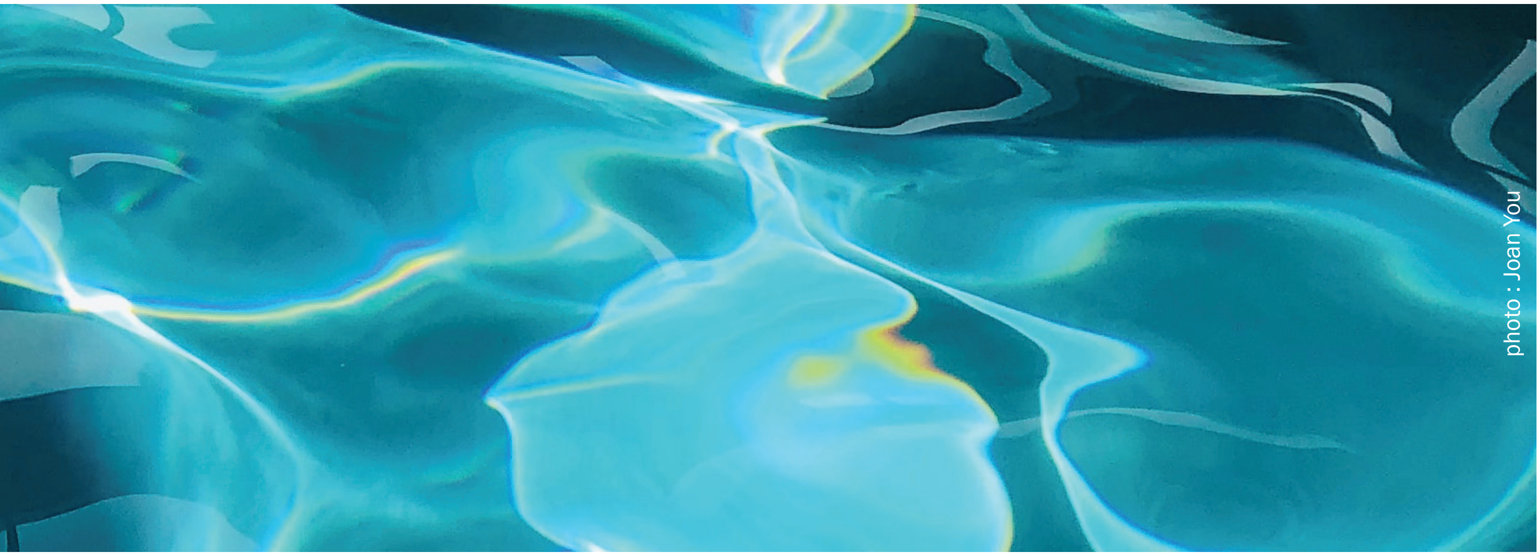
EXECUTIVE SUMMARY

Today many nations, across the world, are facing a myriad and unique blend of pressing social, economic, environmental and political challenges - from climate change to political polarisation to widening economic inequality - which humanity has not witnessed before to such a degree and magnitude. Many of these problems are interconnected and involve different stakeholders, from both the public and private sector, and at local, national and global scales, making it difficult for decision makers to formulate coherent and integrated policies.

The interconnectedness of policy is not the only challenge which policymakers are currently trying to tackle. Governments are also reconsidering their focus on economic performance. Especially the centrality of economic growth in policy – the focus on increasing Gross Domestic Product (GDP) – is increasingly being questioned by society and policy makers. Many of these governments are looking to promote goals "Beyond-GDP", which not only focus on human well-being but also on sustainability and inequality. Humanity's relationship with nature and the way natural resources are valued in society play a prominent role in this Beyond-GDP agenda.

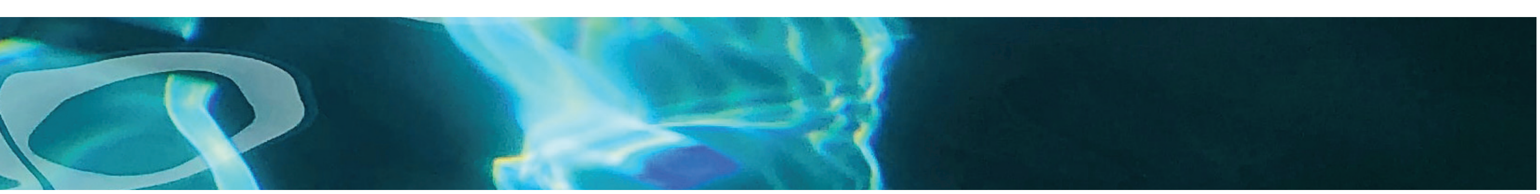
This complex policy context is being implemented through major policy initiatives around the world, including the Sustainable Development Goals (SDGs), "green deals", carbon neutrality targets, and circular economy and well-being economy initiatives. All of these policy goals require a robust statistical framework that can support policy prioritisation, implementation and evaluation. Moreover, moving towards integrated policies and away from a "silo" approach towards policy making requires integrated statistics and data.

To this end, the international statistical community has developed an international statistical standard



for natural capital accounting called the System of Environmental-Economic Accounting (SEEA), which is an integrated framework that shows the relationship between the environment and the economy. By providing a multipurpose view of the interrelationships between the economy and the environment, the SEEA can help uncover trade-offs and synergies across different policy domains. In short, the SEEA reveals society's complex relationship with nature and also helps to identify which policies can be implemented to lower environmental pressures, while at the same time continuing to manage the economy effectively. The SEEA therefore plays an important role in governments' desire to look Beyond-GDP and towards an economy that is focused on the promotion of well-being and sustainability.

The implementation of the SEEA is supported by many national governments around the world (as shown in the examples of Canada, Indonesia, European Union countries and Uganda) as well international organizations (including the United Nations, World Bank, OECD and several others). As a result of this global support, in 2020, close to 100 countries have compiled SEEA accounts (UNSD, 2020). The increased global uptake of the SEEA is leading to a high-quality, comparable and institutionalized supply of natural capital accounts across many nations. To maintain this promising momentum, it remains essential that implementation and usage of the accounts continues to increase, which in some contexts may be challenging. Nevertheless, current country experiences have shown that the SEEA can not only play a vital role in responding to today's policy challenges but also effectively contribute towards the evolution and increased uptake of integrated policies which better match the needs of today's policy reality.



Background

AUDIENCE

This overview paper is aimed at policymakers at various levels including international organizations, national government as well as local authorities. These stakeholders are currently the primary users of the SEEA, and this document will show how the SEEA can answer a variety of policy questions on sustainable development. This paper provides several successful examples that are aimed to inspire policymakers in applying the SEEA to inform their specific challenges.

It is a misconception to think that the SEEA is, or should only be, used to tackle environmental issues such as climate change, biodiversity loss, water management, air pollution and resource exploitation. This paper shows that many policy domains such as economic development, transportation, agriculture and even health are linked to environmental issues. Therefore, policies in these areas stand to benefit from using the SEEA framework because it uncovers the interrelationships between policy domains and environmental developments. Thus, this paper is not aimed exclusively at environmental policymakers; it also discusses how economic and social policies can be improved and therefore appeals to other government ministries.

In addition to policymakers, this paper may be of interest to businesses, NGOs, banks, insurance companies or members of the general public. For example, the corporate sector is increasingly adopting Natural Capital Accounting (NCA) in their decision making processes in order to streamline business models and de-risk supply chains.[1] Citizens are also increasingly interested in their environmental footprints which are often calculated using SEEA data. While the focus of examples in this paper are mainly on country-level applications that appeal to national governments, these examples might also be relevant to other stakeholder groups.

Also related to this overview paper are three separate issue papers on biodiversity, climate change and macro-economic policies, which are targeted towards more specific audiences. The paper on macro-economic policy is meant for finance ministries or central banks that want to understand both the short and long-term impacts of the environment on economic growth. The issue papers on climate change and biodiversity are geared towards environmental policymakers who are interested in the value that the SEEA can bring to their domain.

---

[1] Although companies are adopting NCA it is not always done using SEEA methodology (see also Example 4). There are however efforts to find common ground so that the various approaches align (Spurgeon et al., 2018).

THE ENHANCA PROJECT

This overview paper, as well as the three separate issue papers, are part of a series of papers developed by the project "Enhance Natural Capital Accounting Policy Uptake and Relevance (EnhaNCA)". The aim of the project is to provide materials to increase policymakers' understanding of applications of NCA according to the SEEA.

The objective of the project is to address three shortcomings in the environmental and economic policy space:

(a) A lack of awareness by policy makers on the value added of NCA and how it can address policy needs;
(b) A lack of systemization of the potential applications of NCA; and
(c) A lack of compelling case studies on the impact of NCA policy applications.

ACKNOWLEDGEMENTS

The project has received generous support from the German Federal Ministry for Economic Cooperation and Development, implemented through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

This paper has been authored by Rutger Hoekstra (MetricsForTheFuture.com), under the guidance of an editorial board. The Editorial Board operated under the direction of Alessandra Alfieri and Jessica Ying Chan (United Nations Statistics Division) and included the following persons: Thomas Brookes (IUCN), Raffaello Cervigni (World Bank), Glenn-Marie Lange (World Bank), Wadzanayi Mandivenyi (Department of Environmental Affairs of South Africa), Stefano Pagiola (World Bank), Corli Pretorius (UNEP-WCMC) and Juha Siikamaki (IUCN), and was chaired by A.H. Kroese (Statistics Netherlands).

The author and editorial board would like to acknowledge the inputs of both Chloe Hill and Sarah K. Jones (Altus Impact) for their editorial and design services on this paper. The author and editorial board would also like to acknowledge the support and contributions of Nina Bisom and Johannes Kruse (GIZ) in producing this paper.

With funding from the

Federal Ministry
for Economic Cooperation
and Development

Supported by

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Acronyms

ANS	Adjusted net savings
CBD	Convention on Biological Diversity
CETA	Comprehensive Economic and Trade Agreement
COP	Conference of the Parties
DMC	Domestic material consumption
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GHG	Green house gas
GDP	Gross Domestic Product
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
MFA	Material flow accounts
MRIO	Multiregional input-output model
NCA	Natural capital account(ing)
NGO	Non-governmental organization
OECD	Organization for Economic Cooperation and Development
SDG	Sustainable Development Goals
SEEA	System of Environmental-Economic Accounting
SEEA CF	System of Environmental-Economic Accounting - Central Framework
SEEA EEA	System of Environmental-Economic Accounting - Experimental Ecosystem Accounting
UN	United Nations
UNCEEA	United Nations Committee of Experts on Environmental - Economic Accounting
UNSD	United Nations Statistics Division

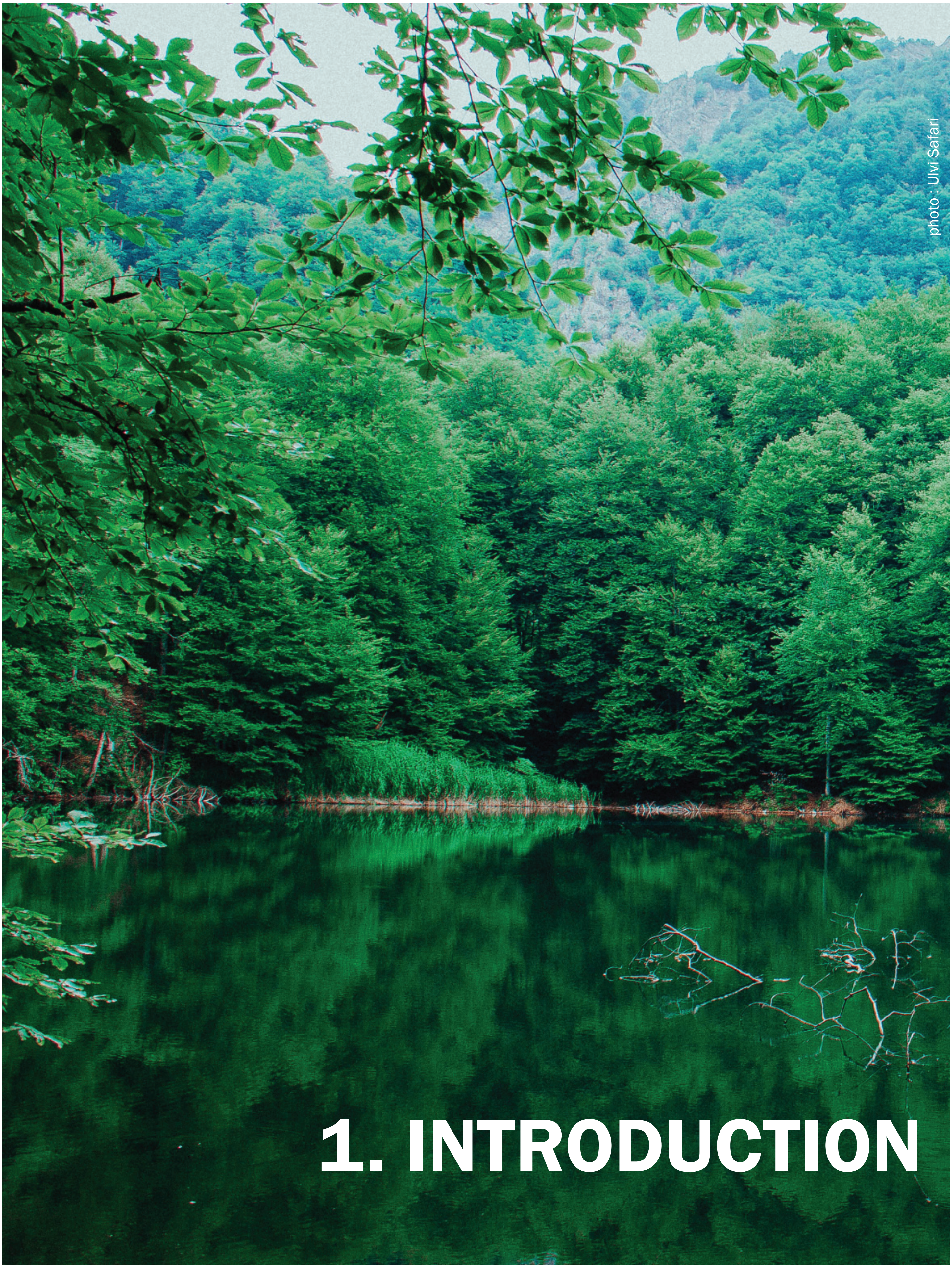


photo : Ulvi Safari

1. INTRODUCTION

1.1 Tackling Complex Policy Challenges

Today, the majority of countries across the world are facing a diverse range and an increasing magnitude of social, economic, environmental and political challenges such as climate change, biodiversity loss, poor air quality, inadequate resource management, inequality and poverty, financial imbalances and health crises, among others. In order to effectively tackle these problems, fundamental societal and economic transformations are needed that not only require innovative thinking but also integrated policies.

The growing intensity of these challenges are now starting to reinvigorate debate amongst policymakers over what policy goals need to be prioritized and then pursued. Currently economic growth, as measured by Gross Domestic Product (GDP), dominates policy discussions, mainly owing to the widespread belief that "growth is good". In reality, though, income is just one of the many other factors that influence human well-being. At the same time, the sole focus on economic growth leads to broader sustainability issues e.g. over exploitation of natural resources etc. Mounting evidence coupled with a growing recognition amongst decision makers has now started to lead to stronger arguments to move to "Beyond-GDP" policies that are geared towards a greener, more inclusive and equitable society. To achieve these policies, decision makers need to develop a clearer view of the stocks of natural, social, human and economic capital that nations have at their disposal. By doing this, these stocks can ultimately be better managed in a way which achieves well-being and sustainability.

One of the most influential Beyond-GDP initiatives is the 2030 Agenda for Sustainable Development, which has, at its core, the Sustainable Development Goals (SDGs). The SDGs are comprised of a number of goals and targets, each of which have been agreed by Member States and are coordinated by the United Nations .[2] The goals provide a vision and future pathway towards enabling Member States to better recalibrate how they value and manage their resources more effectively and sustainably. However, other initiatives and movements such as "green deals", "circular economy", "carbon-neutrality" and the "well-being-economy", including many others, are also contributing towards the improvement of human well-being and sustainability

[2] The SDGs were agreed upon in 2015. More information can be found here: https://sustainabledevelopment.un.org/.

and therefore also play an important role in policy goals. All over the world, governments are grappling with these complex policy questions around how to execute better resource management. What makes these challenges even greater is that they are all interrelated. If these issues are looked at in isolation, using a "silo" approach, it is difficult to take advantage of the synergies across the different policy domains. Moreover, it is likely that there may be unintended consequences of how one policy might impact another.

An example of interrelatedness can be observed in the case of transportation. Due to air emissions, transportation is closely linked to climate change, but also to air quality and public health issues. Transport infrastructure also generates significant economic benefits during the construction phase (jobs, profits), as well as economic benefits that are associated with improved mobility after the infrastructure has been completed. However, if the infrastructure is not executed sustainably it may negatively affect biodiversity through encroachment and/or fragmentation. Transportation policy, therefore, has many social, economic and environmental implications, where trade-offs need to be made and synergies need to be identified in order to maximize the most effective and sustainable outcome. These trade-offs and synergies exist for virtually all policy problems, and so it is imperative to formulate coherent policies that take more of a comprehensive rather than siloed approach to these interrelated issues.

Overlooking these interlinkages can have serious social and political repercussions. For example, when the French Government announced an eco-tax on petrol in 2018, it sparked an uprising of the Gilets Jaunes movement which protested that the new taxes would hit low-income communities the hardest. After months of public protests, the French government was eventually forced to withdraw the proposal. The legacy of this episode is that governments across the world are now far more sensitive to the social impacts that can be caused by climate change policies. Public support for climate policies is crucial and those that are seen to be 'unfair' by the general public will ultimately be rejected. Before these types of policies are drawn up, therefore, it is essential that decision makers are provided with well researched information around the costs and benefits of climate policies on different segments of society in order to better inform policy making.

Beyond these interlinkages, policy challenges can be complex in other ways. For example, there are many stakeholders involved in every policy issue (e.g. international organizations, national governments, regional and local authorities, multinationals, small and medium-sized enterprises (SMEs), banks, insurance companies and individuals), all of which contribute to a certain problem, suffer the impacts, and/or are part of the solution. A further complication is that the impacts, problems and solutions manifest themselves at different spatial scales: global, national, regional, local etc. A modern-day policymaker, in order to be effective therefore, needs to view these challenges from each perspective of the different stakeholders and take on board the differential impacts at the varying spatial scales.

This complex policy reality has significant implications for the type of information that is required for effective policymaking. For example, today's policy issues require data and policy models that can sufficiently deal with the complexity at hand. The System of Economic and Environmental Accounting (SEEA) is an information framework that can help tackle such complexities by providing an integrated view of the environment in the context of economic and social change. Implementation of the SEEA is spreading rapidly. In 2019, close to 100 countries have compiled the SEEA. International organizations such as the United Nations, European Commission and World Bank are investing great efforts into the global implementation of the SEEA (see section 3.1 for further discussion). At the national level, it is often the National Statistical Office which implements the SEEA, though in other cases it is the Central Bank, Ministry of Finance or Ministry of Environment. Whatever the case, implementation of the SEEA necessitates cutting across data siloes and inter-institutional collaboration. However, producing SEEA accounts is not an end goal; it should also be adopted to support integrated policies that strive towards well-being and sustainability.

To enhance the uptake of the SEEA for policy and decision making, the UN Statistics Division has commissioned this overview paper. It highlights, in non-technical terms, the value of SEEA for policy makers. It builds on previous documents which have discussed the value of the SEEA (Bass et al., 2016; Ruijs and Graveland, 2018; Ruijs and Vardon, 2018). In addition to this overview paper, separate issue papers will cover three crucial policy challenges: climate change, biodiversity and macro-economic policy. This paper does not provide a comprehensive overview of all applications. Instead, the aim of the paper is to provide intriguing examples of economic, social and environmental applications from around the world with the intention of inspiring policymakers to think of new and innovative ways in which the SEEA can be used to address their specific needs.

The remainder of Section 1 will discuss the policy context and then look at SEEA in more detail, specifically demonstrating how, using examples, the framework can be useful and indeed how it is already being used in many policy domains. Section 2 is entirely devoted to describing which roles the SEEA can play in various policy domains. Finally, Section 3 sets the scene on how to move forward in terms of using SEEA data to support integrated policies.

1.2 Policy Complexity and the Policy Cycle

There are four dimensions that make the current policy challenges particularly complex:

- **Interconnected domains:** Policy challenges are almost always closely linked to each other. Improvements in one area may lead to detrimental effects in other domains (trade-offs). In other cases, improvements in two domains can go hand in hand (synergies).

- **Multiple stakeholders:** There are various institutions and entities that play a role in creating the problem, suffering the impacts or contributing to the solution. Governments, international organizations, local authorities, businesses, banks and individual citizens all play a role.

- **Various spatial scales:** The problems, impacts, and solutions can manifest themselves at different scale levels. Some problems are global, while others manifest themeselves at the national and/or local level. In some cases problems might even be restricted to a bio-region, such as a water catchment area or a tropical rainforest.

- **New sustainable policy goals "Beyond-GDP":** Governments are looking to shift the traditional focus on economic growth (increasing GDP) towards policies that enhance the well-being of current generations without compromising the well-being of future generations.

To deal with these dimensions of complexity, policy makers and analysts need a flexible, versatile system that takes into account trade-offs and synergies in a spatially explicit way. Moreover, such a system must be able to inform all stages of the decision making process. Taken together, these stages are referred to as the "policy cycle" (see box 1 below based on Bass et al., 2016).

Box 1. *Stages in the Policy Cycle*

1. **Policy definition:** In this phase, new problems are identified, and a judgement is made whether a new issue requires government action. This phase also includes an analysis of the drivers and consequential impacts, as well as the interlinkages with other policy domains.

2. **Policy response (analysis and formulation):** This stage refers to the process of evaluating different policy responses and choosing the preferred option. For example, policymakers might use techniques such as cost-benefit analysis to rank the best alternative paths. When looking at the environment and natural capital, analysis may be needed in either (or both) monetary or physical terms, or as input to scenario modeling or other environmental-economic models.

3. **Policy instruments (implementation):** This stage refers to the actual process of implementing a policy. This is carried out through specific policy instruments such as subsidies, taxes, regulation or government procurement. The main data requirement in this stage is quantifying the size of the phenomena, such as data on taxes and subsidies.

4. **Evaluation and policy appraisal (assessment and monitoring):** In this phase, the success of the policy is evaluated in order to formulate lessons-learnt that can be applied in the future. It is also important to see whether any unpredicted effects have occurred. The evolution includes the appraisal of the policy problem and the policy response and/or the implementation of policy instruments. The evaluation is usually used to reassess the problem definition again, recalibrate or perfect the policy response in a second round of actions.

The SEEA is a sophisticated statistical framework that that can deal with the various dimensions of policy complexity and can be used in all the stages of the policy cycle. The SEEA provides information that helps to identify problems or make decisions about policy priorities. For example, the SEEA can be used in a multitude of ways such as to track the progress of the SDGs, show which industries are causing carbon emissions to increase or assist in making visible the economic value of ecosystems and the services that they provide. The SEEA can also be applied to ex-ante modeling applications which help with making effective choices between various policy options. Modeling using the SEEA might also be used to identify the effectiveness of policy instruments, such as a carbon tax. Given its unique position at the environment-economy nexus, the SEEA is well-placed to help policy makers address complexities that often go ignored.

1.3 Siloed vs Integrated Policy

Policymaking is carried out by various levels of government at the local, regional or national level or by international organizations (e.g. IMF, World Bank, World Trade Organization) or supranational organizations (e.g. European Union). Within each government or entity, responsibilities may be delegated further. National governments have various ministries that focus on specific goals.

For example, the Ministry of Finance or the Ministry of Economic Affairs are responsible for economic development, while the Ministry of the Environment is responsible for tackling issues such as climate change and biodiversity loss as well as improving resource and water management. As a result, many policy discussions quickly conform to the thematic boundaries that have been delegated.

Given the interrelatedness of today's challenges, this traditional demarcation of policy responsibilities is increasingly problematic. For example, economic policies have a profound impact on the environment. At the same time environmental challenges such as climate change, biodiversity loss, resource and water scarcity, can have profound negative impacts on the economy, now and in the future. It is therefore imperative to look at the existing interlinkages between different policy domains by examining economic, environmental, and social developments simultaneously. Clearly, there is tension with the current siloed way in which policy responsibilities are delegated and the way that financial resources and decision making powers are distributed amongst the different ministries. [3]

Two of the main fields that are helping to promote integrated thinking are the Beyond-GDP debate and the SDGs initiative. These movements are based on the idea that societies should be viewed with a very broad lens and that policy domains are very much interrelated. This will require new ways of assigning responsibilities between governmental bodies. However, even if the traditional siloed policy structure is maintained, the SEEA can still be of significant value. Section 2 will explore in more detail the value of applying the SEEA in a more conventional policy making context/structure.

BEYOND-GDP

An important first exercise to help achieve integrated policies would be to identify a nation's priorities such as: what are the key pressing issues that need to be tackled and how can a longer term sustainable future be achieved? Currently, many governments, implicitly or explicitly, adopt economic growth as its primary goal. However, it is now well documented that GDP is not an effective measure of societal progress. Economic growth, if not achieved sustainably, can also contribute to the onset of climate change, the destruction of ecosystems and to the exacerbation of many other environmental problems. In several countries, particularly developing nations, inequality has risen even when their economy has been growing, further accentuating the poverty gap. In addition, and whilst income contributes to societal and individual well-being, it is by no means the only factor. Social relationships, health and thriving communities are also major contributors to the well-being of the population. Clearly, just focusing on economic growth as the goal of policy, therefore, is insufficient. This was recently reiterated by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), which argued that a "key component of sustainable pathways is the evolution of global

[3] See also (OECD, 2016) on "Breaking out of policy silos".

financial and economic systems to build a global sustainable economy, steering away from the current, limited paradigm of economic growth" (IPBES, 2019). One of the focuses of the Beyond GDP movement, therefore, focuses on developing indicators that are as clear and appealing as GDP, but are more inclusive of environmental and social aspects of progress.

The fact that GDP is not a measure of well-being, sustainability, or inequality has been known for a long time (van den Bergh, 2009; Costanza et al., 2014; Coyle, 2014; Fioramonti, 2013; Hoekstra, 2019; Philipsen, 2015). Literally hundreds of Beyond-GDP alternatives have been suggested and, although they use many different methodologies, they are all based on the goal of creating a society that enhances well-being for the current generation in a sustainable way so that future generations are capable of living the "good life" as well.

In response to the narrow focus on economic growth, some governments have taken bold steps towards a "well-being economy" (Exton and Mira d'Ercole, 2019). For example, in 2019, the New Zealand Government presented the first "well-being budget", in which the rationale for budget priorities was explicitly based on well-being (New Zealand, Treasury of New Zealand, 2019). Many of the measurement systems and policy applications for a well-being economy also rely on the idea of a broad set of resources, just like wealth accounting, which is discussed in more detail in section 2.3. The conceptual foundation, therefore, also includes all asset types (produced, financial, social, human and natural capital), although many countries have chosen not to give a monetary value to the capital stocks.

---

[4] There are many examples such as the Human Development Index (HDI), Genuine Progress Indicator (GPI), Ecological Footprint, Sustainable National Income, Subjective Wellebing, U-Index, Sustainable Development Goals (SDGs), SDG index and many others. Hoekstra (2019) suggests that hundreds of alternatives have been suggested and summarizes them in an Annex.

[5] See for example the CES recommendations (UNECE et al., 2014) and countries that follow these guidelines such as the Netherland, New Zealand and Belgium.


photo : Laura Chouette

SUSTAINABLE DEVELOPMENT GOALS (SDGS)

“Sustainable development” is one of the most popular concepts used to advocate a holistic view of progress. Since the Brundtland report (World Commission on Environment and Development, 1987) popularized the phrase in 1987, it has been reflected in many government policies, sparked activist movements, generated private sector interest and has been institutionalized throughout various UN processes. Most recently, the 2030 Agenda for Sustainable Development has provided a major impulse towards achieving sustainable development more concretely. Encompassed in the 2030 Agenda are the SDGs, which are a set of 17 goals and 169 targets, all of which have been agreed upon by Member States as the framework for development, under the auspices of UN.[6] Most of the deadlines for the targets are set for 2030, and the SDGs include a broad spectrum of environmental, social and economic goals. The SDGs have inspired action by governments, businesses, NGOs and individuals.

The SDGs are an important initiative because they define a global policy agenda. The agenda that launched the SDGs also notes that the “interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realized” (A/RES/70/1). In other words, there is an explicit desire to have coherent policies that pay attention to the links between the various goals.

Policy coherence would be enhanced by adopting SEEA indicators for various SDG targets that make it possible to link environmental issues to economic and social developments. Figure 1 presents the findings from an assessment showing how 9 out of the 17 goals can be supported by SEEA data (UNCEEA, 2018). In fact, the analysis indicates that 40 indicators could potentially come from the SEEA framework. Due to data availability, the SDGs are not always measured using SEEA data. Example 1 on the other hand shows how the European Union has already begun to use the SEEA to measure progress towards the SDGs and the effectiveness of this approach for policymaking.

Figure 1. *The SDG goals which are supported by the SEEA*

Source : UNSD

[6] SDG target 15.9.1 explicitly mentions implementation of the SEEA.

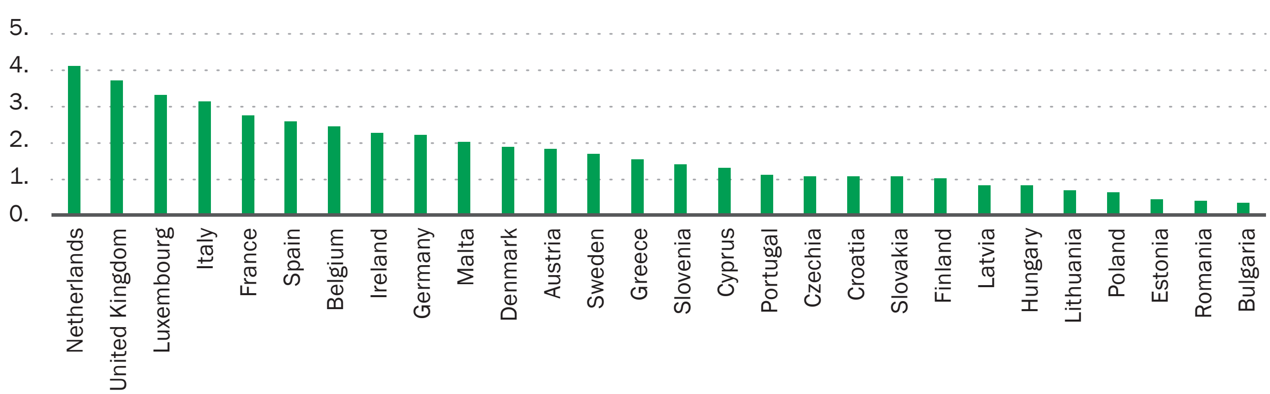
Example 1. Measuring the environmental targets of the SDGs

The European Commission tracks progress towards the SDGs. Several of the SDG targets are measured using data from the SEEA framework. For example, SDG 12.2 states: "By 2030, achieve the sustainable management and efficient use of natural resources." Eurostat has chosen two SEEA indicators to help do this: 1) Domestic material consumption (DMC), which measures the total amount of materials directly used by an economy; and 2) Resource productivity, which is GDP divided by DMC. Resource productivity data for 2018 is shown in the figure below.

The resource productivity measures are an indication of the efficiency with which physical resources are used in an economy. If an economy can generate more income (GDP) per unit of materials used (DMC), this is seen as a positive development, although it is also important to look at the absolute DMC data to show how large the overall material use is per capita.

Using these indicators, policy makers from around Europe can compare their resource productivity with other countries and over time. The use of the SEEA for the SDGs also allows this data to be used in policy models for the 2030 Agenda.

RESOURCE PRODUCTIVITY OF EUROPEAN MEMBER STATES, 2018



UNITS : Euro per kilogram, chain linked volumes (2010)
Source : Eurostat, 2020b

1.4 The System of Environmental-Economic Accounting (SEEA)

The SEEA-Central Framework (SEEA-CF) was adopted in 2012 as an international statistical standard by the United National Statistical Commission (UN et al., 2017). The SEEA-CF focuses on individual environmental assets (e.g. water, energy, etc.), and particularly on how they are extracted from the environment, used within the economy and returned to the environment in the form of residuals.

In 2013, the SEEA-Experimental Ecosystem Accounts (SEEA-EEA) was adopted (UN et al., 2014). The SEEA-EEA complements the SEEA-CF by taking a spatially explicit (i.e. mapping) ecosystems perspective to examine the extent and condition of ecosystems as well as the services that they provide. Together, the SEEA-CF and SEEA-EEA make the overall SEEA framework.

Development of the SEEA is coordinated by the United Nations Statistical Commission and United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA). The SEEA is supported by many national governments around the world and international organizations such as the United Nations (UN), European Commission (EC), Food and Agriculture Organization of the United Nations (FAO), International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), and the World Bank, among others.

A key feature of the SEEA framework is that it shares the same conceptual basis as the System of National Accounts (SNA) - the standard that dictates the compilation of macro-economic information in a systematic set of national accounts for each country. The SNA yields important indicators, such as Gross Domestic Product (GDP), which measures the overall economic performance. The SNA also measures other important quantitative macro-economic measures including consumption, investment, as well as imports and exports. It is the conceptual link between the SEEA and SNA that makes it possible to better understand the complex relationship between the economy and environment. In particular, the SEEA and SNA use the same concepts, definitions, classifications and boundaries. Without this link, it is impossible to formulate integrated policies that simultaneously take on board economic and environmental impacts.

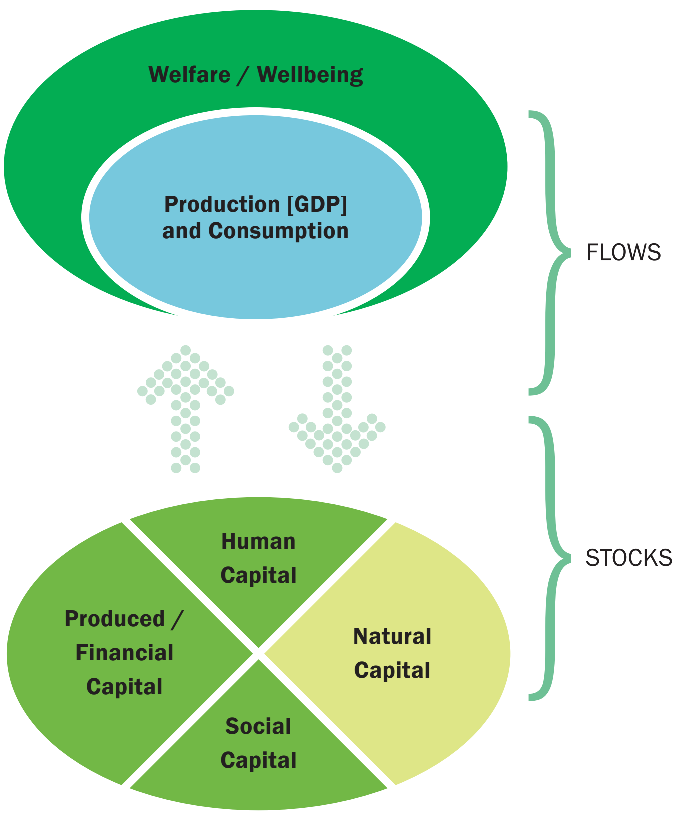
CAPITAL AND STOCK/FLOW ACCOUNTING

The SNA and SEEA frameworks are based on accounts for "stocks" and "flows", as shown in Figure 2.[7] Economic models are based on the idea that a society has resources, or "stocks", at its disposal, which are also referred to as capital. These resources are needed in production processes to create goods and services. Production of goods and services are considered as "flows", which generate welfare. Total production over a one year period, is aggregated into an indicator called Gross Domestic Product (GDP). The production process is an important way to generate income, through the wages that are paid out to employees and

[7] This figure is adapted from Conference of European Statisticians (CES) Recommendations on Measuring Sustainable Development (UNECE, OECD, and Eurostat, 2014). The CES framework is based on the Stiglitz-Sen Fittoussi report (Stiglitz, Sen, and Fitoussi, 2009) but is also similar to the conceptual approach used by the Better Life Inititaive (OECD, 2017a).

the profits generated by businesses. In turn, generated income is used to buy products or invest in new capital. This economic cycle of production and consumption is the underlying factor of economic theory and the SNA.

Figure 2. *Capital, asset stocks and flows*



Source: Author, adapted from UNECE et al. (2014)

The SNA measures a part of the stock/flow accounting structure. It provides an asset account that records the stock of "produced capital" such as machines, buildings, intellectual property products, as well as financial capital (stocks, bonds, gold etc.).[8] The flow accounts of the SNA record flows of production, consumption, investment, depreciation, income generation and distribution.

However, the SNA does not cover all relevant aspects because human well-being is a broader notion than just the consumption of goods and services (UN et al., 2014). Moreover, it is generally understood that a society's resource base is far broader than what the SNA defines it to be. In addition to produced/financial capital, there is also human capital (educated and skilled workers) (UNECE, 2016), social capital (networks and social trust as well as governance and rule of law) (Fukuyama, 2000; Grootaert, 1998; Woolcock, 1998) and natural capital.

The framework shown in Figure 2 above is frequently used in the context of Beyond-GDP policy discussions. For example, in 2009, France's then President Sarkozy commissioned a report on measuring well-being and sustainability. The resulting "Stiglitz-Sen-Fitoussi report" (named after its prominent lead authors) proposed the framework. It argued for a policy framework in which the well-being of current generations and future generations are treated separately and in which the concept of "capital stocks" play an important role (Stiglitz et al., 2009).

What is the role of the SEEA in these Beyond-GDP frameworks? The SEEA is the internationally agreed measurement framework for natural capital and its relationship to the economy. It shows the many ways in which natural capital influences the economy/human well-being as well as the ways in which the economy affects natural capital. The SEEA adopts a stock/flow accounting framework, just like the SNA.

The next sections will look in greater detail at the various parts of the SEEA and their policy applications. Empirical examples are used to illustrate the various accounts. Further details on the SEEA methodology may be found in the Annex.

8 The SNA includes a number of natural capital categories such as natural resources and fossil fuel reserves.

1.5 The SEEA-Central Framework (SEEA-CF)

The SEEA-CF includes three core types of accounts which are related to resource management (physical flows accounts), a country's wealth (asset accounts) and the importance of the "green economy" (environmental activity accounts).

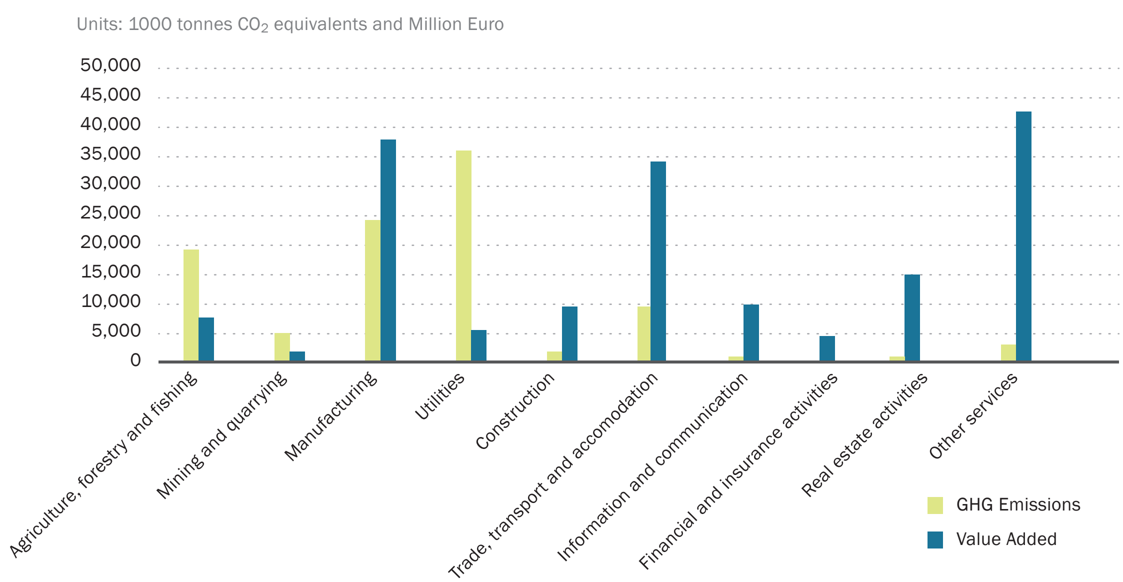
RESOURCE MANAGEMENT (PHYSICAL FLOW ACCOUNTS)

Physical flow accounts present the material flows within the economy-environmental system (UN et al., 2014). Physical flow accounts show the extraction of natural inputs (including mineral, timber, aquatic and water resources) into the economy, how these resources are used within the economy and the flow of emissions of pollutants and waste from the economy back into the environment. Thus, physical flow accounts provide an in-depth picture of the relationship between our economies and the environment - the pressures that humans exert on the environment, the role of the environment in our economy and the impacts we create on the environment.

The SEEA-CF physical flows accounts are consistent with the economic flows data which is produced by the SNA. They both include products and industry breakdowns and share various categories for final demand. This makes it possible to link economic developments in output, value added, consumption, investments, imports and exports to the use of natural inputs or the generation of residuals. This can be done both at the national, industry and product level.

Example 2 presents the greenhouse gas emissions and the value added per industry for the country of Romania in 2017. It shows policymakers the economic importance of the sectors that are contributing most to climate change and thus enables the relevant policies to be created and the appropriate regulations to be applied.

Example 2. *Greenhouse gas emission and value added per industry in Romania (2017)*



WEALTH (ASSET ACCOUNTS)

The natural resource stocks of a country are recorded in asset accounts. These stocks are measured in physical as well as monetary terms. For example, fossil fuel reserves can be measured in terms of the volume and energy content as well as the economic value of these reserves.

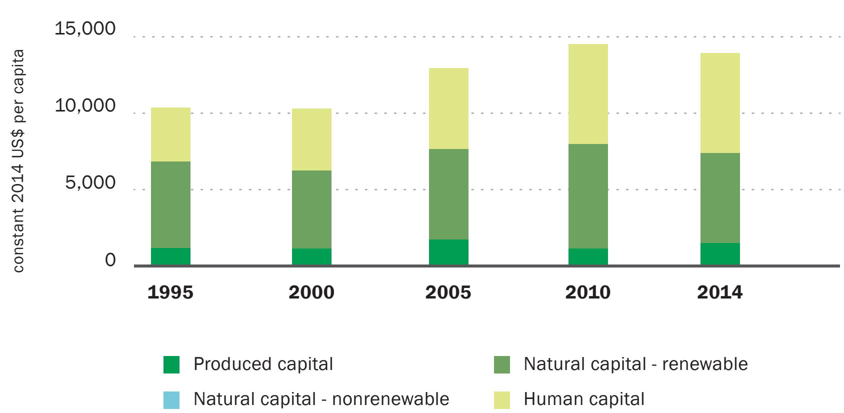
The task of policymakers is to manage these capital stocks in a responsible way. However, non-renewable energy and mineral resources are subject to exhaustion. The resources will not last forever, which poses a long-term threat to a nation's prosperity. Some countries have therefore enacted laws that make it compulsory to invest income that is delivered from non-renewables into other capital stocks. Famously, Norway's Government Pension Fund Global has invested all government fossil fuel revenues into financial assets, leading to the establishment of the world's largest sovereign wealth fund which now reaches over USD1 trillion dollars (Norges Bank, 2020). This ensures that future generations benefit from the current depletion of natural resources. In many other countries, profits from natural resource use and extraction are utilized for consumption by the current generations, thereby leaving future generations with depleted natural capital and no financial resources to compensate.

Example 3 shows how asset accounts have helped produce measures of national wealth in Uganda (Uganda Natural Capital Accounting Program, 2019). While the SNA and its indicators, such as GDP, provide information on economic activity, SEEA asset accounts can be used to generate wealth accounts that supplement this information with information on renewable and non-renewable natural capital (in addition to produced capital, human capital and financial assets).

Example 3. *Wealth Accounts in Uganda*

Under the Uganda Natural Capital Accounting Programme and World Bank Global Programme on Sustainability, the Ugandan government has developed adjusted macroeconomic measures of national wealth and measures of income and savings using the SEEA. These adjusted measures take into consideration human and natural capital and show that natural capital is the second largest single contribution to Uganda's comprehensive wealth, particularly cropland and pastureland (the first largest contribution being human capital). The figures in the graph below also indicate a reduced contribution of forested land to overall wealth, mainly due to rapid depletion and deforestation. The findings point to the importance of increasing the productivity of farmland, as well as reducing (or reversing) the rate of net forest depletion. In addition, as Uganda begins commercial production of oil and gas in the coming years, the SEEA and adjusted measures of wealth will become increasingly important for ensuring the sustainable use of resources.

PER CAPITA WEALTH OF UGANDA



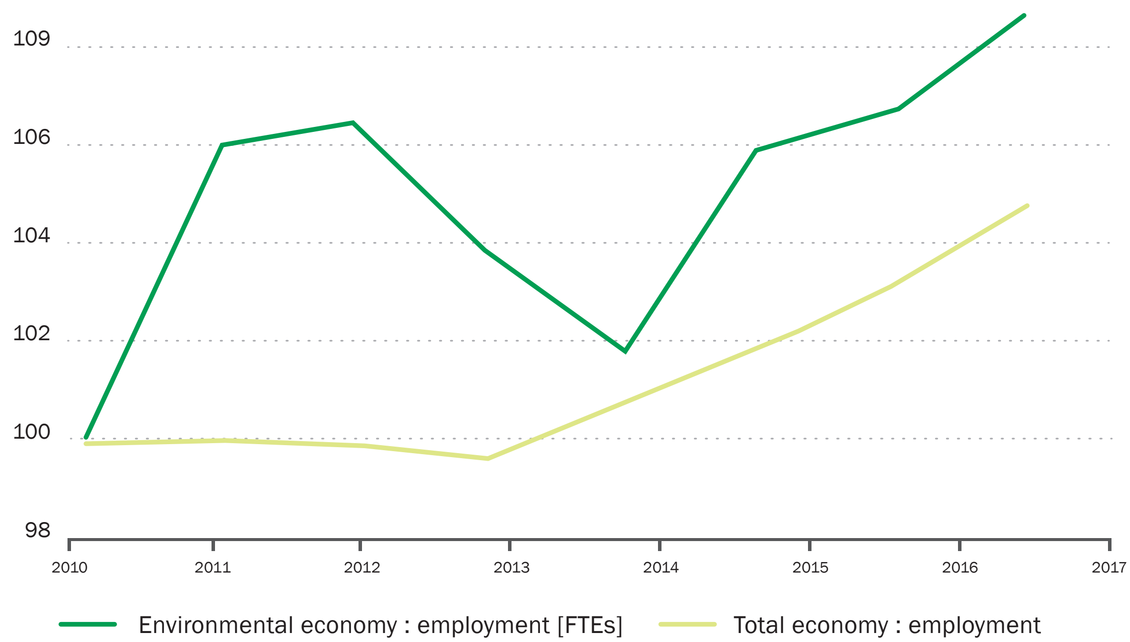
Source: Uganda Natural Capital Accounting Program, 2019

THE "ENVIRONMENTAL ECONOMY" (ENVIRONMENTAL ACTIVITY ACCOUNTS)

The SEEA-CF also includes monetary flow accounts that show the economic importance of environmental activities. An example is the environmental goods and services sector (EGSS), which is also referred to as the "environmental economy" or sometimes as "green economy" - an economy that is low carbon, resource efficient and socially inclusive (UN Environment, 2020). The EGSS account records goods and services that minimize, reduce, eliminate, treat and manage pollution or repair damages to air, water, waste, noise, biodiversity and landscapes. These goods and services can have a significant economic impact, which is reflected in the EGSS accounts.

Example 4 shows the employment generated by the environmental economy in the European Union (EU-28) for the period 2010-2017. The figure shows that the sector is growing faster than the overall economy, particularly in terms of employment i.e. "green jobs". By considering this information in the policy debate, it is possible to factor in the positive economic and employment effects that environmental policies have.[11] This helps to underscore that environmental regulations can sometimes also have beneficial impacts such as increasing employment.

Example 4. *Development of employment in the "environmental economy" and in total, EU-28, 2010–2017 (2010 = 100)*



Source: Eurostat (2020a)

[11] There are other environmental activity accounts such as the Environmental Protection Expenditure Account (EPEA), which quantifies the resources devoted to environmental protection. There is also the Resource Management Expenditure Accounts (REMEA) which include, for example, direct expenditures for the protection of biodiversity. The SEEA-CF also includes accounts for environmental taxes and subsidies accounts in order to show the fiscal dimension of environmental policy.

1.6 SEEA-Experimental Ecosystem Accounts

The SEEA-EEA[12] complements the SEEA-CF by looking at how the individual environmental assets of the SEEA-CF interact over given spatial areas (e.g. ecosystems). As with the SEEA-CF, the SEEA-EEA provides accounts (tables) for stocks and flows.

However, the SEEA-EEA also provides a spatially explicit approach by exemplifying these tables through GIS mapping. By providing guidelines on how to account for the bio-physical developments of ecosystems and biodiversity, the SEEA-EEA is a vital resource towards enabling our understanding of the drivers behind rapid biodiversity loss and the increasing pressures on ecosystems. These experimental accounts include physical accounts for the extent and condition of ecosystems showing the quantity/extent of ecosystems and their health, respectively.

The SEEA-EEA also provides physical and monetary values for the ecosystem services that are provided by ecosystems themselves. These include "provisioning services" (e.g. water, crops), "regulating services" (e.g. climate, bioremediation, water flow regulation, carbon sequestration) and "cultural services" (e.g. recreation, acquisition of information and knowledge). It is vital to have this information because it makes clear what role ecosystems have in enhancing human well-being and economic prosperity.

One of the prime contributions of the SEEA-EEA is that it puts natural capital in a spatially explicit context. The quantity and quality of ecosystems, and the services that they provide, are location specific and indicated through mapping. Thus, spatially explicit mapping under the SEEA-EEA shows which ecosystems provide what benefits, thereby highlighting the contributions of ecosystems to well-being and the benefits of conservation. Likewise, it shows where degradation is taking place and who is suffering the consequences for the degradaton. Due to this spatially-explicit component, the SEEA-EEA can link biodiversity policies with location-specific agricultural development, watershed management, nature conservation and local economic policies. This spatially-explicit approach holds appeal for not only government authorities and their decision making, but also for businesses. Example 5 presents an example of ecosystem services that have been mapped out for a company in Tasmania, Australia, and how the SEEA-EEA approach can help factor natural capital into business decisions in a systematic way.

---

[12] The SEEA-EEA was published in 2014 but there are currently efforts to revise the SEEA-EEA and raise its status to a global standard. More on the revision process can be found here: https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision

Example 5. *Business-uptake of NCA, Forico, Tasmania, Australia*

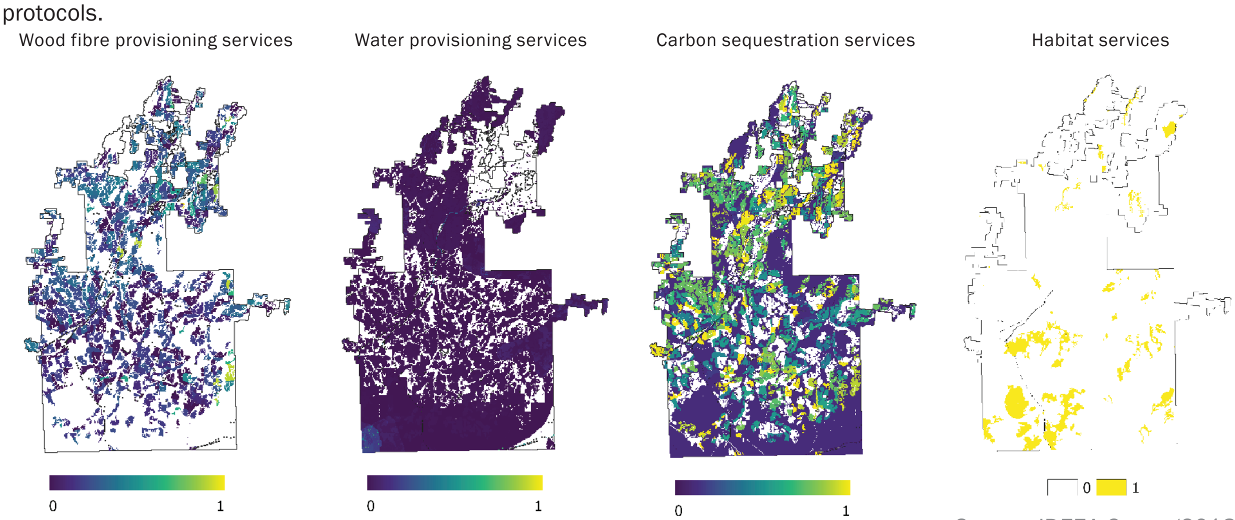
Businesses are increasingly reporting their impacts on society and the environment.[13] Within these corporate reports, NCA is an important approach. Notably, the Natural Capital Coalition, which has published the Natural Capital Protocol (Natural Capital Coalition, 2016), has gained considerable support. However, while companies have been adopting natural capital principles, the approaches used for assessment and accounting are not yet completely harmonized with the SEEA. In principle, harmonisation and alignment with the SEEA is important in order to support comparisons between business-level, industry-level and national results. The potential for the use of methodologies aligned with the SEEA is therefore increasing in business applications.

A good example of SEEA-aligned business-level NCA is Forico, a private forest management company which manages 173,000 hectares of plantation and natural forest land in Tasmania, Australia (IDEEA Group, 2018). Ninety thousand hectares of plantation are managed for wood fibre production, while 77,000 hectares of natural forest are managed for biodiversity conservation purposes. Forico must achieve sustainable forest management outcomes across the entire business.

The “Accounting for Forico’s Forest Assets” project focused on showing how the SEEA’s ecosystem accounts could be applied to allow traditional corporate accounts to embrace environmental and social factors. Specifically, this involved (i) accounting for the stock and changes in stock (including changes in condition) of ecosystem assets held by Forico and (ii) accounting for the flow of ecosystem services supplied by these assets (i.e. beyond plantation fibre production).

So far, the project has produced considerable spatially explicit physical information on ecosystem extent services. The results show that the areas under Forico management provide significant provisioning services as well as carbon sequestration and habitat services (as shown in the maps below). Steps are being taken to link this physical data to monetary values and to integrate this data into business decisions.

The case of Forico shows how the SEEA approach can support business-level decision making, for example through forest management planning, and can underpin delivery against sustainable forest management reporting and assessment protocols.



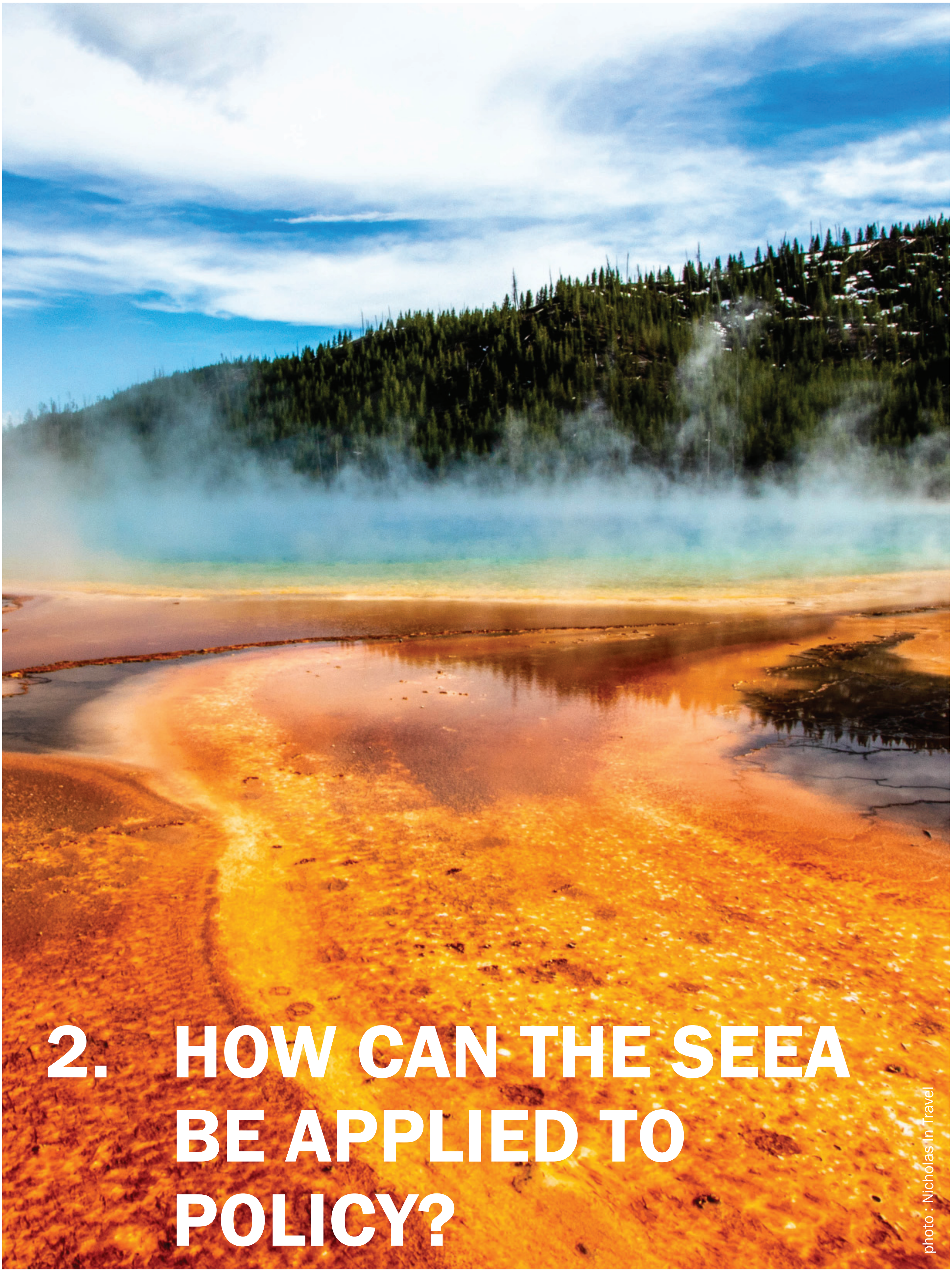
Source: IDEEA Group (2018).

13 According to KPMG (2017) “corporate reporting is standard practice for large and mid-cap companies around the world.” They found that “Around three quarters of the 4,900 companies studied in this survey issue corporate reports”.

1.7 Specialized SEEA Accounts and Policy Modeling

The SEEA-CF and the SEEA-EEA provide a broad foundation to NCA. However, in some cases, additional information is required to tackle specific policy challenges.

One of the prime advantages of the SEEA is that it is flexible, and there are several "sub-systems" of the SEEA, each with their own accounts, which have been developed for specific policy domains. These sub-systems cover topics such as energy, materials flows, water, agriculture and more. For example, the material flows accounts can be used in the context of circular economy policies and resource management. Water and energy accounts provide additional details and classifications needed to create policies for these domains. Section 2 below looks at how the SEEA can be applied to the policy realm in more detail.



2. HOW CAN THE SEEA BE APPLIED TO POLICY?

photo : Nicholas 'n Travel

2.1 Macro-Economic Policy

A central part of government policy is the management of the economy, whereby objectives that are associated with issues such as inflation, debt, employment, innovation etc. are also considered. The achievement of economic growth, as measured by GDP, is one of the most important of these goals.

Section 1.4 above discussed the fact that GDP growth is a poor policy target because it is not a measure /indicator of either human well-being nor of the sustainability of our current economic system. Nevertheless, the economy remains an important determinant for societal progress, sometimes in a positive sense because rising incomes lead to higher quality of life in terms of housing, health and education. On the other hand, though, growth can also have detrimental effects such as increasing environmental pressures or losses in social cohesion.

Economic theory shows that growth occurs when an economy becomes more efficient, in the sense that production processes require fewer resources to achieve the same or greater levels of output. In the long run, these "productivity" improvements lead to increases in national income. Most conventional economic policy focuses on resources such as machines, infrastructure, financial assets and intellectual property that are needed in the production process. For example, investment in new machines, buildings and infrastructure will enable more productive production processes. In addition, investment in intangible capital, such as research and development and innovation, are needed to drive productivity improvements and hence future growth.

This conventional way of looking at long-term economic growth is increasingly questioned because it fails to consider all the relevant inputs into production processes, including natural inputs and the availability of these inputs over time (see section 1.2). It also includes human capital, which is the productive capacity and innovation potential of the workforce. To maintain this capital stock, governments and companies invest in education and training. Additionally, social capital, the networks and trust amongst people, are vital for a well-functioning and efficient society. Good governance and responsive institutions, which are also included in social capital, are crucial for a thriving economy.

Economic growth is also clearly dependent on natural capital. The environment provides many direct inputs into production processes, such as metals and minerals, fossil fuels, wood, fish, food and other materials. Some of these are non-renewable, so their exhaustion represents a threat to the long-term prospects of society. In the case of renewable resources, such as forests and fish for example, excessive logging and overfishing that exceed replenishment rates, could also threaten future prosperity. At the same time, any waste generated by our societies, albeit industrial, commercial, domestic or agricultural waste, either ends up in the ground via landfills, is released into the Earth's atmosphere or is discharged into water bodies, seriously compromising ecosystem health and resilience. For the business sector, such impacts not only affect supply chains but they also increase business risk as well as the long-term growth of many sectors and industries.[14]

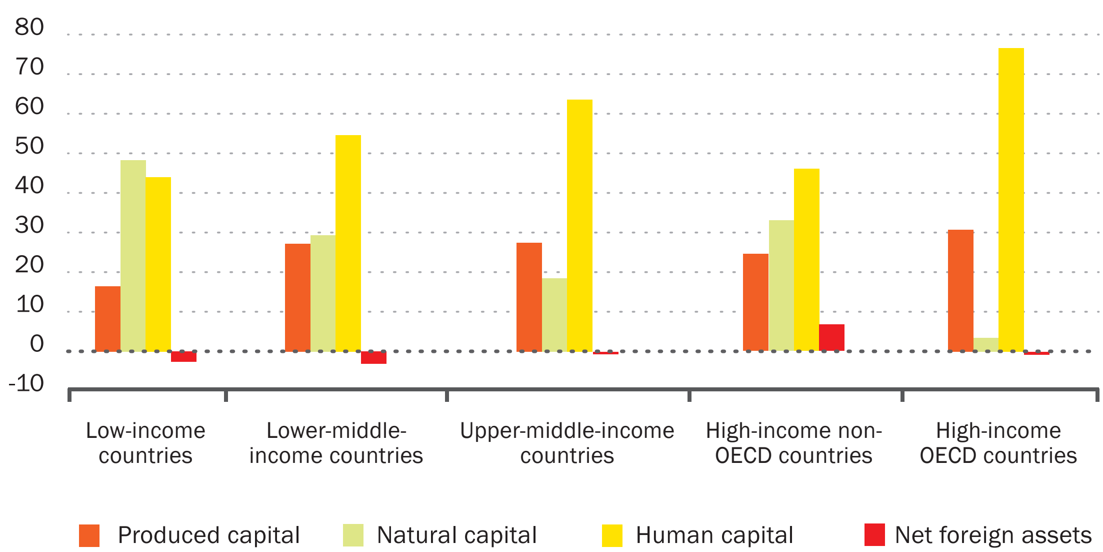
A more comprehensive analysis of economic growth should therefore include all capitals (including financial as well as natural, social and human capital) in economic policy. This is known as "wealth accounting" which leads to economic policies that are geared towards the management of assets. Data for these types of policies is increasing all the time.

To respond to the demands of a more comprehensive and integrated analysis, international institutions, national statistical offices (e.g. Netherlands, Statistics Netherlands, 2020) and universities (Bennett Institute, 2020) are developing databases which are broadly compatible with the SEEA. Example 6 below shows the results derived from the World Bank's Changing Wealth of Nations report. The Inclusive Wealth Report and the Inclusive Wealth Index published by UN Environment, are part of another well-known wealth accounting initiative- see also the separate paper on macro-economic policy applications of SEEA/NCA.

Example 6. *Wealth Accounts*

The World Bank regularly publishes wealth accounting data for 141 countries (Lange et al, 2017). The figure below shows the share of each capital stock in total wealth per country income group (for 2014). The results show that the low-income countries still have a high share of natural capital. In OECD countries, human capital is by far the biggest contributor to overall wealth, with natural capital being a very minor component. Only high-income non-OECD countries, which include many of the Organization of the Petroleum Exporting Countries (OPEC) countries, have a large natural capital share. These wealth estimates give a clear picture of the resource base which each economy has available for sustained growth.

SHARES OF CAPITAL STOCK BY COUNTRY INCOME GROUP

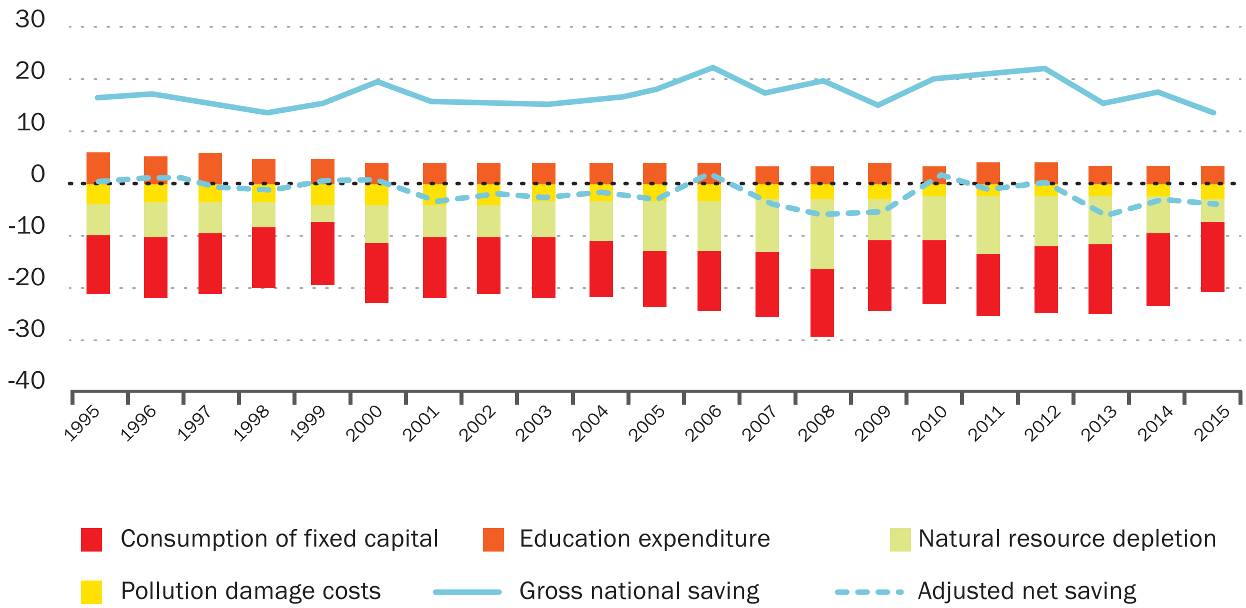


Source: Lange et al. (2017)

[14] The corporate sector has set up the Task Force on Climate-related Financial Disclosures (TCFD) which aims for transparency of the risks which companies face due to climate change.

The World Bank also publishes an indicator called "Adjusted Net Savings" (ANS), which is an indication of whether the stock of capital is increasing. The ANS starts from the figures of Gross National Savings from the SNA, which look at the changes in financial capital. The ANS adds to these figures, the changes in other capital stocks such as human capital (education expenditures). The figure below shows the various variables as a share of national income for Sub-Saharan Africa. The figure shows that, compared to Gross National Saving, the ANS is often negative, with natural resource depletion being a significant negative component. Sustainable economic policies would be converting these natural resources into other productive assets such as human capital or financial capital. For example, money that is earned from the mining of natural resources could be reinvested into education (human capital) or stocks and bonds (financial capital). These data are imperative not only for governments to understand the true asset value of their economy but also to ascertain how well these assets are being managed.

NATIONAL INCOME SHARE FOR SUB-SAHARAN AFRICA



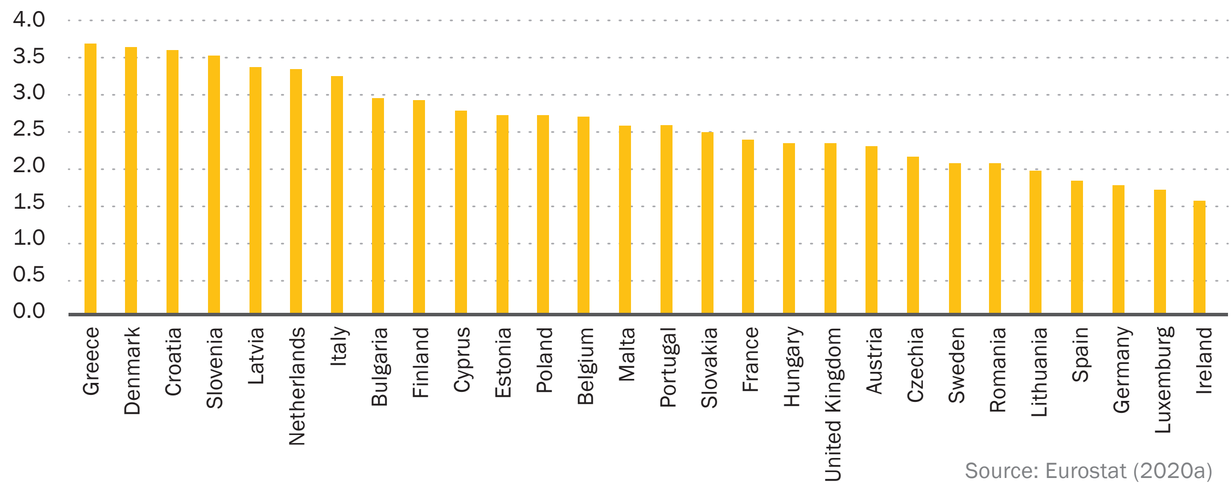
Source: Lange et al. (2017)

So far this section has concentrated on wealth accounting, but the SEEA provides more information relevant for economic decision making. For example, environmental activity accounts of the SEEA-CF provide data on environmental tax revenues. Example 7 shows environmental taxes for the EU28. These accounts enable governments to compare their tax revenues to other countries, providing insights into the importance of government revenues. The accounts also provide information about the environmental tax burden on business. The data can be further split into energy taxes as well as taxes on transport, pollution and resources. In addition, each tax category is presented by the type of economic activity (such as industry and transport) and households. The government can therefore pinpoint precisely who is paying the environmental taxes. When combined with physical data on energy use and other environmental indicators, it is possible to see whether increasing taxes has an effect on environmental performance over time.

__Example 7.__ Environmental Tax Revenues for the EU28

The figure below shows the totals tax revenue as a percentage of GDP. These figures can also be related to other macro-economic data such as total governments taxes. The data shows that the share of tax revenues to GDP can differ significantly. The tax revenue is greatest in Greece and lowest in Ireland. Further analysis could show which type of taxes are largest in Greece and which sectors are paying these dues.

ENVIRONMENTAL TAX REVENUE (% OF GDP)



Source: Eurostat (2020a)

The SEEA can also be used as input for macro-economic models designed to analyse the effects of economic policies on economic and environmental factors. There are many techniques and models that can be applied to a wide variety of policy questions. Example 8 shows a model that was used by the Canadian government to estimate the environmental impact of joining a free trade agreement with the European Union.

__Example 8.__ The environmental effects of free-trade agreements (Government of Canada, 2012)

During the negotiations of the Canada-EU Comprehensive Economic and Trade Agreement (CETA), the Canadian Department of Foreign Affairs, Trade, and Development wanted to have more information about the environmental impacts of the agreement. They used a multiregional computational general equilibrium model and combined it with information from the SEEA accounts.

They looked specifically at three impacts: the scale, composition and technological effects of the agreement. The scale effect quantifies the increase in environmental pressure, which is caused by an economy that is growing quickly because of the CETA agreement. The composition effect is due to changes in the economic structure i.e. sectors and products which either diminish or increase in importance due to the CETA. The final effect looks at changes in technology due to the CETA.

The quantitative analysis showed that the net impact of increased bilateral trade with the European Union on Canada's environment would be minor based on projected changes in GHG emissions, energy use and water use. The results in the table below show that the increase in GHG emissions, energy use and water use is 0.38%, 0.36% and 1.1% respectively, when both scale and composition effects were considered. Technological effects were found to have little impact. These results were used to assist the negotiations of the CETA trade deal, which was eventually passed.

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE CANADA-EU COMPREHENSIVE ECONOMIC AND TRADE AGREEMENT [CETA]

	SCALE EFFECT	COMPOSITION EFFECT	TOTAL CETA-INDUCED EFFECT		TECHNICAL EFFECT	TOTAL EFFECT 2014
GHG Emissions (kilotonnes of CO_2 eq)	3,681	-1,375	2,306	**0.38%**	-393	**1,913**
Energy Use (terajoules)	51,820	-20,835	30,985	**0.36%**	-677	**30,308**
Water Use ('000m^3)	212,401	174,817	387,218	**1.10%**	N/A	**387,218**

Source: Canada, Global Affairs Canada (2012)

2.2 Climate change

In the 1980s and 90s, the realization that greenhouse gas emissions were affecting global climatic conditions became mainstream. A major role was played by the Intergovernmental Panel on Climate Change (IPCC), which, though an international process, provided a synthesis of climate science that can be communicated to both society and policymakers.

The process has led to various accords and agreements, the latest being the Paris Agreement which states that "the central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius". To date, the atmosphere has already changed dramatically, and the sea level has risen significantly. Further climate change is likely to lead to more extreme weather events such as droughts and storms with consequences for the general well-being of people, including, for example, impacts associated with agriculture, infrastructure, health, migration and ecosystems.

There are many policy options that can address climate change. To mitigate emissions, for example, a robust set of policies will be needed to transform the sectors that are contributing the most to greenhouse gas emissions. Many options are being considered, including carbon taxes, removing implicit subsidies on fossil fuels, stimulating renewables energy and shifting food systems towards sustainable agriculture and farming. In addition to reducing emissions, policy should also focus on adaptation towards a changing climate, which includes protecting coasts against sea level rises and anticipating floods and droughts.

The SEEA can support information and modeling requirements in all stages of the policy cycle for climate change policies. For example, scenario models, which are based on SEEA and SNA data, can be built to indicate how environmental pressures are likely to develop under certain assumptions. Example 9 below provides an ex-ante example from Indonesia, which was used by the Ministry of National Development Planning.

SEEA data can also be used to analyse the driving forces of environmental pressures such as technological and economic developments. Example 10 provides an ex-post model of such a decomposition analysis from Denmark.[15]

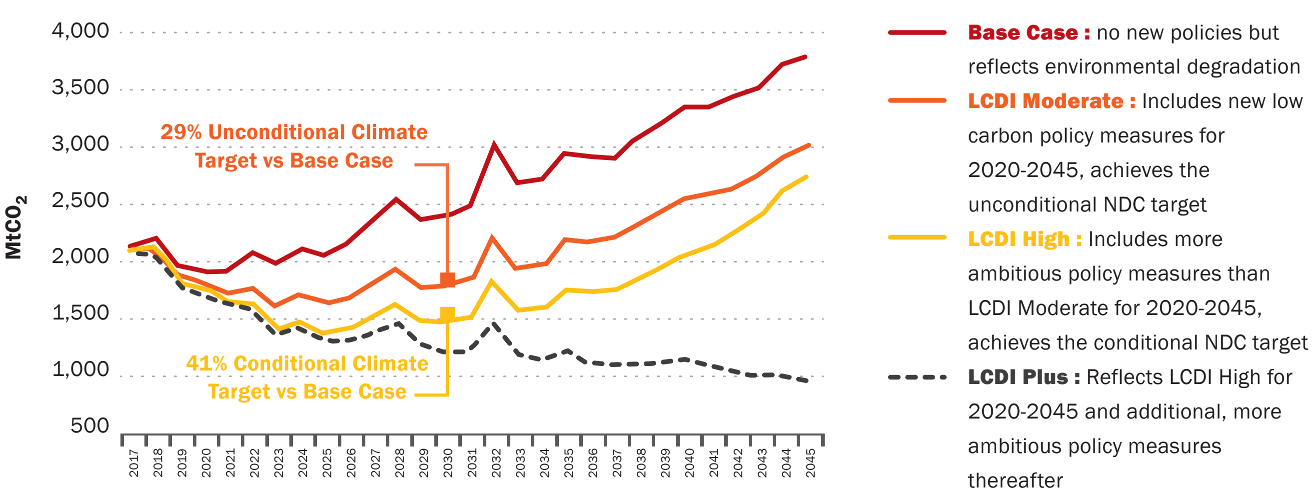
Example 9. *Development towards a low-carbon economy in Indonesia*

In 2017 the Ministry of National Development Planning (Bappenas), in close collaboration with development partners, initiated Indonesia's Low Carbon Development Initiative (LCDI) (LCDI, 2019). To better understand the feasibility of low carbon growth under different scenarios, they conducted scenario modeling using environmental accounting approaches based on the SEEA.

The figure shows various scenarios with their resultant carbon emissions. The modeling demonstrated that a low carbon growth path is feasible, and that it would still deliver an average GDP growth rate of 6% annually until 2045. This scenario requires Indonesia to use its natural resources sustainably and reduce its carbon and energy intensity. In such a scenario, GHG emissions would fall by nearly 43% by 2030.

By conducting scenario modeling using the SEEA, the Ministry of National Development Planning was able to determine which policies might be implemented to curb greenhouse gas emission, and, at the same time, calculate the economic impacts. This provides a solid basis for Indonesian policy makers to choose between the various options and scenarios at hand.

DEVELOPMENT TOWARDS A LOW-CARBON ECONOMY IN INDONESIA

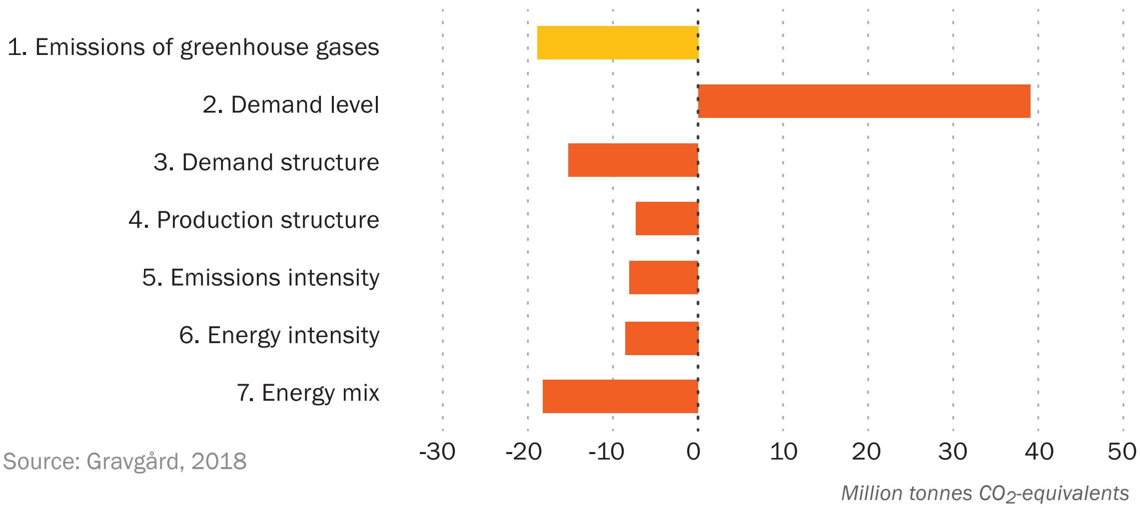


[15] Other examples of integrated environmental-economic models that use SEEA data include (Banerjee et al., 2016, and 2019)

Example 10. *Analysing the driving forces of GHG-emissions in Denmark*

In Denmark, industry GHG emissions fell from almost 62 million tonnes of CO_2 equivalents in 1990 to 42 million tonnes of CO_2 equivalents in 2016. This was a decrease of 19 million tonnes of CO_2 equivalents or more than 31% (see green bar in the figure below). Using a structural decomposition analysis (SDA), it is possible to identify the contributions of the various driving forces. The results show that the increase in the demand level is the largest driving force for increasing GHG emissions. If emissions of GHG in the period 1990 to 2016 had followed the growth in demand for Danish products from private and government consumption, exports and investments, etc., they would have been 39.3 million tonnes higher than in 1990.

ANALYSING THE DRIVING FORCES OF GHG-EMISSIONS IN DENMARK



Source: Gravgård, 2018

However, all other driving forces contribute to lower GHG emissions, with two drivers standing out. The demand structure, which is the mix of products and services that Denmark exports and provides to Danish consumers, has become much less GHG intensive. In addition, the largest negative contribution is through the energy mix, which shows that the shift towards renewables has continued significantly to lower GHG-emissions.

These historical analyses help to untangle the environmental performance of the economy and the underlying driving forces. It shows which of the structural changes have had a major impact and which are less consequential, providing important lessons learned for future policies.

One of the problems related to climate change is the issue of “carbon leakage”, which indicates that a country can reduce domestic emissions, while importing carbon-intensive products from other countries. It is widely documented that, since the 1990s, there has been carbon leakage from developed countries to other countries, China in particular (Peters, 2008; Peters et al., 2011). Thanks to rapid globalization, countries are able to shift environmental pressures among each other. In fact, total global emissions have increased because production has shifted from those countries with efficient technologies to countries with poor technologies (Hoekstra, Michel and Suh, 2016).

There are therefore two ways to represent emissions. The first, shown in the example of Romania (example 1), is to record the emissions from a territory. This approach, referred to as the “production approach”, needs to be augmented by a second perspective in order to tell the full story. The "consumption approach" looks at the emissions "embodied" in the final use of products. This means that all emissions that have occurred in the entire supply chain of the product are included, irrespective of which countries have emitted. These "footprint" calculations can be done using an input-output analysis. Example 11 shows a methane footprint for the European Union. This type of information provides details about how to prioritize policies and how to reduce lifecycle emissions.[16]

Example 11. *Emissions of methane (tonnes) from final use of products (footprint) in 2017 in the EU-28*

Eurostat has created a multiregional input-output (MRIO) model, which shows the economic structure of Europe and the global economy. It has linked the MRIO to SEEA data from the EU28. By using an input-output analysis, it is possible to calculate the "footprint" for a wide variety of emissions. The footprint includes all the emissions that were used in the supply chain of the product. Below is the list of the top-10 products which have led to the largest emissions of methane in the supply chain. This methane emitted in the agricultural sector is therefore linked to the food products that are consumed. In fact, taking all food related categories (rank 1, 2 and 6) together makes up 40% of the methane footprint.

EMISSIONS OF METHANE (TONNES) FROM FINAL USE OF PRODUCTS (FOOTPRINT) IN 2017 IN THE EU-28

RANK	PRODUCTS	2017
1	Food, beverages and tobacco products	5,404,619
2	Products of agriculture, hunting and related services	4,060,785
3	Coke and refined petroleum products	2,141,553
4	Waste management services	1,678,316
5	Constructions and construction works	1,159,719
6	Accommodation and food services	1,151,076
7	Direct emissions by private households	923,707
8	Electricity, gas, steam and air conditioning	772,529
9	Chemicals and chemical products	590,097
10	Wholesale trade services (except of cars/motorcycles)	551,391

Source: Eurostat (2020a)
Data: Emissions of greenhouse gases and air pollutants from final use of CPA08 products - input-output analysis, ESA 2010

[16] This topic will be further discussed in a forthcoming paper under this series: Natural Capital Accounting for Better Climate Change Policies.

2.3 Biodiversity

Ecologists have warned that we are currently in the middle of the sixth mass extinction (Ceballos et al., 2015), which refers to the fact that in Earth's history, there have been five moments when species have experienced extinction at massive rates. However, unlike previous mass extinctions, this one is wholly attributable to the pressures that humans are putting on the ecological system which is sometimes referred to as the "anthropocene" (Crutzen, 2002).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an international collaboration to support science-based policies for biodiversity and ecosystems. It provides the most recent global assessment of the state of biodiversity and associated ecosystem services (IPBES, 2019). The report concluded that if society continues to develop in the same way, over one million species (of the current seven to eight million) would be at risk of extinction. This loss of biodiversity will have profound consequences for humanity, particularly considering that biodiversity is a foundation for human well-being and existence. The IPBES also lists all the drivers that contribute to biodiversity loss which include natural pressures (volcanic eruption etc.) as well as human activities, which include land/sea use change, pollution and many other factors.

The current global policy framework for biodiversity is the Strategic Plan for Biodiversity 2011-2020, adopted by the Convention on Biological Diversity (CBD), (CBD, 2010). The plan includes Aichi Biodiversity Targets that set specific goals. The targets are aimed at improving biodiversity status and implementing policies that lead to enhanced management of nature. In particular, Aichi Biodiversity Target 2 specifically highlights the importance of mainstreaming biodiversity values into policy through the adoption of environmental-economic accounting. Many governments have integrated the Strategic Plan into national planning, including the identification of biodiversity targets. Biodiversity is also a crucial part of the SDGs. The problem of how to tackle severe biodiversity loss will be revisited in 2020 at the 15th meeting of the Conference of the Parties (COP 15) to the Convention on Biological Diversity in Kunming, China. While there has been some progress towards the Aichi Biodiversity Targets, overall there has been less progress than hoped for. Thus, COP 15 will be an opportunity to develop a bold and transformative agenda for biodiversity, one in which measurable and actionable targets will be of great importance.

The SEEA can play a vital role in many policy questions related to biodiversity. It provides a measurement framework for biodiversity extent and condition, reporting on the importance of ecosystem and the services that they provide, analysing driving forces or choosing between policy options and instruments.[17] The SEEA is increasingly being used in national policymaking for ecosystems and biodiversity (for an overview see Ruijs and Vardon, 2018). Example 12 shows an application focused on the value of the ecosystem services provided by public forests in England.

[17] TThis topic will be further discussed in a forthcoming paper under this series: Natural Capital Accounting for Integrated Biodiversity Policies

Example 12. Public forest management in England

In order to support the management of the Public Forest Estate in England so that it continues to deliver a range of ecosystem services other than just timber provisioning, Forestry England established an ongoing set of corporate natural capital accounts based on the SEEA for the land that they manage. These accounts cover the extent and condition of different types of habitat, both in physical and monetary flow accounts and a monetary asset account. The table below shows the results.

The accounts serve as an important tool for understanding what services England's forests are delivering for society. The process of identifying assets and physical flows of services through the development of the accounts has also proven to be beneficial in highlighting what we do and do not understand about the services that the estate delivers, and how they might be improved.

At a strategic level, the information in the accounts enables the organisation to have a regular check on whether the value of the ecosystem services that the estate provides is increasing or decreasing. It also helps to ensure that they have a trend overview for the condition of the different assets. Note that not all of the befenits will accrue to the same stakeholders. The accounts are also used to inform decision making at all levels by clearly linking management activities with the value of the ecosystem services and assets as well as stakeholders.

PUBLIC FOREST MANAGEMENT IN ENGLAND

SPATIAL ACCOUNTING UNIT BY NATURAL CAPITAL BENEFIT	TYPE OF FLOW	BASELINE YEAR 2013/14	REPORTING YEAR 2017/18
Timber provision			
Woodland	Timber produced	£ 10,450,712	£ 12,763,488
Climate regulation			
Woodland	Carbon sequestration value	£ 98,739,421	£ 103,707,655
Bogs		£ (523,001)	£ (571,754)
Grassland		-	-
Heathland		-	-
Woodland on Deep Peat Soils		£ (4,974,455)	£ (5,102,954)
Recreation			
Whole estate	Recreation	£ 346,308,992	£ 446,260,046
	Volunteers	-	-
Plant and seed supply			
Whole estate	Plant and seed revenues	£ 3,091,288	£ 2,790,983
Food provision			
Whole estate	Wild game carcass value	£ 12,677	£ (83,295)
	Livestock production value	£ 143,783	£ 185,172
	Crop production value	£ 57,030	£ 73,688
Minerals			
Whole estate	Mineral production value	£ 896,060	£ 426,925

Source: Forestry England (2019)

2.4 Circular Economy

Modern societies require great quantities of different types of materials. Some are used in bulk, while others are highly specialized materials that are used in minute quantities. When supplies of some materials are limited, this can create substantial problems in supply chains. In the case of bulk materials, such as plastics, there are also significant problems related to waste generation, and even the emergence of what has been referred to as a “plastic soup” in the ocean.

The current economic system is said to be “linear”, in the sense that materials are extracted from nature, then used in products, and finally discarded, otherwise known as the “take, make, waste” model. Over the last decade, the call to create a “circular economy” has intensified. This is an economy in which resources are kept in the loop through recycling, remanufacturing, redesign and by other means. Many international fora, such as the World Economic Forum and the European Commission, have stressed the importance of moving towards a circular economy.

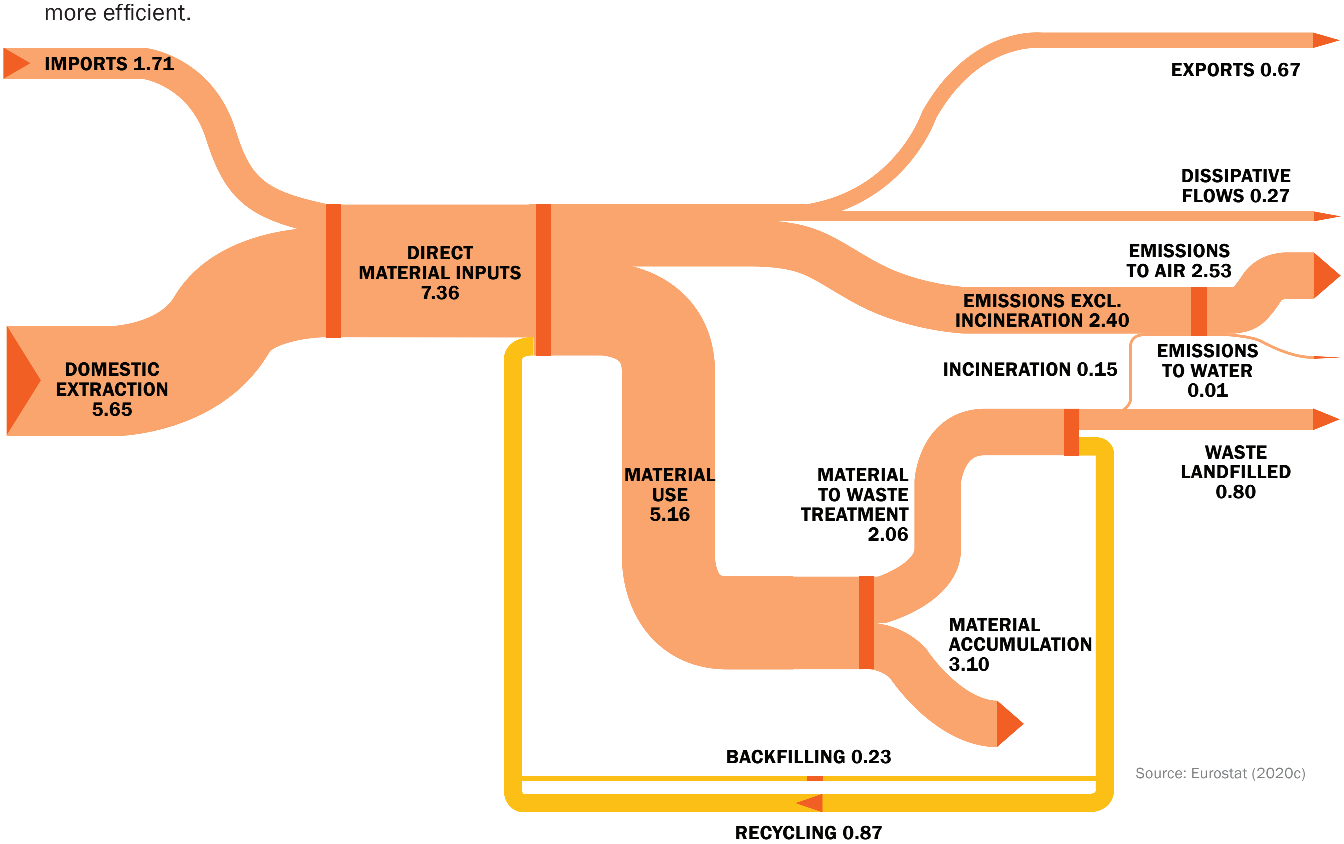
The SEEA provides material flows accounts which show all the material flows to, from and within the economy. It is therefore a powerful way to monitor progress towards a circular economy and to create effective policies. It distinguishes where materials enter the economy, either through mining or imports and also shows where they are used and which materials are emitted to water, air landfills or nature. Example 13 shows how data from material flows accounts can be used to understand the physical metabolism of an economy. The SEEA enables policymakers to track the status, driving forces, and policy options of resource use (Potting et al., 2018).


photo : Juliana Kozoski

Example 13. *Sankey diagram for material flows of the EU28*

By using data from the material flow accounts, combined with other sources, the Sankey diagram below can be produced. It provides a comprehensive overview of the material metabolism of a county. In this case, the figure shows the metabolism of the entire European Union. It shows the quantities that are being recycled are still very small compared to the emissions, dissipation and landfilled quantities.

The figure provides an overview for policy makers at the European Union level, but the advantage of the SEEA is providing a conceptual framework to align diverse data sources and that this diagram can be broken down into individual countries. Furthermore, it is possible to analyse which materials are involved and to derive which products and sectors are using certain materials. This data can also be linked to economic data such as value added, to see whether the material intensity (amount of materials per unit of value added) is reducing. A lower intensity signifies that technology is making production processes more efficient.



Source: Eurostat (2020c)

2.5 Sectoral Policies

Sections 2.1 to 2.4 discuss some of the economic and environmental questions that could be answered by the SEEA. This is by no means a complete overview. Even in terms of environmental problems, there are more issues that countries are currently grappling with such as food security, health and wellness and urbanization, to name just a few.

For instance, agricultural policy has an important environmental component, as farming practices depend on renewable and non-renewable resources and result in emissions to land, water and air. Agriculture also depends upon and affects biodiversity in many ways. Furthermore, it has a clear link to employment and poverty reduction, as it provides income and food to large portions of the population. While formulating agricultural policies, it is therefore necessary to think of the environmental and social implications. The United Nations has coordinated the publication of a specialized manual (SEEA-Agriculture, Forestry and Fisheries) which explicitly links agricultural and rural development to the environment.

Transportation is another example. Demand for mobility is driven by factors such as population growth and urbanization. In some cities, policymakers need to decide on how to transport millions of people in an efficient way. These decisions will shape the transportation landscape for a very long time and will have significant effects on the environmental pressure of the mobility system. For example, transport modalities differ significantly in CO_2 emissions, and investments can therefore have long-term implications for climate change. It is therefore necessary to consider the environmental impacts of these investments. The SEEA can be expanded to show the relationship between modalities, infrastructure and emissions.

Energy policy is based on factors such as the availability of fossil fuels, energy security and sometimes geo-political issues. For example, many countries have policies to lower their dependency upon oil that comes from unstable nations. This could be achieved by substituting these imports by domestic fossil fuels such as shale oil. On the other hand, it could be achieved by transitioning towards renewable energy sources that would have the added benefit of contributing towards the lowering of greenhouse gas emissions. The SEEA can help inform economic, political and technical aspects of this energy transition.

Sometimes, the SEEA can be used to link policy domains that are not usually taken together. Example 14 provides such an example, where the environmental impacts of healthy diets is analysed.


photo : Isaiah Rustad

Example 14. *Understanding how healthy diets affect the environment (Behrens et al., 2017)*

Many countries have dietary recommendations that prescribe what a nutritious and healthy diet should look like. However, in practice, the population usually does not adhere to these recommendations. In richer countries, the population tends to eat too many calories and protein-rich foodstuffs, often leading to obesity. In poorer countries, there is more malnutrition, which means that people do not eat the recommended quantities for optimal health.

Using the global EXIOBASE database, researchers analysed what would be the environmental consequences if all people in a country would adopt a healthy diet. The EXIOBASE database is based on economic data from the SNA accounts of nearly 40 countries or regions of the world. The environmental accounts are structured according to the SEEA, and where possible SEEA data from the 40 regions/countries are used. The difference between the average diet and the recommended diet is calculated.

The results are mixed. For poor countries, where people are undernourished and do not eat enough to constitute a healthy diet, greenhouse gas emission would increase if people increased their consumption to eat a healthy and nutritious diet. However, some countries, particularly Brazil and Australia, eat far more meat than is recommended. If Australians and Brazilians would all adopt healthy diets, this would have major positive impacts on GHG emissions, i.e. they would decrease. The results therefore show that some countries that health policies can have the added benefit of reducing environmental pressures. In case of poorer countries, policy makers could learn which types of foodstuffs could be used to fight malnutrition, while at the same time limiting environmental pressures.

photo : Brunel Johnson

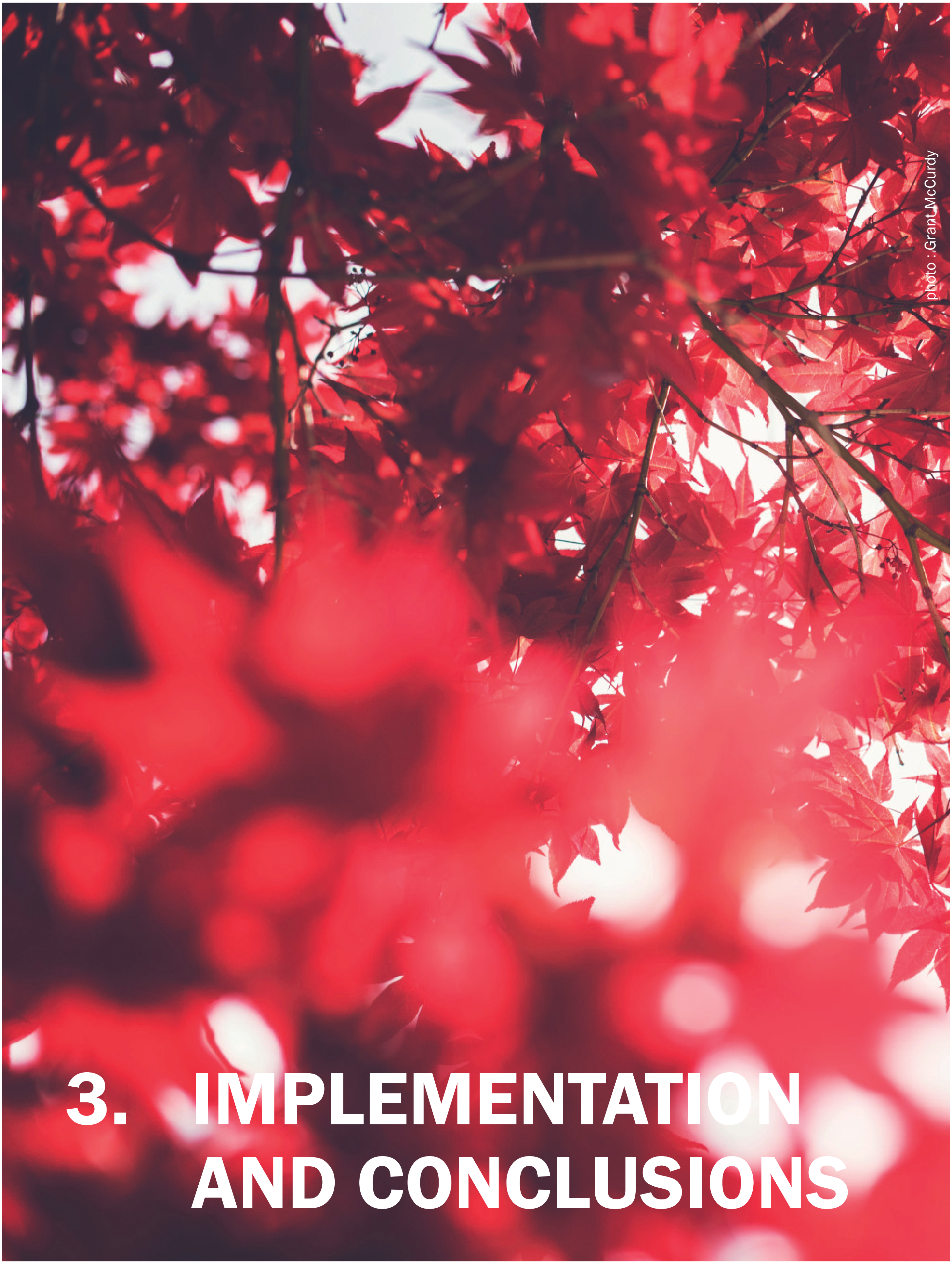


photo : Grant McCurdy

3. IMPLEMENTATION AND CONCLUSIONS

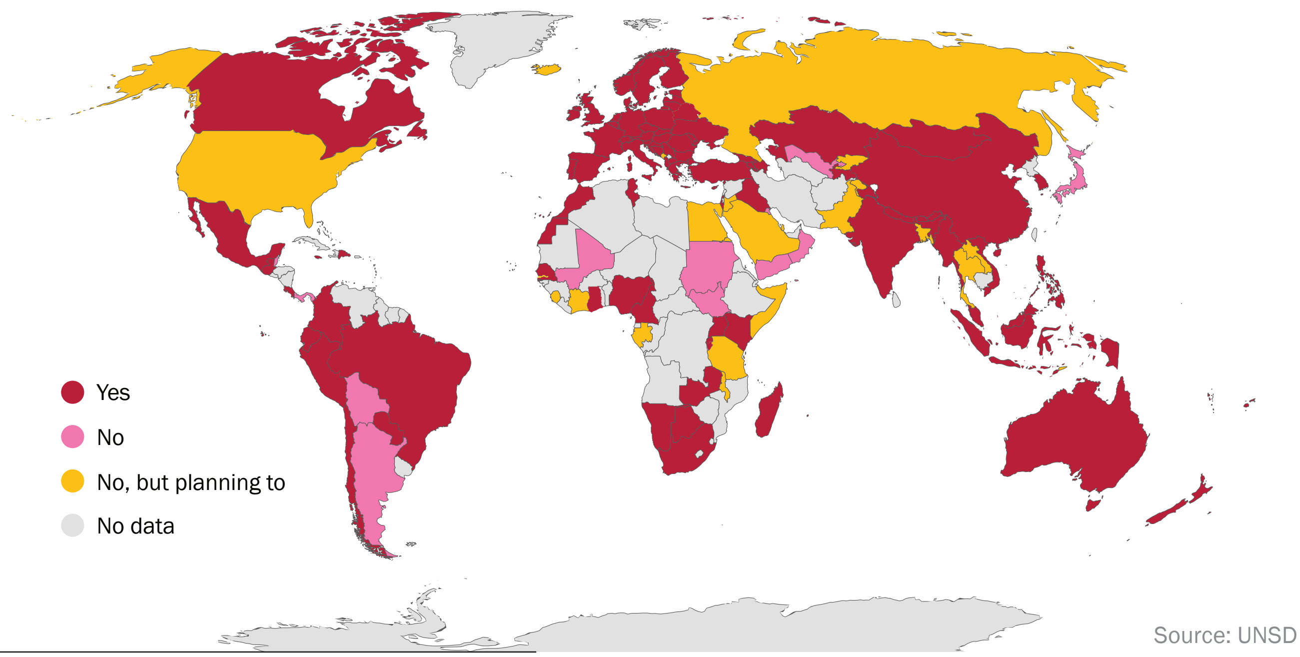
This paper has argued that to tackle modern day resource driven problems, it is imperative to take on board the interrelationship between different policy domains, as well as the various stakeholders and scale levels.[18]

This type of integrated policy making, and one which SEEA can assist with, is increasingly necessary to solve the complex challenges that societies around the world face. However, integrated policymaking is not yet a reality. It will require a re-assessment of the current way of approaching policies and innovative ways in which to organize the policy process. Further implementation of the SEEA will play an important role in this development.

3.1 Implementation

Figure 3 presents the latest information on the use of the SEEA around the world. According to information from a 2017 global assessment on environmental-economic accounting, as well as information from the United Nations regional commissions and informal consultations with Member States, over 90 countries have compiled SEEA accounts (as of late 2019). In some regions, the production of SEEA data is a legal requirement. For example, in the European Union, member states are legally obliged to compile six SEEA accounts (European Court of Auditors, 2019). Many more are also planning to implement the accounts.

Figure 3. *Countries compiling SEEA accounts*



[18] See also OECD report on policy coherence (OECD, 2017b).

The UN Committee of Experts on Environmental Economic Accounting (UNCEEA) has set targets for SEEA implementation by the end of 2020. By that time, its goal is to have at least 100 countries with ongoing, well-resourced programs for the SEEA-CF. An additional goal is to have at least 50 countries that produce and use ecosystem accounting in policymaking. A major boost has been given to the SEEA by introducing legal obligations to produce them. The European Union has been particularly active in requiring member states to produce various accounts. This development has led to improvements in comparability, quality and priority of the SEEA, although more still needs to be done (European Court of Auditors, 2019).

While implementation has been increasing, there are still some remaining challenges to broader SEEA implementation. National statistical offices and line ministries regularly face budget cuts. In addition, it is important that SEEA implementation should be backed by political buy-in, in order to ensure that the accounts are used. More broadly, promoting an entire government approach is critical to facilitate SEEA implementation and ensuring that the accounts are applied for policy. For example, in 2018, the Government of Australia developed a national strategy and action plan that set out a common approach to SEEA implementation, with the aim of supporting decision making by governments, business and the community (Commonwealth of Australia, 2018). Similar approaches have been taken in several other countries.

Nevertheless, SEEA implementation is ultimately cost-effective and efficient. Implementation usually does not require a significant amount of new data collection. Instead, implementation involves collecting existing data within the national statistical office and from line ministries and harmonizing this data. In addition, the SEEA is an efficient data system because all accounts have a common conceptual foundation. Therefore, one consistent statistical system yields multiple environmental indicators. To ensure further efficiency, it is important to use the relevant big-data sources. For example, satellite data is increasingly becoming available and is creating a huge boost for ecosystem accounting. In addition, for the energy accounts, some countries such as the Netherlands and Botswana, are using the original client purchaser logs (For Botswana see Botswana and the World Bank, 2016). These types of big data sources, especially if they are based on comprehensive registers, provide a valuable tool to link macro-economic developments to micro-economic behaviour.

The country-level SEEA data that is produced by national statistics offices or other ministries is being collated into global databases such as EXIOBASE, WIOD, ICIO, FIGARO and EORA (Tukker and Dietzenbacher, 2013). These databases also include data on the global economic structure, which means that that the influence of globalization on environmental pressures can be analysed (see Example 10 above). These databases are now used frequently by scientists, policy makers and even companies.

---

19 Some examples can be found at https://seea.un.org/home/National-Implementation-Project.

20 For EXIOBASE, see https://www.exiobase.eu/; for WIOD, see http://www.wiod.org/;
for ICIO, see https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm;
for FIGARO, see https://ec.europa.eu/eurostat/web/experimental-statistics/figaro;
and for EORA, see https://worldmrio.com/.

21 For example, the pharmaceutical company Novartis used WIOD data to calculate the environmental impacts
https://www.wifor.com/uploads/2019/02/2018_Case_Study_Novartis_Global_Environmental-Impact_WifOR.pdf.

3.2 Conclusions

The increased global uptake of the SEEA is leading to a high-quality, comparable, institutionalized supply of data on NCA around the world. The conceptual link between environmental, economic and social developments embodied in the SEEA allows for the integrated policies that are needed to tackle today's complex challenges. Increasingly, it is possible to take on board trade-offs and synergies between various policy domains, as well as between different stakeholders and scale-levels.

This paper has provided real world examples where the SEEA has been used for better policy making and decisions. The SEEA can be used to track progress on national policies or in models that are aimed at policy preparation or evaluation. There are, however, more ways in which the SEEA can help evidence-based policy decisions. Global initiatives such as the SDGs, post-2020 global biodiversity framework, 'Beyond-GDP' and circular economy are only driving up the demand for integrated data. The number of new applications of the SEEA is increasing every year in policy and academic literature.

Moving towards integrated policies will have important implications for the institutional aspects of policymaking. It will become more important to look beyond the remit of one ministry towards the impacts that it might have on other domains. This collaborative approach has been common to many of the countries implementing the SEEA. Since the SEEA necessitates collaboration between national statistical offices and line ministries, implementation often brings together different ministries, eliminating the silo approach of working. It will also mean that statisticians will increasingly have to respond to the requests of policymakers. The SEEA, as the international statistical standard for NCA, will be an important part of this evolution towards integrated policy.

REFERENCES

Banerjee, O., Cicowiez, M., Horridge, M., and Vargas, R. (2016). A Conceptual Framework for Integrated Economic–Environmental Modeling. The Journal of Environment & Development 25(3):276–305.

Banerjee, O., Cicowiez, M., Horridge, M., and Vargas, R. (2019). Evaluating Synergies and Trade-Offs in Achieving the SDGs of Zero Hunger and Clean Water and Sanitation: An Application of the IEEM Platform to Guatemala. Ecological Economics 161:280–91.

Bass, S., Ahlroth, S., Burnett, P., Castañeda, J.P., and Vardon, M. (2016). Natural Capital Accounting for Better Policy. The Hague: WAVES NCA Policy Forum.

Behrens, P, Kiefte-de Jong, J.C., Bosker T., Rodrigues, J.F.D., de Koning, A, and Tukker, A. (2017). Evaluating the Environmental Impacts of Dietary Recommendations. Proceedings of the National Academy of Sciences 114(51):13412.

Bennett Institute (2020). The Wealth Economy: social and natural capital. https://www.bennettinstitute.cam.ac.uk/research/research-projects/wealth-economy-social- and-natural-capital/. Accessed 18 February 2020.

van den Bergh, J.C.J.M. (2009). The GDP Paradox. Journal of Economic Psychology 30(2):117–35.

Botswana, Ministry of Finance and Development Planning and the World Bank (2016). Energy Accounts for Botswana.

Canada, Global Affairs Canada (2012). Canada-European Union: Comprehensive Economic and Trade Agreement (CETA) Negotiations. Initial Strategic Environmental Assessment - February 2012. https://www.international.gc.ca/trade-agreements-accords-commerciaux/agr-acc/eu-ue/initialea-ceta-aecg-eeinitiale.aspx?lang=eng. Accessed 18 February 2020.

Capitals Coalition (2016). Natucal Capital Protocol. https://naturalcapitalcoalition.org/natural-capital-protocol/.

Convention on Biological Diversity (2010). Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets. https://www.cbd.int/sp/. Accessed 18 February 2020.

Ceballos, G., Ehrlich, P.R., Barnosky, A.D., García, A, Pringle, R.M., and Palmer, T.M. (2015). Accelerated Modern Human–Induced Species Losses: Entering the Sixth Mass Extinction. Science Advances 1(5).

Commonwealth of Australia, Interjurisdictional Environmetnal-Economic Accounting Steering Committee for the Meeting of Environment Ministers (2018). Environmental Economic Accounting: A Common National Approach Strategy and Action Plan. Commonwealth of Australia.

Costanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K.E., Ragnarsdóttir, K.V., Roberts, D., De Vogli, R., and Wilkinson, R. (2014). Time to Leave GDP Behind. Nature 505(7483):283–85.

Coyle, D. (2014). GDP: A Brief but Affectionate History. Princeton: Princeton University Press.

Crutzen, P. J. (2002). The ‘Anthropocene.’ Journal de Physique IV France 12(10):1–5.

Denmark, Statistics Denmark, (2018). Green National Accounts for Denmark 2015-2016. Highlighting the link between the economy and the environment through environmental-economic accounting. https://www.dst.dk/Site/Dst/Udgivelser/GetPubFile.aspx?id=27468&sid=gnatuk. Accessed 18 February 2020.

European Court of Auditors (2019). Special Report NO 16/2019: European Environmental Economic Accounts: usefulness for policymakers can be improved. https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=51214. Accessed 18 February 2020.

Eurostat (2020a). Statistical Database. https://ec.europa.eu/eurostat/web/main/home. Accessed 5 January 2020.

Eurostat (2020b). SDG INDICATORS: GOAL BY GOAL. Website of Eurostat dedicated to the SDGs. https://ec.europa.eu/eurostat/web/sdi/indicators. Accessed 18 February 2020.

Eurostat (2020c). Material Flow Diagram. https://ec.europa.eu/eurostat/web/circular-economy/material-flow-diagram. Accessed 18 February 2020.

Exton, C. and d’Ercole, M.M. (2019). The Policy Application of Well-Being and Sustainability Metrics. Paris: Organisation for Economic Co-operation and Development.

Fioramonti, L. (2013). Gross Domestic Problem: The Politics Behind the World’s Most Powerful Number. London: Zed Books.

Forestry England (2019). Natural Capital Account 2018-19. https://www.forestryengland.uk/sites/default/files/documents/FE_NCA_18-19_FINAL.pdf. Accessed 18 February 2020.

Fukuyama, F. (2000). Social Capital and Civil Society. Washington, D.C.: IMF.

Gravgård, Ole (2018). Green National Accounts for Denmark 2015-2016. Copenhagen: Statistics Denmark.

Grootaert, C. (1998). Social Capital: The Missing Link? Social Capital Initiative Working Paper No. 3. Washington, D.C.: World Bank.

Hoekstra, R. (2019). Replacing GDP by 2030: Towards a Common Language for the Well-Being and Sustainability Community. Cambridge: Cambridge University Press.

Hoekstra, R., Bernhard M., and Suh S. (2016). The Emission Cost of International Sourcing: Using Structural Decomposition Analysis to Calculate the Contribution of International Sourcing to CO_2 -Emission Growth. Economic Systems Research 28(2):151–67.

IDEEA Group (2018). Making Every Hectare Count: Environmental-Economic Accounting for Forico’s Surrey Hills Estate, Tasmania.

Intergovernmental Science-Policy Platform on Biodiveristy and Ecosystem Services (2019). The Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science- Policy Platform on Biodiversity and Ecosystem Services.

KPMG (2017). The Road Ahead: The KPMG Survey of Corporate Responsibility Reporting 2017. https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/10/kpmg-survey-of-corporate-responsibility-reporting-2017.pdf. Accessed 18 February 2020.

Lange, G.M., Carey K., and Wodon, Q. (2017). The Changing Wealth of Nations 2017. Washington, D.C.: World Bank.

Ministry of National Developmetn Planning, Indonesia (2019). Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia.

Netherlands, Statistics Netherlands (2020). Natural gas and oil reserves on the Dutch territory. Dataset available at https://opendata.cbs.nl/statline/#/CBS/en/dataset/82539ENG/table?ts=1574687467011. Accessed 18 February 2020.

New Zealand, Treasury of New Zealand (2019). New Zealand's Well-being Budget. https://treasury.govt.nz/publications/well-being-budget/well-being-budget-2019. Accessed 18 February 2020

Norges Bank (2020). Website of the Norwegian investment bank. https://www.nbim.no/. Accessed 18 Febreuary 2020.

Organisation for Economic Co-operation and Development (2016). Better Policies for Sustainable Development 2016. Paris.

Organisation for Economic Co-operation and Development (2017a). How's Life? 2017. Paris.

Organisation for Economic Co-operation and Development (2017b). Policy Coherence for Sustainable Development 2017: Eradicating Poverty and Promoting Prosperity. Paris.

Peters, G.P. (2008). From Production-Based to Consumption-Based National Emission Inventories. Ecological Economics 65(1):13–23.

Peters, G.P., Minx, J.C., Weber, C.L. and Edenhofer, O. (2011). Growth in Emission Transfers via International Trade from 1990 to 2008. Proceedings of the National Academy of Sciences 108(21):8903–8.

Philipsen, D. (2015). The Little Big Number: How GDP Came to Rule the World and What to Do about It. Princeton: Princeton University Press.

Potting, J., Hanemaaijer, A., Delahaye, R., Hoekstra, R., Ganzevles, J., and Lijzen, J. (2018). Circular Economy: What We Want to Know and Can Measure. Framework and Baseline Assessment for Monitoring the Progress of the Circular Economy in the Netherlands. The Hague: PBL Netherlands Environmental Assessment Agency.

Ruijs, A. and Graveland, C. (2018). Natural Capital Accouting for Mainstreaming Climate-Change in Decisions Making. The Hague: PBL Netherlands Environmental Assessment Agency.

Ruijs, A. and Vardon, M. (2018). Natural Capital Accouting for Mainstreaming Biodiversity in Public Policy. The Hague: PBL Netherlands Environmental Assessment Agency.

Spurgeon, J., Obst, C., Santamaria, M., Gough, M. and Spencer, R. (2018). Combining Forces: Priority Areas for Collaboration: A Thought Leadership Paper on Advancing Natural Capital Approaches. James Spurgeon (Sustain Value), Carl Obst (IDEEA Group), Marta Santamaria (Natural Capital Coalition), Mark Gough (Natural Capital Coalition) and Richard Spencer (ICAEW).

Stiglitz, J.E., Sen, A. and Fitoussi, J.P. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress. Paris: Organisation for Economic Co-operation and Development.

Tukker, A. and Dietzenbacher, E. (2013). Global Multiregional Input-Output Frameworks: An Introduction and Outlook. Economic Systems Research 25(1):1–19.

Uganda Natural Capital Accounting Program (2019). Uganda Adjusted Macroeconomic Indicators Brief. https://www.wavespartnership.org/sites/waves/files/kc/UG%20Macro%20indicators%20and%20Wealth%20brief%20November%20%202019.pdf. Accessed 18 February 2020.

United Nations, European Union, Food and Agriculture Organization of the United Nations, Organisation for Economic Co-operation and Development and World Bank Group (2014). System of Environmental-Economic Accounting 2012 Experimental Ecosystem Accounting. New York. ST/ESA/STAT/Ser.F/112

United Nations, General Assembly (2015). Transforming our World: the 2030 Agenda for Sustainable Development. 21 October. A/RES/70/1.

United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development and the World Bank (2014). System of Environmental-Economic Accounting 2012--Central Framework. New York. ST/ESA/STAT/Ser.F/109

United Nations, European Union, Food and Agriculture Organization of the United Nations, Organisation for Economic Co-operation and Development and World Bank Group (2017). System of Environmental-Economic Accounting 2012--Applications and Extensions. New York. ST/ESA/STAT/Ser.F/114

United Nations Economic Commission for Europe (2016). Guide on Measuring Human Capital, Prepared by the Task Force on Measuring Human Capital. Geneva: United Nations Economic Commission for Europe.

United Nations Economic Commission for Europe, Organisation for Economic Co-operation and Development and Eurostat (2014). Conference of European Statisticians Recommendations on Measuring Sustainable Development. Geneva.

United Nations Environment Programme (2020). Green Economy. https://www.unenvironment.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency/green-economy. Accessed 18 February 2020.

United Nations Environment Programme (2018). Inclusive Wealth Report 2018: Measuring Sustainability and Well-Being. Nairobi.

United Nations Committee of Experts on Environmental-Economic Accounting (2019). SDG Broadbrush Analysis. https://seea.un.org/sites/seea.un.org/files/sdg_cover_note_broadbrush_0.pdf. Accessed 18 February 2020.

United Nations Statistics Division (2020). Where in the World is the SEEA?. https://seea.un.org/news/where-world-seea. Accesed 18 February 2020.

United Nations Statistics Division (2020). Countries compiling SEEA accounts, as of 2020.

World Commission on Environment and Development (1987). Our Common Future – Report of the World Commission on Environment and Development. Oxford: Oxford University Press.

Woolcock, M. (1998). Social Capital and Economic Development: Toward a Theoretical Synthesis and Policy Framework. Theory and Society 27(2):151–208.

ANNEX

Introduction to the SEEA methodology

The System of Environmental-Economic Accounting (SEEA) is the accepted international standard for natural capital accounting and provides a framework for organizing and presenting statistics on the environment and its relationship with the economy.

The SEEA framework follows a similar accounting structure as the System of National Accounts (SNA), which is the statistical standard to measure macro-economic transactions and flows. The SEEA framework uses concepts, definitions and classifications consistent with the SNA in order to facilitate the integration of environmental and economic statistics.

Two different perspectives are embodied in the SEEA. The first perspective is expressed through the SEEA-Central Framework (SEEA-CF), which looks at individual environmental assets such as energy, water, forests and timber, to explore how they are extracted from the environment, used in the economy, and returned to the environment in the form of waste, water and air emissions. The SEEA Central Framework allows for the integration of environmental information (often measured in physical terms) with economic information (often measured in monetary terms) in a single framework. The power of the SEEA Central Framework comes from its capacity to present information in both physical and monetary terms coherently. The SEEA-CF was adopted by the UN Statistical Commission, the apex body of the global statistical system, as the first international standard for environmental-economic accounting in 2012.

The second perspective complements the SEEA-CF by taking the perspective of ecosystems. The SEEA-Experimental Ecosystem Accounting (SEEA-EEA) looks at how individual environmental assets interact as part of natural processes within a given spatial area. The SEEA-EEA constitutes 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. The SEEA-EEA was first drafted in 2012 and is now undergoing a revision, with the intention of reaching an agreement on as many aspects of ecosystem accounting as possible by the end of 2020.

EEA-Central Framework

At the heart of the SEEA-CF is a systems approach to the organization of environmental and economic information which covers, as completely as possible, the stocks and flows that are relevant to the analysis of environmental and economic issues.

The SEEA-CF brings together, in a single measurement system, information natural resources, pollution and waste, production, consumption and accumulation. The SEEA-CF is composed of several subsystems which focus on specific areas of policy interest. For example, SEEA-Water is the conceptual framework and set of accounts which present hydrological information alongside economic information. SEEA-Water supports the analyses of the role of water within the economy and of the relationship between the environment and water-related activities, thereby supporting integrated water management. Other subsystems include agriculture, forestry and fisheries; air emissions; energy; environmental activity; land; material flow; and waste.

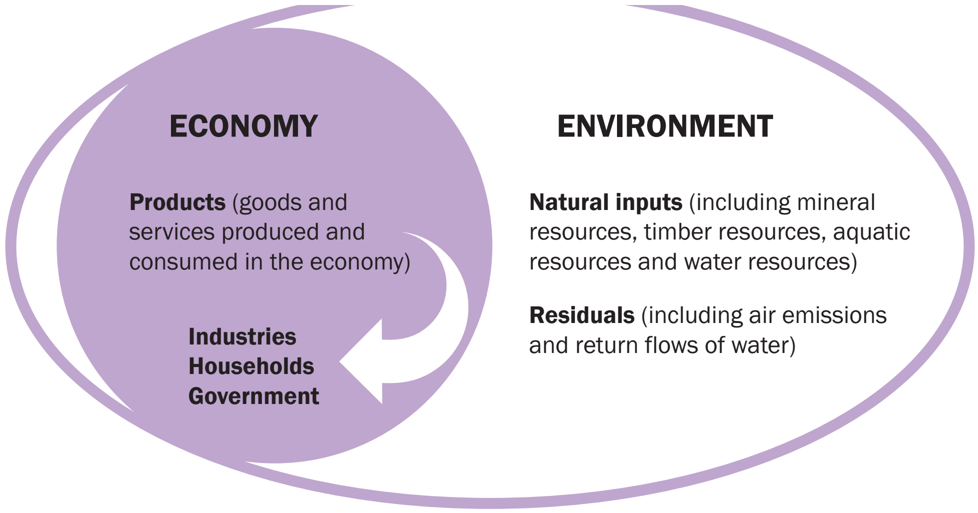
In practice, environmental-economic accounting includes the compilation of physical and monetary supply and use tables, functional accounts (such as environmental protection expenditure, taxes and subsidies accounts) and physical and monetary asset accounts. To assess how the economy supplies and uses natural inputs, SEEA accounts disaggregate flows by different units of production (industries as categorized by the International Standard Industrial Classification[22] and households). Data for SEEA accounts is usually collected from business and household surveys related to resource extraction and use.

SUPPLY AND USE TABLES

Supply and use tables in the SEEA-CF record the flows of natural inputs (e.g. flows of minerals, timber, fish and water), products and residuals (e.g. solid waste, air emissions and return flows of water) in both physical and monetary terms. In recording these flows, the SEEA-CF provides information on the amount and value of materials, water and energy that enter and leave the economy and flows of materials, water and energy within the economy itself. By providing information disaggregated by industries and households, supply and use tables provide valuable information on production and consumption patterns and changes in these patterns over time, as well as changes in the productivity and intensity of the use of natural inputs and the release of residuals.

[22] See https://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4e.pdf.

Figure 1. Physical flows of natural inputs, products and residuals



ASSET ACCOUNTS

Stocks and changes in stocks of environmental assets (e.g. water, timber, fish, minerals and energy resources etc.) are measured in the SEEA-CF through asset accounts. In physical terms, the Central Framework focuses on recording the physical stocks and changes of stocks of individual environmental assets, such as tonnes of coal, cubic metres of timber and hectares of land. However, the SEEA-CF also includes the measurement of stocks in monetary terms. The measurement of stocks in monetary terms focuses on the value of individual environmental assets and changes in those values over time. The valuation of these assets focuses on the net present value of the benefits that accrue to economic owners of environmental assets, and the use of monetary terms enables the analysis of trade-offs between the conservation and use of different natural inputs.

ENVIRONMENTAL ACTIVITY ACCOUNTS

Environmental activity accounts are a subsystem of the SEEA-CF which deserve special mention, as they do not focus on individual environmental assets, but transactions taken to preserve and protect the environment. More specifically, environmental activity accounts record transactions in monetary terms between economic units that may be considered for environmental purposes. Generally, these transactions concern activity undertaken to preserve and protect the environment or activity designed to influence the behaviour of producers and consumers with respect to the environment. Environmental activity accounts in the SEEA-CF include environmental protection and resource management expenditure accounts (which include, for example, direct expenditures for the protection of biodiversity), environmental goods and services sector accounts, and environmental taxes and subsidies accounts. Used in tandem with other SEEA accounts, environmental activity accounts supply valuable information on whether economic resources are being used effectively to reduce pressures on the environment and maintain the capacity of the environment to deliver economic benefits.

SEEA-Experimental Ecosystem Accounting

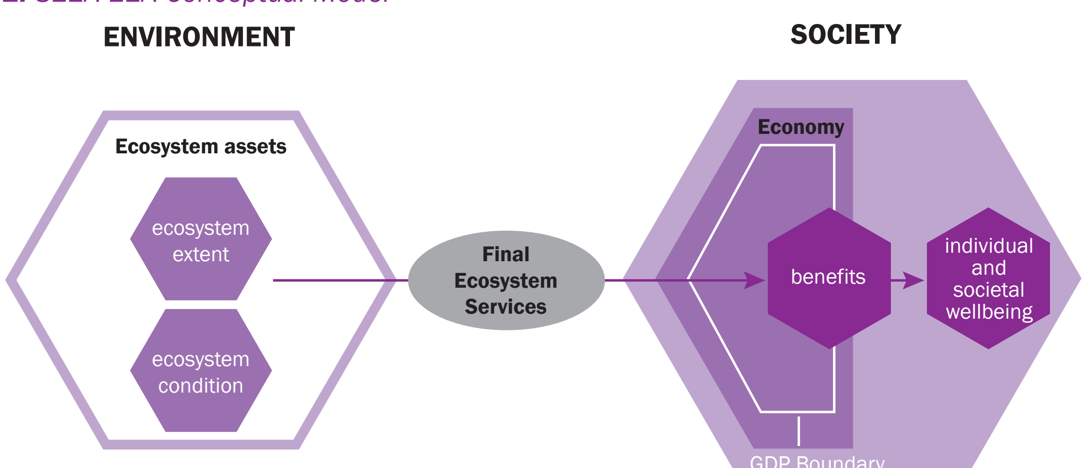
Fundamental to ecosystem accounting is the recognition that ecosystems are the source of goods and services that are essential to economic prosperity and human well-being, now and in the future. In the SEEA, an ecosystem is defined as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (United Nations et al., 2014).[23]

Ecosystem assets are areas covered by a specific ecosystem type, such as forests, wetlands, agricultural areas, rivers, coral reefs etc. The contributions of ecosystems range from natural products such as timber and game to services like purification of air and water, pollination of crops, nutrient cycling, carbon storage and more. The importance of these services underlines the need for a thorough understanding of the ways in which ecosystems support economic and social well-being.

The framework, which is well aligned to national accounting principles, allows for the measurement of ecosystem assets in terms of both their condition (overall health) and the services they provide, and can be applied consistently across terrestrial, freshwater and marine areas. A defining characteristic of ecosystem accounting is that it is spatially explicit, i.e., it builds accounts based on underlying maps with information. As such, ecosystem accounting produces an integrated spatial information system.

Ecosystem accounting is based upon the conceptual model shown in Figure 2. The model starts with identifying ecosystem assets - an ecosystem that is mapped by mutually exclusive spatial boundaries such that each asset is classified to a single ecosystem type. Assets can be described through their condition and extent. Through intra-and-inter ecosystem flows, ecosystem assets generate ecosystem services – the contributions of ecosystems to benefits used in economic and other human activity, for example water regulation.

Figure 2. *SEEA-EEA Conceptual Model*



Source: UNSD

23 The SEEA uses the definition of the Convention on Biological Diversity. See https://www.cbd.int/ecosystem/description.shtml.

ECOSYSTEM EXTENT ACCOUNTS

Ecosystem extent accounts serve as a common starting point for ecosystem accounting. They organize information on the extent of different ecosystem types within a country in terms of area. In particular, ecosystem extent accounts describe the environment in terms of sets of mutually exclusive (i.e. non-overlapping) ecosystem assets. These assets (e.g. an individual forest, or a specific wetland) can be classified in terms of different ecosystem types such as forests, wetlands, cropland etc. All assets together populate an ecosystem accounting area, which could range from a watershed to a municipality to a country etc. The extent account describes the various types of ecosystems that are distinguished within an area and how they change over time.

ECOSYSTEM CONDITION ACCOUNTS

Condition accounts measure the overall quality of an ecosystem asset and capture, in a set of key indicators, the state or functioning of the ecosystem in relation to both its naturalness and its potential to supply ecosystem services. Essential is that the condition account compares at least two different years to track changes over time. As with all ecosystem accounts, condition accounts are built up from underlying maps of the various variables. For every ecosystem type (e.g. forest; inland water bodies etc.), a reference level is provided against which values for indicators can be compared. There is a wide range of indicators that can be assessed in the condition account, and indicators can be ecosystem type specific. Condition accounts provide valuable information on the health and state of ecosystems and their capacity of ecosystems to deliver critical ecosystem services in the future.

ECOSYSTEM SERVICES ACCOUNTS

This set of ecosystem accounts measures the supply of ecosystem services as well as their corresponding use and beneficiaries, classified by economic sectors used in the national accounts, in both physical and monetary terms. In SEEA EEA, ecosystem services are defined as "the contributions of ecosystems to benefits used in economic and other human activity" (United Nations et al, 2014). SEEA EEA uses the following three broadly agreed categories of ecosystem services:

- Provisioning services (e.g. supply of food, fibre, fuel and water);
- Regulating services (related to activities of filtration, purification, regulation and maintenance of air, water, soil, habitat and climate); and
- Cultural services (related to activities of individuals in, or associated with, nature, such as recreation).

Ecosystem services are defined in SEEA EEA as the contribution to benefits, rather than as the benefits themselves, in order to avoid double counting. For example, an agricultural crop such as corn or maize is already recorded in the national accounts. Moreover, corn is the result of combining human capital (in the form of labour), produced capital (machinery) and natural capital (the cropland). The objective of the services accounts is to isolate the contributions of nature to the production of the crop visible. In addition, by expanding the national accounts production boundary, the accounts also recognize a range of ecosystem services that lead to benefits that are not currently recognized in the SNA such as carbon sequestration or air filtration.

MONETARY ASSET ACCOUNT

The monetary asset account records the monetary value of opening and closing stocks of all ecosystem assets within a given ecosystem accounting area, as well as additions and reduction to those stocks. The ecosystem services supply accounts are a key input into the monetary asset account and provide an estimate of the total annual flow that is generated during a specific year. The value of the ecosystem assets can be estimated by capitalizing these annual flows of services over the projected period i.e. the expected lifetime of the ecosystem, using a so-called net present value method. In order to estimate these projected service flows, it is important to take into account the capacity of the ecosystems to sustain these service flows which will depend on their condition and the extent to which these ecosystems are sustainably managed, and if not, make corrections to future service flows. Thus, the valuation of ecosystem assets allows an assessment of a more comprehensive measure of wealth of a country (in addition to produced capital, financial capital etc.).

THEMATIC ACCOUNTS

The SEEA-EEA also includes several thematic accounts. These are standalone accounts, or sets of accounts, that organize data according to an accounting framing about themes of specific policy relevance. For example, species accounts in the SEEA-EEA have the structure of an asset account and describe the opening and closing stock of a particular species over a period of time. The account tries to explain the observed changes in a number of categories (e.g. additions / reductions). The account can be compiled for instance for endangered species or for specific iconic species.

Carbon accounts are another common thematic account. The carbon account was developed to allow for a consistent and quantitative comparison of carbon stocks and flows in the reservoirs 'biocarbon' (organic carbon in soils and biomass), 'geocarbon' (carbon in the lithosphere), atmospheric carbon and carbon in the economy. Other potential thematic accounts include accounting for protected areas, wetlands and forests.

Aggregates and indicators

The SEEA-CF and SEEA-EEA are multipurpose and relevant in a number of ways for policy development and evaluation, as well as decision-making. First, the summary information (provided in the form of aggregates and indicators) can be applied to issues and areas of the environment that are the focus of decision makers. For instance, the SEEA-CF and SEEA-EEA provide the data to inform 40 SDG indicators, including goals 2, 6, 7, 8, 9, 11, 12, 14 and 15.

Second, the detailed information, which covers some of the key drivers of change in the environment, can be used to provide a richer understanding of the policy issues. For example, the SEEA-CF accounts can be effectively communicated to users and decision makers through combined presentations combining physical and monetary data. A combined presentation thus represents an analytical framework showing which parts of the economy are most relevant to specific aspects of the environment, and how changes in the economic structure influence the environment (see Figure 3).

Figure 3. *Possible structure of and typical content for combined presentations*

	Industries (by ISIC divisions)	Households	Government	Accumulation	Flows of the rest of the world	Total
Monetary supply and use: flows (currency units)						
Supply of products						
Intermdiate consumption and final use of products						
Gross value added						
Depletion-adjusted value added						
Environmental taxes, subsidies and similar transfers						
Physical supply and use: flows (physical units)						
Supply of:						
Natural inputs						
Products						
Residuals						
Use of:						
Natural inputs						
Products						
Residuals						
Asset stocks and flows						
Closing stocks of environmental assets (currency units and physical units)						
Depletion (currency units and physical units)						
Closing stocks of fixed assets (currency units)						
Gross fixed capital formation (currency units)						
Related socio-demographic data						
Employment						
Population						

Note: Dark grey cells are null by definition

Source: SEEA-Central Framework (United Nations, 2014).

Further, as the accounts provide consistent environmental and economic indicators, the possible trade-offs in environmental terms between alternative environmental and economic strategies can be analysed. The SEEA enables the calculation of indicators on several topics, including: resource use and intensity; production, employment and expenditure related to environmental activities; environmental taxes and environmental subsidies; and environmental assets, wealth, income and depletion of resources.

The SEEA also enables the derivation of depletion-adjusted balancing items and aggregates within the sequence of economic accounts of the SNA. Using the SEEA, balancing items, within the sequence of economic accounts, can be adjusted for depletion so that estimates of the monetary cost of using up natural resources can be deducted from conventional economic aggregates, such as GDP and saving to yield depletion-adjusted aggregates.

Applications of the SEEA

There are several other applications of the SEEA.[24] One common application of the SEEA is environmentally extended input-output tables (EE-IOT). EE-IOT are datasets that combine information from economic input-output tables from the SNA in monetary units and information on environmental flows, such as flows of natural inputs and residuals, that are measured in physical units.

EE-IOT data sets, which reflect industry and product detail in physical and monetary terms and encompass economic and environmental information, can be powerful tools in analysis and research. Input-output analysis is regularly used to attribute environmental flows to final demand categories. It can identify the link between final demand and resource use, emissions and other environmentally related flows and thereby highlighting "hot spots" or "pressure points" that are highly policy relevant.

The SEEA is also often used for decomposition analysis, a tool which enables separate estimates of the particular drivers influencing changes in environmental impacts or pressures. Since changes in the pressures from the environment occur within dynamic systems of interactions, it is often difficult to identify the extent to which specific consumption and production activities have contributed to changes in environmental impacts or pressures. Decomposition analysis can be used to account in detail for the factors underlying these changes. Typically, the variables used in the calculations include changes in the size of the economy, changes in the structure of the supply chain and demand, changes in the energy intensity of production, and improvements in the production process. Decomposition analysis can be used to understand, for example, the economic or technological changes that have caused emissions of CO_2 to increase. Thus, decomposition analysis can be a powerful tool for analysis and policy design.

Finally, another common application of the SEEA is computable general equilibrium (CGE) models. CGE models are a class of economic models that combine use of input-output data with the application of microeconomic theory and are especially well suited to analysing the future effects of policies. They consist of a system of non-linear demand, supply and market

24 See The System of Evnironmental-Economic Accounting 2012 Applications and Extensions, https://seea.un.org/sites/seea.un.org/files/ae_final_en.pdf.

equilibrium equations, into which various assumptions may be introduced (depending on the model). In the context of the SEEA, CGE models may be developed using information contained in EE-IOT, thus bringing together monetary and physical data. The use of CGE models can facilitate an understanding of what dynamic impacts may be expected in the case of policy interventions, or other developments.

For example, CGE models can assist in understanding the dynamics arising from the introduction of a tax on CO_2 emissions, which will entail a shift away from relatively carbon-intensive inputs.

United Nations

System of
Environmental
Economic
Accounting