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Advancing natural capital accounting in Rwanda

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Acronyms and Abbreviations

GDP Gross Domestic Product
GPS Global Program for Sustainability
LAIS Land Administration Information System
MINECOFIN Ministry of Finance and Economic Planning
MOE Ministry of Environment
NCA Natural Capital Accounts
NST National Strategy for Transformation
NISR National Institute of Statistics of Rwanda
NLA National Land Authority
RCMRD Regional Centre for Mapping of Resources for Development
REMA Rwanda Environment Management Authority
RMB Rwanda Mines, Petroleum and Gas Board
RFA Rwanda Forestry Authority
RWB Rwanda Water Board
SDGs Sustainable Development Goals
SEEA System of Environmental Economic Accounting
SNA System of National Accounts
UN United Nations
UPI Unique Parcel Identifier
WAVES Wealth Accounting and Valuation of Ecosystem Services

1. Introduction

Over the past decade, Rwanda, known as the Land of a Thousand Hills, has embarked on a transformative journey toward environmental conservation and efficient natural resource management. The nation's rich biodiversity—which includes national parks, forests, wetlands, and lakes—is a testament to its dedication to preserving its natural heritage. Environmental and natural resource conservation have been well integrated in country's development blueprints, such as Vision 2020 Economic Development and Poverty Reduction Strategy, Vision 2050, and the National Strategy for Transformation (2018–24).

Rwanda is poised to grow the economy while wisely managing the natural resources that contribute to economic development. An important milestone was the adoption of the Green Growth and Climate Resilience Strategy (GGCRS) in 2011, with the aim to be a developed, climate-resilient and low-carbon economy by 2050. The GGCRS was updated in 2022 to ensure it continues to serve as a relevant, effective, and implementable guiding national document.

To this end, Rwanda is also looking to continue its successful bid to develop Natural Capital Accounts (NCA). Natural Capital Accounting is an approach for analysing trends and trade-offs in the use of the country's land, water, minerals, and ecosystem assets. Natural Capital Accounting can add value in the development planning process, inform economic and statistics departments, and raise attention on economically important natural resource sectors. NCA follow the principles of the System of Environmental Economic Accounting (SEEA), which applies similar principles and standards as the System of National Accounts (SNA). The SEEA was adopted as an international standard by the UN Statistical Commission in 2012, and is implemented by nearly 100 countries (UN, 2023). The alignment to the SNA allows data on land, water, and other resource uses like energy and environmental outcomes to be directly linked to information on economic activity, value-added, and employment for each sector.

Rwanda was one of the pioneering countries in Africa to develop NCA. Joining the World Bank Wealth Accounting and Valuation of Ecosystem Services (WAVES) Global Partnership in 2013, Rwanda developed accounts for land, water, minerals, and ecosystems, along with analyses and tools such as the Land Use Trade-Off Tool (LUTOT). The minerals accounts are updated annually, however the other accounts have been discontinued.

The development of NCA in Rwanda was guided by a steering committee first established in 2013 (World Bank, 2015). The Committee was led by the then Ministry of Natural Resources. Members were from the Ministry of Finance and Economic Planning, Rwanda Environment Management Agency, the Ministry of Infrastructure, National Institute of Statistics of Rwanda, Rwanda Development Board, and the Wildlife Conservation Society. Technical Working Groups were formed to develop and produce the various accounts.

The purpose of this document is to outline a path towards institutionalising NCA in Rwanda. Country experiences from the WAVES and GPS programs show that it is more efficient to start with a few key accounts that are relevant for specific policy needs, where data are available and data processing systems are in place. This follows two criteria for good statistical practice: to focus on the needed and achievable, using existing statistical foundations and providing clear reasons to build on them. Following discussions with GoR, it was decided to focus this assessment on the following three areas:

1. Land use planning and SDG 15,
2. National Water Master Plan and SDG 6,
3. Integrating environmental variables into the CGE models developed in MINECOFIN, potentially focusing on climate change-related variables.

The document describes the achievements, challenges, opportunities and next steps for institutionalising NCA. It has been developed in consultation with agencies of Rwanda's government.

2. Accounts and data availability

This chapter describes the accounts produced to date, and the availability of data to continue to produce the accounts and potentially expand them for the three priority areas. Mineral accounts are included in the description of available accounts, but as they are already in regular production they are not included in the rest of the report.

2.2 Land and ecosystems

Land and ecosystem accounts produced

Land use accounts at the national and provincial level were developed for 2012-2015. The preparation of the land use accounts was aided by the Rwanda's Land Administration Information System (LAIS), which covers 11 million land parcels and just under 2.1 million hectares of land. In addition, land cover accounts were developed using satellite data from Regional Centre for Mapping of Resources for Development (RCMRD), for the years 1990, 2000, 2005, 2010 and 2015 (Government of Rwanda, 2018). The land accounts were prepared jointly by the National Institute of Statistics, Ministry of Environment and Ministry of Lands and Forestry with assistance from the World Bank WAVES. Key insights included that 70% of Rwanda's land is used for agriculture or forestry, there was a substantial shift from forest cover to cropland and a rapid rise in residential or industrial areas, particularly in the period 1990 to 2000.

Ecosystem services supply for soil- and water related regulating services for 1990-2015 were developed using the InVEST modelling platform (Government of Rwanda, 2019 b).¹ This was based on the land cover accounts. The ecosystem services include soil retention, sediment transport, and water yield: baseflow and quickflow. The model gives as a result the ecosystem services potential, irrespective of whether the services are used or not. The definition of ecosystem services in the SEEA is "*the contributions of ecosystems to the benefits that are used in economic and other human activity*".² Thus, to compute ecosystem services accounts, demand for the services also need to be estimated, and subsequently be balanced so that supply equals demand. This is yet to be done to form a set of ecosystem accounts for Rwanda.

Data availability - land

The Land Information System (LAIS) has been in place since 2012. LAIS holds spatial data, administrative data and records information about land and its ownership, use, and transfer. Land use plans are integrated into LAIS. Each land parcel has its land use according to zoning guidelines. Annual snapshots from LAIS are available since 2013. LAIS integrates social data (e.g. number of women owning land) and registers land market prices. LAIS data can be extracted from the Land Dashboard [Rwanda Land | Dashboard \(lands.rw\)](#). LAIS is used for various purposes by many stakeholders, including the Irembo platform for online land services, Rwanda Housing Authority for construction permits, Rwanda Revenue Authority for tax collection and Rwanda Development Board for mortgager registration purposes. The land accounts development influenced LAIS both in terms of its data structure and the way land valuation data are captured (see section 2.2).

Data on land cover has improved since 2019. There are land use/land cover maps up to 2020, with data back to 1990. Roads are currently identified via remote sensing. NLA and Rwanda Transport Development Agency (RTDA) regularly share shape files for road reserves. There is a newly developed Kigali Road Asset management supported by Japan International Cooperation Agency (JICA) which provides updated data on roads.

Spatial data can be accessed on the [Rwanda Spatial Data Hub \(geodata.rw\)](#) under the spatial data window including environment, flood risk areas, Wetland areas, National Parks, Land Slide areas. Other themes like hydrographic, elevation and infrastructure are also accessible on the Rwanda SDI hub.

Rwanda's seasonal agricultural surveys can also provide relevant data. Natural resources are not yet included in any of the surveys. In 2018-19, a forest cover mapping was done and published (MoE, 2019). This provides more detailed information on forest cover than previously available, at national, provincial and district level.

Districts develop their own land use plans, guided by the NLUDMP. So far 13 out of 30 districts have developed land use plans (DLUPs). Spatial data for District Land Use Plans (DLUPs) are collected with tools such as Garmin GPS, DGPS, Earth Collector, SW Maps. The elaboration of

¹ InVEST® is a suite of free, open-source [software models](#) used to map and value the goods and services from nature that sustain and fulfill human life. [InVEST | The Natural Capital Project \(stanford.edu\)](#)

² [seea ea white cover final.pdf \(un.org\)](#), section 6.2.1.

DLUPs also requires data collection from a range of agencies, including forestry from RFA, the water supply system and associated future projects from WASAC, electricity data from REG, tourism data from RDB, transport data from RTDA, rural settlement boundaries and urban master plans from RHA, wetlands and their buffer zones from REMA, rivers, lakes and other water bodies from RWB and many others. The accumulation of these spatial data and projects provides a basis for data collection on the ground and provides detailed information for zoning and subsequent implementation support. DLUPs are currently available for 13 districts.³

2.3 Water

Water accounts produced

The water accounts were developed for the years 2012-2015 (World Bank, 2021). They include water supply and use accounts in physical terms and water assets accounts. Sectoral indicators for water efficiency and water productivity were computed. The water accounts showed that in the period 2012-2015, water use efficiency (SDG indicator 6.4.1) increased by around 13%. The efficiency increase was highest for industry and the services sector, and agriculture reached an efficiency gain of about 10%. The level of water stress (SDG indicator 6.4.2) was still low but increasing. Expected water demand for 2040 is about a third of the estimated annual inflow. Yet, as spatial and seasonal variation of these inflows is large, it is expected that supply is not always and everywhere sufficient to match demand, pointing to the need for seasonal water accounting, to inform water policies and investments in water infrastructure.

The water accounts estimated that 96% of the water is used by agriculture., and that this is mostly for low value crops, which are essential to the country's food security and the rural economy. However, most agriculture is rain-fed (80%), depending on soil water instead of ground or surface water which is used for irrigation schemes. As such, current agricultural water use does not directly compete for the water needed for drinking water, energy or industry. Drinking water mostly comes from groundwater sources. The water utilities, taking around 10% of the groundwater withdrawals, supply a small part of the population, especially a part of the urban population. 80% of groundwater withdrawals are made directly by rural households (e.g. from wells). This information has informed irrigation planning and water fees.

Data availability - water

For water, the Rwanda Water Portal has been established.⁴ This includes data on surface water, ground water, water quality and water users and well administrative forms and procedure, current laws and historical planning and policies documents (the Integrated Strategic Water Resources Planning and Management for Rwanda and the Water Supply and Sanitation Master Plans are not included), training materials and access to models and tools.

³ [NLA: Master Plans \(lands.rw\)](#)

⁴ <https://waterportal.rwb.rw/>

This portal was established to facilitate the access to information related to water in Rwanda. However, not all data included in the portal is publicly available and some information is outdated.

There is a need for a clear data update plan to inform water management. RWB has commissioned the development of Water, Sanitation and Hygiene (WASH) Management Information System (MIS). The WASH MIS is a web-based software that will support management of WASH data from all national districts including data collection, entry, validation, structuring and storage.

The Water Supply and Sanitation Master Plan covers the period up to 2050 and has been updated in 2023⁵. It has static data. The agricultural classification is being changed, and there is a need to analyse the impact of industry on water demand and sanitation. The water treatments plan takes population growth into accounts. As rainfall and water supply varies greatly across the country, investments in water infrastructure is needed. Irrigation has expanded quite a lot in recent years to a fine catchment level (2.5).

NISR published “Rwanda Demographic and Health Survey: Water, Sanitation and Hygiene 2019/2020” in 2023, where indexes on water, sanitation and hygiene progress are computed, providing information to report on SDG 6.1 and 6.2.⁶ Together, they allow for forming a WASH index (NISR, 2023).

For water pricing, market water prices can be applied for some purposes. Rwanda has a water permitting system, but not all use licensed water, so water fees are only partial. An independent regulator, RURA, sets the water prices. Prices are based on cost recovery plus a low profit margin. Depending on the purpose, other ways to value water can be used.

RWB has a long-term financing model (up to 2030), the WEAP (Water Evaluation and Planning) model, which is a macroeconomic model based on the SAM, similar to what MINECOFIN has. WEAP is a software tool for integrated water resources planning developed by Stockholm Environment Institute (SEI). Researchers from SEI and World Bank Group used WEAP and macroeconomic analysis to determine how water efficiency and storage measures can sustainably support Rwanda’s economic growth, taking into account that rising temperatures and more prolonged dry spells threaten crop production and strain water supply.

The available data from the water data portal of surface water, groundwater, and water quality, combined with an assessment of the information included in Rwanda’s main policy and planning documents and consultation with stakeholders suggests that there is sufficient data to allow for regular compilation of water supply and use accounts, and to develop water quality accounts, for the nation and probably at subnational levels.

⁵ [Rwanda - National water supply and sanitation master plans \(afdb.org\)](https://afdb.org/water-supply-and-sanitation-master-plans)

⁶ 6.1 Achieve universal and equitable access to safe and affordable drinking water for all.

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

2.4 Minerals

Mineral accounts for the “three Ts”, cassiterite, wolfram and cobalt, were first compiled for the period 2012-2015 under the WAVES program (Government of Rwanda, 2019 a). Since then, they have been updated annually by NISR. There is thus a time series available for 2012-2022, both in physical and monetary terms. The result showed that the resource rents from mining was negative for the period 2012-2015, mostly due to low prices and system-wide production inefficiencies. From 2016 onwards, resource rents have been positive (see section 2.2).

The 2019 mineral accounts report also included a compilation of studies and data on environmental implications of mining in Rwanda. In addition, a Land-use Trade-off tool (LUTOT) was developed for Rwanda to assist decision-making with respect to land-use options. The LUTOT tool itself is not publicly available, but a case study using the tool was presented in the Annex 4 of the Mineral Accounts Report (Government of Rwanda, 2019 a).

The 2019 mineral accounts report concluded that only a marginal increase of unit prices was required to turn the negative rents to positive, and that there was much scope for such price increases as the differentials between the unit prices of the minerals received and that of the international metal prices are vast. Indeed from 2016 onwards, the resource rents have been positive, albeit at a low level. The report provided recommendations based on the mineral accounts, but also several workshops held during 2018 and 2019 with the technical working group comprising members of RMB and NISR. The focus of these workshops was to ascertain what is needed to improve the efficacy of the mining sector to achieve its growth objectives and to contribute to the Rwandan economy. The recommendations included aspects such as mining structure, investment needs, environmental management, health & safety and data management.

The mineral accounts report furthermore stressed the need to address the environmental management practices and to enforce the environmental legislation actively, as the environmental impacts of mining pose multiple risks to human health, livelihoods, and economic development. The restoration of mined land can largely be considered as ecosystem reconstruction in order to re-establish the capability of the land to capture and retain fundamental resources. It was noted that it is important that the mining companies follow the national planning guidelines for mining strictly during the phase of mineral exploration and exploitation (MINIRENA 2017).

2.5 Greenhouse gas emissions

For including climate change mitigation aspects into the macroeconomic model of MINECOFIN, data on GHG emissions are needed. REMA compiles data on GHG emissions for five major sectors: Energy and transport, Industrial processes and product use, Agriculture, Forest, and other Land uses (AFOLU) and Waste and wastewater. This is reported in the

National Greenhouse Gas Inventory Report (Republic of Rwanda 2021). In this latest inventory, recalculations of the GHG emissions by sources and removals by the sink were conducted to update the Greenhouse Gas emissions inventory submitted previously, and the period 2016 through 2018 was added to increase the coverage of the inventory, which is 2006-2018. The reported GHG emissions and removals estimates were calculated using the 2006 IPCC guidelines through the latest IPCC software.

Data on GHG emissions developed by environmental agencies usually follow the IPCC guidelines, just as described above for the case of Rwanda. This however creates a problem when assessing the impacts on economic actors from policy interventions, eg. introducing or revising taxes or subsidies. In the National Accounts and the SEEA, emissions are allocated to the using economic actor, so energy used for transports and machinery in agriculture is allocated to agriculture, not to the energy sector. Accounts also allow for including emission data in economic models, such as Input-Output models and Computable General Equilibrium Models, which are used for macroeconomic analysis. To integrate the GHG emission data into the Rwanda-MANAGE model, it would thus be useful to compile GHG accounts. To assess the feasibility of this, further information about data availability would be needed, but it is likely that it could be done relatively easily, through using energy statistics or emission factors.

3. Challenges and development needs for NCA

NCA is not possible without data, and data availability is perhaps the biggest challenge for NCA. It is both a question of actual lack of data and of accessibility of available data. The lack of data that is needed for efficient management and planning calls for a long-term statistical plan to increase data collection and compilation. Other challenges faced by many countries, include lack of on-going high-level leadership, coordination, a lack of dedicated resources and capacity for account compilation, data deficiencies, poor communication of accounts, a focus on account production rather than use and limited understanding of NCA by potential users. To institutionalize NCA in Rwanda and ensure efficient production and use of the accounts, some such challenges need to be addressed.

3.1 Data and tools

Data accessibility is an issue in Rwanda, as in many other countries. Data are spread across a number of agencies. Some data are accessible via publications or online, but some data are only available upon request, which limits their use. Some data are not shareable for legal reasons (e.g., protecting confidentiality). Specific gaps in national data sources were identified for non-timber forest products, water and energy use, air emissions (including GHG) by economic sector (rather than the UNFCCC activity-based classification). The latter highlights the use of different classifications and standards used by data agencies. Another example is accounting for forests, which can vary across sectors as they use different definitions and classifications according to the specific needs of the sector, creating confusion and lack of coherence.

The land accounts report from 2019 raised some general challenges, including the following:

- Consistency of definitions. Land use designations are neither consistently, nor narrowly defined, so that in application, there is variability in how parcels are classified.
- Because LAIS is a land administration database there may be places where the actual uses of land on the ground do not match the coding in the database (or where the coding does not accurately describe the land use, e.g., commercial activities). With the recent District Master Plans in place, the issue of land use change can be captured in LAIS, assuming that the land use master plan implementation is monitored effectively.
- In terms of data quality improvements for the future, there may be a rationale to add some land use categories to LAIS. These additional categories could help to clarify land usage on the ground in greater detail and to record additional items such as roads, infrastructure, rivers, reserves and buffer zones. Mining may be considered as an important enough land use to warrant its own LAIS category.

An issue encountered when compiling water accounts is that multiple agencies have partial mandates over different aspects of water resource management, abstraction, treatment, distribution, and valuation. These use different information systems, data sets, collection processes, and indicators of success, and each of them has specific issues of data quality and gaps. This made the task of compiling the water accounts quite complex and time-consuming. Having harmonized data and data systems will be key for streamlining the compilation of accounts, and, more importantly, enable sector agencies and policy makers to get an overall grasp of the water sector.

3.2 Capacity

Capacity, understanding and interest in NCA has increased in GoR since the first accounts were developed in the period 2013-2019. However, only a limited number of people has the technical skills to develop and update the accounts and the knowledge and capacity might be lost over time and with staff overturn. For sustainability and institutionalization of NCA there needs to be larger pool of staff who is knowledgeable of NCA both at a deep technical level and at a more general level, so that results are understood and can be used. Capacity building should include general training on the SEEA as well as specific training on the chosen accounts. In addition to shorter training courses, on-the-job training will be important.

To increase NCA understanding across the whole of government, it is recommended that experts in analytical units in MoF, MoE and MoA receive general training in NCA, providing an understanding of what NCA is as well as examples of policy applications.

Land and ecosystem accounts require expertise in GIS. There is capacity in GoR for spatial data, including both hardware, software and expertise. NLA has a unit of 10 GIS experts, and there are GIS experts in other agencies. Training of additional staff may be needed. While satellite imagery was previously sourced from the Regional Centre for Mapping of Resources

for Development (RCMRD), these are now provided by the Rwanda Space Agency, established in 2020.

Ecosystem accounts require expertise beyond what is usually found in a national statistical office. To review and provide quality assessment of ecosystem data, an understanding of ecosystems is required. In addition, estimating regulating ecosystem services requires expertise in biophysical modelling, which is outside the remit of NSOs. General biophysical models like InVEST and ARIES could be housed in the EPA, NLA or another agency. Hydrological models like SWAT are usually found in water agencies. WASAC gets help from hydrologists with GIS analyses. While there is GIS expertise in many agencies in Rwanda today, especially in NLA, there is currently no expertise in biophysical modelling in government agencies.

Macroeconomic modelling is used by Ministries of Finance to analyse economic policies and future scenarios to inform economic and development planning. This requires specific expertise and dedicated staff. Integrating natural capital data and linkages calls for collaboration with experts from these environmental sectors. Developing an environmentally extended macroeconomic model will require both capacity building and adequate staffing to be a sustainable contribution to green growth policy development.

3.3 Understanding and communication of NCA

Senior officials from a range of agencies in Rwanda expressed support for NCA, including MINECOFIN, MoE, NISR, NLA, RFA, RWB and WASAC. Similar support was also evident in the production of the first suite of accounts produced under the World Bank's WAVES program. The challenge is to ensure widespread and continuous high-level support for NCA production and use. Widespread support is essential so that NCA does not rely on individual champions.

Use of NCA requires understanding of NCA. The multidisciplinary nature of NCA and the complexity of the accounting system means that few in government or private sector have a detailed NCA understanding. Communicating the fundamental features of NCA to non-specialist audiences is important, as well as extracting information from the accounts that suits the needs of different stakeholders. This requires diagrams, indicators and interpretative commentary beyond what is usually provided with the national accounts. With increased understanding, accounts can be co-designed and tailored to the needs of decision-makers. Increased understanding and co-design should also lead to greater trust in the accounts, which is important as the accounts will sometimes deliver bad news.

3.4 Cross-agency coordination

Formal coordination between data agencies is essential for NCA. The process of producing the accounts for policy promotes understanding between account producers and users, encourages different information agencies to work together, identifies data gaps that can be prioritised, permits targeted capacity building, and ult.

Rwanda has multiple agencies holding environmental or economic data. Each agency has its own mandate and systems designed to produce information. Combining and repurposing existing information for NCA and plugging data gaps requires not only coordination but also

dedicated resources. NCA production cannot be done in “spare time” and building the capacity of NCA teams is important. NCA is multidisciplinary, requiring knowledge of environmental and economic data, accounting, biophysical and economic modelling and how NCA can be applied to policy and planning.

4. Policy relevance and uses of NCA

4.1 Use of NCA to date

Rwanda’s first round of natural capital accounts have been used in several ways by government. This includes examining key policy issues and international reporting. For example, land and water accounts have been used in international reporting of the SDGs (see section 3.2). Key policy applications are highlighted below.

Uses of land accounts

There were a range of policy insights from the land accounts (World Bank, 2021). The 2018 land accounts were a key input to the modelling of ecosystem services with the aim of assessing food security and the impacts of land cover change on hydropower.

The land accounts influenced Rwanda’s Land Administration Information System (LAIS), both in terms of its data structure and the way land valuation data are captured. Land use definitions and classifications are being revised to reflect better ground-level understanding of land use. Perhaps more importantly, the Rwanda government is using the land cover accounts in its review of the National Land Use Development Master Plan (NLUDMP), with a focus on areas where land use and land cover are changing rapidly⁷. NLUDMP utilizes land use and land cover change data from the accounts to target areas for special emphasis in the planning process. NLUDMP also uses the ecosystem services modelling results which are discussed below.

The land accounts were further used as a basis for compiling pilot ecosystem services accounts using the InVEST model.⁸ Carbon storage, sediment regulation, and water yield was estimated for the years 1990, 2000, and 2010 (Government of Rwanda, 2019 b). Results showed that while many ecosystem services declined from 1990 to 2000, they rebounded, to some extent, from 2000 to 2010. Preliminary results for 2015 however indicate a decline in ecosystem services, driven largely by continued forest loss. Patterns differ across the country depending on how key model inputs vary in space (e.g., climate, land cover, elevation, soils, vegetation).

⁷ WAVES Annual Report 2018 https://www.wavespartnership.org/sites/waves/files/kc/WAVES-Annual-Report-2018-web_0.pdf

⁸ InVEST | The Natural Capital Project (stanford.edu)

Uses of water accounts

A range of policy uses and insights emerged from the Rwanda's water accounts and were related to the increasing pressure on resources from population growth, agricultural intensification, urbanization and industrialization. These result in increasing competition for water which is exacerbated by more volatile rainfall patterns due to climate change (World Bank, 2021). It is expected that water availability will be constrained in many river catchments over the coming decades because of declining water availability and increasing water demand. Significantly, the water accounts were used in the Integrated Strategic Water Resources Planning and Management for Rwanda. They were highlighted in the introduction and used in the technical detail supporting the strategy, including the cost-benefit analysis used to assess investment options. Information from the accounts has informed irrigation planning and water fees. The water accounts have also been used to improve the FAOSTAT WaPOR database, FAO's portal to monitor Water Productivity through Open access of Remotely sensed derived data.^{9, 10}

WASAC published policy briefs on Water pricing, Water efficiency, and Water allocation (source and purpose to be added).

4.2 Policy demand for NCA

Cross-sectoral strategies

Several high-level strategies are currently up for renewal. This provides a timely window of opportunity for updating and expanding on the work on NCA that Rwanda started in 2013. The two most important strategies in this regard are the **National Statistics Development Strategy 4** (NSDS4) and the first **National Strategy for Transformation** (NST1) and its successor NST2.

The NSDS4 is currently being finalized. There may be space to include NCA, given that 1) there is solid commitment from key line agencies to provide necessary data and expertise 2) concrete input to the NSDS4 document is provided in the first week of June at the latest.

The NST1 ends in December 2024. The development of NST2 is ongoing, which leaves scope to include natural capital to be mainstreamed into the strategy. There are also several sectoral strategies and plans that would benefit from NCA, which are listed below.

Green Growth – linkages between economy and environment

Rwanda adopted the **Green Growth and Climate Resilience Strategy (GGCRS)** in 2011, with the ambitious goal of becoming a developed, climate-resilient, and low-carbon economy by 2050. It has recently been revised, and includes the following objectives:

- Guide national policy and planning in an integrated manner.

⁹ Verba communication, RWB.

¹⁰ [FAO WaPOR](#)

- Mainstream climate change considerations across all sectors of the economy.
- Position Rwanda to access international climate funding and investment.
- Enhance Rwanda's Nationally Determined Contributions (NDC) Climate Action Plan, with a target to reduce emissions by 38% by 2030 compared to business as usual.

NCA can support this strategy in a number of ways. Integrating data on supply and demand for natural resources (eg water, minerals, timber) from the accounts into the CGE model being developed by MINECOFIN will enable analyses of environmental impacts from economic policies and vice versa. To inform climate mitigation measures and include this aspect into economic analysis, GHG emission accounts would be needed. This can be used to assess the trajectory towards reaching NDC target and to analyze the impacts of various policies to reduce GHG emissions, including their impact on the economy.

For climate change adaptation, a range of impacts need to be taken into account. Land, water and ecosystem accounts together provide a solid and consistent basis for analyzing impacts from various interventions. Integrating water accounts into the CGE model would again enable GoR to analyze the impact of policies and investments on the economic sectors, as well as to assess future water demands by economic actors. Spatial scenario analysis of the impacts of changes in condition and ecosystem services can be done using a biophysical models. An example is the currently ongoing Volcanoes Community Resilience Project (VCRP), where an analysis is being done to identify areas within the VCRP sites that will support livelihood diversification for targeted communities as well as opportunities for (a) generating ecosystem services, and (b) generating them for stakeholders able to purchase the ecosystem services. A key part of this analysis is done using the InVEST model.¹¹

It could be interesting to investigate possible interlinkages between Rwanda-MANAGE and RWB's WEAP (Water Evaluation and Planning) model, to find if there are possibilities for sharing data or doing cross-analysis with the models.

Land use plans and strategies

The main policy document guiding land use in Rwanda is the **National Land Use and Development Master Plan (NLUDMP)**, which is a countrywide plan for 2020-2050. It stems from Vision 2050 which envisages the effective use of land for the country's economic development, and includes sectoral strategy plans and national directives on land use. It analyses land use needs for each type of land use, including agriculture, settlements, tourism and natural resources. The NLUDMP includes a forward-looking land use balance sheet. The proposed land use balance aims to achieve a reasonable balance between arable land, natural resources, roads and built-up areas, while fulfilling the targets of Vision 2050. The objectives of the management of environment and natural resources include to preserve all natural forests, ensure effective stormwater management for all new projects, promotions of green energy use, ensure erosion and sediment control, protection of buffer zones, and that the environment and natural resources program should ensure adoption of green growth

¹¹ [InVEST | The Natural Capital Project \(stanford.edu\)](http://InVEST | The Natural Capital Project (stanford.edu))

approaches. Furthermore, the plan includes the undertaking of a cost-benefit analysis of mining activities in relation to their impact on the environment.

The Sector Strategic plan up to 2023 did not make use of or promote NCA. The Sector strategic plan 2024-2029 is under elaboration and expected to be validated by end of May 2024. One of four priorities under the land sub sector is related to NCA: *Improve land valuation and geospatial information to inform natural capital accounting and to mitigate land market speculation.*

As described in section 1, an important contribution of land accounts is to provide the basis for analysis of ecosystem condition and services accounts. NLUDMP describes the contribution of different ecosystems and proposes recommendations to ensure sustainability of vital ecosystem services such as soil retention and water regulation. However, the contributions of regulating and cultural ecosystem services of the land are not quantified, either in physical or monetary terms. Updating the land cover accounts and develop a set of ecosystem accounts would allow for measuring the contributions of ecosystem services to different land uses and economic sectors, such as water regulation, sediment regulation and carbon sequestration. Including the environmental impacts, the sign of the resource rents may again shift. Ecosystem accounts could provide estimates of these impacts.

Land accounts, as well as ecosystem accounts, could be a significant source of data for both NLUDMP, sector strategies and district land use planning moving forward, providing a consistent data base for both national and subnational land use planning. Land use and land cover accounts provide an overview of the use of land across the country in tabular format. District-level accounts would provide a common monitoring framework and a basis for analysis at the district level. These would be generated centrally, to be ground-truthed by the districts. Having the data in accounts format rather than as shapefiles would simplify the integration of information on land use with other aspects that the DLUPs need to include to ensure that they align with Vision 2050. The accounts could then be used both for monitoring and forward-looking analyses.

Forest Plans and Strategies

The **Forest Sector Strategic Plan** ends in 2024, and a new plan is developed for the period 2025-2030. The plan includes a number of objectives, of which several could be informed by land, forest and ecosystem accounts. These include to ensure Sustainable Forest Management through the establishment and implementation of integrated forest management plans at all levels, to develop and implement appropriate regulatory instruments to ensure sustainable and efficient biomass supply and to enhance biodiversity and ecosystems services and values in accordance with national and international agenda. In addition to the strategic plan, the **Forestry Research Strategy and Guidelines for Rwanda** also expires in 2024. Among many other objectives, the research strategy for 2018-2024 includes to provide “An evidence base for the delivery of resilient natural forest ecosystems and biodiversity to enhance multiple benefits for Rwandan society and beyond”.

Water Plans

The **Integrated Strategic Water Resources Planning and Management for Rwanda** was released in 2022 by the Rwanda Water Resource Board (Government of Rwanda, 2022). The strategy acknowledges the importance of natural capital accounting in general and directly uses information from the water accounts. It also cites the mineral accounts. The plan provides extensive information. This includes information on water resources and predictions of how these might be affected by climate change until 2050. These predictions are water balances, which are linked in the strategy to water accounting diagrams and are provided for catchments and sub catchments. Expansion of water supply through dam construction and demand management are a feature of the strategy. Significantly, water accounts are called for to help guide investment in irrigated agriculture and nature-based solutions are recognized.

Complementing the Integrated Strategic Water Resources Planning and Management for Rwanda are the **Water Supply and Sanitation Master Plans** released by the Water and Sanitation Corporation (WASAC) in 2022.⁷ The plans are regionally focused and their objectives are to integrate the long-term Integrated Strategic Water Resources Planning and Management for Rwanda with the 10-year investment plans for the development of water supply and sanitation infrastructure and services.

At the invitation of the Government of Rwanda, The World Bank undertook the analysis *A Water-Resilient Economy: A Hydro-Economic and Climate Change Analysis for Rwanda* (World Bank, 2022). The analysis was undertaken to identify the possible constraints to the nation's sustainable development due to changes in water supply and demand. The analysis uses a variety of data sources and the use of a Social Accounting Matrix (SAM). The water accounts are not specifically referenced, but the data underpinning them is used in the analysis and would have supported the SAM's development.

The policy, plan and related analysis provide significant opportunities for NCA in Rwanda. Importantly, the first accounts have been used in the strategy's development, and within it there are direct calls for water accounts to inform investment in irrigated agriculture. There is also recognition of the need for accounts for the ecosystem service of sedimentation retention to prevent the siltation of dams used for water supply and hydropower. Going forward new water accounts can be used to monitor and refine policies and their implementation. This would include investments in water supply infrastructure and demand management options, including options for water demand management and payments for water-related ecosystem services (e.g., water supply, water purification and sediment retention). New water accounts would allow the social accounting matrices underpinning the analysis conducted by The World Bank Group (2022) to be updated. Their institutionalization would enable further use for water policies and plans.

Payment for Ecosystem services

Payment for Ecosystem Services is an instrument for protecting ecosystems and biodiversity that is increasingly used across Africa. REMA has prepared a PES roadmap for Rwanda, and

the World Bank is currently supporting an analysis for a PES scheme in Volcanoes. Ecosystem accounts can provide the basis for analysis supporting site prioritization and measurement of ecosystem services. An example of this is the Investment Prioritization Tool which has been used in Ethiopia.

Environmentally adjusted macroeconomic indicators

The **Strategic Plan for the Environment and Natural Resources Sector 2018-2024** recommends the “Adoption of Natural Capital Accounting (NCA) practices to track the Total Economic Value (TEV) of natural capital to the Rwandan economy focusing on land, water, forests, wetlands and mining, thereby accounting for gains and losses relative to GDP growth” (REMA, 2017). However, it should be noted that TEV is different from SEEA as it uses welfare values, not exchange values, and will thus give different results from the value of natural capital and ecosystem services as compiled in the natural capital accounts.

Indicators derived from the National Accounts, such as Gross Domestic Product (GDP), Net National Income and Net Savings, measure annual changes in production, income and savings. Adjusted macroeconomic indicators, such as Adjusted Net National Income (ANNI) and Adjusted Net Savings (ANS), adjust these standard indicators for depletion and degradation of natural capital and include investment in human capital (education), to assess the sustainability of the economic development. A pilot report of ANNI and ANS for Rwanda has been prepared using available data. The coverage of the indicators could be considerably expanded, which would enable the indicators to become a useful measure for annual changes in sustainable development moving forward.

Wealth accounting—the balance sheet for a country—captures the value of all the assets that generate income and support human well-being. Gross domestic product (GDP) indicates how much monetary income or output a country creates in a year; wealth indicates the value of the underlying national assets and therefore the prospects for maintaining and increasing that income over the long term. GDP and wealth are complementary indicators for measuring economic performance and provide a fuller picture when evaluated together. By monitoring trends in wealth, it is possible to see whether GDP growth is achieved by building capital assets, which is sustainable in the long run, or by liquidating assets, which is not. Wealth should be used alongside GDP to provide a means of monitoring the sustainability of economic development. This requires data on natural capital stocks and their value. Data to compile total wealth for Rwanda seems quite fragmented for the moment. Further investigation and data compilation would be needed to do an estimation with national data. The World Bank’s Changing Wealth of Nations project compiles data on total wealth and ANS using global datasets, which can be used as proxies in the meantime.¹²

Reporting on international commitments

The indicators for the **Kunming-Montreal Global Biodiversity Framework (GBF)** include indicators relating to the diversity of ecosystems and species, such as the area, connectivity and integrity of natural ecosystems and species abundance. Ecosystem extent and services

¹² Open Knowledge Repository (worldbank.org);

accounts can be a key source of information to report on the GBF. Rwanda has already laid the groundwork for this, as land accounts and partial ecosystem services accounts are available. A commitment to regularly update the land accounts and to develop a fuller set of ecosystem accounts would be the next step.

The following **SDG indicators** could be informed by NCA (*Table 1*). Some of them are already reported by Rwanda. The following table gives an overview of what was reported in Rwanda's Voluntary National Reporting 2019 and 2023. To understand exactly what data the sources provide and how often they are compiled, it would be necessary to have the exact source, which was not available for all the indicators.

The land accounts allow for reporting on forest area (SDG indicator 15.1.1). They can also provide data on land degradation (SDG indicator 15.3.1), when defined as conversion of natural to modified land cover.

The water accounts allow for estimating several of the indicators used for the Sustainable Development Goals (SDG), including water use efficiency (SDG indicator 6.4.1) and water stress (SDG indicator 6.4.2).

Table 1. SDG indicators and NCA

SDG indicator	VNR report	Years reported	Source	SEEA account
6.3.2 Proportion of bodies of water with good ambient water quality	2023	2018, 2020	RWB, admin data	Water quality account
6.4.1 Change in water-use efficiency over time	2023	2020	RWB, admin data	Water use account
6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	2023	2018, 2020	RWB, admin data	Water asset and supply and use accounts
6.5.1: Implementation of Integrated water resource management	2023	Need to check. I do not have the VNR but can see for the indicator report that they have done (and overall score of 68 – medium high)		Water asset and supply and use accounts Ecosystem services accounts

9.4.1 CO ₂ e emissions per sector	2019, 2023	2016, 2018	2017,	Proxy: Total CO ₂ e emissions per year (same as indicator 13.2.2) Rwanda's First Biennial Update Report Under the UNFCCC (REMA, 2021)	GHG emission accounts
13.2.2. Total greenhouse gas emissions per year	2019, 2023	2016, 2018	2017,	Rwanda's report to UNFCCC (REMA, 2021)	
15.1.1 Forest area as a proportion of total land area	2019, 2023	2016, 2019		2016: Rwanda Water and Forestry Authority Report 2019: Rwanda forest cover mapping (MoE, 2019)	Land cover accounts
15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type (baseline value for 2012, no progress value)		?		Land assessment report*	Ecosystem extent accounts
15.3.1 Proportion of land that is degraded over total land area		Not reported			Land or ecosystem extent accounts

* Source complemented by information from NLA: Proxy indicator: Inland water protection. Indicator monitored by Rwanda Forestry Authority

4. Conclusion and recommendations

Rwanda is in a position to capitalise on past national work, new data and international experience. There is high-level recognition and commitment across government. This includes the key MDAs MINECOFIN, MoE and NISR as well as relevant line agencies including NLA, REMA, RFA, RWB and WASAC.

Coordination, prioritization and capacity development are key to make NCA development efficient and sustainable. During the scoping mission in March 2024, it was agreed to focus this assessment on the Land and water accounts, as well as Integrating environmental variables into the CGE models developed in MINECOFIN. With the criteria of needed and achievable in mind, the results from the assessment reaffirm the aptness of starting with updating the land and water accounts.

Including compilation of forest accounts will be valuable, as integrating data on both production and ecosystem aspects of forests into accounts provides consistency across sectors and can support cross-sectoral considerations in land use planning. Forest accounts can be extracted from land and ecosystem extent, condition and services accounts. These will include forest cover, condition, non-timber forest products, and biodiversity and ecosystem services provided by the forest. In addition, statistics on timber production need to be included in the accounts.¹³ Compiling the forest-related part of the accounts into one report and extracting key indicators will enhance visibility and usefulness for the forest sector.

In addition, the assessment shows that expanding the scope of water accounts is feasible given data availability, the data processing systems in place (e.g., the Water Data Portal) and the current expertise in hydrological information. There is high interest from the key line agencies (NLA, RWB, WASAC), and it is relevant also to other agencies, including REMA, RFA and MINECOFIN.

There are several policy applications that would benefit from having the regularly produced quality data that NCA provides. The national plans that will benefit from land and water accounts include the National Strategy for Transformation, Green Growth and Climate Resilience Strategy (GGCRS), National Land Use and Development Master Plan (NLUDMP), Forest Sector Strategic Plan, Integrated Strategic Water Resources Planning and Management for Rwanda, Water Supply and Sanitation Master Plan and District Land Use Plans. They will further provide data for reporting on several SDG indicators.

4.1 Recommendations for institutionalization

To set up a sustainable NCA program, it needs to be embedded into the regular work of the responsible MDAs, with clear responsibilities for account compilation. This applies not only to the entity compiling the accounts but also to the entities responsible for delivering data and the identified users of the accounts. For a successful implementation, the following actions are recommended:

- Lead agencies for each account are appointed, with clear roles and responsibility

¹³ The World Bank, under the WAVES program, compiled a Forest Accounting Sourcebook which can provide guidance on compilation of a full set of forest-related accounts (World Bank, 2017).

- Accessibility of the data is important. While accounts may be produced in the line agencies, NISR should be the main custodian of the accounts, so that they can be found in one place.
- To ensure integration with the National Accounts, NCA should ideally be placed in the National Accounts department at NISR
- Commitments by the agencies need to be backed by dedicated resources for account compilation and technical support for NCA
- NCA development should adhere to the Data Quality Assessment Framework (DQAF)
- An institutional plan including which agencies are responsible for delivering data, which are responsible for compiling the accounts, and which units within agencies are the main users of the accounts should be set up. *Annex 1* shows provides a preliminary list of agencies to be involved in land and water accounts, respectively.
- Clear commitments from data-producing MDAs to deliver data regularly and timely
- Coordination mechanisms to be set up for compilation and technical support
- Specific uses of the accounts should be identified up front. In addition to providing data for SDG reporting, information from and analyses using the accounts can greatly enhance several of the strategies mentioned in this report. This should be further elaborated upon to identify specific parts of the strategies and what NCA can contribute to in each case.
- Decide on the periodicity of each account, with a timeline that fits with the policy agenda, so that NCA results are ready when needed.

It is recommended that a Technical Working Group (TWG) is set up for each account, comprising representatives at the technical level from all the agencies involved. This is important for promoting coordination, cross-support and capacity building. In addition, it will be important to have an overarching Steering Committee (SC) with high-level representatives from the key ministries and agencies. The role of the SC will be e.g. to ensure that there is appropriate staffing and resources, provide guidance to the TWGs as needed, and to approve work plans and reports. At the outset, it might be beneficial to appoint a specific SC to get the work up and running, but if deemed appropriate, this can be added to the responsibilities of an existing body.

Capacity building will be key. As pointed out in this report, there is expertise on NCA within the GoR, but as these are just a handful of persons there needs to be a solid capacity building program, including general training on the SEEA and specific training on land and water accounts. In addition to shorter training courses, on-the-job training with technical support for the TWGs will be important.

To increase NCA understanding across the government, it is recommended that experts in analytical units in MoF, MoE and MoA receive general training in NCA, providing an understanding of what NCA is as well as examples of policy applications.

The MINECOFIN is currently developing a CGE model for Rwanda with support from the World Bank. As previously described, data from NCA readily lends itself to integrating into CGE models. With the suggested update water accounts, water supply and use in physical terms could easily be integrated into the model, allowing for assessments of how economic development could impact water demand. In case the GoR decides to develop GHG emission

accounts, this will allow for analyses of impacts on emissions from economic development and policies, and of impacts from GHG mitigation policies on economic development. This will require capacity building as well as collaboration between RWB, WASAC, REMA and MINECOFIN.

This assessment has focused solely on the three priority areas agreed with GoR. For the longer term, a NCA roadmap should be developed. The long-term payoff of development of NCA is that it will provide regular systematic data; there will be more efficient production of the statistics across government; and the Government will have better data for evidenced-based policy. The building blocks of an NCA roadmap would include:

- Identifying data deficiencies for NCA
- Identifying other policies and plans that may be support by other types of NCA
- Building the statistical foundations for future NCA production
- Costing of future NCA production
- Regional leadership and collaboration

4.2 Next steps

Including the proposed accounts into the NSDS4, which is currently being developed, is key to start institutionalizing NCA in Rwanda. As distinct from standalone NCA programs, including NCA into the national statistical system will ensure quality, efficiency and sustainability of the accounts. It will also enhance usefulness of the accounts, as regular updating and building of time series is crucial for many applications.

For NSDS4, providing data to support NST2 and SDG reporting is priority. As shown in this report, updated and expanded land and water accounts will greatly contribute to these objectives.

A prerequisite to include NCA in the NSDS is that responsible agencies allocate staff and include it in their action plans. It is also vital to have a strong ministry in the lead.

Thus, important next steps will be to provide NISR with the following information:

- clarity on which agency is responsible for what
- what the agencies need in terms of human resources, expertise, infrastructure, and capacity building, with an estimate of the funding resources needed for this
- development of guidelines, including institutional roles and responsibilities.

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