Chapter 35. Measuring the sustainability of wellbeing

(new chapter)

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A. Introduction

35.1 Sustaining and increasing levels of well-being for populations as a whole, for groups within those populations and for future generations is at the heart of sustainable development. Building on the framing of sustainability and well-being presented in Chapter 2 (section B.1), measuring the sustainability of well-being requires introducing a time dimension, i.e. assessing whether the capacity to provide well-being can be secured in the future. From an economic and accounting perspective, the capacity to provide wellbeing in the future is most readily interpreted in terms of the capital available to underpin future well-being with the relevant stocks of capital encompassing economic, natural, human and social capital.

35.2 From the perspective of economic theory, the rationale underpinning a capitals approach to assess sustainability is that non-declining real wealth per capita is a necessary condition for past development to be considered sustainable. An alternative expression of this is that if real wealth per capita has declined then past development should not be considered sustainable, noting that relatively larger increases in real wealth do not imply situations are relatively more sustainable. This economic rationale underpins the work of the World Bank and UNEP in their measurement of comprehensive and inclusive wealth – i.e. by tracking the change in wealth of countries in real terms for multiple capitals, insights can be gained on the sustainability of those countries in providing well-being in the future. Work on wealth accounting reinforces the importance of considering stock measures in both physical and monetary terms for the assessment of sustainable development and not limiting analysis to flow measures of production, income and consumption, such as gross domestic product.

35.3 The use of a capitals approach to assess sustainability provides a broad and structured framework that is grounded in economic theory and can provide a starting point for the assessment of sustainability. However, it cannot be considered an all-encompassing approach. Two general limitations are noted here. First, not all relevant aspects of well-being and sustainability will fall within scope. Chapter 2, Box 1 lists a number of well-being and sustainability measurement initiatives some of which apply or recommend a capitals approach but a number of which do not. The existence of a variety of approaches is not surprising given that whether a given entity, context, region or country can be considered sustainable depends on a wide range of factors including the preferences and aspirations of people. Second, ideally the use of an indicator of real wealth requires a complete coverage of stocks of capital as well as high levels of detail of specific assets such that the aggregate indicator can track substitution across stocks of capital over time. An indicator of this type then allows assessment of weak and strong sustainability (discussed further in Section F). In practice, both the scope and the level of detail may be more limited than ideal.

35.4 Notwithstanding the limits of a capitals approach to providing definitive statements on sustainability, a capitals approach has the distinct advantage of also being able to provide a structured basis for the organization of a relatively comprehensive set of information on sustainability. Thus, this chapter uses the four capitals – economic, natural, human and social – as the starting point for describing accounting approaches for the organization of relevant data which, in turn, provides the capacity for decision makers and analysts to assess sustainability according to their own assumptions and framings. Put differently, accounting can underpin frameworks in which data about the quantity, quality, condition and monetary values of the capitals can be placed in a common context. The subsequent assessment of the effects of future changes in the composition of the capitals and the associated implications for well-being is a task allocated to analysts.

35.5 At the same time, it is noted that the development of an historical time-series of descriptive information about the various types of capital as provided through the implementation of

accounting approaches, can itself help to underpin the development of alternative framings and interpretations of sustainability, for instance by providing data on the extent to which capital has been maintained or there has been substitution across types of capitals. For example, a range of data about stocks of natural capital in physical terms can inform the assessment of sustainability using the planetary boundaries framework.

35.6 A focus on measuring the various capitals using an accounting approach has two related advantages. First, within an accounting approach the measurement of stocks is undertaken in a coherent manner with the measurement of flows. Thus, information about the benefits (and loss of benefits) arising from the use of the stocks of capital can be linked to those stocks. In a system wide context, the mapping of benefit flows associated with different capitals and across multiple locations and economic units provides a rich information set. Second, the information is organized such that it supports communication of the narrative that failure to invest and maintain the stocks of capital (leading to their depreciation, depletion or degradation) implies a loss of benefits from those stocks in the future; and supports the policy-response narrative that investing in stocks of capital (for example through education, restoration of ecosystems, facilitating social networks) is appropriate to secure benefits in the future.

35.7 Within this broad setting of sustainability, this chapter introduces a range of material relevant to the measurement of stocks of capital, both in the context of the SNA sequence of economic accounts and in related accounting frameworks. Section B considers the general descriptions and measurement boundaries for the different types of capital and clarifies the connection to the asset boundary of the SNA. Section C provides a more extensive introduction to the measurement of natural capital as undertaken in the System of Environmental-Economic Accounting (SEEA). Sections D and E discuss the measurement of human and social capital. Section F discusses a number of measurement considerations concerning capital related concepts, such as capacity and resilience, connections to financial assets and issues in valuation.

B. Descriptions and boundaries in measuring types of capital

35.8 This section considers the general descriptions and measurement boundaries for the different types of capital and clarifies the connection to the asset boundary of the SNA. The SNA's sequence of economic accounts incorporates measures concerning a range of different types of capitals within its balance sheet and associated accounts. In the broadest terms, the scope of the sequence of economic accounts encompasses all stocks of capital that satisfy the definition of an asset in Chapter 11. This scope covers stocks of produced non-financial assets (including fixed assets and inventories), non-produced non-financial assets (including purchased goodwill and marketing assets), natural resources (i.e., natural capital excluding ecosystem assets, covering, for example, land, mineral and energy resources and timber resources) and financial assets and liabilities. A complete description of all of the components of the SNA balance sheet is provided in Chapter 14.

35.9 Critical to the discussion in this chapter is that the scope for measurement of assets in the SNA is determined with a focus on the monetary value of the stock of capital which is assessed in terms of expected future flows of (i) benefits arising from goods and services within the production boundary; and (ii) benefits from monetary transactions in assets (e.g. sales of land) or received as property income. Further, the scope of the SNA balance sheet is limited to those assets over which economic ownership is established, including those subject to collective ownership by government on behalf of society generally.

35.10 From a sustainability measurement perspective, this scope supports analysis of, for example, the extent to which the level of investment in fixed assets is sufficient to both offset depreciation of

those assets and underpin future production of goods and services. Such analysis might be applied in the context of individual industries or institutional sectors and can also be considered in the context of investment in specific asset types, such as public infrastructure delivering public goods such as roads and telecommunications networks. However, as introduced in Chapter 2, while this scope of measurement and analysis is important, it is not complete with respect to sustainability since there are a wide range of other factors that should be considered.

35.11 To support wider measurement and analysis of sustainability, four types of capital are identified: economic capital, natural capital, human capital and social capital. Within this typology, the SNA's balance sheet includes economic capital (see section B.1 below) and some aspects of natural capital. Using a wider coverage of capitals, i.e. beyond the SNA balance sheet, provides an improved base for the analysis of sustainability and recognizes explicitly, that other aspects of natural capital, such as the non-market values of ecosystems, and the stocks of human and social capital are important considerations. Figure 35.1 provides a summary of the different components of the four capitals and the following sections provide additional details on the relevant measurement boundaries for each type of capital.

Figure 35.1: Components of four capitals

<table>
<tr><th rowspan="2">Type of capital</th><th rowspan="2">Main components</th><th colspan="2">Links to SNA and SEEA measurement boundaries</th></tr>
<tr><th>SNA</th><th>SEEA</th></tr>
<tr><td rowspan="3">Economic capital</td><td>Produced assets</td><td rowspan="5">SNA Assets in the Sequence of Economic Accounts</td><td></td></tr>
<tr><td>Non-produced assets (excluding natural resources)</td><td></td></tr>
<tr><td>Financial assets and liabilities</td><td></td></tr>
<tr><td rowspan="2">Natural capital</td><td>Natural resources</td><td rowspan="2">SEEA Environmental Assets</td></tr>
<tr><td>Ecosystem assets</td><td></td></tr>
<tr><td>Human capital</td><td></td><td></td><td></td></tr>
<tr><td>Social capital</td><td></td><td></td><td></td></tr>
</table>

35.12 Accounting for different types of capitals should also encompass measurement beyond the monetary value of stocks of capital. Three additional considerations are of particular relevance and are also described in the following sections. First, for all capitals, accounting for the stocks in physical terms and organizing relevant information on the quality, condition and composition of the stocks is fundamental to both the valuation of the stocks and to understanding the sustainability of those stocks, i.e. their capacity to contribute to well-being in the future. Of particular importance in assessing this capacity is understanding the physical thresholds and limits of different types of capital. For example, assessing the capacity to sustainably harvest fish stocks will include, among many other factors, consideration of the size and age structure of the fish stock and the potential rate of replacement of the stock.

35.13 Second, there are flows associated with each stock that are recorded in the sequence of economic accounts and data on these flows will be relevant in supporting an understanding of the changes in the stocks over time and the associated connections to well-being. For example, in relation to human capital, although the stock is not included in the SNA balance sheet, the sequence of economic accounts records flows of remuneration of employees and expenditure on health care, education and training.

35.14 Third, while some flows associated with each stock are recorded in the sequence of economic accounts, all stocks of capital have other associated flows that should be considered in a complete assessment of sustainability. These other flows include a range of benefits that lie outside the SNA production boundary such as ecosystem services generated by natural capital, unpaid household service work (including volunteering contributions), and intrinsic values associated with historic and heritage sites.

35.15 Other flows of interest related to capitals also include those concerning negative effects on stocks of capital such as pollutants and emissions which can reduce the condition of human capital (e.g. through impacts on human health), fixed assets (e.g. through damage to buildings) and ecosystem assets (e.g. through reduced water quality in rivers). Many of these flows can be recorded using accounting frameworks and thus can readily complement the data in the sequence of economic accounts (e.g. by recording data on flows of pollution by industry). Flows of both economic benefits within the SNA production boundary and other benefits such as those listed above will be affected by changes in the condition of stocks of capital.

35.16 Recognizing these other flows, in particular those beyond the SNA production boundary, facilitates a wider discussion on sustainability since the implications of policy choices and investment decisions can be considered more holistically.

35.17 In the following sub-sections, each type of capital is described in turn. This is an understandable structure and is commonly applied in the measurement of capitals, for example in wealth accounting. However, this structure serves to hide the fundamental connections that exist both within each type of capital and among different types of capital; connections which will vary across locations and over time. Thus, while accounting for each of the stocks of capital on its own provides a strong baseline of information, the assessment of sustainability in any given context must consider the (likely non-linear) interactions that are expected to emerge in the future and also consider the different ways in which each capital contributes to wellbeing in any given context. Further, there will be considerable support for analysis and interpretation in providing as fine a level of detail as possible about all types of capital (e.g. in terms of age, location and ownership). For this reason, the aggregation across capitals and interpretation of any balance sheet values in monetary terms, should be undertaken cautiously and using as much complementary data as possible, for example concerning the age and condition of the stock.

1. The scope of economic capital

35.18 *Economic capital refers to the stock of assets that are created through the direct involvement of economic units*. The scope of economic capital includes:

- Produced assets, including fixed assets, inventories, and valuables but excluding cultivated biological resources which are included under natural capital. There are many types of produced assets including buildings, machinery and equipment, infrastructure such as roads, dams and airports, and intellectual property products (e.g. software and artistic originals).
- Non-produced non-financial assets such as contracts, leases and licenses, marketing assets and purchased goodwill but excluding natural resources (and any associated resource leases) which are included under natural capital.
- Financial assets and liabilities.

35.19 Economic capital is a simplifying label to refer to this set of assets. It is useful in the context of discussing sustainability to support communication of the distinction between these assets and the other types of capital. Other labels are also used to refer to this set of assets, most commonly produced capital, but also man-made capital, manufactured capital and built capital. The label

"economic" is applied in an SNA context to support a distinction from the long-standing SNA term "produced assets". Importantly, the use of the label "economic" does not imply that the other types of capital have no economic value and it is noted that some aspects of natural capital are included in SNA balance sheets (see Figure 35.1). The general literature on economics recognizes that natural, human and social capital all generate benefits even if these benefits are not captured within the SNA production boundary.

35.20 The definitions, measurement boundaries and accounting treatments for all of the components of economic capital are thoroughly explained in relevant chapters of the SNA -- in particular chapters 11 - 14. In relation to the measurement of the relevant stocks, the discussion in chapter 17 is most relevant as it describes the concepts and methods for estimating balance sheet values in monetary terms of produced assets (commonly referred to as the "capital stock"), non-produced non-financial assets and associated measures of capital services (including depreciation and depletion).

35.21 The measurement of balance sheet values in monetary terms for produced assets is generally dependent on non-monetary information (or assumptions) about the stock including its age, its expected life and its pattern of contribution to production over time. In addition, using information on the prices of produced assets, it is possible to derive estimates of the volume of the stock of produced assets, i.e. the quantities of the stock weighted by their relative prices. As described in the introduction, indicators of changes in the volume of stock (commonly referred to as real changes), are of direct relevance in the analysis of sustainability and productivity.

35.22 For the assessment of sustainability, it will also be relevant to present separately the non-monetary information about produced assets alongside estimates of their value in monetary terms, including the age and expected life of different asset types. Ideally, estimates of expected asset lives and other forward looking assumptions would incorporate information on the condition of the produced assets (for example from an engineering perspective), expected levels of use (for example in relation to population growth) and exposure to and relationships with catastrophic events (such as fire, flood, or earthquake). This additional information could also be organized and presented to support analysis of sustainability.

2. The scope of natural capital

35.23 The System of Environmental-Economic Accounting (SEEA) provides the international standard to measure natural capital and has agreed concepts, definitions and accounting treatments for measuring the components of natural capital in physical and monetary terms, including approaches to recognizing benefits beyond the SNA production boundary. To establish a measurement scope for the stock of natural capital, SEEA defines environmental assets as *the naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity* (SEEA Central Framework, 2.17). From this broad, biophysical scope, two primary measurement categories emerge: natural resources and ecosystem assets.

35.24 Natural resources are included in the SNA balance sheet since they satisfy the SNA's definition of assets. The relevant types of natural resources include land, mineral and energy resources, biological resources (e.g. timber, fish, livestock), water resources and some other resources (e.g. radio spectra). Chapter 14 provides a complete set of definitions and descriptions of these natural resources from the perspective of the SNA asset boundary.

35.25 *Ecosystem assets are contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions* (SEEA Ecosystem Accounting, 2.11). There are a wide range of types of ecosystem assets including forests, coral reefs, lakes, wetlands and urban areas where each occurrence of a specific type is treated as a distinct ecosystem asset.

When accounting at a national level, all ecosystem assets within the economic territory of a country (including its exclusive economic zone (EEZ)) should be included such that the total area of the economic territory is accounted for.

35.26 While this framing of natural capital encompasses stocks of natural resources and ecosystem assets, these two categories of natural capital are not mutually exclusive and there is a clear overlap between ecosystem assets and a number of natural resources including land, biological resources and water resources. For example, from the perspective of natural resources the stock of fish in a lake is a distinct asset while from the perspective of ecosystem assets the lake is a type of ecosystem and the fish stock is a feature or characteristic of that asset in addition to the water, plants and other animals in the lake. In effect, accounting for the stock of natural resources has a focus on individual components of the biophysical environment whereas accounting for the stock of ecosystem assets has a focus on the combination of individual components in distinct contexts.

35.27 A further important point of difference between accounting for natural resources and accounting for ecosystem assets lies in the range of benefits which are within scope of measurement. For individual natural resources, for example timber resources, accounting in both the SNA and the SEEA is limited to recording the contributions of natural resources to benefits that are within scope of the SNA production boundary. For example, for timber resources, only the contribution of the trees to the production of timber is recognized. In effect, for most natural resources other than land, this limits the accounting to recording those products that are harvested or extracted from the environment.

35.28 In contrast, when accounting for ecosystem assets a wider measurement scope is applied that recognizes the contributions of ecosystem assets, such as a forest, to benefits both within the SNA production boundary (such as timber) and outside the SNA production boundary. To facilitate this recording, the contributions of ecosystem assets are separately recorded as flows of ecosystem services, whereas in the standard sequence of economic accounts the contributions of natural capital to SNA products are implicit in measures of gross operating surplus. The use of a broader scope of benefits and the explicit recording of ecosystem services permits the recognition of a range of contributions from natural capital, including among other things, air filtration services, flood mitigation services, coastal protection services, global climate regulation services, water purification services and recreation-related services. A more complete introduction to ecosystem accounting is provided in section C below.

35.29 Overall, the combination of natural resources and ecosystem assets provides for the comprehensive measurement of the stock of natural capital. However, given the overlapping scope of these two components, careful partitioning of monetary values is required if there is a requirement for aggregation so that there is no double counting.

35.30 Generally, individual elements and substances such as nitrogen, oxygen, carbon, soil nutrients, salt and phosphate that are present throughout the biophysical environment and commonly embodied in natural resources listed above are not treated as distinct assets. However, in some cases, and setting aside the individual elements (gold, copper, lithium) that are within the scope of mineral resources, specific deposits of other elements and substances that are harvested or mined can be treated as natural resources. This would include, for example, deposits of salt that are mined and extracted. Note that carbon embodied in trees and other biological resources may be recorded separately but is not considered a distinct asset.

35.31 From the perspective of the SNA sequence of economic accounts, including the balance sheets, the scope of natural capital excludes environmental assets over which ownership rights have not, or cannot, be established, such as open seas or the atmosphere. Further, stocks of natural capital are only recognized in the sequence of economic accounts to the extent that they provide economic benefits to their owners, either individually or collectively. In this context, economic benefits refer

to gains arising from the economic activities of production, consumption or accumulation.

35.32 Thus, for example, mineral and energy resources are included in the SNA balance sheet to the extent that they are commercially recoverable given current and expected technology and relative prices and potentially recoverable resources are excluded if it is not foreseen that they will be exploited in the near future. Similarly, water resources are included to the extent that their scarcity leads to the establishment of ownership and/or use rights, market valuation and some measure of economic control and biological resources are included to the extent that ownership rights are established which for migrating resources may be evidenced through a quota regime.

35.33 As detailed further in section C below, the measurement scope of natural resources applied in the SEEA is broader than the SNA by including all resources irrespective of their current ownership status or provision of economic benefits. The only limit in the SEEA concerns the exclusion of those resources outside the economic territory over which a country has control, which for those countries with a maritime boundary will include its EEZ. It is also noted that in the SEEA the radio spectrum is not considered part of the biophysical environment and hence is not included as part of natural resources but, in the SNA, it is included as part of natural resources.

35.34 A common topic of discussion in the measurement of natural capital is biodiversity. Following the Convention on Biological Diversity (CBD), *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 a part; this includes diversity within species, between species and of ecosystems*. In short, three levels of biodiversity are recognized – genetic diversity, species diversity and ecosystem diversity. From an accounting perspective, it is possible to organize data to support the derivation of measures of diversity at each of these levels, but diversity itself is not directly measured. For example, accounts can record the composition of different ecosystem types across a country and accounts can be used to record the mix of different species. Measurement of ecosystem assets will support the measurement of ecosystem diversity. SEEA Ecosystem Accounting provides a longer discussion on the links between accounting and the measurement of biodiversity.

3. The scope of human capital

35.35 A general definition of human capital is *the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being*. This definition provides a clear foundation that incorporates both economic and non-economic benefits arising from the use of human capital by individuals. From an economic perspective, the creation of human capital, or put differently, the acquisition of knowledge, skills, competencies and attributes, increases the productive potential of the individuals in an economy and is a source of future economic benefit to them. In addition to knowledge and skills, the productive potential of individuals will be influenced by their health and life expectancy.

35.36 In general, much of the focus from a national accounting perspective on human capital has been on the connection between human capital and labour inputs to production with the value of the stock of human capital being measured either in terms of future flows of labour earnings taking into account the current age and education profile and expected retirement ages or in terms of costs involved in generating human capital, e.g. education costs. The focus on the link to labour inputs to production supports standard macro-economic analysis, including productivity measurement.

35.37 However, there are also important contributions of individuals' knowledge, skills, competencies and attributes to activities outside the SNA production boundary and extended measurement of human capital to recognize these contributions, for example in the areas of unpaid household service work, both to individual households and to wider society is encouraged. Consequently, a

wider range of contributions can be recognized (i.e. beyond labour inputs to the production of goods and services within the SNA production boundary) and also a wider range of individuals can be included in the stock of human capital (i.e. those people outside the labour force).

35.38 Section D provides a longer discussion on the measurement of human capital and the links to measurement of education and training are presented in Chapter 34. There is also relevant content in Chapter 16 on Labour tables that presents a range of information on the composition and structure of the labour force which, in turn, supports understanding of the stock of human capital.

4. The scope of social capital

35.39 In broad terms, social capital refers to the combination of formal and informal institutions and networks that support the functioning of our societies and economies. As noted in Chapter 2, measurement of social capital is a developing area but, at present, its measurement from an accounting perspective, in particular concerning its valuation, is not sufficiently advanced for a substantive discussion on measurement approaches here. Nonetheless, Section E provides an introduction to the concepts and measurement of social capital recognizing the need for research and discussion to establish the ways in which social capital can be effectively defined and measured for statistical and accounting purposes.

C. Measuring natural capital using the SEEA

35.40 As introduced in Section B2, the SEEA provides the statistical standards and accounting framework for the organization of data about natural capital and its connection to the economy. This provides the basis for measuring the wider scope of natural capital that is relevant for the analysis of sustainability. A full description of relevant concepts, definitions, accounting rules, classifications and other content is provided in the SEEA Central Framework and the SEEA Ecosystem Accounting and in a number of related documents and guidance materials. This section provides a short overview of that material and highlights distinctions between the treatments in the SEEA and those applied in the compilation of the SNA sequence of economic accounts.

35.41 This section summarizes four broad measurement themes of the SEEA that are relevant to accounting for the various stocks and flows related to natural capital. They concern (i) accounting for natural resources (excluding land); (ii) accounting for land and ecosystems; (iii) accounting for environmental flows; and (iv) accounting for responses to environmental challenges by economic units.

35.42 An initial motivation for the development of the SEEA was the desire to recognize explicitly the costs arising from economic activity of using, depleting, or degrading natural capital such that measures of economic growth, for example gross domestic product, could be adjusted and hence reflect more completely the implications and sustainability of patterns of economic growth. Over time, while this motivation has remained, the richness of the connections between the environment and the economy has become more fully understood and has driven the breadth of measurement themes listed above.

35.43 A key role of the SEEA is therefore to bring an increased level of consistency and coherence across each of these measurement themes using accounting-based approaches recognizing that, in general, measurement of the environment has been undertaken in a less structured and coordinated way compared to measurement of the economy. Three aspects of the application of accounting approaches in the SEEA are highlighted here. First, the SEEA develops accounts in both physical and monetary terms for both stocks and flows related to natural capital. This focus supports direct

integration of the rich body of scientific research and data about the environment and ensures that measures in monetary terms can be grounded in an appropriate biophysical reality.

35.44 Second, the SEEA applies and adapts the accounting rules and treatments of the SNA with the intent of supporting the integration of environmental data with the standard economic data organized within the SNA sequence of economic accounts. This connection is present in the SEEA's articulation of production boundaries and asset boundaries, approaches to monetary valuation and the structure of accounts such as supply and use tables and asset accounts.

35.45 Third, the SEEA uses standard classifications and typologies to build connections across the different accounts, including the SNA sequence of economic accounts. These classifications and typologies cover industries, institutional sectors, products, natural inputs, residuals, environmental assets, environmental purposes, ecosystem types and ecosystem services. These classifications and typologies also support building connections between the definitions and classifications used by the individual subject matter experts (e.g. energy and water experts) and the standard economic classifications with the objective of integrating existing subject matter specific data with economic data through a structured accounting approach.

35.46 Overall, the SEEA aims to provide a rich description of natural capital and its links to the economy. This description emerges both through compiling accounts that provide a baseline of coherent data and through establishing a common language for economists, environmental scientists, accountants and statisticians to support the organization and exchange of data about the many components of natural capital and their links to the economy.

1. Accounting for natural resources

35.47 Accounting for natural resources in the SEEA is described in the SEEA Central Framework. The aim is to compile comprehensive asset accounts in physical and monetary terms for individual natural resources. The SEEA describes asset accounts for both non-renewable and renewable natural resources including mineral and energy resources, soil resources, timber resources, aquatic resources (in particular fish stocks) and water resources. The purpose in developing these accounts is to organize data on the stocks and changes in stocks of each of the resources and hence support an understanding of whether the current patterns of extraction and harvest of resources is sustainable. It should be noted that in these asset accounts, in situ uses of the resources are excluded.

35.48 For an individual resource, an indicator of sustainability is depletion reflecting the decline in the quantity of a resource that is not offset by regeneration of the stock recognizing that the degree of regeneration will be dependent on the extent and condition of the underlying stock of the resource. Depletion can be measured in physical terms for each resource and in monetary terms by estimating prices for the value of the change in the stock (see SEEA Central Framework Annex 5.1). The SEEA Central Framework describes the accounting entries that are relevant for attributing the cost of depletion against the extractor of the resource and, following a similar motivation, the SNA sequence of economic accounts records depletion as a cost of production of the extractor.

35.49 The natural resource asset accounts described in the SEEA follow the same structure as asset accounts in the SNA commencing with an entry for the opening stock at the beginning of the accounting period, showing entries for additions to stock and reductions in stock, including changes due to normal growth and extraction and changes due to catastrophic events, and concluding with an entry for the closing stock at the end of the accounting period. For the asset accounts in monetary terms a revaluation entry is also included.

35.50 The monetary valuation of natural resource stocks and changes in stocks in the SEEA aligns with the SNA and the same valuation concept is applied. Thus, balance sheet values in monetary terms

and measures of depletion in monetary terms are able to be used commonly in both accounting systems. From this perspective, the description of accounting for natural resources in the SEEA provides a richer and more comprehensive discussion than is provided in the SNA but one which can be used to support directly the compilation of estimates for the SNA sequence of economic accounts.

35.51 The following table shows the entries that are most likely for different types of natural resources and provides a stylized overview of the information organized and presented concerning natural resources using the SEEA.

Table 35.1: General structure of the asset accounts for natural resources

		Mineral & energy resources	Land (incl. forest land)	Timber resources	Aquatic resources	Water resources
Opening stock of resources		Yes	Yes	Yes	Yes	Yes
Additions to stock of resources						
	Growth in stock	na	Yes*	Growth	Growth	Precipitation Return flows
	Discoveries of new stock	Yes	na	na	Yes*	Yes*
	Upwards reappraisals	Yes	Yes	Yes*	Yes*	Yes*
	Reclassifications	Yes	Yes	Yes	Yes	Yes
	Total additions to stock					
Reductions in stock of resources						
	Extractions	Extractions	na	Removals	Gross catch	Abstraction
	Normal reductions in stock	na	na	Natural losses	Normal losses	Evaporation Evapotranspiration
	Catastrophic losses	Yes*	Yes*	Yes	Yes	Yes*
	Downwards reappraisals	Yes	Yes	Yes*	Yes*	Yes*
	Reclassifications	Yes	Yes	Yes	Yes	na
	Total reductions in stock					
Closing stock of resources		Yes	Yes	Yes	Yes	Yes

na – not applicable

* - An asterisk indicates that this flow is not usually a significant flow for the resource or it is typically not separately identified in the source data. In practice, not all cells that show the possibility of an entry here should be shown separately in the published accounts for each type of resource.

2. Accounting for land and ecosystems

35.52 Accounting for land and ecosystems is described in both the SEEA Central Framework and the SEEA Ecosystem Accounting. The starting premise is that a geographic area, such as the total area of the economic territory of a country, can be fully delineated into different types of areas according to agreed concepts, definitions and classifications. This measurement scope is broader than that applied in the SNA sequence of economic accounts which only includes areas of land that satisfy the SNA's definition of an asset.

35.53 Tracking the composition and changes in the composition of a country's land use, land cover and

ecosystems can provide important information on the extent to which certain areas of a country are changing (e.g. due to urbanization), support measurement of changes in the condition of the environment, monitor the balance of ways in which land is used (e.g. for agriculture) and underpin analysis of future trends. In accounting for the area of land and ecosystems data can be presented in tabular form but it is also common and of significant analytical benefit, to present data in the form of maps which best supports spatial analysis. Spatial analysis is needed since, at a national scale, it is likely that the effects of important changes occurring at landscape scale are overlooked and the associated sustainability challenges are ignored.

35.54 In accounting for land, including inland water and marine areas within a country's EEZ, the SEEA does not consider land as a type of natural resource alongside timber, fish and minerals as in the SNA. Rather the SEEA has a distinct view that *land is a unique environmental asset that delineates the space in which economic activities and environmental processes take place and within which environmental assets and economic assets are located*. A consequence of this conceptualization is that land itself is non-depletable – i.e. the space cannot be reduced over time. However, the characteristics or attributes of that space can change and it is these characteristics that are the most common focus of accounting for natural capital. The changes in characteristics may be large, for example from terrestrial to marine ecosystems in the case of sea-level rise, or the reverse in the case of reclamation projects. This approach contrasts with the SNA framing in which the entry point is whether a particular area provides economic benefits.

35.55 An important statistical outcome in conceptualizing land (including inland water and marine areas) as space, is that accounting for land then provides the foundation for ensuring a comprehensive measurement of all ecosystems and natural resources, in a similar way to that of a business register providing a comprehensive basis for the measurement of economic activity of a country.

35.56 The delineation of areas within a country can be undertaken using a range of concepts and methods. The two primary concepts for accounting for land are land use and land cover. Land use reflects both (a) the activities undertaken and (b) the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions (SEEA Central Framework 5.246). Examples of land uses include agriculture and forestry. Land cover refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces. Examples of land cover include herbaceous crops, tree-covered areas and grassland.

35.57 The SEEA Central Framework provides a description of accounts for land use and land cover and the associated classifications. Land accounts take the form of asset accounts with an opening area, additions and reductions in area and closing area. Land accounts may also be developed on the basis of land ownership or tenure, for example by industry or institutional sector, and monetary values for land can also be estimated. A powerful analytical tool is the land account change matrix showing, for a given concept such as land use or land cover, which classes of land have changed between two points in time. The table below shows a land cover change matrix.

Table 35.2: Land cover change matrix (SEEA Central Framework)

		Increases (positive numbers) and decreases (negative numbers) from other land covers													
Land cover	Opening area	Artificial surfaces	Crops	Grassland	Tree covered area	Mangroves	Shrub covered area	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow, glaciers and inland water bodies	Coastal water and inter-tidal areas	Net change (increase-decrease)	Closing area
Artificial surfaces														
Crops														
Grassland														
Tree covered area														
Mangroves														
Shrub covered area														
Regularly flooded areas														
Sparse natural vegetated areas														
Terrestrial barren land														
Permanent snow, glaciers and inland water bodies														
Coastal water and inter-tidal areas														

35.58 Accounting for ecosystems commences with the delineation of a country's area according to a classification of ecosystem types and ecosystem extent accounts which follow the structure of land accounts just described can be compiled. These accounts show the composition of a geographic area referred to as an ecosystem accounting area (e.g. a country, province, catchment) in terms of different types of ecosystem assets, for example, the area of forests, wetlands, mangroves, lakes and urban areas, and how this composition is changing over time. The difference between ecosystem extent accounts and land accounts does not concern the account structure but the different classification of areas – i.e. the different classes of ecosystem types, land uses and land cover.

35.59 Other aspects of accounting for ecosystems build on the delineation of ecosystem assets to provide a structured and coherent data set on the condition of ecosystem assets, the ecosystem services generated by ecosystem assets in physical and monetary terms, the use of ecosystem services by different economic units, and the value of stocks and changes in stocks, including degradation, of ecosystem assets based on the net present value of the expected ecosystem service flows.

35.60 The ecosystem accounting framework is shown in Figure 35.2 below and Figure 35.3 shows the set of ecosystem accounts. SEEA Ecosystem Accounting provides a description of the concepts, definitions, classifications and accounting treatments. Collectively, the information set established through ecosystem accounting provides a basis for a wide range of analysis about the connection between natural capital and the economy including, for example, the potential to estimate a range of market and non-market effects of changes in ecosystems on different economic units.

Figure 35.2: The general ecosystem accounting framework (SEEA Ecosystem Accounting)

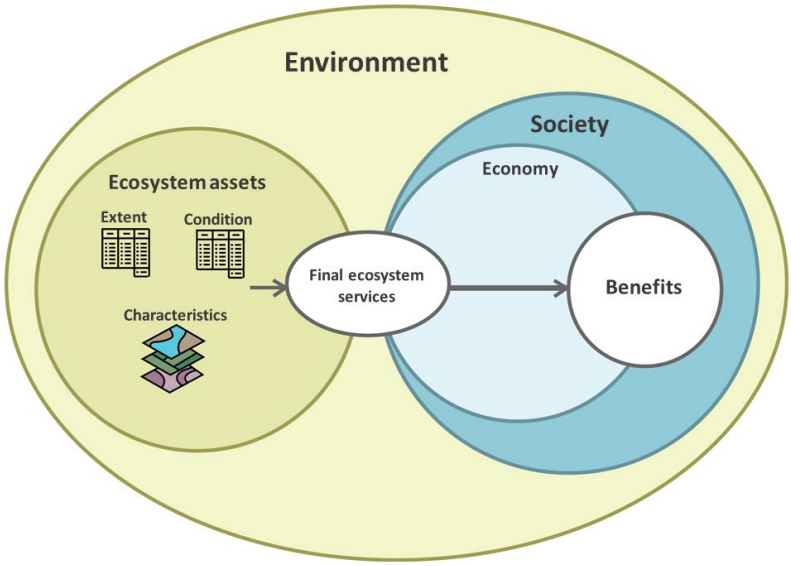
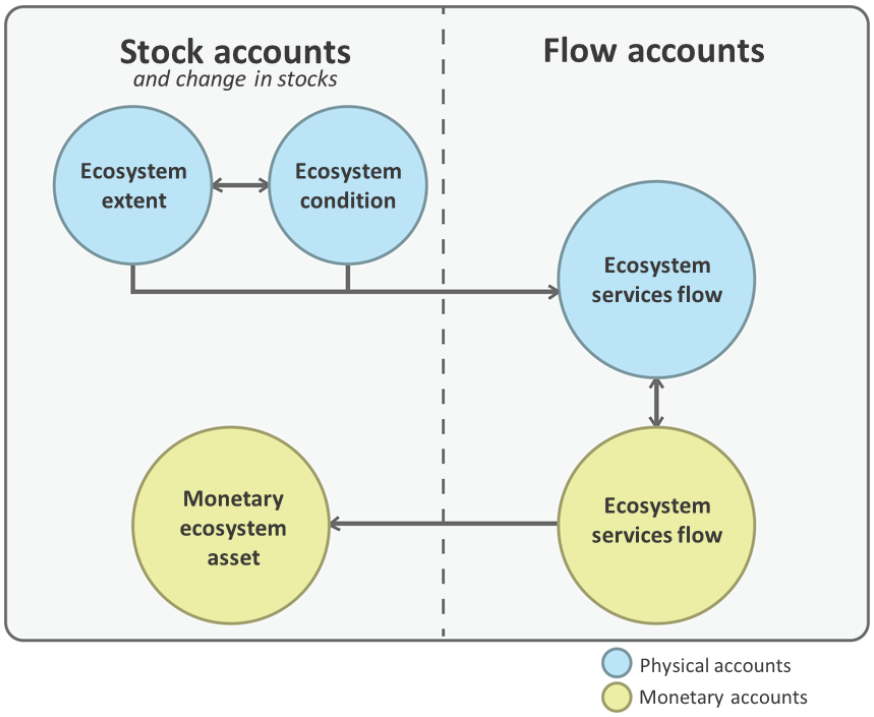


Figure 35.3: Connections between the ecosystem accounts (SEEA Ecosystem Accounting)



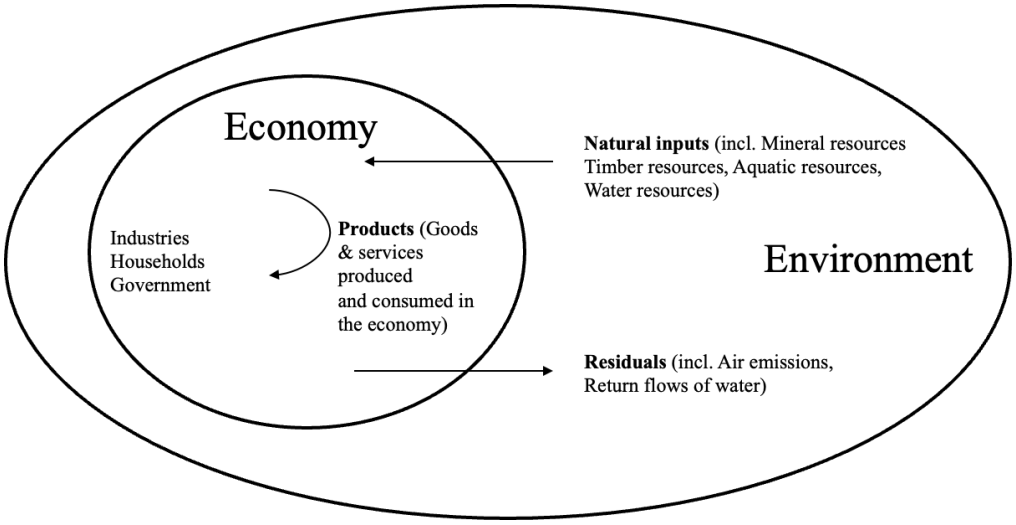
35.61 For some types of land, in particular agricultural land, forest land and urban areas, all of which are in scope of ecosystem accounting, there will be an overlap between the value of ecosystem assets and the value of the land recorded in the SNA balance sheet. This overlap arises because the ecosystem services generated by those areas include some which generate economic benefits for the owners of the land. For example, the value of agricultural land will be linked to the supply of crop provisioning services, the value of forest land will be linked to the supply of wood provisioning services and the value of urban land will be linked to the supply of recreation-related services (e.g. from urban parks). Consequently, care needs to be taken in integrating measures of ecosystem asset values in monetary terms with the value of land and other assets in the SNA balance sheet. A discussion on this topic is presented in SEEA Ecosystem Accounting Chapter 11.

35.62 In the development of ecosystem accounting since 2010, the ecosystem accounting framework has been applied to more directly account for other components of natural capital including stocks and changes in stocks of carbon and species. Data from carbon stock accounts and species accounts provide valuable and policy relevant information in their own right but also support the compilation of the various ecosystem accounts. It has also proved relevant to focus ecosystem accounting work on specific ecosystem types, for example mangroves, forests, wetlands, urban areas and oceans, to provide a systematic view of the links between those ecosystem types and economic activity. Other ecosystem accounting work has looked at connections between ecosystems and selected economic activities such as tourism and agriculture, or for specific land use types such as protected areas. Overall, the core ecosystem accounting framework can be applied in a range of different ways applying the general principles of thematic accounting as described in Chapter 38.

3. Accounting for environmental flows

35.63 A fundamental component in the SEEA is the description of standard approaches to the recording of data about environmental flows. Environmental flows concern flows of substances such as water, energy, solid waste, air emissions, that move from the environment to the economy (natural inputs), within the economy or from the economy to the environment (residuals) (see Figure 35.4). The accounting is undertaken in physical terms for each substance using a supply and use structure with the environment being included as an additional supplier and user.

Figure 35.4: Flows between the economy and the environment (SEEA Central Framework)



35.64 The physical supply and use tables (PSUT) that are used to record environmental flows provide a rich information set linking the flows of each substance to extracting or generating industries. For example, the energy PSUT organizes data on flows of energy from different natural inputs (coal, oil, gas, biomass) to economic units and through the economy; and the air emissions PSUT organizes data on the flows of air pollutants generated by different industries.

35.65 The tracking of environmental flows using PSUT supports direct connection to production and consumption data in the standard monetary SUT and more generally, provides insight into the pressures and impacts on the environment from different industries and how this is changing over time. The information can be readily linked to measuring the success of progress toward a more circular economy, a common focus of sustainability policies. Further, these accounts are essential for building footprint indicators that reflect the quantity of carbon, energy, materials, water and emissions embedded in products being consumed domestically or traded internationally.

35.66 Generally, PSUT are compiled at national level but where they can be compiled at a sub-national scale (for example, water PSUT compiled by catchment) the variation in environmental pressures and impacts across the country can be identified and, ideally, linked to data from the ecosystem accounting on the changing condition of ecosystem assets. For example, data on the condition of rivers might be linked to data from the water PSUT on abstraction of water and generation of wastewater. PSUT are usually compiled on an annual frequency but higher frequencies can also be compiled. For example, quarterly air emission accounts can be compiled and released side by side with quarterly estimates of GDP to track progress towards a low carbon economy.

35.67 In addition to these flows of natural inputs, products and residuals, flows of ecosystem services can be recorded in supply and use tables in both physical and monetary terms. These tables show the supply of ecosystem services by different types of ecosystem assets and the use of ecosystem services by economic units. The SEEA EA provides a reference list of ecosystem services covering provisioning services, regulating and maintenance services and cultural services.

4. Accounting for environmental transactions

35.68 The three accounting components discussed above focus on recording different natural capital stocks and flows. The fourth component focuses on identifying transactions recorded in the SNA's sequence of economic accounts that relate to natural capital. There are a number of types of transactions that are within scope

- Environmental taxes
- Environmental subsidies and similar transfers
- Transactions related to environmental protection and resource management
- Transactions related to the environmental goods and services sector
- Transactions related to the use of natural resources including permits, licences and rents

35.69 Each of these types of transactions is described in the SEEA Central Framework along with relevant definitions, accounting treatments and classifications.

35.70 These data are of high relevance in the discussion of environmental sustainability since they provide insight into the responses of economic units to environmental challenges. Many of the transactions concern government activity and regulation concerning natural capital but there is also the potential to record the activities of businesses and households as they relate to production and expenditure for environmental purposes. Across all sectors there is an increased level of economic activity for these purposes and the use of standard frameworks and definitions to record the

relevant transactions, including cross-border flows, is of significant policy and analytical interest, for example in relation to managing responses to climate change.

35.71 While conceptually all of these transactions are within scope of the SNA, in practice, the major challenges are identifying the relevant transactions, especially in terms of whether a particular transaction has a primary purpose which is environmental, and consistently classifying the transactions to support comparability over time and across countries. The Classification of Environmental Purposes adopted in 2024 provides a framework for classifying a wide range of relevant transactions.

35.72 To support a more structured approach to recording transactions for environmental purposes, the SEEA Central Framework describes environmental protection expenditure accounts (EPEA) which provide a series of tables for recording the supply of environmental production specific services, the national expenditure on environmental protection and the financing of that expenditure. The SEEA Central Framework also describes a table for the presentation of data on the environmental goods and services sector (EGSS) covering the output of environmental goods and services and associated measures of intermediate consumption, gross value added, compensation of employees, gross fixed capital formation, exports and employment.

D. Measuring human capital

TO REVIEWERS: The discussion of human capital was initially envisaged for inclusion in Chapter 34 on the Measurement of Well-being. Subsequently, it has been determined that it is more appropriate for that material to be included in this chapter. However, at this stage, the material on human capital has not been included in this version of Chapter 35 for Global Consultation, since it has already been the subject of global consultation via Chapter 34. The relevant material will be incorporated in Chapter 35 (taking on board comments already received) for the full version of the SNA to be posted for Global Consultation in June 2024.

E. Measuring social capital

35.73 The concept of social capital is expressed in a number of different ways. Most broadly, it is about the social norms, shared values and institutional arrangements that foster co-operation among population groups. Given the variety of norms, values and institutional arrangements, it is not surprising that social capital can be measured in a range of ways and researchers have highlighted social capital's influence at the level of individuals, at the level of social networks and at the level of institutions. For the purposes of discussion here, social capital is defined as the combination of formal and informal institutions and networks that support the functioning of our societies and economies.

35.74 Drawing from the research on by the Conference of European Statisticians (CES) on measuring sustainable development (UNECE, 2015), social capital can influence well-being through three primary channels:

i. Direct well-being effects on individuals who are part of social networks. From a well-being perspective, it is important to include in the measurement of social capital those networks that aim to connect different groups in society as these networks can be expected to generate high levels of generalized trust and may have the highest impact on the well-being of society

as a whole.

ii. Stimulation of increases in other types of capital. This may occur for example in the context of human capital where social networks facilitate job searches and reduce unemployment or in the context of education where supportive parents and communities can drive better education outcomes for students. In the context of economic capital, social networks can support innovation and the general creation and diffusion of knowledge. In the context of natural capital, social networks can build and change social norms and values with respect to the environment and the restoration of stocks of natural capital.

iii. Through networks, increases in social capital can improve efficiency in the use of other capitals and in production processes generally and hence can support reductions in transaction costs. This effect will be driven not only through the number of networks but also by the levels of trust that are built up within networks. Higher levels of generalized trust can provide informal checks on processes and transactions and facilitate higher levels of social and economic interaction. At a macro-scale this effect can be seen in terms of the extent to which there are harmonious relationships between state and society.

35.75 Social capital is almost exclusively measured in physical units. The CES recommends five indicators two concerning the theme of trust – generalized trust and bridging social capital; and three concerning the theme of institutions – voter turnout, the percentage of women in parliament and the contribution to international institutions. Research in a range of contexts is ongoing to further develop metrics in this area and the integration of this research within a general multiple capitals framing is important given the range of connections across the capitals that are evident. In many contexts, it may be that investments in social capital provide a cost-effective means of securing well-being outcomes via its influence on the condition of the stocks of other capitals.

35.76 The monetization of social capital seems to be out of reach for the foreseeable future and consideration is needed as to whether this is a required objective. Recognizing that the assessment of sustainability requires a strong basis in data on the quantity and condition of capital stocks, a relevant near-term measurement objective is likely to involve a focus on physical measures and establishing agreed definitions and interpretations of social capital within the official statistical community as well as the wider sustainability and well-being community.

F. Considerations in measuring sustainability

35.77 The measurement of the different types of capital and all of the more detailed components is a significant undertaking. The SNA provides key definitions and treatments for all types of economic capital and some components of natural capital but for compilation purposes, additional guidance must be consulted and a range of handbooks and other materials have been prepared to provide this support. These include guidance on the measurement of the capital stock (of produced assets) (OECD, 2009), and guidance on the measurement of land (OECD & Eurostat, 2015). With respect to natural capital there are many SEEA based compilation resources, handbooks for individual natural resources such as timber, fish and mineral and energy resources, and implementation guidance on the measurement of natural resources within the context of the SNA sequence of economic accounts.

35.78 This section highlights a small number of general measurement considerations that can arise in the measurement of stocks and flows of capitals and in interpreting the resulting data. A general message is that all measures of capitals should be well documented to explain clearly the measurement scope and all relevant assumptions. These considerations are relevant in relation to

measurement of the SNA sequence of economic accounts and to measurement of capitals beyond the sequence of economic accounts. With this scope in mind, the discussion in the following sections aims to highlight opportunities and connections relevant to national accounts compilers in the measurement of sustainability more generally.

1. Links to measurement of adjusted economic aggregates and extended accounts

35.79 The SNA sequence of economic accounts incorporates a range of net measures which adjust for the costs of depreciating and depleting economic and natural capital. These net measures include NDP, net national income and net household saving. Further, monetary values in balance sheets are recorded at their depreciated or depleted values, i.e. in net terms. It is possible to extend the scope of net measures, both in the income accounts and in the balance sheets, to incorporate a broader range of capitals. The economic theory for this extension is developed in the literature on wealth accounting and estimates of inclusive and comprehensive wealth based on this theory have been regularly published including by the World Bank and UNEP, recognizing that these estimates do not cover all capitals and associated benefits.

35.80 The SEEA Ecosystem Accounting, Chapter 11, describes the potential to extend the sequence of economic accounts based on monetary values of ecosystem services (thus extending the SNA production boundary) and associated monetary values of ecosystem assets and changes in the value of those assets reflected in measures of enhancement and degradation. There are a number of challenges in making this extension including aligning the values of ecosystem assets with the value of land as an economic asset and determining an appropriate allocation of values to institutional sectors in cases where the beneficiaries are not the economic owners.

35.81 A separate accounting application related to the measurement of environmental flows is the compilation of input-output tables which incorporate additional rows alongside the standard set of products. The additional rows, which concern things like water use, energy use, GHG emissions, material flows and ecosystem services, may be recorded in monetary or physical terms. These environmentally extended input-output tables are likely to be of significant relevance in the development of extended economic models aimed at assessing the implications of alternative climate and nature related policies. SEEA Applications and Extensions provides an introduction to environmentally extended input-output tables.

2. Valuation of natural capital

35.82 The measurement of economic assets in the context of the SNA balance sheet has a focus on monetary valuation of the relevant stocks. For this purpose, the SNA has established relevant valuation concepts and principles that are described in Chapter 4. For the measurement of those assets that do not have an observed market price at the balance sheet date, the SNA proposes two measurement approaches (i) written down replacement cost (often estimated using the perpetual inventory method (PIM)) and (ii) net present value of future benefits. The first approach is commonly used in estimating the values of produced assets where the purchase price is observed but the current market value of the asset is not, while the second approach is most commonly used in estimating the monetary values of natural resources.

35.83 To estimate monetary values for those capitals outside the sequence of economic accounts, a range of methods and valuation concepts have been applied. The approach outlined in the SEEA Ecosystem Accounting applies the same value concept – exchange values – as used in the SNA balance sheet to support the potential of extending the SNA balance sheet to incorporate the values of ecosystem services. The use of the exchange value concept supports the measurement of levels

as required for national accounting and inherently incorporates both price and quantity components. In turn this supports the measurement of changes in volume and measurement in real terms as needed for the assessment of sustainability as discussed in the introduction to the chapter.

35.84 In a similar way to the valuation of natural resources, the valuation of ecosystem assets is undertaken using the net present value approach based on expected future flows of ecosystem services estimated at their exchange values. SEEA Ecosystem Accounting Chapters 8-10 provides a discussion on a range of considerations concerning the implementation of this valuation approach.

35.85 While the approach outlined in the SEEA Ecosystem Accounting does provide monetary values for natural capital beyond the SNA balance sheet, the values do not capture all of the possible benefits that may be attributed to ecosystems and, more broadly, any monetary value of natural capital will not reflect the complete set of values that can be attributed to natural capital. It is beyond the scope of this chapter to provide a complete discussion of this issue but the following points are highlighted.

35.86 First, in applying the concept of exchange value, the SNA and the SEEA, limit the scope of measurement to what are commonly called "use" or "instrumental" values, i.e. those values derived by people and economic units from natural capital through the direct or indirect use of natural capital in production or consumption, noting that use does not necessarily imply extraction of goods from the environment. In the valuation of natural capital, many economists also consider the role of non-use values which people associate with natural capital. Non-use values are commonly separated into two main types: (i) existence values where the value is based on knowledge that the ecosystem is present now; and (ii) bequest values where the value is based on making sure that the ecosystem is available to future generations. Also recognized in some cases are option values that concern the potential for an ecosystem to provide use values in the future.

35.87 Second, beyond economic values, other research on the value of natural capital has considered relational values and intrinsic values. Both of these types of value are likely to be relevant considerations in decision making but cannot be measured directly in monetary terms. However, they may be observed indirectly, for example, a person with high intrinsic value for an ecosystem might donate or may send time volunteering with conservation organizations. Overall, the organization of data concerning the extent and condition of ecosystems and data on related expenditure or time-use can support the assessment of these non-economic values.

35.88 Third, it should be recognized that for any given stock of natural capital, it is most likely that different stakeholders will hold different values – i.e. there are multiple value perspectives. Some of these perspectives may be able to be expressed in monetary terms but, as just noted, some may not. In this context, the role of statistics and accounting is not to provide a single measure or value but to organize a coherent set of complementary information that allows decision making processes to function as efficiently as possible.

3. Weak and strong sustainability

35.89 A focus on the measurement of the stocks of capitals can support different perspectives and interpretations of sustainability. As noted in the introduction, in economic theory, the sustainability of past developments is implied if the level of wealth in real terms is non-declining. Ideally, the measurement of past trends in wealth would be calculated at a relatively detailed level for specific asset types (i.e. below the level of economic, natural, human and social capital). Since it is expected that the relative prices of each asset type would change over time, it is expected that there will be substitution between asset types that would then be revealed in the measurements in both physical and monetary terms. Based on these trends in substitution and other information, such as limits on

the availability of stocks of each asset type, projections may be made about future flows of benefits from the stocks as part of assessment about future prospects for sustainability and well-being.

35.90 In this framing, the concept of weak sustainability, assumes a situation where all types of capital (and all asset types) are perfect substitutes, a situation which is highly unlikely to occur. Importantly, the measurement of relative prices and changes in real wealth does not need to make an assumption of weak sustainability a priori. Conversely, the concept of strong sustainability assumes that no substitution is appropriate, again this is a situation which is unlikely to be revealed in measurement of past trends. However, in making projection about future trends, it may be of interest to identify specific types of capital which should not be lost. With respect to natural capital, the concept of critical natural capital has been used to this end. The development of projections for real wealth based on maintaining certain capital stocks and comparing these projections to the subsequent trends may be of significant policy and analytical interest.

4. Aligning benefits and ownership

35.91 In defining assets, the SNA makes a direct link between economic ownership, including collective ownership, and the future benefits that are attributable to that asset. Consistently, costs associated with the use of an asset, including its depreciation or depletion, are attributed to the economic owner (or owners in the case of applying the split-asset approach where the benefits from a single resource are shared (see Chapter 27)).

35.92 This standard national accounting approach provides a complete structure for the organization of relevant information. It can also be extended to incorporate additional types of assets (such as ecosystem assets and human capital) and additional benefit flows (such as non-market ecosystem services). However, for some types of economic analysis, the allocation of benefits to economic owners is not appropriate. Two particular examples highlight the potential for alternative economic framings. First, consider the supply of public goods by public infrastructure (such as roads) to transport firms and households or the supply of recreation-related services to visitors by national parks. Both cases demonstrate that the benefits from a range of assets do not necessarily accrue to economic owners of those assets, which is generally general government. (Note that the SNA does support distinguishing between individual and collective consumption of households that can support analysis of public goods supplied to households.)

35.93 Second, many assets may decline in value and have reduced capacity to supply services for reasons other than use in production by an economic owner. For example, water bodies used for recreation or water supply may be degraded as a result of excess nitrogen use in agricultural activities; and human health may be damaged by air pollution thus reducing the productivity of human capital. Consequently, there is a loss of benefit to the economic owner that is not related to the use of the asset by the owner.

35.94 In both of these examples, there is often interest in developing alternative allocations and presentations of the flows of benefits and the costs of degradation or capital loss such that the economic connection of different economic units to the assets is revealed. For example, in the second example, the loss of benefit to the economic owner from damage to the water body might be attributed as a cost of production of the agricultural activity whose excess use of nitrogen is causing the damage. This general area of economic analysis concerns the assessment of positive and negative externalities. Discussion on the links between accounting and the analysis of externalities is presented in Chapter 2 and in SEEA Ecosystem Accounting Chapter 12.

35.95 Although standard accounting-based approaches do not provide a presentation that reflects these alternative presentations, the data organized using accounting structures, especially when it is extended to capture a more complete set of data on multiple capitals and non-market benefits,

provides a well-structured information set to support such analysis. Further, externality analysis will require a baseline set of information and also a counterfactual or alternative scenario for the purposes of comparison. As for the assessment of sustainability just noted above, accounting-based approaches can provide the baseline information set for use across multiple analyses.

35.96 It may well be the case that the requirements for the analysis of externalities is more local or project specific in nature in which case a set of national accounts may be too coarse but, in theory, the same accounting rules can be applied at all levels of granularity subject to the availability of data and resources.

5. Links to the assessment of capacity, resilience and risk

35.97 The assessment of sustainability is often discussed in the context of other systems related concepts such as capacity, resilience and risk. The assessment of all of these concepts is related in the sense that they require consideration of the future and the projection of potential changes. Most assessments rely on using a baseline set of information about past trends and current levels of relevant stocks and flows. With a baseline in place, alternative scenarios and projections involving different assumptions can be made to complete assessments of sustainability, capacity, resilience and risk.

35.98 Accounting-based approaches that bring together information in a structured way and which cover multiple capitals provide an excellent structure for the required baseline information. Indeed, the use of a common baseline across different assessments can enhance the usefulness of assessments for decision makers since the differences across assessments can be more readily compared. This use of accounting-based approaches has been common practice in economic and financial modelling for many decades but its application in sustainability and related discussions has not (yet) been well-developed or widely adopted.

35.99 In addition to providing baseline information, accounting-based approaches support the use of a common framing for the formulation of alternative scenarios and assumptions. In particular, the use of a capitals framing facilitates organization of complementary data on relevant thresholds for the stocks of capitals, for example data on relevant biophysical limits (e.g. with respect to water quality) can be presented alongside accounting information on the current condition of ecosystem assets. In this example this complementary data would allow identification of those ecosystem assets that are close to physical limits.

35.100 With respect to the assessment of risk in particular, a common starting point is understanding physical risks, for example due to the effects of climate change on agricultural production. From this starting point, the assessment of associated financial risks to companies and to the wider economy can be evaluated. The use of accounting-based approaches that present both physical and monetary data and that are designed to integrate with standard economic data and models can provide a robust basis for these assessments. In particular, accounting-based approaches can be adapted and applied at local and landscape scales on a consistent basis thus allowing context specific information to be utilized which will generally be of importance in the assessment of risks concerning environmental and social factors.

6. Considerations in assessing financial sustainability and stability

35.101 While the main focus in the discussion of sustainability in this chapter has been on natural capital, the same general principles of assessing sustainability can be applied to types of economic capital. Of specific relevance in some contexts are financial assets and liabilities and the extent to which

there are imbalances within financial systems (financial stability) that might highlight concerns about the sustainability of the financial system. As well, the financial system will have connections to other types of capital for example in relation to the potential of demographic change to affect government finances and the effect of climate change influencing the frequency and intensity of natural disasters which in turn affect banking and insurance systems. The financial accounts within the SNA sequence of economic accounts provide a rigorous framework to provide baseline information describing the financial system and chapter 37 discusses how the SNA can be used in the analysis of financial sustainability.

35.102 Related to this, there is a general area of activity known as sustainable finance which considers the activities within the financial sector that are considered to be contributing to the achievement of more sustainable outcomes. These activities are most commonly reflected in new financial products and classes of financial assets such as green bonds. The development of more rigorous criteria for the definition and measurement of sustainable finance is progressing. <<To be developed further pending updates on IMF/OECD work in this space.>>

35.103 As introduced above, a related area of work is the assessment of companies' exposure to environmental risks, including climate risks and risks emerging from declines in nature and biodiversity. This work extends from assessing the physical risks to quantifying the financial risks to corporations, including through their supply chains. Accounting-based data sets can be applied to support these assessments through the provision of baseline information. Two avenues of support can be envisaged. First through national and landscape scale public data presenting industry benchmarks and changes in the wider context for each company's operations (e.g. water scarcity, workforce skills) and second, through companies using accounting-based approaches to organize similar data for their own operations (e.g. on water use, GHG emissions, workforce capability). These micro-macro connections are quite well-established for economic and financial data and are now developing in the environmental and social contexts often in the context of requirements for corporate reporting on sustainability. Examples of this include the requirements for GHG emissions reporting in the European Corporate Sustainability Reporting Directive and the Securities and Exchange Commission. These reporting requirements have been developed from initial work from the Financial Stability Board who developed the recommendations on climate-related disclosures and is extending to recommendations on nature-related disclosures. Ongoing research into the role of the SNA, SEEA and other accounting frameworks to support work in corporate reporting on sustainability is required.

7. Supporting the measurement of sustainable finance

35.104 A related but separate area of measurement concerns sustainable finance. Alongside the increasing range of activity and policy response to the challenges of sustainability, there is increasing level of financing of these activities. While the financial instruments (e.g. loans, bonds, equities) that are used to provide resources are the same as those used for other purposes, separate quantification of the level of financing for sustainability purposes, for example measures of the value of green bonds, is important for tracking investment in the green and climate/transition economy and informing decisions on monetary and fiscal incentives relating to it (OECD, *Developing Sustainable Finance Definitions and Taxonomies*, 2020).

35.105 The measurement of sustainable finance requires determining which components of the different financial instruments should be considered sustainable. This is an active area of research and discussion in many fora across both the private and public sector. Nonetheless, recognizing the policy relevance of the data, definitions have been determined in order to operationalize the concept of sustainable finance. They also aim to serve as baseline definitions to help limit the potential for "greenwashing" which arises when inconsistent definitions are applied by different

stakeholders. These definitions should be reviewed in the light of further advances, especially in the context of changes in the regulatory and reporting requirements.

35.106 Two primary types of sustainable finance are defined: ESG (Environmental, Social, Governance) finance and green finance with green finance being a sub-set of ESG finance. ***ESG finance is finance for activities or projects that sustain or improve the condition of the environment or society or governance practices. Green finance is finance for activities or projects that sustain or improve the condition of the environment.***

35.107 Countries are encouraged to compile measures of ESG finance and green finance as *of which* items for the following financial instruments: debt securities (AF.3), loans (AF.4), equity (AF.51) and investment fund shares/units (AF.52). The definitions of each of instruments are adaptations of the general definitions above. Thus, for ESG debt securities the scope concerns those where the issuer agrees to achieve performance objectives that improve the condition of the environment or society or governance practices. For ESG loans the scope concerns those in which 50% or more of the debtor's activities improve the condition of the environment or society or governance practices. For ESG equities the scope concerns those investments in institutional units in which 50% or more of the institutional unit's activities the condition of the environment or society or governance practices. For ESG investment fund shares the scope concerns those funds invested that intend to achieve performance objectives that the condition of the environment or society or governance practices. The definitions concerning green instruments have the same measurement scope except that they are limited to improving the environment.

35.108 It is also recommended that for debt securities the total ESG debt securities should be further broken down to identify the following of which categories in addition to green debt securities: social debt securities, sustainability debt securities, sustainability-linked debt securities and other ESG debt securities. Focus should be placed on recording the stock values for these instruments with transactions being recorded as a second order of priority. If possible, the estimates should be provided for all of the main sectors and sub-sectors.

35.109 There is a range of measurement challenges in implementing these recommendations that are addressed in associated guidance material[1]. A principal challenge is effectively determining whether the purpose of a given financial instrument satisfies the definition of sustainable finance. This may be determined by the label placed on the financial instrument, but since the labelling practices are not commonly independently assured, and the outcomes (in terms of improvements in environmental, social or governance condition) from the use of the finance cannot be known at the time the instruments are issued, a combination of approaches, potentially country specific, will need to be adopted and will require the collection of a range of metadata.

35.110 To assess the effectiveness of sustainable finance, it is relevant to link data on the levels of investment in ESG and green activities (as just defined) to data about the outcomes arising from that activity. A particular focus for green finance may be the extent and condition of the natural capital stocks which the investment aims to improve. For example, for green debt securities measures of changes in the extent and condition of mangroves that have been the focus for the use of the funds would be relevant as part of understanding whether the planned activities (and the associated finance) are making a contribution to environmental outcomes. At a macro and landscape scale, data on stocks of capital and changes over time will support the identification of locations where sustainable finance may be best targeted.

35.111 Consistent with these recommendations, BPM7 also encourages countries to compile measures of ESG and green finance, for the IIP (stocks) and BOP (flows) as "of-which" categories of debt securities, loans, equity and investment fund shares as separate tables outside the standard

[1] To be developed based on OECD 2020 and the Issue Note on Sustainable Finance definition (February 2024)

components. BPM7 also suggest compilation of other environmental indicators including the physical location of investments, direct investments in specific sectors as well as climate-related international cooperation grants to low-income countries *(BPM7, Annex 10).*

8. Accounting for areas beyond national jurisdiction

35.112 In the measurement of natural capital, the accounts of the SNA and the SEEA are usually compiled for countries and hence the geographic scope is limited to the economic territory of a country including its EEZ. While this scope covers a reasonably large share of the world's natural capital, there is a significant amount of natural capital, in particular concerning oceans, that may be excluded. This includes natural resources such as fish stocks and seabed mineral resources and the ecosystem services provided by oceans such as in relation to global climate regulation, noting that if economic ownership can be established for natural resources, for instance via internationally agreed quotas, these resources are within scope of the SNA sequence of economic accounts.

35.113 Where there is interest in organizing data about these types of natural capital outside of the scope of the SNA sequence of economic accounts in a manner that can be directly related to country based measures, the accounting definitions and treatments of the SNA and the SEEA can be applied. For example, it would be possible, conceptually, to compile accounts for the natural capital of the Pacific Ocean. A similar logic could be applied to develop accounts for the atmosphere on a more holistic basis.