

Defining the biodiversity economy with a view to developing a Biodiversity Economy Satellite Account: progress from South Africa

Paper presented to the London Group on Environmental Accounting, 27th Meeting
27-30 September and 4 October 2021

Amanda Driver¹, Riaan Grobler², Yuval Tchetchnik³, Aimee Ginsburg¹, Gerhardt Bouwer²

With acknowledgements to participants in the work sessions discussed in Section 4, where consultation and expert opinion was provided by individuals from Statistics South Africa, the Department of Forestry, Fisheries and the Environment, the South African National Biodiversity Institute and others.

¹ *South African National Biodiversity Institute*

² *Statistics South Africa*

³ *Department of Forestry, Fisheries and the Environment*

Contents

List of tables	ii
List of figures	ii
Acronyms	iii
1 Introduction	1
2 Background	2
2.1 Why measure the biodiversity economy?	2
2.2 What is a satellite account?	3
2.3 Why take a satellite accounting approach to measuring the biodiversity economy?.....	4
3 Defining the biodiversity economy	5
3.1 A conceptual framework for the biodiversity economy	5
3.2 Links with SEEA Ecosystem Accounting and the SEEA Central Framework	8
4 Progress in developing the account.....	11
4.1 Setting up the project	11
4.2 Linking to classifications used in the national accounts	11
4.3 Developing principles.....	12
4.4 Results: industries and products related to biodiversity	14
4.5 Next steps and future work	20
4.6 Lessons learnt	21
5 Questions for the London Group	22
References	23
Appendix A: Ten steps towards a thematic satellite account.....	25

List of tables

Table 1: Classification of Environmental Activities: Overview of groups and classes	10
Table 2: Principles guiding the assessment of inclusion or exclusion of industries and products from the biodiversity economy	13
Table 3: Summary of results for industry codes	15
Table 4: Summary of results for product codes.....	15
Table 5: Summary of biodiversity economy sub-categories.....	15
Table 6: Industry codes selected as biodiversity-related from the full set of 3-digit level codes in the Standard Industrial Classification.....	16
Table 7: Product codes selected as biodiversity-related from the full set of 3-digit level codes in the Central Product Classification	17
Table 8: Proposed proportions to be used to calculate the economic contribution of the industries and products identified as biodiversity-related to GDP and employment.....	20

List of figures

Figure 1: Conceptual framework for biodiversity-related economic activity, showing two broad categories and five sub-categories	8
---	---

Acronyms

CEA	Classification of Environmental Activities
CPC	Central Product Classification
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
EGSS	Environmental Goods and Services Sector
GDP	Gross Domestic Product
ISIC	International Standard Industrial Classification of all Economic Activities
IUCN	International Union for Conservation of Nature
OECD	Organisation for Economic Co-Operation and Development
NBA	National Biodiversity Assessment
NGO	Non-government organisation
SANBI	South African National Biodiversity Institute
SASCO	South African Standard Classification of Occupations
SEEA	System of Environmental-Economic Accounting
SIC	Standard Industrial Classification of All Economic Activities
Stats SA	Statistics South Africa
SNA	System of National Accounts
SUT	Supply and Use Table
TEEB	The Economics of Ecosystems and Biodiversity
UNEP	United Nations Environment Programme
WWF	World Wide Fund for Nature

1 Introduction

The System of National Accounts (SNA) recommends the development of satellite accounts for the measurement of economic phenomena that are not explicitly shown in the core set of accounts. Satellite accounts have been developed for various sectors, such as the tourism sector and the ICT sector. As far as we are aware, no country has yet developed a satellite account for the biodiversity economy, and there is currently no internationally agreed definition of the biodiversity economy. With increasing focus globally on nature's contributions to people, a satellite account for the biodiversity economy could provide useful information for informing policy and decision-making. As a mega-diverse developing country, there is great interest in South Africa in how the country's wealth of biodiversity assets can contribute to national development goals, including inclusive economic growth, employment creation and rural development.

Statistics South Africa (Stats SA) is collaborating with the Department of Forestry, Fisheries and the Environment (DFFE) and the South African National Biodiversity Institute (SANBI) to develop a Biodiversity Economy Satellite Account for South Africa, which we envisage publishing in 2022. The work forms part of the broader national programme of work on Natural Capital Accounting (NCA), which is set out in the National NCA Strategy published by Stats SA in June 2021 (Stats SA, 2021a). This paper describes the process to date, including some of the conceptual issues and lessons learnt.

The paper is structured as follows:

- Section 2 provides background, including the rationale for measuring the biodiversity economy and for using a satellite accounting approach to do so.
- Section 3 sets out the conceptual framework we have used for defining the biodiversity economy.
- Section 4 describes the approach we have taken to developing the satellite account, including both process and content aspects. It includes a set of principles we have developed to guide linking the industry and product classifications to the biodiversity economy as well as lessons learnt to date and future work.
- Section 5 poses questions for discussion by the London Group.

2 Background

This section gives background on the importance and relevance of measuring the size of the biodiversity economy in the current policy context in South Africa, and discusses why a satellite account is useful approach for undertaking this measurement. For readers unfamiliar with satellite accounts it also briefly describes what such an account is.

2.1 Why measure the biodiversity economy?

South Africa faces substantial economic and development challenges, including slow growth, extremely high and persistent unemployment, inequality and poverty. Current unemployment is estimated at 34.4% using the official definition of unemployment and 44.4% using the expanded definition (Stats SA, 2021b), and income distribution in South Africa is considered one of the most unequal in the world.

South Africa's biodiversity is also globally exceptional. The country has an exceptional wealth of biodiversity assets, ecosystems and ecological infrastructure, much of which is still relatively intact, as assessed in the National Biodiversity Assessment (SANBI, 2019), providing an opportunity to contribute to addressing development challenges.

Recognising this opportunity, a National Biodiversity Economy Strategy was developed in 2016 and updated in 2017, led by DFFE (DEA,¹ 2017). This was followed by a Biodiversity Economy Phakisa² which was a sector-inclusive, facilitated planning laboratory, in which over the course of a few weeks three components of the biodiversity economy were mapped out: wildlife, bioprospecting and ecotourism. The Phakisa process included detailing the aspiration of each of these sectors, the challenges, and key initiatives including targets and implementation plans. These have been adopted into DFFE's implementation plan and incorporated as part of the measured annual performance monitoring. The Phakisa process identified ambitious targets for growth and employment related to biodiversity, including 100 000 new jobs in the wildlife sector and 10 000 new jobs in the bioprospecting sector, but with no clear baseline either for the size of the biodiversity economy or biodiversity-related employment.

Measuring the benefits of biodiversity for the economy can help to make the case for biodiversity as a socio-economic asset and to motivate for resources and policy attention to gear up the implementation of National Biodiversity Economy Strategy, including the implementation plan developed through the Biodiversity Economy Phakisa and related initiatives.

South Africa's National Biodiversity Assessment (NBA) is conducted periodically, most recently in 2018, and goes some way to measuring the benefits of biodiversity for people and the economy. For example, the NBA 2018 included first attempt to quantifying biodiversity-related employment, which found that the contribution of biodiversity to employment is substantial – more than 400 000 jobs, comparable to the mining sector. The initial quantification of biodiversity-related employment also found that for every job dedicated to conserving or managing biodiversity, at least five jobs depend on biodiversity, across a range of sectors. This suggests that the contribution of biodiversity to the economy as a whole is substantial, and work on specific sub-sectors of the biodiversity economy, such as biodiversity tourism, has done the same (SANBI, 2019).

¹ Department of Environmental Affairs, now the Department of Forestry, Fisheries and the Environment.

² "Phakisa" is a Sesotho word meaning "hurry up". Operation Phakisa in South Africa is based on Malaysia's Big Fast Results methodology, and has been applied to the ocean economy and the biodiversity economy.

At the same time, biodiversity is under pressure from a range of activities in other sectors, providing an additional reason to show that conserving and managing biodiversity is not an obstacle to development but can contribute to development.

Some definitions

Biodiversity is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. (Convention on Biological Diversity)

Biodiversity assets include natural ecosystems, indigenous species and other biodiversity-related resources (such as genetic material) that generate social, cultural or economic benefits, including supporting livelihoods, providing the basis for economic activity, and contributing to human wellbeing. (SANBI, 2016)

Ecological infrastructure refers to naturally functioning ecosystems* that generate and deliver valuable services to people, such as fresh water, climate regulation, soil formation and disaster risk reduction. It is the nature-based equivalent of built or hard infrastructure, and is just as important for providing services and underpinning socio-economic development. (SANBI, 2016)

* Naturally functioning ecosystems are ecosystems that have retained their ecological processes. They may be in a semi-natural rather than natural or near-natural state.

2.2 What is a satellite account?

Satellite accounts are linked to, but distinct from, the central system of the SNA 2008. Broadly speaking, there are two types of satellite accounts:

1. The first type involves some rearrangement of central classifications and the possible introduction of complementary elements – these are referred to thematic satellite accounts;
2. The second type of satellite analysis is mainly based on concepts that are alternatives to those of the SNA 2008.

Satellite accounts, especially of the second type, allow experimentation with new concepts and methodologies, with a much wider degree of freedom than is possible within the central system. There is a growing demand for compiling satellite accounts, particularly for thematic satellite accounts (the first type). A major strength of such satellite accounts is that they are fully embedded in the traditional set of national accounts data, thus making it possible to analyse the impact of certain theme-related policies on economic growth, employment, government debt and deficit, foreign trade, etc.

The emphasis on the flexibility of the SNA 2008 extends to allowing complete flexibility about how many and what sort of satellite or other extended accounts may be developed. Stats SA already compiles and publishes an annual Tourism Satellite Account (TSA), with a current TSA time series from 2005 to 2018. Stats SA also previously compiled and published an annual Information and Communication Technology (ICT) Satellite Account, with the ICT Satellite Account time series from 2005 to 2014.

Thematic satellite accounts typically use the framework of supply and use tables (SUTs) as a starting point. The SUTs are an integral part of SNA 2008 and they form the central framework for the compilation of a single and coherent estimate of gross domestic product (GDP); they integrate all the components of the production, income and expenditure approaches to GDP; and they provide key

links to other parts of the SNA 2008 framework. SUTs are considered the cornerstone of the national accounts.

Ten steps towards a thematic satellite account have been described in a working paper published by the OECD (OECD, 2019), summarised in Appendix A. At the time of writing, we had undertaken the first two steps, which are discussed in Section 4.

2.3 Why take a satellite accounting approach to measuring the biodiversity economy?

There are several reasons that a satellite account provides a useful approach to measuring the contribution of biodiversity, including ecosystems and species, to the economy.

A satellite account enables calculation of the contribution of biodiversity to GDP and employment, which can then be compared directly with the contributions of other economic sectors such as mining and agriculture. For policymakers, it provides metrics that link directly to implications for GDP and employment. Further, large portions of the biodiversity economy are non-observed, including subsistence activities that depend on biodiversity. This non-observed activity is included in the national accounts and can thus be made visible through a satellite account.

The Biodiversity Economy Satellite Account will complement the suite of ecosystem and species accounts that are being developed in South Africa through the System of Environmental-Economic Accounting (SEEA) Ecosystem Accounting. The focus of ecosystem accounts is on the contributions of ecosystems that fall outside of the SNA production boundary (non-SNA benefits), while the focus of the Biodiversity Economy Satellite Account is on the contributions of ecosystems and species to activities that fall inside the SNA production boundary. A large portion of “the environment” is already included within the SNA production boundary, and satellite accounts for environment-related sectors can help to highlight this.

While SEEA focuses on environmental statistics and indicators, satellite accounts focus on economic and social statistics and indicators. Drawing on both will help to show the interlinkages between the domains of environment, economy and people.

3 Defining the biodiversity economy

Before applying the more technical steps that need to be undertaken to arrive at a full-fledged thematic satellite account, a critical discussion needs to take place, in consultation with the main users, about the definition of the theme and setting a boundary around what should be included and what is not included. This section describes how we have defined the biodiversity economy, and briefly discusses links and differences between this definition and SEEA Ecosystem Accounting, the Classification of Environmental Activities (CEA) in the SEEA Central Framework and the Environmental Goods and Services Sector (EGGS).

3.1 A conceptual framework for the biodiversity economy

[Note: This section has been extracted largely from an earlier paper on measuring biodiversity-related employment (Driver et al, 2019), which includes a conceptual framework for biodiversity-related economic activity. The conceptual framework set out in that paper is essentially unchanged.]

The starting point was to conceptualise clearly what we mean by the biodiversity economy, to guide the scope of the measurement effort. The intention was to limit the scope to economic activities directly linked to biodiversity, and not to include indirect effects in the wider economy via multipliers. This section sets out the logic and rationale for a conceptual framework that was developed and refined iteratively, initially through work sessions held in 2014 and 2015 in SANBI, and then through further discussions in 2020 with the group of people in Stats SA, DFFE and SANBI involved in developing the Biodiversity Economy Satellite Account.

Defining the biodiversity economy is not straightforward, and there is no international consensus on a definition. One challenge is to distinguish between the “green economy” and the biodiversity economy. The United Nations Environment Programme (UNEP) defines the green economy as “an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (UNEP, 2013). This is a broad concept, often related to renewable energy, reduced waste and more sustainable business choices. There is not necessarily a direct link to biodiversity. The “nature-based economy” is another term used, for example in the Rewilding Europe initiative that focuses on economic opportunities related to natural environments. The nature-based economy would likely have more direct links to biodiversity than the green economy would.

The Economics of Ecosystems and Biodiversity (TEEB), a global project led by UNEP, recognises that there are two ways that business can be linked with biodiversity, firstly through business impacts on biodiversity and secondly through business dependence on biodiversity (TEEB, 2012). Most business activities have both impacts and dependencies on biodiversity, but some economic sectors are more likely to have stronger links through either their impacts or dependence on biodiversity. In practice, business activities that depend on biodiversity are less well described and have received less attention in discussions about business and biodiversity than those that impact (often negatively) on biodiversity.

South Africa’s National Biodiversity Economy Strategy adapted a definition for the biodiversity economy proposed by the World Wide Fund for Nature (WWF) (Van Paddenburg et al., 2012). This definition encompasses “businesses and other economic activities that either directly depend on biodiversity for their core business or that contribute to conservation of biodiversity through their activities” (DEA, 2017).

We have used the WWF/DFFE definition of the biodiversity economy as the basis for the conceptual framework presented here. Fundamental to this definition is that it sets out two broad categories of biodiversity-related economic activity: those activities that contribute directly to conservation, and those that depend directly on biodiversity. It does not include activities simply because they attempt to reduce impacts on biodiversity or the natural environment, even though such activities are often considered part of the “green economy”.

Given this definition, biodiversity-related economic activity can be separated into two broad categories: those that contribute to conserving biodiversity and those that utilise biodiversity. Broadly speaking, conserving biodiversity is often the role of government agencies and NGOs, while use of biodiversity often occurs within the private sector or on a subsistence basis. Within these two categories of biodiversity-related economic activity we identified further sub-categories as follows:

- **BDE Category A: Conserving Biodiversity, including economic activity in:**
 - A1. Protecting and managing biodiversity assets
 - A2. Restoring and maintaining ecological infrastructure
 - A3. Research and professional services related to biodiversity
- **BDE Category B: Using Biodiversity, including economic activity that depends on:**
 - B1. Non-consumptive use of biodiversity
 - B2. Extractive use of biodiversity

It was important to consider the boundaries of the sub-categories carefully, and to clarify the logic for both inclusion and exclusion of economic activities from each. A brief description of the sub-categories is provided below.

A1. Protecting and managing biodiversity assets

Activities directly involved in conservation of the country’s biodiversity assets, both ecosystems and species. This includes management of protected areas and conservation areas, and efforts to conserve particular species. It also includes efforts to mainstream biodiversity in planning and decision-making in biodiversity priority areas outside of the protected area network.

A2. Restoring and maintaining ecological infrastructure

Activities aimed at restoring the functioning of natural or semi-natural ecosystems to improve their ability to generate and deliver valuable services to people. This includes, for example, removing invasive alien plants to improve water supply and agricultural productivity, and restoring wetlands to improve water quality and prevent flooding. It also includes a range of natural resource management and catchment management activities that contribute to maintaining healthy ecosystems.

A3. Research and professional services related to biodiversity

Activities that contribute to knowledge of biodiversity, forming the foundation for effective management of biodiversity as well as innovation in the management and sustainable use of biodiversity. This includes the work of universities, other research institutions, biodiversity consulting services and biodiversity information management.

B1. Non-consumptive use of biodiversity

Activities that depend on the enjoyment of biodiversity but do not involve extraction or consumption of the underlying biodiversity asset and can thus be sustained on a long-term basis. This includes nature-based tourism (e.g. bird watching, whale watching, diving, hiking), some adventure sports, and production of media and art related to biodiversity (e.g. through nature

journalism, photography, and film making). These activities can take place inside or outside of protected areas.

B2. Extractive use of biodiversity

Activities that depend on the direct extraction or consumption of biodiversity in the form of indigenous species or natural ecosystems, either for profit or subsistence. This includes:

- wildlife (game) ranching and hunting,
- rangeland agriculture (which depends on natural ecosystems such as Grassland and Karoo),
- harvesting of wild indigenous resources (e.g. fisheries, medicinal plants, wildflowers such as Proteas),
- biotrade (trade in harvested indigenous resources),
- cultivation of indigenous species (e.g. rooibos, honeybush),
- horticulture and floriculture based on indigenous species,
- processing or manufacturing of products based on indigenous resources (e.g. fibres and building materials from reeds),
- bioprospecting (e.g. to develop pharmaceuticals, nutraceuticals, cosmetics based on indigenous species and genetic resources).

Some of these activities in Category B2, such as wildlife ranching, rangeland agriculture and harvesting of wild resources, can, at least in principle, be compatible with the long-term persistence of biodiversity if they are appropriately managed. Others, such as intensive cultivation or farming of indigenous species, such as rooibos, ostriches or game, almost always have substantial negative impacts on biodiversity as they result in outright and usually irreversible loss of natural ecosystems. All of these activities are included, partly because in practice it is often difficult to distinguish between products produced from wild-harvested indigenous resources and those from cultivated indigenous resources, and partly because cultivated or intensively farmed indigenous resources depend on indigenous genetic resources even if they are produced outside of their natural ecosystem context. Not included in this sub-category is intensive farming of non-indigenous species (i.e. conventional intensive agriculture or aquaculture).

These two broad categories and five sub-categories of biodiversity-related economic activity, summarised in Figure 1, form a coherent conceptual framework for defining and classifying the biodiversity economy, and provide the framework upon which the Biodiversity Economy Satellite Account will be based.

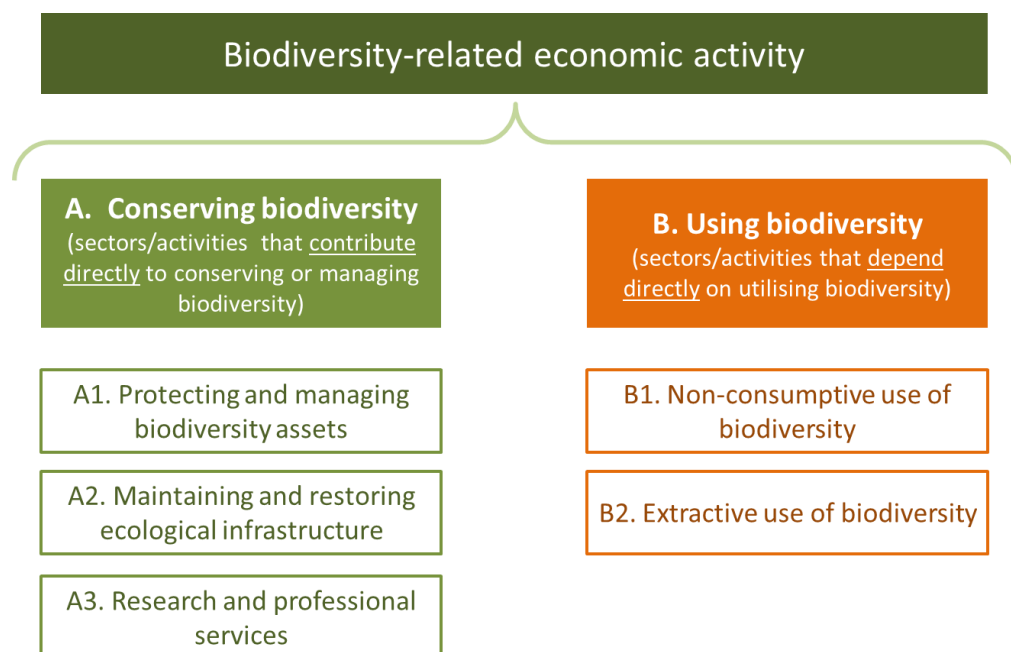


Figure 1: Conceptual framework for biodiversity-related economic activity, showing two broad categories and five sub-categories

The National Biodiversity Economy Strategy focuses its attention on a subset of the biodiversity economy: the bioprospecting section and the wildlife sector. Further, it explicitly excludes the informal sector. The bioprospecting sector encompasses organizations and people that are searching for, collecting, harvesting and extracting living or dead indigenous species, or derivatives and genetic material thereof for commercial or industrial purposes. The wildlife sector is centred on game and wildlife farming/ranching activities that relate to the stocking, trading, breeding, and hunting of game, and all the services and goods required to support this value chain. It is a rapidly growing sub-sector within the biodiversity economy.

The relatively narrow focus of the National Biodiversity Economy Strategy makes sense from the point of view of a strategy that is intended to focus action and interventions; however, for the Biodiversity Economy Satellite Account it makes sense to be inclusive and to consider all aspects or elements of the biodiversity economy.

3.2 Links with SEEA Ecosystem Accounting and the SEEA Central Framework

The biodiversity economy as defined here has links with some but not all ecosystem services. Ecosystem services are defined in SEEA Ecosystem Accounting as “the contributions of ecosystems to the benefits that are used in economic and other human activity” (para. 2.14). Ecosystem services can be provided by any ecosystem type, including natural, semi-natural or intensively managed³ ecosystem types. They can also be related to any species, including indigenous and non-indigenous (exotic) species.

The definition of the biodiversity economy presented here explicitly requires that the economic activity be linked to either natural ecosystems or indigenous species or both. It excludes economic activities that rely on the solely on intensively managed ecosystems and non-indigenous species,

³ Also referred to in the South African context as intensively modified. Semi-natural ecosystems would be considered moderately modified.

such as most intensive agriculture and aquaculture. It also excludes recreational activities that rely solely on intensively managed ecosystems such as managed urban parks. Intensively managed ecosystems such as cultivated areas and urban parks are considered to provide substantial ecosystem services, but these ecosystem services would in general not be seen as contributing to the biodiversity economy as conceptualised here. An exception would be where the species that is farmed or cultivated is an indigenous species.

In another example, regulating and provisioning services are provided by timber plantations in South Africa, which use exotic species that are often invasive (such as pines and eucalypts). Timber plantations are an example of an intensively managed ecosystem type that provides substantial ecosystem services but does not form part of the biodiversity economy in South Africa. (Timber plantations may be considered part of the biodiversity economy in other countries to which the species involved are indigenous.) Logging of indigenous forest species is included in our definition of the biodiversity economy, but in the South African context, where the indigenous forest biome is naturally very small and fragmented, this is a tiny element of the biodiversity economy.

The biodiversity economy as defined here also has some links and overlaps with environmental activities as defined in Chapter 4 of the SEEA Central Framework (UN et al, 2014). The SEEA Central Framework includes a Classification of Environmental Activities (CEA) as a functional classification used to classify environmental activities, environmental products and environmental expenditures and other transactions. It covers two broad types of environmental activities, namely environmental protection activities and resource management activities, as shown in Table 1. The CEA forms the basis for defining the Environmental Goods and Services Sector (EGSS) and for environmental protection expenditure accounts.

Group I Class 6 of the CEA, “Protection of biodiversity and landscapes”, clearly falls within Category A1 of the biodiversity economy as it has been defined here. Broadening the CEA class to “Protection of biodiversity and ecosystems in landscapes and seascapes” would make it more inclusive. It could be useful to make a link to the IUCN’s widely accepted definition of protection, which is used in the Post 2020 Global Biodiversity Framework under development by the Convention on Biodiversity.

The classes in Group II “Resource Management” do not explicitly include activities related to restoration and management of ecosystems (including, for example, wetland restoration and clearing of invasive alien vegetation), which would fall within Category A2 as it has been defined here. Such activities do not necessarily involve formal protection of ecosystems or biodiversity but rather focus on management, so they fit better under resource management than under environmental protection.

It would be useful to further explore the links and differences between the biodiversity economy and environmental activities as conceived in the SEEA Central Framework and the EGSS.⁴

⁴ It may be worth noting that the biodiversity *sector* in South Africa would be understood to be narrower than the biodiversity *economy*. The biodiversity sector, although not formally defined, consists of people and organisations whose primary focus is on managing and conserving biodiversity, and corresponds more or less to Category A of the biodiversity economy as defined here. Also included in Category A would be parts of the natural resource management sector, such as public sector programmes for restoring ecological infrastructure. The biodiversity sector would generally not be considered to include the activities in Category B of the biodiversity economy.

Table 1: Classification of Environmental Activities: Overview of groups and classes

Group	Classes
I: Environmental protection (EP)	1 Protection of ambient air and climate
	2 Wastewater management
	3 Waste management
	4 Protection and remediation of soil, groundwater and surface water
	5 Noise and vibration abatement (excluding workplace protection)
	6 Protection of biodiversity and landscapes
	7 Protection against radiation (excluding external safety)
	8 Research and development for environmental protection
	9 Other environmental protection activities
II: Resource management (RM)	10 Management of mineral and energy resources
	11 Management of timber resources
	12 Management of aquatic resources
	13 Management of other biological resources (excluding timber and aquatic resources)
	14 Management of water resources
	15 Research and development activities for resource management
	16 Other resource management activities

(Source: SEEA Central Framework, Table 4.1 on page 99)

In summary, the conceptual framework for defining the biodiversity economy presented here is narrower than the green economy, which includes a range of activities that have no relation to natural ecosystems or indigenous species. The biodiversity economy is linked to ecosystem services that derive from natural or semi-natural ecosystem types, but in general not to those that derive from intensively managed ecosystem types. The biodiversity economy includes some activities in the Classification of Environmental Activities in the SEEA Central Framework, which could be explored further.

4 Progress in developing the account

Discussions towards the development of the Biodiversity Economy Satellite Account for South Africa have taken place during 2020 and 2021 between Stats SA, SANBI and DFFE, including engaging on:

- “defining and compiling data for the desired breakdown of economic activities” (step one of the ten steps towards a thematic satellite account),
- “defining and compiling data for the desired breakdown of products” (step two of the ten steps towards a thematic satellite account (OECD, 2019).

The focus has been to substantively define the biodiversity economy with respect to the national accounts, identifying where biodiversity-related economic activities are included in the national accounts and indicating the degree of economic contribution (as a percentage range).

This section describes the process to date, including principles developed and the results that have emerged from these initial steps towards the satellite account.

4.1 Setting up the project

A small core working group was established in 2020 to develop the Biodiversity Economy Satellite Account, including to tackle the task of identifying the desired breakdown of economic activities and the desired breakdown of products that will form the basis for the account. The working group is comprised of individuals from Stats SA, DFFE and SANBI. Since this work forms part of the national programme of work on NCA, the working group includes people who are familiar with and have technical experience in the subject matter of the NCA programme.

The following sessions have been held:

- An initial scoping workshop used for planning of work, identifying key stakeholders, and agreeing on adopting the conceptual framework for the biodiversity economy from the National Biodiversity Assessment (one-day workshop in February 2020),
- A series of 12 work sessions with the core working group over the period April to August 2021, roughly two hours per session. Invitations to join these sessions were extended to a broader reference group comprising subject matter experts in specific areas e.g. marine ecosystems, agriculture, forestry, biomass and others. The work sessions focused on linking the conceptual framework for the biodiversity economy to the industry and product classifications used for compiling South Africa’s national accounts.

4.2 Linking to classifications used in the national accounts

The benchmarked and rebased estimates of GDP that were released by Stats SA in August 2021 (Stats SA, 2021c) will be used as the starting point for the Biodiversity Economy Satellite Account. The newly benchmarked SUTs from the national accounts cover 118 products and services across 213 industries for the years 2013 to 2018.⁵

The Standard Industrial Classification of All Economic Activities (SIC) (5th edition) was used to classify industries in the SUTs. The SIC is based on the third revision of the International Standard Industrial

⁵ 118 products and services across 213 industries were used to compile the SUTs – this is referred to as the “compilation level” of the SUTs and is available internally in Stats SA. The published SUTs, which are publicly available, are aggregated to 108 products and services across 124 industries. It is significant that the satellite account will be based on the compilation level SUTs, which provide a greater level of detail with fewer assumptions needed to do analyses.

Classification of all Economic Activities (ISIC), which was published in 1990, with suitable adaptations for local conditions. The SIC was designed for the classification of establishments according to kind of economic activity, and provides a standardised framework for the collection, tabulation, analysis and presentation of statistical data on establishments. The Central Product Classification (CPC) version 2.01 was used for commodity classification in the SUTs. This is a global classification with no local adaptations made. The SIC and CPC are hierarchical classifications. In each case we have used the 3-digit level, which is referred as the group level in the CPC.

A key challenge for measuring biodiversity-related economic activity is that the activities involved are scattered across the industry and product classifications used in the national accounts and in economic surveys. A similar challenge exists for the tourism economy or green economy. It arises because biodiversity-related economic activity, as with tourism-related economic activity, is not characterised by the primary activity of the firm. Firms are classified in terms of their primary activity or core activity, whereas the biodiversity economy or the tourism economy is a characteristic or objective that cuts across a range of primary activities. The same applies for products.

Each individual industry code (at the 3-digit level) and product code (at the 3-digit level) was assessed in respect of five parameters:

- Inclusion within the biodiversity economy (yes or no),
- Degree of inclusion (indicated as a percentage range),
- Rationale for inclusion, with examples,
- Category and sub-category of the biodiversity economy into which is best fits,
- Areas of research for further refinement or increased certainty.

Each code was assigned to one of four groups based on an estimate of the proportion of the industry or product class related to biodiversity:

- **All or most** activities/products related to biodiversity (> 80%),
- **Some** activities/products related to biodiversity (between 20% and 80%),
- **Few** activities/products related to biodiversity (< 20%),
- **Not** related to biodiversity (0%).

4.3 Developing principles

The core working group found that it was essential to develop principles to guide the decisions about which industries and products are included in the biodiversity economy and to what extent. Seven inter-related principles were developed iteratively through the work sessions and are summarised in Table 2.

Table 2: Principles guiding the assessment of inclusion or exclusion of industries and products from the biodiversity economy

Principle	Rationale
1. Use the definition of the biodiversity economy, and keep coming back to it!	<p>Definition from the National Biodiversity Economy Strategy (DFFE, 2017): “The biodiversity economy encompasses businesses and other economic activities that either directly depend on biodiversity <i>in South Africa</i> for their core business or that contribute to conservation of biodiversity <i>in South Africa</i> through their activities”.</p> <p>The National Biodiversity Economy Strategy singles out two focus areas, namely the bioprospecting sector and the wildlife sector. Notwithstanding this relatively narrow focus of the National Biodiversity Economy Strategy, the broader definition stands and should be the primary guide for the scope of the Biodiversity Economy Satellite Account.</p> <p>We have added “in South Africa” to the definition as a reminder that the focus is on natural ecosystems native to South Africa and indigenous species.</p>
2. Where an activity is considered part of the biodiversity economy, no part of that activity is excluded because it has a negative environmental impact.	<p>The scope of the satellite account includes all economic activities that depend on biodiversity, regardless of whether their impact on biodiversity and the environment more broadly is positive or negative. Many economic activities that depend on biodiversity can have a negative impact on biodiversity, for example through impacting negatively on ecosystem condition or over-exploiting indigenous species. In some cases these negative impacts are not inevitable but depend on how the activity is managed or regulated. It is not the role of a satellite account to make judgement calls about whether the environmental impact of a biodiversity economy activity is positive or negative.</p> <p>An example is rooibos production. Rooibos is an indigenous species endemic to a small area of the Western Cape, used as a tea and in a range of cosmetic and nutraceutical products. Rooibos can be harvested sustainably from the wild or can be intensively cultivated. Intensive cultivation often involves destruction of threatened ecosystem types when they are converted from natural areas to cultivated fields. Similarly, wildlife ranching can be managed in a way that conserves the associated ecosystem types, or can have negative impacts through overstocking and fencing that fragments the landscape. Intensive farming of wildlife species has similar negative impacts to intensive farming of any livestock.</p>
3. All economic activities related to indigenous species are included.	<p>Economic activities that utilise indigenous species are included, even if they do not also depend on intact natural ecosystems. For example, intensive ostrich farming is included, even though the ostriches have been removed from their natural habitat and are farmed in pens.</p>
4. All economic activities that depend on natural ecosystems are included.	<p>Economic activities that depend on natural ecosystems native to South Africa are included, even where the activity involves non-indigenous species. For example, sheep or cattle farming that relies on grazing in natural rangelands is included. Their inclusion is regardless of whether they are sustainably managed or not, in line with principle 2.</p> <p>In some cases the ecosystem may be semi-natural (or moderately modified) rather than natural, reflecting impacts on its condition from a range of possible factors. So the interpretation of “natural” includes natural, near-natural and semi-natural.</p>

Principle	Rationale
5. Non observed activities in the biodiversity economy are included (inclusive of subsistence, informal and illegal activities)	National accounts provide an estimate for the formal economy and the non-observed economy, which includes illegal production, informal production and own account production (such as subsistence farming). Because the satellite account will use the framework of the Supply and Use Tables compiled in the national accounts, it will also include both formal and non-observed activities. This is important for at least two reasons: <ul style="list-style-type: none"> • Biodiversity makes a substantial contribution to rural economies which are often non-observed, e.g. subsistence activities related to ecosystems and indigenous species. This principle ensures that this economic activity is included in the measurement of the biodiversity economy. • It can be important and useful to get a measure of illegal activities, as this can influence decisions about policy and enforcement.
6. Activities are included even where the proportion related to biodiversity is currently estimated to be negligible (less than 5%)	Many such examples were identified. In some cases, the contribution is likely to remain negligible, but in other cases the contribution may increase in future. Also, the cumulative contribution of these small contributions can be substantial.
7. Activities that may be considered to be part of the green economy more broadly but that are not directly related to biodiversity are excluded.	This is implicit in principle 1 but we feel it is important to reiterate. The biodiversity economy is more narrowly conceived than the green economy.

4.4 Results: industries and products related to biodiversity

This section summarises the results of linking the conceptual framework for defining the biodiversity economy to the industry and product classifications used for compiling South Africa’s national accounts. As explained in Section 4.2, for each SIC and CPC code, at the 3-digit level, an estimate was made of what proportion of the industry or product concerned is related to biodiversity, using the principles set out in Table 2. This approach is similar to the approach used in Eurostat’s EGSS accounts (Eurostat, 2016).

Table 3 and Table 4 give a summary of the number of codes that were assessed as being related to biodiversity for industries and products respectively. The number of codes for which all or most industries or products are considered biodiversity-related is notably small – just two industry codes (0.9% of the total number of codes) and three product codes (2.5% of the total number of codes). If one includes all codes related to biodiversity, including those with likely only a negligible proportion related to biodiversity, the results are 39 industry codes (18.3% of the total number of codes) and 39 product codes (33.1% of the total number of codes).

Table 5 provides a reminder of the five sub-categories of biodiversity-related economic activity that were explained in Section 3. This is followed by Table 6 and Table 7, which list all of the codes that were considered biodiversity-related, together with the proportion estimated to be biodiversity related and the sub-category of the biodiversity economy to which the code was assigned.

In many cases it was clear which group (all or most / some / few / none) a particular code should fall into; in others a judgement call was required. Decisions were made based on the description for each code, combined with our knowledge of industries and products that contribute directly to

conserving biodiversity or depend directly on biodiversity. The ranges (>80%, 20-80%, <20%) were kept broad, reflecting the fact that in most cases there was insufficient basis for finer divisions.

We acknowledge that the process of estimating the proportion of each code related to biodiversity often has unavoidable degrees of subjectivity, and it was through the consultative discussions that a set of assumptions and the guiding principles in Section 4.3 were established and agreed to. Over time, as additional research is undertaken and learnings through the actual measurement of the biodiversity economy take place, the accuracy of the estimates will greatly improve and many of the subjective estimates will be either validated or invalidated. Notes on the decisions about allocation of codes to groups have been documented in a spreadsheet that will be available when the satellite account is published and that they can be revisited in future based on research and further input from expert informants. It may become possible to take a more nuanced approach in which the proportions are customised for different codes rather than applied uniformly within each group of codes.

Table 3: Summary of results for industry codes

Proportion related to biodiversity	Number of SIC codes	% of total number of codes
All or most (>80%)	2	0.9%
Some (20-80%)	1	0.5%
Few (<20%)	36	16.9%
None	174	81.7%
Total	213	100%

Table 4: Summary of results for product codes

Proportion related to biodiversity	Number of CPC codes	% of total number of codes
All or most (>80%)	3	2.5%
Some (20-80%)	1	0.8%
Few (<20%)	35	29.7%
None	79	66.9%
Total	118	100%

Table 5: Summary of biodiversity economy sub-categories

Sub-category of biodiversity-related economic activity	Brief description
A1: Protecting and managing biodiversity assets	Economic activities contributing directly to the conservation of biodiversity, such as management of protected areas
A2: Restoring and maintaining ecological infrastructure	Economic activities aimed at restoring functioning of ecosystems to improve the provision of benefits to people, such as the removal of invasive alien plants or restoring wetlands
A3: Research and professional services related to biodiversity	Economic activities that contribute to knowledge of biodiversity, forming the foundation for management and sustainable use, such as biodiversity-related work in universities and museums
B1: Non-consumptive use of biodiversity	Economic activities that depend on the enjoyment of biodiversity, such as ecotourism or adventure sports, but do not involve consumptive use of biodiversity
B2: Consumptive or extractive use of biodiversity	Economic activities that depend on direct extraction of biodiversity, such as hunting of game or fishing

Table 6: Industry codes selected as biodiversity-related from the full set of 3-digit level codes in the Standard Industrial Classification

SIC code (3-digit level)	Industry description	Estimated proportion related to biodiversity			BDE category (majority fit)
		All or most (>80%)	Some (20-80%)	Few (<20%)	
115	Game hunting, trapping and game propagation, including related services	✓			B2
131	Ocean and coastal fishing	✓			B2
963	Library, archives, museums and other cultural activities		✓		A3
111	Growing of crops, cereal, grain, tobacco, oil seed, fruit, nuts, seeds for sewing; sugar beet; chicory; cotton; vegetable textile fibres; latex; dried veg; pharmacy ingredients;			✓	B2
112	Farming of animals			✓	B2
113	Growing of crops combined with farming of animals (mixed farming)			✓	B2
114	Agricultural and animal husbandry services, except veterinary activities			✓	A3
121	Forestry and related services			✓	A2
132	Fish hatcheries and fish farms			✓	B2
301	Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats			✓	B2
304	Manufacture of other food products			✓	B2
305	Manufacture of beverages			✓	B2
315	Dressing and dyeing of fur; manufacture of articles of fur			✓	B2
316	Tanning and dressing of leather; manufacture of luggage, handbag,			✓	B2
317	Manufacture of footwear			✓	B2
321	Sawmilling and planing of wood			✓	B2
322	Manufacture of products of wood, cork, straw and plaiting material			✓	B2
611	Wholesale trade on a fee or contract basis			✓	B2
612	Wholesale trade in agricultural raw materials, livestock, food, beverages and tobacco			✓	B2
622	Retail trade in food, beverages and tobacco in specialized stores			✓	B2
641	Hotels, camping sites and other provision of short stay accommodation			✓	B1
642	Restaurants, bars and canteens			✓	B1
623	Pharma retail			✓	B2
741	Supporting and auxiliary transport activities; activities of travel agencies			✓	B1
819	Other financial intermediation N.E.C.			✓	A3
851	Renting of transport equipment			✓	B1 B2
871	Research and experimental development on natural sciences and engineering			✓	A3

SIC code (3-digit level)	Industry description	Estimated proportion related to biodiversity			BDE category (majority fit)
		All or most (>80%)	Some (20-80%)	Few (<20%)	
881	Legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and public opinion research; business and management consultancy			✓	A3
882	Architectural, engineering and other technical activities			✓	A3
911	Central government activities			✓	A1
914	Provincial administrations			✓	A1
932	Veterinary activities			✓	A1
951	Activities of business, employers and professional organisations			✓	Unsure - could be any
959	Activities of other membership organizations			✓	Unsure - could be any
961	Motion picture, radio, television and other entertainment activities			✓	B1
964	Sporting and other recreational activities			✓	B1

Table 7: Product codes selected as biodiversity-related from the full set of 3-digit level codes in the Central Product Classification

[Note: This table represents a draft set of codes to be discussed further]

CPC code (3-digit level)	CPC group name	CPC group description	Estimated proportion related to biodiversity			BDE category (majority fit)
			All or most (>80%)	Some (20-80%)	Few (<20%)	
041-042, 049	Fish and other fishing products	Fish, crustaceans, oysters, other molluscs and aquatic, other aquatic plants	✓			B2
180	Natural water	Natural water	✓			B1
212	Prepared and preserved fish	Fish, frozen; dried; crustaceans, molluscs and other aquatic invertebrates	✓			B2
961-966, 969	Recreational, cultural and sporting services	Museum and preservation services, Botanical, zoological and nature reserve services, Sports and recreational sports services		✓		B1
011, 014	Cereals and oilseeds	Cereals including maize, wheat, rice, barley, oats, millet, rye and sorghum, and oilseeds and oleaginous fruits including soya beans, groundnuts in shell, cottonseed, linseed, mustard seed, rape seed, sunflower seed, other oil seeds n.e.c, coconuts, olives			✓	B2

CPC code (3-digit level)	CPC group name	CPC group description	Estimated proportion related to biodiversity			BDE category (majority fit)
			All or most (>80%)	Some (20-80%)	Few (<20%)	
012-013, 015-019	Vegetables and fruits	Vegetables, fruit and nuts, edible roots, potatoes, stimulant, spice and aromatic crops, pulses, including beans, sugar crops, forage products, fibers, and others N.E.C.			✓	B2
021-029	Live animals and animal products (excluding meat)	Live animals, raw milk, eggs, reproductive materials of animals, other			✓	B2
031-032	Forestry and logging products	Wood in rough, non-wood forest products			✓	B1
211	Meat and meat products	Meat and edible offal of mammals and poultry; fresh, chilled or frozen			✓	B2
213	Prepared and preserved vegetables	Frozen and canned vegetables, pulses and potatoes; vegetable juices			✓	B2
215-217	Animal and vegetables oils and fats	Animal and vegetables oils and fats, margarine; oil-cake; flours, meals; waxes			✓	B2
233	Preparations used in animal feeding	Preparations used in animal feeding n.e.c., lucerne meal and pellets			✓	B2
239	Food n.e.c.	Coffee, tea, spices and aromatics, soups, vinegar, sauces, yeasts, other n.e.c.			✓	B2
241-243	Alcohol beverages	Ethyl alcohol, spirits, liqueurs, wines, malt liquors and malt			✓	B2
261-268	Yarn and thread; woven and tufted textile fabrics	Textile fibers and yarn, woven fabrics			✓	B2
282-283	Wearing apparel	Wearing apparel; tanned or dressed fur skins and artificial fur			✓	B2
291-292	Leather and leather products	Tanned/dressed leather, luggage, handbags, saddlery, harness, straps			✓	B2
293-296	Footwear	Footwear; waterproof, rubber, plastic, leather, textile materials, wood; sport			✓	B2
311-317, 319	Products of wood, cork, straw and plaiting materials	Wood; sawn, rough, boards, panels, sheets, boxes; cork, straw, plaiting materials			✓	B2
352	Pharmaceutical products	Pharmaceutical products			✓	B2
381	Furniture	Furniture, mattress support, mattresses, parts of furniture			✓	B2
382	Jewellery and related articles	Pearls, industrial diamonds, jewellery and other articles of precious metal, coin			✓	B2

CPC code (3-digit level)	CPC group name	CPC group description	Estimated proportion related to biodiversity			BDE category (majority fit)
			All or most (>80%)	Some (20-80%)	Few (<20%)	
491	Motor vehicles, trailers and semi-trailers; parts thereof	Motor vehicles, bodies for motors; trailers and semi-trailers; parts thereof			✓	B1 B2
496	Aircraft and spacecraft, and parts thereof	Balloons, gliders, hang gliders, aeroplanes, helicopters, and parts thereof			✓	A3
660, 671-676, 679	Rental and supporting transport services	Rental, cargo handling, storage, warehousing, other supporting services			✓	B1 B2
711-712	Other Financial Services	Other Financial Services excluding FISIM			✓	A3
715-716	Services auxiliary to financial services	Mergers, acquisition, corporate finance services; brokerage; trust, custody			✓	A3
721-722	Real estate services (Owner Occupied), Other Real estate services	Owner occupied real estate services, involving own property, 'Real estate services involving leased property, real estate services on a fee or contract basis			✓	A3
731-733	Leasing or rental services without operator	Leasing/rental for transport equipment, machinery, television, radio; licensing			✓	Unsure could be any of A3, B1, B2
811 -814	Research and development services	Research/development services in natural and social sciences, engineering			✓	A3
821-824	Legal and accounting services	Legal, accounting, auditing, book-keeping, tax consultancy, insolvency			✓	A3
911-913, 941-945, 949	Public administration; sewage and waste collection	Public administration, compulsory social security; sewage, waste collection			✓	A1
921-925, 929	Education services	Pre-primary, primary, secondary, post-secondary, tertiary, other education			✓	A3
951-952, 959, 990	Services of membership organizations	Membership organisations, services by business, employers and professional organisations, services furnished by trade unions, services by other membership organizations, services provided by extra-territorial organisations and bodies			✓	Unsure - could be any

In order to compile the satellite account, a decision will be necessary for each group of codes (all or most, some, few) about what proportion within the range for that group (>80%, 20% - 80%, <20% respectively) should be used in extracting data from the SUTs of the national accounts. The proportions that we propose to use are shown in Table 8, together with alternative proportions that

could be used for sensitivity testing. The choice of these proportions is ultimately arbitrary but the intention is to err on the side of being conservative, with the proportion to be used in each case falling closer to the bottom than the top of the range. As discussed above, further research and information from expert informants may help to refine the proportions on the basis of evidence.

Table 8: Proposed proportions to be used to calculate the economic contribution of the industries and products identified as biodiversity-related to GDP and employment

Group to which industry/product code allocated	Proposed proportion to be used to extract data from SUTs	Alternative proportions that could be used for sensitivity testing	
		Conservative	Generous
All or most (estimate >80% related to biodiversity)	85%	80%	90%
Some (estimate 20-80% related to biodiversity)	40%	30%	50%
Few (estimate <20% related to biodiversity)	3.5%	1%	5%

4.5 Next steps and future work

As the first next step, Stats SA will start with the development and compilation of the first draft Biodiversity Economy Satellite Account for South Africa in September 2021, based on the process and results as was described in Sections 4.1 to 4.4. The framework of the new SUTs time-series for 2013 to 2018, released by Stats SA in August 2021 as part of the benchmarked and rebased estimates of GDP, will be used as the starting point for compilation of the first draft Biodiversity Economy Satellite Account.

As part of this first attempt, Stats SA will also examine the communalities (or “overlaps”) between the Biodiversity Economy Satellite Account for South Africa and the existing Tourism Satellite Accounts for South Africa, which are compiled and released annually by Stats SA. Stats SA is currently in the process of compiling a new TSA time-series for 2013 to 2019 (which will include the new SUTs time-series for 2013 to 2018) for release in November 2021.

Stats SA and SANBI have also already done work on compiling Biodiversity Tourism Estimates for South Africa based on the data from the TSAs for South Africa, the Stats SA Domestic Tourism Survey (DTS), the South African Tourism (SAT) DTS as well as the SAT Departure Survey. Some of the findings from this work were included in the National Biodiversity Assessment 2018 (SANBI, 2018). After Stats SA has released the new TSA time-series for 2013 to 2019 in November 2021, the Biodiversity Tourism Estimates for South Africa will be updated with the new TSA time-series data, as well as additional data from the relevant Stats SA and SAT DTS’s and the SAT Departure Survey for inclusion into the compilation of the Biodiversity Economy Satellite Account for South Africa.

Another next step is for DFFE, SANBI and Stats SA to start engaging on defining and compiling data for more detailed data on employment for the Biodiversity Economy Satellite Account (step 7 of the ten steps towards a thematic satellite account (see Annexure A). Decisions need to be made on including more labour market related variables (e.g. data by level of education, by gender, and/or by occupational group) for the economic activities which are relevant for the biodiversity economy. Decisions on the inclusion of more detailed employment data will depend on the labour market issues that are considered of special significance for policy and research by DFFE and SANBI for the biodiversity economy.

As the development of the Biodiversity Economy Satellite account is still in early stages, there are many areas that will be further developed over time. Research is needed to refine and qualify the many assumptions that were made in the initial assessment of biodiversity-related economic activities. Various research and information needs were identified and recorded through the 12 work sessions held to date, that may allow more granular detail on both the industry and product assessments to improve the current estimates of proportion of each code related to biodiversity. In this first iteration of the satellite account, three ranges will be used (few: <20%; some: 20-80%; all or most: >80%). These ranges are broad and hence create inaccuracy in the measurement process. Focused research to refine these ranges will allow for a more nuanced and accurate account.

For each industry and product code, recommendations for additional research activities have been identified and captured. These research needs have then been assessed on two criteria: 1 – what is the ease of conducting the research and obtaining a result? 2 – what is the potential impact on the estimate of the proportion of the code concerned related to biodiversity? The output of this analysis has provided a list of priority research areas, highlighting potential quick-win research efforts.

As mentioned above, additional work that must still be finalised as part of the first iteration of the Biodiversity Economy Satellite Account is the assessment of the occupational codes in the South African Standard Classification of Occupations. The occupation codes will be assessed with respect to the same criteria and assumptions used for the industry and product classifications. The established working group will continue to lead this process, drawing on additional expertise and guidance where needed.

4.6 Lessons learnt

Notwithstanding that the development of the Biodiversity Economy Satellite Account is at an early stage, several lessons have emerged from the process. Stats SA, DFFE and SANBI will build on these as the project progresses.

1. Defining the biodiversity economy is a novel and complex task that should be guided by principles developed in consultation with key national experts.

The biodiversity sector or biodiversity economy is not measured as an industry in its own right in the national accounts, because "biodiversity" does not constitute an industry in ISIC, but rather an amalgamation of portions of a range of industries. Unlike for example the Tourism Satellite Account, there are no internationally agreed upon manuals or standards that provide concepts, definitions, scope and methodological guidance for the biodiversity economy. Further, the biodiversity economy will look different in different countries. National experts should be involved, and principles should be used to guide the process.

2. Have a small core technical working group is essential.

The working group should consist of identified national stakeholders who are technical experts. It is important to have economists, statisticians and biodiversity experts in the group, so it is likely to require members from beyond the national statistical office. We started off with a larger group but then ended up just having a core team who met consistently and had sufficient stamina and commitment to complete the process. Consistency in membership of this core group is essential to the quality of the work.

3. Hold multiple shorter meetings to avoid fatigue.

This is a methodical process that must be undertaken thoroughly. It takes attention to detail, time and commitment, and can feel tedious. We held sessions of approximately 90 minutes to two hours to hold attention and energy.

4. Involve additional experts as needed to help get better estimates.

In the process we involved subject matter experts in specific areas, such as in marine ecosystems, agriculture, forestry, wildlife ranching. These people were invited to attend specific work sessions rather than being expected to be part of all of them.

5. Allow time in the process for unpacking concepts (even repeatedly) to get to common understanding.

A major strength of satellite accounts is that they are fully embedded in the traditional set of national accounts data. The classifications of industries and products used in the national accounts and their descriptions/definitions are unfamiliar to most people in the biodiversity sector. It takes time to get used to the language and the approach to classification and to work through the definitions, interpreting them in the context of the biodiversity economy. This was an inherently multi-disciplinary task. Multi-disciplinary tasks require facilitation that makes time for coming to shared understanding and allowing for learning.

6. Make assumptions based on best available knowledge or expert judgement, take note of gaps and areas for future research but don't get stuck.

The SNA does not try to provide specific and precise criteria for the definition of what identifies a key sector or activity. It is a matter of judgement in each country, based on economic analysis and economic and social policy requirements. There is an inevitable degree of estimation in the process of initially identifying the products and industries of the biodiversity economy. Areas for future research can be identified but cannot and should not hold up the process of developing the satellite account. It is important to acknowledge that the task is not easy and that using judgement is expected in assigning the proportion of product or industry that is related to the biodiversity economy. This is often very uncomfortable for scientists and biodiversity specialists.

5 Questions for the London Group

In presenting this paper to the London Group, we look forward to discussion around the following questions:

1. Is a Biodiversity Economy Satellite Account likely to be a useful tool in contexts other than South Africa?
2. Is the proposed conceptual framework for the biodiversity economy, including the distinction between the green economy and the biodiversity economy, useful?
3. Is this work relevant to classifications or approaches in the context of the SEEA or the Environmental Goods and Services Sector?

References

Department of Environmental Affairs (DEA). 2017. National Biodiversity Economy Strategy. Department of Environmental Affairs, Pretoria.

Driver, A., Mukhadi, F. & Botts, E.A. 2019. An initial assessment of biodiversity-related employment in South Africa. Developed by the South African National Biodiversity Institute (SANBI) in collaboration with the Development Policy Research Unit. Working Paper 201902. DPRU, University of Cape Town.

Eurostat. 2016. Environmental goods and services sector accounts manual. 2016 edition. European Union, Luxembourg.

Organisation for Economic Co-Operation and Development (OECD). 2019. Developing Thematic Satellite Accounts: The Example of a Thematic Satellite Account for Transport. SDD Working Paper.

South African National Biodiversity Institute (SANBI). 2016. Lexicon of Biodiversity Planning in South Africa. First edition, June 2016. South African National Biodiversity Institute, Pretoria. 72 pp.

South African National Biodiversity Institute (SANBI). 2018. National Biodiversity Assessment 2018 Supplementary Material: Compendium of Benefits of Biodiversity. South African National Biodiversity Institute, Pretoria.

South African National Biodiversity Institute (SANBI). 2019. National Biodiversity Assessment 2018: The status of South Africa's ecosystems and biodiversity. Synthesis Report. South African National Biodiversity Institute, an entity of the Department of Environment, Forestry and Fisheries, Pretoria. pp. 1–214.

Statistics South Africa. 1993. Standard Industrial Classification of All Economic Activities (ed.5). Statistics South Africa, Pretoria.

Statistics South Africa. 2021a. National NCA Strategy: A ten-year strategy for advancing Natural Capital Accounting in South Africa. Report 04-01-00. Statistics South Africa, Pretoria.

Statistics South Africa. 2021b. Quarterly Labour Force Survey, Quarter 2: 2021. Statistical Release P0211. Statistics South Africa, Pretoria.

Statistics South Africa. 2021c. National Accounts: Sources and Methods (Report 04-04-04). Statistics South Africa, Pretoria.

TEEB. 2012. The Economics of Ecosystems and Biodiversity in Business and Enterprise. Edited by Joshua Bishop. Earthscan, London and New York.

United Nations Environment Programme (UNEP). 2013. Green Economy Scoping Study: South African Green Economy Modelling Report – Focus on Natural Resource Management, Agriculture, Transport and Energy Sectors. Report for South African Green Economy Modelling project (SAGEM).

United Nations Statistics Division. Central Product Classification, Version 2.1. Statistical Papers Series M No. 77.

United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, & World Bank. 2010. System of National Accounts 2008. United Nations.

United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, & World Bank. 2014. System of Environmental-Economic Accounting 2012: Central Framework. United Nations.

United Nations. 2021. System of Environmental-Economic Accounting: Ecosystem Accounting. White cover version. United Nations.

Van Paddenburg, A., Bassi, A., Buter, E., Cosslett C. & Dean, A. 2012. Heart of Borneo: Investing in Nature for a Green Economy. WW, Heart of Borneo Global Initiative, Jakarta.

Appendix A: Ten steps towards a thematic satellite account

Based on OECD working paper on developing thematic satellite accounts (OECD, 2019).

Step	Action
Step 1: Defining and compiling data for the desired breakdown of economic activities.	Define the preferable additional breakdowns of economic activities, presented in the columns of the supply and use table.
Step 2: Defining and compiling data for the desired breakdown of products.	Define the preferable additional breakdowns of goods and services, presented in the rows of the supply and use table.
Step 3: Further breaking out taxes less subsidies on products.	In the use table, taxes less subsidies on products are included in the purchasers' price of the product. As a consequence, they are an indistinguishable part of the value of the purchases recorded in the use table. To better account for e.g. the potential impact of changes in these taxes and subsidies on products, one could consider breaking down the rows of the relevant products in the use table, valued at purchasers' price, into the relevant taxes and subsidies and the value excluding these taxes and subsidies.
Step 4: Defining and compiling data for the desired breakdown of value added components.	May want to have a further breakdown of compensation of employees into various categories of employment. May want to have a further breakdown of other taxes (less subsidies) on production.
Step 5: Extending the production boundary with services produced within the enterprise.	If one wants to arrive at a more comprehensive recording of certain activities in the context of a thematic account, one would also need to account for such services produced in-house, even more so if the relevant services are frequently produced within an enterprise. For this purpose, one will have to extend the production boundary as defined according to the SNA.
Step 6: Extending the production boundary with services produced by households for own private use.	May want to extend the production boundary for the unpaid services produced by households for their own final consumption.
Step 7: Defining and compiling data for more detailed data on employment.	Could decide on including more labour market related variables for the economic activities, which are relevant for the theme under consideration. Here, one could think of data by level of education, by gender, and/or by type of jobs. Decisions on the inclusion of more detailed employment data depend greatly on the labour market issues that are considered of special significance for policy and research.
Step 8: Defining and compiling data for more detailed data on investments and capital stocks.	It may be considered useful to have more details on the investments, the capital stocks, and the depreciation costs for various types of non-financial assets. It should be noted that the internationally agreed tables for the collection of data by international organisations does not contain that much detail on investments and capital stocks by economic activity.

Step	Action
Step 9: Complementing the supply and use tables with physical performance and/or outcome indicators relevant for the satellite account under consideration.	May want to complement the socio-economic data on the production process and the related transactions in goods and services with data which provide additional information on the performance or the outcomes of the theme under consideration. Including such data would make it possible to link the production of relevant goods and services, which often is the starting point for (government) policies, with the actual outcomes, and thus analyse the effectiveness of such policies.
Step 10: Complementing the supply and use table with other physical indicators relevant for the satellite account under consideration.	In addition to the physical data on the performance or outcomes directly related to the theme under consideration, one may want to add other policy relevant information as well.