2nd Policy Forum on Natural Capital Accounting for Better Decision Making

Applications for Sustainable Development

PART 2

May 2018

WAVES

WORLD BANK GROUP

2nd POLICY FORUM ON

Natural Capital Accounting for Better Decision Making

Applications for Sustainable Development

Edited by Arjan Ruijs and Michael Vardon

PART 2 – Case studies

WAVES is a World Bank-led global partnership that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts.

1818 H Street NW

Washington, DC 20433

Telephone: 202-473-1000

Internet: www.worldbank.org

Suggested Citation

Ruijs, A. and Vardon, M. (Eds) (2018). 2nd Policy Forum on Natural Capital Accounting for Better Decision Making: Applications for Sustainable Development - Part 2: Case Studies. World Bank WAVES, Washington D.C.

Cover photo: Chhor Sokunthea / World Bank

Contents

5. Ecosystem accounting to inform decisions about forest management in the Central Highlands, Australia

By Heather Keith, Michael Vardon and David Lindenmayer

Fenner School of Environment and Society, Australian National University

Summary

Ecosystem accounts developed for the Central Highlands region, near Melbourne, informed government decisions about forest use. Currently, native forest timber harvesting conflicts with water provisioning, carbon sequestration, biodiversity conservation and recreation. The native forest on public land is managed under an agreement that guarantees wood supply within a defined area on public land and conservation within a national park boundary. This agreement is currently being re-negotiated. Synthesizing environmental and economic information in the form of ecosystem accounts allowed quantitative comparisons in physical and/or monetary terms that enabled trade-offs to be defined explicitly and spatially.

The accounts included values of ecosystem services and of economic value-added of industries that rely on the ecosystem services. Results demonstrated that a transition away from native forest harvesting would improve the condition of ecosystem assets, the conservation of biodiversity, and the provision of ecosystem services for other land uses, and would reduce the threat of extinction of critically endangered species. Economic gains from increased water supply and carbon storage exceeded the losses from ceasing native timber production. Results from the study are contributing to government decision making and public education.

5.1 The need for information to inform policy

This paper reports on the development and application of natural capital accounting (NCA) in the Central Highlands of Victoria, in south-eastern Australia. The accounts were developed over a 2-year period, specifically to feed information into government decisions about forest use in an area close to Melbourne, the capital city of Victoria.

Current land use activities in the Central Highlands of Victoria include timber production, biodiversity conservation, agricultural production, water supply, carbon sequestration, recreation and tourism. These activities are dependent on ecosystem assets and services, and their use can be either complementary or conflicting. Land can be managed for biodiversity conservation, water supply, carbon sequestration and ecotourism (minimal impact activities) in a complementary manner. Harvesting of native forests conflicts with the assets and services used by the previous activities. Agricultural production and plantations occur on different areas of land, but use some ecosystem services generated on the native forest land. The region is home to a wide range of species, including the endemic and critically endangered Leadbeater's Possum and Helmeted Honeyeater, the two faunal emblems of Victoria, as well as the world's tallest flowering plant, a eucalypt called Mountain Ash. The area provides practically all the water for Melbourne, a city of 4.4 million people, making it the second biggest in Australia. Water is also supplied for irrigating crops in

the surrounding farmland. The forests are some of the most carbon dense in the world and maintaining this stable and resilient store of carbon in a natural ecosystem is important for climate change mitigation. With its proximity to Melbourne, the region supports a large and growing tourism industry. There is a small timber industry that uses both wood supplied from native forests and plantations that produce paper pulp and sawlogs.

The region forms part of the Central Highlands Regional Forest Agreement that is due for re-negotiation in 2018. These agreements are made between state and national governments and legislate a 20-year plan for forest management that guarantees wood supply from defined areas. Proponents within the native timber industry have called for a guaranteed and expanded allocation of native forests for timber harvesting. By contrast, stakeholders within the environmental and tourism sectors have promoted an expansion of the national park network, proposed as the Great Forest Reserve System, to promote biodiversity conservation and eco-tourism. Negotiations of previous agreements have been protracted with controversial processes involving debates among public, industry, government and non-government organizations.

Managing the various activities within the region is complex and requires evaluation of the trade-offs between different land uses. Synthesizing environmental and economic information in the form of ecosystem accounts provided a basis for quantitative comparisons in physical and/or monetary terms that enabled trade-offs to be defined explicitly and spatially.

The study involved collating and synthesizing site and spatial data, and functions describing ecosystem processes to generate a time series. Data at different spatial and temporal scales required integration to develop consistent accounts that aligned with the area and timeframe of study. Data in the accounts were analyzed using physical and monetary metrics, ecosystem services and Industry Value Added, trends over time, and scenarios with changing land use to provide results relevant to natural resource management policy. In this paper, we describe briefly the process of developing the accounts; the outcomes in terms of results from the analyses and how they could inform decision making; communication strategies for the results about the Central Highlands to inform policy makers, scientific community and the public; and general lessons from this case study that are applicable for future work on ecosystem accounting. We compare experiences from this case study with the 10 living principles for making NCA fit-for-policy.

5.2 Process of developing ecosystem accounts

The study was undertaken within an academic institution using multi-disciplinary expertise. The need for information that can be provided by ecosystem accounts was identified by us as a useful input to the Regional Forest Agreement negotiations, as well as to inform both policy makers and the public. Additionally, developing a case study demonstrated the value of ecosystem accounting for policy making as part of the ongoing process of dissemination of the concepts and practices of NCA. Synthesizing information in the form of accounts was based on long-term ecological research in the region and understanding of the ecosystem. The goal was to provide an information system that would improve decision making by quantifying the relative values of different ecosystem services, the contributions of industries (native and plantation timber, tourism, water supply and agriculture) to the economy, and the potential trade-offs in changing land use activities. Goods and services that lie outside current economic systems were identified as unrecognized contributions of ecosystems to economic activity and human well-being, for example carbon storage and sequestration. The researchers provide and communicate information in the accounts but are not part of the policy process.

The framework of ecosystem accounts enabled a large amount of ecological and spatial data to be organized so that decision makers could see the potential for trade-offs. Previous reports about the region were polarized about the relative importance of specific environmental or economic factors. Ecosystem accounting provided a framework to incorporate a range of ecosystem assets and services, so that the analysis became broader than the two opposing viewpoints by incorporating a range of land uses and explicitly comparing their costs and benefits.

The process of developing the accounts involved collation and analysis of data from long-term research sites; adaptation and calculations using existing ecological models to describe ecosystem assets and services both temporally and spatially; and investigation of publicly available environmental, productivity and financial data in reports and spatial data. Key factors in synthesizing these data from varied sources was good ecological knowledge of the ecosystem, co-ordination of inputs from a range of disciplines, and the principle of using the best available data in terms of the most recent and highest resolution with subsequent aggregation where necessary.

A draft set of accounts was presented for discussion.[1] These were available on the web and presented at a workshop in Melbourne of key stakeholders and data providers in August 2016. The draft report was reviewed by national and international experts in accounting. Feedback from all these comments was incorporated in revisions of the accounts and their analysis. The updated and final accounts incorporated additional information on plantation forestry, new and corrected spatial data. The final set of accounts were published as a full report[2] and appendices[3] on the web, as well as a summary report[4] and factsheet[5] in June 2017. A scientific paper based on the accounts was published in September 2017.[6] Other forms of communication were also undertaken and are outlined below.

[1] Draft document for discussion 2016: https://fennerschool-associated.anu.edu.au/documents/CLE/VCH_Accounts_Summary_FINAL_for_pdf_distribution.pdf
[2] Full Report: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-40mb
[3] Appendices: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-31mb
[4] Summary Report: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-summary
[5] Fact Sheet: http://www.nespthreatenedspecies.edu.au/Ecosystem%20factsheet_single_V3.pdf
[6] Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer D 2017. Ecosystem accounts define explicit and spatial trade-offs for managing natural resources. *Nature Ecology and Evolution* 1: 1683-1692. DOI:10.1038/s41559-017-0309-1.
https://www.nature.com/articles/s41559-017-0309-1.epdf?author_access_token=k0P9vV4GBmSSWVctcJwW19RgN0jAjWel9jnR3ZoTv0OZKuhU197jBGp3TvgY6Mmn9h7beuyfbO7Vtkqzygh4co05os54UEUKASFSiz9SSgzdUTTb0Q4u3PhPkA66WrQoYYxJhtZwk5CZbK2kWGXxlA%3D%3D

Table 5.1 Accounts produced for the Central Highlands, their data layers and time periods

Account	Layers	Metrics Physical (P) and/or Monetary (M)	Years*
Land	Land cover	P	2005, 2013, 2015
	Land use	P	2006, 2010, 2014
	Land management	P	2015
Ecosystem extent	Land cover	P	1750, 1990 - 2015
Ecosystem condition	Logging history	P	1932 - 2015
	Fire history	P	1903 - 2015
	Forest age	P	1990 - 2015
Water asset (storage)		P & M	1990 - 2015
Water yield (inflows)		P & M	1985 - 2012
Water supply (abstractions)		P & M	1990 - 2015
Carbon stock		P & M	1990 - 2015
Carbon sequestration		P & M	1990 - 2015
Native forest timber	Wood volume & yield	P & M	2005 - 2014
Plantation timber	Wood volume	P & M	2006 - 2014
Agricultural		M	2010 - 2015
Tourism		M	2006 - 2014
Biodiversity	Threatened species	P	1990 - 2015
	Indicator species	P	1987 - 2015
	Habitat attributes	P	1998 - 2015

*A span of years refers to annual data, compared with individual years.

5.3 Outcomes from the accounts

Structuring information in the form of ecosystem accounts revealed the interactions between human activities and ecosystem assets, and their impacts on ecosystem extent and condition. Outcomes from accounts that can provide policy-relevant information often require analyses and interpretation of the data to provide quantified trends, scenarios or trade-offs. Data in the accounts were analyzed to investigate the relative benefits of ecosystem services and industries within the region to inform natural resource management decisions. Analyses were based on existing data and functions describing ecosystem processes (for example, tree growth and decomposition) to generate historical time series. Analyses were performed at three levels:

1. Values of ecosystem services, both currently valued but hidden in other information, and previously unrecognized, such as carbon storage and sequestration, and water yield
2. Values of economic output of industries that use ecosystem services as their contribution to industry value added (IVA) (with the sum of all IVA equal to GDP for the entire economy)
3. Potential gains and losses in IVA and ecosystem services under scenarios of changes in land use from timber production to forest protection.

The key outcome was the capacity to quantify ecosystem services and their contribution to industries, and hence explicitly reveal the trade-offs made or required when use of services by different industries conflicted or resulted in a reduction in ecosystem extent or condition.

For the Central Highlands, the time series of data in the ecosystem accounts and their subsequent analyses can inform decision making by:

1. Identifying change in ecosystem extent and condition and potential drivers from land use change, including the changing balance of economic activities in the region, biodiversity loss, carbon emissions and reduction in carbon stocks, influence of climate change and variability on water supply, expansion of built-up land and infrastructure and fragmentation of habitats
2. Tracking progress towards policy targets (based on historical time series), such as improving regional economic outlook or decreasing risks to threatened species and ecosystems
3. Assessing the sustainable use of natural resources, especially timber and water, by analyzing supply and use of ecosystem services and their change over time
4. Assessing the cost-effectiveness of expenditure on conservation of species or habitats
5. Enabling analysis of trade-offs between land uses with conflicting use of ecosystem services, and scenario modelling of change in land use from timber production for forest protection
6. Identifying goods and services that can be replaced easily while others cannot. Most of the timber from the native forest is used by a pulp and paper mill. Ready alternative products exist in the form of de-inked newsprint, recycled paper and plantation timber, so while ceasing native forest logging may increase costs of product supply, the production of paper can continue. Alternatives for the supply of water indicated likely problems: the quality of recycled water is insufficient for drinking water; transport from another region conflicts with local use and requires high energy inputs; desalination is expensive and has high energy inputs. The Mountain Ash forest is a unique ecosystem that provides services for recreation, particularly with its proximity to Melbourne.

The conclusions from the analyses of trade-offs between land uses, based on the data in the ecosystem accounts for the Central Highlands, were that a transition away from harvesting of native forests would improve the condition of ecosystem assets and provision of ecosystem services for other activities, such as water supply, carbon storage, culture and recreation, and biodiversity conservation. The accounts demonstrated that solutions to conflicting land uses could be seen as a process of maximizing benefits for the greatest number of beneficiaries.

Presenting information in the form of the accounts showed the relative economic contributions of key industries within the region, and the contributions of ecosystem services that were not recognized explicitly in economic data. The value of market goods was estimated, and the contribution of ecosystem services was undertaken. The information in the accounts identified trade-offs between land uses. The trade-offs were considered in the following terms:

1. The economic gains from increased water supply and carbon storage exceeded the losses from ceasing native timber production. Entering the carbon market could replace the money from native timber harvesting if the right regulatory framework was established.
2. A judgement about whether conservation of biodiversity in the threatened ecosystem of the Mountain Ash forest and reducing the threat of extinction of the critically endangered Leadbeater's Possum is worth the loss of the AUD$12 million per annum from ceasing native forest timber harvesting

5.4 Communication

Outputs and analysis from the accounts have been communicated widely to government policy makers, political leaders, community groups, business community, organizations implementing accounting, and the academic community. Providing information in a policy-relevant form and

timely manner were important to contribute effectively to the public and political negotiations about forest management in the region.

Report

- Publication of the full report and appendices on the web
- Summary report and factsheet printed for distribution to stakeholders

Publication in the scientific literature

- Synthesis paper published in *Nature Ecology and Evolution*
- Papers on thematic accounts for carbon, water and biodiversity are in preparation and will be submitted to *Environmental Science and Policy*, *Ecosystem Services* and *Biological Conservation*.
- Methodological paper about carbon measurements will be submitted to *Austral Ecology*.
- Papers about accounting processes were contributed to the London Group Meeting on Environmental Accounting, including water accounts, ecosystem condition, methodologies and policy processes.

Publication in the popular literature and newsletters

- Science for Saving Species
- The Conversation, with an extensive online discussion with more than 50 comments
- EnviroNews
- World Bank global partnership Wealth Accounting and the Valuation of Ecosystem Services (WAVES) website and newsletter

Media

- Interviews on national radio plus local radio in Canberra and Melbourne
- ANU media release
- Short videos about ecosystem accounting and the Central Highland region available on YouTube

Government engagement

- Results from the accounts were used by the Victorian government forest industry taskforce.
- Researchers met with the Victorian Minister for Environment. The Victorian government is negotiating potential changes to the Regional Forest Agreement, with considerations about changing government regulations, subsides, planning rules and industry support.
- Invited presentation at a workshop on environmental-economic accounting by the Commonwealth Department of Environment and Energy, held in Melbourne
- Invited contribution to a Department of Environment and Energy document on the national strategy for environmental-economic accounting, to be presented to the Meeting of Environment Ministers in December 2017
- Briefing to the Department of Environment and Energy sections on forest policy, threatened species conservation and environmental accounting
- Communication and response to the Assistant Minister for Agriculture and Water Resources about the Regional Forest Agreement

Education

The research from the Central Highlands is being used for teaching at ANU:

- ANU-ABS course Introduction to Environmental Accounting[7]
- Guest lecture to 3rd year course Complex Environmental Problems in Action

[7] http://fennerschool.anu.edu.au/education/short-courses/introduction-environmental-accounting

The synthesized information presented in the accounts and the links between environmental and economic values has produced greater traction in political considerations than previous conservation advocacy. The ultimate impact is not yet known, as political decisions have not yet been made, but the accounts are being influential in shaping discussions.

5.5 Lessons for ecosystem accounting development

Implementing the SEEA ecosystem accounts in the Central Highlands has identified conceptual issues, data gaps and topics that require further consideration. These considerations include scale (1 to 4), dynamics (5, 6), and boundaries (7, 8):

1. Data are collected mostly at the site scale, but this must be scaled up to the landscape scale to be used in ecosystem accounts that relate physical and biological components of ecosystems within spatial areas. This is one of the most critical processes in implementing ecosystem accounting.
2. The experimental design for establishing monitoring systems and collecting site data is paramount so that the data can be scaled up successfully.
3. Site and spatial data need to be linked through relationships derived between site data and ecosystem characteristics that can be presented spatially, from remote sensing, survey, or ground-based classifications. The most relevant ecological processes that determine these relationships for different ecosystems need to be identified.
4. Economic data are generally available for large spatial areas not related to biophysical characteristics. More detailed economic and cadastral data, which is region- and industry-specific, would be valuable to improve spatial attribution of economic and social data to match environmental data.
5. Ecological processes need to be defined in terms of dynamic functions used to derive time series of accounts" for example carbon accumulation, decomposition, mortality, reproduction, dispersal, and collapse of dead trees.
6. Drivers of ecological change need to be identified and quantified, such as disturbance events and degradation processes. These drivers are important to understand the reasons for change in the past that are documented in the accounts, and to allow prediction of future changes.
7. Selecting the boundary for a study area is complex because the many sources of data integrated in the accounts use different boundaries, such as natural resource management area, catchments, local government, statistical areas, ecosystem types and land use regions. No single boundary will accommodate all the different sources of data. Furthermore, social, geographical and policy considerations all play a role in the selection of appropriate boundaries. Thus, consideration should be given to the appropriate boundaries and how these may impact findings, particularly in terms of how the choice of study area can best address the policy questions that need to be answered. In the Central Highlands, no existing boundary was appropriate, so a simple rectangular boundary was used that encompassed the site data and the area of forest under contention.
8. The boundary between market and non-market contributions from ecosystem services is difficult to define in many cases, but decisions are needed to ensure boundaries are defined explicitly and classifications are compatible and mutually exclusive. An example is the ecosystem service of water provisioning as the inflow to reservoirs and the water supply as the outflow from reservoirs.

5.6 Assessment of study in light of the "10 living principles"

The study was initiated before the 10 living principles for making NCA fit-for-policy that emerged from the 1st Policy Forum were conceived. In reviewing the principles now, only a few months since the publication of the final accounts, a number of observations may be made (Table 5.2).

Table 5.2 Assessment of the Central Highlands NCA against the "10 Living principles for making NCA fit-for-policy"

Principles	Observations from Central Highlands
Comprehensive	
Inclusive – acknowledging the diverse stakeholders concerned with decisions affecting natural capital, responding to their information demands, respecting different notions of value, and using appropriate means of engagement **Collaborative** – linking the producers of NCA, the users of NCA for policy analysis, and the policy makers using the NCA results; and building their mutual understanding, trust and ability to work together **Holistic** – adopting a comprehensive, multi/interdisciplinary approach to the economic and environmental dimensions of natural capital and to their complex links with policy and practice	A draft report and workshop were the primary means used to engage stakeholders. Much of the engagement was technically focused. The polarized positions about forest management were revealed in the workshop as well as in online discussion fora. The production of the accounts involved a multi-disciplinary team primarily of data producers, although some with experience in the policy area. Ongoing work is aimed at strengthening the links with policy.
Purposeful	
Decision-centered – providing relevant and timely information for indicator development and policy analysis to improve and implement decisions with implications for natural capital **Demand-led** – providing information actually demanded or needed by decision makers at specific levels	Relevant information was provided in time for consideration of the accounting information in the decision-making process targeted. Information was provided on the key industries (agriculture, forestry, water supply and tourism) within the region as well as key aspects of biodiversity. The study was initiated by researcher to inform policy and to demonstrate the benefits of accounts for policy.
Trustworthy	
Transparent and open – enabling and encouraging public access and use of NCA, with clear communication of the results and their interpretation including limitations of the data sources, methods and/or coverage **Credible** – compiling, assessing and streamlining data from all available sources; deploying objective and consistent science and methodologies	The draft and final accounts were published with extensive details of methodology and data sources. There was expert review of the accounts as well as a workshop to discuss the data sources and methodology. Comments received were incorporated into the final accounts. The journal article was published after a standard international peer-review process.

Mainstreamed	
Enduring – with adequate, predictable resourcing over time; continuous application and availability; and building increasingly rich time series of data **Continuously improving** – learning-focused, networked across practitioners and users, trialing new approaches, and evolving systems to better manage uncertainty, embracing innovation and taking advantage of emerging opportunities **Embedded** – NCA production and use becoming part of the 'machinery' of government and business, building capacity, improving institutional integration for SD, and incorporating NCA use in procedures and decision-support mechanisms	The accounts were produced within an academic institution and not by government. The data sources and methods used could be used to repeat the accounts for the area and some could be applied to other areas. The process of developing the accounts has been shared with both national and state government agencies and are feeding into the development of environmental accounting in Australia and internationally.

5.7 Future work

We are planning to apply the SEEA framework in a landscape dominated by agriculture to assess the relative values of land management activities on farm productivity compared with water supply, carbon storage, soil conservation, and biodiversity conservation. This will provide information to policy makers in a complex agri-environmental landscape.

Based on practical accounting in regional studies and developing conceptual frameworks for accounting, we will be continuing contributions to the following issues:

1. Biodiversity accounting, measurement, interpretation and recommendations for monitoring
2. Aligning results from carbon accounts with the policy needs for emissions reduction targets and payments for abatement activities
3. Developing the processes of linking accounting to government and business decision making

5.8 References

Experimental Ecosystem Accounts for the Central Highlands of Victoria. Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer D 2017

Draft document for discussion 2016: https://fennerschool-associated.anu.edu.au/documents/CLE/VCH_Accounts_Summary_FINAL_for_pdf_distribution.pdf

Full Report: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-40mb

Appendices: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-31mb

Summary Report: http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-summary

Fact Sheet: http://www.nespthreatenedspecies.edu.au/Ecosystem%20factsheet_single_V3.pdf

Keith H, Vardon M, Stein JA, Stein JL, Lindenmayer D 2017. Ecosystem accounts define explicit and spatial trade-offs for managing natural resources. *Nature Ecology and Evolution* 1: 1683-1692. DOI:10.1038/s41559-017-0309-1.
https://www.nature.com/articles/s41559-017-0309-1.epdf?author_access_token=k0P9vV4GBmSSWVctcJwW19RgN0jAjWel9jnR3ZoTv0OZKuhU197jBGp3TvgY6Mmn9h7beuyfbO7Vtkqzygh4co05os54UEUKASFSiz9SSgzdUTTb0Q4u3PhPkA66WrQoYYxJhtZwk5CZbK2kWGXxlA%3D%3D

6. State of the Environment Reporting: A natural capital accounting approach

By David M. Summers,*[1,2] Becky Smith,[1] Kate Auty[1] and Michael Vardon[2]

[1] ***Office of the Commissioner for Sustainability and the Environment***
[2] ***Australian National University, Fenner School of Environment and Society***
Corresponding author: david.summers@anu.edu.au

Summary

The Australian Capital Territory (ACT) Office of the Commissioner for Sustainability and the Environment (OCSE) developed a set of natural capital accounts (NCA) using the System of Environmental-Economic Accounting for State of the Environment (SoE) reporting in the ACT. In developing the accounts, the OCSE sought to better link environmental information with policy development and sustainability goals while also maintaining legislated environmental reporting requirements and building local capacity. These accounts, released along with a "Proof of Concept" paper for expert and public review, represent the first time that an Australian jurisdiction has attempted to include NCA in regular environmental reporting.

Working with local and federal agencies, the OCSE produced NCA across seven environmental themes: land, environmental condition, biodiversity, water, air, solid waste and environmental expenditure. These used both the SEEA Central Framework and SEEA Experimental Ecosystem Accounting frameworks, employing novel data sets, experimental designs and methodologies not previously used in the production of accounts. The accounts developed and published in the Proof of Concept have provided a valuable tool to initiate dialogue with data custodians and potential users including government, business and community decision makers. Importantly, high-level officials have recognized the importance of the accounts in delivering environmental information in a form which can better inform policy development and sustainability goals.

6.1 Introduction

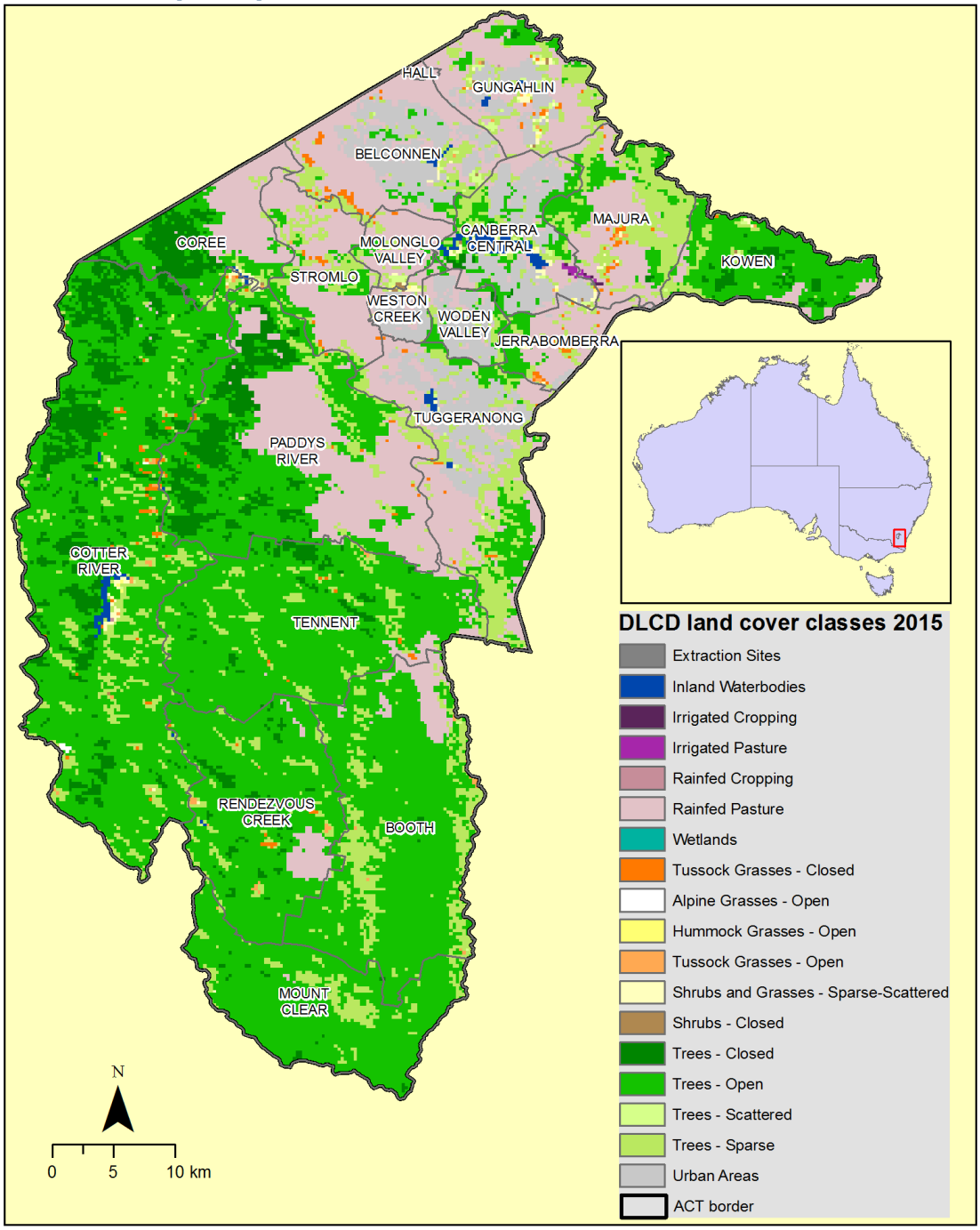
In 2016, at the 1st Forum on Natural Capital Accounting for Better Policy Decisions, we presented plans to use natural capital accounting for State of the Environment (SoE) reporting in the Australian Capital Territory (ACT) (see Smith et al., 2017a). This year we are pleased to report that we successfully executed the plans and, in September 2017, produced a first set of accounts along with a "Proof of Concept" paper. Both the accounts and Proof are now available for expert and public review (Smith et al., 2017b). The accounts were presented to a variety of people, including the ministers responsible for planning and the environment.

In this note we highlight lessons and achievements over the course of the project for development, communication and use of the accounts. The term "environmental-economic accounts" or EEA is used in this paper and other reports prepared as part of this project. For us, EEA and NCA are synonymous.

6.2 Background

The ACT holds a unique place in the Australian cultural and natural landscape. It is a small landlocked jurisdiction dominated by an extensive system of national reserves juxtaposed against the city of Canberra, which is Australia's national capital (Fig. 6.1). Local residents place a high value on environmental health and natural capital, and the ACT Government has set ambitious policy and sustainability goals to guide future development (ACT Government, 2009; OCSE, 2017b). These goals focus on economically, socially and environmentally sustainable policy outcomes that align well with the United Nations Sustainable Development Goals (SDGs). However, despite significant advancements in some areas, the ACT still faces challenges in meeting some of these goals.

Figure 6.1 Australian Capital Territory and dynamic land cover data set (DLCD) classes for 2015



Canberra is a low-density city by national and international standards. It is subject to many related sustainability issues, particularly around transport inefficiencies, waste disposal and energy use (Minister's Annual Report, 2016). The ACT has the highest ecological footprint of all Australian states and territories (ISARG, 2015) and this footprint is much higher than most similar international jurisdictions (Global Footprint Network, 2016). The city of Canberra is also growing rapidly with the population expected to rise from 409,100 to 500,000 by 2030 (ABS, 2013). Much of that growth is expected in greenfields developments with flow-on consequences for the environment, especially for transport and clearing of native vegetation. Furthermore, with world-leading greenhouse gas emissions reduction targets (EPSDD, 2014), air emissions are of particular policy relevance to the ACT.

In 2016, the ACT Office of the Commissioner for Sustainability and the Environment (OCSE) undertook an effort to incorporate national carbon accounting into its regular environmental reporting. The inception and initial stages of this plan were reported by Smith et al. (2017a) which provides extensive background material explaining the boundaries and motivations of the study, as well as the establishment of working groups, communications and engagement strategies, and the rationale for selecting the System of Environmental-Economic Accounts (SEEA). Following this, the OCSE undertook a pilot study to produce an initial set of environmental-economic accounts (EEA) for the ACT (from here "ACT EEA") (OCSE, 2017a). The OCSE also published the "Environmental-Economic Accounts for ACT State of the Environment Reporting: Proof of Concept" (Smith et al., 2017b) ("Proof of Concept") to report on the process and identify benefits and challenges for implementing EEA for the ACT SoE reporting.

6.3 Environmental reporting: The State of the Environment Report

The OCSE produces a quadrennial report called the "State of the Environment" (SoE) report. The next report is due in 2019. The SoE is intended to provide the basis for measurable, transparent and rigorous policy development and facilitate sustainable development outcomes. The content of the SoE report is stipulated by the Commissioner for Sustainability and the Environment Act 1993 (ACT). Over time, concerns have been raised that SoE reporting processes have not always provided the most suitable instrument to inform policy and help the ACT Government achieve sustainability goals.

Previous SoE reports in the ACT and elsewhere typically rely on versions of pressure-state-response models and do not address complex interactions or produce analysis that assists in developing policy. Rather, these kinds of models have been found to be over-simplistic and at risk of bias, reporting outcomes that promote linear causal relationships for what are inherently complex systems (Carr, 2010; Carr et al., 2007; Ness et al., 2010). Furthermore, there has been a reliance on ad hoc studies and data sources with little to no continuity between reports. This makes any sort of temporal analysis or comparison difficult, in turn restricting evidence-based policy development.

To address these concerns, the OCSE joined with the Australian National University and the Australian Bureau of Statistics and others as part of a broader discussion in Australia in which we are considering the practical application and incorporation of environmental information in economic and policy decision making (Vardon et al., 2016). To this end, the OCSE undertook to develop a suite of EEA for the ACT to overcome some of the limitations of the current SoE reporting while still meeting its legislated reporting requirements.

The SEEA provided the definitions and the structures for the organization of data for the ACT EEA. The SEEA was chosen because it supports integration with the national accounts and other economic

data, as well as comparison of results with other jurisdictions and countries producing accounts and, where applicable, will support integration and analysis across themes.

The broad aims of the project were to:

- Develop a suite of EEA for the ACT
- Assess the ability of EEA to meet the OCSE's statutory reporting obligations
- Test the practical issues related to producing the environmental-economic accounts,
- Identify and understand required processes necessary for ongoing implementation of environmental-economic accounts
- Provide a suite of accounts that would instigate discussion
- Allow for exploration of how environmental-economic accounts might be used in broader government, business and community decision making
- Assess the advantages and disadvantages of EEA with regard to previous SoE reporting methodologies

6.4 Development of the ACT environmental-economic accounts

Environmental-economic accounts for Canberra and the ACT were produced across seven different themes. These themes were land, environmental condition, biodiversity, water, air, solid waste and environmental expenditure (Table 6.1).

The accounts were developed through an iterative process. Initial designs were developed by the working group before consultation with relevant government managers and data custodians to explore available data and refine account categories and metrics. Draft accounts were then populated before once more being reviewed and modified appropriately.

In most instances, this process resulted in accounts that followed existing SEEA practices and methodologies. In some cases, we brought together and had to actually build new data sets from raw data held by government. We also had to develop experimental accounting designs to bring the data into alignment and exploit its potential for accounting purposes. All this negotiation prompted us to design organizational consultation methodologies which more actively contributed to gaining, exploring and reporting data sets.

This paper is intended to provide information on the policy links and process and not the detail of the data sources and methods, which can be found elsewhere (Smith et al., 2017b). Table 1 provides a summary of the each of the accounts created and brief notes on data sources. In addition, given the new data, methods and accounting format, we provide a brief description of the experimental Environmental Condition account below.

6.5 Environmental condition accounts

Three environmental domains were covered in the experimental environmental condition accounts: terrestrial (land) condition, water condition, and atmosphere condition. These accounts were largely experimental, sourcing data that was not previously explored in SEEA but also offering considerable insight into environmental trends not previously examined in this application.

The terrestrial condition account was developed using the experimental Environmental Condition Score (ECS). The ECS was calculated as the average of six indicators developed from tree cover, soil exposure, leaf area, river inflow, inundation and carbon uptake (Fig. 6.2). These indicators were selected for the ECS because they capture changes in land cover type as well as responses to changing environmental conditions. Several of these indicators are correlated to water availability, a

primary driver of environmental condition in Australia, but they also reflect land management and the broader consequences of environmental policy such as land clearing regulations. The underlying data behind these indicators were created using satellite remote-sensing and landscape modelling, and are available through Australia's Environmental Explorer (Van Dijk and Summers, 2017). A comprehensive explanation of the ECS and the data used to calculate it can be found at Australian Environmental Explorer (Van Dijk and Summers, 2017).

Figure 6.2 Environmental condition score and individual indicators for the Australian Capital Territory, 2000-2016

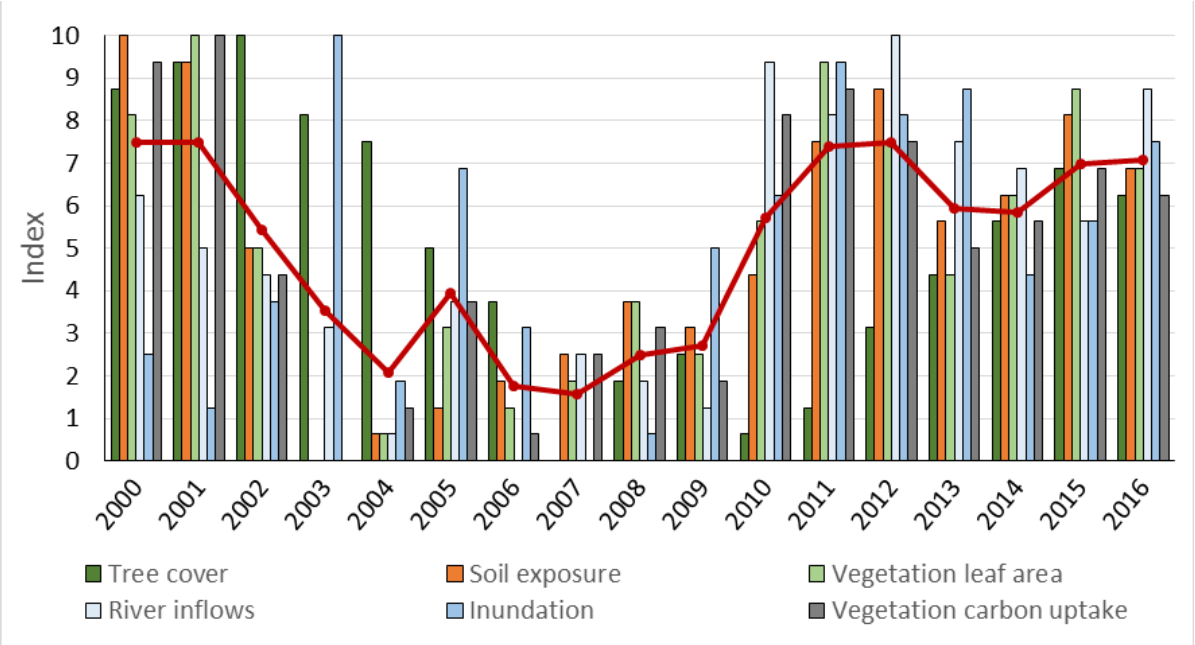


Table 6.1 ACT environmental-economic accounts for State of the Environment reporting accounts summary

Themes	Account	Notes and data sources
Land	Land cover	Geoscience Australia Dynamic land cover data set (Lymburner et al., 2011) (Fig. 1)
	Land use	ACT Territory Plan land use zoning (ACT Government, 2017)
Environmental condition	Terrestrial condition	Environmental Condition Score (ECS) (Van Dijk and Summers, 2017)
	Water condition	Catchment Health Indicator Program (CHIP) developed by the Upper Murrumbidgee Waterwatch Program (Upper Murrumbidgee Waterwatch, 2016)
	Atmospheric condition	Atmospheric carbon dioxide concentration and National Environment Protection Ambient Air Quality Measure (AAQ NEPM) substances; carbon monoxide (CO), ozone (O_3), total volatile organic compounds (TVOC) and particulate matter at 10 µm (PM10) and 2.5 µm (PM2.5) (Department of Environment and Energy, 2016)
Biodiversity	Threatened species	ACT Government legislative instruments that outline conservation policy for species and threatened communities
Water	Physical supply and use	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
	Water asset	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
Air emissions	Greenhouse gas emissions	A range of greenhouse gases recorded as carbon dioxide equivalents (CO_2^e): carbon dioxide (CO_2), methane (CH_4) nitrous oxide (N_2O), sulfur hexafluoride (SF_6) and hydrofluorocarbons. Sourced from ACT Government reports (Pitt and Sherry, 2015) and National greenhouse gas reporting
	Air pollution emissions	Based on the actual emissions of AAQ NEPM substances including; CO, oxides of nitrogen, total volatile organic compounds (TVOC), PM10 and PM2.5 (Department of Environment and Energy, 2016)
Solid waste	Physical supply and use	Australian Bureau of Statistics (ABS) Water Account (ABS, 2016) and the Australian Bureau of Meteorology (BoM) National Water Account (BOM, 2016)
Environmental expenditure	Environmental expenditure	Developed to identify and measure the ACT Government activity with regard to environmental protection and natural resource management services. The account is based on the Classification of Environmental Activities (CES) outlined in the SEEA.
	Value of volunteering	Estimates of the value of volunteer labor to environmental protection and natural resource management. This extension beyond the SEEA is consistent with general national accounting principles and gives important insights into the ways environmental policy objectives may be advanced

The water condition account was developed using the data from the Catchment Health Indicator Program (CHIP) developed by the Upper Murrumbidgee Waterwatch Program (Upper Murrumbidgee Waterwatch, 2016). The CHIP methodology assesses water quality (pH, electrical conductivity, turbidity, phosphorus, nitrates and dissolved oxygen), macro-invertebrates, and riparian condition through time and at numerous sampling sites across the ACT water catchment areas. Indices based on each of these components were combined as weighted averages to provide a single condition index for the account.

The atmosphere condition account consisted of two separate metrics. The first measured the changing concentration of CO_2 in the atmosphere, while the second measured air quality standards that relate to human health. Specifically, National Environment Protection Ambient Air Quality Measure (AAQ NEPM) substances; carbon monoxide (CO), ozone (O_3), total volatile organic compounds (TVOC) and particulate matter at 10 µm (PM10) and 2.5 µm (PM2.5) were used. The metric was based on the number of days that quality standards were exceeded.

6.6 Achievements and lessons

This initial set of ACT EEA was developed to explore the opportunities and challenges of EEA for the ACT SoE reporting. Identifying achievements and lessons through this process is particularly important in embedding the accounts within regular environmental reporting. The successful development of the first suite of accounts was an important step in itself.

The accounts were created by a small multi-disciplinary collaboration of government agencies and academics, demonstrating that it is both practical and feasible to build the accounts with available data and expertise. Furthermore, the ACT EEA and the Proof of Concept provide examples that can be used to establish and maintain dialogue with potential users of the accounts in the ACT (government, business and community decision makers) as well as the data custodians who are critical for ongoing data collection and account design.

High-level officials have uniformly recognized the importance of delivering environmental data in a form which appeals to the needs of the agencies of central government, in this case Treasury and Department of the Chief Minister. Discussions building these relationships continued throughout the development of the ACT EEA and prompted a clearer understanding of the benefits of data sharing and consolidation into accounts. A meeting with ACT Chief Financial Officers was productive, and there was wider engagement and briefings about the Proof of Concept, provided to ministers and ministerial advisers. These discussions have generated further interest in how the accounts might be deployed in decision making and policy contexts. Further briefings have been scheduled.

Through developing the accounts, the working group also established constructive relationships with relevant policy and technical stakeholders including field staff, data producers, collators and archivists. The iterative process of creating the accounts built collaborative relationships with these stakeholders, who have in turn acquired skills and understanding of EEA for improving environmental policy. It also facilitated dialogue and awareness raising about how data collection can be optimized for future accounting applications. Stakeholders have embraced the prospect of reaching a wider audience and finding greater traction by adopting an accounting methodology.

The environmental-economic accounts developed for the ACT SoE demonstrated their value as a mechanism for interpreting and analyzing environmental, social and economic indicators. Previous SoE reports had relied primarily on narrative or discourse analysis and interpretation to explain the linkages and interconnections between indicators. This limited the ability of state of the environment report developers and authors to provide objective and precise analysis, interpretation of the data and its relationship with different indicators. This restriction extended to the value of SoE reporting for policy

and decision making. EEA largely overcomes this problem by a providing the mechanism by which social, economic and environmental indicators can be quantitatively and objectively linked.

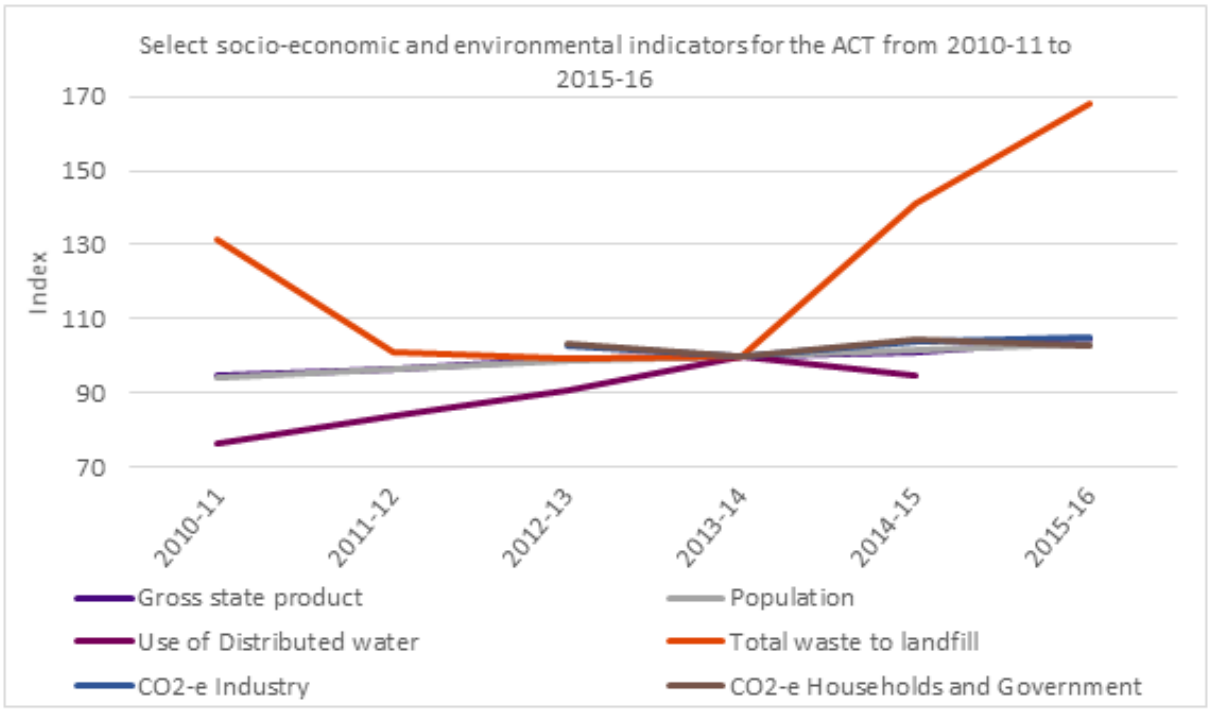
6.7 Linking socio-economic and environmental indicators for improved policy and decisionmaking

The primary goal in implementing EEA within the SoE report is to better link environmental information with environmental policy development and decision making. The following case studies from the Proof of Concept illustrate how accounts can combine indicators from environmental, social and/or economic components of sustainability to produce a quantitative picture of state, trends and relationships.

Case study – Decoupling

Decoupling, as identified by Smith et al. (2017b), refers to the ability of an economy to grow without corresponding increases in environmental pressure. Using socio-economic data from the Australian Bureau of Statistics we were able to observe decoupling trajectories across a number of sectors for the Proof of Concept. The policy uses of this information are of much significance to the ACT given its well-above national average rates of consumption and high ecological footprint (ISARG, 2015). The preliminary findings in Figure 6.3 show ACT decision makers that environmental pressures, as identified by waste, CO_2 emissions, and water use, are (variously) increasing at a rate faster, or equal to, economic growth. Such a scenario places pressure on the environment and is potentially unsustainable. It also conflicts with the ACT Government's triple bottom line and sustainability policy (ACT Government, 2009). Policy and decision makers would be further able to use these findings to determine why these adverse trends are occurring and develop necessary strategies or policies in response.

Figure 6.3 Select socio-economic and environmental indicators for the ACT from 2013-14 to 2015-16



Case study – Valuing environmental volunteering

An important achievement was the incorporation of the value of volunteering in the environmental expenditure account which revealed the importance of this previously unrecognized or quantified contribution. It is clear that environmental volunteering is "worth" millions of dollars to governments (across the whole country) which increasingly need to service environmental issues (particularly as a result of climate change). The usefulness of this account from a policy point of view is that we know that environmental coordinator positions in Australia – vis Landcare coordinators, Frog and WaterWatch coordinators – have often been the positions which are lost in times of budgetary constraints. The environmental volunteers account can be used to argue that the paid coordinators' roles must be retained as it is their coordination function which makes the volunteering beneficial. We have already been made aware of this account being cited in the budget submission of environmental non-government organization and the account has been persistently raised in discussions about policy development in respect of volunteering.

It is clear that environmental volunteering has even more direct policy implications when we consider the role of organizations such as the Great Aussie Bird Count, Red Map, Friends of the Beware Reef, and WaterWatch. Local and regional volunteers are able to undertake regular surveys and respond quickly to survey windows in ways that are impractical or prohibitively expensive for paid employees. In Gippsland Victoria, for example, Beware Reef volunteers are able to regularly access the reef and carry out fish surveys taking advantage of calm seas when opportunity arises. They then feed the data back to researchers hundreds of kilometers away, who would otherwise not have been able to collect it.

6.8 Future Directions

While the Proof of Concept has produced an initial set of environmental accounts, there is much work to be done before the release of the next SoE. Further research and development is required to extend some of the current accounts and develop new accounts not included in the current release. There is also a need to assess how the data and understanding from previous SoE reports can be integrated into a new framework based on NCA. This work needs to be considered iterative and, as Vardon et al. (2016) identify, framed within the context of "decision-centered design."

To this end, efforts are underway to compare the accounting in the Proof of Concept with past reports, improve the accounting already produced, and extend the range of accounts produced. For example, it would be useful to extend the ecosystem condition accounts to better capture biodiversity and to add monetary and valuation components to the land and water accounts. We also intend to develop an energy account and ecosystem service accounts.

6.9 Acknowledgements

Many people have assisted with the development of NCA in the ACT. We would like to thank all the individuals and agencies that provided data and helped us to understand how it may be used in the accounts. We would particularly like to thank: Woo O'Reilly, Danswell Starrs and Gayan Ratwatte for the ACT Government; Peter Meadows, Peter Comisari, Sarah Coleman and Steve May from the ABS; Albert van Dijk and Annabelle Dolan from the ANU; and Carl Obst and Mark Eigenraam from the Institute for the Development of Environmental-Economic Accounting.

6.10 References

Commissioner for sustainability and the environment act 1993, 1993, ACT, Australian Capital Territory

ABS, Australian Bureau of Statistics, 2013. Population projections, Australia, 2012 to 2101, cat. No. 3222.0. http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features12012%20(base)%20to%202101?opendocument&tabname=Summary&prodno=3222.0&issue=2012%20(base)%20to%202101&num=&view=. Accessed on 24 October 2017.

ABS, Australian Bureau of Statistics, 2016. Water account, Australia, 2014-15, cat. No, 4610.0. http://www.abs.gov.au/ausstats/abs@.nsf/mf/4610.0. Accessed on 1 August 2017.

ACT Government, 2009. People, place, prosperity: The ACT's sustainability policy, Canberra, Australia. http://www.cmd.act.gov.au/__data/assets/pdf_file/0003/119730/people_place_prosperity.pdf.

ACT Government, 2017. Territory plan land use zones. http://actmapi-actgov.opendata.arcgis.com/datasets/acee3284096d496bb9eb74ca90b4faf7_3.

BOM, Bureau of Meteorology, 2016. National water account 2016. http://www.bom.gov.au/water/nwa/2016/canberra/index.shtml. Accessed on 1 August 2017.

Carr, E.R., 2010. The place of stories in development: Creating spaces for participation through narrative analysis. Development in Practice 20(2) 219-226.

Carr, E.R., Wingard, P.M., Yorty, S.C., Thompson, M.C., Jensen, N.K., Roberson, J., 2007. Applying dpsir to sustainable development. International Journal of Sustainable Development & World Ecology 14(6) 543-555.

Department of Environment and Energy, 2016. National pollution inventory database, Australian Government Department of Environment and Energy, Canberra, Australia. http://npi.gov.au/npi-data/latest-data.

EPSDD, Environment, Planning and Sustainable Development Directorate, 2014. Carbon neutral ACT government framework ACT Government, Canberra, Australia. http://www.environment.act.gov.au/__data/assets/pdf_file/0020/630065/Carbon-Neutral-ACT-Government-Framework_ACCESS_aug.pdf.

Global Footprint Network, 2016. National Footprint Accounts 2016, Open Data Platform. http://data.footprintnetwork.org. Accessed on 24 October 2017.

ISARG, Integrated Sustainability Analysis Research Group, 2015. The 2011-12 ecological footprint of the population of the Australian Capital Territory. University of Sydney, Sydney, Australia. http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0007/825406/2011-12-Ecological-Footprint-ACT-for-2015-ACT-SoER.pdf.

Lymburner, L., Tan, P., Mueller, N., Thackway, R., Lewis, A., Thankappan, M., Randall, L., Islam, A., Senarath, U., 2011. The national dynamic land cover dataset. Geoscience Australia, Canberra, Australia.

Minister's Annual Report, 2016. Minister's annual report: Climate change and greenhouse gas reduction act 2010. http://www.environment.act.gov.au/home/latest_news/201516-ministers-annual-report-climate-change-and-greenhouse-gas-reduction-act.

Ness, B., Anderberg, S., Olsson, L., 2010. Structuring problems in sustainability science: The multi-level dpsir framework. Geoforum 41(3) 479-488.

OCSE, Office of the Commissioner for Sustainability and the Environment, 2017a. Environmental-economic accounts for the ACT, Canberra, Australia. http://www.environmentcommissioner.act.gov.au/publications/environmental-economic-accounts.

OCSE, Office of the Commissioner for Sustainability and the Environment, 2017b. Implementation status review of ACT government's climate change policy. Office of the Commissioner for Sustainability and the Environment, Canberra, Australia. http://www.environmentcommissioner.act.gov.au/__data/assets/pdf_file/0018/1116324/CSE-ISR-Report-Aug2017_FA_AccPDF_c2.pdf.

Pitt and Sherry, 2015. Interim ACT greenhouse gas inventories for 2012-13 and 2013-14, report prepared for ACT government environment and planning directorate, Canberra, Australia. http://www.environment.act.gov.au/__data/assets/pdf_file/0005/711959/Attachment-A-Interim-ACT-Greenhouse-Gas-Inventory-2012-13-and-2013-14_web.pdf.

Smith, B., Auty, K., Burnett, P., Vardon, M., 2017a. Natural capital accounting for state of environment reporting in the Australian Capital Territory, In: Vardon, M., Bass, S., Ahlroth, S., Ruijs, A. (Eds.), Forum on natural capital accounting for better policy decisions: Taking stock and moving forward. The World Bank: Washington D.C.

Smith, B., Summers, D., Vardon, M., 2017b. Environmental-economic accounts for ACT state of the environment reporting: Proof of concept. ACT Office of the Commissioner for Sustainability and the Environment, Canberra, Australia.

Upper Murrumbidgee Waterwatch, 2016. Catchment health indicator program. Upper Murrumbidgee Waterwatch, Canberra, Australia. http://www.act.waterwatch.org.au/chip.html.

Van Dijk, A.I.J.M., Summers, D.M., 2017. Australia's environment in 2016. Australian National University. http://www.ausenv.online.

Vardon, M., Burnett, P., Dovers, S., 2016. The accounting push and the policy pull: Balancing environment and economic decisions. Ecological Economics 124 145-152.

7. SDG 13, the SEEA and New Zealand's missing carbon tax

By Jeremy Webb

Director, Challenge Institute
Doctoral Student, Department of Science, Technology, Engineering and Public Policy, University College London
Corresponding author: jeremy.webb@challenge.institute

Summary

After more than 25 years of work on environmental accounting, there is a need for demonstrable policy applications. In today's context, this includes how environmental accounting can contribute to domestic policies and the Sustainable Development Goals. The case of New Zealand's carbon tax is almost such an example. Between 2001 and 2004, Statistics New Zealand used the System of Environmental-Economic Accounting (SEEA) to draw together data from a range of sources to form a comprehensive set of energy and greenhouse gas emissions accounts including both the monetary and physical flow tables. Together, these data formed the basis of carbon tax working papers prepared by the New Zealand Treasury, and the carbon tax became an important issue in the 2005 election and subsequent formation of a government. Based on the New Zealand experience, this paper provides an insight into the role that statistics and environmental accounts can have in policy making, highlighting the need to be cautious with regard to expectations around the application of environmental accounting to policy.

7.1 Introduction

The development of New Zealand's first energy accounts using the System of Environmental-Economic Accounting (SEEA) (UN et al 2014) shows the possibility of using the SEEA to support powerful policy analyses that can contribute to the preparation of national determined contributions (NDCs) to the global response to climate change and Sustainable Development Goal (SDG) 13. In brief, SDG 13 is to take urgent action to combat climate change and its impacts,[8] and is one of 17 SDGs adopted by the United Nations as part of its Agenda 2030.[9] Under SDG 13 there are 5 targets, including to "integrate climate change measures into national policies, strategies and planning" (SDG 13.2), such as NDCs (UN 2017).

A carbon tax is one way of supporting SDG 13, by simultaneously internalizing the cost of climate change driven by greenhouse gas emissions from combustion, and sending a price signal to businesses, households and individuals to change behaviour. How taxes can help achieve the SDGs is an area of growing interest.[10] However, carbon taxes are a politically contentious issue, requiring not only good data to help with policy analyses, but also public acceptance and political leadership (Grubb et al. 2014).

As such, the case presented here consists of multiple elements. The first was the political opportunity and the second was the funding of an environmental accounting program. The third element regards the SEEA, which served as the framework for organizing data. Importantly, data organized by the SEEA could

[8] See: https://sustainabledevelopment.un.org/sdg13
[9] See: https://sustainabledevelopment.un.org/sdgs
[10] See, for example: http://www.worldbank.org/en/events/2017/06/06/first-global-conference-of-the-platform-for-collaboration-on-tax#1

be used in existing computable general equilibrium models. The fourth element was the human and institutional network, and the building of connections with the purpose of identifying potential users for the energy accounts. The fifth element regards the use of data by policy agencies to understand the current circumstance, test assumptions, and investigate options. The final element was understanding the political trade-offs and the politics that ultimately meant a carbon tax was not adopted in New Zealand.

After presenting these elements, the paper goes on to discusses policy making styles and the role of a national statistics office in relation to policy agencies and political processes. The paper finishes with a summary and conclusions.

7.2 New Zealand carbon tax case study

Political opportunity
Following the 1999 election, a Labour-led coalition government was formed. The Greens were outside the coalition but were able to secure provisions in successive budgets, including NZ$ 730,000 for "pilot work on alternative national accounts and business environmental reporting" (Green 2000). This included funding for Statistics New Zealand (SNZ).

Resourcing of environmental accounts
With government funding, SNZ undertook recruitment and formed a team of six to prepare New Zealand's first environmental accounts. The team had a diversity of backgrounds including economics, environmental science, geography, geology and statistics. These accounts developed included: minerals, energy, water, forest, land use, CO_2 emissions, fish, and environmental protection expenditure. The team had the benefit of being able to focus on environmental accounting full-time, building their capacity with support from experts from National Accounts, literature, international case studies, and successive drafts of the *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003*, which was being developed by the London Group (UNSD 2017). The time required to find existing data and compile accounts was around two years, which was longer than expected for most accounts.

SEEA energy accounts
New Zealand's energy flow accounts provided estimates for the flow of energy from the environment into the economy, including geothermal energy, hydro and wind, as well as coal, oil and gas. The accounts then included product flow tables (i.e. supply and use tables) with data on the value of energy flows through the economy along with corresponding physical quantities. Finally, the energy accounts were published with energy-related greenhouse gas emissions (SNZ 2004). The energy flow accounts were based on data from the Ministry of Economic Development's (MED) Energy Data File (EDF), the Energy Efficiency Conservation Authority's (EECA) Energy End Use Database (EEUDB), as well as input output tables from Statistics New Zealand's national accounts (SNZ 2004).

The majority of the work preparing the energy flow accounts was spent unpacking transport energy demand. This involved taking physical energy data for transport available in the energy balance and splitting it between the economic activities (i.e. the industries and sectors defined in the national accounts). Monetary data for fuel purchases were already available but needed to be split between the different fuel types (e.g. petrol, diesel, gas). Once physical energy use data were compiled, it was possible to estimate the energy-related greenhouse gas emissions by economic activity (SNZ 2004).

Connecting with the Treasury
While preparing the energy and greenhouse gas emission accounts, there was a desire within the Environment Statistics team to determine how the accounts could be applied to policy (SNZ 2003).

Given the link between energy-related greenhouse gas emissions and the issue of climate change, the Energy Accounting Lead attended a public consultation by the government team working on climate policy. Following the consultation, contact was made with the Treasury as it was determined they were seeking information similar to what was included in the energy accounts. This contact directly led to the Treasury contact using SNZ's energy accounts. The energy accounts were used in preference to other information sources on the basis that SNZ had greater time and resources available to compile the required data, and there was an expectation that this would improve the quality of the data available for analysis (Pers. Comm. John Creedy 2002).

SNZ had various organisations review the first draft of the energy accounts, given that they were being produced for the first time. The reviewers included the Treasury, who provided feedback that the data were too aggregate to be useful for the analysis they intended to carry out. After discussion within SNZ and the allocation of additional resources to the project, this led to a more detailed breakdown being prepared. The draft energy flow accounts were sent for final review by other government departments[11] just prior to Christmas 2003, and after incorporating feedback, were published in 2004 (SNZ 2004).

Treasury analysis

Unknown to the Energy Accounts Lead, the contact at the Treasury was a carbon tax expert who had been recruited for two years while on leave from his academic role at Melbourne University. Being an expert, he attended a carbon tax group meeting and volunteered to undertake an empirical assessment of the potential effects of a carbon tax on New Zealand. SNZ's engagement was welcomed as it reduced the amount of work the Treasury staff member and intern would have to undertake in support of the analysis.

From the energy accounts, the Treasury prepared two Treasury Working Papers. The first was titled "Carbon Taxation, Prices and Household Welfare in New Zealand" (Creedy and Sleeman 2004a). By looking at the use of fossil fuels by industries, inter-industry transactions, and a range of possible carbon taxes, Treasury was able to assess:

- What carbon tax rates would do to consumer prices
- Changes in household expenditure by type of household
- The level of inequality of carbon tax burden (Creedy and Sleeman 2004a)

The second paper was titled "Carbon Dioxide Emissions Reductions in New Zealand: A Minimum Disruption Approach" (Creedy and Sleeman 2004b). In this paper, the Treasury looked at how carbon dioxide emissions may be reduced by changes in the structure of the economy, specifically in relation to final demand; use of fossil fuels by industry; and the structure of inter-industry transactions. Treasury modelled how to reduce carbon dioxide emissions in the least disruptive way possible by assessing the minimum changes to the above components that would achieve necessary greenhouse gas reductions. Treasury constrained their model by limiting the acceptable changes in GDP growth and aggregate employment (Creedy and Sleeman 2004b). Academic papers also resulted from the studies by Treasury (Creedy and Sleeman 2005, 2006).

It is unclear to what extent this work was used to inform carbon tax policy or informed the political carbon tax debate.

[11] As these were experimental accounts compiled using existing data it was considered appropriate to share them with other government departments and select reviewers in advance of publication. For established statistical products this would not happen, but rather figures would be embargoed until the time of publication.

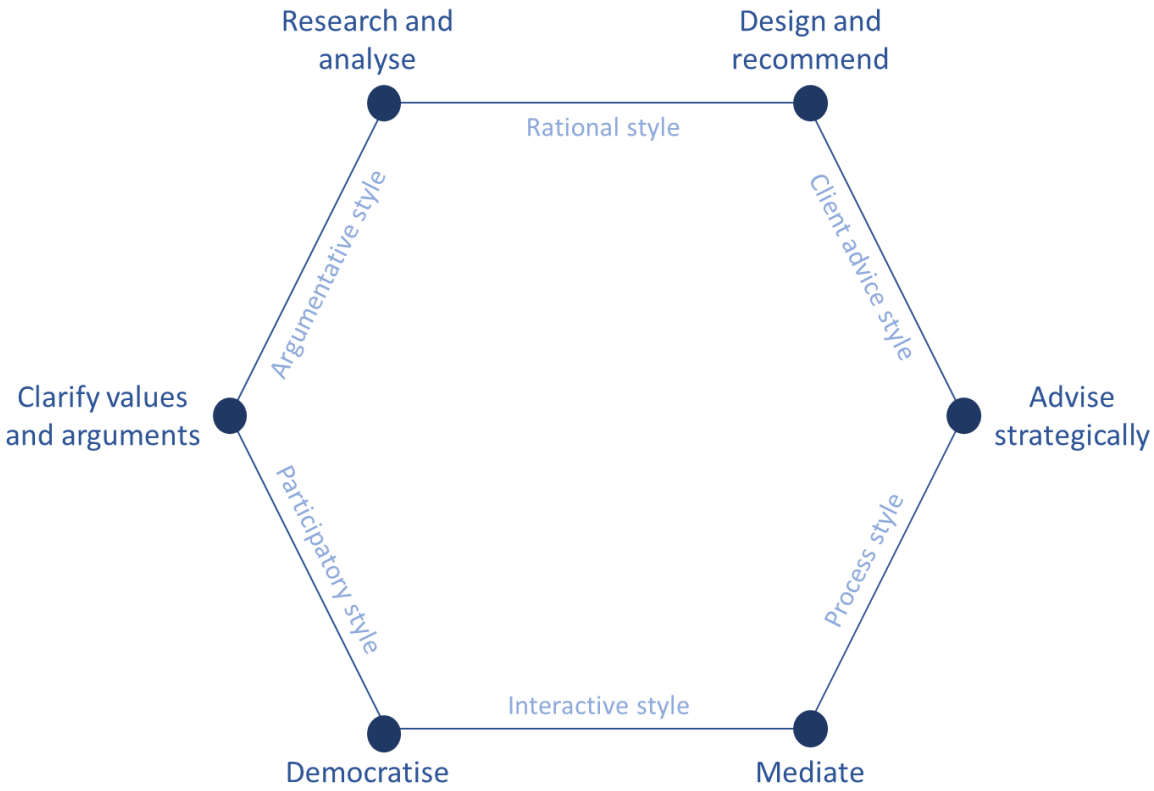
Political Trade-offs

So, what happened? In the national election in 2005, Labour campaigned for a carbon tax but United Future, whose support was required to form a government, had campaigned against the carbon tax. The confidence and supply agreement between Labour and United Future included a review of the carbon tax (Bennet 2005) and the carbon tax was never implemented. Thus, while the New Zealand case study illustrates that the accounts were useful in analysis of issues and the assessment of different policy options, ultimately the decision to implement the tax was a political decision.

7.3 Environmental accounting and policy making styles

In the book titled "Public Policy Analysis: New Developments" edited by Thissen and Walker (2013), six policy making styles were presented using a hexagonal plot (Figure 7.1) (Mayer et al. 2013). The case study from New Zealand demonstrates many of these policy-making styles. In the first instance, mediation between Labour and the Greens created the opportunity for funding of environmental accounting activities at SNZ. Importantly, there was sufficient funding for dedicated staff to be recruited to undertake the complex task of preparing accounts for the first time.

Figure 7.1 Styles of policy making



Source: Mayer et al (2013)

The government undertook public consultations following the participatory style of policy making, serving as an opportunity for the democratization and clarification of arguments by business, civil society and others (MfE 2001). It also facilitated an opportunity for networking and the connection between SNZ and the Treasury, and ultimately the use of energy accounts in the Treasury working papers. The networking by the SNZ Energy Accounting Lead can be considered a case of "policy

entrepreneurship," or at least "data entrepreneurship," where an individual seeks to find an application of their data within government.

The actual compilation of energy and emissions accounts followed the rational research-and-analyze mode, following the fundamental principles of official statistics (UNSD 2014) and the norms within SNZ. This also meant that the accounts did not make interpretations of the data or their policy implications, but rather, descriptive commentary. That said, assumptions and choices were made with regard to methods, especially where there were data gaps or alternative data to choose from. The methods and data used were described in the report (see SNZ 2004).

The preparation of Treasury Working Papers followed the rational style involving designing and recommending a policy. In this case, it involved staff at the Treasury taking the best available data and using existing models to look at how a carbon tax could be optimized, and then informing the government and other interested parties (e.g. business and civil society) through working papers.

Like the Energy Accounts Lead, the Treasury contact also acted as a policy entrepreneur, volunteering to undertake the research. However, it is difficult to gauge the influence of the working papers without further analysis, for example on the timing of publication in relation to policy processes, including who read the documents.

In the end, politics and the mediation style of policy making that created the opportunity to compile the energy and emissions accounts also demonstrated that while data and analyses are available, there are other factors in government decision making resulting in trade-offs. Thus, a confidence and supply agreement involving Labour and United Future meant that the carbon tax was never implemented.

7.4 Conclusions

From the New Zealand case study, it is clear that no one thing resulted in the energy and emissions accounts being used as an input to the Treasury working papers on New Zealand's carbon tax. As such, if environmental accounts are to be applied to policy, many things need to happen. In the New Zealand case, this included having the mandate and adequate resources to compile environmental accounts, engagement with other parts of government, the active pursuit of opportunities to have data used by others, and an interest from the government in a policy (i.e. carbon tax) that could benefit from environment accounts.

It should be noted that energy and related CO_2 emissions accounts and a carbon tax were in the "sweet spot" for the application of environmental accounts to policy questions. Annual accounting periods provide meaningful data, there are no geographic constraints to consider when assessing CO_2 emissions, and the policy being considered (i.e. carbon tax) can readily be assessed using existing models in government. In other cases, seasonality may be very important, national data may have limited analytical value as issues may be geographically constrained (e.g. local in character), potential policy options may not be clear - and even if the options are clear, the models and methods needed may not exist.

The SEEA energy and energy-related greenhouse gas emissions accounts could be a very important framework for organizing information for further analysis in support of NDC preparation and addressing SDG 13. However, given the resources required to prepare environmental accounts, consideration of whether environmental accounts will generate meaningful and analytically useful information should be considered in advance. In some cases, indicators and other types of analyses may be adequate and require less effort to be collected, compiled and analyzed.

An awareness of policy styles may help those preparing environmental accounts to engage with others government agencies and manage expectations. Data entrepreneurship was central to the New Zealand case study, but at the same time, there was an awareness of the need to follow the fundamental principles of official statistics and stick to the rational style of data preparation (i.e. research and analyse). Through interactions with the Treasury, an awareness emerged of the role the Treasury had following the rational design and recommended style of policy making. However, it was only on reflection that the wider issues of mediation, participation, democratization and the clarification of values and arguments emerged as being important to the case study. Mediation not only created the opportunity for developing environmental accounts, but also the trade-off that led to the carbon tax being abandoned following the 2005 election.

In conclusion, in New Zealand environmental accounts provided a framework for organizing data used to analyze the impact of a carbon tax. The production and use of the accounts depended on many things including resources, linking with other government agencies, and finding an alignment of opportunities. Perhaps most importantly, if accounts are to be applied to policy issues, it is useful to take a proactive "data entrepreneur" approach being aware of policy making styles, while at the same time ensuring data quality through the rational style of research and analysis.

7.5 Acknowledgements

I would like to thank John Creedy (Treasury) and Chase O'Brien (Statistics New Zealand) for their advice and valuable comments on the paper. The views expressed in the paper are my own and do not represent those of the New Zealand Government.

7.6 References

Bennet, A., 2005. Dunne post lifts optimism. New Zealand Herald, 18 October 2015. Online 11/11/2017: http://www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=10350959

Creedy, J. and Sleeman, C. 2004a. Carbon Taxation, Prices and Household Welfare in New Zealand. New Zealand Treasury Working Paper 04/23. Online 11/11/2017: http://www.treasury.govt.nz/publications/research-policy/wp/2004/04-23/twp04-23.pdf

Creedy, J. and Sleeman, C. 2004b. Carbon Dioxide Emissions Reductions in New Zealand: A Minimum Disruption Approach. New Zealand Treasury Working Paper 04/25. Online 11/11/2017: http://www.treasury.govt.nz/publications/research-policy/wp/2004/04-25/twp04-25.pdf

Creedy, J. and Sleeman, C., 2005. Carbon dioxide emissions reductions in New Zealand: a minimum disruption approach. Australian Economic Papers, 44, no. 3, pp. 199-220.

Creedy, J. and Sleeman, C., 2006. Carbon taxation, prices and welfare in New Zealand. Ecological Economics, 57, pp. 333-345.

Green (Green Part of Aotearoa New Zealand) 2000. Green Budget Package far reaching. Green Party press release. Online 11/11/2017: https://home.greens.org.nz/press-releases/green-budget-package-far-reaching

Grubb, M., Hourcade, J.C. and Neuhoff, K., 2014. Planetary economics. London: Routledge. Online 11/11/2017: https://www.routledge.com/Planetary-Economics-Energy-climate-change-and-the-three-domains-of-sustainable/Grubb-Hourcade-Neuhoff/p/book/9780415518826

Mayer, I. S., C. E. van Daalen and P. W. G., 2013. Chapter 3 Perspectives on Policy Analysis: A Framework for Understanding and Design. In Thissen, W. A. H., and Walker, W. E. (Eds). Public Policy Analysis:

New Developments. International Series in Operations Research and Management Science, Volume 179. Springer.

MfE (Ministry for Energy). 2001. Climate Change: Plan for Consultation and Release of Discussion Documents. Online 11/11/2017: https://mfe.govt.nz/sites/default/files/pol-01-262.pdf

SNZ (Statistics New Zealand). 2004. Energy Flow Account 1996-1999. Statistics New Zealand. Online 11/11/2017: http://m.stats.govt.nz/~/media/Statistics/browse-categories/industry-sectors/energy/energy-flow-account-1996-1999/e-flow-acc-1996-1999.pdf

SNZ (Statistics New Zealand). 2003. Statistics New Zealand's Environment Statistics Strategy 2003. Statistics New Zealand. Online 11/11/2017: http://www.stats.govt.nz/~/media/Statistics/browse-categories/environment/sustainable-development/environment-statistics-strategy/ess.pdf

Thissen, W. A. H., and W. E. Walker (Eds.). 2013. Public Policy Analysis: New Developments. International Series in Operations Research and Management Science, Volume 179. Springer.

UNSD (United Nations Statistics Division). 2014. Fundamental Principles of Official Statistics webpage. United Nations Statistics Division. Online 11/11/2017: https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx

UNSD (United Nations Statistics Division). 2017. History of the London Group. United Nations Statistics Division. Online 11/11/2017: https://unstats.un.org/unsd/envaccounting/londongroup/history.pdf

UN (United Nations). 2017. Sustainable Development Goal 13. United Nations. Online 11/11/2017: https://sustainabledevelopment.un.org/sdg13

8. Research-practice co-creation as a strategy to foster use of natural capital accounting at the national level: Practical reflections from the Pacific

By Pierre Bertrand,[1] Gilles Dubochet[2] and Francesco Obino[1]

[1]*GDN*
[2]*Ideas Belong*
**Corresponding author: pbertrand@gdn.int*

Summary

Implementing the SDGs calls for a holistic understanding of the interactions between socio-economic activities and the environment. The systematic integration of environmental and related data into mainstream national accounts, through the development of Natural Capital Accounting (NCA), can significantly advance this task. Linking the production to the use of natural capital accounts, however, faces important hurdles, many of which are related to the need for new modes and models of collaboration. In this paper, we discuss the experience of developing a Research and Practice Network on NCA in the Pacific region on a nationally- and demand-driven model. The paper concludes with some practical lessons with regard to the engineering of collaboration, and can be useful to broader discussion about NCA advances in developing countries, and SDG implementation more broadly.

8.1 Introduction

Implementing the Sustainable Development Goals (SDGs) calls for a holistic understanding of the interactions between socio-economic activities and the environment. The idea that achieving the SDGs rests upon integrating social, economic and environmental dimensions of development is widely acknowledged, and it is represented in the complex interconnections between the SDGs.

Natural Capital Accounting (NCA) can provide a tremendous contribution to this task: it provides a clear accounting framework that integrates environmental information with conventional socio-economic statistics, in line with the existing System of National Accounts (SNA) already used by governments as a reference for policy discussions and decisions. Stimulating the adoption of NCA at the national level, in terms of both production and use of these accounts, remains a key challenge. NCA can help achieve the SDGs only if used and owned by national stakeholders. This challenge is particularly urgent in developing countries, where both production and use are, in most cases, at an incipient, experimental stage.

In 2017, the Global Development Network (GDN) and Ideas Belong explored the creation of a Research and Practice Network (RPN) in the Pacific (PANCAnet) as a strategy to work on NCA *use* at the same time as other actors, specifically WAVES and UNESCAP, worked on the *production* of SEEA-CF accounts (energy, land, water, waste) with selected National Statistical Offices (NSOs). PANCAnet was born with the aim to facilitate the emergence of nationally-driven research projects that use NCA to produce policy-relevant evidence on the link between the economy and the environment. In the process, we also learned a lot about what it takes to use an RPN to foster linkages between demand and supply of policy-relevant knowledge at the national level, in connection with global debates and expertise but on a clear

demand-driven model. This paper reflects on this experience, the tools developed, and the lessons learnt that can usefully inform other initiatives globally. It also provides a discussion on the collaboration challenges that will be key to implementing the SDGs at the national level, and the role of global actors in accelerating them.

8.2 Linking the production and use of the accounts: A collaboration challenge for local and global actors

In recent years, much effort has gone into supporting the production of natural capital accounts and to strengthening statistical and data-handling capacities in countries to do so, notably through the WAVES partnership. Capacity-building activities and training have been delivered in the countries that expressed interest, and the agencies responsible have produced a growing number of accounts, either in an experimental or full-fledged form.

Accounts organize environmental data in a useful manner, but they are rarely directly useful to policy makers in their raw format. Users, whether decision makers or program managers, need "processed" information (Oosterhuis, Van der Esch, and Hoogervorst 2016) in the form of indicators or analysis that link the accounts to context and policy priorities. The NCA community, notably through the first WAVES Policy Forum in 2016, has started to debate this issue, yet the practicalities of linking production and use and how the accounts can permeate the policy cycle (Vardon, Burnett, and Dovers 2016) remain a terrain of experimentation and discussion.

As pointed out by earlier studies (Vardon, Burnett, and Dovers 2016; and Oosterhuis, Van der Esch, and Hoogervorst 2016), the link between production and use necessitates the mobilization of a broad range of actors to act as "intermediaries" and "translators," and researchers in particular are a critical intermediary link between producers and end users. Their mobilization in this effort, however, poses a number of challenges. Development researchers mainly use traditional socio-economic statistics, particularly in their link to GDP, but at the current stage of development of NCA, the interest of academia in environmental and ecosystem accounting remains a niche. Accelerating their involvement in using NCA requires addressing a number of challenges for which tools and methods are lacking:

- **Interdisciplinarity:** Turning natural capital accounts into useful and useable information requires an interdisciplinary effort between economists, statisticians, natural accountants, and natural scientists, to name a few, but also social scientists more broadly. However, the accounts rely on concepts and definitions that are not necessarily shared by the different disciplines to be involved. This also comes at odds with hyper-specialization trends in research due to which the accounts may not be perceived as a useful set of data that can advance individuals' research.
- **Working across professional practices:** National accountants, academics and policy makers are perceived as (and, for the most part, are) distinct groups with distinct interests and with limited space and habit to collaborate. Turning statistics into policy-relevant analysis requires collaboration mechanisms that acknowledge upfront the distinct roles of different profiles involved. There is no "how to" guide to set up such collaborations, and this creates a knowledge-to-practice gap. Addressing the lack of proven ways to support diverse collaborations between different categories of stakeholders is necessary to accelerate the implementation of sustainable development policies through better and timely evidence.
- **Connect global, regional and local discussions:** Interactions between socio-economic activities and the environment cut across research scales and policy-making levels, from local, to regional, national and global. This calls both for better coordination of initiatives at the international and national levels, and for the development of a strong ownership of the NCA framework through a demand-driven approach connected with the existing expertise and experiences, globally.

Experiences in Guatemala and the Netherlands show that this type of collaboration between disciplines and across professional practices can sometimes happen endogenously, without the involvement of external or international actors, and as a step-by-step process. Even in these cases, international actors have a role to play in accelerating the collaborative agenda to link production and use of accounts by supporting cross-country learning and cross-country collaboration on approaches and tools adopted to this end.

The next section reflects on the role of international actors based on the experience of GDN and Ideas Belong in setting up PANCAnet.

8.3 Setting up PANCAnet: A research and practice network to link production and use of NCA at the national level

GDN and Ideas Belong identified an opportunity to start linking early-on production and use of NCA in the Pacific. Of particular interest were five island countries in the South Pacific where SEEA-CF accounts (energy, land, water, waste) were being built in 2016-7 with the support of UNESCAP (Federal States of Micronesia, Fiji, Palau, Samoa and Vanuatu). WAVES was also supporting the development of some accounts in the Philippines, further expanding the potential for collaboration opportunities at the regional level.

Through PANCAnet, GDN and Ideas Belong approached linking of production and use of accounts in the Pacific as essentially a collaboration challenge. The intention of the project was to involve a broad range of actors. A first group were NCA producers, by which we mean the institutions in charge of producing the accounts: national statistical organizations, ministerial departments or, in some cases, departments of several ministries or central banks. A second group were end-users: policy makers and civil society organizations who need relevant information to design, implement and monitor policies or actions. A third group were intermediary users, researchers more precisely: the project assumed that researchers had the expertise to make the link between the accounts and policy concepts or policy-relevant indicators, through analytical work. As we pointed out earlier, the knowledge transmission between actors was not intended to be a linear mechanism; rather, the expectation was that repeated interactions between these different stakeholders would result in collaborations around specific questions, which could be answered through analytical work on the accounts, done by the researchers but with a scope defined by all involved. PANCAnet also included international organizations and experts, who were meant to play a role of observers, resource people and advisors.

The purpose of PANCAnet was to accelerate the transition from a situation where stakeholders simply expressed a generic interest in NCA, to one where groups of researchers and practitioners from the concerned countries engage in a co-creation process leading to concrete research projects in response to real demands, and of a scientific quality such that they could contribute to national policy debates on the relevant underpinning development issues.

In sum, the decision to use a Research-Practice Network as a strategy to foster these collaborations was justified by three main ideas:

- The need to mobilize and connect diverse groups of stakeholders, without privileging the capacities, interest or goals of one groups over another
- The need to develop spaces and tools fit for enabling meaningful interactions between these groups, based on common thematic interests
- The need to accompany, and structure, the progression of these interactions, whenever possible, to enable specific collaboration groups to turn their ideas into fundable research projects with a clear demand.

PANCAnet was set up in three steps: we conducted a mapping of the actors in the region, we convened a stakeholder workshop to design the network with its potential users, and we set up an online collaboration interface to facilitate interactions, remotely, after the workshop.

The mapping intended to gather information on the potential actors who would be involved in this RPN, and their agendas, needs and capacities. We identified five specific groups interested in linking the production and use of NCA, in line with the categories of stakeholders mentioned above: researchers from research institutions in the region, national policy makers, national statistical offices, international and regional experts from Australia and New Zealand, and international organizations working on NCA production.

Respectively, international organizations were keen on demonstrating that the accounts can provide useful information to policy makers; the conversation we had with researchers from the University of South Pacific led us to assume that they were also interested in working on this topic and that they saw NCA as an opportunity to engage in policy-relevant research; experts and researchers from Australia and New Zealand supported the idea, shared the sense of timeliness of the project, and agreed to engage in this process by providing their expertise.

A first face-to-face workshop with all the people previously contacted was a critical step in our effort, and it allowed the team behind the project to turn the vision of a network into a working plan and platform, whose design was based on inputs from its potential users. The workshop was an opportunity to define a short- to medium-term work program. The workshop was organized by GDN in association with WAVES and UNESCAP, at the Oceania Ecosystem Services Forum (OESF) in March 2017, in Brisbane, Australia. It gathered around 30 people: international experts on NCA, national accountants in charge of NCA in the Pacific, researchers and practitioners either identified by GDN and its partners, or as OESF delegates.

Specifically, in terms of inputs, the workshop allowed for the identification of five themes of broad interest to the group: sustainable tourism, marine and coastal ecosystems, SDG 14 (Oceans), energy regulation, and health-environment links. These became the thematic backbone of the online platform at its launch. Along with each theme, we also identified “champions”: individuals that could play an instrumental role in steering one of the chosen themes on PANCAnet.

Following the workshop, the online interface of PANCAnet was launched, attracting over 40 members in the first weeks. Given the stage of development of NCA in the region, this result was considered extremely encouraging. Turning the dynamic of the workshops into concrete discussion on the platform, however, proved more difficult than anticipated. Discussion on the dedicated online spaces struggled to pick up pace, forcing us to revert to one-to-one discussion with “champions” and partners on the use of the platform. A forthcoming paper discusses the specific approach implemented on the online platform (Bertrand, Dubochet and Obino, forthcoming). For the purpose of this contribution, we would like to focus on the fact that, at the time of writing, October 2017, the platform is dormant, and GDN and Ideas Belong are reviewing their engagement strategy with the PANCAnet community.

Discussions with different stakeholders were instrumental to confirm that interest was genuine and its level significant, but some of the assumptions the initiative was built on needed refining. We had a good understanding of the dynamic between the different stakeholders and the desire for collaboration was confirmed. Two main issues, however, proved critical. These should inform further fine-tuning of the specific role international actors play in the success of such initiatives, within and beyond PANCAnet.

First, there was a genuine and continued interest to be on the network at the national level, and an eagerness to define thematic priorities across the region. Though there is a general interest for environmental issues, for many, however, the link between NCA and individual and institutional

agendas remains too vague. The awareness about NCA is still uneven, and the lack of references and examples of NCA use in policy undermines the capacity of members to take a proactive role and coalesce around concrete projects, even at a seminal state.

Second, researchers specifically remained silent on the platform, despite the key role they were expected to play. More work needs to go into understanding, from an insider's perspective, the incentive structure researchers face when they engage in a new project of this scope. The incentives PANCAnet put forward were not necessarily appropriate at a stage where academic institutions themselves have not started working on NCA.

These two conclusions do not imply that a conversation on NCA use is premature in the region, or that a nationally-driven effort is not viable, rather the contrary. At a general level, they imply, however, that any such effort should be woven together, systematically, with existing initiatives on strengthening NCA awareness and production, and not independently from them. More specific practical reflections on the experience of PANCAnet are listed in the next sections.

8.4 Practical reflections on how to set up a research and practice network

A few lessons can be gathered from the experience of setting up and running PANCAnet for around one year. These are useful to start building a toolbox for using RPNs to foster linkages between production and use of NCA in countries.

1. Conduct a comprehensive and early mapping of the context in which the network is to be set up. Of particular importance is to understand stakeholders' readiness to engage on NCA production and use. It should aim to identify individual researchers and practitioners, appraise their level of readiness and understanding of NCA, how it relates to their existing priorities, and what they seek to gain individually and in terms of NCA development in general. It should be expected that this mapping will identify a need to raise awareness or build capacities of specific actors before the RPN can be set up.
2. Provide incentives to all stakeholders from the start. The transition from showing interest to engaging in an RPN is likely to be the most difficult step. Appropriate incentives, while necessary throughout the lifetime of an RPN and in need of attentive calibration throughout, are critical at this point. Financial incentives (like access to competitive funding) may be useful. However, two issues must be considered: one is that actors may be less attracted to funds from new sources, weakening the incentive. The other is that RPNs cover, by definition, activities that are not yet structured in goal-oriented projects, and that funding with pre-defined goals might limit the scope of co-creation and the level of participation of different groups. This requires a certain level of creativity in providing funding on other bases. It is therefore valuable to balance financial incentives (if any) with other incentives, such as facilitating access to global experts (networking), an emphasis on visibility and recognition gains, or to provide access to desirable assets such as difficult-to-obtain data or opportunities to engage in research projects perceived as innovative.
3. Broaden membership to become, from a core group of pre-existing experts, an inclusive group that is genuinely interdisciplinary and cross-sectoral. Existing approaches do not work well. Workshops and online platforms, while useful to reinforce existing networks, provide little return when it comes to reaching beyond those already interested. Early RPN members and facilitators should expect to take on the effort of extending the network, by individually identifying and approaching potential new members. A well-designed communication strategy can accelerate this process.
4. Create formal relationships with key research institutions before launching the RPN. Considering the specific challenge of engaging academic researchers in PANCAnet, it would be ideal for an RPN to be "anchored" in existing or developing research centers of concerned developing countries.

This is an area where financial incentives can be used effectively. How to set up academic centers that complement RPNs goes beyond the scope of this paper and is an area where more experience reports are needed.

5. Coordinate with international stakeholders that drive the global agenda on NCA. Using RPN as a strategy can accelerate the development of NCA in countries where international actors already have some programs to create synergies between these initiatives.

8.5 Lessons for the NCA community

NCA has a tremendous potential to help achieve the SDGs. However, this contribution will materialize only if NCA starts to be effectively used by national stakeholders (broadly understood), in-country. This will require some changes in the process of designing, implementing and evaluating projects and policies, and should inform a reflection on the scope of internationally-supported capacity building on NCA.

For international actors specifically, there is a need to focus on a broad range of actors, well beyond national statistical organizations, and to acknowledge that incentives that work for actors involved in the production of NCA will be different from those interested in their use. Any initiative on NCA to help countries compile the accounts should also support new research and evidence agendas on the link between the economy and the environment. Recognizing the need to address the collaboration challenges underpinning NCA use with practical but highly engineered tools and processes, such as those enshrined in RPNs, will increase the ownership of the process and accelerate the integration of actionable knowledge on natural resources in policies and practices, in the spirit of the SDGs.

8.6 References

Bertrand, Dubochet and Obino. Forthcoming. Fostering research and practice co-creation for development: *The experience of setting up PANCAnet: a research and practice network on natural capital accounting in the Pacific*

Oosterhuis, Van der Esch, and Hoogervorst. 2016. "From Statistics to Policy. The Development and Application of Environmental Statistics and Environmental Accounts in the Netherlands." PBL Netherlands Environmental Assessment Agency, The Hague.

Vardon, Burnett, and Dovers. 2016. 'The Accounting Push and the Policy Pull: Balancing Environment and Economic Decisions.' *Ecological Economics* 124 (April):145–52. https://doi.org/10.1016/j.ecolecon.2016.01.021.

9. Implementation of natural capital accounting in the Pacific: A summary of achievements and lessons

By Sanjesh Naidu[1] and Michael Vardon[2]

[1]***United Nations Economic and Social Commission for the Asia Pacific, Sub-regional Office for the Pacific***

[2]***Fenner School of Environment and Society, Australian National University***

Summary

In the Pacific region, natural capital accounting (NCA) is synonymous with the application of the System of Environmental-Economic Accounting (SEEA). Following the adoption of SEEA as an international statistical standard in 2012, the United Nations Economic and Social Commission for the Asia Pacific (UNESCAP) Pacific Office began implementation work, with most work occurring since 2015. To date, five Pacific Island countries have made significant progress: Federated States of Micronesia (FSM), Fiji, Palau, Samoa and Vanuatu. This paper reports on the development of the NCA in the region, providing concrete examples of the way information from accounts relates to key policies related to energy, water and waste. The achievements and lessons described are likely to be relevant to other regions and countries considering the development and application of the SEEA.

9.1 Introduction

In the Pacific region, natural capital accounting (NCA) is synonymous with the application of the System of Environmental-Economic Accounting (SEEA)[12] which was adopted as international statistical standard in 2012. In the Pacific region, while some work happened shortly after adoption, substantial work on its implementation began after 2015. This work was undertaken by the United Nations Economic and Social Commission for the Asia Pacific (ESCAP) Pacific Office.

As the Pacific region embarks on its journey towards attainment of the Sustainable Development Goals,[13] practical and scalable tools for collecting, analyzing and tracking data are necessary to support decision making in governments, civil society, development partners and the private sector. The SEEA has significant potential to improve policy making, resource use and environmental outcomes.

The general approach used was to build national capacity to produce policy-relevant environment indicators using SEEA. The approach was tailored to each country, with the development of accounts driven by national priorities, data availability, and the capacity within each country. Further details are found in a knowledge product published in December 2017, by ESCAP.[14]

This paper summarizes[15] the lessons from the implementation of SEEA in the Pacific in pursuit of better data to achieve sustainable development. It aims to share the experiences, achievements and lessons,

[12] SEEA Central Framework https://unstats.un.org/unsd/envaccounting/seearev/

[13] See https://sustainabledevelopment.un.org/sdgs

[14] See http://www.unescap.org/resources/implementation-system-environmental-economic-accounting-pacific-achievements-and-lessons

[15] Based on contents of a publication issued by the United Nations Economic and Social Commission for Asia and the Pacific, Pacific Office (dated 20 December 2017), titled *SEEA Implementation in the Pacific – Achievements and*

and signpost future work in the Pacific region, which could guide development partners to focus and design any planned assistance.

To date, significant work has been done in five countries – Federated States of Micronesia (FSM), Fiji, Palau, Samoa and Vanuatu (Table 9.1). Notably, Fiji has completed three accounts (energy, water and solid waste), FSM has completed an energy account, Palau has produced both energy and water accounts, while Samoa has published a second iteration of water accounts. Other countries have also been involved, via, for example, regional training courses. So far, most work has been on production of accounts, but the accounts produced have had clear uses in mind and there have been a range of activities designed to engage the analytical and policy communities.

Table 9.1 Status of SEEA implementation in Pacific Island countries

Country	Accounts produced	Accounts planned or possible over short to medium-term
Federated States of Micronesia	Energy PSUT, MSUT	Water Further iteration of energy account
Fiji	Energy PSUT Water PSUT Solid waste PSUT	Land cover (in-progress) Further update and iteration of accounts produced
Palau	Energy PSUT, MSUT Water PSUT, MSUT	Waste Further update and iteration of accounts produced
Samoa	Water PSUT, MSUT	Energy Further iteration of water account
Vanuatu	Currently collating data for compiling land cover accounts	Water

The use of accounts in the design of policy has been limited to date, but information for the accounts have been used to derive indicators and in analysis of issues. One example is productivity indicators (the ratio of outputs over inputs)[16] in the analysis of energy and water issues.

9.2 Energy

Energy is a critical issue for the Pacific and the region is lagging behind in terms of access to energy, energy infrastructure, regulation and clean energy generation. Over 80% of electricity generation in the Pacific is from oil. The region's geographical isolation, small economies of scale, and limited generation capacity have translated into high electricity costs and low electrification rates, with 70% of households without modern electricity services.[17] Between 2005 and 2030, electricity demand is expected to grow by about 7% per year, while electricity generation is forecast to grow by only 6.4% per year. By 2030, refined petroleum fuels are projected to remain the Pacific region's dominant primary source of energy for electricity generation, but complemented by hydropower and natural gas.[18]

Lessons. See http://www.unescap.org/resources/implementation-system-environmental-economic-accounting-pacific-achievements-and-lessons

[16] Young, E.K et al. 2016. *Productivity as the key to economic growth*. World Bank. http://documents.worldbank.org/curated/en/314741472533203058/pdf/108092-BRI-Policy-3.pdf

[17] UNESCAP. 2017

[18] ADB. 2013. *Energy Use in the Pacific*

Pacific leaders have prioritized the development of affordable and clean energy to break the dependence on volatile global fossil fuel markets, reduce high costs associated with transporting fuel, promote low-carbon growth, and expand access to electricity.

Energy accounts have been produced for the FSM, Fiji and Palau. Key results for each of these countries are highlighted below.

Federated States of Micronesia (FSM)

Energy is a critical input to the economy and well-being of FSM. The FSM Strategic Development Plan 2004 – 2023 and National Energy Policy both aim for more efficient use of energy, diversification of energy sources, and increasing the level of renewable energy use. Achieving these aims requires understanding the cost and benefits of different courses of action. Such analysis requires an integrated analysis of environmental and economic considerations.

The experimental energy accounts for the FSM[19] included physical (kilojoules) and monetary (US$) information and showing the main suppliers and uses of energy in the nation as well as for each of the four states. These accounts showed that:

- Virtually all energy is produced from fossil fuels.
- The value of energy used increased between 2009 and 2015.
- Pohnpei uses the most energy of all states.
- Physical energy productivity – the ratio of GDP (US$) to physical energy use (kilojoules) – is declining.

The policy implications of the account include:

- Identification of the most cost-effective investments in energy supply infrastructure to reduce physical energy losses
- Assessing financing options for investments, including user pays principles
- Promoting more efficient physical energy use by business and households

Fiji

The need for reliable and affordable energy, lack of public awareness regarding energy efficiency, and the consequent need to monitor energy use and the sustainability of its supply are all key concerns highlighted in the Green Growth Framework and the National Development Plan of Fiji. In addition, the national Energy Policy 2014-2020 outlines Fiji's vision and strategic direction for achieving sustainable energy for all.

In response to these policy demands, the Fiji Bureau of Statistics produced experimental energy accounts for 2006 through to 2014.[20] The accounts are in physical terms and only include the electricity generated and distributed by Fiji Electricity Authority (FEA) but this amounts to 97.5% of all electricity generated in the country.

The main findings from the energy accounts were:

- Energy use in Fiji is increasing.
- The major consumer of energy is the commercial sector, followed by other industries, and households.
- The physical energy productivity (i.e. the ratio of GDP to physical energy use) of the Fijian economy is improving.

[19] Available at www.unescap.org and http://www.fsmstats.fm

[20] Available at www.unescap.org and www.statsfiji.gov.fj

- Over half of electricity generated in Fiji comes from thermal (diesel) generation – this comes at significant cost and environmental impact.
- A large proportion of energy content of the fuel being used for thermal (diesel) generation in Fiji is being lost in energy transformation.

The policy implications of the results are still to be analyzed thoroughly.

Palau

The Palau National Energy Policy (2010) aims to reduce energy use, raise energy efficiency, and convert to renewable energy sources. A range of actions and targets are outlined in the Policy, including:

- 30% reduction in overall national energy consumption by 2020
- 20% of electrical energy generated in Palau through renewable sources by 2020

Such targets are directly measurable by energy accounts, and physical and monetary energy accounts were developed for the fiscal years (FY) 2014 to 2016.[21] The Palau FY is from 1 April to 31 March and is the same as the US FY. Key results for Palau included:

- The physical use of energy (kilojoules) declined between FY2014 and FY2016.
- Energy productivity ($ of GDP per $ of energy use) increased 60% between FY2014 and FY2016, due mostly to decreases in energy use and the price of energy products.
- The physical efficiency of energy use (gigajoules per $ of GDP) declined from 9,049 gigajoules/US$ million in FY2014 to 6,280 in FY2016.
- Per capita use of energy (kilojoules) declined between FY2014 and FY2016, due to a combination of increasing population and decreasing physical use of energy and water.
- The value of infrastructure for electricity supply, water supply, and sewerage treatment increased slightly from $85.7 million in FY2014 to $86.2 million in FY2016.
- Use of solar electricity more than doubled between FY2014 and FY2016, with government the largest user. However, solar electricity makes up less than 1% of total energy use.

The energy accounts had a range of policy implications, including:

- **Regulatory issues** - The retail price of fossil fuel is higher than regional benchmarks, but the retail price of electricity is lower (both in pre- and post-tax prices). Reviewing government taxes and subsidies on energy products might lead to a more equitable and user pays pricing regime, encourage renewable energy and switching to hybrid or electric cars.
- **Infrastructure planning** - The accounts reveal that there are significant losses of energy via the distribution networks, while energy efficiency has also declined. Increased investment in supply infrastructure may reduce losses while increased investment in energy saving technology may increase efficiency.
- **Renewable energy** - The accounts show the increasing use of solar energy reflecting positively on government policy. Reductions in price of renewable technology could see further reductions in the dependence on fossil fuels.
- **Tracking the Sustainable Development Goals (SDGs)** - The accounts can produce several of the indicators for the SDGs related to energy, e.g. SDG 7.1 to 7.3.

9.3 Water

Water, a basic human need, is also a key input to much economic activity, including the production of food. Water insecurity is rapidly increasing with pressure coming from climate change, urbanization and

[21] Found at www.unescap.org and http://palaugov.pw/system-of-environmental-economic-accounting-seea/

energy needs, and the UN estimates that global water use over the last century has been growing at twice the rate of population increase.[22] Given similar development challenges in the Pacific, access to safe, reliable and affordable water is also a priority. Samoa, Fiji and Palau have all produced water accounts and key results and policy relevance are presented below.

Samoa

Samoa is fortunate in having high rainfall and a small population, but with increasing tourism, urbanization, and the impacts of climate change, water management is a key policy issue.

The Samoa Bureau of Statistics (SBS) produced two experimental water accounts. The first was published in 2015 and covered three financials years (2011-12, 2012-13 and 2013-14) while a second covered 2014-15 and was added in 2017.[23] The accounts included physical and monetary supply and use tables and showed that:

- Total water consumption varied little each year.
- Households were the major consumers of water in each year.
- The implicit price of water varied between water suppliers and sectors.
- While water use for electricity generation was extremely high, consumption was very low as the water used for hydro-electric power is immediately discharged back to the environment (and hence available for other uses).
- Estimated water use by livestock was relatively static.

The policy implications of the experimental water accounts included:

- The need for better targeted investments in water infrastructure and awareness raising of water conservation measures, particularly in rural areas
- Setting appropriate water tariffs and helping to ensure the production and use of water in Samoa is efficient and equitable
- Improved reporting against targets and indicators including the Sustainable Development Goals
- Compiling tourism satellite accounts in conjunction with relevant SEEA accounts would allow policy makers to better understand the dependence of tourist industries on natural resources to be more fully appreciated.

Fiji

The 2013 Fiji Constitution guarantees the right of every person to clean and safe water in adequate quantities. The National Development Plan and the Green Growth Framework for Fiji underscores the need, and adopts measures, to improve access to safe drinking water for the population. In particular, to address data gaps in water resource planning, the Framework calls for developing an "integrated database on national water use, extraction and replenishing rates and disseminate widely for water resource planning and matching water supply with demand by 2017."

Experimental water accounts were prepared by the Fiji Bureau of Statistics for 2013 to 2016 in response to the need for better data and statistics to inform policies on water resource management and universal access to safe drinking water without increasing pressure on the environment.[24] The main findings of the water accounts were:

- Surface water extraction was increasing year on year.
- Most metered water consumption was by households, followed by the commercial sector.

[22] e.g. UN World Water Development Report 2015 http://unesdoc.unesco.org/images/0023/002318/231823E.pdf
[23] Found at www.unescap.org and www.sbs.gov.ws
[24] Available at www.unescap.org and www.statsfiji.gov.fj

- Not all water abstracted for metered water production was used, as 44% is being lost through distribution and 2.4% through the purification processes.

This experimental account was the first attempt toward a more complete accounting of water availability, supply and use in Fiji. While the accounts could derive some useful information, further development of SEEA water accounts will facilitate gathering of water data to address a number of important policy questions, such as:

- How much water is available for use? How much of that portion has already been used?
- Which source of water have we been most dependent on? Is it sustainable?
- What is the main use of water?
- Which industry uses water more/less efficiently?

Palau

The National Water Policy (2012) aims to protect and conserve Palau's water resources; and ensure access to affordable and sustainable water supply and wastewater services. Furthermore, an Executive Order, effective till May 2018, established water use and conservation policies in anticipation of extreme drought conditions. Measures target government offices and facilities, including implementation of water efficiency practices and technologies, and awareness raising and training.

Physical and monetary accounts for water were developed for the FY 2014 to 2016.[25] Key results for the water accounts in Palau were:

- The physical use of water (mega liters) declined between FY2014 and FY2016.
  Water productivity ($ of GDP per $ of water use) decreased 38% between FY2014 and FY2016 due mostly to increases in the price of water.
- The physical efficiency of water use (megaliters of water use per $ of GDP) has declined by 31%.
- Per capita use of water (i.e. mega liters per person) declined between FY2014 and FY2016, due to a combination of increasing population and decreasing physical use of water.
- The value of PPUC infrastructure for electricity supply, water supply, and sewerage treatment increased slightly from $85.7 million in FY2014 to $86.2 million in FY2016.

Some of the policy implications from the water accounts were:

- **Infrastructure planning** - The accounts reveal that there are significant water losses (2,735 mega liters in FY2016) via the distribution networks, while water efficiency also declined. Increased investment in supply infrastructure may reduce losses while increased investment in water saving technology may increase efficiency.
- **Tracking the Sustainable Development Goals** - The accounts can produce several of the indicators for the SDG targets related to water.

9.4 Solid Waste

Solid waste management is a particularly challenging issue for Pacific Island countries. Volumes of solid waste have been growing in line with rising living standards, increased importation of goods, and larger tourist arrivals. Planned and careful management of solid waste is a priority for the countries of the region, but data on production, reuse, and disposal of waste is limited, making policy making and budgeting difficult. To this end, Fiji produced an experimental solid waste account.

[25] Found at www.unescap.org and http://palaugov.pw/system-of-environmental-economic-accounting-seea/

Fiji

Rapid urbanization and expansion of economic activity have increased both consumption and imports in Fiji, placing significant pressure on the management of all forms of waste. Ineffective waste management system, littering, absence of organized waste management systems in the rural and outer islands, and ineffective enforcement of existing laws are outlined in Fiji's Green Growth Framework.

The Fiji Bureau of Statistics produced experimental waste accounts for the years 2013 to 2016.[26] The main findings were:

- Increasing levels of waste generation; between 2013 and 2016, the quantity of waste increased at more than double the rate of GDP.
- The composition of waste is: general (80%), green (10%) and special waste (10%).
- Almost all waste generated in Fiji ends up in a landfill, almost nothing is recycled.
- In 2016, capital expenditure related to waste management by the Department of Environment represented 0.07% of total central government expenditure.

While providing extremely useful data to policy makers, due to constraints on data availability the solid waste account only includes the proportion of waste collected and sent to landfills from areas representing around 40% of the total population. Addressing this data limitation is among the next steps under consideration by the Fiji Bureau of Statistics.

9.5 Five selected lessons from the implementation of SEEA in the Pacific

Several lessons emerged from the implementation of the SEEA in the Pacific. Current efforts are located within statistics offices and not among data analysts or decision makers. However, the production of the accounts was a useful first step to engaging with the analytical and decision-making communities. Helping this engagement process is the ability of Pacific Island countries to compile pilot accounts, usually with simplified industry breakdowns, within a short space of time (within 12 months).

So far, water and energy have been a focus as they are key issues for all countries. As there is usually only one water supplier and one electricity supplier, information is relatively easy to obtain, and countries have been able to start with these to build knowledge and understanding of the SEEA. In this, a combination of local staff and development partner expertise has proved successful in preparing accounts. Development partner expertise must recognize country context, respect national systems and approaches, and adapt to national realities for successful outcomes.

In this, simplifying accounting tables, broadly consistent with the SEEA, has provided a practical way forward as well as recognizing the data realities of countries. While there are data gaps and deficiencies, these can be overcome using standard statistical techniques (e.g. imputation, extrapolation, use of coefficients); and the production of experimental accounts along with selected examples of policy use have helped demonstrate both the feasibility of producing and using accounts in the region.

A key feature of the work in the Pacific has been the upfront attempt to link account production to policy and analysis. This is reflected in the assessment process and in the documents produced, which in addition to the accounting tables have also provided a range of interpretive and analytical text. This goes beyond what is done in many statistical offices. Government resources are smaller in Pacific island countries and often there is limited capacity outside of statistical offices to interpret and analyze the accounts.

[26] Available at www.unescap.org and www.statsfiji.gov.fj

Increasing the policy use of the accounts requires the involvement of planners, key sector agencies and budget policy makers in the planning, production and post-production analysis of accounts. This builds ownership and raises understanding of the policy applications of the accounts, with concrete sectoral, infrastructure and fiscal policy uses in mind. It is evident that specific policy, budgeting, and planning applications are still being developed globally, with little expertise among statisticians alone to fully integrate data for policy purposes. This highlights the importance of the Policy Forum on Natural Capital Accounting for Better Decision Making[27] for sharing experiences. In this, economists, planners and sector policy experts can comment and facilitate analysis of public policy using accounting. In the Pacific region, these include:

- Budgeting and fiscal policy issues, such as taxation to create incentives that determine use of natural resources
- Specific sector/resource policy and planning, for example, measuring sustainable tourism (as discussed in Fiji's case study earlier) and oceans management
- Infrastructure investment and maintenance planning
- Regulatory measures that determine production and use of natural resources

The SEEA also provides data relevant to monitoring progress against priorities and targets contained in national and international development plans. For example, Palau's SDG indicators 6 and 7 on change in energy and water use efficiency over time can be obtained from the energy and water accounts:

- **6.4.1 Change in water-use efficiency over time** – The physical efficiency of water use, as measured by GDP per liter of water use, increased between FY2014 and FY2016 from $0.09 to $0.16 per liter. Conversely, the economic efficiency of water use decreased, as measured by GDP per value of water use, from $99 to $62 GDP per dollar of monetary water use; and
- **7.2.1 Renewable energy share in the total final energy consumption** – The amount of electricity produced from solar is less than 1% but has increased from 1,397 to 2,907 GJ between FY2014 and FY2016.

Communication of the accounts to regional policy makers, the general public, academic audiences and the statistical world has also been a feature of the work in the Pacific. Short policy briefings with infographics (e.g. from FSM)[28] have been a highlight, while information has been shared through UNSD newsletters[29] and World Bank WAVES online[30] resources.

9.6 Future directions

Further support to Pacific island countries in the implementation and use of the SEEA should be provided. Capacity-building efforts should continue and draw on regional expertise and experience. In this, the initial aim will be to improve the quality of the existing accounts and eventually extend the range of accounts produced. Increasing the number of countries in the Pacific producing and using accounts is a goal, although ground realities, level of country commitment and policy value added will need to be assessed on a country-by-country basis.

Going forward, additional work needs to be directed at better understanding how the SEEA can be used for fiscal policy, infrastructure planning and regulatory measures to create higher national demand.

[27] Refer to https://www.wavespartnership.org/en/forum-natural-capital-accounting-better-policy
[28] Refer to http://www.fsmstats.fm/wp-content/uploads/2017/07/FSM-Energy-Accounts-Infographic.pdf
[29] Refer to newsletters 38-41, at https://unstats.un.org/unsd/envstats/newsletters
[30] Refer to https://www.wavespartnership.org/knowledge-center

Furthermore, greater effort to use SEEA findings to monitor the achievement of national priorities and SDGs will create added value.

In this context, broad partnerships are needed to sustain the development and application of SEEA in the region. Development partner support, together with the expertise already developed in Pacific Island countries, could support and improve the existing accounts as well as new ones. Relevant types of assistance for the Pacific region include:

- Regional workshops to share national experiences and provide training on account production/ use in areas where PICs have most interest (aimed to consolidate and build on existing accounts compiled). Use of PIC and other national statistics office expertise to facilitate such training could be explored
- Regional workshops focused on policy, budgeting and planning use of SEEA findings
- Regional workshops on sectoral application of SEEA could be explored, in particular, for measuring sustainable tourism (building on Fiji's case study findings discussed earlier), given importance of tourism in most PICs, and UNWTO and UNSD interest, and ocean resources
- Country assistance for assessment, production and importantly policy use
- Coordination of peer-review process for account production
- Prepare and disseminate knowledge products
- Facilitate access to specialist knowledge and guidance

A range of opportunities exist for consolidating and sustaining SEEA in the Pacific region, and for maintaining a tailored approach to implementation remains crucial.

9.7 Acknowledgements

This paper is based on content of a publication issued by the United Nations Economic and Social Commission for Asia and the Pacific, Pacific Office (dated 20 December 2017), titled "SEEA Implementation in the Pacific – Achievements and Lessons."[31]

[31] See http://www.unescap.org/resources/implementation-system-environmental-economic-accounting-pacific-achievements-and-lessons

10. Ecosystem accounting for water and biodiversity policies: Experience from a pilot project in Peru

By Rosimeiry Portela,[1,2] Mahbubul Alam,[1] Claudio Schneider[3] and Daniel Juhn[1]

[1]Betty and Gordon Moore Center for Science, Conservation International
[2]Center for Biodiversity Outcomes, Arizona State University
[3]Conservation International Peru

Summary

This chapter describes the piloting of Ecosystem Accounting in San Martin, Peru and its potential to inform national, regional and international policy commitments. This was done in accordance to Peruvian national and regional frameworks for natural resources management, and international frameworks such as the 2030 Agenda for Sustainable Development (Sustainable Development Goals, SDGs) and Strategic Plan for Biodiversity 2011-2020 (Aichi Biodiversity Targets). We argue here that Ecosystem Accounting – by incorporating nature into frameworks that government use for development planning – can be of great relevance in informing long-term sustainability goals. In this chapter, we focus on water resource management and conservation of biodiversity, two key priority policies for Peru, which have been the focus of numerous initiatives and efforts, and the basis for a green growth development strategy both at national and sub-national levels.

We provide examples of how Ecosystem Accounting-generated indicators – ranging from the spatial distribution of ecosystem types over a given accounting period of time (*extent accounts*), complemented by indicators that inform characteristics and health of the ecosystems (*condition accounts*), and the flow of benefits to beneficiaries and/or economic sectors, both in biophysical and monetary terms (*ecosystem services supply and use accounts*) – can be critically important in conservation and sustainable use of water and biodiversity management. These indicators can be used, for example to: (i) identify the ecosystem sources of water-related benefits; (ii) show changes in these benefits associated with ecosystems' degradation; and (iii) to monitor water use by different beneficiaries, thereby helping to address equity issues associated with access to resources or impacts from degradation. As for biodiversity, accounting-derived indicators can be used for regularly monitoring the status and trends of threatened and endangered species, as well as for the conservation, restoration and sustainable use of ecosystems. All of these are reflected in SDGs and Aichi Biodiversity goals and targets, and are described in Table 10.1.

10.1 Introduction

Peru's economy has experienced significant growth over the last decade and the country has also made significant headway in poverty alleviation measures (IBRD 2017). To ensure continuous growth and shared prosperity, governmental policies ought to prevent and respond to the risks of current development patterns, such as those associated with natural resources use and climate change (ibid). The recognition of the interaction between economic growth and nature is an important step toward that goal, and one embraced by the Peruvian Government, as evidenced by numerous policies and commitments. For example, Peru has recently adhered to the OECD's Declaration of Green Growth (OECD. 2017) by promoting green growth through investment and the sustainable use of natural resources. Peru is also committed to incorporating information on natural capital into development

planning, having recognized the strong potential for significant ecological and socio-economic benefits from doing so (PLANAA PERÚ 2011).

In this chapter, we describe a Natural Capital Accounting pilot project that was implemented at the sub-national level through the Ecosystem Values and Accounting (EVA) project, a partnership between Conservation International, the Government of Peru (GoP), the World Bank Wealth Accounting and Valuation of Ecosystem Services (WAVES), and many others. The EVA project was an effort to demonstrate the value of incorporating ecological-economic information into standard economic statistics through Ecosystem Accounting, following the System of Environmental Economic Accounting (SEEA) – Experimental Ecosystem Accounting (UN et al. 2014). Ecosystem accounts developed for the project included extent, condition, ecosystem services supply and use, as well as thematic accounts – such as biodiversity, carbon, and water. The results were published in Conservation International et al. (2016).

The choice to pilot Ecosystem Accounting in San Martin was inspired by the regional government's innovative green growth policies developed to address sustainable development in the face of high levels of threats to ecosystems and biodiversity. San Martin has been experiencing high rates of deforestation, mostly concentrated in the Amazon region where 30% of the original forest cover has been lost primarily by unsustainable logging and agriculture conversion. Most importantly, the selection of the pilot region reflects both national and sub-national government alignment on the importance of building a more sustainable and greener economy.

The Ecosystem Accounting pilot in San Martin is an experiment testing various methodological approaches, as well as a demonstration at a sub-national scale to derive lessons for what would be required for application at the national level. It is also a real-world application of accounting information and statistics to address regional environmental and conservation policies. Considering that international commitments such as the SDGs, Aichi Targets and United Nations Framework Convention on Climate Change (UNFCCC) are reflected in national and sub-national policy priorities, Ecosystem Accounting is also a way of pragmatically meeting information commitments through a harmonized information system. While acknowledging that natural capital accounting (NCA) can contribute in a great many ways in policy discussions, we focus this paper on two important regional priorities: (a) water resource management; and (b) conservation and sustainable use of biodiversity. We first discuss the key benefits of NCA in national and regional decision-making process, and then address specific linkages of Ecosystem Accounting to policies for water and biodiversity conservation and sustainable use.

NCA and policy and decision making at national and regional levels

There is an increasing recognition that NCA, broadly speaking, ought to shift away from a supply-side and toward a demand-side, decision-centered approach (Bass et al. 2017). We argue that for that to become a reality, there needs to be an understanding of how public policies, incentives and/or investments lead to on the ground changes, and most importantly, how and what kind of information generated by accounts can facilitate this process. In Peru, environmental governance is decentralized, with the national government providing a policy framework to regulate private and public activities, while the regions work toward implementing policies, often through projects developing the enabling conditions and incentives to stimulate local economies.

At the national level, the overarching policy framework for environmental management is the National Environmental Plan (PLANAA for its acronym in Spanish). This presents the vision for key environmental issues up to 2021 (PLANAA PERÚ. 2011). The latest National Agenda for Environmental Action, also called Agenda Ambiental (Agenda Ambiente Perú 2015-2016), provides a road map for coherently addressing short-term national priorities with respect to biodiversity, climate change, water resources and environmental quality and, broadly speaking, for environmental governance and international

commitments (MINAM. 2014). At the regional level, the Agenda Ambiental Regional San Martin (Agenda Ambiental Regional 2014-2015) sets short-term strategic actions and goals for the region, based on priorities that are well-aligned with the national level policy, though addressing specific regional environmental management and sustainability issues (ARA-SM. 2014)

Ecosystem Accounting in Water Resources Management

Peru has significant surface water resources, though they are unevenly distributed across the country (Kuroiwa 2009) (Figure 10.1). Indeed, 30% of surface water resources are located in arid, semi-arid and sub-humid areas, while about 80% of the population is situated on the arid coast, the semi-arid and sub-humid highlands dry places where economic activities associated with agricultural, industrial and mining are concentrated (ibid). Peru's freshwater ecosystems not only support great biodiversity (Olson and Dinerstein.1998) but provide urban and rural communities with essential services, including fish, water for drinking and irrigation, and moderation of floods and droughts (Kvist and Nebel. 2001). Artisanal fisheries are critical to rural economies, providing food security and livelihoods. Recent studies in the Peruvian Amazon have shown that fisheries provide a safety net for rural households when faced with environmental disasters, such as floods or fires (Coomes. 2010).

Though water is relatively abundant in San Martin, it is also recognized as a critical resource for many economic activities and settlements. A key policy challenge in that sense includes the protection of mountain ecosystems and highlands (headwaters of various water bodies that supply production lands agricultural services and water supply). A recent study commissioned by Conservation International in the Mishquiyacu, Rumiyacu and Almendra watersheds, source of water for the capital city of Moyobamba, found 174 bird species, 13 of which were migratory species and two endemic species to Peru (Ayapi and Ruiz. 2014). These watersheds have been deforested and degraded to the point that water provision in Moyobamba has become erratic during the dry season. A water payment for ecosystem services has been set up in these watersheds with the Moyobamba water provision company. However, the fee collected in the water bill for the recovery efforts, about US$ 0.3 per month per household, is insufficient and needs to be reconsidered.

One important and nascent initiative by the national government is the "Water Factories" (Fábricas de Agua, in Spanish), which seeks to address the degradation of high Andean ecosystems, the headwaters of many of Peruvian rivers (MINAM. 2017). The ultimate goal is to promote investment in the conservation, restoration and sustainable use of the freshwater ecosystems that provide water-related ecosystem services – water provisioning and water filtration. The Water Factories initiative relies on regulatory, economic and technical instruments including public investments in biodiversity conservation and ecosystem services programs, compensation incentives for ecosystem services (MERESE in Spanish). The Water Factories initiative seeks to identify and promote other existing financing mechanisms through, for example, private and cooperation funds, public treasury, corporate social responsibility or other contributions.

Figure 10.1 Hydrographic Map of Peru

Another relevant initiative, the "Incubator for Ecosystem Services Retribution Mechanisms," was implemented as a partnership between government and non-government organizations in Peru (MINAM et al. 2012). At the national scale, the Incubator sought development of tools and guidelines including rapid hydrological assessment for investments, whereas, at the local scale (e.g. in Alto Mayo watersheds in San Martin) it supported the developments of frameworks to assess cost-effectiveness of alternative watershed protection investments (ibid).

Information generated through *ecosystem extent and ecosystem services supply and use accounts* in San Martin (Conservation International et al. 2016) provides vital information for broad water management issues, and for the Water Factory and Incubator initiatives, in particular. For example, we estimated that total water use in the region between 2009 and 2013 ranged between 4.70 and 6.71 million m^3/year, most of which was extracted by the agriculture sector (70%) followed by non-consumptive use by the energy sector (23%) and public sector (5%). Our findings also show that (natural) terrestrial ecosystems contributed the most to water provisioning, with the highest contribution from Humid Montane Forest (84%). Although water use in the region is increasing by 3.3% per year to meet the growing demand, there is only a 2.5% average increase per year in the contribution from natural terrestrial ecosystems (Conservation International et al. 2016). In monetary value, the water provisioning ecosystem service contributed by natural ecosystems was estimated between 24 – 26 million PEN (Sol) for the region in that period (ibid).

These results quantify the role of natural ecosystems in providing water for different beneficiaries. In San Martin watershed services are used by different sectors, such as households, municipal water suppliers, agriculture and commercial uses. Any degradation of ecosystems that leads to changes in quality and quantity of water supply will affect all these users, but our results suggest that impact would fall disproportionately on rural households. The accounts demonstrate how such integrated information can help assess policies that promote a fair and equitable sharing of benefits which requires promulgation of legislative frameworks backed up by adequate information about who benefits and by how much (see Table 10.1). Indeed, the water-related ecosystem services supply and use accounts are specifically designed to address some of those challenges and applications, by measuring: (i) in physical terms, how water flow is regulated through inter-ecosystem processes; and (ii) in economic terms, how water contributes to different sectors of economy as both direct use value (e.g. household consumption) and inputs to downstream production (e.g. irrigation of rice paddy).

Ecosystem accounting and biodiversity conservation and sustainable use

Peru stands out as one of the most biologically diverse countries on Earth and has been designated as one of the 17 megadiverse countries (Mittermeier et al. 1998). It hosts 84 of the 104 life zones of the planet, from the staggering heights of its mountain peaks to its 72 million hectares of forests to the depths of the Pacific Ocean off its shores. Threats to biodiversity are tightly linked to anthropogenic disturbances, such as those associated with deforestation, illegal mining, extraction and illegal trade of species, flora, fauna and biological resources, among others. Furthermore, Peru's vast numbers of endemic species, given their small range and restricted requirements, are particularly threatened by climate change (Larsen. 2012). The biggest conservation challenge is the reduction of deforestation, estimated at 150,000 ha^{-1} $year^{-1}$ (1990-2000). Around 70% of this deforestation is caused by smallholder farmers (< 5 ha) migrating from depressed areas in the Andean region (ENBCC 2016).

San Martin is not only a region of high biodiversity but also as a region where ecosystems are highly threatened. In a study about the distribution of endemic species in the Andes of Peru and Bolivia, researchers concluded that San Martin has critical areas of importance due to the irreplaceability of a large quantity of micro-endemic species (Young. 2007). Furthermore, the high susceptibility of montane and premontane forests to climate change and land use change require urgent actions to promote their conservation, not only because of its high biodiversity value but also because of the critical water provisioning, food security and climate regulation services they provide for human well-being (Ecobona 2009).

"Ecosystem extent accounts" in San Martin recorded the area of the distribution of various ecosystem types over the chosen accounting periods and were complemented by "*ecosystem condition account"* that recorded biodiversity as a characteristic of different ecosystem types. *"Biodiversity accounts"* in San

Martin measured biodiversity in various ways, including species richness, independent of different ecosystem types. These accounts demonstrated that species richness was reduced by 0.3% between 2009 and 2013 in different ecosystems. Habitat important for threatened species (including for example the Critically Endangered Yellow-tailed Woolly Monkey) has been reduced by 17% compared to its original extent, although some important habitat areas showed much greater loss. From 2009 to 2013 an average of 2.9% of habitat for threatened species was lost (UNEP-WCMC, 2016).

These types of accounting information not only contribute to national/regional biodiversity action plans, but also help meet international reporting commitments. For example, such measurements, when consistently and repeatedly measured, can be used for regularly monitoring the status and trends of threatened and endangered species. This also enables appropriate legislative and policy measures to be implemented in Peru. SDGs call for conservation, restoration and sustainable use of ecosystems and ecosystem services (Target 15.1), which requires identification, delineation and measurement of areas which are to be conserved and protected. This was an important application of the *ecosystem extent accounts*. In addition, the identification of degraded areas in the *ecosystem condition accounts* suggests were restoration activities are needed. The SDGs also call for the conservation of critical mountain ecosystems that provide benefits to downstream populations (Target 15.4). In the San Martin region our study showed that, in 2013, about 67% ecosystems are classified as mountain ecosystems of different elevation range. The *ecosystem services supply and use* accounts measured both in monetary and biophysical terms the ecosystem services provided by the mountain ecosystems. This information could lead to identification and protection of the most valuable, in terms of ecosystem services, mountain ecosystems in the high and mid-Andes.

Ongoing biodiversity-related initiatives focus on better identification of the values of biodiversity and ecosystem services, and also on business opportunities such as bio-commerce. These efforts are strongly based on the Government of Peru's recognition that biodiversity is an important resource for both rural and indigenous communities, whose livelihoods and economic opportunities associated with conservation and sustainable use of biodiversity are limited. Indeed, MINAM is working with partners on: (i) business plans for numerous natural products (e.g., cocoa, chestnut, textiles, ornamental flowers, gamitana, ecotourism, etc.); (ii) development of value-chain for products extracted around protected areas (ASBYSE Project); and (iii) bio-commerce of native potatoes by indigenous communities (PRODERN Project). The ultimate goal is innovation and generation of products and processes that add value to biodiversity.

Table 10.1 An illustrative example of the cross-linkages between SDGs (UN n.d.) and Aichi Targets (CBD et al. n.d.) with San Martin regional priorities and how Ecosystem Accounting contributes to resource management, monitoring and achieving those commitments

	Water resources management	Biodiversity conservation and sustainable use
SDG	• **Target 15.1**: **Conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services** ○ "Extent accounts" and "condition accounts" as implemented in San Martin can help to identify and delineate areas targeted for conservation, and for restoration of degraded areas. • **Target 15.4 Conservation of mountain ecosystems, including their biodiversity to provide benefits which are essential for sustainable development** ○ "Extent accounts" as implemented in San Martin can help the identification of different classes of mountain ecosystems.	• **Goal 1: End poverty in all its forms everywhere** • **Goal 2**: **End hunger, achieve food security and improved nutrition and promote sustainable agriculture** ○ "Ecosystem supply and use" as implemented in in San Martin can show the relevance of better resource management for numerous benefits, including food security and nutrition. • **Target 15.6: Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed** ○ "Ecosystem services supply and use" as implemented in San Martin can facilitate implementation of policies toward equitable sharing of benefits from biodiversity.
Aichi targets	• **Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity** ○ "Ecosystem extent and condition accounts," in addition to "biodiversity accounts" as implemented in San Martin can be used for monitoring the status and trends of threatened and endangered species. • **Target 17: By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.** ○ Ecosystem extent and condition accounts", in addition to "biodiversity accounts", as implemented in San Martin can inform the development of appropriate legislative and policy measures and serve as a tool to monitor its implementation over time. • **Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society** ○ **Target 1, 2 & 6:** "Ecosystem supply and use accounts", as implemented in San Martin can be used as an incentive for a systematic measurement and monitoring of biodiversity - and benefits nature provides, facilitating reporting and accomplishment of these targets.	• **Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.** ○ "Ecosystem extent", "condition accounts" and "ecosystem supply and use accounts", in addition to "biodiversity accounts", as implemented in San Martin can demonstrate the importance of nature to livelihoods and the economy, increasing awareness and support for more sustainable management uses of ecosystems and biodiversity. • **Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.** ○ "Ecosystem extent and condition accounts", in addition to "biodiversity accounts", as implemented in Peru, can be critically relevant for the incorporation of biodiversity values into national official statistics, and for their use on policy, planning, management and reporting. • **Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services** ○ Ecosystem extent, condition accounts and ecosystem supply and use accounts", in addition to "biodiversity accounts", as implemented in San Martin, can help the identification of critically important biodiversity as well of its numerous benefits to a range of beneficiaries, allowing understanding of distribution of benefits (and costs).

Note: The connections between the Aichi Targets and the System of Environmental and Economic accounts were mapped in Vardon et al (2016).

10.2 Conclusion

In this chapter we summarized how natural capital accounting, and Ecosystem Accounting in particular, contributes to regional and national policy processes in San Martin, Peru. Specific examples from water resources management and biodiversity conservation perspectives are provided. Sectorial and cross-sectorial policy and development-decision processes can take advantage of recent science, statistics and information to ensure their success and maximize impacts. Ecosystem Accounting not only provides spatially explicit information and data, it also provides an opportunity to understand conservation and development interventions, particularly as it relates to changes and trade-offs in the provision of benefits, equity issues on the distribution of benefits (and costs).

Our experience with ecosystem accounting in San Martin helps to illustrate the utility of ecosystem accounting for more holistic management of natural resources, facilitating the identification of ecosystems regulating flows, enabling improved monitoring of benefits over time, ultimately allowing for more efficient implementation of policies, as well as compliance with international commitments such as SDGs and Aichi targets.

Despite all the promises of accounts, to fully exploit their potential it is important for ecosystem accounts to be integrated into national information systems and repeatedly measured like many other statistical measurements and census. Nature is the starting point of prosperity and human well-being; therefore, it is important that it is considered and reflected in development decisions.

10.3 Acknowledgements

We are grateful for support provided from a grant from the Gordon and Betty Moore Foundation (Grant # 3518). CI's EVA technical team included Daniel Juhn, Rosimeiry Portela, Hedley Grantham, Miroslav Honzak, Ana Rodriguez, Mahbubul Alam, Timothy Wright, Ivo Encomenderos and Claudio Schneider. This project was implemented in Peru in partnership with the Government of Peru (GoP), through the Ministry of Environment (MINAM) General Bureau of Evaluation, Valuation and Financing of the National Heritage (DGEVFPN for its name in Spanish) and the San Martin government Regional Environmental Authority (ARA for its name in Spanish). Important research partners include the Commonwealth Scientific Industrial Research Organization (CSIRO), Clark University, the World Bank's Wealth Accounting and the Valuation of Ecosystem Services (WAVES), the United Nations Statistics Commission, Geoville, etc. We are grateful to Luis Francisco Rosa-Pérez Tuesta (MINAM) for comments on earlier draft of the manuscript.

10.4 References

ARA-SM. 2014. Agenda Ambiental Regional 2014-2015. Agencia Regional Ambientatl (ARA) Gobierno Regiona de San Martin.

Ayapi-Da Silva, J.A. & Ruiz-Ramos, S.A. (2013). Avifauna de las microcuencas de Almendra, Mishquiyacu y Rumiyacu. Tesis de pregrado.

Bass, S., Ahlroth, S., Ruijs, A. and M. Vardon. 2017. "The Policy and Institutional Context for Natural Capital Accounting". In Forum on Natural Capital Accounting for Better Policy Decisions: Taking Stock and Moving Forward, edited by M. Vardon, S. Bass, S. Ahlroth, and A. Ruijs, 268. Washington D. C.: The World Bank. Available at https://www.wavespartnership.org/sites/waves/files/kc/WAVES%20report%20final%20version%20%20%281%29.pdf

CBD (Convention of Biological Diversity), Food and Agriculture Organization, The World Bank, United Nations Environment, and United Nations Development Programme. n.d. "BIODIVERSITY AND THE

2030 AGENDA FOR SUSTAINABLE DEVELOPMENT: Technical Note." Montreal. Available at http://www.undp.org/content/undp/en/home/librarypage/environment-energy/ecosystems_and_biodiversity/biodiversity-and-the-2030-agenda-for-sustainable-development---p.html

Conservation International, INEI (PERÚ Instituto Nacional de Estadística e Informática) and ARA (San Martin Regional Environmental Authority). 2016. Las Cuentas Experimentales de los Ecosistemas en San Martín, Perú [Online]. Available at http://www.wavespartnership.org/es/knowledge-center/las-cuentas-experimentales-de-los-ecosistemas-en-san-martin-peru

Coomes, O.T., Takasaki, Y. Abizaid, C, and B.L. Barham. Floodplain fisheries as natural insurance for the rural poor in tropical forest environments: evidence from Amazonia. Fisheries Management and Ecology Volume 17 (6): 513–521

ENBMC (Estrategia Nacional sobre Bosques y Cambio Climático). 2016. Estrategia Nacional sobre Bosques e Mudanca Climatica. 2016. Decreto Supremo No. 007-2016-MINAM. Available at http://www.bosques.gob.pe/estrategia-nacional

IBRD (International Bank for Reconstruction and Development). 2017. Country Partnership Framework: The Republic of Peru for the period FY17-FY21. Report No. 112299-PE. Washington, DC. Available at http://documents.worldbank.org/curated/en/522711493949637279/pdf/Peru-CPF-112299-PE-04102017.pdf

Kvist, L.P and G. Nebel. 2001. A review of Peruvian flood plain forests: ecosystems, inhabitants and resource use. Forest Ecology and Management 150 (1-2): 3-26

Koruiwa, J.M. (2009). Water resources in Peru: A strategic view. Fourth Meeting of the National Focal Points of the Water Programme. Nicaragua. Available at http://167.249.11.60/anc_j28.1/images/stories/agua/waterresourcesjuliokuroiwa.pdf

Larsen, T. 2012. Upslope Range Shifts of Andean Dung Beetles in Response to Deforestation: Compounding and Confounding Effects of Microclimatic Change. Biotropica 44 (1): 82–89

MINAM (Ministry of Environment), SDC (Swiss Agency for Development and Cooperation), Forest Trends, EcoDecision and CONDENSAN (Consorcio para el Desarollo Sustenible de la Ecoregion Andina). 2012. Incubator for Ecosystem Services Projects. Available at http://forest-trends.org/documents/files/Peru_Incubator_Brochure.pdf

MINAM (Ministry of Environment, Perú). 2014. Agenda Ambiente Perú 2015-2016. Resolución Ministerial N° 405-2014-MINAM. Available at http://sinia.minam.gob.pe/documentos/agendambiente-peru-2015-2016

MINAM (Ministry of Environment, Perú). 2017. 'Fabricas de Agua'. Available at http://www.minam.gob.pe/economia-y-financiamiento-ambiental/fabricas-de-agua/

Mittermeir, R.A, Myers, N., Thomsen, J.B., Da Fonseca, G.A.B. and S. Oliveri. 1998. Biodiversity Hotspots and Major Tropical Wilderness Areas: Approaches to Setting Conservation Priorities. Conservation Biology 12 (3): 516–520.

OECD (Organization for Economic Co-operation and Development). 2017. Available at http://www.oecd.org/greengrowth/greengrowthincountriesandterritories.htm#Peru

Olson, D.M., Dinerstein, E., 1998. The Global 200: a representation approach to conserving the earth's most biologically valuable ecoregions. Conservation Biology 12, 502–515.

PLANAA PERÚ (Plan Nacional de Acción Ambiental Perú). 2011. Reporte de seguimiento 2015 del Plan Nacional de Acción Ambiental 2011-2021 (PLANAA PERÚ: 2011- 2021). Available at http://www.legislacionambientalspda.org.pe/index.php?option=com_content&view=article&id=822&Itemid=5317

UN (United Nations). n.d. "Transforming Our World: The 2030 Agenda for Sustainable Development. A/RES/70/1. Available at http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

(UN) United Nations, European Commission, Organization for Economic Co-operation and Development, World Bank. 2014. System of Environmental-Economic Accounting - Experimental Ecosystem Accounting, New York. http://unstats.un.org/unsd/envaccounting/seeaRev/eea_final_en.pdf

UNEP-WCMC (United Nations Environment Programme- World Conservation Monitoring Centre). 2016. Exploring approaches for constructing Species Accounts in the context of the SEEA-EEA. Available at http://beta.unep-wcmc.org/system/comfy/cms/files/files/000/000/792/original/Exploring_Approaches_for_constructing_Species_Accounts_in_the_context_of_the_SEEA-EEA_FINAL.pdf

Vardon, M., S. King, D. Juhn, S. Bass, P. Burnett, C. Manuel Rodriguez, and S. Johnansson. 2017. "The Aichi Targets and Biodiversity Conservation – The Role of Natural Capital Accounting." In Forum on Natural Capital Accounting for Better Policy Decisions: Taking Stock and Moving Forward, edited by M. Vardon, S. Bass, S. Ahlroth, and A. Ruijs, 268. Washington D. C.: The World Bank. Available at https://www.wavespartnership.org/en/knowledge-center/forum-natural-capital-accounting-better-policy-decisions-taking-stock-and-moving

Young, B. 2007. Distribución de las especies endémicas en la vertiente oriental de los Andes en Perú y Bolivia. NatureServe, Arlington, Virginia, EEUU

11. Revisiting the role of natural capital accounting for biodiversity conservation - Discussion and a case study from Uganda

By Steven King,[1] Mark Eigenraam,[2] Carl Obst,[2] Michael Vardon[3] and Daniel Juhn[4]

[1]*UN Environment World Conservation Monitoring Centre (UNEP-WCMC)*
[2] *Institute for the Development of Environmental-Economic Accounting (IDEEA)*
[3]*Fenner School of Environment and Society, Australian National University*
[4]*Conservation International*

Summary

Given its importance to many economic activities, and well-being more generally, biodiversity is recognized as an essential natural capital asset for sustainable development (UN, n.d.; CBD et al., n.d.). Both the Sustainable Development Goals (via Target 15.9) and Aichi Targets (via Target 2) identify natural capital accounting as a means of mainstreaming biodiversity into decision making and development policies for better management of this resource. This is because well-designed natural capital accounts can provide a framework to integrate, synthesize and communicate information on the environment and the economy. Moreover, they do that in the format decision makers require in their pursuit of a sustainable use and conservation of biodiversity. This can cover a spectrum of applications, from informing on detailed spatial planning for natural capital and biodiversity management to generating indicators to inform on progress towards policy targets. This includes achieving the SDGs and the Aichi Targets.

During the *2016 Forum on Natural Capital Accounting for Better Policy Decisions*, Vardon et al. (2017) mapped the Aichi Targets to the System of Environmental-Economic Accounting (SEEA). This clearly identified that indicators informing many of the Aichi Targets may be generated via natural capital or ecosystem accounts as described in either the SEEA Central Framework or SEEA Experimental Ecosystem Accounting (SEEA EEA). In this paper, we revisit and extend this work by mapping SDG 15 and the Aichi Targets to the SEEA, with a focus on land, ecosystem extent and species (Table 11.2). We illustrate the potential of these natural capital accounts to support evidence-based decision making for achieving objectives for biodiversity and ecosystems via a case study application for Uganda. To this end, we summarize an approach for the rapid development of SEEA based accounts designed to target key policy entry points for natural capital information (described in UNEP-WCMC and IDEEA 2017). We also illustrate the relevance of these accounts for informing on progress towards SDG 15, the Aichi Targets and wider SDGs.

This short paper illustrates the use of natural capital accounting for biodiversity conservation generally and of natural capital accounting in pursuit of the SDGs. It provides a useful, practical contribution to countries and agencies looking to begin work in this area.

11.1 Introduction

The Sustainable Development Goals (SDGs) recognize that biodiversity loss and ecosystem degradation are exacerbating the challenges humanity faces and that social and economic development is dependent on sustainable use of this natural capital asset (UN, n.d.). To this end, SDG 15 calls for a halt to biodiversity loss and the integration of biodiversity into accounts via SDG Target 15.9.[32] This is because the value of biodiversity and the ecosystem services it supports are not reflected in market prices, often leading to biodiversity being neglected in traditional assessments of economic progress and development planning. Thus, natural capital accounting is identified as a vehicle to accelerate mainstreaming of the value of biodiversity into decision making and development policies in a systematic manner (Weber 2014; UNEP-WCMC and IEEP 2013). This is also clearly reflected in the Convention of Biological Diversity's strategic plan (2011 to 2020) for improving the status of biodiversity via Aichi Biodiversity Target 2.[33]

Given that biodiversity is central to many economic activities, it also features across many of the SDGs and their targets, (CBD et al., n.d.). These links between the SDGs and the Aichi Targets have been mapped by the CBD, FAO, World Bank, UN Environment and UNDP (CBD et al., n.d.) and are noted in the wider conservation literature (e.g., Brooks et al. 2015). Accordingly, the Aichi Targets and SDGs provide a set of aligned entry points that natural capital accounting can speak to across all stages of the policy cycle (i.e., problem identification, policy response, implementation, policy monitoring and evaluation).

However, accounting for biodiversity has remained challenging. This is due, in part, to complexities in measuring the multiple aspects of biodiversity and the contribution it provides to the economy. Nonetheless, in recent years a range of work on thematic accounting for biodiversity drawing on the System of Environmental Economic Accounting - Experimental Ecosystem Accounting (SEEA-EEA) (UN et al. 2014) and other frameworks has emerged. During the 2016 *Forum on Natural Capital Accounting for Better Policy Decisions*, Vardon et al. (2017) highlighted this work in a paper aiming to generate discussion about the potential uses of natural capital accounting for biodiversity conservation. This clearly identified that many of the Aichi Targets may be addressed via accounting described in either the SEEA Central Framework or SEEA EEA.

In this short paper, we aim to contribute to this debate further by presenting a set of natural capital accounts, incorporating land, ecosystem extent and thematic species accounts. These accounts have been designed to provide information relevant to identified policy entry points in Uganda related to the attainment of the SDGs and Aichi Targets. The table of Aichi Targets and environmental and ecosystem accounts presented by Vardon et al. (2017) is also revisited in this context, to illustrate the potential of these types of accounts to inform on progress towards SDG 15 targets, the Aichi Targets and wider SDGs (Table 11.1).

[32] By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. See: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

[33] By 2020 at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems. See Aichi Biodiversity Targets http://www.cbd.int/sp/targets/

11.2 Experimental ecosystem accounts for Uganda

Uganda ranks among the top 10 most bio-diverse countries in the world (NEMA 2016). This natural richness generates a range of products and services that underpin livelihoods, including tourism, fisheries, forestry and agriculture. As such, biodiversity is widely recognized as an important part of the country's natural capital stock. However, in common with global trends, there are concerns about the rate at which Uganda is losing its biodiversity (i.e., its species and their habitats) (NEMA 2016). In response, Uganda has committed to addressing biodiversity loss and implementing the Aichi Targets via its Second National Biodiversity and Action Plan (NBSAP II) (NEMA 2016). Uganda's NBSAP II is also aligned to the SDGs, which are implemented via its National Development Plan (NDP II) (NPA 2015). Therefore, biodiversity conservation is a key national policy goal for both the NBSAP (II) and NDP II.

As part of a joint project between UNEP-WCMC, the IDEEA Group, National Planning Authority, National Environmental Management Authority and Wildlife Conservation Society, a set of experimental ecosystem accounts, incorporating land, ecosystem extent and species accounts, were compiled for Uganda. Responding to stakeholder demands, these accounts were designed to yield spatially explicit information and key indicators relevant to the following policy entry points in Uganda:

1. To inform the ongoing debates surrounding the gazettement and de-gazettement of protected areas
2. To make the case for increased budget allocation and investment in biodiversity rich sectors for conservation and management
3. To establish the extent of ecosystem degradation and where declining biodiversity threatens the delivery of ecosystem services and implications on economic growth and human well-being
4. To increase awareness and appreciation of biodiversity as a natural capital asset amongst decision makers and the public
5. To assess national progress towards the objectives of Uganda's National Biodiversity Strategy Plan (NBSAP II) and National Development Plan (NDP II) and associated international commitments (i.e., the Aichi targets and SDGs)

In order to inform on the above demands, the information generated by the accounting process provided metrics on the rate and trends in habitat loss, progress towards protecting ecologically representative areas with high biodiversity importance, progress towards protecting the range and conservation status of threatened species and identifying areas where tourism and non-timber forest products (NTFP) possibilities can contribute to local economic development.

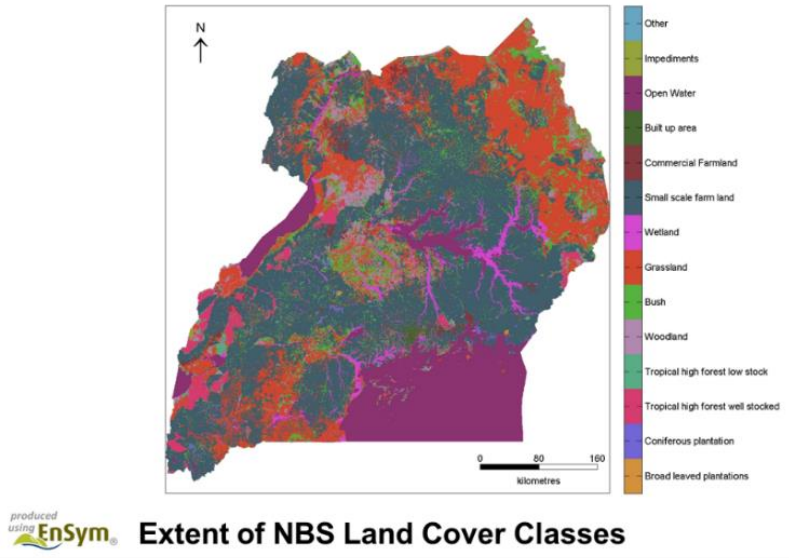
11.3 Summary of the Accounting Approach

The approach is based on integrating information on land cover with spatial data on ecosystems to develop a set of Experimental Ecosystem Accounts for Uganda (described in full in UNEP-WCMC and IEEP 2013). These accounts are compiled using the SEEA framework and provide information on the stocks of land and ecosystems. As highlighted in Vardon et al. (2017), these types of accounts can be compiled and updated using existing and remotely sensed data.

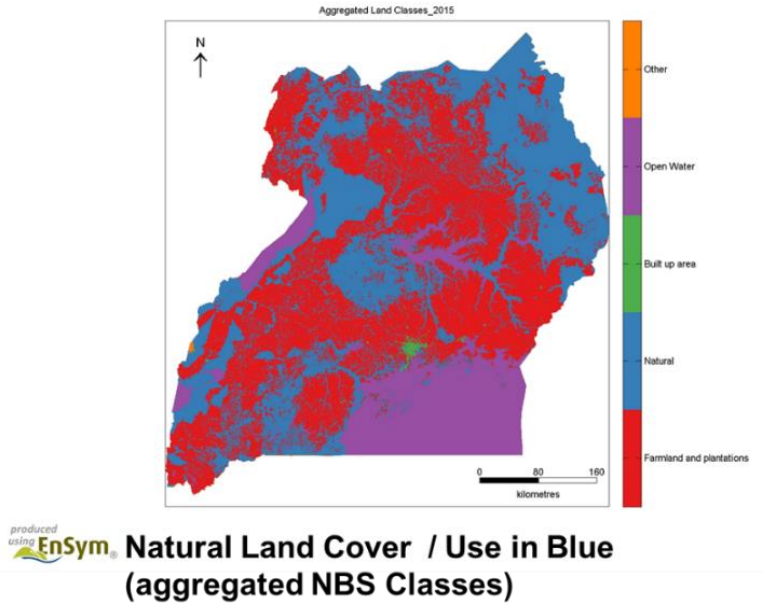
For Uganda, we use land cover maps produced by the National Forest Authority (NFA) for 1990, 2005, 2010 and 2015 (as described in Diisi 2009). Land Accounts have been created for the extent of natural and non-natural land cover based on aggregations of relevant land cover classes. With these aggregated accounts in place, accounts of ecosystem extent have been compiled by intersecting areas of natural cover with a distribution of the original extent of vegetation in Uganda (as proposed by Langdale-Brown, Osmaston, and Wilson 1964). The information is useful to evaluate the location and magnitude of ecosystem loss (and gains) and trends over time. Integrating expert knowledge on habitat preferences of selected species can provide these accounts with further value and policy insight for conservation

decision makers, such as on the impact of historic land-use decisions on species habitat.[34] We term these constructs "Species Accounts," which fit within the SEEA-EEA framework as a thematic account for organizing information relevant to biodiversity (as described in UNEP-WCMC, 2016). The Species Accounts provide information on the extent of suitable habitat for three Non-Timber Forest Product (NTFP) species (Gum Arabic, Shea butter nuts and *Prunus Africana*) and two flagship mammal species (Chimpanzees and Elephants) important for wildlife tourism. We summaries our approach for compiling the accounts in Figure 11.1 below.

Figure 11.1 Approach to calculating natural capital accounts for Uganda



Land cover accounts: The first stage in the process was to construct accounts of the extent of land cover classes for 1990, 2005, 2010 and 2015 using land cover maps produced for Uganda. These land cover maps are derived from the FAO Land Cover Classification System and derived from LandSat imagery.

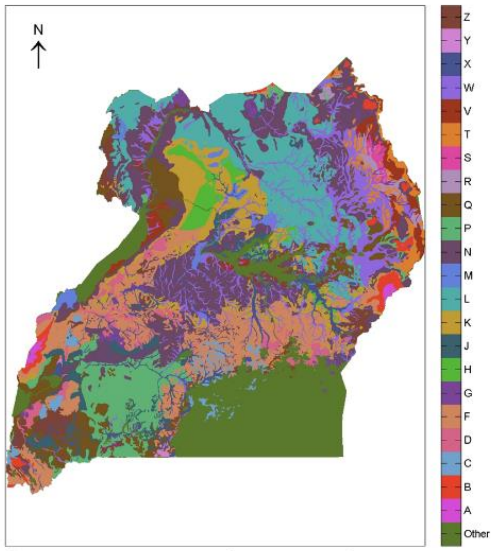


Aggregated land cover accounts: Using this information, accounts have then been created for 1990, 2005, 2010 and 2015 for the extent of:

- Natural land cover
- Open water
- Farmland and plantation
- Built-up areas

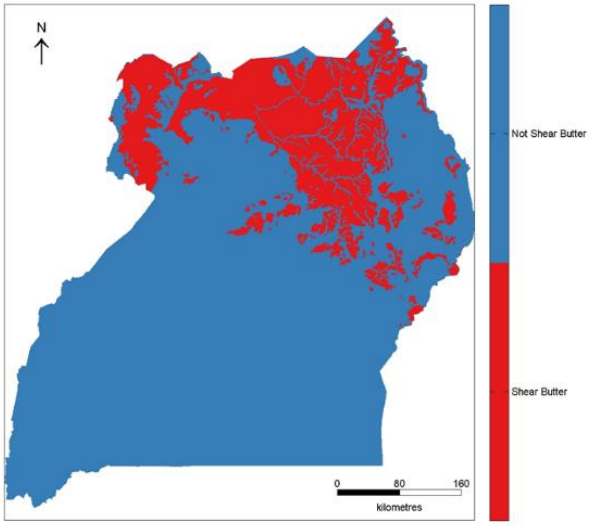
These were based on aggregations of relevant land cover classes.

[34] The approach draws on similar work undertaken by SANBI in South Africa (Driver et al. 2015) with respect to ecosystem accounting and existing work to associate natural ecosystems with species derived benefits in Uganda coordinated by Makerere University (Pomeroy et al. 2002).



produced using EnSym

Langdale Brown - Original extent of ecosystems in Uganda



produced using EnSym

Original extent of Shea butter nut tree suitable habitat

Ecosystem accounts: By intersecting the extent of natural land cover with a map of the original distribution of vegetation classes (i.e., before anthropogenic change), accounts have been created for 1990, 2005, 2010 and 2015 for the extent of these vegetation classes.

These are our "natural ecosystem" accounts and are based on 22 vegetation classes that aggregate to four biomes. First mapped by Langdale-Brown et al., in the 1950s/1960s.

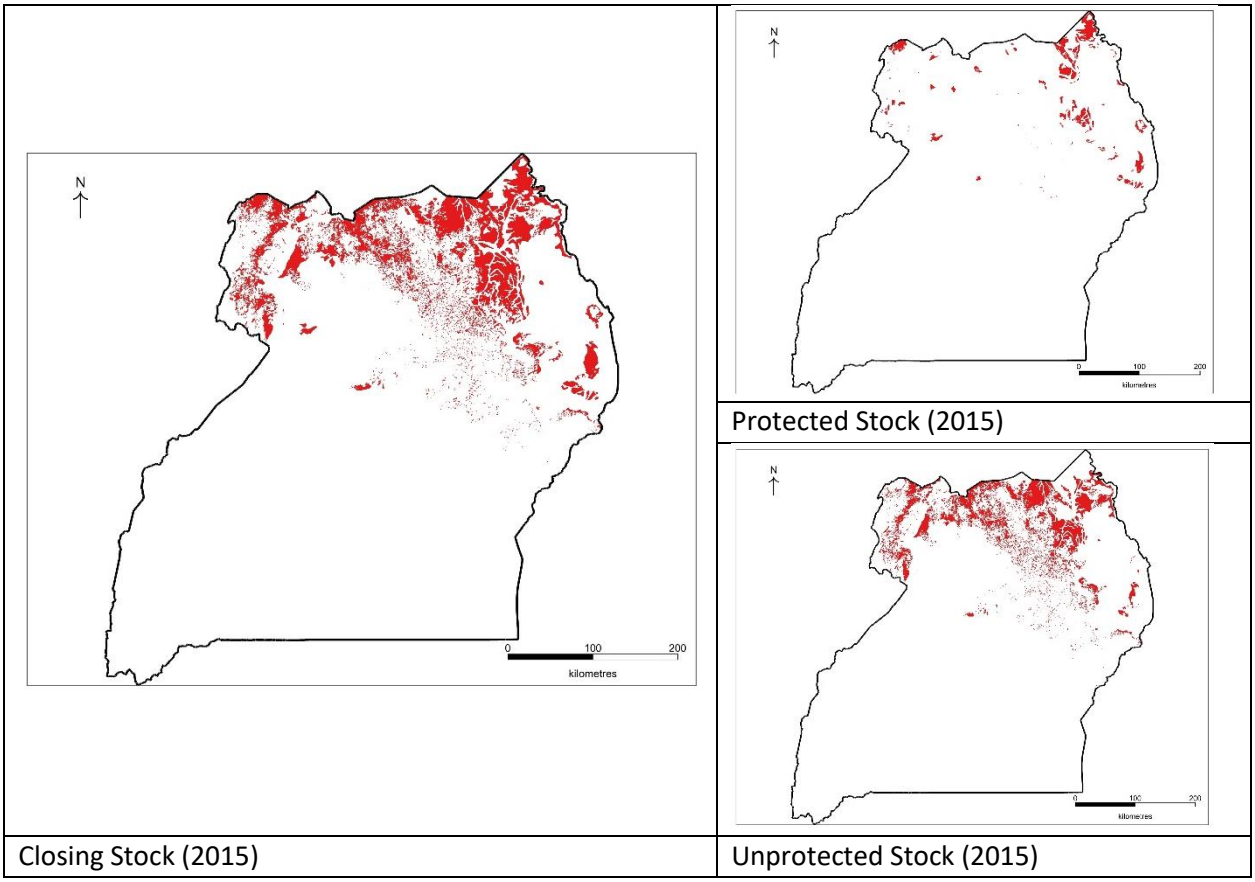
Species accounts: Accounts of the extent of suitable habitat for individual species were calculated for 1990, 2005, 2010 and 2015 using expert knowledge to link species to the remaining extents of preferred natural ecosystem types or land cover classes within species ranges:

- Shea butter nut trees (linked to natural ecosystem preferences)
- Gum Arabic (linked to natural ecosystem preferences)
- *Prunus Africana* (linked to natural ecosystem preferences)
- Chimpanzees (linked land cover class preferences and range of occupancy data)
- Elephants (linked land cover class preferences and range of occupancy data)

11.4 Results and their policy applications

By overlaying information on economic decisions regarding land-use (e.g., the zoning and conversion of natural forests to agricultural land) and spatial information on biodiversity (e.g., the extent of suitable habitat for Chimpanzees), the accounts reveal a number of key findings that can inform on the key policy entry points identified in Uganda. Figure 11.2 provides such an example, showing the extent of suitable habitat that may support Shea Butter Nut harvesting in Uganda in 2015 (Closing Stock 2015), the extent included in the protected area estate (Protected Stock 2015) and the extent outside of the protected area estate (Unprotected Stock 2015). This information can assist decision makers in identifying areas where conservation of biodiversity outside of protected areas and Shea Butter production go hand-in-hand. This type of information will be relevant to all the key policy entry points for biodiversity information identified for Uganda, for example identifying where investments in conserving, enhancing and accessing natural capital outside of protected areas can support poverty alleviation.

Figure 11.2 Example of Shea Butter Nut Tree information and species accounts for Uganda



Closing Stock (2015) | Protected Stock (2015) | Unprotected Stock (2015)

Table 11.1 on the next page illustrates how the spatial information presented in Figure 11.2 can be presented as a species account.

Table 11.1 Example of Shea Butter Nut Tree Account for Uganda (1990-2015)

	Extent (ha)
Opening Stock (1990)	2,706,485
Net change	*-605,561*
Closing Stock (2015)	2,100,924
Protected Stock (2015)	442,466
Unprotected Stock (2015)	1,658,458

In combination, the Land, Ecosystem Extent and Species Accounts for Uganda reveal a number of key policy finding that can inform on progress towards SDG 15 and the Aichi Targets. These are summarized in Table 11.2. Drawing on the linkages between the Aichi Targets and the SDGs proposed by the CBD et al., (n.d.), the final column in Table 11.2 also illustrates the links between the Relevant Aichi Target (Column 2) and wider SDGs.[35]

11.5 Conclusions

Overall, the rich spatial data and spatial infrastructure underpinning the accounts is demonstrated to be very flexible and further analysis of the data is possible. This can be extended to a more holistic and integrated land use planning that better considers biodiversity and the impacts of management on biodiversity and the ecosystem services it provides. Such an integrated planning approach would be a significant improvement from traditional land planning regimes as it could help to build the bridge that is often missing between land use planning and economic and development planning. This clearly speaks to the key policy-entry points identified in Section 11.2 and how such information on biodiversity and ecosystems can enhance effective planning and management in Uganda. This is also fundamental to achieving the SDGs, which, by design, require that the environmental, economic and social dimensions of sustainable development are addressed in a holistic manner. In these regards, the accounts compiled for Uganda deliver a spatial evidence base for:

- Informing expansion of the protected areas estate to secure threatened species and tourism development opportunities
- Targeting investments for the development of sustainable harvesting programs for non-timber forest species (NTFP) and tourism development
- Highlighting the benefits of biodiversity by linking the accounts to spatial statistics on the economy (e.g., tourism expenditure and NTFP yields)
- Evaluating the trade-offs between biodiversity benefits and different development options
- Tracking the degree of habitat conversion and degradation associated with different economic sectors and potential implications on NTFP harvests and the tourism sector
- Reporting on progress towards achieving the SDG 15 and the Aichi Targets.

From a practical perspective, the rapid development of the accounts using existing data also allows insights to be quickly disseminated. This will assist in retaining the support of key users of the accounts and foster ownership through elicited feedback. This staged approach is also likely to prove more efficient, as investments to fill data gaps and compile additional natural capital accounts can then be targeted to policy and user priorities, and can also be used as a motivation for investment in local data and skill development.

[35] It should be noted this final column is for indicative purposes to illustrate where, potentially, the types of natural capital accounts produced in Uganda could inform or monitor policy.

Table 11.2 Links between SDGs and Aichi Targets and Uganda natural capital accounts

SDG 15 Targets	Relevant Aichi Target	Relevant accounts	Relevant indicators and uses	Aichi Target Links to other SDGs (CBD et al., n.d.)
SDG Target 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Aichi Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	Land Cover Accounts Ecosystem Extent Accounts Species Accounts	The flagship and NTFP species, ecosystem extent and land accounts provide information on the sustainable use of terrestrial ecosystems that can inform on the maintaining a sufficient stock of ecosystem assets that can provide long-term benefits for all.	SDG 1; SDG 3; SDG 5; SDG 6; SDG 7; SDG 8; SDG 9; SDG 11; SDG 13; and, SDG 14;
	Aichi Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	Ecosystem Extent Accounts Species Accounts	The flagship species and ecosystem extent accounts can reveal progress towards protecting an ecologically representative set of areas with high biodiversity importance in Uganda. They flagship and NTFP species accounts can also assist in identifying opportunities for conservation and socio-economic development, via activities such as sustainable harvesting and wildlife watching tourism	SDG 6; SDG 11; and, SDG 14.
SDG Target 15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Aichi Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	Ecosystem Extent Accounts Species Accounts	The species and ecosystem extent accounts provide information on the sustainable use of terrestrial ecosystems that can be used to monitor habitat loss (including forests) and provide the spatial data for analyzing fragmentation.	SDG 7; SDG 13; and, SDG 14
SDG Target 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species				

SDG Target 15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	Aichi Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	*Prunus Africana* Species Accounts	This species is associated with medium to high altitude forest. As such the Species Accounts con inform on progress towards protecting the range of this species in mountainous areas.		SDG 7; SDG 13; and, SDG 14
SDG Target 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	Aichi Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	Species Accounts	The flagship species, Shea butter tree nut and *Prunus Africana* accounts can inform progress towards protecting the range and conservation status of these threatened species. There is also likely to be a number of other threatened species whose status would be improved via an umbrella effect.		SDG 14
15.6 Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed	Aichi Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	Species Accounts	The *Prunus Africana* and NTFP species accounts can help monitor trends in the maintaining the genetically diversity of these species based on distributions of different communities in different sub-regions and associated access rights.		SDG 2; SDG 3.
SDG Target 15.9: By 2020 integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	Aichi Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.	Ecosystem Extent Accounts Species Accounts	The ecosystem extent and species accounts provide the first step in integrating biodiversity values into the national accounting system. Further integration can be achieved by making links to economic statistics related to tourism and provisioning ecosystem services.		SDG 1; SDG 8; SDG 9; SDG 11; SDG 13; SDG 14; and, SDG 17
Important for achieving SDG 15 generally (CBD et al., n.d.)	Aichi Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.	Land Cover Accounts Ecosystem Extent Accounts	In combination, the land cover and ecosystem extent accounts can identify areas that have been degraded and are characterized by high ecosystem diversity potential. This can inform selection of areas for restoration and improving biodiversity and resilience.		SDG 6; SDG 7; SDG 9; SDG 10; SDG 11; SDG 13; and, SDG 14.

11.6 References

Brooks, T.M., S.H. Butchart, N.A. Cox, M. Heath, C. Hilton-Taylor, M. Hoffmann, N. Kingston, J.P. Rodríguez, S.N. Stuart, and J. Smart. 2015. "Harnessing Biodiversity and Conservation Knowledge Products to Track the Aichi Targets and Sustainable Development Goals." *Biodiversity* 16 (2–3): 157–74. http://www.tandfonline.com/doi/pdf/10.1080/14888386.2015.1075903?needAccess=true.

CBD, FAO, The World Bank, UN Environment, and UNDP. n.d. "BIODIVERSITY AND THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT: Technical Note." Montreal. https://www.cbd.int/development/doc/biodiversity-2030-agenda-technical-note-en.pdf.

Diisi, J. 2009. "National Biomass Study: Technical Report 2005." Kampala, Uganda.

Driver, A., J.L. Nel, J. Smith, F. Daniels, C.J. Poole, D. Jewitt, and B.J. Escott. 2015. "Land and Ecosystem Accounting in KwaZulu-Natal, South Africa. Discussion Document for Advancing SEEA Experimental Ecosystem Accounting Project, October 2015." Pretoria, South Africa. http://www.statssa.gov.za/wp-content/uploads/2016/08/Land-and-Ecosystem-Accounting-in-KZN-Discussion-Document-FINAL.pdf.

Langdale-Brown, I., H. Osmaston, and J. G. Wilson. 1964. "The Vegetation of Uganda and Its Bearing on Land Use." Entebbe, Uganda.

NEMA. 2016. "National Biodiversity Strategy and Action Plan II (2015-2025)." Kampala, Uganda. https://www.cbd.int/doc/world/ug/ug-nbsap-v2-en.pdf.

NPA. 2015. "SECOND NATIONAL DEVELOPMENT PLAN (NDPII) 2015/16 – 2019/20." Kampala, Uganda. http://npa.ug/wp-content/uploads/NDPII-Final.pdf.

Pomeroy, D, H Tushabe, P Mwima, and P Kasoma. 2002. "Uganda Ecosystem and Protected Area Characterisation." Kampala, Uganda. http://pdf.usaid.gov/pdf_docs/pnacy477.pdf.

UN. n.d. "Transforming Our World: The 2030 Agenda for Sustainable Development. A/RES/70/1." https://sustainabledevelopment.un.org/content/documents/21252030 Agenda for Sustainable Development web.pdf.

UN, European Commission, FAO, OECD, and World Bank. 2014. "System of Environmental Economic Accounting 2012— Experimental Ecosystem Accounting." New York. http://unstats.un.org/unsd/envaccounting/seeaRev/eea_final_en.pdf.

UNEP-WCMC, and IDEEA. 2017. "Experimental Ecosystem Accounts for Uganda." Cambridge, UK. www.wcmc.io/0524.

UNEP-WCMC, 2016. "Exploring Approaches for Constructing Species Accounts in the Context of SEEA-EEA" Cambridge, UK. Available at: http://wcmc.io/Species_Accounting

UNEP-WCMC, and IEEP. 2013. "Incorporating Biodiversity and Ecosystem Service Values into NBSAPs: Guidance to Support NBSAP Practitioners." https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/004/original/Guidance_doc_NBSAP_A4_FINAL.pdf?1395066492.

Vardon, M., S. King, D. Juhn, S. Bass, P. Burnett, C. Manuel Rodriguez, and S. Johnansson. 2017. “The Aichi Targets and Biodiversity Conservation – The Role of Natural Capital Accounting.” In *Forum on Natural Capital Accounting for Better Policy Decisions: Taking Stock and Moving Forward*, edited by M. Vardon, S. Bass, S. Ahlroth, and A. Ruijs, 268. Washington D. C.: The World Bank. https://www.wavespartnership.org/en/knowledge-center/forum-natural-capital-accounting-better-policy-decisions-taking-stock-and-moving.

Weber, J-L. 2014. “Ecosystem Natural Capital Accounts: A Quick Start Package, Montreal, Technical Series No. 77.” https://www.cbd.int/doc/publications/cbd-ts-77-en.pdf.

Wealth Accounting and the Valuation of Ecosystem Services

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a global partnership led by the World Bank that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and economic accounts.

www.wavespartnership.org