Forum on Natural Capital Accounting for Better Policy Decisions:

Taking Stock and Moving Forward

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Forum on Natural Capital Accounting for Better Policy Decisions:

Taking Stock and Moving Forward

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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.

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Cover photo: Fishermen ©Curt Carnemark/World Bank

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Abbreviations

25 YEP	25 Year Environment Plan
A4S	Accounting for Sustainability Project
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AFR	Africa
ANU	Australian National University
BANGUAT	Bank of Guatemala
Bappenas	Ministry of Development Planning, Indonesia
BCCR	Central Bank of Costa Rica
BCG	Central Bank, Guatemala
BMZ	Deutsche Gesellschaft Fur Internationale Zusammenarbeit
BOM	Bureau of Meteorology, Australia
BPC	Botswana Power Corporation
BPS	National Statistics Office, Indonesia
BUAN	Botswana University of Agriculture and Natural Resources
BUR	Biennial Update Report, Costa Rica
CAR	Regional autonomous corporations
CBD	Convention on Biological Diversity
CBS	Statistics Netherlands
CEA	Competent Environmental Authorities, Colombia
CGE	Computable general equilibrium
CIC	Core implementing country
CICES	Common International Classification of Ecosystem Services
CO_2	Carbon dioxide
COMPES	Council for the National Economic and Social Policy, Colombia
COP	Community of practice
COP	Conference of the Parties
COP21	UNFCCC COP Paris 2015
CRIRSCO	Combined Reserves International Reporting Standards Committee
DANE	National Administrative Department of Statistics, Colombia
Defra	Department for Environment, Food, and Rural Affairs, United Kingdom
DENR	Department of Environment and Natural Resources, Philippines
DfID	Department for International Development, United Kingdom
DNP	National Planning Department, Colombia
DP	Development partner
DPSIR	Drivers, pressures, state, impacts, and responses
DTRP	Department of Town and Regional Planning, Botswana
DWA	Department of Water Affairs, Botswana
EAP	East Asia and Pacific
EC	European Community
ECA	Europe and Central Asia
ECLAC	Economic Commission for Latin America and Caribbean
ECN	Energy Research Centre of the Netherlands
EDPRS	Economic Development for Poverty Reduction Strategy
EEA	European Environment Agency

EEA	Experimental Ecosystem Accounting
EFTA	European Free Trade Agreement
EGSS	Environmental goods and service sector
EMEC	Environmental Medium-Term Economic Model
ENA	National Water Study
ENCC	National Climate Change Strategy
ENRA	Environmental and Natural Resources Accounting
ENRAP	Environmental and Natural Resources Accounting Project
EO4EA	Earth Observations for Ecosystem Accounts
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	European Union
FCPF	Forest Carbon Partnership Facility
FDI	Foreign Direct Investment
FIP	Forest Investment Program
FONAFIFO	National Forest Financing Fund
GFS	Government Finance Statistics
GG	Green growth
GDN	Global Development Network
GDP	Gross domestic product
GDSA	Gaborone Declaration for Sustainability in Africa
GE	Green economy
GEF	Global Environment Facility
GEO	Group on Earth Observations
GGCR	Green Growth and Climate Resilience Strategy
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOI	Government of Indonesia
GRI	Global Reporting Initiative
GSBPM	Generic Statistical Business Process Model
GWP	Global Water Partnership
HDI	Human Development Index
IARNA	Institute of Agriculture, Natural Resources, and Environment, Guatemala
ICE	National Electricity Institute Costa Rica
ICT	Information communication technology
IDA	International Development Association
IDB	Inter-American Development Bank
IDEAM	Institute for Hydrology, Meteorology and Environmental Studies
IEEM	Integrated Economic-Environmental Modeling
IEEM-GUA	Integrated Economic-Environmental Modeling Platform for Guatemala
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
IIRS	International Integrated Reporting Council
IMF	International Monetary Fund
INDC	Intended nationally determined contribution
INE	Institute of National Statistics, Guatemala
INEC	National Institute of Statistics and Census, Costa Rica

IR	Intermediate Results Indicator
ITB	Bandung Institute of Technology
IWRM	Integrated water resources management
IWRM-WE	Integrated Water Resources Management & Water Efficiency Plan, Botswana
KG STAT	Kyrgyz Republic Implementation of the National Strategy for Development of Statistics
KTH	Royal Institute of Technology
LAC	Latin America and the Caribbean
LAIS	Land Administration Information System
M&E	Monitoring and evaluation
MADS	Ministry of Environment and Sustainable Development, Colombia
MARN	Ministry of Environment, Guatemala
MAVDT	Ministry of Environment, Housing and Territorial Development, Colombia
MDTF	Multidonor trust fund
MFA	Ministry of Foreign Affairs, Netherlands
MFDP	Ministry of Finance, Development and Planning, Botswana
MGB	Mines and Geosciences Bureau, Philippines
MIDEPLAN	Ministry of Planning and Economic Policy, Costa Rica
MINAE	Ministry of Environment and Energy, Costa Rica
MMEWR	Mining Energy and Water Resources, Botswana
NAMRIA	National Mapping and Resource Information Authority
NASA	National Aeronautics and Space Administration
NBSAPs	National Biodiversity Strategies and Action Plans
NCA	Natural capital accounting
NCEAS	National Center for Ecological Analysis and Synthesis
NCM	Nordic Council of Ministers
NCP	National Conservation Policy
NDP	National Development Plan
NEDA	National Economic Development Authority, Philippines
NEO	National Energy Outlook
NEPM	National Environment Protection Measure
NEPP	National Environmental Policy Plans
NEWP	Natural Environment White Paper
NFP	National Forest policy
NGO	Nongovernmental organization
NPV	Net present value
NRA	Natural resources accounting
NRM	Natural resource management
NRS	National Reserve System
NSCB	National Statistical Coordination Board, Philippines
NSW	National Study of Water, Colombia
NWMP	National Water Master Plan
OCSE	Office of the Commissioner for Sustainability and the Environment, ACT
OECD	Organisation for Economic Co-operation and Development
ONS	Office of National Statistics
PAGE	Partnerships for Action on Green Economy
PBL	Environmental Assessment Agency, Netherlands
PDO	Project Development Objective

PEENRA	Philippine Economic-Environmental and Natural Resources Accounting
PES	Payment for ecosystem services
PNGIRH	National Policy for Integrated Water Resource Management
POMCA	Watershed Use and Management Plan
PRTR	Pollutant Release and Transfer Register
RAN-GRK	National Action Plan for Reducing Emissions of Greenhouse Gases
RCMRD	Regional Centre for Mapping of Resources for Development
REDD+	Reducing emissions from deforestation and forest degradation
RETF	Recipient executed trust fund
RVO.nl	Netherlands Enterprise Agency
SAM	Social accounting matrix
SASB	Sustainability Accounting Standards Board
SC	Steering committee
SDG	Sustainable Development Goal
SEEA	System of Environmental-Economic Accounting
SEEA-CF	SEEA Central Framework
SEEA-EEA	SEEA Experimental Ecosystem Accounting
SEAs	Strategic Environmental Assessments
SEEAW	System of Environmental-Economic Accounting for Water
SEGEPLAN	National Planning Agency, Guatemala
SINAC	National System of Conservation Areas
SISNERLING	Integrated System of Environmental Economic Accounting
SIWI	Stockholm International Water Institute
SNA	System of National Accounts
SNAPP	Science for Nature and People Partnership
TC	Technical committee
TJ	Terajoule
TNC	The Nature Conservancy
TWG	Technical working group
UK	United Kingdom
UN	United Nations
UNCEEA	United Nations Committee of Experts on Environmental-Economic Accounting
UNEP	United Nations Environmental Programme
UNFC	United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources
UNFCCC	United Nations Framework Convention on Climate Change
UNGRD	Disaster Risk Management National Unit, Colombia
US	United States
USAID	United States Agency for International Development
USGS	United States Geological Survey
WACA	West Africa Coastal Areas Management Program
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WEF	World Economic Forum
WRMP	National Water Resources Master Plan
WTO	World Trade Organization
WUC	Water Utilities Corporation, Botswana
WUF	Water use fee
WWF	World Wildlife Fund

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- Participants (see annex 2)
- Authors, not all of whom were at the Forum, and are listed in each chapter (biographies can be found in annex 3)

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Preface

It is with great pleasure that we present this publication that has resulted from the discussions and written contributions to the first WAVES Policy Forum. Cohosted by our respective organizations in The Hague in November 2016, the Forum brought together users and producers of natural capital accounts in a way not done before. The forum provided a platform for very productive lesson sharing and for building a consensus on priorities to improve policy decisions through natural capital accounting (NCA). The subsequent process of drafting and updating the many country and thematic papers has provided a focus for the ongoing engagement of account producers and users.

This resulting publication, with input from nearly 50 world experts, is authoritative in highlighting the many uses for NCA. This work draws not only from countries with long-established NCA programs like the Netherlands, but also from countries that have more recently started implementing NCA, such as the WAVES countries. The broad range of active policy applications is very encouraging, with good examples in the water, forest, and energy sectors, as well as in multifaceted strategies like green growth and climate change.

Perhaps even more importantly, the Policy Forum has led to the identification of many opportunities to use NCA in policy and government processes. The editorial team has synthesized 10 draft principles for achieving greater uptake of NCA by decision makers that can now be tested. As Peter Burnett's chapter encourages: Just do it!

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Executive Summary

The Hague Forum: "Natural Capital Accounting for Better Policy"

Policy decisions on poverty reduction, investment, economic growth, and environmental management are increasingly sensitive to natural resource values, scarcities, and deterioration. Worldwide, many countries have made progress in constructing natural capital accounts, although its regular use to design and review policy is still an aspiration for most. However, the understanding and use of natural capital accounting (NCA) is now at a stage where it can better inform policy decisions, as the growing number of examples illustrates.

The Netherlands Ministry of Foreign Affairs and the World Bank–led WAVES Global Partnership share an ambition to improve the uptake, use, and effectiveness of NCA. Based on the successful lesson sharing at the first NCA forum, "Natural Capital Accounting for Better Policy," organized by both parties in The Hague on November 22–23, 2016, this publication presents a rich and diverse set of case studies from 12 countries that take stock of NCA, how it engages decision makers, and how it improves policy. This report offers an initial synthesis of achievements, challenges, lessons, tentative principles, and productive ideas for next steps, drawing on experiences and interactions among a range of countries, from low- to high-income countries and those with long or short experience with NCA. The aim is to help NCA developers and policy makers in all countries learn how to obtain good natural capital information to influence real-life policy decisions.

Why, who, and how: Closing the gap between NCA production and NCA use in policy making

Work on NCA needs a new emphasis if it is to inform policy decisions. To actually use the accounts, insights from NCA, indicators, analyses, and so forth, NCA has to get inside the institutional machinery of decision making. The cases in this publication provide examples of NCA that have been (or could be) used in all stages of the policy cycle, namely:

- Issue or problem identification
- Policy response
- Implementation
- Monitoring and
- Review

The extent to which NCA has been used to develop policy has varied among countries. Many countries have only recently begun NCA programs, but there are also many countries that are already using NCA for policy monitoring and review, often by deriving indicators from the accounts, for example, for water, climate, energy, the Sustainable Development Goals (SDGs), green growth, or for State of Environment reporting. Actual use of NCA for policy design and implementation comes from countries with longer experiences with NCA, but even those relatively new to NCA are beginning to use the accounts to develop policy responses, such as master plans or forestry, water, or mining strategies.

The different chapters show the many different NCA users. For example, NCA is used by particular government agencies for the following:

- Natural resources (for example, water, forests, minerals)
- Geographical areas
- Strategic decision making and
- Research.

NCA is also used by businesses and civil society.

The accounts are, however, not automatically put to use even if they are in place. Unless special attention is given to NCA use, it will take time for NCA to make its way into policy formulation processes. Active engagement is needed between NCA producers and potential policy users. Besides analytical and research institutes, so far government agencies and subnational institutes responsible for natural resources like energy, water, minerals, land, and forests have been the main users of NCA in most countries. In the WAVES countries, high-level steering committees, including officials from ministries of finance, planning, development, and others, have been formed to generate policy momentum. Such high-level policy engagement is one of the key drivers of NCA acceptance. Furthermore, the chapters in this document show that many countries and institutions have begun implementing NCA, but relatively few have effectively integrated NCA into public policy processes and the associated government "machinery." A key achievement of those countries with long-standing NCA programs, like the Netherlands, Sweden, and the United Kingdom, is that they have managed to build enduring links among the NCA users and producer communities. In each of these countries, there is a clear delineation of roles, with NCA production being undertaken in national statistical offices, and policy departments receiving the information. Over time, relationships have been built among producers and users of accounts and with the research community. This has helped bring credibility and legitimacy to NCA production, improving efficiency and aligning NCA producers and users.

However, those countries that have more recently begun NCA programs also have notable achievements. Botswana, for example, has institutionalized accounting within the Department of Water Affairs, and the importance of NCA is recognized at the highest levels of government. Costa Rica has institutionalized account production in its central bank and established collaborative mechanisms between the producers and users of accounts for water, energy, and forests. Colombia has institutionalized NCA production in the national statistical office, with NCA being explicitly mentioned in the 2014–18 National Development Plan. Indonesia is aligning its existing NCA production system to better meet the needs of climate change policy. Rwanda has developed formal processes for sharing data among government agencies and has used NCA information for water management. The Philippines has mandated the inclusion of NCA in mining policies. Finally, Guatemala's national development plan calls for the creation of statistical mechanisms to monitor its progress. It can be concluded that NCA is well placed to be a key navigational feature for adaptive, multi-issue policy making in the future, and will help better link institutions together for sustainable development.

Opportunities for NCA to improve policy decisions

The policy areas that NCA is particularly well-placed to inform are those that concern complex and dynamic links between the environment and the economy; concern many parts of government as well as business and civil society; are information and/or consultation intensive; and are high profile and/or include major policy or investment decisions. The papers point to three such policy areas:

- SDGs and the 2030 Agenda
- Green growth/green economy (GG/GE) and circular economy and
- Climate change.

NCA is "wired" to inform comprehensive, complex, and multistakeholder policy processes such as these. The policy demand for NCA can also be reinforced by the trend for improvements in regular cross-sectoral processes, such as national development planning, competition analysis, risk analysis, science-policy fora, environmental/biodiversity mainstreaming, review processes such as parliamentary commissions, and future-search and visioning exercises. Calls for more evidence-based approaches to policy also increase the need for integrated environmental-economic information that NCA provides. Countries cite international drivers as opening up such opportunities, such as Colombia with its aspirations to accede to the Organisation for Economic Co-operation and Development (OECD).

Next steps

First, greater collaboration between producers and users, in-country and regional, can generate the critical mass of expertise needed to promote, develop, and use NCA in policy and to have it broadly accepted by the public and private sectors. There is also clearly a role for continued collaboration at the global level, building on the first NCA Policy Forum.

Developing practical guidance documents is another priority. Guidance and associated capacity-building work could cover applying NCA to complex policy agendas, such as the SDGs, green growth, and nationally determined contributions (NDCs); using NCA to manage particular policy instruments, such as reducing emissions from deforestation and forest degradation (REDD+) or payments for ecosystem services (PES); applying NCA to analytical tools such as input-output and scenario modeling; communications work on NCA and especially its results, using infographics, case studies, messaging, and the like.

25 | Applying Natural Capital Accounting to Water Policy

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Summary

This chapter provides an introduction to key water policy areas and the concepts of full cost recovery and integrated water resource management to which natural capital accounting (NCA) has or could contribute. The discussion uses examples from Australia, the Netherlands, and Wealth Accounting and the Valuation of Ecosystem Services (WAVES) countries to illustrate some key points, which are likely to be relevant beyond the countries examined.

It is important to understand, that the limited freshwater resources on the planet require management through water policies that regulate the supply as well as the demand of multiple users. Freshwater resources are unevenly distributed in time and space. Reservoirs are used to manage water over time, but options for increasing water supply in dry areas are limited. Because water is a bulky good, the demand in one region cannot simply be addressed by supply from another region.

Water policy targets are set at different levels: globally (for example, through the Sustainable Development Goals [SDGs]), regionally (for example, European Water Framework Directive), as well as through national strategies and legislation. Water accounting is a helpful tool to analyze current water uses and related environmental and financial implications. Accounting helps in demand forecasting to assess the impact on the economy of reduced water availability and determine cost-effective options for increasing supply or reducing demand. Furthermore, it is a useful tool to model the impact of regulative measures on water use patterns and the impact of changing the price of water on the economy.

25.1 | Introduction

Several countries have experience or are experimenting with NCA for their water resources. This chapter summarizes the main water policy areas and outlines some key concepts used in these policy areas that are particularly amenable to being informed by NCA. This assessment is based on a range of experiences in a number of countries, spanning every continent and a variety of social-economic-environmental settings, in particular Australia, the Netherlands, and the five WAVES countries (Botswana, Colombia, Costa Rica, Madagascar, and the Philippines). The main points in this chapter are broadly applicable and hence useful for other countries beginning water accounting.

25.2 | Objectives of water policy

The amount of freshwater on earth is limited, and the demand by a variety of users is continuously increasing due to the planet's growing population and economy. Freshwater resources are unevenly distributed across regions, and the amount available varies significantly over time. Droughts and floods are extreme situations, with huge possible impacts on human well-being, the economy, and the environment. The quality and quantity of the available water resources are under constant pressure due to human activities, including the degradation of water-related ecosystems and climate change.

The World Bank report *High and Dry: Climate Change, Water, and the Economy* (World Bank 2016) suggests that water scarcity, exacerbated by climate change, could cost some nations up to 6 percent of their gross domestic product (GDP), spur migration, and spark conflict. The combined effects of growing populations, rising incomes, and expanding cities will result in an exponential increased demand for water, while supply becomes more erratic and uncertain. The World Bank (2016) report stresses the need to increase water security for all, as it is considered to be among the top global risks to development.

Water policy targets are set at many levels: globally (for example, through the Sustainable Development Goals), regionally (for example, European Water Framework Directive, Zambezi Watercourse Commission), nationally, and subnationally (for example, by river basin) through legislation and planning. In general, water policies ensure water security by satisfying four major objectives (see figure 25.1 and UNSD and WWAP 2011):

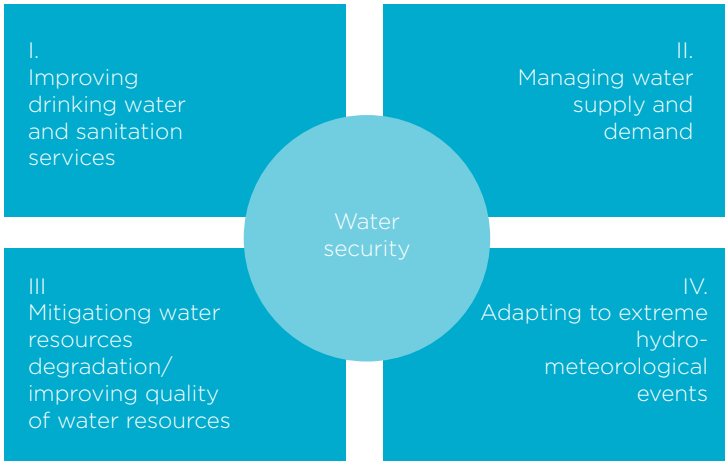
1. Improving and maintaining drinking water and sanitation services: This requires investments in infrastructure (water supply, sanitation facilities, and waste water collection, and treatment) and decisions on pricing of water services to ensure full cost recovery.

2. Managing water supply and demand: The policy options to manage supply and demand include regulations of water uses (for example, water permits, water use restrictions), education of consumers (awareness raising campaigns), increased water use efficiency and various technical measures to increase supply or reduce demand (building of dams, desalination plans, reducing leakages, and so forth), and financial incentives to save or reuse water.

3. Mitigating water resources degradation and improving water quality: The policy options include land protection (for example, for important aquifers of springs), regulation of the use of harmful substances (for example, nutrients and pesticides), and technical measures, such as reforestation.

4. Adapting to extreme hydro-meteorological events: Adapting to both extreme water scarcity and floods includes land management (for example, protecting or restoring natural flood prone areas), settlement planning, and different technical measures (transferring water from other areas, building wells, dams, and so forth).

Figure 25.1: Four major objectives of water policy



Source: UNSD and WWAP (2011).

These four objectives are also addressed by goal 6 of the SDGs (ensure availability and sustainable management of water and sanitation for all). It has the following targets:[1]

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women, girls, and those in vulnerable situations.

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.

6.6 By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes.

6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling, and reuse technologies.

6.b Support and strengthen the participation of local communities in improving water and sanitation management.

25.3 | How can NCA support water policy?

25.3.1 | Water accounting

NCA helps to understand the complexity of water-related issues by integrating information from different sources into a suite of connected accounts, including the following:

- Water accounts (physical and monetary supply and use tables, value and condition of water supply, and wastewater collection infrastructure)
- National accounts, and in particular, the metrics for the water supply, agricultural, and energy industries
- Land cover and land use accounts
- Environment protection accounts
- Ecosystem accounts (water provisioning and water filtration services)
- Energy accounts (important when there is significant hydro-electric power generation)
- And other accounts, such as agriculture, forestry, and fishery accounts.

WAVES uses the System of Environmental-Economic Accounting (SEEA; UN et al. 2014) as the underlying framework for its NCA application, with data originating from different sources (for example, water supply companies, household surveys, industry surveys) that are integrated in a globally standardized way. It allows for comparable data across countries (for example, for benchmarking or regional assessments) and helps to identify important data gaps. NCA provides a useful tool for demand forecasting and the assessment of the impact of reduced water availability on the economy. It also helps to model the impact of price changes on the economy (for example, increase of water price) and the impact of regulative measures on water use patterns.

NCA has proved to be especially helpful for the objective of managing water supply and demand. Brief examples of this are provided in section 25.4, but it must be understood that supply in a certain region is ultimately limited and that demand cannot simply be met by supply from other regions. With the physical water accounts, it can be monitored how much water is stored in groundwater aquifers and natural or artificial lakes, and how much water is demanded in other sectors or flows toward other regions or countries. Water accounts are helpful for keeping track of transboundary water issues. One of the roots of regional conflicts is often the competition for limited water resources (for example, in the Middle East and North Africa, AbuZeid and Abdel-Meguid [2006]). Moreover, water accounts are useful to follow water uses and emissions to water sources from various economic sectors, such as agriculture and energy production. So, the water accounts are used to consider important cross-cutting issues in the water-food-energy nexus.

To a smaller extent, NCA also supports the achievement of the other three major objectives of water policy (improvement in drinking water and sanitation services, mitigation of water resources degradation, and adaption to extreme hydro-meteorological events). The limitations are due to lack of consideration of the social dimension (for example, human health), water quality, and temporal and spatial disaggregation of the information (that is, considering seasonal and subnational phenomena, such as local or short-term water scarcities). To some extent, these are addressed through the emerging ecosystem accounting which has, among other things, a spatial underpinning and recognizes a broader suite of benefits to people than recognized in the SEEA.

25.3.2 | Use of NCA for two key policy concepts

Water accounts in particular provide valuable information for two of the key concepts that are on the basis of many water policies and that contribute to all four objectives: full cost recovery and integrated water resources management (IWRM).

Full cost recovery includes incentive pricing and applying the polluter pays principle. In the European Union, full cost recovery is specified in Article 9 of the Water Framework Directive, and member states often face a key challenge in setting up a functional pricing system that satisfies this requirement to an adequate degree while keeping water services affordable (EEA 2013).

Applying full cost recovery means that those providing water services (water supply, wastewater collection) should charge those using these services to cover costs, including:

- Direct costs (all capital and running costs)
- Externalities or the costs of dealing with public health or environmental impacts of water use and the discharge of wastewater (the polluter pays principle)
- Opportunity costs (the value of future sacrifices implied by current use).

To assess cost recovery, the following information is needed, which is provided by the water accounts:

- Water supply assets (expected life, performance profile and value of the built and natural infrastructure)
- Operating costs
- Water users (how much they use, what they use it for, how much they pay)

The second key concept is integrated water resources management, which is defined by the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Therefore, IWRM covers water for people, food, nature, and industry, and an enabling environment, with institutional roles and management instruments.

IWRM was recommended in the final statement of the ministers at the International Conference on Water and the Environment in 1992, and it has become a requirement to be globally implemented through SDG target 6.5.

For IRWM, the water accounts provide information about

- Water resources, users, and uses
- Water pricing, water supply assets, and operating costs
- Land, land use, and the environment
- Water quality and environment protection expenditure.

Table 25.1 shows the links between the four objectives and the corresponding natural capital accounts and key water policy concepts. The country examples mentioned in the table are discussed in more detail in section 25.4.

Table 25.1: Links between natural capital accounts and key water policy areas and concepts

Policy area	Key concept		Examples
	Full cost recovery	Integrated water resource management	
1. Improving drinking water and sanitation services	Physical and monetary water supply and use tables SNA accounts (with the emphasis of the water supply and sewerage industries) Environment protection expenditure accounts Water asset account	Physical and monetary water supply and use tables Land cover and land use accounts	Colombia, Costa Rica
2. Managing water supply and demand	Physical and monetary water supply and use tables Water asset account Land cover and land use accounts SNA accounts (with the emphasis of the water supply and sewerage industries)	Land cover and land use accounts Physical and monetary water supply and use tables Water asset account	Australia, Botswana, Colombia, Costa Rica, Madagascar, Netherlands, Philippines

Policy area	Key concept		Examples
Mitigating water resource degradation	Physical and monetary water supply and use tables (emphasis on return flows and operation on sewerage collection and treatment) Land cover and land use accounts Water quality accounts Environment protection expenditure accounts	Land cover and land use accounts Physical and monetary water supply and use tables Water asset account	Netherlands, Philippines
Adapting to extreme hydro-meteorological events	Land cover accounts Water asset accounts Environment protection expenditure accounts Ecosystem service accounts (for flood protection and regulation of water flows)	Land cover accounts Water asset accounts Environment protection expenditure accounts Ecosystem service accounts (for flood protection and regulation of water flows)	Philippines

Source: Developed by authors.

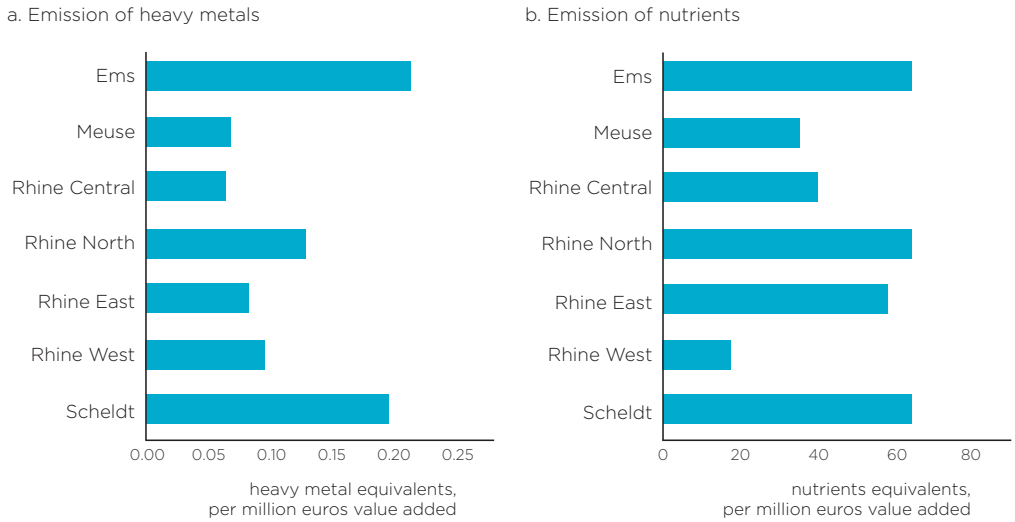
25.4 | Case studies

This section provides case studies from the Netherlands, Australia, and the five WAVES countries. These examples show how NCA is used for the key concepts IWRM and cost recovery (water pricing).

25.4.1 | The Netherlands

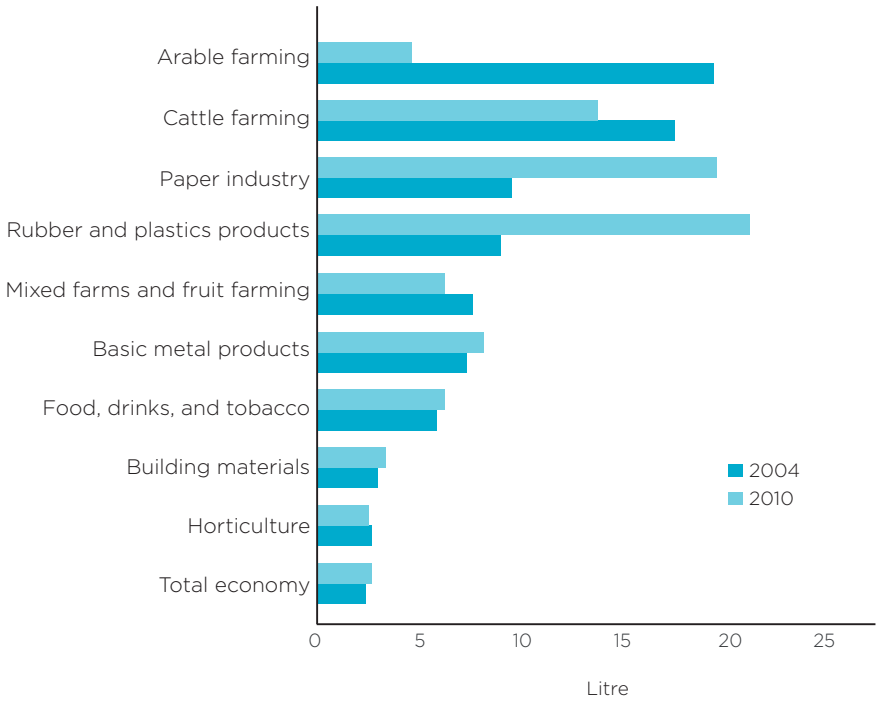
As a member state of the European Union, the Netherlands must achieve good status for all its surface water bodies according to the European Water Framework Directive (2000/60/EC), which is an example of a water policy to mitigate water resources degradation. Water accounts play an important role in the implementation of this directive. Examples for water accounts based information are the emission intensities for different river basins (figure 25.2) and the groundwater abstraction per-euro value added in different sectors (figure 25.3).

Figure 25.2: Emission intensity for different river basins for 2007, producers only



Source: Statistics Netherlands (2011).

Figure 25.3: Groundwater abstraction per Euro value added in different sectors



Source: Statistics Netherlands (2011).

The Netherlands uses the water accounts for the economic description of the river basins and the analysis of cost recovery. The use in selecting measures to achieve the objectives of the Water Framework Directive is limited due to scale and nature of these measures (see also chapter 16 of this document).

25.4.2 | Australia

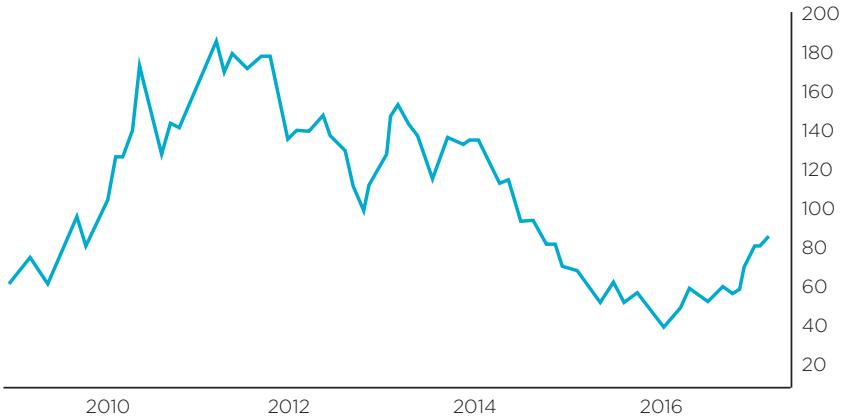
In South Australia, the Natural Resources Management (NRM) Act of 2004 is the primary legislation that regulates the use and management of natural resources. With respect to water resources, the NRM Act governs the development of Water Allocation Plans, which provide a formal water sharing arrangement for the natural water stocks, by allocating the right to access a share of the water resource on an ongoing basis. Water Allocation Plans are generally prepared in areas where water resources are scarce and are prepared by Natural Resource Management Boards (NRM Boards).

The NRM Act (section 76) dictates that Water Allocation Plans must set out principles used in the determination of water access entitlements (the formal rights to access the water resource) and for the taking and use of water so that there is an *equitable balance achieved between environmental, social, and economic needs for the water.*[2] In reality, balancing these often competing factors is far from easy. It requires an understanding of the value of water resources to the environment, society, and the economy, and also some understanding of the linkages between them. For example, consider two identical agricultural water users, each extracting the same quantity of water each year and generating the same economic output. One employs 15 people (Operator 1), the other (Operator 2) employs 5. From an economic efficiency perspective, as labor is an input cost, Operator 2 may be the more efficient operator. The economist may therefore prefer that water be allocated to Operator 2. However, there are strong social benefits to employment, and in this example, much of society may prefer Operator 1. While such trade-offs are difficult using environmental accounts alone, by adding in other social information, these decisions can be made much easier.

To inform their decision making, NRM Boards have engaged independent consultants to conduct analysis on the economic impacts of various water sharing scenarios. These scenarios include a range of volumes of water allocated to the water entitlement holders licensed in each region. The analysis used Australian Bureau of Statistics (ABS) data, including data from the water accounts (for example, ABS [2016]) on water use by industry type (including agricultural, commercial, domestic, and other industries). Other ABS economic data are used to highlight the economic value-added of the water used by industry type, as well as other ABS social data, such as employment by industry. Decisions can then be made, following a public consultation process, by the NRM Boards as to which scenario maximizes the benefits and are socially acceptable in the region at that time. The result is a water resource sharing regime that takes into account environmental, economic, and social objectives using evidence and a participatory decision-making process.

However, using water accounting information for this process has its limitations. For example, estimates of economic value derived from water use can fluctuate substantially for certain industries. In mining, for instance, commodity prices can fluctuate substantially from year to year (see figure 25.4). In agriculture, water used in irrigation can vary considerably from year to year, as in wet years, less irrigation water is needed. Such temporal changes in either the amount of water used by industry or the value of output of commodities produced need to be understood, hence single-point-in-time estimates from water accounts have limited usefulness. A time series of accounts can help show the long-term average of industry contributions and water uses and be used to understand particular times of stress or how demand might change with commodity prices.

Figure 25.4: Iron ore price, 2009–17 (US$ per ton)



Source: Trading Economics (2017).

The water accounts remain one of the best tools available in South Australia for allowing for such assessments as those required for the preparation of Water Allocation Plans, particularly through their linkages between environmental and economic information. Furthermore, market-based mechanisms such as water trading can provide effective tools to help correct for significant temporary adjustments to the value of water to an industry at a point in time. These tools can allow water entitlement holders to buy or sell their entitlements on either the permanent or temporary market in accordance with the value that they place on water.

25.4.3 | WAVES countries

All of the first five WAVES countries—Botswana, Colombia, Costa Rica, Madagascar, and The Philippines — developed either national or regional water accounts (Vardon et al. 2016). A range of policy applications of the water accounts to particular industries, regions, or issues were examined, and these are summarized in table 25.2.

Two of the examples, one for Botswana (Pule et al.) and one for Colombia (Romero et al.), are explored more fully in other chapters of this document (chapters 7 and 9, respectively).

Table 25.2: Summary of use or potential use of water accounts in WAVES countries

Country	Issue	Year	Reference
Botswana	Mining	2015	WAVES Policy Briefing, https://www.wavespartnership.org/en/knowledge-center/policy-briefing-water-resources-and-mining-botswana
	Water use efficiency Water allocation	2015	WAVES Policy Briefing, https://www.wavespartnership.org/en/knowledge-center/policy-briefing-sustainable-equitable-and-productive-use-water-through-water
	Wildlife water use	2017	Pule et al. (chapter 7, this publication)
	Water management	2017	Pule et al.(chapter 7, this publication)
Colombia	Regional water planning in Lake Tota and Chinchina		Vardon et al., https://www.wavespartnership.org/en/knowledge-center/achievements-and-lessons-waves-first-5-core-implementing-countries
	Water pricing	2017	Romero et al. (chapter 9, this publication)
Costa Rica	Water pricing Infrastructure investment	2015	WAVES Policy Briefing, https://www.wavespartnership.org/en/knowledge-center/policy-briefing-water-accounts-inform-policies
Madagascar	Access to water Water use efficiency	2016	Madagascar Comptes Eau, https://www.wavespartnership.org/en/knowledge-center/madagascar-comptes-eau
Philippines	Flood mitigation Water quality	2016	WAVES Policy Briefing, https://www.wavespartnership.org/en/knowledge-center/policy-briefing-ecosystem-accounts-inform-policies-better-resource-management

The WAVES countries applied accounting for water pricing or water management. In all cases, information was missing on the value of water supply and sanitation infrastructure, thus the determination of full cost recovery was hampered.

The use of water accounts for the management of industries or areas was clearly evident. These were areas of limited water availability and increasing demand (for example, for Lake Tota and Chinchina in Colombia) or areas with water quality concerns limiting supply (for example, in Laguna de Bay in the Philippines). The use of the accounts for understanding and managing the water demand of particular industries was evident in Botswana, Colombia, Costa Rica, and Madagascar. The focus was generally on agriculture, typically the largest consumer of water, but Botswana, which is a water-scarce country, also used water accounts to examine the dependence of the mining sector and wildlife tourism on water.

25.5 | Final remarks

Water accounting has been undertaken in range of countries around the world. This initial review has shown that accounts can inform a range of water policy issues, including the important notions of full cost recovery and IWRM related to managing water supply and demand. In most cases, accounts have lacked full information and, in particular, information on the economic aspects of the value of infrastructure and estimates of the damage

caused to the environment from pollution, thus limiting their ability to fully inform full cost recovery for mitigating water resource degradation.

The broad range of experience, spanning low- to high-income countries with high and low water availability (for example, Botswana to the Netherlands), demonstrates that accounts can be prepared and clearly indicate where they could be useful for decision makers. Explicit, direct use of accounts in decision making for water is still uncommon, but the signs are encouraging. There are examples from the Netherlands and Australia, two countries with long histories in the production of water accounts and their use in decision-making processes. There are likely to be others, particularly in Europe (for example, Sweden and the United Kingdom) but also in other places (for example, Mexico).

Uses of accounting for water policy and management are emerging from WAVES countries, and the water SDGs provide an excellent opportunity to demonstrate the potential of the accounts, not just for monitoring the SDGs but also for achieving the targets. Adding additional information on economic values and further analysis of data in the accounts (for example, scenario modeling) will increase the usefulness of the accounts and should lead to a broader use of NCA in water policy.

25.6 | References

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25.7 | Endnotes

1 https://unstats.un.org/sdgs/indicators/Official%20Revised%20List%20of%20global%20SDG%20indicators.pdf.
2 https://www.legislation.sa.gov.au/LZ/C/A/NATURAL%20RESOURCES%20MANAGEMENT%20ACT%202004/CURRENT/2004.34.UN.PDF.