WAVES
Wealth Accounting and the
Valuation of Ecosystem Services
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From Accounts to Policy:
WAVES
closeout report

Wealth Accounting and
Valuation of Ecosystem
Services (WAVES) Global
Partnership

2012-2019

FROM ACCOUNTS TO POLICY: WAVES CLOSEOUT REPORT

Wealth Accounting and Valuation of Ecosystem Services Global Partnership (2012-2019)

WAVES

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EXECUTIVE SUMMARY

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a USD23 million World Bank–led global partnership aimed at mainstreaming natural capital in development decisions by better measuring it, valuing it, and integrating it into national economic accounts. The goal of this report is to summarize the main results that the program has achieved at the national and global levels, from its inception in 2012 to its 2019 completion, and to assess the significance of those results across four dimensions: data and information, tools and capacities, institutions, and decision making. The principal audience of the report is the many WAVES partners—notably donors—who contributed to the program and authorities in participating countries who established country teams to develop and use natural capital accounting (NCA) (finance, development, statistics, environment, sector authorities) but also the broader development community active in this space.

The report finds that WAVES has supported development of 32 natural capital accounts. These accounts contributed to the monitoring of 11 Sustainable Development Goals (SDGs) and helped establish 10 country solutions to institutionalize NCA, and informed 52 decisions across the different stages of the policy-making cycle (design, implementation, monitoring, reform).

WAVES also contributed to results that World Bank Group (WBG) operations achieved. Outputs such as data sets, valuations, advice, and analytics produced under the program became useful to WBG operations and informed their design. In countries such as Colombia, Guatemala, and Rwanda, WAVES funding of USD4.5 million has informed the design of World Bank lending operations worth USD1.1 billion, for a leveraging ratio of more than 1 to 240. WAVES did not finance preparation of any WBG operations, and the contribution is thus indirect. It is measured by the leverage ratio (the ratio between financing amount of WBG informed and the cost of WAVES support). An indirect contribution was also made to national policy reforms as measured by the number of reforms informed.

NCA provides a framework to systematically measure and value the interactions between the environment and economic systems (Box ES1). When WAVES was first presented in 2010 in Nagoya, Japan, NCA was a relatively new concept, and countries had limited capacity to understand and implement it. During the Rio+20 meeting in 2012, 70 countries supported a communiqué that called on governments, the United Nations system, international financial institutions, and other international organizations to support NCA. To capitalize on that momentum, the World Bank teamed up with a number of donors (European Union, Denmark, France, Germany, Japan, the Netherlands, Norway, Switzerland, United Kingdom) to establish the USD23 million WAVES multidonor trust fund.

Box ES1 • Natural Capital Accounting

Natural capital accounting provides a framework for measuring and valuing natural resources in a consistent way over time and space. It identifies the interlinkages between the economy and the environment, providing a broader, richer picture of development progress than standard measures such as gross domestic product. Natural capital accounts complement the system of national accounts by providing data on natural resources and ecosystem services that go into economic production and consumption and the resulting emissions and waste. This, in turn, can inform policies and resource management or development decisions so that they respond to critical links between the environment and the economy. More details on Natural Capital Accounting in Appendix A

The overarching objective of WAVES was to mainstream natural capital into decision making. This was further articulated in more specific objectives: implement NCA at the national and subnational levels in partner countries based on the System of Environmental-Economic Accounting (SEEA), incorporate NCA into policy analysis and development planning, develop methodology and guidelines for implementing ecosystem accounting for global implementation, and promote adoption of NCA beyond WAVES partner countries.

In 2012, WAVES started its country-level work, which over time included eight core implementing countries (Botswana, Colombia, Costa Rica, Guatemala, Indonesia, Madagascar, the Philippines, Rwanda). The same year, the United Nations Statistical Commission adopted the SEEA Central Framework as a coherent global standard for producing many types of natural capital accounts. This helped in garnering support for the program to help countries implement the SEEA methodology.

The WAVES program was designed using experiences from developed and developing countries since the 1990s. One of the most important lessons was that ministries of finance and planning and line ministries needed to be involved for the accounts to be used in policies and decisions. Another was that short-term support, with the consultants doing most of the work, rarely results in natural capital considerations being mainstreamed into countries' policies. Thus, the WAVES approach was to give in-depth support to a few countries, with a focus on building capacity so that countries could produce and use NCA once the program was over. A steering committee was set up in each country that the Ministry of Finance or Ministry of Planning typically chaired that included representatives from all relevant line ministries and the statistical office. The WAVES program also formed an expert group, the Policy and Technical Expert Committee, that provided technical and policy advice and formed the roster of experts on NCA that the WAVES program called upon to train and support government staff in partner countries. Globally, a variety of donors, UN agencies, civil society and business organizations, and knowledge partners contributed to WAVES.

Overall achievements

WAVES closed in December 2019, disbursing close to 100% of the USD23 million that donors provided, 58 percent of which was allocated to national or regional work (Table ES1). WAVES funding informed World Bank operations of considerable size. In Colombia, the WAVES program was a key input into preparation of the Second Sustainable Development and Green Growth Development Policy Loan (USD500 million). The WAVES program in Guatemala informed the dialogue that led to the design of Probosque, an incentive program that transfers payments of about USD15 million annually for 30 years (USD450 million in total), which is 1 percent of the country's budget and is its biggest environment-related investment program. In Rwanda's Urban Development Project II, the WAVES program informed USD150 million. Overall, USD4.5 million leveraged USD1,100 million in World Bank projects.

The assets built under WAVES constitute a strong basis for integrating natural capital considerations into global and national policies and investments in future years. Over the past 8 years, they have proven robust enough to overcome the typical structural and political barriers to evidence-based natural capital policy.

▶ Lack of policy readiness and space for policy change—NCA has been able to raise the profile of multidimensional and long-term natural capital issues that were not highest on the current policy agenda.

▶ Political weakness of authorities concerned with environment and natural capital—NCA has provided a shared information base highlighting the importance of the natural capital mandate.

▶ Lack of transparency of natural capital data—Where NCA has been published, these data are now in the public sphere.

▶ Frequent absence of legal requirement or appetite for evidence-based policy—NCA has demonstrated the value of well-structured evidence informing critical decisions, as shown in the proceedings of three NCA policy forums to date.

▶ Lack of experience in holistic policy—NCA is increasingly attractive where there are growing expectations for countries to shape holistic, integrated solutions and make better-informed trade-offs—but where they lack experience in doing so. With countries currently working out how to achieve 17 integrated and indivisible SDGs, NCA provides an integrated framework, reveals the indivisible links between environment and economy, unites the disciplines (economics, environment, development, statistics), and can feed progressive economic models. Thus, NCA assets are well suited to take advantage of positive policy contexts.

Table ES1 • Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Financial Data According to Activity Type

Activity Type	Allocation	Disbursement	Disbursement rate	Share of total disbursement
	(USD million)		%	
National	12.72	12.71	99.94	55
Regional	0.75	0.75	100.00	3
Global	5.76	5.76	99.99	25
Other	3.79	3.79	100.00	16
WAVES inception activities	1.92	1.92	100.00	8
Program management and administration	1.87	1.87	100.00	8
Total	**23.02**	**23.01**	**99.97**	**100**

Note: More detailed information on activities supported by the program can be found in Appendix B and C..

The **results framework** for WAVES comprised 12 indicators intended to capture the program's outcomes and outputs at the national and global levels. The full results framework is provided in Appendix B.

Most of the targets were met or exceeded. In all countries, policy analysis using NCA was disseminated, and steering committees were established. All countries but one published natural capital accounts for at least two sectors. Capacity building resulted in 220 staff skilled in NCA and its uses in governments, on average 28 per country. In total, 45 key policy documents in the eight countries referenced NCA. There were 1,175 project beneficiaries—people attending workshops, events, and trainings and being briefed on what NCA could bring to their line work. By the time of its closing, the program achieved an overall rate of accomplishment of 96 percent, with peaks of 99 percent at the country level

To enrich the information that the program's results framework provided, based on the insights gained during implementation, this report proposes a complementary approach to assess WAVES' effects on four main types of contributions (building blocks) that are considered essential to achieve lasting impacts: information, capacities and tools, institutions, and policy use and decisions made. The program's main contributions to each of the building blocks are summarized in Table ES2 and discussed in the rest of the executive summary.

Table ES2 • Overview of Key Assets Built within Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Partnership

Area	Country results	Global results
Information on natural capital	• 9 types of natural capital accounts covering the 8 WAVES countries plus new WAVES+ countries; more than 30 accounts produced • More than 130 in-country WAVES publications explaining significance of natural capital in sector, local, or national economies	• Changing Wealth of Nations outlines wealth accounts for 141 countries • Around 40 WAVES policy briefs and 3 global NCA policy forum proceedings extending information on NCA and its use
Tools and capacities	• Technical working groups established for nearly every account developed • New jobs and trained staff to operate the NCA system and to interpret and communicate NCA in all countries • More than 200 people undertaking WAVES training and awareness courses in all participating countries	• System of Environmental-Economic Accounting Experimental Ecosystem Accounting improved methodology • Forest accounting methodology • WAVES Knowledge Center—a global knowledge platform on NCA containing more than 500 publications, news articles, and presentations • 10 principles for policy-fit NCA developed through global consensus in NCA policy forum • Knowledge exchange and South–South cooperation (global network of account producers)
Institutions	• NCA national steering committees in all participating countries enable and stimulate cooperation between stakeholders • All participating countries have embedded NCA (e.g., through establishing NCA units and other capabilities)	• Partnership meeting convened annually from 2011 to 2018 • NCA policy forum met 4 times since 2016, offering a new event for global learning and exchange • Effective partnership between World Bank, UN Statistics Division, UN Environment Programme, London Group on Environmental Accounting
Decisions made	• 33 national or sectoral development plans informed by NCA (e.g., for water, energy, forest, land development plans) • 9 new policy instruments or investments agreed upon or under review (e.g., payments for ecosystem services, licensing, taxation, pricing) • 10 policies monitored, reviewed, or reformed based on information in accounts	• Uses and potential uses of accounts in decision making catalogued in publications after NCA policy forum • Toolkit for using NCA being developed for World Bank Environmental and Social Framework use in lending operations

Note: NCA, natural capital accounting.

The clearest achievement of the WAVES program is the new information available from national natural capital accounts, which has enabled more evidence-based decision making. WAVES supported production of 32 accounts across seven domains, with forest, land, and water accounting for close to half (Table ES3).

Table ES3 • Accounts Supported by Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Program

Country[a]	Ecosystems	Energy	Forest	Land	Minerals	Other[b]	Water	Total
Botswana		1			1	1	1	4
Colombia	1	1	1	1		1	1	6
Costa Rica	1	1	1	1			1	5
Guatemala		1		1		2	1	5
Indonesia	1			1			1	3
Philippines	1				1	1	1	4
Rwanda	1		1	1	1		1	5
Total	**5**	**4**	**3**	**5**	**3**	**5**	**7**	**32**

(a) Madagascar was also a WAVES core implementing country. Although intermediate and advanced technical reports have been delivered on water, forests, minerals, and macroeconomic indicators, these have not been turned into final products ready for publication, reflecting challenges related to the political situation, limited capacity in relevant government agencies, and the overall weakness of the statistical system (e.g., Madagascar has not had a general census of the population for more than 20 years). Because only partial results have been obtained, data for Madagascar are not included in this Table.
(b) Includes macroeconomic indicators.

The accounts consolidated data that were previously unavailable, outdated, scattered over multiple institutions, or based on different concepts and various measurement methods. The accounts provided the participating ministries and institutes with:

▶ new and coherent information that allowed them to pinpoint the causes of problems and to find new solutions

▶ common ground, providing one trustworthy source of information used by all

▶ time series that allowed them to monitor changes in resource availability and trends in resource use by economic sector

In several countries, the accounting information was an input to more sophisticated analysis and modeling. By linking with other natural capital accounts or the System of National Accounts (SNA), the relationship between the use of different natural resources, resource availability, and the larger economy could be shown and a suite of indicators proposed. For instance, the Rwandese government used the information gathered and lessons learned from the accounts to reformulate its water development plan, setting targets for the water-related SDGs.

A valuable achievement of the WAVES program is the increase in cooperation between participating ministries, statistical agencies, and resource agencies. The program institutionalized cooperation between participating organizations and interagency working groups for specific natural capital accounts and formalized data-sharing arrangements. In several countries, dedicated NCA units were set up or specific staff positions for NCA created, meaning that NCA is well established in almost all WAVES partnership countries. In many countries, NCA steering committees or working groups remained after World Bank support ended, because authorities recognize the

importance of regular meetings and cooperation for ongoing account production and use. In all cases, greater understanding of each other's tasks and responsibilities and working together to collect and analyze data have increased trust and cooperation between agencies.

Directly or indirectly, the WAVES partnership has influenced more than 50 national, subnational, and sectoral decisions in many fields of natural resource management and throughout different stages of the policy-making process (Table ES4).

Table ES4 • Summary of Application of Wealth Accounting and the Valuation of Ecosystem Services –Supported Accounts to Different Stages of the Policy-Making Cycle

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform	Total
Botswana	5	1	2	8
Colombia	5	1	1	7
Costa Rica	6	2	1	9
Guatemala	3			3
Indonesia	8	1		9
Philippines	4	2	4	10
Rwanda	2	2	2	6
Total	**33**	**9**	**10**	**52**

Notes: On Madagascar, see note to Table ES3.

Policy decisions that WAVES has informed can be summarized as follows (country-level specifics provided in Table ES4).

► **Policy plans developed:** The accounts contributed to a broad range of multiyear development plans in all WAVES partnership countries, such as the National Water Plan of Rwanda, the Power Generation Expansion Plan in Costa Rica, and regional development plans in Colombia and the Philippines. The accounts also provided indispensable inputs for regulations, such as for the payments for ecosystem services and reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (REDD+) programs and licensing schemes for water use. Accounting information was used in models and other analyses that enabled policy makers to assess the expected impacts of various policy response options and to select the optimal policies.

► **Policies implemented:** The information in the natural capital accounts and the capacity and institutions strengthened through the WAVES program enabled more efficient policy implementation. For instance, the Costa Rican accounts showed that energy efficiency initiatives should be targeted to the sugar cane sector and that the energy-intensive cement, chemical, and petroleum sectors are taking steps to reduce their energy intensity.

► **Policies monitored, reviewed, and reformed:** The time series information enabled monitoring of policy progress—not only whether countries followed the right pathway, but also in which sectors or regions the best results were attained or how the policies

affected other resources or sectors. For instance, the suite of accounts compiled for the Palawan region in the Philippines showed how the mining, agricultural, fisheries, and tourism sectors interacted. The information also provided necessary inputs into tools such as environmental impact assessments and cost-benefit analysis of existing policies. For instance, they helped institutions make decisions such as setting priority areas for mangrove protection and restoration in South Palawan in the Philippines.

It is encouraging that, in all participating countries, WAVES' contributions have already had so many positive impacts on policy makers and policy decisions, although development and use of natural capital accounts and embedding NCA in the machinery of government and business is a mid- to long-term objective—it took decades for the regular SNA to become mainstream. Thus, some of WAVES' possible contributions to institutional strengthening and improved decision-making are yet to come. Nonetheless, there are signs of further impacts of WAVES that will benefit partner countries in the near future.

Lessons learned

The WAVES program has generated valuable experience, not only in the technical and programmatic aspects of NCA development and use, but also in addressing the broader institutional and political aspects of making the case for NCA, using and embedding NCA, and supporting its improvement. In this section, we synthesize what the program has learned, drawing on the lessons learned presented in the theme chapters, other documented experience (WAVES Annual Reports, NCA policy forum proceedings, the 2016 review of the first five WAVES countries' experiences[1]), and interviews with government representatives.

Overall, WAVES has demonstrated that it is possible to build natural capital accounts in developing countries and to use them to inform national development plans and policies. Implementing the program has also provided important lessons on how to integrate sustainability into the development process that have been incorporated into the new Global Program for Sustainability (GPS), which will include as one of its pillars the continuation and expansion of the country-level work started with WAVES.

Ten lessons have been identified:

1. **Mandate:** Continued high-level support for the development and use of natural capital accounts is essential for securing NCA's mandate and for opening up the most strategic entry points.

2. **Policy focus:** If natural capital accounts are designed to be decision centered, they can be uniquely fit to inform today's difficult, interconnected decisions.

3. **Flexibility:** Country programs have been most successful when they have combined quick analyses to support decisions with longer-term development of NCA.

4. **Engagement:** NCA takes off when diverse data suppliers and potential data users are

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1 Vardon, M., Lange, G.M. and S. Johansson. 2016. Achievements and Lessons from the WAVES First 5 Core Implementing Countries. https://www.wavespartnership.org/sites/waves/files/kc/First%205_Achievements%20and%20Lessons.pdf

well connected: building trust and realizing synergies between their work.

5. **Cooperation and coordination:** A national steering committee of NCA producers, users, and quality assurers, supported by technical working groups, can smooth the path to developing, using, and embedding NCA. A complementary policy working group can further embed the results in policy making.

6. **Communications:** A dedicated communications strategy can engage stakeholders, ensure that NCA's role and its results are visible and understood, and deliver the right messages to target audiences.

7. **Institutionalization and capacity:** Effective NCA is an iterative system, not a one-off project; time needs to be allowed to develop, use, prove, and embed NCA.

8. **Transparency:** Knowing how and by whom data were acquired, analyzed, interpreted, and made accessible is critical for NCA's credibility and trustworthiness, but there is no single solution.

9. **Multiple levels:** NCA adds value at all scales from national to local; although WAVES is focused nationally, some of the toughest decisions that NCA can inform are proving to be intensely local and distributional.

10. **Networking:** Bringing together a community of practice can accelerate the learning, expand the knowledge base, build the capacity, and provide the confidence necessary to improve NCA.

These lessons show that there is a need to fast-track the application of NCA to policy. The GPS will explore ways to support development of first-draft national accounts using global data, which could provide prototypes that government staff can build on and improve using national data. Building a global database and developing tools and methodologies for using the data in decision making will also make it possible to compare performance on sustainable development across countries.

There is also a need to meet increasing country demand to measure natural capital and respond flexibly to rapidly evolving country circumstances; a relevant example of a new area of focus for future work is the greening of post-COVID stimulus packages. The GPS will increase flexibility in deploying its assistance through greater use of targeted technical assistance (TTA), which has been introduced in WAVES+ (the second phase of WAVES) as a complementary modality of country support. TTAs are smaller grants than core implementing country assistance, typically linked to large, preexisting World Bank engagements. TTA is intended to provide analysis and insights based on use of NCA information already available from national or global sources (rather than on generation of new sources). Through leveraging the funding in operations included in regular World Bank country programs, TTA can demonstrate the usefulness of NCA for specific policy or project use, thereby building confidence in expanding NCA across space or thematic areas.

It will be important to find efficient ways to support more countries. A modality that will be promoted is formation of regional communities of practice for NCA, which have been piloted under WAVES in Latin America. To promote uptake and use of NCA, GPS will increase its efforts in capacity building, working with partners such as the UN Environment Programme, UN Statistics Division, and Conservation International.

1

1. INTRODUCTION

1.1. Purpose of the report

The Global Partnership on Wealth Accounting and the Valuation of Ecosystem Services (WAVES) was a World Bank–led global partnership designed to incorporate the many diverse values of natural capital in development decisions and to recognize them more fully in national economic accounts. This report outlines WAVES' work from 2012 to 2019. The program resulted in a multitude of reports, briefs, blogs, and events and contributed to policies and plans in partner countries. The goal of this report is to compile all this information into one volume, to demonstrate the program's contributions to sustainable development, and to explain how it achieved them.

The principal audience is the many WAVES partners—notably donors who contributed to the program and authorities in participating countries who established country teams to develop and use natural capital accounting (NCA) (finance, development, statistical, environmental, sector authorities). The report may also interest the broader development community, including World Bank units not directly involved in implementation of WAVES.

This report looks for the contributions of WAVES, not necessarily attributions to WAVES. WAVES built on previous work on NCA and associated methodology and capacity development—supported variously by the UN Statistics Division (UNSD), the UN regional commissions, development assistance agencies, and government expertise from Australia, the United Kingdom, and the Netherlands, among others. The national ministries, agencies, and other institutions in partner countries performed much of the work. Thus, it is not always easy to split WAVES contributions from the contributions of others. This is particularly true when it comes to the influence of the WAVES program on country policies and plans. The accounts and analyses produced, as well as the communication and institutional contributions of the program, can inform decisions, but ultimately change is in the hands of government and implementing agencies.

Furthermore, given the time it takes to scope, build, use, and refine natural capital accounts and to embed NCA into the machinery of government and business, some of WAVES' contributions have not yet materialized or are outside the control of the WAVES program. Nevertheless, further impacts of WAVES will benefit partner countries in the future. Thus, the report finishes with a forward look at the legacy of the WAVES investment—the assets it has built, and lessons learned in the process.

1.2.   Objective of the WAVES program and theory of change

The objective of the WAVES program was to mainstream natural capital in development decisions by better measuring it, valuing it, and integrating it into national economic accounts. The vehicle chosen for this was natural capital accounts, to respond to the long-time demand for alternatives to gross domestic product (GDP) and measures of wealth restricted to produced capital and subsoil assets. The information that the accounts provide would be embedded into decision-making processes. Natural capital accounts—or environmental-economic accounts—had been produced in several developed countries for close to two decades but with little evidence of impact on decision making. The WAVES program aimed to change this by ensuring that the accounts did not stay within the statistical offices and, even more importantly, that the work would reach not only the environment ministries, but also ministries in charge of economic growth and planning, to integrate environmental considerations into economic policy.

The theory of change of the WAVES program is depicted in Figure 1.1, and the corresponding results framework is provided in Appendix B. To achieve the program objective, a number of critical assumptions must be in place (Box 1.1).

The envisaged impact of the program, shown in the blue Box in Figure 1.1., is ultimately better management of natural capital, which is beyond the control of the program, as denoted by the dotted line.

Figure 1.1 • Theory of Change for WAVES
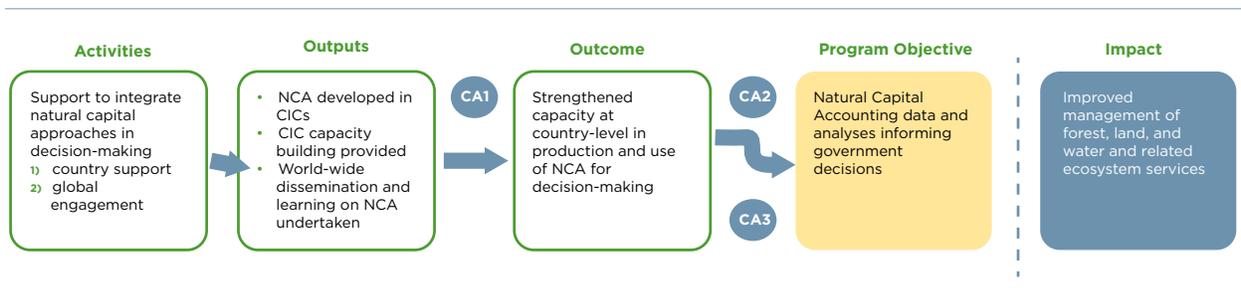
Box 1.1 • Critical assumption

CA1: Natural capital accounting and VCA embedded in institutional structure

CA2: Policy formulation driven by data

CA3: Cross-sectoral coordination effective and incorporates natural capital management

1.3. Outline of the report

The next chapter provides a general overview of NCA and the scope of the WAVES program. The following chapters explore the national, regional, and global achievements of the WAVES partnership in greater detail, bringing together evidence from the literature, supplemented with interviews where possible. They take a *thematic* approach, covering

- ▶ Land and ecosystem services, Chapter 3
- ▶ Water, Chapter 4
- ▶ Forests, Chapter 5
- ▶ Energy and minerals, Chapter 6

The last chapter provides a summary of lessons learned and recommendations for the umbrella program succeeding WAVES, the Global Program for Sustainability (GPS). Activities and achievements are summarized according to country in Appendix C.

The thematic chapters highlight specific countries' experience and achievements, notably through case studies. They examine why accounts were made, who drove them, and which problems or potentials they were designed to address. They explore how the accounts were made and used—the "entry points" into the policy-making process; the actors and institutions involved; and how they accessed data, policy analysis, and actual decision making. They also offer evidence of and insights into the direct and indirect achievements of NCA.

To enrich the information that the program's results framework provides (for the full results framework, see Appendix B), this report proposes, based on the insights gained during implementation, a complementary approach to assess WAVES' impacts for four main types of contributions (building blocks) that are considered essential to achieve lasting impacts: information, capacities and tools, institutions, and policy use and decisions made (Figure 1.2).

Figure 1.2 • Main Contribution of Wealth Accounting and the Valuation of Ecosystem Services to Environmental Sustainability
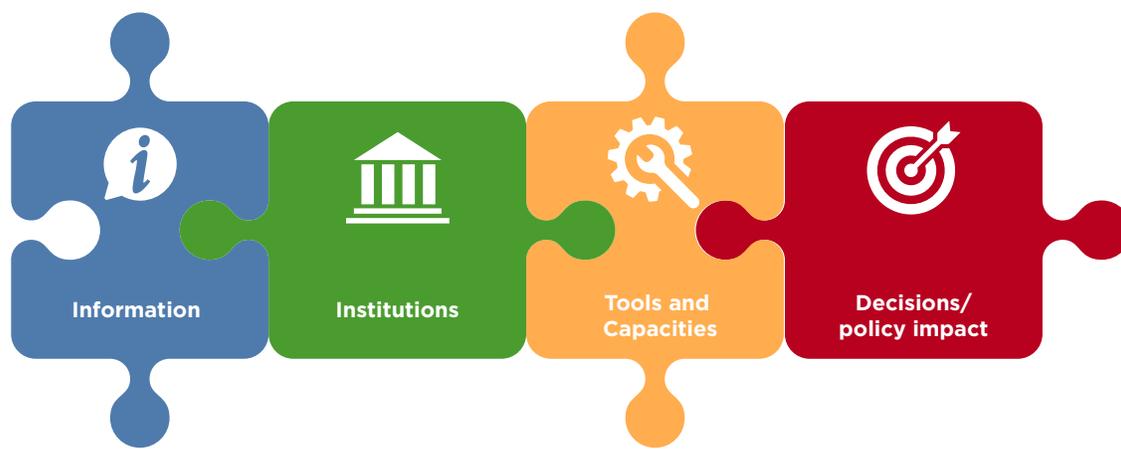
2

2. OVERVIEW OF WAVES PROGRAM

2.1. Introducing NCA

NCA provides a framework for measuring and valuing environmental and economic phenomena in a consistent way over time and space. It identifies the interlinkages between the economy and the environment, providing a broader, richer picture of development progress than standard measures such as GDP.

Without such a coherent measurement framework, one cannot establish whether development decisions increase and sustain natural capital and hence its potential to increase economic prosperity or whether they deplete natural capital and eventually undermine prosperity. It is then also difficult to prove or dispute claims such as "environmental protection slows growth" or "growth is bad for the environment."

The well-established System of National Accounts (SNA) captures the flows of produced goods and services in monetary terms, which the rectangles in Figure 2.1 represent. NCA complements the SNA by providing data on the natural resources and ecosystem services going into economic production and consumption, as well as the resulting emissions and waste. Integrating data on economic activities and the environment enables the analysis of different scenarios: for example, how developing the economy in particular ways affects the environment or how degrading aspects of the environment will affect the economy. This, in turn, can inform policies and resource management or development plans so that they respond to critical links between the environment and the economy.

Figure 2.1 • Environmental and Economic Context for Natural Capital Accounting
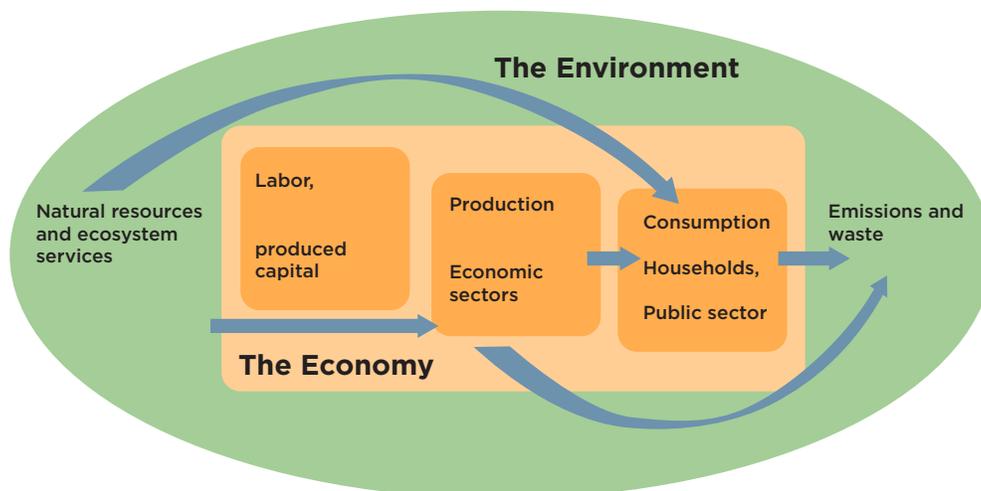
NCA provides quantitative, objective information on perceived and potential problems and encourages cooperation between institutions—governmental and nongovernmental, national and regional—that can drive progress along the "policy cycle"; it can play roles in informing, implementing, monitoring, and reviewing policy and planning decisions (Figure 2.2).NCA has played a big role in identifying problems and thus feeding debate for some years, but no government is applying NCA comprehensively and routinely throughout its decision making; examples of use in decision making are only just emerging, and many have come to light via the policy forum on NCA (see chapter 7).

Figure 2.2 • The Policy Cycle and Information System
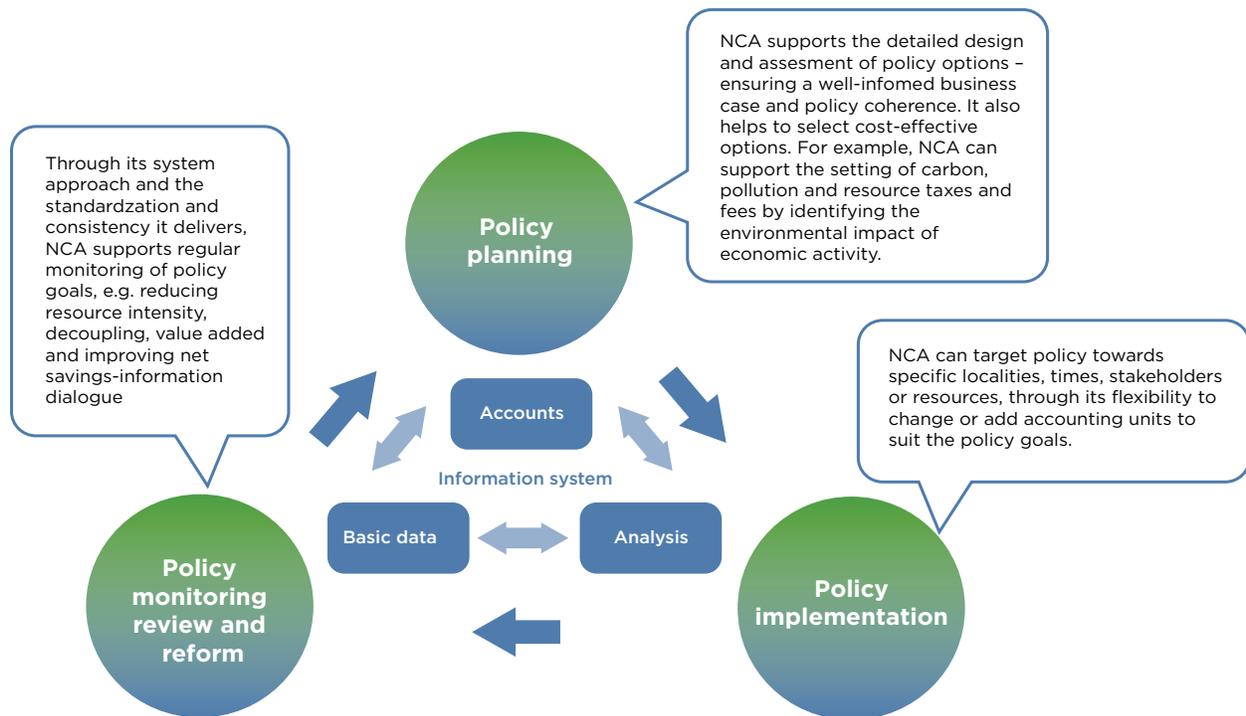
Adapted from Vardon et al. 2016.
NCA, natural capital accounting.

NCA is no more nor less challenging or time-consuming to embed than SNA has been. To accelerate progress, dedicated efforts are needed to build accounts, develop tools for account use, and increase capacity. The multiyear WAVES program was designed to meet these needs and to help countries realize, as far as possible, the full range of benefits of NCA. Box 2.1 presents six key benefits of NCA that participants in the first WAVES NCA policy forum in 2016 jointly identified.[2]

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2   Vardon M., S. Bass, S. Ahlroth, and A. Ruijs. 2017. Forum on Natural Capital Accounting for Better Policy Decisions. Taking Stock and Moving Forward. WAVES Partnership, World Bank, Washington, DC.

Box 2.1 • Key Benefits of Natural Capital Accounting (NCA)

The first NCA policy forum in December 2016 produced a consensus on the value of NCA, determining that it

- provides systematic, structured, integrated information using a framework, the System of Environmental-Economic Accounting, which is consistent with the System of National Accounts (SNA), offering a holistic, integrated view of the economy and the environment.

- because of being consistent with the SNA, can be readily used in models and tools regularly employed in economic policies, complementing the analysis with information on environmental impacts

- adds value by integrating existing information and offering it to policy makers regularly and consistently.

- can support decisions in policy agendas spanning economy and environment, as well as multiple sectors, such as green growth, climate change, and the Sustainable Development Goals.

- can be scaled up and down and aggregated in various ways to support different levels of policy making.

- promotes openness and transparency.

2.2. Introducing the WAVES program

The WAVES concept was initially presented at the 2010 conference of the parties to the Convention on Biological Diversity in Nagoya, Japan. The governments of Colombia and the Philippines joined the World Bank as the founding partners, with Botswana, Costa Rica, and Madagascar joining the following year. From the outset, the WAVES strategy was ambitious. It included:

- ▶ working through statistical offices and ministries of finance and development to develop and use wealth accounts (including natural, produced, and human capital).

- ▶ embedding accounts in national governance frameworks and not simply producing one-off accounts.

- ▶ scaling up efforts so that a critical mass of countries would use NCA to address critical policy questions and development priorities. This consisted of adding three further core implementing countries, along with a range of communication, global, and regional networking, and technical assistance activities.

The World Bank correctly anticipated a general trend in favor of NCA, and 2012 saw many developments in which WAVES became strategically well positioned. The SEEA was adopted, and WAVES committed to implement it. Natural capital approaches gained traction at the Rio+20 conference, helped by the World Bank launching a campaign to attract political endorsement of NCA implementation, which gained the commitment of more than 70 countries. Ten African countries committed to NCA through the 2012 Gaborone Declaration on Sustainability in Africa. Moreover, WAVES attracted funding commitments in 2012, allowing the program to start that year.

After a high-level ministerial dialogue on NCA at the 2013 World Bank spring meetings, demand for WAVES support grew further still, and Guatemala, Indonesia, and Rwanda joined in 2014.

2.2.1. WAVES country programs

The core of the WAVES program was its country programs, which focused on supporting efforts of core implementing countries in Africa, Asia, and Latin America to implement NCA (concentrating on the environment-related aspects of the more comprehensive wealth accounting included in the program's title). This focus was in response to country demands; for several governments, NCA was a more practical approach than full wealth accounting. Most projects that development agencies supported consisted of expert-driven technical work performed by consultants over a relatively short time span and little time for embedding the work in country institutions and policy making. The core implementing country modality was an entirely new concept: a 4-year engagement working closely with government agencies to develop and use natural capital accounts. The programs were demand driven, focused on identifying policy needs of the country and prioritizing accounts that could help address these needs, coupled with intense capacity building and strong communication.

In each country, WAVES used the World Bank's leverage to engage key ministries with wide policy mandates, such as ministries of planning and finance, and central banks, to ensure that there would be uptake outside the statistical and environmental communities. The core implementing country model included setting up a national steering committee headed by one of these central ministries and hiring a local country coordinator, ideally a former high-level government employee, who would ensure continued engagement and collaboration of the ministries and agencies involved. Stakeholder consultations were held to identify policy priorities and design a work plan. Then technical working groups were formed with government staff from the relevant agencies who were trained and worked together with international and national experts to produce accounts for water, land, forest, agriculture, fisheries, ecosystems, minerals, energy, waste, and other natural capital. Meanwhile, the program was socialized by developing communication products such as policy briefs, videos, and blogs, as well as through stakeholder consultations at key points in the program. Dissemination and meetings with policy analysis units in the ministries involved were undertaken throughout to ensure uptake when the accounts became available. Table 2.1 summarizes the themes for which countries developed natural capital accounts. Some accounts have already been produced as a second or even third iteration. The thematic accounts are further explored in chapters 3 to 6.

Table 2.1 • Natural Capital Accounts Produced

Country	Agriculture	Energy	Forest	Greenhouse gas emissions	Land	Minerals	Water	Ecosystem	Macroeconomic indicators
Botswana		■				■			■
Colombia		■	■	■			■	■	
Costa Rica		■		■	■	■	■	■	
Guatemala	■	■		■	■	■	■		■
Indonesia		■			■	■	■	■ (completed)	
Madagascar			■ (partial)			■ (partial)	■ (partial)		
Philippines						■	■	■	■
Rwanda			■		■	■	■	■	

Notes: The dark-shaded cells indicate accounts that have been completed. Light-shaded cells indicate partly completed accounts.

The initial basis of the WAVES program was a strong technical training component in which agencies in partnership countries were linked to other statisticians experienced in NCA for long time periods. As part of this, many people received training in NCA. Some of this was in workshops, but much consisted of on-the-job training, in which participants learned about the details and challenges of accounting by constructing accounts. This component was, as planned, time consuming, because accounting is demanding work, requiring many choices and assumptions, but it also provided a foundation for the many achievements of the WAVES program. Participating institutions came to embrace accounting and created capacities to continue the work without WAVES participation. Such investments may not pay off immediately but are mid- to long-term investments that should prove themselves in the years to come.

WAVES supported in-country use of these accounts in such things as modeling and scenario analysis, which variously informed national and sector plans, land management, climate strategies, fiscal reform, and SDG monitoring. Natural capital data were incorporated into national accounts to reveal how economic activity and the environment interact. Table 2.5 provides a full overview of the decisions that the natural capital accounts developed in the WAVES countries have directly or indirectly affected and the analyses for which they were an essential input. These decisions are discussed in more detail in chapters 3 to 6.

2.2.2. WAVES regional and global work

Given increasing interest in NCA beyond its core implementing countries, WAVES also played catalytic roles within the regions in which it also operated national programs: strengthening understanding and capacity of strategically placed stakeholders to apply NCA to critical policy needs, sharing experiences and lessons between countries, and improving communication and cooperation. This often linked "graduated" countries with others. For example, Botswana, Colombia, Costa Rica, and the Philippines—the original WAVES countries—acted as regional mentors after the end of their WAVES programs, advising other countries in their regions. Seminars and training courses were held on common regional topics and experiences, aiming for a multiplier effect, although the resources available for WAVES regional work were relatively limited.

WAVES global work—WAVES aimed to support adoption of policy-relevant NCA by promoting application of the international standard SEEA. It also enriched SEEA by improving ecosystem accounting methodologies. WAVES supported a ground-breaking global analysis of the significance of natural capital alongside other forms of capital in 141 countries; the *Changing Wealth of Nations* (CWON) assessment revealed how natural capital makes up nearly half of the wealth of low-income countries. WAVES' global work in training and communications promoted understanding of, commitment to, and best use of NCA through a variety of knowledge products, including case studies and briefing papers, and by curating the WAVES partnership website.[3] Moreover, an NCA community of practice has evolved through annual WAVES partnership meetings (eight to date), which are important venues where partner countries can share experiences and network and learn from experts working in the NCA space from developing and developed countries. Since 2016, the annual global Forum on NCA for Better Policy Decisions has been organized (four to date), with the objective of sharing experiences among high-, medium-, and low-income countries on building and using NCA. The forum has included a wide range of countries brought in by co-organizers such as UNSD, the Ministry of Foreign Affairs of the Netherlands, and the Capitals Coalition.

WAVES operated as a diverse global partnership, comprising several UN agencies, governments, civil society and business organizations, and donors. Key partners included UNSD, UN Environment Programme, UN Development Programme, governments of the core implementing countries, and several centers of excellence. Some of these were also part of the initial Policy and Technical Expert Committee (PTEC) of the WAVES partnership. France, Japan, Norway, the United Kingdom, Denmark, Switzerland, and the Netherlands funded WAVES work. Australia and the Netherlands also provided extensive technical support, funded by their ministries of foreign affairs.

2.3. Main results

The first five countries, Botswana, Colombia, Costa Rica, Madagascar, and the Philippines, signed up in 2012 and finalized their programs in 2016. The second group of countries, Guatemala, Indonesia, and Rwanda started their programs in 2014 and finalized in 2019. Seven of these countries have fully institutionalized NCA since WAVES support ended. They have set up special units and coordination procedures, with standing capacity and data-sharing arrangements, and are accounting regularly and applying the data to routine development planning processes and key policy decisions. Madagascar developed water accounts and some simplified accounts for forests and minerals. For several reasons, including poor data availability and political unrest, the accounts were not officially published, and no institutionalization took place at the time. They have therefore not been included in further discussion in this report.

WAVES closed in December 2019, disbursing close to 100 percent of the USD23 million that donors provided, 58 percent of which was allocated to national or regional work (Table 2.2). WAVES funding informed World Bank operations of considerable size. In Colombia, the WAVES program was a key input to preparation of the Second Sustainable Development and Green Growth Development Policy Loan of USD500 million. The WAVES program in Guatemala informed the dialogue that led to the design of Probosque, an incentive program that transfers payments of about USD15 million annually for 30 years (USD450 million total). The amount is 1 percent of the

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3   https://www.wavespartnership.org/

country's budget and is its biggest environment-related investment program. In Rwanda's Urban Development Project II, the achievements of the WAVES program informed USD150 million. In total, USD4.5 million leveraged USD1,100 million in World Bank projects.

Table 2.2 • WAVES Financial Data (US$ Million) According to Activity Type

Activity Type	Allocation	Disbursement	Disbursement rate	Share of total disbursement
	(USD million)			%
National	12.72	12.71	99.94	55
Regional	0.75	0.75	100.00	3
Global	5.76	5.76	99.99	25
Other	3.79	3.79	100.00	16
WAVES inception activities	1.92	1.92	100.00	8
Program management and administration	1.87	1.87	100.00	8
Total	23.02	23.01	99.97	100

More detailed information on activities supported by the program can be found in Appendix B and C.

The results framework for WAVES comprises 12 indicators intended to capture the program's national and global outcomes and outputs. Most of the targets were met or exceeded. By the time of its closing, the program achieved an overall rate of accomplishment of 96 percent, with a peak of 99 percent at the national level. In all countries, policy analysis using NCA was disseminated, and steering committees were established. All countries but one published natural capital accounts for at least two sectors. Capacity building resulted in 220 government employees being skilled in NCA and its uses, on average 28 per country. In total, 45 key policy documents in the eight countries referenced NCA. There were 1,175 project beneficiaries—people attending workshops, events, and trainings and being informed of what NCA could bring to their work. By the time of its closing, the program achieved an overall rate of accomplishment of 96 percent, with peaks of 99 percent at the national level. The full results framework is provided in Appendix B.

In this report, the achievements are analyzed in relation to four key building blocks that are essential for achieving sustainable development:[4]

1. **Information:** data, accounts, time series, and analysis leading to greater knowledge and understanding

2. **Tools and capacities:** methodology development, communication, instruments, mechanisms, funding, and training, plus associated skills

3. **Institutions:** organizations, coordination, cooperation, collaboration, and policy-making processes (including monitoring)

4. **Decisions:** a wide range of decisions resulting from the above at the national, subnational,

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4   *The analytical framework draws on a 2018/19 peer learning exercise involving Organisation for Economic Co-operation and Development's De-velopment Assistance Committee donors on integrating the environment into development processes (OECD DAC 2019 forthcoming[[if it was 2019, it can't be "forthcoming"]]) that concluded that there is no inherent hierarchy among the building blocks. If even one of the building blocks is weak, sustainable development may be severely compromised, although depending upon country context, one or more building blocks may be more important to address.*

and sectoral levels; in the theme chapters, they are categorized according to three stages of the policy-making process: planning; implementation; and monitoring, review, and reform—see Tables 2.3 and 2.5 and Tables in the theme chapters.

The program's main contributions to each of the building blocks are summarized in Table 2.3.

Table 2.3 • Overview of Key Achievements of the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Partnership

Area	Country results	Global results
Information on natural capital	• 9 types of natural capital accounts covering the 8 WAVES countries plus new WAVES+ countries; more than 30 accounts produced • More than 130 in-country WAVES publications explaining significance of natural capital in sector, local, or national economies	• Changing Wealth of Nations outlines wealth accounts for 141 countries • Around 40 WAVES policy briefs and 3 global NCA policy forum proceedings extending information on NCA and its use
Tools and capacities	• Technical working groups established for nearly every account developed • New jobs and trained staff to operate the NCA system and to interpret and communicate NCA in all countries • More than 200 people undertaking WAVES training and awareness courses in all participating countries	• System of Environmental-Economic Accounting Experimental Ecosystem Accounting improved methodology • Forest accounting methodology • WAVES Knowledge Center—a global knowledge platform on NCA containing more than 500 publications, news articles, and presentations • 10 principles for policy-fit NCA developed through global consensus in NCA policy forum • Knowledge exchange and South–South cooperation (global network of account producers)
Institutions	• NCA national steering committees in all participating countries enable and stimulate cooperation between stakeholders • All participating countries have embedded NCA (e.g., through establishing NCA units and other capabilities)	• Partnership meeting convened annually from 2011 to 2018 • NCA policy forum met 4 times since 2016, offering a new event for global learning and exchange • Effective partnership between World Bank, UN Statistics Division, UN Environment Programme, London Group on Environmental Accounting

Area	Country results	Global results
Decisions made	• 33 national or sectoral development plans informed by NCA (e.g., for water, energy, forest, land development plans) • 9 new policy instruments or investments agreed upon or under review (e.g., payments for ecosystem services, licensing, taxation, pricing) • 10 policies monitored, reviewed, or reformed based on information in accounts	• Uses and potential uses of accounts in decision making catalogued in publications after NCA policy forum • Toolkit for using NCA being developed for World Bank Environmental and Social Framework use in lending operations

2.3.1. Production of Natural Capital Accounts

The clearest achievement of the WAVES program is new information available from the natural capital accounts, which has enabled more evidence-based decision making. WAVES supported production of 32 accounts across seven domains, with forest, land, and water accounting for close to half of the total (Table 2.4).

Table 2.4 • Accounts supported by the WAVES program

Country[a]	Ecosystems	Energy	Forest	Land	Minerals	Other[b]	Water	Total
Botswana		1			1	1	1	4
Colombia	1	1	1	1		1	1	6
Costa Rica	1	1	1	1			1	5
Guatemala		1		1		2	1	5
Indonesia	1			1			1	3
Philippines	1				1	1	1	4
Rwanda	1		1	1	1		1	5
Total	**5**	**4**	**3**	**5**	**3**	**5**	**7**	**32**

(a) Madagascar was also a WAVES core implementing country. Although intermediate and advanced technical reports have been delivered on water, forests, minerals, and macroeconomic indicators, these have not been turned into final products ready for publication, reflecting challenges related to the political situation, limited capacity in relevant government agencies, and the overall weakness of the statistical system (e.g., Madagascar has not had a general census of the population for more than 20 years). Because only partial results have been obtained, data for Madagascar are not included in this Table.

(b) Includes macroeconomic indicators.

The accounts consolidated data that were previously unavailable, outdated, scattered over multiple institutions, or based on different concepts and measurement methods. The accounts provided participating ministries and institutes with

▶ new and coherent information that allowed them to pinpoint the causes of problems and to find new solutions

▶ common ground, providing one trustworthy source of information used by all

▶ a time series that allowed them to monitor changes in resource availability and trends in resource use by economic sector

In several countries, the accounting information was used as input to more sophisticated analysis and modeling. By linking with other natural capital accounts and the SNA, the relationship between the use of different natural resources, resource availability, and the larger economy could be shown and a suite of indicators proposed. For instance, the Rwandese government used the information and lessons learned from the accounts to reformulate its water development plan, setting targets for the water-related SDGs.

2.3.2. Use and usefulness of NCA

The WAVES program has provided proof that a program whose core is developing data and information can contribute to decision making, provide important lessons about user engagement, and capture use stories, which have been shared throughout the program in policy briefs, reports, and the annual NCA policy forums. Many are included in the thematic chapters. The uses of NCA developed under the WAVES program are summarized in Table 2.5.

As described in section 2.1, NCA has several advantages over other statistics or ad hoc data. Its key feature is that it uses the same framework and classifications as SNA, enhancing the ability to perform joint environmental–economic analyses. Environmental statistics are typically tailored to the needs of the sector and environmental concerns, but it is not possible to link this information to macroeconomic information on value added, returns to capital, employment, and investments. Thus, analyses of how environmental policies affect economic actors, or how economic policies affect the environment, are difficult to perform. Comprehensive wealth indicators also respond to the call for going "beyond GDP," providing high-level macroeconomic indicators that include human and natural capital, but this is not the only purpose of having natural capital accounts. The other crucial feature of NCA is that it provides accessible, quality-proofed data. Developing NCA is not a quick fix, but over time, you will have access to time series of high-quality data that are regularly produced, publicly accessible, officially endorsed, and recognized by relevant stakeholders. This is a significant advantage over having to re-create data and studies when need arises. Countries often do not accept data from ad hoc studies, and such data are less accessible than official data. In addition, having access to data that are officially agreed upon provides a significant advantage; stakeholders often develop data for their own needs that may not be compatible with information from other stakeholders, making cross-sectoral discussions challenging. There have been many testaments that having a high-profile product like NCA significantly increases the visibility of challenges involving natural capital. Table 2.5 includes all instances for which the NCA produced have been used, highlighting various ways that NCA can be used—not only analyses and decisions for which it is necessary to have NCA, but also examples of instances for which it can be useful if it is readily available.

The uses have been categorized according to which phase of the policy cycle they belong to:

1. **Planning:** Formulation and adoption of national, subnational, and sectoral development plans, strategies, action plans, etc.

2. **Implementation:** Approval by the legislative or executive branches of government of laws, by-laws, regulations, etc. that determine allocation of financial or human resources to undertake activities identified at the policy planning stage

3. **Monitoring, review, and reform:** Activities conducted by or on behalf of government bodies to monitor and assess the effects of polices and evaluate the need for modifications

Table 2.5 • Use of Natural Capital Accounting (NCA) for Decisions Contributing to Sustainable Development at Various Stages of the Policy-Making Process

Country	Planning	Implementation	Monitoring, review, and reform
Botswana	• All: informed National Development Plan 2017-2022; National Strategy for Sustainable Development; National Vision 2036. • Water accounts: used for water reforms as part of the National Water Master Plan and to agree on covenants with the mines to encourage efficient water use. Informed revision of National Water Master Plan, Master Plan for Wastewater and Sanitation, and 2013 Integrated Water Resources Management Plan. • Mineral accounts: used to predict changes in fiscal returns from mining and to inform new Economic Recovery Plan.	• Water accounts: improved water distribution and water use prices for mining industry, considering water scarcity and cost recovery. Reduced water distribution losses of water utilities, increased wastewater use, and improved irrigation and distribution systems.	• Water accounts: used to monitor treated effluent and non-fresh water by mines and monitor competition over water resources between mines and settlements.
Colombia	• Forest accounts: input for REDD+ plans and analysis of costs from forest fires caused by El Niño. • Water accounts: provided supporting information for Integrated Water Resource Management Policy and Lake Toto water management policies. Information being incorporated into models to regulate efficient, proper use of water and calculate impacts of a PES scheme. • Diverse accounts: information from accounts used to calculate avoided costs of environmental damage through conflict during the peace process. NCA as an instrument included in National Development Plan 2014-2018.	• Water accounts for Chinchina river watershed influenced allocation of extra budget for wastewater management.	• Diverse accounts: measurement and monitoring of Green Growth policy based on multiple indicators following from the accounts. Green Growth National Strategy focuses on reduction of deforestation and GHG emissions and strengthening of climate change adaptation.

Country	Planning	Implementation	Monitoring, review, and reform
Costa Rica	• All accounts: integration of environmental objectives and NCA data into National Development Plan. • Water and energy accounts: supported Power Generation Expansion Plan as part of National Energy Plan 2015-2030, which affects technology and infrastructure investment and cost recovery strategies. • Forest accounts: incorporated into REDD+-strategy as part of National Plan for Forest Development 2011-2020. • Water accounts: included in National Plan for Integrated Management of Water Resources.	• Forest accounts: information from these accounts has contributed to design of national PES program. • Water accounts: policy guidelines on better stocktaking, control, monitoring, and management of water bodies. New water law under consideration to ensure sustainable use of water resources and oblige government to use economic accounting of water resources as tool for policy making.	• Energy accounts: used as monitoring tool for energy use patterns, productivity, sustainability, and decarbonization.
Guatemala	• Forest accounts: forest section of National Development Plan K'atun: Our Guatemala 2032 built on findings of accounts. National Strategy for Production and Use of Fuelwood related to new public–private strategy for sustainable production and use of natural resources, including firewood and soils. Includes policy measures and incentive systems for forest protection, forest recovery, reforestation, and 20,000 direct and 60,000 indirect jobs in the future. • Multiple accounts: accounts served as basis for modeling fuelwood use and impacts of sanitation on development using Integrated Economic-Environmental Modeling compuTable general equilibrium model.	• Uses and potential uses of accounts in decision making catalogued in publications after NCA policy forum • Toolkit for using NCA being developed for World Bank Environmental and Social Framework use in lending operations	

Country	Planning	Implementation	Monitoring, review, and reform
Indonesia	• Mineral, land, and ecosystem accounts: analysis of impact of easing export ban on semi processed minerals on environment and economy. • Diverse accounts: information used for analyses underlying Vision Indonesia 2045 and Low Carbon Development Initiative, which are included in current 5-year development plan 2019-2024. Low Carbon Development Indonesia plan highlights renewable energy investments required to reach Indonesia's climate targets. Ministry of National Development Planning uses asset accounts to model growth limits and economic capacities and develop green economy scenarios in a system dynamics model. • Energy accounts: played a role in designing policies to reach GHG reduction targets set in nationally determined contribution to Paris Agreement. • Peatland accounts: helped make stronger case for peatland restoration initiatives and affected moratorium on oil palm plantations on peatlands.	• Forest and land accounts: used to adapt pricing for timber and mineral, identify pilots for carbon finance programs and PES schemes and for its REDD+ program.	
Philippines	• Ecosystem services accounts: integration of ecosystem services modeling and assessment in process of forest use planning. Used for National Greening Program; Integrated Area Development, Risk Resilience, and Sustainability Program; Green Climate Fund; People Survival Fund; and comprehensive land use plans of local governments. Provided inputs into technical bulletin on Carbon Accounting, Verification and Certification System Incorporation of ecosystem approaches in Forest Land Use Planning process. • Forest accounts served as input into carbon accounting. • Ecosystem accounting in South Palawan region showed importance of mangrove protection and replanting and helped set priority areas for mangrove protection.	• Soil erosion control and flood control accounts in Laguna Lake basin were basis for developing scorecard for local governments. • Local ecosystem, fisheries, and water accounts: implementation of Laguna Lake Watershed Greening Program.	• Ecosystem and land accounts: estimates of resource rent for fisheries used to revise licensing and permit fees for aquaculture in Laguna Lake basin. • Ecosystem and water accounts: informing review of environmental compliance certificates and conduct of environmental impact assessments and in the proposed revision of the EIA Law. • Mineral accounts: information from these accounts helps shape fiscal regime, budget reforms, and potential benefit-sharing arrangements with indigenous peoples resulting from mining. • Ecosystem accounts prompted review of issuance of permits for new oil palm plantations.

Country	Planning	Implementation	Monitoring, review, and reform
Rwanda	• Land accounts: used in plans to increase climate resilience and forest investments. As part of its Vision2020 plan, Rwanda partners with Climate Investment Fund. • Water accounts: used for national water sector plan and water development plan, which focus on Sustainable Development Goals.	• Water accounts: data and analysis from accounts prompted government to set up a National Water Board. Data also used to monitor water-related Sustainable Development Goals and serve as input into analyses of financial mechanisms, PES, and water-use fees. • Land and water accounts: provided input into investment plans to safeguard energy security, for large-scale landscape protection investments, to maintain dam capacity, and to increase capacity of water utilities.	• Land, ecosystem, and water accounts: used to revise Land Use Master Plan and State of the Environment Report. • Land and ecosystem accounts: incorporation of information into revision of National Land Use Development Master Plan and Land Administration Information System.

Note: Madagascar was signed up as a core implementing country and developed accounts for water, but for several reasons did not use them during the program period and is therefore not discussed in this report.

GHG, greenhouse gas; REDD+, Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks; PES, payments for ecosystem services.

3

3. LAND AND ECOSYSTEM ACCOUNTS

3.1. Introduction

Land is a unique environmental asset on which human activities and environmental processes take place and environmental assets and economic assets are located. As such, land is needed for virtually all productive activity by industry, for housing, for conservation of biodiversity, and for the supply of ecosystem services.

Land can be analyzed in many ways, and as such, land and ecosystem accounts are prepared from several points of view. From a geographic point of view, accounts are compiled for the country as a whole, as well as for administrative regions (e.g., state or local government boundaries) or biogeographic regions (based on biophysical characteristics such as ecosystem type, biodiversity, and topography (e.g., mountains, plains)). From an economic viewpoint, accounting can be done according to sector (e.g., agriculture, forestry, conservation) and zoning for different activities (e.g., residential, industrial, transport corridors, recreation). Land accounting provides the launching pad for ecosystem accounting, including biodiversity accounting, which makes possible more comprehensive assessments of the trade-offs between competing land uses and their impact or reliance on ecosystem services. The geographic dimension that land accounts provide is vital for planning and monitoring purposes because many natural resource and environment issues are local or regional in nature.

This chapter examines why land and ecosystem accounts were useful in WAVES countries, how these accounts were set up, and how they have been used and ends with reflections on how the lessons learned from accounting for land and ecosystems can be applied. We aim to demonstrate how land and ecosystem accounts have been and can be used to prepare policies or plans to manage land, ecosystems, and biodiversity and to investigate what might happen if there were changes to the use of land (e.g., from forestry to conservation). Box 3.1 provides some background on land and ecosystem accounting.

> **Box 3.1** • Land and Ecosystem Accounting According to the System of Environmental-Economic Accounting (SEEA) Framework
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>
> - Land accounts are described in the SEEA Central Framework 20125 and in the SEEA Experimental Ecosystem Accounting (EEA).6 Land accounts are usually asset accounts, showing the area of land according to land cover and land use, with land use defined according to the industries using it. Land accounts can also be prepared as part of implementation of SEEA-EEA, showing how ecosystem condition, ecosystem services, and the biodiversity of the different types of land cover are outlined.
>
> - The land accounts show the different types of land cover and how and in which sectors they are used. The SEEA defines a series of land cover types, including forest, grassland, cropland, mangroves, bare earth, and sparse vegetation. From these different types of land cover, a variety of ecosystem services may be obtained, for example, food provisioning, water and air filtration, flood mitigation, carbon sequestration, and cultural and recreational services. The biodiversity, and in particular the species, found in each type of land cover can also be shown in an accounting format.
>
> - Integrating biophysical and economic data on land enables managers to, for instance, develop and monitor policies and plans related to agricultural production, forestry, urban planning, and protection of biodiversity. The accounts can also support a number of indicators related to the Sustainable Development Goals (SDGs), in particular SDG 15 (protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss). Also relevant is SDG 7 (sustainable energy from fuelwood) and reduction of climate change threats.
>
> - Ecosystem accounts add information regarding the extent, condition, and capacity of different ecosystems in a country. Ecosystems can consist of the same classes of land cover as land cover accounts, in which case ecosystem extent accounts and land cover accounts will be identical or can have land cover classes subdivided according to more specific characteristics. In addition, supply and use of provisioning, regulating, and cultural services of the ecosystems can be measured and monetized. Although provisioning services may be straightforward to measure, estimating regulating services typically requires use of biophysical models.

3.2. Why compile land and ecosystem accounts?

Land is a key policy priority—Countries produce land or ecosystem accounts for a variety of reasons, ranging from national planning to local management of areas and their natural resources. A major reason that WAVES partnership countries choose to develop land accounts is the growing interest in ecosystem accounting and the fact that land accounts are the basis of ecosystem accounts for ecosystem condition, ecosystem services, and biodiversity.

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5   https://seea.un.org/content/seea-central-framework

6   https://seea.un.org/sites/seea.un.org/files/seea_eea_final_en_1.pdf

Identify synergies and trade-offs between land uses—A key reason for choosing to produce land and ecosystem accounts is the importance of land management in maintaining the integrity of ecosystems, biodiversity, forests, and water resources. For example, changes in land cover from forest to cropland can result in downstream problems with water quality and loss of biodiversity. Hence, management of land, forest, ecosystem biodiversity, and water often go together. Accounts in Colombia, Guatemala, and the Philippines specifically examined the relationships between water, land, and forest management using a combination of forest, water, land, and ecosystem accounts along with information in the SNA.

Identify the contribution in physical and monetary terms of non-marketed services from ecosystems—Ecosystem accounts can provide information about physical services and the value to the economy of these services, for example, storm protection services that mangroves offer to the communities behind them in the South Palawan region of the Philippines. Loss of mangroves increases the risk of damage from storms. As such, the ecosystem accounts helped estimate the economic benefit of clearing mangroves for housing and compare it with other ways of protecting the coastline and its economic value. Similarly, they showed synergies of protecting mangroves for multiple ecosystem services in addition to storm protection, such as flood protection, spawning grounds for fisheries, water purification, and shelter for wildlife.

Box 3.2 • Rwanda: Support from Land Accounts for Sustainable Development Planning

The Rwandese land account report clearly describes why land accounts were among the first accounts developed in Rwanda: "*In Rwanda, land is the basis for agriculture and rural livelihoods, but it faces pressures from population growth, the need for jobs, and rapid urbanization, as well as vulnerability to changes in climate, weather extremes and rainfall patterns. Land Accounts can add value in sustainable development planning by providing indicators and trend analysis to track performance targets for sustainability, land allocation, service delivery, and productivity. Land accounts can help to clarify and compare economic values generated by land in competing uses and how changes in land use may affect land asset value. When integrated with other sectoral data, land accounts can also provide insights about potential effects on water use and food production. NCA can also contribute to accounTable governance by increasing the quality, credibility, and consistency of the statistics and analyses that support national development plans and targets.*"[7]

3.3. Which land and ecosystem accounts were compiled and by whom?

Nearly all countries in the WAVES partnership produced land or ecosystem accounts (Colombia, Costa Rica, Guatemala, Indonesia, the Philippines, Rwanda) (Table 3.1). WAVES+ countries Uganda and Zambia have also produced land accounts. Accounts have been produced at national and subnational levels. For example, Colombia, Indonesia, the Philippines, and Uganda have all produced

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7   Government of Rwanda (NISR, Ministry of Environment and Ministry of Lands and Forestry), Natural Capital Accounts for Land, March 2018. Page vii.

land accounts at a subnational level for particular watersheds or areas (e.g., for provinces), and these are often the basis for ecosystem accounts (e.g., in Colombia, Indonesia, and the Philippines). Rwanda and Guatemala produced national land and ecosystem accounts. Not all these accounts are publicly available yet. Some of the accounts shown in Table 3.1 are discussed in other chapters of this report (e.g., the accounts for Laguna Lake in the Philippines and Chinchina in Colombia are examined in chapter 3 on water).

Table 3.1: Overview of Land and Ecosystem Accounts Produced by Wealth Accounting and the Valuation of Ecosystem Services countries

Country	Physical land cover	Physical land use	Ecosystem accounts*	Other related accounts
Colombia[8][9][10]	Yes	Yes	Chinchina, Lake Tota, ecosystem services[11]	Water and forest accounts
Costa Rica[12]	Yes	Yes	Yes	Water and forest accounts
Guatemala[13]	Yes		Yes	Water, forest, and agriculture accounts
Indonesia[14][15]	Yes		Peatland[16]	
Philippines			South Palawan,[17] Laguna Lake,[18] mangroves	
Rwanda[19]	Yes	Yes	Yes	Land value

*All ecosystem accounts except for Rwanda are on a regional or local scale

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8   https://www.dane.gov.co/index.php/estadisticas-por-tema/ambientales/cuenta-satelite-ambiental-csa

9   WAVES Country Report 2016

10   Land Asset Account http://www.dane.gov.co/files/investigaciones/pib/ambientales/PI_Ctas_ambientales_con-sideraciones_mtd_y_aprox_prel_cuenta_act_para_colombia.pdf

11   See experimental ecosystem account 2013-14 https://www.dane.gov.co/index.php/estadisticas-por-tema/ambi-entales/cuenta-satelite-ambiental-csa#cuenta-experimental-de-ecosistemas

12   Included in the forest accounts https://www.bccr.fi.cr/seccion-cuentas-ambientales/cuentas-ambientales

13   Towards Natural Capital Accounting in Guatemala: Synthesis Report. May 2019.

14   Pilot Land and Extent Account Sumatera & Kalimantan https://www.wavespartnership.org/sites/waves/files/documents/01_Land%20and%20%20Extent%20Account%20%20Sumatra%20%26%20Kalimantan%20dev%208_CMYK_low.pdf

15   Indonesia Synthesis Report https://www.wavespartnership.org/sites/waves/files/documents/03_Synthesis%20Report%20Dev%203_CMYK_low.pdf

16   Peatland Accounts for Sumatra and Kalimantan https://www.wavespartnership.org/sites/waves/files/docu-ments/02_Peatland%20Account%20Dev%204_CMYK_low.pdf

17   Pilot Ecosystem Account for Southern Palawan https://www.wavespartnership.org/en/knowledge-center/pi-lot-ecosystem-account-southern-palawan

18   Pilot Ecosystem Account for Laguna Lake Basin https://www.wavespartnership.org/en/knowledge-center/pi-lot-ecosystem-account-laguna-de-bay-basin

19   Rwanda Natural Capital Accounts—Land https://www.wavespartnership.org/en/knowledge-center/rwanda-natu-ral-capital-accounts-land

Concepts and methods—Land accounts are described in the SEEA Central Framework (CF). As shown in Table 3.1, WAVES countries produced asset accounts showing different land cover and land accounts showing different land uses according to area (e.g., measured in hectares) and how this changes overtime due to human or natural changes. The supply and use of land is not captured in a supply and use Table because the area of land in countries is essentially fixed, although small amounts of land can be added via land creation in coastal areas or can be lost to sea level change. Usually, the land accounts were related to other supply and use Tables; for example, Guatemala related them to the water, agricultural, and forest accounts, and Colombia used the land accounts as the basis for its ecosystem accounts; countries also used the SEEA Experimental Ecosystem Accounting (EEA) framework, mainly to show the links between types of land cover and supply of ecosystem services (e.g., water filtration). These were modeled using tools such as InVest[20] and ARIES.[21] In the future, land and ecosystem accounts may be used as a base for biodiversity accounting.

Land use data were obtained using remote sensing—A major challenge in each of the WAVES partnership countries was obtaining the data necessary for land and ecosystem accounts. A wide variety of agencies in each country held data on land, and a range of data on land cover was available from international sources. Countries generally produced land cover accounts from remotely sensed data available from international agencies. Such data were used in Colombia, Costa Rica, Guatemala, Indonesia, the Philippines, Rwanda, Uganda, and Zambia. Although the international data sources were (and remain) imperfect, they allowed countries to generate a basic set of maps and land accounts in physical terms (e.g., hectares of different land cover types). These basic accounts were compared with national and subnational data sources and updated as necessary. The ecosystem services were then modeled using geographic data underpinning the land accounts.

The SNA is a key data source related to land accounts in all countries—Agriculture and forestry are two key industries in many countries' economies, and each of these industries requires land. In some countries, much production and use of agricultural and forest products is by households and in the informal sector. This production can often be missed in the SNA even though it is theoretically in scope. Some countries identified the "informal sector" in the accounts, as was the case in Zambia in the forest accounts.

Need for geographic information specialists and modeling expertise in developing land accounts and ecosystem accounts—Countries used different institutional approaches to compiling land and ecosystem accounts. In most countries, the agencies responsible for land cover data took the lead in account development, primarily because production of land and ecosystem accounts requires geographic information systems and the expertise needed to operate such systems, which is not usually available in national statistical offices or the central banks that traditionally produce national and environmental accounts. Ecosystem supply and use accounts for regulating ecosystem services also requires using biophysical models to estimate the services. In Guatemala, Rwanda, and the Philippines, academic institutions were involved in production, especially to model and generate estimates of ecosystem services.

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20   https://www.usgs.gov/software/invest-18-different-models-ecosystem-services
21   http://aries.integratedmodelling.org/

3.4. Achievements

The land and ecosystem accounts of the WAVES partnership countries were used in a variety of ways. Below, some specific examples for Indonesia, the Philippines, and Rwanda illustrate these achievements. These examples are discussed according to the key building blocks that have been essential for achieving sustainable development: information, capacities and tools, institutions, and policy use and decisions made.

3.4.1. Information

Land accounts provide reliable, agreed-upon data across institutions and countries—The clearest achievement is that the land accounts showed policy-relevant information about speed and locations of land use and land cover changes that were in several cases different from what was generally perceived. The accounts provided new information about and insights into the environmental, economic, and social importance of the land and the ecosystems on the land and enabled linkage of physical and monetary information on land resources.

Box 3.3 • Indonesia: Regional Differences in Land Cover Change

The land accounts for Indonesia consolidated a range of data to provide a variety of interesting information. Forests declined significantly, with about 22 million hectares of natural forest lost between 1990 and 2014. The highest rate of change took place from 1996 to 2000, when 9 million hectares of natural forest was converted to other land covers (an average rate of 2.2 million hectares/year). The rate of change in forest cover decreased significantly after 2010. Perennial crop area, currently dominated by oil palm plantations, expanded by 6 million hectares from 1990 to 2014, largely at the expense of forests. Different island groups had different patterns of land cover change. The largest conversion of forests took place in Sumatra, where about 8.9 million hectares was lost, closely followed by Kalimantan, where 8.3 million hectares was lost. The decrease in forests was largely due to transformation from natural forest to plantation forests (e.g., acacia) and perennial crops (e.g., oil palm).

Map B3.3.1 • Land Cover in Indonesia, 1990 and 2014
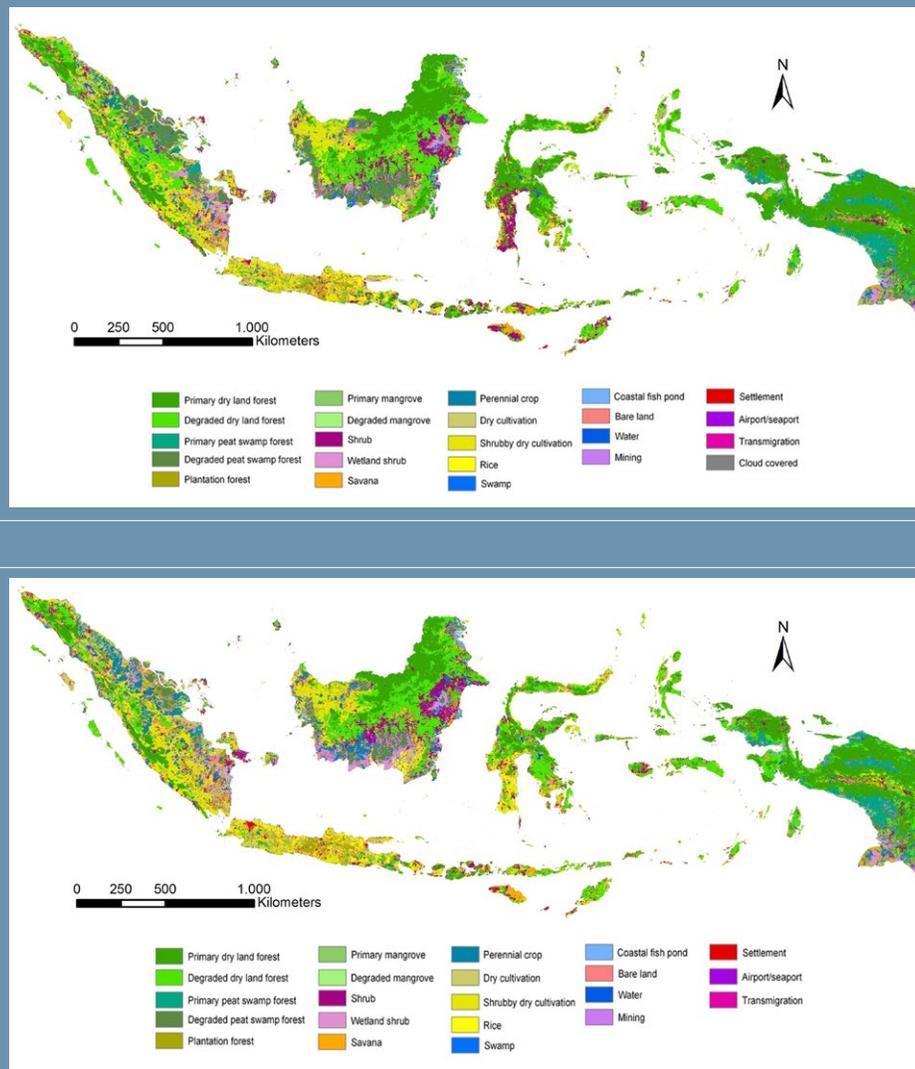
Sources: Map from p. 26 of 2018 WAVES Annual report

Land accounts form the basis for development of ecosystem accounts—Several countries developed ecosystem supply and use accounts for a variety of ecosystem services, including provisioning and regulating services. Coverage was national in some cases, such as in Rwanda, and local in some cases, such as for specific watersheds, such as in Colombia, or key areas of interest, such as Laguna Lake in the Philippines. Ecosystem extent accounts were developed on a national scale for the Philippines, providing detailed information on how ecosystem coverage has changed over time. Building ecosystem service accounts in most cases required a modeling exercise—using data from the accounts and using the accounts to verify the modeling results. The strength of the ecosystem accounts is that they consolidate data from different disciplines that are in many cases unknown to policy makers or are not used in a format they are familiar with. The interlinkages show that decisions they make have broader impacts—on multiple ecosystem services and on wider scales than usually considered.

Box 3.4 • Impacts of Land Cover Changes in Rwanda

Ecosystem accounts in Rwanda focused on landscape processes that influence soil erosion and loss and water flows and run-off, which affect economically important ecosystem services, including water availability (particularly in the dry season), flood risk reduction, soil fertility, and sedimentation avoidance. These ecosystem services, in turn, support hydropower production, provision of irrigation and drinking water, and agricultural production.

The team used the InVest model to estimate carbon storage, sediment regulation, and water yield for 1990, 2000, and 2010. Ecosystem services were mapped (e.g., water yield, map B.3.4.1), and the results showed the impacts of land cover changes, with many ecosystem services declining from 1990 to 2000 and rebounding, to some extent, from 2000 to 2010. Preliminary results for 2015 indicate a decline in ecosystem services, driven largely by forest loss. Patterns differ across the country depending on key landscape features (e.g., climate, land cover, elevation, soils, vegetation). This can be seen in map B.3.2.2, which shows that the potential for soil erosion is much lower in the forested eastern part of the country, despite high annual water yields. Quick flow has increased in Rwanda by 35 percent over the last 25 years, increasing flooding, sedimentation, and landslides.

Source: Rwanda Ecosystems Accounts 1990–2015
(https://www.wavespartnership.org/en/knowledge-center/rwanda-ecosystems-accounts-1990-2015)

Map B3.4.1 • Water Yield in Rwanda, 2015   **Map B3.4.2 •** Soil Erosion in Rwanda, 2015
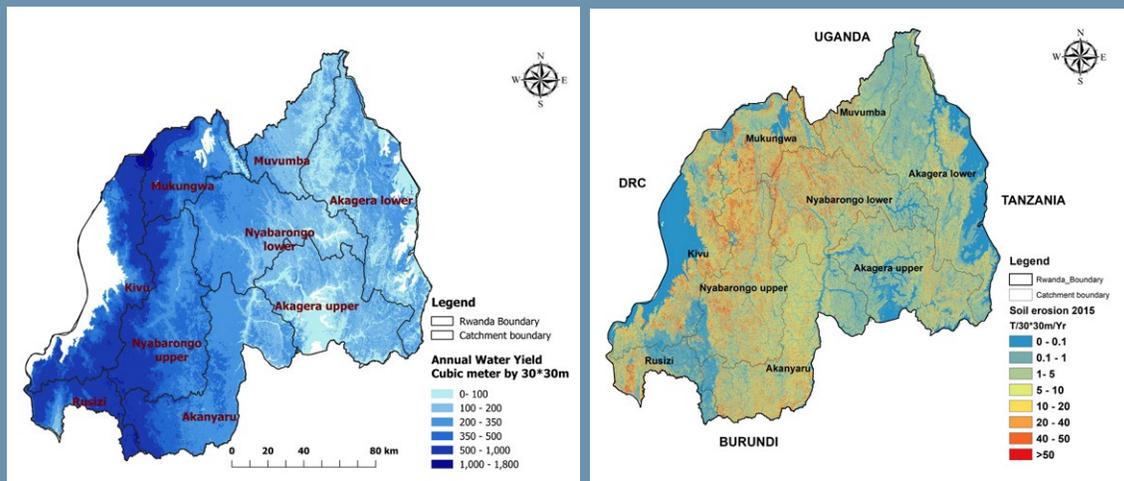
Source: Rwanda Natural Capital Accounts—Ecosystems (2019), Figure 8 Annual Water Yield in 2015, p.28, and Figure 7, Estimated soil erosions 2015, p. 26.

Ecosystem accounts provide information about the economic value of land use changes— In addition to showing the physical impacts of land use changes, the accounts are useful for estimating monetary impacts. For instance, monetary valuation techniques can be used to estimate the flooding damage that mangrove protection prevents or the impacts of soil erosion or water quality deterioration on people's income.

Box 3.5 • Philippines: Coastal Protection from Mangroves

Significant areas of mangroves have been lost in recent decades in the Palawan region of the Philippines, and the government realized that this had significantly increased coastal risk. The mangrove ecosystem accounts demonstrated that mangroves significantly reduce risks from flooding,[22] which was communicated to decision makers in presentations and a policy briefing.[23] The report was prepared using high-resolution flood models and compared flooding scenarios with and without mangroves under different storm conditions to estimate annual expected benefits of mangroves for protecting people and property. Specifically, the report compared people and property flooded under three different scenarios: mangrove cover existing in 1950, mangrove cover existing in 2010, and no mangrove cover.

Key findings from the report included:

- If all mangroves in the Philippines were lost, an additional 613,000 people, many of whom live in poverty, would be flooded annually. Damage to residential and industrial property would increase 28 percent, to more than USD1 billion annually.

- On average, 1 hectare of mangroves in the Philippines provides more than USD3,200/year of direct flood reduction benefits. Restoring the mangroves lost between 1950 and 2010 would bring more than USD450 million/year in flood protection benefits.

- For more catastrophic events, such as a 1-in-25-year storm, mangroves would provide more than USD1.6 billion in averted damages throughout the Philippines.

Figure B3.5.1 • Expected Impact of Flooding on People and Property with and Without Mangrove Protection The Palawan Region
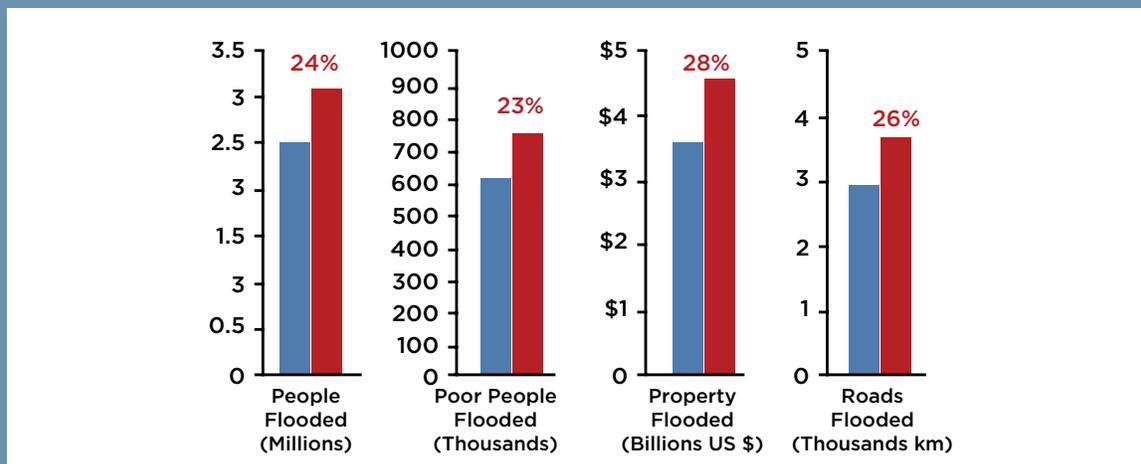
22   Losada, I.J., M. Beck, P. Menendez, A. Espejo, S. Torres, P. Diaz-Simal, F. Fernandez, S. Abad, N. Ripoll, J. Garcia, S. Narayan, D. Trespalacios, A. Quiroz. 2017. Valuing Protective Services of Mangroves in the Philippines: Technical Report. World Bank, Washington, DC.

23   Policy Brief: Valuing the Protection Services of Mangroves in the Philippines

3.4.2. Capacities and tools

Technical training as a core component of the WAVES partnership—Technical training on land or ecosystem accounts took place in all core implementing countries, and a global knowledge exchange on ecosystem accounting including representatives from all WAVES partner countries was organized in the Philippines in 2015. Four international experts on ecosystem accounting developed and conducted the training, which was highly interactive, involved a number of group exercises, and included sessions on land accounting as the basis for ecosystem accounts.

Existing NCA systems strengthened and expanded—Capacity building for land and ecosystem accounting was undertaken in all countries except Botswana (which determined that land accounts were not a priority). In addition to support from the World Bank WAVES team and other international partners, countries usually had support from national statistics organizations from high-income countries. For example, Statistics Netherlands assisted Rwanda, and the Australian Bureau of Statistics assisted Indonesia, with a focus on improving its environmental economic accounting system (Integrated System of Environmental and Economic Accounts (SISNERLING)), developing macroeconomic sustainability indicators, and applying economic resource valuation. Special attention was paid to improving data collection and data quality management and experts reviewed all countries' land and ecosystem accounts using processes that the WAVES partnership established. Training was also provided to government officials from statistical and other agencies, with the latter asked to participate so that they could appreciate how to apply the accounts to policies and decision making. The approach of involving people from multiple agencies and disciplines fostered collaboration and created synergies across the government in all WAVES partnership countries.

Core to the WAVES partnership was that, as much as possible, the statistical agencies, ministries, or central banks, and not external consultants, developed the accounts. This may have taken more time but has resulted in greater capacity to repeat account construction. Maybe more importantly, it increased ownership by the institutes themselves and helped them appreciate how the accounts provided new insights and helped policy-making processes. In several WAVES countries, this resulted in dedicated NCA units.

Box 3.6 • Land Accounts influencing Use of Land Administration Register in Rwanda

Rwanda's land accounts have influenced its Land Administration Information System (LAIS), in terms of its data structure and how land valuation data are captured. The accounts demonstrated the value of LAIS as a tool for analyzing conditions and trends, not just for tracking ownership, as it had been used previously. Land use definitions and classifications are being revised to reflect better understanding of land use, and new fields are being added to allow for more precise capture of land use data and of the type of development on the land. The information in LAIS is used in conjunction with land cover and land use accounts to monitor and review land use and to monitor reclassification of land and possible impacts on productivity and efficiency of land use.

The Rwandese government is using the land cover accounts together with LAIS in its review of the National Land Use Development Master Plan, with a focus on areas where land use and land cover are changing rapidly.[24] The master plan uses land use and land cover change data from the accounts to determine areas for emphasis in the planning process and uses the ecosystem services modeling results.

3.4.3. Institutions

NCA stimulated institutional coordination—Production of the accounts consolidated a large amount of existing information and provided a reason for agencies to cooperate. This was especially important for ecosystem accounting because it addressed topics that were unfamiliar to many statistical agencies and central banks. As a result, institutional coordination for better land and ecosystem management has been advanced. Large land-using industries, such as agriculture and forestry, and the government agencies responsible for them, have coordinated with the agencies responsible for biodiversity conservation, finance and planning, and statistics. Agencies have worked together to identify existing data, share knowledge, and develop plans to fill information gaps. Establishment of technical working groups on account production was an important feature of the process. Some examples of the types of institutional development are outlined in the Boxes below.

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24   WAVES Annual Report 2018 https://www.wavespartnership.org/sites/waves/files/kc/WAVES-Annual-Report-2018-web_0.pdf

Box 3.7 • Account Development and Institutional Cooperation in the Philippines

Development of land and ecosystem accounts in the Philippines revealed that different agencies used different databases and were not always aware of the information in other departments or agencies. In numerous cases, new land titles were issued in the Pulot watershed where the slopes were too steep for agricultural activities, possibly because the land agency was not sufficiently aware of the topography. Cooperation between various agencies to prepare the accounts has resulted in stronger ties between these agencies in the Philippines and elsewhere.

The Laguna Lake Development Authority (LLDA) chose to compile a range of related accounts, which allowed them to approach the Laguna Lake problems from an integrated perspective. This was a successful approach. The accounts provided useful inputs to the new policy plans to improve the dire situation of Laguna Lake. Two institutional developments are worth mentioning.

First, to develop the Laguna Lake fisheries accounts, new data had to be collected because the agencies responsible for agricultural and fisheries data did not collect fisheries data covering the entire lake. The LLDA, jointly with the Philippine Statistics Authority (PSA), developed two new fisheries surveys—for aquaculture operators and for fisherfolk. As a result, the LLDA, PSA, and Bureau of Fisheries and Aquatic Resources jointly established a partnership to collect information and prepared a joint procedure for data collection. Moreover, the LLDA created a unit to manage the fisheries accounts and coordinate them with the Bureau of Fisheries and Aquatic Resources and PSA.

Second, already during the project, important steps were taken to mainstream accounting in the participating institutions. In joint workshops in 2015 and 2017, data-sharing protocols were discussed, and guidelines were developed for standardizing accounting and valuation approaches.[25] Moreover, the Department of Environment and Natural Resources' budget was restructured to be in line with the new environmental goals. A roadmap was developed on how the department would work with natural capital accounting (NCA), as well as which agencies they would collaborate with. To ensure staff capacity, the PSA started providing System of Environmental-Economic Accounting training to staff members working in sectoral agencies, which resulted in a continuing process to develop and refine the natural capital accounts first prepared under the umbrella of the Wealth Accounting and the Valuation of Ecosystem Services partnership. PSA also created an NCA unit with nine positions under the national accounts.

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25   See e.g., https://www.wavespartnership.org/en/what-does-it-mean-%E2%80%9Cinstitutional-ize%E2%80%9D-natural-capital-accounting and https://www.wavespartnership.org/en/philippines-holds-nation-al-conference-natural-capital-accounting.

Box 3.8 • Rwanda: Natural Capital Accounting (NCA) in Government Agencies and Academic Curriculum

The government of Rwanda is investing in an institutional structure to carry NCA work forward. The state Minister for Economic Planning has been appointed as the focal point for NCA, and the macroeconomic unit of the Ministry of Finance, together with the National Accounts Division of the National Institute of Statistics for Rwanda, are the key entities responsible for NCA. The University of Rwanda is building NCA into its curriculum, building an Environmental Economics and NCA program to train the next generation of economists and planners. National Institute of Statistics for Rwanda surveys are being expanded to allow better recording of water and land use information by industrial sectors, which will improve NCA efforts going forward.

3.4.4. Policy use and decisions

The accounts influenced a broad range of decisions. Table 3.2 shows which decisions the land and ecosystem accounts influenced. They are categorized into the three types of decisions discussed earlier: policy planning; policy implementation; and policy monitoring, review, and reform. Many more policy impacts are possible.

Specific country examples are discussed in more detail below. Some of the achievements that included land and ecosystem accounts are discussed in some of the other theme chapters because the three thematic chapters on land, water, and forests overlap to a large degree, particularly in ecosystem accounting.

Policy planning—The land and ecosystem accounts have influenced numerous development plans. Because land accounts are in many cases the basis for forest and water accounts, the land accounts affect more than just land use planning policies. As the example from Indonesia shows, the exact influence from the accounts in the final policy plans is not always easy to identify. The insights and data are combined with information from many other sources to formulate new policy and development plans.

Box 3.9 • Inputs from Land and Ecosystem Accounts to Low-Carbon Development Indonesia Program

The Indonesian land accounts were used to identify areas for pilot projects and to shape monitoring systems for carbon finance programs, payment for ecosystem services, and other research. For example, the land accounts are used in the system dynamics model of the Ministry of National Development Planning, which was used for the Low Carbon Development Indonesia program (see chapter 5). The model has been set up with feedback representation for demographics and labor, welfare (poverty), the macro-economy, climate and carbon emissions, energy systems, and other components for carrying capacity, including water resources, oceans and fisheries, use of forests (including peatlands), and biodiversity.

In several countries, the land and ecosystem accounts provided essential input for soil erosion, deforestation, land conversion, and water management policies. The accounts were useful for assessing the suitability of land use changes and the expected trade-offs, for instance for water availability and soil erosion.

Box 3.10 • Ecosystem Accounts for the Laguna Lake Region and Policy Instruments in the Philippines

The ecosystem condition accounts, particularly water quality and sedimentation, are contributing to the review of the issuance of environmental compliance certificates, the conduct of environmental impact assessments, and the proposed revision of the environmental impact assessment law.

The ecosystem service accounts on soil erosion control and flood control in the Laguna Lake basin are being used to develop a scorecard for local government units.

The ecosystem service accounts on fisheries, particularly on the estimates of resource rent, are being considered in revising the licensing and permit fees for aquaculture in the Laguna Lake basin.

Map B3.10.1 • Sediment loading by sub-watershed
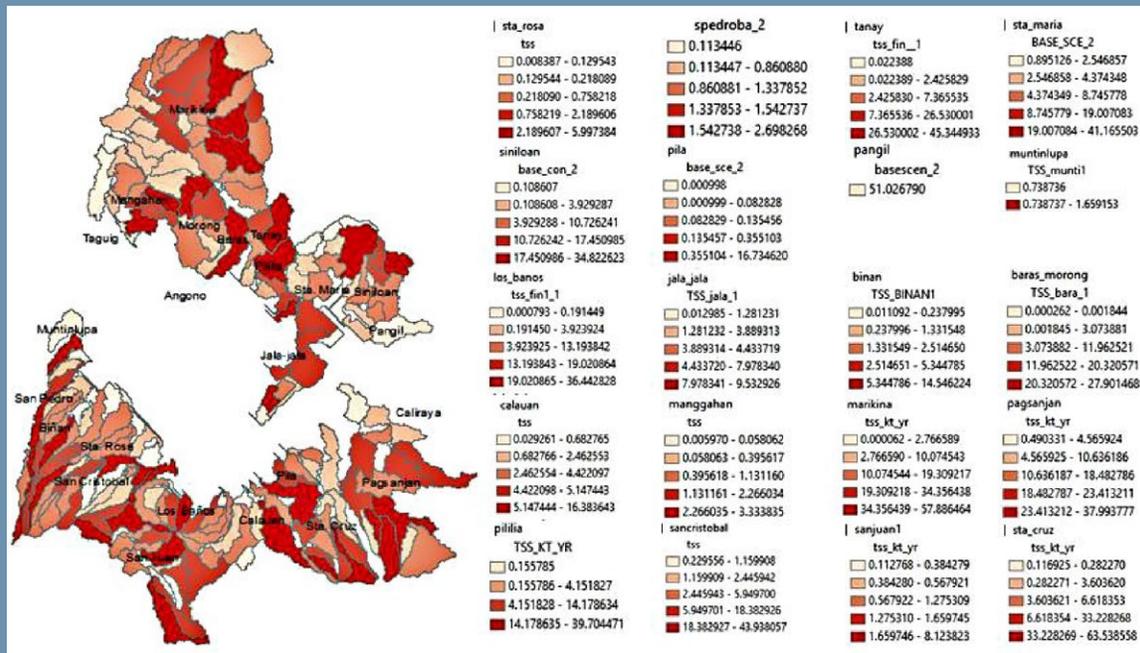
Source: Pilot Ecosystem Account for Laguna de Bay Basin

Map B3.10.2 • Potential cost of damage from floods
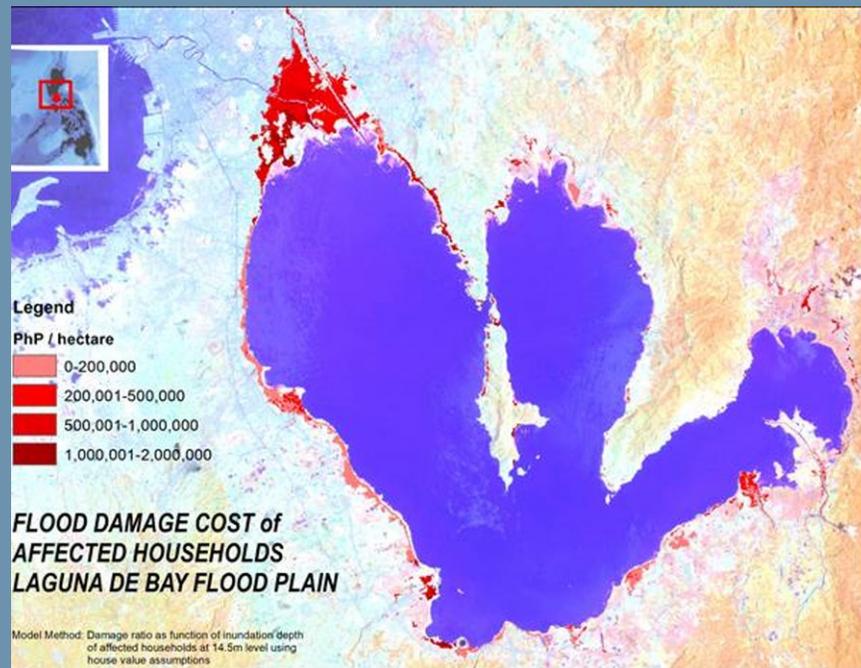
Box 3.11 • Ecosystem Accounts for Peatlands and Expansion of Oil Palm Plantations in Indonesia

The land accounts for Indonesia were useful for national and provincial geographic planning and for ecosystem accounting. The land accounts have strengthened the geographic data in Indonesia's national natural capital account (Integrated System of Environmental and Economic Accounts) and were used to compile accounts for ecosystem extent and ecosystem services of areas and thematic accounts for carbon and biodiversity. Peatland accounts have helped make a case for stronger government action on peat preservation and restoration, showing that the peatland area of Indonesia was much larger than expected and that, given the moratorium on oil palm plantations on peatlands, had direct consequences for plans to expand oil palm plantations into peatlands. The challenge now is to ensure that the data developed at a national level reach provincial and local authorities.

Policy monitoring, review, and reform—The examples below show that the accounts have affected existing land policies. For instance, authorities in Rwanda (Box 3.6) and the Philippines saw that the accounts provided essential new information to improve their land administration system or make the oil palm permit system more evidence based (Box 3.12).

Box 3.12 • Ecosystem Account Results and Oil Palm Permit Issuances in the Philippines

In the Philippines, significant trade-offs in land and resource management were shown in the ecosystem accounts for South Palawan. The dramatic decline in forest cover, coral reefs, mangroves, and seagrass was due to a range of human activities, in particular conversion of forest to oil palm and coconut plantations. Such conversion was done to increase economic benefits, but many farmers in the Pulot watershed complained that they earned less from oil palm than they would have from other uses of the land and about equal to that received from growing rain-fed rice. The resource rent calculation in the ecosystem accounts showed that the rent was negative, which supported this claim and prompted a review of the issuance of permits for new oil palm plantations.

Table 3.2 • Use of Land and Ecosystem Accounts at Various Stages of Policy Making

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform
Colombia	• Information from accounts has been used to calculate avoided costs of environmental damage through conflict during the peace process. • NCA as an instrument has been included in the National Development Plan 2014-2018.	• Water accounts for the Chinchina river watershed were used to allocate extra funds for wastewater management.	• Measurement and monitoring of Green Growth policy based on multiple indicators following from the natural capital accounts. The Green Growth National Strategy focuses on reducing deforestation and greenhouse gas emissions and increasing climate change adaptation.
Costa Rica	• Integration of environmental objectives into National Development Plan.	• Information from forest accounts has contributed to design of national payment for environmental services program.	
Guatemala	• Forest section of National Development Plan K'atun: Our Guatemala 2032 was built on findings of the forest accounts. • National Strategy for Production and Use of Fuelwood is related to a new public-private strategy for sustainable production and use of natural resources, including firewood and soil. • Multiple accounts served as basis for modeling fuelwood use and impacts of sanitation on development using the Integrated Economic-Environmental Modeling compuTable general equilibrium model.		

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform
Indonesia	• Ministry of National Development Planning used information from the forest and land accounts for its REDD+ program. • Mineral, land, and ecosystem accounts were used to analyze impact of easing export ban on semi processed minerals on the environment and the economy. • Information from diverse accounts was used for the analyses underlying Vision Indonesia 2045 and the Low Carbon Development Initiative, which are included in the current 5-year development plan 2019-2024. • Peatland accounts have strengthened the case for peatland restoration initiatives and affected the moratorium on oil palm plantations on peatlands. • Ministry of National Development Planning used several asset accounts to model growth limits and economic capacities and developed green economy scenarios in a system dynamics model. • Land accounts helped identify pilots for carbon finance programs and payments for ecosystem services schemes.	• Forest and land accounts were used to adapt pricing for timber and minerals.	
Philippines	• Ecosystem services accounts were used to integrate ecosystem services modeling and assessment in the process of forest use planning. Results were used for National Greening Program; Integrated Area Development, Risk Resilience, and Sustainability Program; Green Climate Fund; People Survival Fund; and comprehensive land use plans of local governments. • Ecosystem accounting in South Palawan region revealed importance of mangrove protection and replanting and helped determine priority areas for mangrove protection.	• Soil erosion control and flood control accounts in Laguna Lake basin were basis for developing a scorecard for local governments. • Local ecosystem, fishery, and water accounts were used to implement Laguna Lake Watershed Greening Program.	• Ecosystem and water accounts informed review of environmental compliance certificates, conduct of environmental impact assessment, and proposed revision of environmental impact assessment law. • Ecosystem accounts prompted review of issuance of permits for new oil palm plantations.

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform
Rwanda	• Land accounts used in plans to increase climate resilience and forest investments. As part of its Vision2020 plan, Rwanda partners with the Climate Investment Fund.		• Land, ecosystem, and water accounts were used to revise Land Use Master Plan and State of the Environment Report. • Land and ecosystem accounts were used to incorporate information into revision of National Land Use Development Master Plan and Land Administration Information System.

3.5. Reflection—lessons from WAVES support to land and ecosystem accounting

We end this chapter with a few reflections about the compilation, institutionalization, and use of the accounts for policy. The WAVES partnership has achieved a lot, and much more can be achieved. Key lessons on land and ecosystem accounting are the need to:

▶ **Build confidence in the accounts:** Land cover accounts can be produced relatively quickly from a combination of local expertise in geographic information, international data sources on land cover, and training in accounting concepts and methods. This is shown explicitly in the rapid development of land accounts in the countries that have more recently joined the WAVES partnership, Uganda and Zambia, where draft accounts were available around a year after work began on their production.[26] Such rapid progress is important for building confidence in the teams producing the accounts in countries and ensuring that account users and senior government officials can see progress and react to the information provided.

▶ **Ensure availability of expertise needed for land and ecosystem accounting:** Rapid progress in land account production requires good institutional arrangements and allocation of appropriate staff to the task. The technical working groups recognized the need for a range of expertise, spanning geographic information, accounting, economics, land management, and the large land-using sectors—agriculture, forestry, and conservation. Land accounts are often developed as the first stage of ecosystem accounting and are a foundation for these accounts and an achievable stepping-stone to help countries develop capacity, as well as providing a useful intermediate product. Developing and using land and ecosystem accounts requires geographic information systems and the expertise to use them. This expertise is often available to a limited extent in many of the participating statistical agencies and ministries. For many ecosystem services, knowledge of biophysical modeling is also necessary. This expertise is usually scarce within government, so academic institutions have often been involved. The WAVES partnership has invested in this expertise, but it is important that it be maintained.

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26 UNEP-WCMC. 2017. Experimental Ecosystem Accounts for Uganda 2017 https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/445/original/Ecosystem_Accounting_in_Uganda_Report_FINAL.pdf?1494865089

▶ **Access and consolidate data across agencies:** Lack of data is a key barrier to account production. International data sources can overcome national-level shortcomings, but national-level data will ultimately be needed to increase the accuracy and usefulness of the accounts in decision making. In addition, using national data and involving government authorities in producing the accounts is crucial for generating trust in the results of the accounts by producers and users of the accounts

▶ **Include biodiversity:** Although many countries produced ecosystem accounts that can provide an indication of biodiversity at the ecosystem level, none produced species-level accounts. Biodiversity accounting is a new area, with few examples globally and limited international guidance. Going forward, countries will need global and national data sources and must keep in mind the potential uses of such accounts in the National Biodiversity Strategy and Action Plans and refining existing or developing new strategies to conserve biodiversity[27].

▶ **Ecosystem accounts for developing payments for ecosystem services (PES) schemes:** Ecosystem condition accounts and ecosystem services accounts provide geographically distinct values that can be readily used to inform PES schemes in several parts of the policy cycle (geographic prioritization, monitoring and enforcement). This was not done under the WAVES program, but under its successors WAVES+ and GPS, ecosystem accounts are used for this purpose in several projects.

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27   Ruijs, A., and M. Vardon. 2019. Natural Capital Accounting for Mainstreaming Biodiversity in Public Policy. In M. Vardon, S. Bass, and S. Ahlroth., eds. 2019. Natural Capital Accounting for Better Policy Decisions: Climate Change and Biodiversity. Proceedings and Highlights of the 3rd Forum on Natural Capital Accounting for Better Policy Decisions. World Bank WAVES, Washington D.C. https://www.wavespartnership.org/en/knowledge-center/natural-capital-accounting-better-policy-decisions-climate-change-and-biodiversity

4

4.   WATER ACCOUNTS

4.1. Introduction

Water is a key natural resource, and several countries are seeing increasing competition over water because of inefficient management, increasing rainfall variability, and growing demand. Countries are faced with water shortages, resulting in loss of economic opportunities, which affect the most vulnerable groups in society the most.

Many countries already collect data on their water resources but lack a full picture of their stocks of water resources, water use, and water quality. Water data are often scattered over multiple institutes, do not cover the entire country, or are only available for particular periods. They often do not cover all types of water and water uses and hence cannot be used to systematically analyze the importance of water for society and the economy. The WAVES program has shown that water accounts are critical in providing this picture.

This chapter examines how water accounts have helped WAVES partnership countries. Some countries focused on national water management systems, whereas others concentrated first on regional water problems. This chapter first explains why so many WAVES partnership countries have embraced water accounts and how the accounts were compiled and discusses results that have been achieved.

4.2. Why compile water accounts?

Water is a policy priority—Natural capital accounts for water are among the most popular accounts in the WAVES partnership countries. Colombia, Costa Rica, Guatemala, Rwanda, Botswana, and Zambia have produced water accounts on a national level. Indonesia, Colombia, and the Philippines have produced them on a subnational level for particular watersheds or areas. For these countries, the work of the WAVES partnership was timely, supporting their ambitions to manage their water resources to contribute to long-term economic growth and poverty alleviation. In a demand-led process, participating institutions and ministries in each country identified water as one of their priority policy problems and as a critical resource for economic development and livelihoods. The water accounts would provide them with new, detailed information about water sources, availability, users, and economic importance. Box 4.1 describes water accounting according to the SEEA-Water framework.

Box 4.1 • Water Accounting According to the System of Environmental-Economic Accounting
(SEEA)-Water Framework

Several specialized manuals, including SEEA-Water, have been developed as a complement to the SEEA Central Framework 2012. SEEA-Water describes in detail how to organize hydrological and economic information in a coherent framework to show the interactions between economic and hydrological systems.[28] SEEA-Water follows structures, definitions, and concepts similar to those of the System of National Accounts.

SEEA-Water contains more than 20 types of accounts that summarize economic and physical information about water. In addition to the physical supply and use Tables (PSUTs) and the asset account, there are accounts for emission of pollutants to water, water quality, expenditure on water protection and water management, and monetary supply and use Tables, corresponding to the physical flows. Combining hydrological and economic data on water enables water managers to, for instance, develop and monitor water policies and instruments, identify water stress at the country or river basin level, identify sources of pollution, and model how different policy options might change how water is used. Linkage to national accounts allows for water productivity indicators to be estimated and supports development of a number of indicators related to the Sustainable Development Goals (SDGs), in particular SDG 6, which addresses water stress and water productivity.

The most widely produced and used water accounts are the PSUTs and the physical asset accounts. PSUTs report use and supply of water for each economic sector. Water use Tables report how much water each economic sector uses. These uses are supplied by water abstraction from different sources of water—surface water (reservoirs, lakes, rivers), groundwater, soil water, rainfall, and sea water. They also show the water that certain economic units supply to other economic units, for example, irrigation authorities to farmers, and report flows of reused water and wastewater to sewage systems and return flows from economic sectors to the environment. Asset accounts report on different sources of water and show opening and closing stocks of water over a year. Additions to stocks depend on return flows, precipitation, and inflows from other territories and water sources. Water abstraction (evaporation and transpiration) and outflows to other territories or water sources reduce stocks.

Competing claims for scarce water resources—There is growing awareness that water is a scarce resource, with many competing uses, and needs to be managed well. In its scoping study, the government of Rwanda concluded that water distribution and future water scarcity are major challenges.[29] Botswana, being a water-scarce country, has water high on its political agenda and recognizes that there are increasingly competing claims over water resources.[30] Population and economic growth and impacts of climate change put pressure on water resources. The agricultural, energy, mining, and tourism sectors and the country's nature and biodiversity are expected to

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28   SEEA-Water Manual https://seea.un.org/content/seea-water

29   WAVES 2016, Rwanda Country Report 2015 https://www.wavespartnership.org/en/knowledge-center/waves-rwanda-country-report-2015.

30   WAVES 2015, Botswana Country Report 2014 https://www.wavespartnership.org/en/knowledge-center/waves-botswana-country-report-2014.

increasingly compete over limited water resources. Based on similar insights, Colombia needed better data to inform its Integrated Water Resources Management policy nationally and for specific regions and to provide efficient, regulated, adequate water concessions.[31] Generally, all WAVES partnership countries that have developed water accounts concluded that more knowledge was needed about their water resources; the accounts were useful for identifying information gaps.

Upstream impacts on the downstream water situation in the Philippines—Upstream water management practices substantially affect downstream water quality and water use opportunities. For the Philippine government, water quality problems in the Laguna Lake area are a critical challenge.[32] Located next to the capital of Manila, it is the largest lake in the country and experiences severe water quality problems due to untreated sewerage discharges, toxic emissions, extensive use of fertilizers and pesticides, uncontrolled aquaculture, and saltwater intrusion. Moreover, soil erosion has increased sedimentation, reducing the lake's flood control capacity, and increasing the likelihood of flooding. For an integrated development plan, the Laguna Lake Development Authority (LLDA) needed information about water use, discharges, and availability, as well as about the economic impacts of lake protection measures, so it developed subnational water and ecosystem accounts that clarified the sources of the problems and provided information needed to revise the management plans. The accounts also enabled the authority to convince other stakeholders of the need to manage the economic and ecological impacts of their plans.

4.3. Which water accounts were compiled and by whom?

Stronger focus on physical than monetary accounts—The WAVES partnership countries produced a broad range of water accounts (Table 4.1). Most countries focus on the physical supply and use Tables (PSUTs) and the asset accounts, which enable them to conduct additional analyses by relating sectoral water use data from PSUTs to sectoral employment data and contributions to GDP and by analyzing water use efficiency changes over time (see also section 3.4.1). A few countries developed monetary supply and use Tables, which require information about monetary flows related to water use and supply. Only a few countries have this information readily available because water supply companies are usually reluctant to share the information with account producers. Only a few countries developed the full suite of water accounts, including water quality and emissions (Table 4.1). Information on water quality may be available for important water bodies, but attributing emissions to actors is challenging, and data are typically scarce.

Several countries relate their core water accounts to other natural capital accounts. For instance, the Philippines combined insights from the PSUTs and asset accounts with water emission, water quality, and fisheries accounts, as well as estimates of flood protection services, resulting in an integrated view of problems in the Laguna Lake area.

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31 WAVES 2016, Colombia Country Report 2015 https://www.wavespartnership.org/en/knowledge-center/waves-colombia-country-report-2015.

32 WAVES 2016, Philippines Country Report 2015 https://www.wavespartnership.org/en/knowledge-center/waves-philippines-country-report-2015.

Table 4.1 • Overview of Water Accounts Produced by Wealth Accounting and the Valuation of Ecosystem Services Partnership Countries

Country	Physical land cover	Physical land use	Ecosystem accounts*	Other related accounts
Botswana[33][34]	Yes	For 5 reservoirs	2003-2011[a]	
Colombia[35]	Yes	Yes		Emission accounts
Costa Rica[36]	Yes	Yes	Yes	Statistics on pollution
Guatemala[37]	Yes			
Indonesia	Yes			
Philippines[38]	Yes (local)	Yes (local)		Water emissions Water quality Fish provisioning Flood mitigation
Rwanda[39]	Yes	Yes		Statistics on water use efficiency[b]

(a) Revenues and recurring expenditures of the Department of Water Affairs.
(b) Calculated by linking the water accounts to the System of National Accounts.

Varied institutional set-up for water accounts—Countries used different institutional approaches to compiling water accounts. National or subnational water management institutes developed the accounts in Botswana (Department of Water Affairs) and the Philippines (LLDA). In Colombia and Rwanda, developing the water accounts was a joint effort between the statistical agency (the National Institute of Statistics of Rwanda and the National Statistics Department in Colombia) and a resource or water institute. In Guatemala, the Instituto de Agricultura, Recursos Naturales y Ambiente–University Rafael Landívar led production, assisted by various government agencies and the water supply industry. In Rwanda, the Ministry of Environment was leading the work, collaborating with the Water and Sanitation Corporation and the University of Rwanda. In Colombia, the Institute of Hydrology, Meteorology, and Environmental Studies, the environmental research institute of Colombia that is linked to the Ministry of Environment and Sustainable Development, developed the accounts. To ensure policy application, the Colombian National Planning Department was appointed as focal point. Costa Rica followed a similar path. The Central Bank of Costa Rica was responsible for compilation of their accounts, but the Ministry of the Environment was the lead political agency. The position of the Central Bank within Costa Rica and the support they had from key ministries eased the data collection process.

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33   Republic of Botswana. 2016. Botswana Water Accounting Report 2014/2015. WAVES Partnership, Centre for Applied Research, MMEWR.

34   Republic of Botswana. 2017. Botswana Water Accounting Report 2015/2016. Department of Water Affairs, Ministry of Land Management, Water and Sanitation Services.

35   DANE, IDEAM. 2015. Hacia la construcción de la cuenta del agua a nivel nacional. Bogotá.[[Provide additional information]]

36   Banco Central de Costa Rica. 2016. Cuentas Agua, Banco Central de Costa Rica, WAVES. [[Provide additional information]]

37   See e.g., http://www.infoiarna.org.gt/nuestro-trabajo/cuentas-ambientales/

38   LLDA 2016. Pilot Ecosystem Account for Laguna de Bay Basin. https://www.wavespartnership.org/en/knowledge-center/pilot-ecosystem-account-laguna-de-bay-basin

39   Government of Rwanda. 2019. Rwanda Water Accounting 2012-2015. https://www.wavespartnership.org/en/knowledge-center/rwanda-water-accounting-report-2012-2015

Greater data coherence as a common goal—Obtaining the necessary data was a major challenge in each WAVES partnership countries, so it was important that the dedicated water or environmental institutes be involved in the partnership. In most countries, data are available but are scattered over multiple agencies and ministries; stored in various formats and systems using multiple indicators, classifications, and geographic allocations; and based on multiple data collection systems. Each agency has a partial water management mandate, and data quality differs between agencies. The result is that it is not easy to obtain a full picture of the status and trends of water resources. One of the core objectives—and main achievements—of the WAVES program was to increase data availability and data coherency in participating countries. As envisaged, organizing the process for collecting and storing data in coherent frameworks, improving data quality, and ensuring continued delivery of accounts was challenging and time consuming but turned out to be feasible. In all countries, high-level steering committees were helpful in formally organizing the mandates to obtain the required water data and to develop uniform classification schemes.

Box 4.2 • Overcoming Data Challenges in Botswana and the Philippines

In the Philippines, significant trade-offs in land and resource management were shown in the ecosystem In Botswana, the Department of Water Affairs developed a template that all major water users and data providers, such as the Water Utilities Corporation; the ministries of agriculture, mineral resources, water resources, and mines; the statistical agency; and water users such as mines, tourist companies, and construction agencies, must fill in regularly.[40.] Without the mandate from the steering committee, which the Ministry of Finance and Development Planning chaired, and the President supported, it would have been difficult to enforce this mandate.

In the Philippines, the annual fish survey of the Bureau of Fisheries and Aquatic Resources, which has been set up jointly with the Laguna Lake Development Authority and related ministries, contains questions related to the accounts, providing better data on the use of the lake.

4.4. Achievements

Water accounts in WAVES partnership countries have enabled numerous achievements. Several changes in water management practices are clearly visible and well established in participating institutions. Accounts have continued to be produced in Botswana, Colombia, and Costa Rica since the end of WAVES support. These countries underscore that the accounts can be used to their full potential when they are regularly produced and allow changes in water use and availability to be monitored and the accounting process to be embedded in the policy planning process. More achievements are expected in the coming years, given the plans and strategies that WAVES partnership countries have developed based on the accounting information, as evidenced in "Beyond WAVES Country Roadmaps for Botswana, Colombia and Costa Rica." These changes will help solve water-related challenges, which was why countries started with water accounting. The main achievements are briefly discussed below in terms of the basic building

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40   Republic of Botswana. 2016. Botswana Water Accounting Report 2014/2015. WAVES Partnership, Centre for Applied Research, MMEWR. [[Provide additional information]]

blocks for sustainable development: information, capacities and tools, institutions, and policy use and decisions made.

4.4.1. Information

Two of the core objectives of the WAVES program were to help countries adopt and implement accounts that are relevant for policies and to compile a body of experience. The Knowledge Center of the WAVES program proves that an impressive collection of policy-relevant information has been compiled that has found its way to policy makers. Three main achievements are worth mentioning.

Information for evidence-based decision making—The clearest achievement is the new information that follows from the accounts and that enables more evidence-based decision-making. In all countries, the accounts consolidated data about water availability and water use that was previously not readily available or was outdated or scattered over multiple institutions. The accounts provided coherent information that enabled participating institutions and ministries to substantiate claims over water availability and use, the main contributors to water challenges, and the urgency of water problems, allowing them to better pinpoint the causes of the problems and find new solutions.

Time series for monitoring trends—The time series of the water accounts were useful, for instance for monitoring changes in water availability, trends in water use according to economic sector, and changes in storage capacity of reservoirs and lakes. The coherency of data gathering and processing was especially important for increasing trust in the trends that the data illustrated, showing, for instance, rainfall patterns becoming more volatile, water quality levels deteriorating, or that some sectors were using increasing amounts of water. The trend information encouraged some participating ministries and institutions to prepare action plans or call for better water or land management.

Indicators and analysis—In several countries, the accounting information was an input to more sophisticated analysis and, via linking with other natural capital accounts and the SNA, a suite of indicators. By linking natural capital accounts, the relationship between water quality levels and fisheries or between soil degradation and sedimentation loads could be shown. By linking natural accounts to national accounts, water use efficiency differences between sectors, changes in water use efficiency over time, or relationships between population growth and water use became visible. Moreover, it showed how water use has changed as a function of economic growth—did we see absolute or relative decoupling? This new knowledge was summarized in many policy briefs that were discussed with the relevant ministries and that entered the policy procedures.

Box 4.3 • Water Accounts in Botswana: Water Losses and Opportunities for Water Reuse

After initial water supply and use accounts were established in 1993 and 2003, the government of Botswana again took up work on water stock and flow accounts with WAVES support.[41] Their water stock accounts showed annual changes in surface water stock for five water supply reservoirs caused by water inflow, abstractions, and evaporation. They showed that some reservoirs received insufficient inflows to support abstractions, leading to declining water levels and the need for water efficiency improvements by water users or for more dams.

Water flow accounts showed that water use increased by 33 percent between 1993 and 2012. Although total use increased, water use had somewhat decoupled from economic and population growth, both of which grew faster over the same period. Per capita water use decreased by 12 percent, and water productivity almost doubled over this period, but because more than half of water used is self-supplied and is used mainly for agriculture and mining, water management is a challenge for authorities. A related dilemma is that, on a macro level, agriculture is by far the largest water consumer, whereas its contribution to gross domestic product and formal employment are limited. The data also show that distributional challenges are significant because, in some localities and for some social groups, agriculture may be the highest-value land use, and in some parts of the country, livestock grazing is essentially the only viable use of the land.

Because of growing water use, it is likely that not every sector's demands can be met. The analysis also shows that water utilities can help address this problem by reducing their water losses in the distribution system; they lose about one-quarter of their water. Competition over scarce water resources can also be reduced by encouraging construction of wastewater plants. About 10 percent of used water is treated, but only 10 percent of this is reused. Particularly in agriculture and mining, reuse can be stimulated.

4.4.2. Capacities and tools

Objectives of the WAVES program were to establish a global platform for training and knowledge sharing, improve the ecosystem accounting methodology, and build international consensus around NCA. Many activities in or between WAVES partnership countries and participation in a broad range of international meetings have contributed to these objectives. Four achievements stand out.

Capacity to construct water accounts—The first, and clearest, achievement in all WAVES partnership countries is the increase in capacity to construct water accounts. The number of people with the knowledge to properly develop water accounts is limited. It requires specific knowledge of statistical processes and of hydrology and water economics that is usually found in several organizations and people. The statistical agencies or central banks responsible for the national

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41   Department of Water Affairs, Centre for Applied Research. 2012. Accounting for Water in Botswana. WAVES Technical Report. Department of Water Affairs, Centre for Applied Research, World Bank Group, Botswana.

accounts of most countries have only limited knowledge about the water system. Similarly, water management institutions in many cases lack the statistical or economic knowledge needed to develop and interpret water accounts. Translating the dynamic geographic and temporal interactions between the different types of water in a static, aggregated accounting framework requires that the specialists involved apply new concepts.

The training component of the WAVES program has helped water specialists and statisticians see the added value of the water accounts. Maybe one the largest added values is that water information can be presented to higher-level policy makers in an accounting format they are familiar with and that is in line with and linked to the economic information that is regularly presented to them. The underlying geographic and temporal data are critical in the policy process for more detailed policy analysis but may be less effective when quickly communicating the urgency and situation of the water system to decision makers.

The National Institute of Statistics of Rwanda, the Department of Water Affairs in Botswana, and the LLDA in the Philippines have set up dedicated units to maintain the (water) accounts, which is an indication that water accounting is here to stay.

> **Box 4.4 •** Training on Water Accounting in Several Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Countries
>
> Rwanda had a long-term relationship with Statistics Netherlands to develop its accounts. Statisticians from Statistics Netherlands held a number of trainings and workshops on natural capital accounting (NCA) in Rwanda and supported the Rwandese statistics agency and participating ministries in developing land and water accounts through in-country visits and remote support. The Netherlands also hosted a study trip for the Rwandese team, providing training and insights into how NCA has been produced and used in the Netherlands. Similarly, Botswana had a long-term relationship with the Australian Bureau of Statistics and the Australian National University. During visits, intensive workshops were organized to show how to compile water accounts, collect the required data, and learn about estimation methods and quality control. The data available were used to calculate initial accounts, and working programs were formulated and challenges resolved through regular meetings and discussions (face-to-face, by phone, and by email).
>
> These intensive relationships were useful for finding solutions to the data challenges encountered. The System of Environmental-Economic Accounting training manuals do not fully prepare account producers for the challenges encountered during the process. All countries had to find solutions for such things as missing data, diverging data collection methods, units used, and time periods covered. In addition, mandates for account production had to be arranged or surveys set up to ensure future data delivery for account production.

During these country missions, how accounting units could best be organized within the hosting organizations was also discussed. Which skills were needed, how many staff members had to do the work, and how could collaboration and data collection processes best be organized? This differed in each country but was key to ensuring that countries built the necessary capacity to continue working on the accounts beyond the WAVES program. Experience in Botswana, Colombia, Costa Rica, and the Philippines shows that countries continue building accounts without support from the World Bank or other participating institutions. It helps the countries if they have access to an international helpdesk for questions if new challenges emerge, such as what Statistics Netherlands has provided to Rwanda and other countries.

Strong communications with stakeholders—In all countries, much effort was put into sharing the results from the water accounts with broad groups of stakeholders. Policy briefs were written for ministries and related institutions, newspaper messages were written to inform stakeholders, and numerous meetings were organized to share the results and discuss the implications of the plans developed. In addition, many WAVES partnership countries stimulated international cooperation and assisted in water accounting initiatives in other countries. WAVES participants in Botswana trained colleagues in Zambia to develop water accounts. Through the Gabarone Declaration for Sustainability in Africa, specialists trained in Rwanda and Botswana could introduce water accounting to their colleagues in other Gabarone Declaration for Sustainability in Africa countries. A regional workshop in Costa Rica in 2014 allowed specialists in Costa Rica, Guatemala, and Colombia to train experts from six other Latin American countries to develop water accounts.

In the Philippines, the LLDA organized a series of dissemination meetings with representatives from the private sector, academia, fisherfolk, local government, indigenous people's organizations, and media. During these meetings, they discussed the results of the accounting studies and policy scenarios developed for the Laguna Lake watershed. Similarly, the Palawan Council for Sustainable Development organized stakeholder meetings for residents in the municipalities that the ecosystem accounts covered. The Department of Water Affairs in Botswana organized several meetings with stakeholders from the Ministries of Agriculture; Minerals, Energy, and Water Resources; and Environment, Wildlife, and Tourism and the National Strategy Office and with their district teams to discuss the policy plans that were based on the water accounts. The Department of Water Affairs presented the results from the water accounts at the national water meeting in 2015, where 150 stakeholders discussed the implications of declining water resources and increasing demand.[42] Moreover, as discussed in chapter 6, the WAVES program, participating countries, and related international organizations such as the UN Statistics Department organized multiple international workshops and meetings. During these workshops, NCA approaches and experiences, including water, were discussed, and shared with other interested countries.

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42   https://www.wavespartnership.org/en/botswana-annual-water-pitso-held-against-backdrop-water-crisis

4.4.3. Institutions

It is too early to evaluate whether the WAVES program has succeeded in firmly mainstreaming water accounting into development planning. That said, the results in the different countries are promising. The program has created an enabling environment in which multiple ministries recognize the added value of water accounting, and the institutions are in place to regularly provide decision makers with policy-relevant water information. The following four achievements stand out.

Anchoring accounting in the participating institutions—In most WAVES partnership countries, dedicated accounting focal points or units were installed to ensure continued future account production and that technical capacities remain up to date. This is the case in the water management agencies and resource ministries that gained the new responsibility of regularly preparing water accounts. In addition, the statistical agencies and central banks installed specialized units to ensure staff availability and knowledge about the water system. In addition to the specialized technical capacity-building initiatives for these units, general training was provided to a broader group of people working in ministries, focusing on application of the accounting data in water policy and planning processes. A remaining challenge is to keep the skills of the people at the key accounting institutions up to date. Only a few people know the details of water accounting. Therefore, the University of Rwanda is involved in training students in NCA, and the Universidad Rafael Landivar in Guatemala has a unit in its environmental research institute to train students in accounting. The World Bank and the Australian National University worked together to develop an introductory course that many countries in the WAVES partnership use. In most WAVES partnership countries, universities are involved to meet future training needs.

Institutional mandate and institutional cooperation—A major difficulty in many water development programs that has received special attention in all participating countries is achieving cooperation between ministries, statistical agencies, and institutions responsible for managing water resources. One problem in efficiently managing water resources is related to scattered data, knowledge, and responsibilities. The WAVES program has spurred cooperation between all these institutes and in several cases with academic and other research institutions. In all countries, interagency working groups were established to produce water accounts. In some cases, cooperation has been institutionalized by formalizing data sharing and cooperation. In many countries, the steering committees or working groups remained past World Bank involvement because they recognize the importance of regular meetings and cooperation for ongoing account production and use. In all cases, better understanding of each other's tasks and responsibilities has improved cooperation between agencies and enabled better water management decisions.

Institutional cooperation has also emerged between countries, with Rwanda and Costa Rica signing a memorandum of understanding to strengthen partnership on innovative financial mechanisms for environmental conservation. These mechanisms include PES for water, natural capital valuation, and NCA.

Improved policy processes within institutions—The increase in uptake of water accounting information in the development plans of countries participating in the WAVES program proves that policy-making processes have changed. To be able to go through all stages of policy making and prepare new water management plans, implement them, and monitor their impacts, coherent, up-to-date information about water resources is needed. Participating institutions acknowledge

that NCA has given them an extra tool to improve decision making at all stages of policy making. They are better equipped to identify priorities, impacts, and policy options and to present economic gains of better water management or costs of inaction. For instance, in the Philippines, this has resulted in stricter guidelines for environmental impact assessment of new plans, and in Rwanda and Colombia, additional budgets have been created for water management authorities.

Box 4.5 • Institutionalizing Water Management in Rwanda and Colombia

Rwanda

The WAVES partnership has institutionalized considerations of water in Rwanda's development plans. The role of the steering committee was paramount. Participants acknowledged that regular meetings between ministries and institutes that had not been in close contact before increased awareness of the importance of water for national development and better cooperation and allocation of work. In Rwanda, the National Institute of Statistics compiled the accounts, which the Ministry of Economics and Finance and the Ministry of Environment use for macroeconomic analysis and to calculate water-specific indicators. A memorandum of understanding has been signed with the University of Rwanda to ensure continued training on natural capital accounting (NCA) and cross-sectoral understanding of water issues.

An important development in Rwanda was establishment of the Rwanda Water Board in the Ministry of Environment, a specialized body focusing on efficient management of Rwanda's water and forest resources. The Water Board uses the accounts for its monitoring tasks and to prioritize projects. The accounts also provide input into a recently initiated program on landscape restoration and integrated water resources management in several catchments in Rwanda.

A solid base to consolidate the National Committee of Environmental Accounts. National, regional, and local results were used to prepare departmental and regional water plans, as regulated by the National Planning Department.

Colombia

The Colombian Steering Committee deliberately chose a program in which (water) accounts were compiled on a national, regional, and local scale; multiple institutions had to cooperate to compile the accounts. The Colombian WAVES team compiled national water accounts and ecosystem accounts (including for water) for the Orinoquia region and three watersheds (Tota, Chinchina, Suárez). In that way, stakeholders at all levels could see the added value of accounting, creating momentum and demand for institutionalized accounting in institutes and procedures. This was achieved by elaborating a road map that supported ongoing construction of environmental accounts in addition to dissemination of results.

It was realized that inter-institutional coordination was necessary for construction of accounts, so the institute in charge of orientation and consolidation of economic information (National Administrative Department of Statistics) and the Institute of Hydrology, Meteorology, and Environmental Studies jointly worked on the accounts. NCA procedures were seen as a good tool to find agreement between the different viewpoints on how to manage water resources. NCA had been included in the National Development Plan 2014-2018, providing a solid base to consolidate the National Committee of Environmental Accounts. National, regional, and local results were used to prepare departmental and regional water plans, as regulated by the National Planning Department.

4.4.4. Policy use and decisions

Improvements in water management realized in several WAVES partnership countries show that the achievements of the WAVES program already surpass the direct objectives set at the start of the program. Mandates of water management institutes have been strengthened, water accounting information is firmly embedded in water development plans, and several instruments to better manage water resources have been introduced. See Table 4.2 for an overview.

Policy planning—One of the clearest achievements of the WAVES program is that, in all countries that have prepared water accounts, new insights into priorities and causes of water problems have encouraged related institutes to prepare new water management plans or embed the results from the accounts in general development master plans. The policy-relevant language of the accounts enabled more evidence-based plans to be made. For instance, Colombia used national water accounts to highlight the economic relevance of water resources in the Integrated Water Resources Policy and to reach efficient, regulated, adequate water use. Similarly, on a local level, the Lake Tota water accounts provided relevant information for water management plans for the lake. In Costa Rica, the water accounts provided transparent, robust information to formulate an Integrated Water Governance National Plan. Whereas many political decisions had previously been made without proper data on water resources, the improved information about sectoral water use and water availability allowed for formulation of better policies on water allocation, prices, and use. The improved data allowed for new policies that could be monitored and for water fees to be calculated that lead to cost recovery of water utilities and greater capacity to invest in water infrastructure.

Box 4.6 • Water Development Plans in Botswana and Rwanda Based on Water Accounts

With Botswana being a water-scarce country, the government prioritized compilation of water accounts to better understand the stocks of available water and use by water users. Data from the accounts, for instance, helped the Department of Water Affairs conclude water covenants with the mines to encourage efficient water use. The accounts helped monitor the use of treated effluent and nonfresh water and helped monitor competition over water resources between mines and settlements. Water accounts were also used in the National Water Master Plan and water sector reforms, as well as the Master Plan for Wastewater and Sanitation, the Integrated Water Resources Management Plan, the National Development Plan (2017–22), and Vision 2036.

In Rwanda, based on information from the water accounts, the national water sector plan and the water development plan focused on the Sustainable Development Goals. Targets related to water efficiency improvement, water stress reduction, and access to water by 2025 were formulated. The accounts gave new insights that could not be made with the normal water statistics.

Policy implementation—Several countries implemented new policies to improve water management. For instance, water pricing mechanisms were considered in Botswana, Colombia, and Rwanda.

Box 4.7 • Water Pricing to Increase Water Use Efficiency and Cost Recovery in Botswana

In Botswana, the accounts were used to develop a better water pricing system for the mining industry. If mines arrange their own water abstraction, they pay the full supply costs but do not pay a water scarcity charge. When the Water Utilities Corporation provides water, mines often benefit from special rates, which are lower than supply costs. In 2013, the Water Utilities Corporation introduced a payment system to gradually reach cost recovery. A water scarcity charge and a higher fee would provide further incentive to mines to increase water use efficiency and reduce groundwater abstraction and demand from the water utilities. In addition, the accounts proved to be relevant for analyzing benefit sharing strategies from tourism to local communities.

In Colombia, the National Planning Department and the Ministry of the Environment and Sustainable Development used the accounts to analyze the economic impacts of changing the water use fee. In addition, the regional environmental authority, Corpoboyaca, intended to use the water accounts for Lake Tota to design a payments for ecosystem services (PES) scheme.

In Rwanda, the Water Board within the Rwanda Water and Forest Authority was authorized to charge water fees. Based on the monetary accounts, they developed advanced plans to change the existing water pricing and water use fee schemes to improve cost recovery of the water utilities while considering accessibility of water for the poor. The Rwanda Water and Forest Authority is exploring the use of PES, pricing, permits, and penalty instruments for groundwater and surface water users to better manage their water resources. They also have plans for payment schemes for ecosystem capacity improvement, with payments based on demonstrable increases in ecosystem resilience, such as landscape restoration, terrace building, and land conservation. The water and ecosystem services accounts are used to monitor progress.

Many countries decided to make investments to increase the efficiency of their water distribution system, improve waste water treatment, and increase treated wastewater reuse. Reaching targets or reaching the SDGs in these areas requires massive investments. For instance, the government of Rwanda increased investments in water utilities and water infrastructure in and around Kigali to achieve the development targets set in the National Strategy for Transformation and to achieve SDG 6 on water. The water accounts helped reveal current and future water availability and demand from key sectors. Similarly, in Colombia, the regional environmental authority, Corpocaldas, allocated 21 percent of its investment budget to wastewater management, especially investing in wastewater facilities. The local water accounts for the Chinchina River watershed showed that 75 percent of pollutants from wastewater poured directly into the environment and that water supply companies had distribution losses of about 35 percent. Botswana invested in wastewater treatment plants, irrigation schemes, and distribution systems to reduce water distribution losses of the Water Utilities Corporation by 15 percent and increase the share of wastewater reuse and recycling. The government also invested in irrigation schemes that use treated wastewater—the Glen Valley Irrigation Scheme in Gaborone. The accounts were useful for monitoring efficiency improvements and calculating financial returns of such improvements.[43]

Policy monitoring, review, and reform—Participating countries found that the accounts were useful to monitor impacts of policies and develop possible policy reforms. As mentioned above, the insights gained into cost recovery for water and wastewater utilities led to new pricing mechanisms in several countries. In the Philippines, the accounts also led to a number of legal reforms, with the objective of improving environmental management.

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43   Republic of Botswana. 2013. Environmental Economic Accounting for Water in Botswana: Detailed Accounts for 2010-2011 and 2011-2012 and General Trends 1993-2010. Republic of Botswana, WAVES Partnership.

Box 4.8 • Policy Reforms in Laguna Lake in the Philippines

In the Philippines, the soil erosion control and flood control accounts in the Laguna Lake basin were used to change a number of legal instruments, with the objective of improving environmental management of Laguna Lake. Four examples stand out. [44]

- The accounts helped in developing a scorecard to encourage local government units to include environmental conditions in their decision-making processes.
- The findings inform environmental impact assessments and cost-benefit analyses, which are data intensive but considerably improve fact-based policy making.
- The Laguna Lake Development Authority adapted its system to provide water permits to water users in the Laguna Lake area. Based on the water accounting information, permits now better account for temporal water shortages and changes in water availability.
- Estimates for resource rent for fisheries were used to revise licensing and permit fees for aquaculture in the Laguna Lake basin. Limits were set on the area of fish pen operations, and permit fees for fish pen and fish cage owners were determined. The fees collected are shared with local lakeshore governments to finance environmental projects.

Box 4.9 • Information from Water Accounts to Monitor Sustainable Development Goals (SDGs) in Rwanda

The accounts allow several indicators used for the SDGs to be estimated. For instance, from 2012 to 2015, water use efficiency (SDG indicator 6.4.1) increased from 4,500 Rwandese francs (Rwf)/m^3 to 5,100 Rwf/m^3, which is close to the annual economic growth rate. The efficiency increase was highest for industry and the services sector, although agriculture reached an efficiency gain of about 10 percent. Moreover, although the level of water stress (SDG indicator 6.4.2) is still low, it is increasing. On average, Rwanda has a net inflow of water of around 11.3 billion m^3 per year. Expected water demand for 2040 is only about one-third of this annual inflow, but because geographic and seasonal variation in these inflows is large, it is assumed that supply is not always and everywhere sufficient to meet demand.

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44   LLDA 2016. Pilot Ecosystem Account for Laguna de Bay Basin. https://www.wavespartnership.org/en/knowl-edge-center/pilot-ecosystem-account-laguna-de-bay-basin.

Table 4.2 • Use of Water Accounts at Various Stages of Policy Making

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform
Botswana	• Water accounts were used for water reforms as part of the National Water Master Plan and to agree on covenants with the mines to encourage efficient water use. They also inform revision of the National Water Master Plan, the Master Plan for Wastewater and Sanitation, and the 2013 Integrated Water Resources Management Plan.	• Water accounts improved water distribution and accurate water use prices for the mining industry, considering water scarcity and cost recovery. They were also used to reduce water distribution losses of water utilities, increase wastewater reuse, and improve irrigation and distribution systems.	• Water accounts were used to monitor treated effluent and non-fresh water from mines and monitor competition over water resources between mines and settlements.
Colombia	• Water accounts provide supporting information for the Integrated Water Resource Management Policy and Lake Toto water management policies. The information is being incorporated into models to regulate efficient and proper use of water and calculate the impacts of a PES scheme.	• Water accounts for the Chinchina River watershed were used to allocate extra budget for wastewater management.	
Costa Rica	• Environmental objectives and natural capital accounting data were integrated into the National Development Plan. • Water accounts supported the Power Generation Expansion Plan as part of the National Energy Plan 2015-30, which affects technology and infrastructure investment and cost recovery strategies. • Water accounts were included in the National Plan for Integrated Management of Water Resources.	• Water accounts influenced policy guidelines on better stocktaking, control, monitoring, and management of water bodies. A new water law is under consideration to ensure sustainable use of water resources and oblige the government to use economic accounting of water resources as a tool for policy making.	
Guatemala	• Multiple accounts served as the basis for modeling fuelwood use and impacts of sanitation on development using the Integrated Economic-Environmental Modeling compuTable general equilibrium model.	• Forest and land accounts were used to adapt pricing for timber and minerals.	

Country	Policy planning	Policy implementation	Policy monitoring, review, and reform
Philippines		• Local water, fisheries, and ecosystem accounts were used in implementing the Laguna Lake Watershed Greening Program.	• Water accounts were used to estimate resource rents for fisheries and to revise licensing and permit fees for aquaculture in Laguna Lake. They informed review of environmental compliance certificates and were used in the proposed revision of the environmental impact assessment law.
Rwanda	• Water accounts were used for the national water sector plan and the water development plan, which focus on the Sustainable Development Goals.	• Data and analysis from the accounts prompted the government to set up a national water board; serve as input into analyses of financial mechanisms, PES, or water use fees; and provided input into investment plans to safeguard energy security for large-scale landscape protection investments, to maintain dam capacity, and to increase the capacity of water utilities.	

Note: PES, payments for ecosystem services.

4.5. Reflection—lessons from WAVES support to water accounts

As discussed above, benefits from the production and use of the water accounts are manifold. The accounts and related analyses created new, policy-relevant information. The WAVES partnership has trained many people and helped strengthen institutions and the institutional cooperation that is indispensable for integrated water resources management. Directly or indirectly, the information in the accounts has been an input into several decisions and actions and has led to actual changes on the ground.

We end this chapter with reflections on the use and compilation of the water accounts.

> ▶ **Highlight the usefulness of natural capital accounts:** The water accounts have influenced many decisions in participating countries, but the role of the accounts is not always clearly visible. Policy makers combine information from multiple sources to shape ideas, create policy, or develop management plans. The WAVES policy briefs have demonstrated the

importance of communication of results from the accounts. These briefs are visible and open to many people and show the policy relevance of the accounts. The impact of the accounts would be enhanced if these policy briefs could be published regularly.

▶ **Local accounts have the potential to be used in the short-term:** Some of the most visible and concrete achievements of the water accounts come from the use of a suite of natural capital accounts for concrete, local problems (e.g., the achievements in the Laguna Lake region in the Philippines and for two watersheds in Colombia, where combining multiple natural capital accounts resulted in clear solutions that local authorities could immediately execute.) The use of the accounts for national water scarcity or water efficiency problems is equally important, but results may take more time to materialize as often the national accounting information often needs to be complemented with other information sources to form a fuller picture of the sector. To be able to use the accounts to their full potential, it is important to continue to compile the accounts and not see their development as a one-off exercise with immediate payoffs. Other data sources are less coherent and therefore provide a less sTable basis for policy making.

▶ **A valuable next step for countries is to develop water quality and emission accounts:** Data on emissions are often less available than data on water quality. Even more important from a policy perspective is to identify the responsible actors so that efficient policy instruments can be designed. The accounting framework lends itself particularly well to this because it links emission data to value added and employment in the relevant economic sectors.

5

5.   FOREST ACCOUNTS

5.1.   Introduction

Forests are a key resource, supporting a wide range of commercial and domestic human activity. Beyond timber production, forests contribute in a variety of ways to livelihoods of more than 1 billion people around the world: food, firewood, and medicines are collected from forests, which are also used for recreation and tourism. Forests provide valuable ecosystem services, such as protecting watersheds from erosion and storing carbon, and play a critical role in conserving the world's biodiversity. They provide habitat for more than three-quarters of the world's terrestrial biodiversity, and they are some of the most species-rich environments on Earth.[45]

Although most countries have information about the economic value of commercial timber, the broader contributions of forests to economic and social wellbeing is often underestimated or invisible, largely because they have no market price.[46] Forest accounts provide a way to understand and assess trade-offs between commercial timber production, use of forests by local communities, ecosystem services, and biodiversity conservation. Such trade-offs are inherently challenging, but the integrated environmental and economic information that natural capital accounts provide gives governments and others a place to begin discussions on these issues and enables them to build this type of information into decision-making processes.

This chapter examines how forest accounts have helped WAVES partnership countries improve forest management. It begins by explaining why WAVES countries produced forest accounts and how the accounts were compiled. It then discusses the broad range of results that have been achieved in terms of influence on or contribution to sustainable development according to information, capacities and tools, institutions, and policy use and decisions made. The chapter ends with some reflections on lessons learned from WAVES support to forest accounting in partner countries.

5.2.   Why compile forest accounts?

Forests are more than timber—Forest accounts provide a framework with which to capture the value of all the economic contributions of forests and how they are linked to the economy. Countries chose to produce forest accounts for a variety of reasons, but foremost among these was that, in many low- and middle-income countries, timber harvesting is a sizable industry. Forests also provide rural people with a variety of goods and services, many of which are not within the formal economy: for example, wood for heating and cooking, which is of particular

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45   Millennium Ecosystem Assessment 2005

46   World Bank. 2014. Forest Accounting for Development: Capturing the Value of Forests Using Natural Capital Accounting

importance in many areas. Forests also play roles in conserving biodiversity and maintaining environmental quality maintaining water quality, sequestering carbon, and preventing soil erosion. Informing how all these needs can be better balanced was a key driver of account production.

Forest accounts organize diverse information and have been used to prepare policies or plans to manage forests and to investigate what might happen if there were changes to the use of forests (e.g., from forestry to conservation or preventing illegal logging). Box 5.1 provides some background on the technical aspects of forest accounting.

Box 5.1 • Forest Accounting According to System of Environmental-Economic Accounting (SEEA) Framework

Two reports complement the forest accounts described in the SEEA Central Framework 2012: the SEEA Experimental Ecosystem Accounting (EEA) framework and the Forest Sourcebook (Castaneda et al. 2017). The Forest Sourcebook follows the definitions and concepts of the SEEA but also describes the methods and data sources needed to prepare the forest accounts. This product grew out of demand for practical guidance that was evident from a range of WAVES workshops, in particular the Global Forest Accounting Workshop.[47]

There are several accounts for forests, including stock and flow accounts in the SEEA Central Framework and accounts for ecosystem condition and ecosystem services from the SEEA-EEA. The forest accounts show the different types of forests, how they are used, the income and other benefits derived from them, and how these change over time and space.

Combining biophysical and economic data on forests enables managers to, for instance, develop and monitor forest management plans and identify times and places where forest degradation could lead to economic hardship or put biodiversity conservation or ecosystem health at risk. Linkage to national accounts allows forest productivity indicators to be estimated and shows how income generated from forests is split between households, businesses, and government. The accounts can also support a number of indicators related to the Sustainable Development Goals (SDGs), in particular SDG 15 (protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss). Also relevant is SDG 7 (sustainable energy from fuelwood) and reduction of climate change threats.

In many countries, demand for forest products increases while its supply falls—An important reason that WAVES partnership countries chose to develop forest accounts was the growing awareness that the availability of forest to provide products may be decreasing because of climate change and inefficient forest management, whereas other factors may cause demand for forest products to grow. For example, in Guatemala, increases in electricity and fossil fuel prices led to greater use of wood for cooking and heating.[48]

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47   https://www.wavespartnership.org/en/knowledge-center/global-forest-accounting-workshop

48   http://documents.worldbank.org/curated/en/33215156110448571/Towards-Natural-Capital-Accounting-in-Guatemala-Synthesis-Report

At the beginning of the WAVES partnerships, countries started working on forest accounts with the expectation that this would help decision makers, from forest management authorities to ministries of finance and economic planning, make more informed decisions. They realized that they could not begin to address the problem of unsustainable use of their forests unless they knew how much forest was available and how it contributed to economic development, as well as human wellbeing more generally. It is equally important to identify and understand the pressures on forests from other sectors such as agriculture, transport, mining, and urban development. Forest management can be difficult because it often must balance local demands for access to natural resources with national economic development plans that often rely on forests for timber, conservation reserves, or nature-based tourism.

Colombia and the Philippines chose to compile forest accounts because of the impacts of forest management on water. They observed that loss of forest resulted in downstream water quality problems and reduced the quantity of water run-off. Both countries examined the relationship between water supply and forest management using a combination of forest, water, land, and ecosystem accounts, along with the information contained in the SNA.

Forest accounts inform the SDGs—In several WAVES partnership countries, forest accounts were used to inform the SDGs, for example:

- ▶ **SDG 15.2:** By 2020, promote the implementation of sustainable management of all types of forest, halt deforestation, restore degraded forest and substantially increase afforestation and reforestation globally. The focus of national accounts on timber resources, omitting other important forest services such as carbon sequestration and watershed benefits, deters investment in forest conservation and contributes to forest deterioration and loss worldwide. For instance, the forest accounts for Guatemala: which incorporate non-timber forest products, carbon sequestration, and water filtration: give a more accurate assessment of the forest's worth. By compiling them year after year, the forest accounts show the unsustainable use of the country's forests and how the services and benefits of forests are shared in society.

- ▶ **SDG 13.1:** Strengthen resilience and adaptive capacity to climatic hazards and natural disaster in all countries. Accounting for the ecosystem services that forests, and mangroves provide, such as water flow regulation and barriers for storms and cyclones, can help inform policies that can build resilience to climate change. For instance, the regional ecosystem accounts in the Philippines showed the importance of maintaining mangroves and forests to protect the population from cyclones.

- ▶ **SDG 10.1:** By 2020, progressively achieve and sustain income growth of the bottom 40 percent of the population at a rate higher than the national average. The Guatemalan forest accounts clearly showed that poorer social groups are highly dependent on forests for food and fuelwood. The accounts showed the distributional consequences of changes in land use, forest cover, and ecosystem function, which helped the government gauge whether economic growth was inclusive and how its forestry policy options would affect poverty.

5.3. Which forest accounts were compiled and by whom?

Forest accounts complement other ecosystem accounts—Countries rich in forest resources are more likely to have developed natural capital accounts for forests (Table 5.1). Forest accounts typically include production of timber and non-timber products (e.g., provisioning services) and may also include forest extent accounts that provide more detail about forest cover than land accounts. Accounts for condition, as well as regulating and cultural services, are often part of ecosystem accounts for all types of land cover, although they can be part of comprehensive forest accounts, as described in the Forest Accounting Sourcebook.[49] Colombia, Costa Rica, Guatemala, Indonesia, Rwanda, and later Uganda and Zambia all produced forest accounts at a national level, often within the context of broader work on land accounts. Colombia, Indonesia, the Philippines, and Uganda produced forest accounts at a subnational level for watersheds or areas. Botswana, which has little or no commercial forestry, decided not to produce forest accounts.

Table 5.1. Overview of Forest Accounts Produced by Wealth Accounting and the Valuation of Ecosystem Services Partnership Countries

Country	Forest assets	Physical supply and use Table	Monetary supply and use Table	Other related accounts
Colombia[50] [51]	No	Yes	Yes	Water and ecosystem accounts
Costa Rica[52]	Yes	Yes	Yes	Water accounts
Guatemala[53] [54] [55]	Yes	Yes		Water and forest accounts
Indonesia				Ecosystem accounts for peatlands
Philippines		South Palawan[56] [57]		
		Laguna Lake[58] [59]		
Rwanda[60]	Yes	Statistics on water use efficiencyb		Mangrove accounts and flood mitigation service[61]
Rwanda[62]	Yes			

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49   https://www.wavespartnership.org/en/knowledge-center/forest-accounting-sourcebook

50   DANE 2017: Cuenta ambiental y económica de flujos del bosque, en unidades físicas y monetarias. National Administrative Department of Statistics; DANE, IDEAM, MADS 2016: Avance metodológico de la cuenta ambiental y económica del bosque. Documento de trabajo

51   WAVES Colombia Country Report 2016 https://www.wavespartnership.org/en/knowledge-center/waves-colombia-country-report-2016

52   https://www.bccr.fi.cr/seccion-cuentas-ambientales/cuentas-ambientales

53   Towards natural capital accounting in Guatemala: Synthesis Report. May 2019

54   2018 WAVES Annual Report

55   Guatemala environmental-economic accounts - provisional link

56   Southern Palawan Ecosystem Accounts

57   Ecosystem Accounts Provide Inputs for Decision-Making and Policy Analysis in Southern Palawan

58   http://www.wavespartnership.org/sites/waves/files/kc/WAVES%20Snapshot%20Laguna%20Lake.pdf

59   http://www.wavespartnership.org/sites/waves/files/kc/WAVES%20policy%20brief%20-%20Laguna%20de%20Bay_3.pdf

60   2018 WAVES Annual Report]

61   Losada, I.J., M. Beck, P. Menendez, A. Espejo, S. Torres, P. Diaz-Simal, F. Fernandez, S. Abad, N. Ripoll, J. Garcia, S. Narayan, D. Trespalacios, A. Quiroz. 2017. Valuing Protective Services of Mangroves in the Philippines: Technical Report. World Bank, Washington, DC.

62   Government of Rwanda. 2019. Rwanda Water Accounting 2012-2015. https://www.wavespartnership.org/en/knowledge-center/rwanda-water-accounting-report-2012-2015

Forest accounts for timber and non-timber forest products—All countries developing forest accounts first accounted for timber resources and forest land. These accounts showed biophysical data for forest cover (hectares) and volume (m^3 of timber) for existing stock at the beginning of a period, changes during the period (due to natural growth, harvest, losses), and how much was available at the end of the period. Colombia, Guatemala, Indonesia, the Philippines, and Rwanda also included other forest benefits, such as non-timber forest products (e.g., fuelwood) and some forest ecosystem services (e.g., carbon sequestration). In some countries, consumption was disaggregated according to household type and income level, and all countries examined final and intermediate consumption by other industries— for example, intermediate consumption of timber by the furniture industry.

Technical training on forest accounting took place in Costa Rica, Colombia, Guatemala, Indonesia, and Rwanda, with Rwanda also sharing their experience with Uganda and Zambia. In the Philippines, training in forest accounting was part of a broader training program on land and ecosystem accounting.

Remote sensing and SNA are base data sources—To develop forest accounts, data from a variety of sources were used. A key data source was remotely sensed data of forest extent from international agencies, which were used in Colombia, Costa Rica, Guatemala, Indonesia, the Philippines, Rwanda, Uganda, and Zambia. Although international data sources are not perfect, they allowed countries to generate a basic set of forest accounts in physical terms (e.g., hectares of forest according to forest type). These basic accounts could then be compared with national and subnational data sources and updated as necessary.

Another key data source was the SNA. Forestry is an industry identified in the national accounts of most countries, although estimates of its contribution to the economy are often combined with those of agriculture and fishing. The information contained in the national accounts was only partially useful because much production and use of forest products is by households and in the informal sector and is largely missed in the SNA even though it is theoretically within scope.

Forest accounts are generally set up in a centralized manner—In all countries, multiple institutions were involved in compiling forest accounts, yet forest accounts in general are compiled in a more centralized way than water accounts. Where compiling water accounts requires specialized water knowledge, which in many countries was obtained from specialized water institutes, much of the forestry and forest ecosystem information can be obtained from the institutions already responsible for compiling national accounts and from ministries of environment and their related institutes. In Colombia, Costa Rica, the Philippines, and Indonesia, institutes responsible for national accounts also set up forest accounts—the National Administrative Department of Statistics for Colombia, the Central Bank in Costa Rica, the PSA in the Philippines, and Statistics Indonesia (BPS). In all countries, the ministries of environment were involved in data collection and in mainstreaming information from the accounts in the government's policy priorities and policy analysis. In the Philippines, where most WAVES work focused on regional studies in Palawan and Laguna Lake, a number of local organizations were also involved. Much of the timber-related information was already available in these institutes. To reach consensus on measurement methods, indicators, and data source use, other institutes and societal organizations were involved in compiling the non-timber-related information.

5.4. Achievements

Forest accounts have yielded policy-relevant results in all WAVES partner countries that prepared them. One of the clearest proofs of this is that they have continued to be produced in Costa Rica and Indonesia after WAVES support ended. They also look set to continue in Colombia and Guatemala. Zambia and Rwanda have already drafted forest accounts—the speed of their production is an illustration of successful application of lessons learned by the first group of core implementing countries. Below, the main achievements are briefly discussed in terms of the basic building blocks for sustainable development—information, capacities and tools, institutions, and policy use and decisions made.

5.4.1. Information

Policy-relevant data, knowledge, and information—A clear achievement of the WAVES program has been availability of new information about forests and their uses. In all countries, forest accounts provided integrated data that was previously unavailable. Although all countries had some data on forest extent and use, in many cases, they were out of date and scattered over multiple institutions. The accounts provided a coherent framework that enabled physical and monetary information on forests to be linked. As will be discussed in section 5.4.4, this new information yielded insights that enabled more evidence-based decision making.

> **Box 5.2 •** Forests in Guatemala: More Important Than Envisaged but Declining Faster Than Thought
>
> Forest accounts for Guatemala were developed using the System of Environmental-Economic Accounting and the Forest Sourcebook. Figure B5.2.1 shows the process of account development. The accounts show that Guatemala is rapidly losing forests and that little of the value from forests is properly reflected in the economic data. Forests' contribution to the economy is 2.5 percent of gross domestic product, not 1 percent as currently recorded in the national accounts. Between 2006 and 2010, the deforestation rate was 1.4 percent —significantly higher than the 0.4 percent average for all South America. The massive disparity between reported activities and actual forest change shows that as much as 96 percent of forest use was illegal. The forest accounts also show that 64 percent of households depend on firewood as their main energy source and that much forest clearing came from private sector wood brokers. This information helped the government design the National Forest Policy, with a focus on instruments to address illegal logging.

Figure B5.2.1 • Development and Use of Forest Accounts in Guatemala

| System of Environmental Economic Accounting	→	Forest accounts	→	Sectoral studies	→	National strategies	→	Institutional strengthening	→	Financial instruments
				Modeling deforestation		National Strategy for Production and Use of Fuelwood		Institutional restructuring of National Forest Institute		Eg ProForest – extending forest incentives to 30 years and to forest restoration and agroforestry systems
				Supply and demand for fuelwood in Guatemala		National Strategy for Control of Illegal Logging				
				Non controlled logging in Guatemala – the impact on the economy and on forests						

Source: https://www.wavespartnership.org/sites/waves/files/images/NCA%20in%20Action_Guatemala%20forests.pdf

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Box 5.3 • Calculating the Peace Dividend and Costs of El Niño for the Economy of Colombia

The forest accounts in Colombia confirmed the problem of forest loss, which was nearly 5 million hectares between 1990 and 2012 (Figure B5.3.2).[63] Illegal harvest of timber and forest fires were two drivers of forest loss. A novel use of the forest accounts was an assessment of how peace would benefit environmental degradation (Figure B5.3.3). It was found that, if peace reduced net deforestation, the avoided costs of forest loss would amount to 96 billion Colombian pesos per annum. This estimation was possible only with information from the forest account.

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63   WAVES Colombia Country Report 2016

Figure B5.3.1 • Forest Area in Colombia, 1990 to 2012
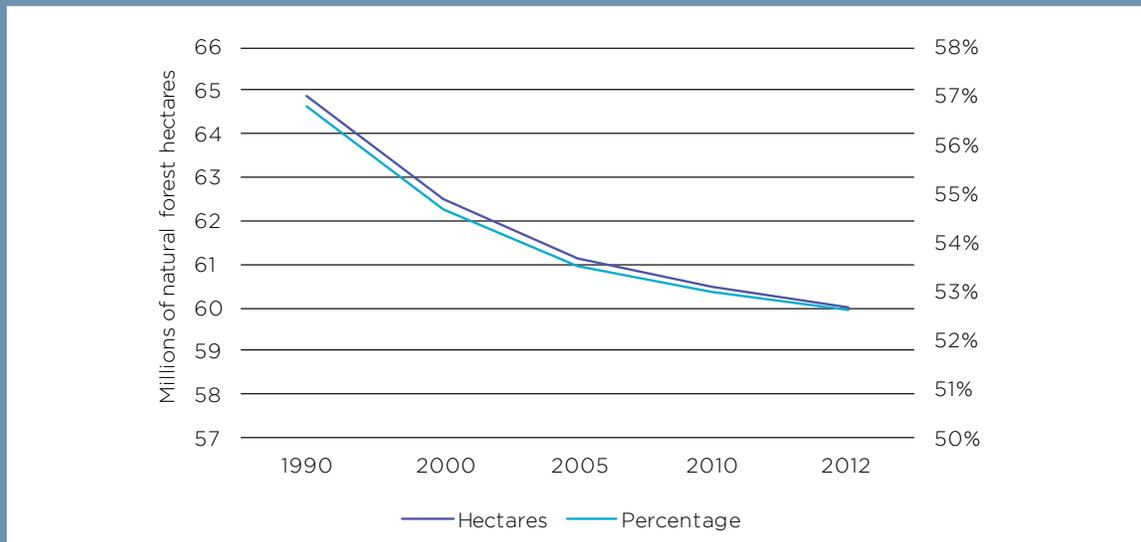
Figure B5.3.2 • Environmental Impact of Conflict in Colombia

Impactos ambientales acumulados del conflicto entre 1990 y 2013*

3 millones de hectáreas de bosque deforestadas (IDEAM, 1990-2013)

Equivalente al área de bosques de República Checa*

1.300 millones de **toneladas** de CO2 emitidas por deforestación*

Equivalentes al 13% de la emisiones de China en 2012*

1,5 millones de ha. de suelo degradadas**

Que tomarán al menos 20 años en recuperarse

60% de las fuentes hídricas del país **potencialmente afectadas** por extracción ilícita de minerales*** y derrames de petróleo****

Equivalente a 10 veces el caudal del río Nilo

780 mil hectáreas deforestadas cuyo uso actual es diferente al de su vocación*****

Equivalente a la mitad de Irlanda del Norte

Source: Uso de las cuentas em el desarrollo de Políticas[64]

In addition, the forest and timber accounts were the basis for the analysis of the cost of forest fires triggered by El Niño. Based on this analysis, the National Planning Department released an alert and a detailed analysis according to region that estimated that the forest fires in 2015 had cost the country 476,000 million (Colombian) pesos (~USD170 million) in lost production.[65]

64   Subdirección de Desarrollo Ambiental Sostenible. 2016. https://www.wavespartnership.org/sites/waves/files/images/Colombia%20DNP%20Presentation.pdf

65   WAVES Colombia Country Report 2016

Box 5.4 • Forest Accounts in Madagascar*⁶⁶*

Madagascar had chosen to compile forest accounts to learn about the status of its forests and to design a forestry strategy that allows for conservation, sustainable forest use, and use of fuelwood. It was recognized that the population depends to a large extent on the country's forests, yet the accounts showed that, between 2005 and 2013, fuelwood use increased at an unsustainable rate of 15 percent per year, that illegal use of forest resources was immense, and that deforestation was continuing at alarming rates. Between 2005 and 2013, 25 percent of the forests in Madagascar disappeared.

5.4.2. Capacities and tools

Capacities to construct forest and related accounts—Developing and using forest accounts requires specific knowledge of basic data, statistical analyses, forest management, and macroeconomics that, in most countries, are found in different organizations. Through the WAVES partnership, people in these different organizations were trained so that they could jointly develop the forest accounts. Given the broadness of the information in the forest accounts, this involved multiple disciplines and institutions. Whether capacities were increased in many participating organizations, such as in the Philippines, or fewer organizations were involved in the training, such as in Indonesia and Costa Rica, differed from country to country. This was also related to the main objective of the country projects. The Philippine teams had the objective of jointly addressing a number of integrated regional problems, which required close cooperation between several institutes and multiple accounts to obtain an integral picture of the local problems. The Indonesian, Guatemalan, and Costa Rican teams followed a more focused approach, examining forest ecosystems and the multiple ecosystem services that forests provide.

Economic modeling using the ecosystem accounts—The accounts also provided input into sophisticated statistical and modeling studies. While the WAVES program was ongoing, Banerjee et al.[67] developed the Integrated Economic-Environmental Modeling (IEEM) general equilibrium framework, which allowed for detailed environmental policy analysis, showing the interlinkages between environmental changes and economic development (Box 5.5). The IEEM compuTable general equilibrium analysis of the impacts of fuelwood policies in Guatemala was among the first uses of the model. In addition, the Philippines used its mangrove accounts to analyze in detail the economic benefits of mangrove protection.

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66   WAVES Madagascar, 2016. Madagascar Compte Bois.

67   Banerjee et al. 2017. The Integrated Economic-Environmental Modelling Framework: An Illustration with Guatemala's Forest and Fuelwood Sector. Environmental & Resource Economics.

> **Box 5.5 •** Integrated Economic-Environmental Modeling (IEEM) Framework applied to Guatemala[68]
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>
> The IEEM framework integrates System of Environmental-Economic Accounting (SEEA) data into an economy-wide general equilibrium model. Using the national accounts and the SEEA accounts, IEEM enables analysis of a broad range of public policies and investments in the economy and the environment. One of the first applications was for Guatemala's forest and fuelwood sector, where negative health and environmental impacts arise from inefficient household fuelwood use. IEEM was used to compare several policy scenarios, such as a scenario leading to more efficient fuelwood use that results in smaller health impacts and greater labor productivity and a scenario assessing the impacts of more stringent deforestation regulations. The results showed how a better fuelwood strategy and fuelwood incentive policy would enhance Guatemala's wealth and prospects for growth.

5.4.3. Institutions

Institutional coordination and coherence—WAVES has helped institutional coordination and coherence in forest management. A problem that received special attention in all participating countries is the cooperation between ministries, statistical agencies, and institutions responsible for managing forests. The WAVES program promoted cooperation between all these types of institutions and in several cases with academic institutions. In some cases, cooperation has been institutionalized by formalizing data sharing and cooperation. For example, in Guatemala, Rafael Landivar University produced the forest accounts,[69] and the Inter-American Development Bank conducted additional analyses.

> **Box 5.6 •** Compiling the Philippine Palawan Forest Ecosystem Accounts: A Multiagency Effort
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>
> Setting up the accounts for the Palawan region in the Philippines was a multiagency effort. Coordinated by the Philippine WAVES Steering Committee, a large number of national and local organizations cooperated to develop a broad range of ecosystem service accounts for forests and other ecosystems to find solutions for the increasing conversion of forest lands to plantations, shifting cultivation, intensive mineral extraction, illegal logging, and other pressures on its ecosystems. .

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68   Banerjee et al. 2017. The Integrated Economic-Environmental Modelling Framework: An Illustration with Guatemala's Forest and Fuelwood Sector. Environmental & Resource Economics.

69   Banco de Guatemala & IARNA-URL. 2009. Cuenta Integrada del Bosque: Bases Teóricas, Conceptuales y Metodológicas. Ciudad de Guatemala: Banco de Guatemala & IARNAURL.

The team included the Planning and Policy Service of the Department of Environment and Natural Resources, the Palawan Council for Sustainable Development, various offices and bureaus under the Department of Environment and Natural Resources, the National Mapping and Resource Information Authority, and representatives from nongovernmental organizations and academic institutions in Palawan. The Philippine Statistics Authority supported development of the ecosystem account by assisting with data collection strategies, including survey design, quality assurance, and the valuation conducted in this pilot ecosystem account. Finally, the European Space Agency extended additional support through the GECOMON project for additional remote sensing analysis for Palawan..

Greater recognition of the broad range of forest benefits—Another valuable achievement of the WAVES program was improving the institutional standing of organizations responsible for forest management and recognizing that forests can provide a wide range of benefits, not just timber. For example, the importance of mangrove forests is now better recognized in the Philippines.

Box 5.7 • Philippine Initiative to Develop a Research Agenda for Forest Ecosystem Services[70]

The Philippine WAVES Steering Committee considered development of a research agenda for forest ecosystem services to be a useful start for institutionalizing and formulating data collection, data sharing, and analysis. The following steps were suggested for developing the research agenda:

- (i) identify stakeholders within agencies and institutions at national and regional levels that have the potential to generate or use forest ecosystem services data and information

- (ii) analyze the needs of stakeholders to understand the different types of landscape management questions that decision makers must answer

- (iii) identify agencies and institutions with a mandate for ecosystem data collection and determine the data and information that they could collect, analyze, and disseminate

- (iv) develop a memorandum of understanding (where one does not already exist) between agencies and institutions for data and information sharing and for sharing of resources

- (v) regularly update the research agenda

5.4.4. Policy uses and decisions

Table 5.2 gives an overview of the policy uses and decisions that have been achieved in the WAVES countries. The forest accounts have provided policy makers with indispensable input into

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70 Rawlins, M.A., L.F. Aggabao, A. Araza, M. Calderon, J. Elomina, G.B. Ignacio, and E. Soyosa. 2017. Understanding the Role of Forests in Supporting Livelihoods and Climate Resilience. Case Studies in the Philippines. DENR, the Philippines.

a broad range of policy and development plans and analyses so that they can update or change their forest policies. It is often difficult to pinpoint exactly how the information contained in the accounts has influenced policy makers, but experience shows that the coherency with which the accounts are compiled results in more trustworthy information about trade-offs and synergies than other data sources. This is among the main reasons why so many countries continue with their SEEA accounts, even without external support, and why such a broad range of policy uses can be identified in such a short time period. It is only a matter of time before new policies based on the forest accounts will be implemented.

Policy planning—Insights from the forest accounts have been incorporated into several forest and development plans and have provided important information for the REDD+ strategies of Colombia and Costa Rica.

Box 5.8 • Addressing forest loss in the Colombia

The government of Colombia has committed to reducing emissions from deforestation and forest degradation (REDD) as one of the strategies in its development plan, which has the objectives of formulating the national REDD strategy by enabling the economic development of regional communities through access to the global carbon market, implementing the intersectoral agreement on legal timber harvest, making progress toward land use planning for 1 million hectares of natural forest, formulating a strategy to combat forest fires, and defining a policy for environmental management and land use planning of the Colombian Amazon. The forest accounts provided essential inputs for these aims, demonstrated which stakeholders could be held responsible for deforestation, and provided new insights into how causes of deforestation might be addressed.

Box 5.9 • Using Forest Accounts for Guatemala's National Forest Policy

Guatemala's National Forest Policy focuses on instruments to address illegal logging and contains a new public-private strategy for sustainable production and use of natural resources, including firewood and soils. The forest accounts provided essential information to estimate the magnitude of illegal logging and firewood problems. The policy plans include policy measures and incentive systems for forest protection, forest recovery, and reforestation, as well as 20,000 direct and 60,000 indirect jobs in the future. The National Strategy for Production and Use of Fuelwood is related to this incentive system.

Using forest accounts for policy monitoring, review, and reform—Policy monitoring and review is one of the main policy uses of NCA. The government of Colombia, for instance, focuses its policies on green growth, with objectives related to sustainable, low-carbon growth; protecting its natural capital; and reducing vulnerability to natural disasters. By regularly compiling forest accounts, Colombia keeps track of these objectives and, if necessary, adapts its policies. Similarly,

in Indonesia, the forest accounts showed deforestation rates for different regions of the country, which enabled better monitoring of the value of timber, which is the basis for taxing the private sector for its forestry activities. Monitoring the environmental damages of illegally burning peatland forests also led to lawsuits against the responsible company.[71]

Box 5.10 • Monitoring Climate Resilience in Rwanda

Rwanda is developing a strategic plan for climate resilience and a forest investment plan with preparation funding from the Pilot Program for Climate Resilience and the Forest Investment Program, both of which are under the umbrella of the Climate Investment Funds.[72] Related to this is an analysis of forest cover changes, pace of development, and areas of vulnerability, using data from the land, ecosystem, and forest accounts

Table 5.2 • Use of Forest Accounts at Various Stages of Policy Making

Country	Policy planning	Policy monitoring, review, and reform
Colombia	• Forest accounts provided input for REDD+ plans and analysis of the costs of forest fires caused by El Niño.	• Diverse accounts: Measurement and monitoring of green growth policy based on multiple indicators following from the accounts. The Green Growth National Strategy focuses on reduction of deforestation, reduction of greenhouse gas emissions, and strengthening of climate change adaptation.
Costa Rica	• Forest accounts were incorporated into REDD+ strategy as part of the National Plan for Forest Development 2011-2020.	
Guatemala	• Forest section of National Development Plan'K'atun: Our Guatemala 2032 was built on findings of accounts. • National Strategy for Production and Use of Fuelwood is related to a new public-private strategy for sustainable production and use of natural resources, including firewood and soils. This includes policy measures and incentive systems for forest protection, forest recovery, and reforestation, as well as 20,000 direct and 60,000 indirect jobs in the future. • Accounts served as the basis for modeling fuelwood use and impacts of sanitation on development using Integrated Economic-Environmental Modeling compuTable general equilibrium model.	

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71   WAVES Indonesia, 2017. Natural Capital Accounting and Policy – Indonesia. [[Provide additional information]]

72   http://www-cif.climateinvestmentfunds.org/country/rwanda

Country	Policy planning	Policy monitoring, review, and reform
Philippines	• Forest and ecosystem accounts allowed for integration of ecosystem service modeling and assessment in the process of forest use planning. Results have also been used for National Greening Program; Integrated Area Development, Risk Resilience, and Sustainability Program; Green Climate Fund; People Survival Fund; and comprehensive land use plans of local governments.	
Rwanda		• Land accounts: Incorporation of information about forest land into revision of National Land Use Development Master Plan and Land Administration Information System.

Note: REDD+, Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks.

5.5. Reflection—lessons from WAVES support to forest accounts

Balance local and national use of forests—Forests are an area of contention in many countries because local communities depend on forests for food, fuel, medicine, and clean water. Timber in forests can be harvested and used to generate income, exports, and employment, whereas conversion of forests or other treed areas (woodlands) to agricultural use generally means increased production of food. This loss of forests almost always also means loss of biodiversity. How to balance these competing uses of forests was the major reason for compiling these accounts in Colombia, Costa Rica, Guatemala, the Philippines, and Rwanda. The forest accounts played a prominent role in providing an agreed-upon set of facts for discussion, exploring different options for forest use, and ensuring that stakeholders appreciated the challenges in striking a balance between local and national objectives.

Forests as a solution for climate change mitigation and adaptation—Forest accounts help assess benefits from carbon sequestration and storage and hence enable countries to access international schemes such as REDD and REDD+[73] that would attract payments for these ecosystem services. This is an underexplored area, but it has the potential to provide local communities and national governments with financial incentives to manage forests sustainably for a variety of benefits.

Forest accounts for biodiversity conservation—The addition of forests to the national park estate is in many cases equated with achieving biodiversity conservation, but in many countries, forest loss, and hence biodiversity loss, continues after the declaration of national parks. To address the problem, the forest accounts account for use of forests by local people and account for how locals may benefit—or lose out—from establishment of national parks, for example, by generation of income from tourists and ecosystem services such as clean water. It is unreasonable to expect that locals, who are often poor, should bear the costs of the benefits that others enjoy.

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73   The Red Desk https://theredddesk.org/

6

6. ENERGY AND MINERAL ACCOUNTS

6.1. Introduction

Energy and minerals are important economic natural resources. Many countries economically depend on mineral mining but also experience the damages of the mining sector to their scarce water and natural resources. Energy is also vital for economic development. Because of climate change, many countries are searching for more sustainable energy sources such as hydropower and other renewable resources and trying to reduce the use of fossil fuels such as coal, oil, and gas.

The SEEA-CF provides guidelines for compiling energy and mineral accounts. Several WAVES partnership countries compiled energy and mineral accounts and combined them with other accounts to better learn about the relationships between these and other natural resources and the economy at large.

This chapter discusses what WAVES countries have achieved with energy and mineral accounts. The chapter starts by explaining why several countries chose to implement the SEEA-CF for energy and mineral resources despite the information they already receive from the SNA. It explains which accounts have been compiled and by whom and what has been achieved with them. As in the other theme chapters, not all achievements in all countries are mentioned. They are discussed in general terms and illustrated with lessons from some WAVES partnership countries.

6.2. Why compile energy or mineral accounts?

Energy and emission accounts as input into climate policy—As part of the Paris Climate Agreement, many countries are developing policies to reduce their greenhouse gas (GHG) emissions. Energy accounts are an important input into this. For instance, Indonesia has introduced the Low Carbon Development Initiative to incorporate GHG emissions into its development plan 2020–25. A substantial part of Indonesia's emissions originates from land use change, deforestation, peatland conversion, and forest fires, but rapid growth of fossil fuel use also contributes to emissions. To learn about sources of GHG emissions, Indonesia has developed energy and emission accounts in addition to their forest and peatland accounts. Also, in Costa Rica, the accounts were used to design and monitor strategies for reducing GHG emissions. The accounts show the share of each energy source in total energy supply and their contributions to GHG emissions.

Energy and mineral accounts for monitoring macroeconomic sustainability—Many governments formulate sustainable development plans. To monitor progress, time series of macroeconomic sustainability indicators are indispensable, to be used complementarily with macroeconomic indicators such as GDP. Examples include indicators for comprehensive wealth or adjusted net savings and indicators related to energy efficiency and energy security. For instance, Indonesia uses its energy accounts to compare the share of renewable energy sources with that of energy

based on fossil fuels. Costa Rica uses its energy accounts to shape its renewable energy investments and to identify the energy footprints of each economic sector, which showed, for instance, that sugar manufacturing had the highest emission intensity of the economic activities—much higher than expected. Botswana uses its accounts to assess prospects for long-term development and whether its growth path is sustainable in the long term.

Importance of minerals for the economy—The countries that have developed mineral accounts—Botswana and the Philippines—learned from these accounts how important their mineral stocks are for their economies. In Botswana, they served as important input into policy dialogue about rent returns, investment choices, and diversification of the economy. They were used in discussions about the best use of Botswana's coal stocks and sustainability of the government budget. Similarly, the Philippines wanted more insight into changes in their mineral stocks to plan for their responsible use. Have the resource rents been reinvested, how do resource rents compare with environmental damage, how are benefits shared between authorities and with the local and indigenous communities?

6.3. Which energy and mineral accounts were compiled and by whom?

Not all participating countries compiled energy and mineral accounts. Countries with significant mineral stocks compiled mineral accounts. Energy accounts are relevant for all countries, but the SNA and energy statistics already contain much relevant information.

PSUTs versus asset accounts—The types of accounts compiled show which policy questions are being raised. Botswana and the Philippines have set up mineral asset accounts to keep track of changes in their mineral stocks and to learn about resource rents, relevance of minerals to the economy, and dependency of the government budget on mineral revenues. Energy policy questions refer to energy use according to sector, energy efficiency, and contribution of economic activities to GHG emissions. For this, the PSUTs are especially relevant. Because of the policy relevance of the mineral and energy accounts, most WAVES partnership countries integrated them into their regular updates of macroeconomic indicators.

WEALTH ACCOUNTING AND VALUATION OF ECOSYSTEM SERVICES GLOBAL PARTNERSHIP

Table 6.1 • Overview of Energy and Mineral Accounts Produced by Wealth Accounting and the Valuation of Ecosystem Services Countries

Country	PSUT	Asset account	Monetary supply and use Table	Other related accounts
Minerals				
Botswana[74]	Yes	Yes (physical and monetary)		Macro indicators
Madagascar[75]	Yes		Yes	Macro indicators
Philippines[76]		Yes		Water and forest accounts
Rwanda[77]	Yes			
Energy				
Botswana[78]	Yes		Yes	
Costa Rica[79]	Yes (only use)		Yes	Emission physical supply and use Table + macro indicators
Colombia[80]	Yes	Yes		Emission PSUT
Guatemala[81]	Yes			Emission PSUT
Indonesia[82]	Yes			Emission

*Not yet finished.
Note: PSUT, physical supply and use Table.

Accounts built by institutions responsible for the national accounts versus a dedicated ministry—In most WAVES partnership countries, the agencies responsible for the national accounts compiled the mineral and energy accounts. In the Philippines and Indonesia, these were the PSA and BPS. In Costa Rica, it was the Central Bank. These agencies already had most of the data and knowledge needed to produce natural capital accounts. In Indonesia, BPS set up its first environmental economic accounts (SISNERLING) in 1990. They integrated the SEEA-CF into SISNERLING in 2016 and published their first experimental energy accounts in 2018. BPS, given its experience with SISNERLING, has strong contacts with other ministries and institutes that provide the necessary data. The same holds for PSA and the Costa Rica Central Bank, which have long experience compiling economic accounts and have the authority and contacts to obtain the required data. For instance, in the Philippines, PSA worked closely with the Mines and Geosciences Bureau of

74   WAVES Botswana. 2016. Economic Accounting of Mineral Resources in Botswana. Technical Report. https://www.wavespartnership.org/sites/waves/files/kc/Technical%20Rept%20WAVES%20Botswana%20Minerals%20pub%205-28-16%281%29.pdf

75   WAVES Madagascar. 2016. Madagascar Comptes Mines https://www.wavespartnership.org/en/knowledge-center/madagascar-comptes-mines

76   WAVES Philippines. 2017. Mineral Accounts of the Philippines https://www.wavespartnership.org/en/knowledge-center/mineral-accounts-philippines

77   Government of Rwanda. 2019. Rwanda Water Accounting 2012-2015. https://www.wavespartnership.org/en/knowledge-center/rwanda-water-accounting-report-2012-2015

78   WAVES Botswana. 2016. Economic Accounting of Mineral Resources in Botswana. Technical Report. https://www.wavespartnership.org/sites/waves/files/kc/Technical%20Rept%20WAVES%20Botswana%20Minerals%20pub%205-28-16%281%29.pdf

79   Banco Central de Costa Rica. 2017. Energy Accounts — working paper.

80   https://www.wavespartnership.org/en/colombia

81   http://www.infoiarna.org.gt/nuestro-trabajo/cuentas-ambientales/

82   BPS Statistics. 2018. Report of Experimental Energy Flow Accounts – Indonesia.

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the Department of Environment and Natural Resources, the bureau tasked with administration and disposition of mineral lands and resources.

In Botswana, the Ministry of Minerals, Energy, and Water Resources was responsible for the energy and mineral accounts. It chaired multisectoral technical working groups, which had members from multiple ministries and agencies. The working groups also included members from the coal mining industry and the Botswana Power Company and from the Botswana Geosciences Institute. They provided the data, coordinated with agencies within their sectors to support activities, reviewed reports, and participated in training activities to internalize application of the NCA in day-to-day policy making. The Ministry of Finance and Development Planning coordinated the work and compiled the macroeconomic indicators. This setup ensured that data were available and that the results were used for policy-relevant analyses and processes.

In all of the countries, a ministry with policy responsibilities facilitated use of the accounts for the macroeconomic indicators—for instance, the Ministry of National Development Planning in Indonesia, the Ministry of Finance and Development Planning in Botswana, the Ministry of Environment and Energy in Costa Rica, and the National Economic and Development Authority in the Philippines.

6.4. Achievements

The subsections below describe in more detail what the mineral and energy accounts have been used for. Specific examples are given for Botswana, Costa Rica, the Philippines, and Indonesia. These main achievements are briefly discussed in terms of the basic building blocks for sustainable development: information, capacities and tools, institutions, and policy use and decisions made.

6.4.1. Information

The WAVES partnership countries learned many new lessons from the analysis based on the energy and mineral accounts. Lessons stand out in three areas: information for fact-based decision making, times series monitoring of trends, and statistical analysis.

Information for fact-based decision making—The new information enables more data-driven and fact-based decision making. The national accounts already contain some minerals and energy data but not in physical terms and with a lower level of detail. Table 6.2 gives an overview of the mineral and energy accounts that WAVES partnership countries have produced and the types of data they contain. The energy accounts are especially relevant for showing energy use according to economic sector and energy source. They are also relevant for compiling emissions and carbon dioxide accounts that are essential input for developing, implementing, and assessing climate change policies.

Time series for monitoring of trends—The time-series of the mineral accounts was useful for monitoring changes in mineral stocks, sustainability of government budgets, diversity of the economy, rent capture, and who captures the rent. Especially for mineral-dependent countries such as the Philippines and Botswana, it is important to know how vulnerable their economies are to price volatility in mineral commodities. Employment, government budgets, and foreign exchange reserves depend on mining and related sectors. Monitoring changes in energy use and energy mixes was important for learning about energy security and the impacts of climate policies. The accounts provide detailed information that shows changes in sectoral energy use, and these were essential inputs into energy forecasts.

Statistical analysis—The close linkages between the mineral and energy accounts and the national accounts allowed key macroeconomic sustainability indicators to be estimated. Energy efficiency, decoupling of GHG emissions from economic growth, and sustainability of government budgets are among the key analyses performed with the aid of the mineral and energy accounts.

**Figure 6.1** • The Philippines: Changes in Mineral Contribution to Export Revenue, 2001–12
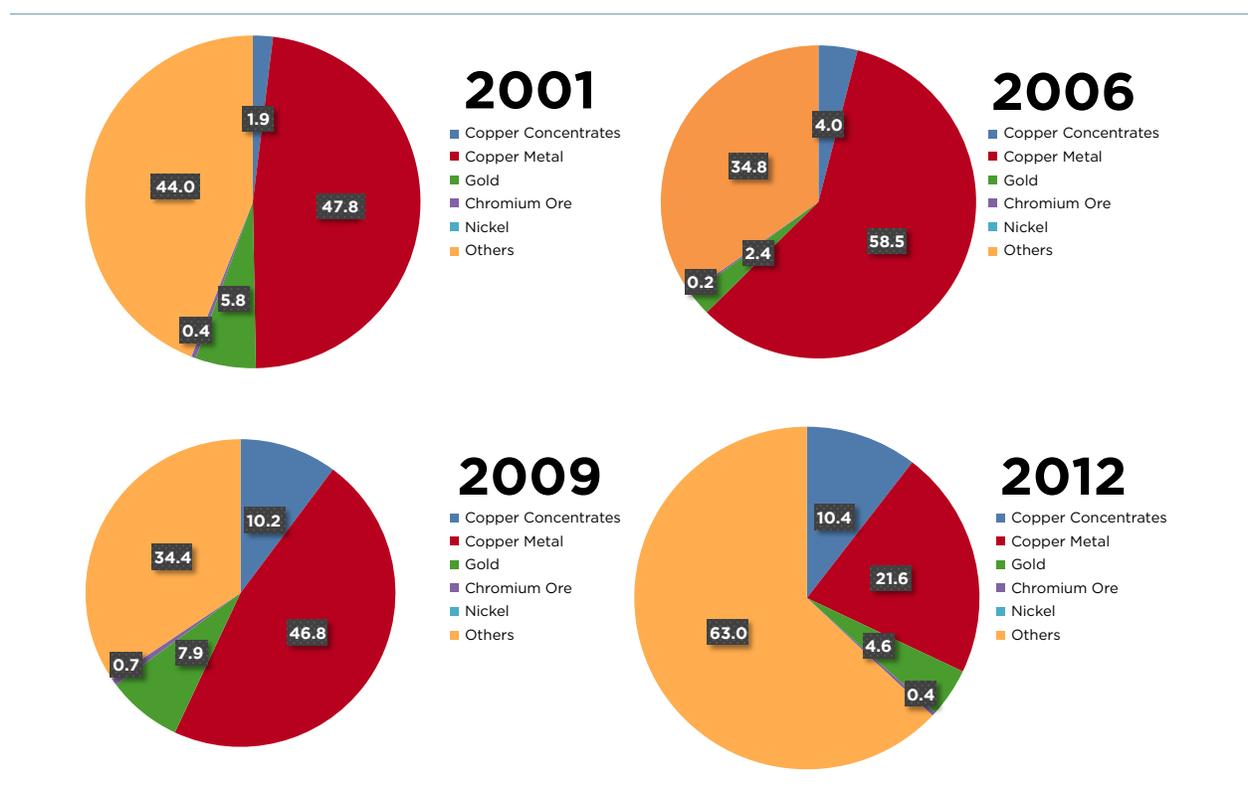
Box 6.1 • Risks and Opportunities for the Mining Sector in Botswana

The mineral accounts in Botswana showed that about 25 percent of gross domestic product (GDP) comes from the mining sector,[83] a substantial decrease from an average of 42 percent from 1985 to 1994. Botswana's economy is increasingly diversifying, but only slowly. Diamond mining still yields the highest earnings, with smaller contributions from base metals (copper, nickel, cobalt), coal, soda, ash, and gold. In 2015, diamond production decreased 15 percent. This decrease is expected to continue over the coming years. Diamonds were exported in rough form for many years, but in recent years, the diamond cutting, and polishing industry has grown steadily in Botswana. Coal is produced in small quantities, mainly for power generation in Botswana.

Resource rents are volatile, with some products having negative resource rents during the financial crisis. Rents from diamonds dominate resource rents, accounting for 94 percent of total resource rents. The government budget of Botswana is sustainable, meaning that recurrent spending is being financed from non-mineral sources and resource rents are invested well. The dependency of the economy on the mining sector provides many benefits to Botswana but is also risky. GDP depends on the sector, but mining employment is low, and water consumption by the mining sector is the second highest of the country, after the agricultural sector. The expected future increase in water demand from mining may increase the country's water scarcity.

Figure B6.1.1 • Resource Rent According to Mineral at Current Prices, 1994-2015

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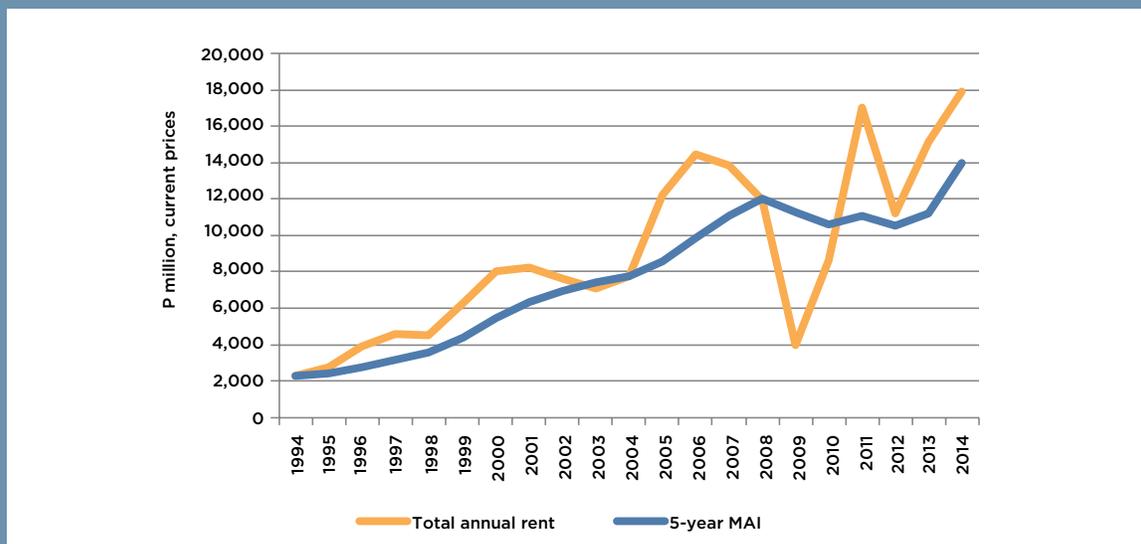
83   WAVES Botswana. 2015. Water Resources and Mining in Botswana. Policy Briefing. https://www.wavespartnership.org/sites/waves/files/images/Bostwana%20mining%20and%20water%20briefing-Jan.%202015.pdf

6.4.2. Capacities and tools

Capacity building—Unlike in many other accounts in the SEAA-CF and SEEA-EEA, the energy and mineral accounts are already partly integrated into the SNA via the balance sheet, but in monetary terms. Building the physical energy and mineral flow and asset accounts requires as much specialist knowledge of natural resources as building other types of natural capital accounts, but because the mining and energy sectors are large economic sectors and already partly in the national accounts, much of this knowledge is already within the agencies preparing national accounts; agencies also have established networks with key information providers, at least for the main economic data. That said, collecting the necessary physical information, properly distinguishing between primary and secondary energy use, determining the evolution of stocks of natural assets, and properly transforming energy flows into joules as a common accounting unit, among other things, is not common knowledge in most statistical agencies. It is also not common knowledge in the ministries that must include this information in their policy-making processes. Therefore, the capacity-building component was one of the most valuable components of the WAVES partnership, training not only those who compile the energy and mineral accounts, but also those who use them.

Box 6.2. Capacity Building for Energy and Mineral Accounts in Costa Rica

In Costa Rica, the staff working in the dedicated natural capital accounting (NCA) unit in the Central Bank were trained to compile water, forest, and energy accounts. The WAVES Costa Rica team also organized several workshops to share lessons and discuss the relevance of NCA in decision making and policy design. Stakeholders included academics, government officials, and potential NCA experts.

In Botswana, Statistics Netherlands organized training and capacity-building sessions for energy accounting, and an officer from the NCA unit attended a training course on the System of Environmental-Economic Accounting at the Australian National University. Moreover, Econsult, a local consultancy, organized sessions to develop macroeconomic indicators of sustainability and to learn how to update mineral accounts. An important milestone was the memorandum of understanding between the Ministry of Finance and Development Planning and the University of Botswana on NCA training, which will ensure future knowledge development and training opportunities.

Methodology development—The accounts are especially relevant as input in forward-looking, economy-wide models such as general equilibrium and integrated assessment models. Coherency with the SNA enables modelers to integrate the data into their models quickly, allowing for analyses of future energy needs, energy efficiency changes, carbon emissions, and developments in the mineral and mining sectors for several scenarios of change.

Box 6.3 • Using Accounts in System Dynamics Model in Indonesia

In Indonesia, the Ministry of National Development Planning used information and lessons from the Integrated System of Environmental and Economic Accounts, the Indonesian environmental accounting framework, to prepare low-carbon development plans and a roadmap toward greener growth.[84] For this, they developed a new economic model that measured the impacts of different development pathways for Indonesia. Four scenarios were considered:

- The base case, characterized by ongoing environmental degradation

- The Low Carbon Development Initiative Moderate scenario that is consistent with Indonesia's unconditional nationally determined contribution target of 29 percent less emissions in 2030 and introduces a set of low-carbon policy measures

- The Low Carbon Development Initiative High scenario that is consistent with the conditional nationally determined contribution target of 41 percent but reaches an emission reduction of 43 percent with more ambitious policy measures

- The Low Carbon Development Initiative Plus scenario that, after 2024, introduces additional, more-ambitious policy measures and considers a set of measures not considered in the current 5-year plan

A system dynamics model was constructed—Indonesia Vision 2045—that combines a set of feedback relationships between the macroeconomy, society, and natural capital into one integrated assessment model. Natural capital includes energy, land use, water resources, biodiversity, fisheries, and carbon emissions. The model can be used to assess a range of economic, social, and environmental policies. The results from this model are used in a geographically dynamic model and a global biosphere management model to better analyze the geographic impacts of the policy analyses.

The Ministry of National Development Planning built the model jointly with the New Climate Economy, the World Resources Institute, the World Bank, and other partners. WAVES contributed by providing data and protocols useful to integrate natural resource information into an economic model.

6.4.3. Institutions

Anchoring accounting in participating institutions—In several WAVES partnership countries, mineral and energy accounting units have been anchored firmly in the national statistical agencies. By creating NCA units within statistical agencies, organizing cooperation with universities, and institutionalizing data collection approaches, participating countries have made important steps toward ensuring continued compilation of energy and mineral accounts.

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84   BAPPENAS. 2019. Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia. BAPPE-NAS, Indonesia.

Box 6.4 • Institutionalizing Mineral and Energy Accounting

In Costa Rica, the Central Bank started building water and forest accounts during 2013 to 2015, which were categorized as priority resources. In 2016, they also started working on energy accounts and experimental ecosystem accounts, and the Central Bank initiated a dedicated natural capital accounting unit that will lead technical working groups to regularly compile water, forest, and energy accounts.

In Botswana, collecting data on changes in mineral stocks was complex. The data covered multiple minerals and many different companies from whom information had to be obtained. An important milestone, very important for guaranteeing future compilation and data quality, was development of new templates for direct data collection from mining enterprises.

In Indonesia, accounts were institutionalized through innovative legislation as part of broader legislation on natural capital and economic instruments. Interagency coordination played a key role in setting the basis for institutionalizing a coordination mechanism on data sharing and policy analysis. This is largely due to the institutionalized Steering Committee, which issued a new decree on the establishment of the Coordinating Group for implementation of the Integrated System of Environmental and Economic Accounts.

Improved policy processes within institutions—The accounts for energy and mineral resources have influenced policy-making processes in the institutions involved. Several participating countries have set energy efficiency and emission targets and monitor their GHG emissions, for which the energy accounts are indispensable. In addition, the accounts were used to prepare policies to reach their energy targets. The mineral accounts have provided essential information for monitoring government budget sustainability and for planning future mining activities. Moreover, by combining the mineral accounts with water and other natural capital accounts, countries have learned about the net benefits of their mineral exploitation, which include not only the resource rents, but also the negative impacts on water resources and ecosystem services. The influence of the accounts is not often seen directly. Accounts often indirectly influenced policy processes and policy makers through the insights they provided, the cooperation between institutions they enabled, or the analyses in which they were used.

6.4.4. Policy use and decisions

The energy and mineral accounts have provided relevant information for many policy plans and have influenced existing policies in WAVES partnership countries. Table 6.2 provides an overview of the policy uses and decisions that have been taken based on the energy and mineral accounts.

Policy planning—In several countries, the energy accounts fed into national energy plans to make the country less dependent on fossil fuels and to plan for ways to set nationally determined contributions to the Paris Agreement. The energy accounts provide time series of energy efficiency improvements according to sector, as well as changes in the energy mix in the country, both of which are essential for determining realistic targets for nationally determined contribution pledges per country.

Box 6.5 • Contribution to the National Energy Plan of Costa Rica

The energy accounts of Costa Rice provided input into the expansion plan of electricity generation of the National Electricity Institute. The VII National Energy Plan (2015-2030) aims to reduce the country's dependence on fossil energy sources and realize higher economic growth with less use of petroleum and lower greenhouse gas emissions. The energy accounts show the energy intensity of each economic activity and therefore helped target the industries and energy sources where improvements in energy intensity were possible. They helped determine input-output ratios based on energy consumption, providing better understanding of the relationship between the energy sector, the environment, and the economy. In that way, they assisted in formulating policies related to the VII National Energy Plan and as a monitoring tool for energy use patterns, productivity, and sustainability.

The National Development Plan of Costa Rica has a stated environmental objective, particularly regarding decarbonization of the economy. The energy and emission accounts that the Central Bank compiled provide the data to monitor progress and, if necessary, to propose policy changes. (WAVES Annual Report 2018).

Box 6.6 • Reaching the Nationally Determined Contribution for Indonesia

In its National Climate Action Plan, the government of Indonesia has set a target (nationally determined contribution) to reduce greenhouse gas emission by 41 percent below baseline.[85] Reaching this target is a major challenge. The energy accounts are not only necessary for monitoring this but have also proven their importance in designing the policies to reach this target. Information from the Indonesian environmental accounting framework and insights from the analyses were input into the Low Carbon Development Indonesia report. One of the key findings of this report was that a low carbon growth path can deliver an average gross domestic product growth rate of 6 percent annually until 2045. Through the sustainable use of its natural resources and by reducing its carbon and energy intensity, Indonesia's total greenhouse gas emissions can be decreased by nearly 43 percent by 2030. This surpasses Indonesia's target of a 41 percent decrease in its national climate action plan. In addition, the low carbon growth path reduces extreme poverty, generates jobs, and avoids deaths due to poor air quality. In addition, by 2045, it could lead to a level of well-being that is comparable with that of many European countries.

Policy monitoring, review, and reform—Monitoring progress is probably one of the most important contributions of the energy and mineral accounts to policy making. By regularly updating the accounts, the impacts of energy, climate, and mineral policies can be monitored. The energy accounts time series in Botswana, Costa Rica, and Indonesia showed whether energy intensity

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85   Low Carbon Development Indonesia. 2019. Low Carbon Development: A Paradigm Shift Towards a Green Economy in Indonesia. Kementerian PPN/Bappenas.[[Is this different from the reference in footnote 89?]]

policies reached the envisaged targets and whether they were following the pathway toward their GHG emission targets. The accounts show not only whether countries follow the right pathway, but also in which sectors or regions the best results are attained or how the policies affect other resources or sectors. For instance, the suite of accounts compiled for the Palawan region in the Philippines shows how the mining, agricultural, fisheries, and tourism sectors interact.

Review of existing fiscal and economic energy and mineral policies—The accounts also provided indispensable inputs for regulations such as fiscal spending rules in all the countries that made mineral accounts, including Botswana and the Philippines. Countries with mineral stocks are usually dependent on these assets. They need strong fiscal regulations to receive sufficient rents from their resources. On the other hand, fiscal spending rules are important to avoid too volatile government budgets. The mineral accounts have proven that they provide important information to improve fiscal policies related to minerals. The analyses that used the accounting information enabled policy makers to assess expected impacts of multiple policy responses and select optimal policies.

> **Box 6.7 •** Use of Accounts for Fiscal Policies in Botswana
>
> Botswana has a sTable mineral fiscal regime, with revenues invested in social and economic development. The fiscal regime is based more on guidelines than strict rules, which may work for now but may not be sufficient if the mining industry matures and resource rents decline. The time series of mineral accounts for Botswana show that the peak of minerals' contribution to government revenues may have passed. The accounts show how mineral stocks change over time and what fiscal returns can be expected in the future. This provides input into discussions about how to make the fiscal framework future proof.
>
> In the Philippines, reforms are necessary to regulate the mining sector and to address social and environmental concerns of mining activities. Mineral and other natural capital accounts provided input into the on-going deliberations on a new mining fiscal regime and revenue arrangements between the government and mining sector. This includes benefit-sharing arrangements for indigenous peoples and communities in the mining regions.

Reviewing investments in energy infrastructure—The energy accounts enable better predictions of energy needs and therefore provide for better investment planning for energy infrastructure. They show the sectors that need the energy and the energy sources for which capacities may have to be expanded.

In Costa Rica, the National Electricity Institute has developed an expansion plan for electricity generation. Based on predictions of future energy use and considering the country's renewable energy targets, the plan considers the sources of energy that the country's productive sectors use. In this way, the accounts provide essential inputs into the expansion investment plans.

In Rwanda, the land and water accounts, rather than the energy accounts, provided input into investments to safeguard the country's energy security. A land-use trade-off tool was developed using data from land, water, and ecosystem accounts to analyze impacts of land use change.

Insights into the sedimentation that land degradation caused was an important input into decisions on large-scale landscape protection investments and investments to maintain water storage capacities of dam reservoirs.

Table 6.2 • Use of Energy and Mineral Accounts at Different Stages of Policy Making

Country	Policy planning	Policy monitoring, review, and reform
Botswana	• Accounts inform National Development Plan 2017-2022, National Strategy for Sustainable Development, National Vision 2036, and new Economic Recovery Plan. • Mineral accounts are used for predicting changes of fiscal returns from mineral mining over time.	• Water accounts, jointly with mineral accounts, were used to agree on covenants with the mines to encourage efficient water use.
Colombia		• Diverse accounts were used to derive a broad range of indicators to measure and monitor the green growth policy. The Green Growth National Strategy focuses on reduction of deforestation, reduction of GHG emissions, and strengthening of climate change adaptation.
Costa Rica	• Integration of environmental objectives into National Development Plan. • Water and energy accounts informed Power Generation Expansion Plan and National Development Plan, both of which affect technology and infrastructure investment and cost recovery strategies. • Water and energy accounts supported the Power Generation Expansion Plan as part of the National Energy Plan 2015-2030.	• Energy accounts were used as a monitoring tool for energy use patterns, productivity, sustainability, and decarbonization.
Guatemala	• Forest accounts informed the forest section of the National Development Plan'K'atun: Our Guatemala 2032. • Multiple accounts served as a basis for modeling fuelwood use and impacts of sanitation on development using the Integrated Economic-Environmental Modeling compuTable general equilibrium model.	

Country	Policy planning	Policy monitoring, review, and reform
Indonesia	• Low Carbon Development Indonesia plan highlights renewable energy investments required to reach Indonesia's climate targets. • Mineral, land, and ecosystem accounts were used to analyze the impact of easing the export ban on semi processed minerals on the environment and the economy. • Diverse accounts provided information used for the analyses underlying Vision Indonesia 2045 and Low Carbon Development Initiative, which are included in the current 5-year development plan 2019-2024. • Energy accounts played a role in designing policies to reach the GHG reduction targets as set in the nationally determined contribution to the Paris Agreement. • Ministry of National Development Planning uses asset accounts to model growth limits and economic capacities and develops green economy scenarios in a system dynamics model.	
Philippines	• Inputs to technical bulletin on Carbon Accounting, Verification and Certification System: Incorporation of ecosystem approaches in Forest Land Use Planning process.	• Information from mineral accounts helped shape fiscal regime and budget reforms and potential benefit-sharing arrangements with indigenous peoples resulting from mining.
Rwanda	• Information from a land-use tradeoff tool developed in conjunction with the mineral accounts—building on land and mineral accounts, among other inputs—informed a nationwide program for land-use planning.	

GHG, greenhouse gas.

6.5. Reflection—lessons from WAVES support to energy and mineral accounts

Use energy and mineral policies for integral analyses—In many countries, energy and mineral accounts are much closer to the core of government priorities than most of other natural resources such as water, forest, or ecosystem services. Energy and minerals are, to a certain extent, already part of the national accounts and usually cover a significant part of the formal economy and, for these reasons, are already institutionalized within statistical agencies. This provides a solid basis for broadening the scope of the energy and mineral accounts in the SNA and producing full energy and mineral accounts. This also allows for integrated analysis with other natural capital accounts that show, for instance, trade-offs between mineral exploration, water scarcity, and tourism potentials or between hydropower potential and impacts of improper water and land management.

Mineral exploration affects macroeconomic development—Mineral accounts in the Philippines, Botswana, and Zambia were important for monitoring macroeconomic stability. They also showed the importance of minerals to the economy, which is not always as great as previously envisaged. The accounts also clearly show the negative impacts of mineral exploration, such as water pollution and land degradation. The accounts show the balance between short-term gains from mining

of minerals and long-term sustainable development. They provide the information necessary to diversify the economy or reduce negative externalities from mineral mining yet reducing dependency on minerals is not easy. Individuals who are harmed do not have as strong a voice as mining companies and do not contribute to short-term benefits to the country's budget.

The energy and mineral accounts show the inconvenient truth—The energy and mineral accounts reveal politically sensitive insights. They can show inconvenient truths, such as that energy or GHG emission targets are not reached or that the net economic contribution of mineral mining is less positive than envisaged. If the accounts are firmly embedded in the government machinery and policy procedures, trustworthiness of the accounts will be better ensured, and policy makers will be more inclined to accept the inconvenient truths. In all countries, this has been addressed through high-level steering committees and joint fact-finding and knowledge-sharing initiatives. Continuation of these institutional mechanisms is important to firmly institutionalize the accounts.

7

7. CONTRIBUTIONS OF WAVES AT THE GLOBAL LEVEL

7.1. International capacity and networking

The WAVES partnership has emphasized international capacity building and networking. Through many types of networking and capacity-building meetings, workshops, and forums, participants from countries shared experiences and lessons, stimulating and improving account development. Seeing the NCA applications in other countries, the country teams became enthusiastic about the potential of NCA, encouraging them to further develop and institutionalize NCA in their own countries. Three activities stand out: the WAVES annual partnership meetings (APMs), the WAVES International Forum on NCA for Better Policy Decisions, and the global and regional training initiatives and workshops.

7.1.1. WAVES APMs

The regular APM of WAVES program partners has evolved a highly collegial, experience-sharing, lesson-learning, open-discussion approach that largely set the tone for the broader WAVES NCA policy forum described below.

Although each APM has addressed routine program management business, over the years, several trends have become apparent. The 8th APM (which took place in November 2018 in Paris, immediately after the third NCA policy forum) offered an opportunity to highlight the following topics.

- ▶ **Country engagement:** Partnership countries from Africa, Latin America, and Asia now lead the APM discussion on NCA supply- and demand-side issues far more frequently than in the early years, when the World Bank and donors more often led it.
- ▶ **Vision for NCA:** High-level representatives from partnership countries have become increasingly knowledgeable and ambitious about NCA's impact. At the 2018 APM, three ministers from WAVES partnership countries offered a compelling vision of "why NCA and its potential" for realizing natural capital values from neglected resources (Zambia), real confidence on "how to do NCA and with what results" (Rwanda), and high-level recognition of NCA and respect for the NCA community (Indonesia).
- ▶ **Institutionalization of NCA:** With NCA having established its real potential for improving decisions, there is an aspiration to embed NCA in the machinery of government, although there are concerns about the sustainability NCA from a financial angle and technical support.
- ▶ **Donor collaboration:** WAVES donors have been able to fully understand the program

by participating in the APMs and to offer appropriate advice and support, contributing to joint solutions and not only asserting individual agency priorities.

▶ **Involvement of the WAVES PTEC:** During earlier APMs, the expert members of the WAVES PTEC (Box 7.1) were present to reflect on progress in WAVES partnership countries and to share new developments in NCA in terms of methodology and NCA use in other countries. These reflections inspired participants to try new approaches and use the accounts for other policies.

These trends are all positive and have derived from the experience-sharing and lesson-learning emphasis of APM agendas and facilitation, with its focus on country case studies and building a WAVES community of practice. Country participants have especially appreciated holding some APMs in partner countries and organizing field trips. However, they have also frequently raised untapped potentials: of better communicating what NCA has done, of more South-South collaboration, and of other ways of meeting.

Box 7.1 • Wealth Accounting and the Valuation of Ecosystem Services (WAVES) Policy and Technical Experts Committee (PTEC)86

The WAVES PTEC consisted of a multidisciplinary group of world-leading specialists in economics, environmental accounting, natural sciences, and policy from the World Bank, UN Environment Programme, academic institutions, think tanks, and governments. It operated from November 2012 to May 2016 and was of vital importance in the early stages of the WAVES program—in conducting research for WAVES, acting as a consultative group for the World Bank, and advising on the work plan. PTEC members explored approaches to valuation and contributed to development of new methodologies for ecosystem accounts, helping WAVES contribute to internationally agreed guidelines. PTEC oversaw work compiling new evidence of in-country policy applications of NCA and explored its implications. It also provided advice on establishing a community of practice on development and use of NCA. Ultimately, PTEC's work inspired the global NCA policy forum, which in many ways is an expansion of the original PTEC exchange and consultative role, albeit no longer focused on the WAVES program alone.

7.1.2. The International Forum on NCA for Better Policy Decisions

WAVES has catalyzed and supported a unique global forum to bring together developers and users of NCA. Meeting each year since 2016, the international Forum on NCA for Better Policy Decisions has grown, diversity, and influence.

Drivers of the forum—By 2016, WAVES' and partners' experience in the first five WAVES countries had identified key trends that needed a rethink as the work progressed. Although natural capital accounts were proliferating around the world, attention to their production was not matched by promoting and using them in policy decisions. Although NVA had been used successfully to

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86   https://www.wavespartnership.org/en/waves-policy-and-technical-experts-committee-ptec

inform policy decisions, little of this experience was being shared. Meanwhile, countries were continuing to sign up for multiple comprehensive policy commitments (e.g., SDGs,[87] inclusive green economies, low-carbon development) without a good information base upon which to implement them

What WAVES did—In 2016, WAVES partners decided it was time to bridge many gaps by linking:

▶ developers of NCA (*supply-side* accountants and statisticians) with potential users of NCA (*demand-side* decision makers)

▶ countries that had much experience of NCA with other countries just starting NCA

▶ the many international institutions and frameworks supporting NCA, notably UNSD, which maintains the SEEA standard; the Natural Capital Coalition, which maintains the Natural Capital Protocol business standard; the World Bank; and key funders

How WAVES did it—The Forum on NCA for Better Policy Decisions has successfully played these bridging roles through a mix of engagement objectives, learning objectives, and policy influence objectives. The forum has met annually—for 2 days each year in 2016 and 2017 (The Hague), 2018 (Paris), and 2019 (Kampala). It shared experiences of high-, medium- and low-income countries on building and using NCA through high-level keynote speeches, expert case study and synthesis papers and presentations, panel discussions, and group work—all subsequently presented and summarized in freely available published proceedings.

For each forum, an organizing committee of hosts and facilitators shaped the annual agenda. To ensure it met the needs of participants and donors, participant surveys were conducted before each forum meeting. The annual forum agendas focused on demand-led policy challenges:

▶ Understanding and influencing national public policy processes (2016)

▶ Implementing holistic policy (SDGs, green growth, poverty reduction) and linking private sector and government work on natural capital approaches (2017)

▶ Improving policy decisions that affect biodiversity and climate change (2018)

▶ Discussions each year regarding the special challenges of making geographic and social distributional decisions, especially at local levels, leading to the 2019 forum being dedicated to improving local management and governance

In advance of each forum, the Dutch Environmental Protection Agency contributed an in-depth report relating NCA to that year's topic, providing a basis for the discussions. During forum meetings, participants co-constructed consensus views on best ways forward for the themes discussed in terms of principles and action agendas for specific challenges. This was realized through independent facilitation, encouraging trust-building between diverse participants from many countries and disciplines, and offering a safe space for debate.

What WAVES achieved with the forum: Although it used only a small proportion of WAVES' resources, the forum's results are impressive:

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87   The SDGs themselves include a commitment to NCA in SDG17.

▶ **Information:** More than 50 forum papers and four annual deliberations have analyzed a huge range of policy uses of NCA and ways to bridge the data–policy gap, covering more than 20 countries. The World Bank published the full proceedings of each forum, each with several in-depth papers on country and thematic experience, many with developing country authors, and all edited to a good professional standard. This has significantly added to the evidence base on how to influence policy through NCA, including a synthesis paper.88

▶ **Networking and capacity:** Growing numbers of participants (45 in 2016, 60 in 2017, 134 in 2018) from countries on all five continents and a range of institutions from government, business, civil society, and academia and including economists, accountants, statisticians, policy makers, financiers, and entrepreneurs from the supply and demand sides of NCA, have been attracted to the forum. The diversity has been well managed, increasing mutual understanding and good connections.

▶ **Institutional cooperation:** The forum has also enabled international institutions active in NCA to come together and combine energies. As the forum has evolved, key international actors have become active partners: notably UNSD (the custodians of the SEEA standard); the Natural Capital Coalition (which networks many private sector actors); and the Dutch, French, and German governments. The forum has helped with trust building, mutual recognition, and joint work; the 2018 and 2019 forums each kicked off a week of natural capital activities led by different partners.

▶ **Policy norms:** All forum participants have contributed to valuable co-created products, including the 10 living principles for decision-centered NCA that inform (and not just monitor) the whole policy cycle (Table 7.1); these were developed at the 2016 forum and validated in 2017. The 2018 forum enriched a draft-shared narrative on why natural capital matters to governments and the levers of change. Each forum has concluded with NCA for policy priorities and steps to take, covering issues as diverse as:

- NCA's role in informing a wide range of holistic policies such as SDGs, green growth, and poverty reduction—and not only sector policies that closely map to, for example, individual forest accounts or water accounts (yet also showing that many types of accounts can inform sector policies)

- NCA informing treatment of climate change loss and damage and biodiversity loss and protection

- Rationalizing data protocols and guidelines between various international policy mandates for climate, the environment, and the accounting framework (SEEA for governments, Natural Capital Protocol for business)

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88 Ruijs, A., M. Vardon, S. Bass, S. Ahlroth. 2019. Natural Capital Accounting for Better Policy. Ambio 48:714-725. https://doi.org/10.1007/s13280-018-1107-y

Table 7.1 • The 10 Living Principles for Natural Capital Accounts[89]

Comprehensive	
1. Inclusive	Acknowledging the diverse stakeholders concerned with decisions affecting natural capital, responding to their information demands, respecting different ideas of value, using appropriate means of engagement
2. Collaborative	Linking producers and users of natural capital accounts for policy analysis and policy makers using natural capital accounts results and building mutual understanding, trust, and ability to work together
3. Holistic	Adopting a comprehensive, multidisciplinary, interdisciplinary approach to the economic and environmental dimensions of natural capital and to their complex links with policy and practice
Purposeful	
4. Decision centered	Providing relevant, timely information for indicator development and policy analysis to improve and implement decisions with implications for natural capital
5. Demand led	Providing information that decision makers at specific levels request or need
Trustworthy	
6. Transparent, open	Enabling and encouraging public access and use of natural capital accounts, with clear communication of results and their interpretation, including limitations of data sources, methods, and coverage
7. Credible	Compiling, assessing, and streamlining data from all available sources and deploying objective, consistent science, and methodologies
Mainstreamed	
8. Enduring	With adequate, predicTable resourcing over time, continuous application and availability and building of increasingly rich time series of data
9. Continued improvement	Learning focused, networked across practitioners and users, testing new approaches, and evolving systems to better manage uncertainty, embrace innovation, and take advantage of emerging opportunities
10. Embedded	Natural capital accounts production and use becoming part of machinery of government and business, building capacity, increasing institutional integration for sustainable development, incorporating natural capital account use into procedures and decision-support mechanisms

Looking forward—The forum has increased understanding, confidence, trust, readiness, and collaboration to embed NCA and use it to improve policy decisions. It has firmly linked decision makers with NCA producers. It has created a real sense of NCA being used to address complex problems and realize opportunities. The following ideas are now on the horizon for the forum:

▶ **Community of practice on NCA for policy:** Through the forum's annual events, it has become clear that participants are as important as the agenda. The need for effective mobilization of stakeholders with shared concerns suggests that the forum should evolve as a committed community of practice and not just an annual event, with more emphasis on activities between annual meetings. WAVES is exploring the prospects for an African community of practice.

▶ **Guidance on NCA for policy:** The forum's successful sharing and learning has built up a large collection of reports on what works in terms of NCA informing policy in country.

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89   Bass et al. 2017. Natural Capital Accounting for Policy – A Global View of Achievements, Challenges and Prospects https://www.wavespartnership.org/sites/waves/files/kc/WAVES%20report%20final%20version%20%20%281%29.pdf

This material is didactically valuable, and there is potential to synthesize the learning, perhaps as a precursor to more formal guidance, which would be in the mandate of UNSD.

▶ **Mutual support for institutionalizing NCA in effective, efficient ways:** There is now the need and potential to progress from one-off or pilot accounts to embedding NCA as an integral, regular part of the machinery of government and business. In doing so, there is potential for forum participants to collaborate in country, not only through annual meetings.

7.1.3. Global and regional training

Before the WAVES program was established, few people in WAVES core implementing countries or even globally had experience developing and using NCA. There was little guidance or training material available, especially covering the whole cycle of NCA development and use. The program therefore had almost to start from scratch. A priority was to train the people in country who would prepare the accounts.

WAVES used four main approaches—all of them practical and experiential rather than overly formal and academic: in-country, on-the-job training involving formal training sessions and ongoing professional support; national, regional, and global workshops; peer mentoring; and training trainers. Other WAVES knowledge activities supported this: production of introductory training material, notably by the Australian National University, Australian Bureau of Statistics, and World Bank, and the growing number of resources available on the WAVES knowledge platform, which enabled exploration of diverse experience. In terms of comprehensive, standardized guidance, WAVES' reference point was the SEEA methodology and training manuals. Statistics Netherlands and the Dutch Environmental Protection Agency, funded by the Dutch Ministry of Foreign Affairs, and the Australian Bureau of Statistics, funded by the Australian Department of Foreign Affairs and Trade, provided significant support in country and regionally. In addition to Statistics Netherlands and the Australian Bureau of Statistics, Statistics Canada and Statistics Sweden have given in-kind support by reviewing accounts that WAVES partner countries have developed. Receiving this validation from international experts is of great importance to countries starting to develop NCA.

On-the-job training—An early emphasis of the WAVES program was strong technical training while people were working on the accounts. Key agency staff in country were linked to statisticians and others experienced in NCA, often for months or years. Many trainers were from specialist WAVES partners, notably Statistics Netherlands, the Australian Bureau of Statistics, Australian National University, and the International Institute for Environment and Development (IIED). Training in NCA took place on the job, supplemented by technical training workshops for preparing specific types of accounts, using geographic information systems, modeling, developing communications, and other activities critical to NCA development and use. This enabled participants to learn about the practical challenges and strategies of accounting while being guided through real-time construction of accounts. This component was, as planned, time consuming, but it built real capacity and ownership and is doubtless why NCA has become embedded in most WAVES core implementing countries. It created an enabling environment in which participating institutions came to embrace accounting and built enough capacity to continue NCA work.

Workshops—WAVES ran many regional and global workshops. Some were focused on training, but even those that were not—such as the APMs—included opportunities for peer-to-peer sharing of experience and other didactic approaches. By 2016, WAVES was able to claim that its international

workshops had reached 104 institutions in 23 countries and an additional 20 global or regional organizations.[90] These workshops were held for experience sharing, networking, methodology development, communications, scoping, and planning reasons, as well as for formal training. They served to get the idea of NCA discussed, understood, accepted, and in some cases lodged in agencies' agendas and commitments. For example, to address ecosystem accounting, it was decided to hold initial South-South peer learning and knowledge exchange regional workshops on ecosystem accounting in the Philippines in 2015[91] and Indonesia in 2016.[92] Most WAVES workshops were held with partners, ranging from UNSD and the UN Economic and Social Commission for Asia and Pacific and Economic Commission for Latin America and the Caribbean to Conservation International, the U.S. National Aeronautics and Space Administration, World Water Network, and the Secretariat of the Gaborone Declaration on Sustainability in Africa.

Peer mentoring—Given increasing interest in NCA beyond the core implementing countries, WAVES developed a catalytic role for the regions in which it had national programs: increasing the understanding and capacity of strategically placed stakeholders in other countries to apply NCA to critical policy needs, sharing experience and lessons, and linking graduated WAVES countries with others. For example, staff from Botswana, Colombia, Costa Rica, and the Philippines—the original WAVES countries—acted as regional mentors after the end of their WAVES programs, advising other countries in their respective regions. In addition, a memorandum of understanding between Rwanda and Costa Rica helped knowledge sharing on how to use the accounts for PES initiatives.

Training trainers—Capacity was also built among those who can continue to train successive generations of NCA expertise in country. In most WAVES partnership countries, universities are already involved in supplying future capacity needs; for example, the University of Rwanda and the Universidad Rafael Landivar in Guatemala are training students in NCA. Government agencies are playing their part too; for example, the Philippines Statistics Agency is providing SEEA training to staff members of sectoral agencies.

7.2. Global methodology

7.2.1. Experimental ecosystem accounting

The SEEA-CF was adopted as an international standard for NCA in 2012. At the time, ecosystem accounting was not developed enough to be part of this standard but was published separately in the SEEA Experimental Ecosystem Accounting (SEEA-EEA) manual.[93] The approach was designed to measure and value ecosystem services. The SEEA-EEA also has a spatial approach, which means that changes in the contribution of ecosystem services to a nation's economy can be mapped and measured over time.

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90   WAVES Annual Report 2017 https://www.wavespartnership.org/en/knowledge-center/waves-annual-report-2017

91   https://www.wavespartnership.org/en/knowledge-center/first-waves-global-knowledge-exchange-ecosystems-and-their-valuation

92   https://www.wavespartnership.org/en/indonesia-hosts-first-waves-south-south-knowledge-exchange

93   In 2021, following the end of WAVES, the SEEA - Ecosystem Accounting was adopted as an international standard." You could embed the link https://seea.un.org/ecosystem-accounting into SEEA Ecosystem Accounting. The actual decision is on pp 8-9 of the UN document linked here https://unstats.un.org/unsd/statcom/52nd-session/documents/decisions/Draft-Decisions-Final-10March2021.pdf

There are many technical challenges, and the SEEA-EEA approach is an experimental one. The experiences of different groups trying it for different ecosystem services in different contexts to answer different policy questions have been instrumental in efforts to refine it as an agreed-upon international statistical standard alongside the SEEA-CF. This is where WAVES has played a leading role, supporting methodological development, testing, and refinement. WAVES has facilitated practitioner interaction on ecosystem accounting and field testing of different approaches. This has clarified key conceptual issues; supported research in key areas, notably valuation of ecosystem services and measuring biodiversity; provided tools and guidance for implementation; and generated data through experimental accounts in WAVES core implementing countries. WAVES has also supported capacity in the core countries and, more broadly, through a series of regional and global training events[94] and developing an e-learning course on ecosystem accounting with the UNSD.[95]

WAVES has done this with key partners—notably UNSD, UN Environment Programme, and UN regional commissions—to ensure mainstreaming of the results in the international framework, as well as the European Union and the Dutch, U.K., and German governments—which have committed to ecosystem accounting and have much experience of it. WAVES co-organized or participated in several international meetings that were part of the critical path for developing and agreeing upon the methodology for ecosystem accounting. These culminated in WAVES co-organizing the 2018 and 2019 Forum of Experts in SEEA-EEA,[96] which brought together experts from all over the world, including former and current WAVES countries the Philippines, Costa Rica, and Indonesia. In addition, WAVES contributed to key technical groups, notably the SEEA-EEA Technical Committee[97] and the London Group on Environmental Accounting (see Box 7.2). Finally, WAVES has worked with the Group on Earth Observations in a joint initiative, Earth Observations for Ecosystem Accounts, which has increased understanding of how satellite data can inform ecosystem accounting with higher-quality, more-timely data.

Box 7.2 • Wealth Accounting and the Valuation of Ecosystem Services' (WAVES') Experiences as Input in the Meetings of the London Group on Environmental Accounting

WAVES partners have participated actively in meetings of the London Group on Environmental Accounting.[98] For instance, during the 21st meeting in 2015, the WAVES teams from Guatemala, the Philippines, and Colombia presented their experiences with ecosystem accounting. During the London Group meeting in 2016, the water accounting experiences of Botswana were shared. In 2017, the Central Bank of Costa Rica hosted the London Group meeting, during which Colombia presented its experiences with the System of Environmental-Economic Accounting. This included lessons on their mineral and energy accounts. The presentation from Costa Rica also covered the linkage of the energy accounts with the carbon emission accounts, as well as their experience with the usefulness of the accounts in the policy-making process.

7.2.2. Biodiversity, valuation, and other unresolved methodological problems

The WAVES team has contributed substantially to the knowledge base on unresolved problems in ecosystem accounting. The following reports are especially worth mentioning.

94. E.g., First WAVES Global Knowledge Exchange on Ecosystems and their Valuation, https://www.wavespartner-ship.org/en/global-knowledge-exchange-ecosystems

95. https://elearning-cms.unstats.un.org/course/category/1

96. See, e.g., https://seea.un.org/events/forum-experts-seea-experimental-ecosystem-accounting-2018 and https://seea.un.org/events/technical-expert-meeting-revision-seea-eea-2019

97. https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision

98. https://seea.un.org/content/london-group-environmental-accounting

▶ **Prices for Ecosystem Accounting (2017:** is a research report that describes the extent to which ecosystem service values estimated using valuation techniques from environmental economics are consistent with the valuation principles of the SNA.99 The discussions it has prompted are being used in the drafting of the new handbook for ecosystem accounting.

▶ **Managing Coasts with Natural Solutions (2016):** co-authored by WAVES and the Nature Conservancy, provides guidance on how to measure and value the coastal protection services that coral reefs and mangroves provide in ways that work for mainstream players.100 It applies assessment techniques commonly used in the engineering and insurance sectors alongside frameworks consistent with national economic accounts. The report shows how to include these values in decision-making processes for development, disaster risk, and coastal zone management. It makes the case that mangroves and reefs can substantially mitigate coastal risks such as flooding, erosion, and severe weather and can offer sustainable, cost-effective alternatives to traditional grey infrastructure such as sea walls. This was the first publication of its kind, attracting significant interest (downloaded 385 times in the first 2 months), and its guidelines have been implemented in several countries.

▶ **Defining Ecosystem Assets for Natural Capital Accounting (2016):** is a WAVES-supported research paper that explains the concepts of ecosystem capacity and degradation for mapping, modeling, and valuing ecosystem services within accounts.101 In the SEEA, ecosystem assets tend to be valued on the basis of the net present value of the expected flow of ecosystem services. The paper demonstrates how other ways to understand ecosystems as assets are needed, ecosystems' capacity and ability to supply ecosystem services, as well as the potential supply of ecosystem services.

▶ **Compendio de artículos sobre cuentas de energía y emisiones en los países de ALC.102 This working paper published in Spanish was based on a 2017 regional workshop held in Guatemala that translates as Agendas for Sustainable Development:** How Accounting for Energy and Emissions Can Contribute to the Design of Policy and Decision Making. The publication provides practical suggestions for how energy and emissions accounts can be used in Latin American countries.

In addition to publishing these reports, the WAVES team has brought biodiversity accounting a step forward. In contrast to recent global progress in ecosystem services accounting, biodiversity accounts have remained a challenge[103] because of the uncertain links between biodiversity and ecosystem services; contestation over the values of biodiversity, with over-reliance on "willingness

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99   Atkinson G., and C. Obst. 2017. Prices for Ecosystem Accounting. WAVES Partnership, World Bank https://www.wavespartnership.org/en/knowledge-center/prices-ecosystem-accounting

100 World Bank. 2016. Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs. WAVES, World Bank. https://www.wavespartnership.org/sites/waves/files/kc/Technical%20Rept%20WAVES%20Coastal%202-11-16%20web.pdf

101 Hein, L., K. Bagstad, B. Edens, C. Obst, R. de Jong, and J.P. Leschen. 2016. Defining Ecosystem Assets for Natural Capital Accounting. PLOS One. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0164460

102 World Bank. 2017. Compenio de artículos sobre cuentas de energiía y emisiones en los países de ALC. WAVES, CEPAL, World Bank https://www.wavespartnership.org/sites/waves/files/kc/compendio.pdf

103 Ruijs and Vardon. 2018. Natural Capital Accounting for Mainstreaming Biodiversity in Public Policy. PBL Netherlands Environmental Assessment Agency https://www.pbl.nl/en/publications/natural-capital-accounting-for-mainstreaming-biodiversity-in-public-policy

to pay" methods for valuing biodiversity; differing concepts and measures of biodiversity at the ecosystem, species, and genetic levels; and data scarcity.

Nevertheless, a small but growing group of countries is producing biodiversity accounts covering ecosystem extent, ecosystem condition, and species. Species accounts are less common and focus in general on endangered species. Little attention seems to be paid to species abundance accounts, and no attempts have been made to generate genetic diversity accounts. WAVES has helped address the many methodological obstacles to incorporation of biodiversity values into economic accounts.

Valuing ecosystem services has been of intense interest to countries. WAVES has contributed in a number of ways, including the papers by PTEC members exploring relationships between concepts of marginal value (as used in the System of National Accounts and SEEA) in several stylized economies and evaluating the consistency of the exchange value concept relative to different methods of valuing production externalities and environmental public goods.[104] A paper on prices for ecosystem accounting,[105] which explores how commonly used valuation techniques in environmental economics can be used to estimate exchange values for ecosystem services, also addresses this. The paper includes a worked-through example to show how to include ecosystem flows and stocks in NCA in physical and monetary units.

WAVES' work on EEA has contributed significantly to sustainable development, notably in terms of the second sustainable development building block: tools and methodologies.

7.3. Global analysis: CWON

In 2018, the World Bank released CWON 2018,[106] which WAVES supported because it complements WAVES' work on NCA in several strategic ways (Box 7.3). First, CWON addresses differences in natural capital between countries, time periods, and development stages. Second, it offers insights into the relative importance of natural and human capital and other forms of capital that make up a nation's wealth. Third, it has stimulated policy debate on what constitutes wealth, how to assess it, and how to track it over time—which opens possibilities of expanding from NCA to wealth accounting.

WAVES support to CWON's background papers enriched the method and data available. It covered forest assets (improving timber and ecosystem service values), agricultural land (with better estimates of rental values and how climate change affects them), and mineral assets (drawing on datasets on the costs of mineral extraction to improve mineral value estimates). These in turn fed into the global CWON assessment.

WAVES helped the CWON report's launch secure widespread media attention, with more than 45 mainstream media outlets reporting on the findings, including The Financial Times, Bloomberg, The Guardian, and *El Pais*. The EU Parliament invited presentations, and a flagship event was

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104   Vincent, J. 2013. Research on Valuation of Ecosystem Services: Points for Discussion. Paper for the WAVES Policy and Technical Expert Committee Meeting, October 2013.

105   Atkinson and Obst 2017.[[Provide full reference]]

106   Lange, G.M., Q. Wodon, and K. Carey. 2018. The Changing Wealth of Nations 2018: Building a Sustainable Future. World Bank. https://openknowledge.worldbank.org/handle/10986/29001

organized in Germany with the Minister for Cooperation and Development. The World Bank environment department kept up the conversation on wealth and natural capital with more than 2,400 retweets. The CWON 2018 report has been downloaded more than 100,000 times (data until September 2019).

In the WAVES core implementing countries, the in-country influence of CWON has been only modest so far. The Philippines, Uganda, and Indonesia have been working to develop wealth accounts with national data, and this is where the World Bank more broadly is positioning for the future, because macroeconomic analysis has routinely excluded wealth. The CWON team is exploring what macroeconomic analyses would look like if they included wealth as well as such things as income and balance of payments.

Box 7.3 • The Changing Wealth of Nations (CWON)

CWON tracks the wealth of 141 countries between 1995 and 2014 by aggregating natural capital (e.g., forests, minerals), human capital (e.g., training, health), produced capital (e.g., buildings, infrastructure), and net foreign assets. It also strengthens the wealth accounting methodology. Natural capital is measured as the discounted sum of the value of rents generated over the lifetime of the asset, and there are improved estimates for 19 categories of natural capital, including energy (oil, gas, coal), minerals (10 categories), agricultural land, forests, and terrestrial protected areas.

The breadth of renewable natural capital is still not fully represented in CWON. Some ecosystem services such as pollination are undervalued or omitted, as is the condition of natural capital (e.g., pollution, land, and forest degradation). Furthermore, uncertainties connected to irreversible changes in natural systems and thresholds that may precipitate catastrophic events such as climate change impacts are not incorporated. The ecosystem accounts developed in several countries in the WAVES program may shed light on some of these issues.

The most noTable findings of CWON in relation to natural capital are that:

- A country's level of economic development is strongly related to the composition of its national wealth. Wealth is a better predictor of economic success than income, because it measures the flow of income that a country's assets generate over time. Assessing an economy according to GDP instead of wealth is like looking exclusively at a company's income statements without considering the assets on its balance sheet.

- Natural capital is the largest component of wealth in low-income countries (47 percent in 2014) and accounts for more than 25 percent of wealth in lower-middle-income countries. In 10 of the 24 low-income countries covered, natural capital accounts for more than 50 percent of wealth, mostly because of their significant agricultural land and forests.

- Growth is partly about more efficient use of natural capital (and its sustainable management in the case of renewable natural capital) and investing the earnings from natural capital sources in infrastructure and education. This involves bringing to bear other assets to increase natural capital productivity, together with the strong institutions and policies that make investment attractive. This investment then results in growth of total wealth.

- Renewable resources—agricultural land and forests and protected areas—can produce benefits in perpetuity if managed sustainably. In low- and middle-income countries, the monetary value of renewable assets has more than doubled, keeping up with population growth on average, with net gains in value of agricultural land but net losses in forest values. More than two dozen low-income countries, where natural capital dominates the composition of wealth, have moved to middle-income status, in part by investing prudently in natural resources, infrastructure, and education.

- In contrast to renewable resources, nonrenewable natural capital—such as fossil fuels and minerals—offers only a one-time chance to finance development by investing resource rents. Nearly two-thirds of countries that have remained low income since 1995 are classified as natural resource rich, fragile and conflict states, or both, showing that these resources alone cannot guarantee development; strong institutions and good governance are needed to ensure that rents are well invested.

7.4. Communications and knowledge

Communications work was embedded in the WAVES program, with much effort expended to ensure that it was not merely an add-on. This contrasts with many international development programs, in which the role of communications is often simply to deliver products in attractive ways. Four strategic communications components were incorporated at the national and global levels, led by the central WAVES communications team and with strategic advice from IIED:

- ▶ branding WAVES to give the program and its values a high profile
- ▶ engaging stakeholders to bring together supply- and demand-side actors to deliver decision-centered NCA
- ▶ influencing strategy to make the case for NCA and to use its results
- ▶ sharing and managing knowledge to inform quality NCA swork at scale

At national levels, locally appointed communications advisers were integral members of the WAVES country teams in all core implementing countries. Not being from planning or environment authorities, or from data providers, the communications advisers were able to take a quasi-independent position and therefore lead on stakeholder analysis and target audience strategy. They helped build stronger ties between the players needed to prepare and use accounts. They shaped messages and communications products tailored to each country's priorities and political economy and addressed to the full NCA production and use cycle. Understanding that communications is too often neglected even in multidisciplinary programs, much attention was paid to building local capacity to develop a communications strategy and use communications tactics to support the program's aims. IIED mentored the seven communications advisors and brought them together for joint training sessions.

WAVES communications work has made for strong outreach and enhanced capacity building, which has helped drive the whole program. The communications work greatly increased WAVES' profile and enabled high-level political buy-in. For example, Botswana's president, Costa Rica's Environment Minister, and the Philippines' Cabinet Secretary all became strong champions of NCA,

mentioning it in their speeches and highlighting the need to consider natural capital differently. Showcasing work globally fostered a sense of pride—the global WAVES website and Knowledge Center were sought-after resources for countries to showcase their work. Country representatives were invited to attend large international meetings such as the UN Secretary General's Summit, Global Environment Facility meetings, and the Natural Capital Forum, where they could talk about their work on natural capital.

Box 7.4 • Communications Case Study: Rwanda

The Wealth Accounting and the Valuation of Ecosystem Services (WAVES) communications team held a stakeholder dialogue with key Rwandese government agencies, civil society, academics, and media early in the project in 2015 to familiarize them with natural capital accounting (NCA) and WAVES and to jointly start building a communications strategy—identifying champions, possible influencers, and opportunities on the policy front. The Rwanda Steering Committee approved the resulting communications and engagement strategy, and a local communications specialist was hired to work closely with the country coordinator. One of the first tasks was to build a database of key agencies, institutions, and individuals involved in NCA activities. An electronic newsletter was distributed every 3 weeks with updates on recent NCA developments, facilitating a consistent flow of information. A Twitter account was started to raise public awareness. High-level events such as National Water Week in March 2016 were used as platforms to feature work on NCA. This work paid off. For example, in 2018, Rwanda placed NCA under the Ministry of Finance and Economic Planning, thus fully institutionalizing NCA. Rwanda's land accounts have changed the land management system, and its water accounts have influenced establishment of a new water board.

At the global level, WAVES has been the key force behind launching NCA as a concept. An important contribution has been provision of information about NCA-related work through the WAVES partnership website.[107,108] A knowledge center was launched in 2016 as a repository of information on NCA.[109] Before WAVES, information on NCA had been difficult to find; the UNSD website had posted some countries' national accounts, but there was little to engage popular or technical audiences. WAVES has pulled together a curated, comprehensive, accessible knowledge resource—one that is far more than a knowledge center for the WAVES program alone; covering NCA experience and guidance from many countries and organizations, it is still active and evolving. The center:

▶ Collates hundreds of technical and policy resources on NCA, including many countries' national accounts, and loads them onto a free online database searchable by country, theme, and date.

▶ Showcases technical information for implementing accounts, including information from WAVES and government statistical agencies from low-, middle-, and high-income

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107   https://www.wavespartnership.org/

108   https://www.wavespartnership.org/

109   https://www.wavespartnership.org/en/knowledge-center

countries; academic institutions; the private sector; and other important NCA partners.

▶ Includes proceedings, papers, and analyses from NCA policy forums.

▶ Issues a monthly newsletter designed to respond to growing demand for information on NCA, including in mobile format (for the one-third of users who said they wanted it that way).

▶ Offers a suite of specially written popular products that ensure that NCA is accessible to an expanded and general audience. The products have been popular with countries wanting to see examples from around the world before they embark on the NCA journey and include:

- *Natural Capital Accounts Explained*[110]—describes in simple terms what forest, land, and water accounts are, how they are produced, and their potential benefits.

- *Natural Capital Accounting in Action*—shows how accounts inform national policies and translate into action. Examples include Australia, South Africa, Guatemala, and Sweden.

- *Natural Capital Accounting and Global Issues*—describes how NCA can be used to address such topics as sustainable development, poverty, and valuing marine and coastal ecosystems.

Use of the WAVES Knowledge Center has grown continuously. In 2018, there were 2,600 newsletter subscribers, 6,154 publication downloads, and 140,000 website hits. Considerable use of social media and engagement with traditional media by the WAVES communications team has driven traffic to the WAVES Knowledge Center. This media work has focused on key publications such as CWON and a joint report with the Nature Conservancy, *Managing Coasts with Natural Solutions* (17,800 tweet impressions from the World Bank's related story).

IIED has reflected on the experience of communications work across the WAVES program and produced four blog posts on what the communications team learned and wanted to share with others in similar situations.

1. **Reminder to self:** information supply needs to be driven by demand; February 2015 (196 views)[111]

2. **First steps in communication:** raising awareness; May 201–post Rwanda visit (162 views)[112]

3. **Natural capital accounting:** six tips for engaging policymakers; August 2016 (917 views)[113]

4. **Making the link between the SDGs and natural capital accounting:** January 2018 (1,168 views)[114]

As the last blog emphasized, WAVES' communications work for NCA helped not only to present existing accounts in a relevant way, but also to engage with stakeholders about which accounts to prepare in the future.

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110   https://www.wavespartnership.org/en/natural-capital-accounts-explained.

111   https://www.iied.org/reminder-self-information-supply-needs-be-driven-demand

112   https://www.iied.org/first-steps-communication-raising-awareness

113   https://www.iied.org/natural-capital-accounting-six-tips-for-engaging-policymakers

114   https://www.iied.org/making-link-between-sdgs-natural-capital-accounting

8

8. LEGACY OF THE WAVES PARTNERSHIP

In this chapter, we draw on the preceding analysis to paint a picture of the legacy of valuable assets built through the investment of all WAVES partners. This is discussed in detail in section 8.1. In section 8.2, we discuss the main technical, programmatic, political, and institutional lessons learned through the common WAVES experience—what works and the challenges.

8.1. Assets built under WAVES

The joint investment by WAVES partners, building on previous and ongoing work by UNSD and others, as explained in chapter 1, has built a legacy of valuable assets for the world and for specific countries. These assets have been described in previous chapters and are summarized in Table 8.1

Table 8.1 • WAVES global and country assets

	Typical in-country assets	Global assets
Information on natural capital	• 9 types of natural capital accounts covering the WAVES 8 countries plus new WAVES+ countries (see Table 1.1) • In-country WAVES publications that explain natural capital significance to sector, local, or national economy	• Changing Wealth of Nations outlines wealth accounts for 141 countries • WAVES policy briefs and NCA policy forum proceedings extend information on NCA
Tools and capacities	• Technical working groups for nearly every account developed • New jobs and trained staff to operate NCA system in all countries and to interpret and communicate NCA • Many people in all participating countries undertaking WAVES training and awareness courses	• System of Environmental-Economic Accounting Experimental Ecosystem Accounting improved methodology • Forest accounting methodology • WAVES Knowledge Center—a global knowledge platform on NCA • 10 Principles for Policy-fit NCA • Knowledge exchanges and South-South cooperation (global network of account producers)
Institutions	• NCA national steering committees in all participating countries enabling and stimulating cooperation between stakeholders • All participating countries have embedded NCA (e.g., with NCA units and other capabilities)	• NCA policy forum meeting 4 times, offering new global learning and exchange role • Effective partnership between World Bank, UN Statistics Division, UN Environment Programme, London Group on Environmental Accounting

	Typical in-country assets	Global assets
Decisions made	• 33 national or sectoral development plans influenced by NCA, such as for water, energy, forest, and land development plans • 9 new policy instruments or investments agreed upon or under review (e.g. payments for ecosystem services, licensing, taxation, pricing) • 10 policies monitored, reviewed, or reformed based on information in accounts See Table 1.2 for a complete overview.	• NCA policy forum resulting in publications that have catalogued uses and potential uses of accounts in decision making • World Bank inclusion of NCA in its new Global Program for Sustainability and its lending evaluation processes. NCA is also featured in the PROGREEN and PROBLUE Trust Funds. A toolkit for using NCA is being developed for the World Bank Environmental and Social Framework used in lending operations

Note: NCA, natural capital accounting.

These assets constitute a strong basis for integrating natural capital considerations into global and national policy and investment in future years. Over the past 8 years, they have proven robust enough to overcome the typical structural and political barriers to evidence-based natural capital policy:

▶ **Lack of policy readiness and space for policy change:** NCA has been able to raise the profile of multidimensional, long-term natural capital problems that were not high on the current policy agenda.

▶ **Political weakness of authorities concerned with environment and natural capital:** NCA has provided a shared information base highlighting the importance of the natural capital mandate.

▶ **Lack of transparency of natural capital data:** Where NCA has been published, these data are now in the public sphere.

▶ **Frequent absence of a legal requirement or appetite for evidence-based policy:** NCA has demonstrated the value of well-structured evidence informing critical decisions, evidenced in the proceedings of three NCA policy forums.

▶ **Lack of experience in holistic policy:** NCA is increasingly attractive where there are growing expectations for countries to devise holistic, integrated solutions and make informed trade-offs but where they lack experience in doing so. With countries determining how to achieve 17 integrated and indivisible SDGs, NCA provides an integrated framework, reveals the indivisible links between environment and economy, unites the disciplines (economics, environment, development, statistics), and can feed progressive economic models. Thus, NCA assets are well suited to take advantage of positive policy contexts.

8.2. Lessons learned

The WAVES program has generated valuable experience not only in the technical and programmatic aspects of NCA development and use, but also in addressing the broader institutional and political aspects of making the case for NCA, using, and embedding NCA, and supporting its improvement. In this section, we synthesize what the program has revealed, drawing on lessons in the theme chapters, other documented experience (WAVES Annual Reports, NCA policy

forums proceedings, the 2016 review of the first five WAVES countries' experience115), and some interviews. Ten lessons have been learned:

1. **Mandate:** Continued high-level support for developing and using natural capital accounts is essential for securing a mandate for NCA and for opening the most strategic entry points.

2. **Policy focus:** If natural capital accounts are designed to be decision centered, they can be uniquely fit to inform today's tough, interconnected decisions.

3. **Flexibility:** Country programs have been most successful when they have combined quick analyses to support decisions with longer-term development of NCA.

4. **Engagement:** NCA takes off when diverse data suppliers and potential data users are well connected: building trust and realizing synergies between their work.

5. **Cooperation and coordination:** A national steering committee of NCA producers, users, and quality assurers, supported by technical working groups, can smooth the path to developing, using, and embedding NCA. A complementary policy working group can further embed the results in policy making.

6. **Communications:** A dedicated communication strategy can engage stakeholders, ensure that NCA's role and its results are visible and understood, and deliver the right messages to target audiences.

7. **Institutionalization and capacity:** Effective NCA is an iterative system, not a one-off project; time needs to be allowed to develop, use, prove, and embed NCA.

8. **Transparency:** How and by whom data were acquired, analyzed, interpreted, and made accessible is critical for NCA's credibility and trustworthiness, but there is no single solution.

9. **Multiple levels:** NCA adds value at all levels; although WAVES was mostly focused nationally, some of the toughest decisions that NCA can inform are proving to be intensely local and distributional.

10. **Networking:** Bringing together a community of practice can accelerate the learning, expand the knowledge base, build the capacity, and increase the confidence necessary to improve NCA.

These 10 lessons are broadly common across diverse countries; even at the first global Forum on NCA for Better Policy, it was found that many countries' experience of effective NCA was coherent enough to be presented in the form of 10 Living Principles (Table 7.1).

Although the lessons emphasize what works across WAVES countries, all countries face challenges in undertaking NCA. These challenges are addressed below under each lesson; although some challenges are operational and relatively easy to solve, others are more deeply rooted in structural and political areas.

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115   Vardon, M., G.M. Lange, and S. Johansson. 2016. Achievements and Lessons from the WAVES First 5 Core Implementing Countries. https://www.wavespartnership.org/sites/waves/files/kc/First%205_Achievements%20and%20Lessons.pdf

1. **Mandate—Continued high-level support for developing and using natural capital accounts is essential for securing NCA's mandate and for opening the most strategic entry points.**

What works—Most WAVES partner countries have benefitted from powerful central ministries such as finance and planning leading on NCA. This has helped in gaining access to important mainstream decision-making processes such as national and sector planning and access to the data to set up accounts. Finally, experience in, for instance, Costa Rica and Botswana shows that high-level involvement helps firmly embed NCA units and coordinating structures in the machinery of government.

Challenges—A fundamental challenge is to sustain and expand high-level political will and support for natural capital policy and the role of NCA. The accounts are not a once-and-for-ever task; NCA must continuously prove its added value to politicians and bureaucrats (and probably now business and the wider public) to keep earning a role in the institutional landscape. NCA's ability to reveal macroeconomic problems is important, but the higher the political profile of the decisions that the accounts address, the more likely it is that NCA will clash with prevailing political interests (e.g., if a minerals account shows that the powerful minerals sector is less important to the economy than was thought or an ecosystem account reveals high pollution and degradation costs from mining). Properly communicating each policy gain from using NCA should help expand political support for it.

2. **Policy focus—If natural capital accounts are designed and combined to be decision centered, they can inform tough, interconnected decisions.**

What works—Policy making is invariably a messy process. NCA can make the process easier, providing a standardized framework for information that is relevant throughout the whole policy cycle. NCA's regular accounting to a standard format is akin to how businesses make decisions having routinely taken stock of diverse assets, depletions, and additions in addition to income. NCA has helped evidence-based policy making and transparency, whereas before the complexities had paralyzed; it has provided a clearer perspective on the trade-offs resulting from political choices. Although the issue may be contentious, the use of environmental statistics and accounts can depoliticize parts of the policy process, notably analysis and monitoring.

Challenges—Today's decisions are multifaceted, and more than one natural capital account may be needed to assist in making them. In many countries, the question is now which *set* of accounts is needed for addressing holistic goals such as the SDGs and how to combine accounts. For example, given the links and trade-offs between hydropower, water, and forestry, energy accounts alone may not be enough for making hydropower decisions; water and forestry accounts also offer relevant data. NCA must be promoted as the natural capital navigation system to achieve the SDGs, designed to feed regular decision-making and review processes (e.g., economic modeling and scenarios, national and sector plans, public expenditure reviews).

3. **Flexibility—Country programs have been most successful when they have combined quick analyses to support decisions with longer-term development of NCA.**

What works—Data quality often constrains NCA, but WAVES' experience has shown that good-enough information is better than no information and may be all that is required to attract initial

policy attention. In such early stages, data quality must focus more on relevance, timeliness, interpretability, and accessibility than on accuracy. Subsequent success in using the data—perhaps just to raise the question or inform debate, along with clarity on data weaknesses, can then generate the demand and resources to improve the data. Similarly, starting with just one kind of account can be a good way to focus efforts. For example, initial water accounts have yielded results that have opened demand for other accounts (e.g., highlighting watershed problems leads to demand for supplementary forest accounts). "Just do it" sums up the views of those who have seen the benefits of simply getting started and building the system step by step.

*Challenges—*NCA demand and supply are not sequential. In the real world, account production and policy processes proceed in parallel. Few policy decisions wait for evidence, so a basis of quality evidence must always be accessible to policy processes and the work of think tanks, although as the NCA system evolves to meet more ambitious needs, the problem of data quality cannot be side-stepped. Data quality must improve, as must data quality assessment procedures and capacities to disaggregate and analyze data for increasingly tough decisions.

4. **Engagement—NCA takes off when diverse data suppliers and potential data users are well connected—building trust and realizing synergies between their work.**

*What works—*NCA must earn its place in the institutional machinery; decision-makers must be seen as the clients and data suppliers as the expert service providers. The contribution of the accounts has been greatest when account developers have been able to understand and anticipate major policy decisions and when policy makers have understood the case for NCA. Engagement is needed not only to drive the NCA process, but also to build cooperation and trust among the many disciplines and agencies involved: statistical, economic, natural sciences, and policy.

*Challenges—*NCA potentially derives its data from other sources that have not yet contributed, such as the private sector, where natural capital assessment has taken off. Likewise, effective policy is not simply a top-down decision by a single authority, but also involves wider societal demand and validation. Thus, NCA may need to expand, to work with policy influencers in civil society and business and with scientists who are working on questions of, for example, thresholds and tipping points, as well as citizens whose livelihoods depend on natural capital and who are able to provide data on natural capital.

5. **Cooperation and coordination—A national steering committee of NCA producers, users, and quality assurers can smooth the path to developing, using, and embedding NCA. A complementary policy working group can further embed the results in policy making.**

*What works—*Cooperation has been critical to WAVES' success. Many national agencies succeeded in transcending the entrenched barriers to cross-sectoral and cross-disciplinary cooperation; those on the supply side of NCA did not usually have a history of working productively with those on the demand side. The WAVES program understood this, establishing national steering committees including representatives from ministries of finance, development, and other line ministries to ensure coordination across ministries and integration of NCA into broader economic considerations; interagency technical working groups to oversee construction of natural capital accounts and coordinate inputs from different agencies; and NCA units with staff from relevant government agencies assigned to construct the accounts. The steering committees worked

best when they were relatively high level, with enough command over resources and timing to ensure that NCA was well developed, enough power to establish and uphold administrative arrangements for data sharing, enough knowledge of the political economy of information and natural capital to keep the work decision centered, and enough clout to ensure that decision makers were primed to expect and act on resulting accounts.

Challenges—National NCA steering committees must be closely linked to a range of existing cross-cutting authorities and policy committees so that production and policy processes can proceed in parallel. This might include integrating initial NCA committees into more-mainstream data-for-policy processes. During the NCA development phase, it could be useful to have a technical policy working group to ensure the best focus and use of NCA results.

6. **Communications—A dedicated communication strategy can engage stakeholders, ensure that the role and results of NCA are visible and understood, and deliver the right messages to target audiences.**

What works—Mainstream players have not been aware of NCA, its role, and its implications. Almost all countries struggled with how to communicate NCA results to policy makers and how to interpret those results. WAVES' experience is that strategic communications can help with profiling NCA, engaging stakeholders, sharing information on progress, and communicating the results. Communications is not simply an add-on for publication and dissemination; presenting the accounts well through infographics, maps, and charts has helped make complex results and their implications easier to understand, enabling better debate and sharper policy decisions.

Challenges—At the national level, as decisions affecting natural capital become increasingly contentious politically, NCA communication strategies must incorporate the political economy of natural capital and information. At the global level, the WAVES Knowledge Center must grow so that it can continue to curate the most comprehensive and accessible knowledge resource on NCA and engage with and inform international knowledge, assessment, and policy processes.

7. **Institutionalization and capacity—Effective NCA is an iterative system, not a one-off project; time must be allowed for to develop, use, prove, and embed NCA needs.**

What works—Embedding SNA took decades of learning, use, refinement, and standardization, with—ultimately—such deep institutionalization that SNA-linked measures such as GDP have become ends in themselves. Similarly, it has taken many years (decades even in some Organisation for Economic Co-operation and Development countries) for NCA to make its way into policy formulation and review processes. The WAVES experience shows how the learning and institutionalization process can be accelerated. Several iterations of natural capital accounts in some countries have by now established the case for NCA and in some countries also led to permanent NCA systems. One of the reasons for the success of the WAVES partnership is cooperation between ministries and institutes that did not have a history of cooperation. The structure, with a cross-ministerial steering committee and working groups, helped countries make linkages between accounting institutions, policy and management agencies, and universities.

Challenges—In spite of progress, NCA is not yet central and mainstream. Where there are considerable structural and political barriers to NCA, government teams must deploy an NCA mainstreaming strategy aimed at key regular processes and 'hot' decisions. Co-constructing

national NCA roadmaps tailored to the machinery of government and business can accelerate progress. Clarifying rights, responsibilities, relationships, and rewards may help firm up NCA. A future challenge will be to keep capacities of individuals and institutions up to date. Many people have been trained on compiling accounts. It is important that capacity building continue and that SEEA training modules be embedded in universities or other training institutes to ensure availability of skilled persons as trained staff move on in their careers.

8. **Transparency—How and by whom data were acquired, analyzed, interpreted, and made accessible is critical for NCA's credibility and trustworthiness, but there is no single solution.**

*What works—*Credibility and trustworthiness of data matter if data are to be treated seriously and used. There is no single way to achieve this. In some countries, accounts were produced independently from policy makers to increase trust in the data, whereas in others, such as Botswana, Colombia, and Guatemala, accounts were produced and used within the same organization/ ministry. In some countries, the accounts have not been formally published; although this has not hindered some use of the accounts by government decision makers, it may limit NCA's ultimate utility.

*Challenges—*Making the accounts publicly available, using an embedded, clear data quality assessment process, will help make policy making more participatory and ensure NCA's societal relevance over the long term. Not publishing the accounts can contribute to the perception that NCA is more relevant for top-down than for bottom-up decision-making processes. It also limits potential inputs from the marginalized groups that often suffer most from natural capital problems and do not have other means to contribute and access data.

9. **Multiple levels—NCA adds value at all levels; although WAVES is focused nationally, some of the toughest decisions that NCA can inform are local and distributional.**

*What works—*Globally, CWON raised awareness of what makes up national wealth and of how the share of different capitals changes through typical development stages from low to high income. Nationally, WAVES partner governments have made real progress in informing natural resource allocation, management, and taxation with NCA's big-picture information on the links between natural capital and the economy. At the subnational or local level, NCA has been less common but has had some of the most convincing impacts because the sharpest trade-offs are local in nature. For instance, the accounts have led to changes in the Laguna Lake and South Palawan regions in the Philippines.

*Challenges—*There is a positive trend toward policy decisions and the concerns of businesses and civil society alike shifting to the local level. Local natural capital problems and development requirements usually demand a local solution and therefore local data. National-level accounts may be of limited use for this and can be misleading when results are averaged for the nation as a whole or for all user groups. For NCA's potential to be fully realized requires more investment to obtain and interpret disaggregated data at the local and user-group levels.

10. Networking—Bringing together a community of practice can accelerate the learning, expand the knowledge base, increase the capacity, and increase the confidence necessary to improve NCA.

*What works—*When NCA is new and struggling to fit into the current institutional set-up, there is no substitute for sharing real experience and diverse perspectives. WAVES' original PTEC networked leading economists, statisticians, and policy analysts to advise the World Bank. Subsequently, the national programs networked the disciplines and responsible organizations in country while there were multi-country workshops for knowledge exchange and country-to-country exchanges. The regional mentoring by WAVES teams from the core implementing countries appears to have helped non-focal countries and new partner countries. Finally, the WAVES partnership established the NCA policy forum to share, discuss, and combine experience. The anecdotal evidence is that this networking helped accelerate awareness and use of NCA. It would not have worked as well to have the World Bank simply driving the program from the center.

*Challenges—*If networking around decision-centered NCA has been of help nationally and globally, the next step might be to organize regional or theme-based NCA communities of practice with, for example, a facilitator and preliminary resources to enable it to be responsive and find direction. This is being considered for NCA in Africa following a concept prepared by WAVES.

Moving forward...

Overall, WAVES has demonstrated that it is possible to build natural capital accounts in developing countries and to use them to inform national development plans and policies. Implementing the program has also led to important lessons on how to further integrate sustainability into the development process. These lessons, along with the findings of the recent mid-term program review, have helped inform the design of the new Global Program for Sustainability (GPS) program[116]. Building on the experience of the WAVES program, the GPS is organized around three inter-related pillars of action—global information, implementation, and incentives.

1. Information

Building natural capital and ecosystem accounts can be a time- and resource-intensive process. To reduce the turnaround time and fast track the NCA applications to policy, it will be important to support development of first-draft national accounts using global data, which could provide prototypes that government staff can build on and improve using national data. Pillar 1 of the GPS will increase the coverage and quality of global data and help develop methodologies for policy use of data on natural capital and ecosystem services. In addition, by making it possible to compare sustainability performance across countries, it will create incentives for countries to boost their performance against comparators, including through better use of NCA in policy design and implementation.

2. Implementation

With the urgency of global environmental challenges, most notably climate change and diminishing biodiversity, there is increasing need for developing data and tools on natural capital at the national

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116   For more information about the GPS program, see https://www.worldbank.org/en/programs/global-program-on-sustainability

level, embedding this information in government decisions. As the recent global assessment of the UN Committee for Environmental Accounting shows, some 90 countries have already implemented SEEA, which underpins NCA. Another 22 countries are planning to do so soon. This is a good indication of the sizeable demand for use of NCA in policy planning and implementation. It will be important to balance long-term engagement, to build a sustainable commitment and capacity, with the need to reach more countries. Pillar 2 of the GPS, the extension of WAVES, will do this using two scales of work at the country level:

▶ At the national level, with the goal of developing a comprehensive information system on one or more types of natural accounts and valuation of ecosystem services (focusing on land, forest, water, air pollution, coastal ecosystems, watersheds). At this scale, national capacity to apply NCA approaches would be strengthened using a top-down approach.

▶ At the project level (bottom-up capacity strengthening), with the goal of establishing a monitoring and evaluation system sound enough to assess the project's impacts (positive and negative) on natural capital and ecosystem services and provide important information on the performance of the project itself and on how to expand investment to promote natural capital management and conservation of ecosystem services beyond the project geographic boundaries and time.

In regions with a critical mass of countries developing NCA, Pillar 2 will establish regional communities of practice, which can provide peer learning opportunities to exchange experiences and report back on results, knowledge management, and facilitation of a wide range of training services (webinars and other e-based learning, workshops, and training materials).

3. Incentives

This pillar focuses on greening the financial system. It will seek to enable financial system operators to better distinguish between sustainable and unsustainable behavior of actors, sectors, and projects. It builds on the work of the first pillar, which provides global information for benchmarking sustainability, and the second, which provides national- and regional-level technical assistance. The objective of Pillar 3 is to better integrate sustainability considerations into the functioning of financial markets

WAVES' assets (section 8.1) and WAVES' lessons (section 8.2) can serve as preliminary guidance for effectively embedding NCA in country systems. They can help accelerate a country's learning curve, inform its institutional setup for NCA, avoid typical mistakes, and more comprehensively realize the benefits of well-informed natural capital policy and investment.

APPENDIX A. BACKGROUND ON NATURAL CAPITAL ACCOUNTING

Although the concept of accounting for natural capital has existed for more than 30 years, experience has been somewhat fragmented. It was not until 2012 that the United Nations Statistical Commission adopted the System of Environmental-Economic Accounting (SEEA) Central Framework to provide a coherent, internationally agreed-upon concept and set of methods for producing many types of natural capital accounts. (Figure A.1 lists these, and subsequent thematic chapters describe them in more detail.) Accounting for ecosystem services is relatively new, with an experimental framework becoming available in 2014—the SEEA Experimental Ecosystem Accounts.

Figure A.1 • The Policy Cycle and Information System
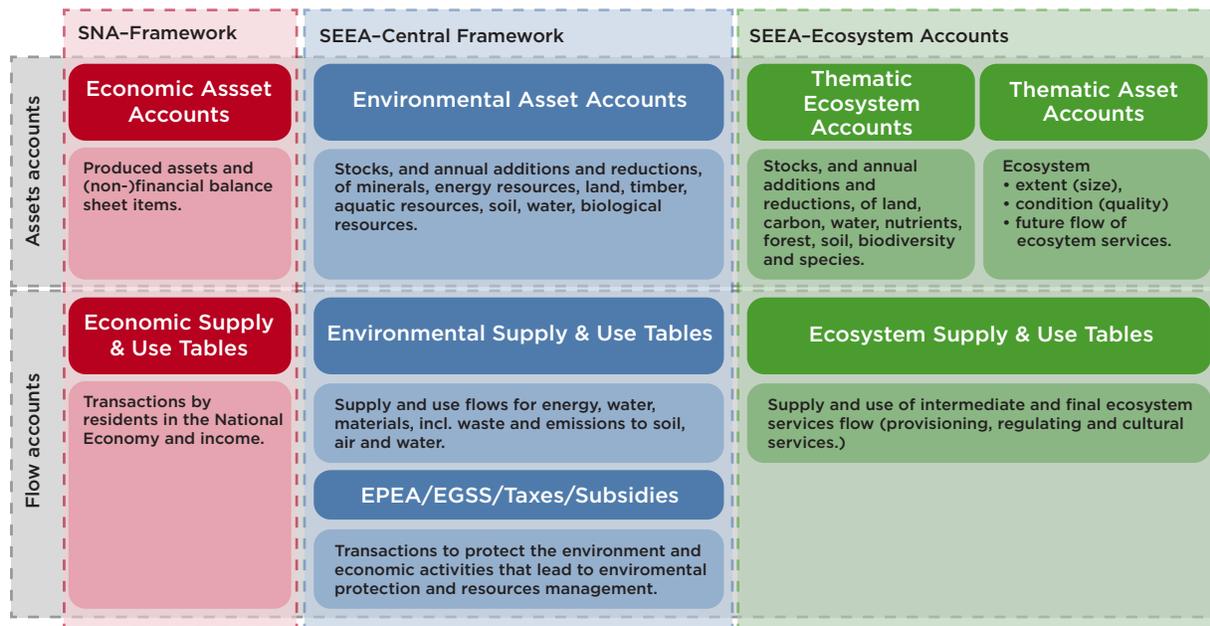
The point of natural capital accounting (NCA) is not simply to construct accounts; it is to use them to inform decisions. Decisions regarding natural capital are complex. The many problems of natural capital scarcity, maldistribution, and ecological limits are on the rise; have a wide range of environmental, social, and economic implications; and interact with each other. To analyze them is a multifaceted endeavor, and to arrive at real-world solutions is a multistakeholder affair. This is difficult to do. Too often, the complexities paralyze stakeholders, and the decisions they make are short term or partial. This is no longer considered good enough. With increasing competition for land, forests, water bodies, biodiversity, and other natural assets—as well as troubling trends in climate change and environmental risk—most governments realize that these issues are important and seek to reform their decision making to make better choices about natural capital.

There are growing expectations for making more-integrated, more-equitable decisions, with better-informed, more transparent trade-offs. This is especially the case since the adoption of

the 2030 Agenda for Sustainable Development; countries must determine how to achieve 17 integrated and indivisible SDGs, not all of which are mutually supportive.

As a result of these demands and trends, as well as the work of the WAVES partnership described in this report, countries are increasingly embracing NCA. According to the United Nations, in 2017, 69 countries reported working on NCA, with a further 22 planning NCA work, although of the countries working on NCA, so far only a few (mostly high-income countries) produce regular accounts.

Countries face challenges in developing, using, and embedding NCA. There is often little awareness of what NCA is, what it entails, what it can do, and who should do it. There are also institutional challenges: uniting people across disciplines (economics, environment, development, accounting); bridging silos between institutions that should be involved; preparing, interpreting, and using accounts; and embedding a decision-centered NCA system that generates the range of data that governments need to meet today's sustainable development challenges. Such a process takes time. It is not simply a matter of a one-off effort to improve data. The very long process of developing and mainstreaming the system of national accounts is testament to this (Box A.1).

Box A.1 • Why Natural Capital Accounting (NCA) Is Taking Time to Implement and Use

NCA has developed to address deficiencies with standard economic accounting. Although NCA theory and practice have progressed, it is taking time for it to be accepted and used routinely in decision making. This is unsurprising given the earlier experience of developing the now prevailing System of National Accounts (SNA).

The first SNA was published in 1953,[117] growing out of theory and practices that emerged in the 1930s, in particular the landmark General Theory of Employment, Interest and Money.[118] It was 17 years between the initial theory underpinning the SNA and its standardization in 1953. It has been updated three times since—in 1968, 1993, and 2008—which is indicative of the complexity of the system, the changing nature of the economy, and the need to build consensus to achieve and maintain standardization.

Adding the environment to the SNA increases the complexity, and confounding this is that the theory underpinning NCA is not fully agreed upon, although the System of Environmental-Economic Accounting (SEEA) provides a broad basis for integrating environmental and economic information. The SEEA was boosted when the 1992 Rio Conference on Sustainable Development called to move beyond gross domestic product as a measure of progress.[119] Nonetheless, development of the SEEA from the first draft in 1993 to standardization in 2012 took 19 years.

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117   See Vanoli, 2005. A History of National Accounting, IOS Press, Amsterdam. and SNA 2008 https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

118   Keynes 1936. General Theory of Employment, Interest and Money [[Provide additional reference information]]

119   See Agenda 21: https://sustainabledevelopment.un.org/outcomedocuments/agenda21

APPENDIX B. RESULTS FRAMEWORK

Table B.1 • Results Framework

Indicator (according to geographic scale and hierarchy)	End-of-program goal	Achieved 2019	Rate of accomplishment[a] (%)
Country total outcomes and outputs	**199**	**1,469**	**96**
Total outcomes	**173**	**1,189**	**96**
Countries supported by the project with at least two environment-related sectors in natural capital accounts in accordance with defined criteria and publicly accessible	8	7	88
Countries supported by the project with at least two NCA–related policy analyses made publicly accessible	5	7	100
Direct project beneficiaries (number of female beneficiaries)	160	1,175	100
Total outputs	**26**	**280**	**97**
IR Indicator 1.1: Countries supported by the project with natural capital accounts steering committee established	8	8	100
IR Indicator 1.2: Skilled staff in relevant government institutions participating in NCA and related policy analysis (number of women participating)	10	220	100
IR Indicator 1.6: Number of key policy documents, such as development plans, sectoral policies and strategies, and bills that reference NCA or the accounts	-	45	100
IR Indicator 1.7: Countries supported by the project with policy question(s) identified, methodologies chosen, and first results available (number of targeted technical assistance activities)	8	7	88
Global total outputs	**153,224**	**152,822**	**94**
Subscriber newsletters	4,000	2,800	70
IR indicator 2.1: Regional knowledge events on NCA supported by the project	3	4	100
IR Indicator 3.2: Global knowledge products on developing ecosystem accounts made publicly accessible	3	3	100
IR Indicator 3.4: Global knowledge products on policy uses of NCA made publicly accessible	10	15	100
IR Indicator 3.5: Hits on WAVES website (global and country pages)	149,208	150,000	100

(a) The rate is 100 percent when the corresponding indicator has achieved, or exceeded, its target.

APPENDIX C. FINANCIAL SUMMARY

Table C.1 • Summary of Disbursements (as of December 30, 2019): Wealth Accounting and the Valuation of Ecosystem Services (WAVES)

Activities	Allocation USD	Disbursed USD	Available balance
Country work[a]	**12,716,015**	**12,708,486**	**7,529**
WAVES- Botswana	1,793,449	1,793,449	
WAVES- Colombia	1,777,288	1,777,288	
WAVES- Costa Rica	645,319	645,319	
WAVES- Guatemala	851,707	851,707	
WAVES- Indonesia	1,845,844	1,845,844	
ID WAVES 2.0 - Indonesia	393,321	388,720	4,601
WAVES- Madagascar	797,631	797,631	
WAVES- Philippines	2,562,079	2,562,079	
WAVES- Rwanda	2,049,378	2,046,449	2,929
Regional work	**749,700**	**749,700**	
WAVES-Regional Workshops	749,700	749,700	88
Global work	**5,760,523**	**5,760,023**	**500**
WAVES-Annual partnership forums	1,329,871	1,329,371	
WAVES-Changing Wealth of Nations 2016	149,272	149,272	
WAVES-Engagement with wider NCA community	909,118	909,118	
WAVES-Global communication strategy	1,321,645	1,321,645	
WAVES-Methodology development and policy application for ecosystem accounting[b]	2,050,617	2,050,617	
Cross-cutting work	**1,920,739**	**1,920,739**	
WAVES inception activities[c]	1,920,739	1,920,739	
Other	**1,873,319**	**1,873,319**	
WAVES program management and administration	1,873,319	1,873,319	
Total	23,020,295	23,012,266	8,029
Funds available at the trustee and sub-fund level (unallocated)			1,076
Funds available at the trustee, sub-fund, and grant level (unallocated)	23,020,295	23,012,266	9,106

(a) Including scoping activities conducted during identification stages and communication work performed at the country level.
(b) Including pilot application to selected countries (e.g., Philippines).
(c) This activity was labeled in previous annual reports as "WAVES Global Knowledge Sharing." It includes activities conducted during the inceptio phase of the program (up to 2014), before the internal reporting system was set up to track national, regional, and global activities separately, and therefore comprises activities belonging to each of these groups.

ACKNOWLEDGEMENTS

WAVES