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Integrating Ecosystem Assets in the World Bank's Changing Wealth of Nations Program Measurement Challenges and Strategies

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Integrating Ecosystem Assets in the World Bank's Changing Wealth of Nations Program

Measurement Challenges and Strategies

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Abstract:

The World Bank is at the forefront of global measures of economic progress, including the measurement of weak sustainability. A key element of this work is to further extend the asset boundary of comprehensive wealth measures published in the World Bank's Changing Wealth of Nations (CWON) program to include selected ecosystem assets, along with new renewable natural capital assets. This extension requires the integration of traditional capital measures valued at observed market prices or proxied exchange values with new measures of natural capital aligned with emerging methods and standards. Wherever possible, the CWON methodology adheres to internationally accepted statistical standards, including emerging guidance for the System of National Accounts (SNA) and the System of Environmental Economic Accounts (SEEA-CF and SEEA-EA). Given implementation experience is relatively limited and practical guidance continues to mature, the CWON can serve as a test ground to address key measurement challenges. These include, for example, the appropriate choice of ecosystem assets for inclusion in the extended asset boundary, consistent bases of valuation to avoid risks of double counting, along with appropriate methods for the deflation and aggregation of wealth metrics and their components. Data availability is also a key practical challenge, in particular for developing countries, and indirect estimation techniques must often be employed to attain comprehensive global measures.

This paper provides an overview of challenges in the most recent update to comprehensive wealth measures in the World Bank's Changing Wealth of Nations program, with a particular focus on the global estimation of new ecosystem assets, including carbon storage. It discusses the advantages and risks of options evaluated in the choice of measurement strategies. It concludes with next steps for a forward-looking research agenda for the CWON, highlighting implications for implementation of emerging statistical standards.

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[1] The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Background on the World Bank's Changing Wealth of Nations (CWON) program[2]

Gross Domestic Product (GDP) is widely recognized as an insufficient measure of economic progress and national "success" (e.g., Solow, 1993; Dasgupta and Maler, 2000; Arrow et al., 2004; and Dasgupta, 2021). Since GDP is nearly universally available and comparable across countries, it is extensively used as a benchmarking and reference statistic even for purposes for which it was not designed (Jorgenson, 2018). GDP measures the level of domestic productive activity in, say, a given year, but it ignores the costs of this growth in terms of, for example, resource depletion and environmental degradation that occurs in the process of production.[3] Sir Partha Dasgupta likened this to a soccer team that only measures success as goals for and ignores goals against.

Whether economic progress is sustainable can be measured by how real wealth per capita is changing, as this represents changes in future production and ultimately consumption opportunities passed on to future generations (Dasgupta, 2001; Arrow et al., 2004; and Polasky et al., 2015). "Production and consumption" must be understood broadly here to include the myriad non-market goods and services humans benefit from every day, many of which are "produced" by nature, such as breathable air, clean water, food, weather regulation and recreation and not just goods and services exchanged on the market. Wealth in this context, thus, encompasses the value of all the assets of a nation that support economic production, such as its factories and roads (*produced capital*), fossil fuel reserves, fish stocks, and forests as well as the non-market ecosystem services they provide such as "a walk in the woods" (*natural capital*), the current labor force (*human capital*), and net foreign assets. As long as real wealth per capita does not decline, future generations will have at least the same opportunities as the current generation, suggesting that development may be sustainable.[4]

However, while virtually all countries produce GDP estimates, few measure wealth; a gap that the World Bank's *The Changing Wealth of Nations* (CWON) program fills. The CWON program is one of the pioneering efforts in measuring wealth, producing the most comprehensive, publicly accessible, and reproducible wealth database currently available. These monetary estimates draw on internationally endorsed concepts and valuation principles from the System of National Accounts (European Commission et al., 2009) and System of Environmental-Economic Accounting (United Nations et al. 2014 and 2021). This ensures that CWON's wealth measure is methodologically rigorous and comparable to other metrics of economic progress like the Gross Domestic Product (GDP).

Over the past two decades, the CWON program has updated and expanded its comprehensive wealth estimates with each new edition, as new data sources, measurement techniques, and guidance have become available. The forthcoming 5th edition continues this tradition and adopts international best practice in computing wealth in real terms using a chained Törnqvist volume index. In this approach, the relative changes in the physical assets of a nation, such as the size of its fish stocks or the number of workers in the labor force, are weighted by their relative economic importance (as measured by their

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[2] This section draws extensively on the executive summary and chapter 1 of the 5th edition of *The Changing Wealth of Nations* report series (World Bank, 2024 *forthcoming*).

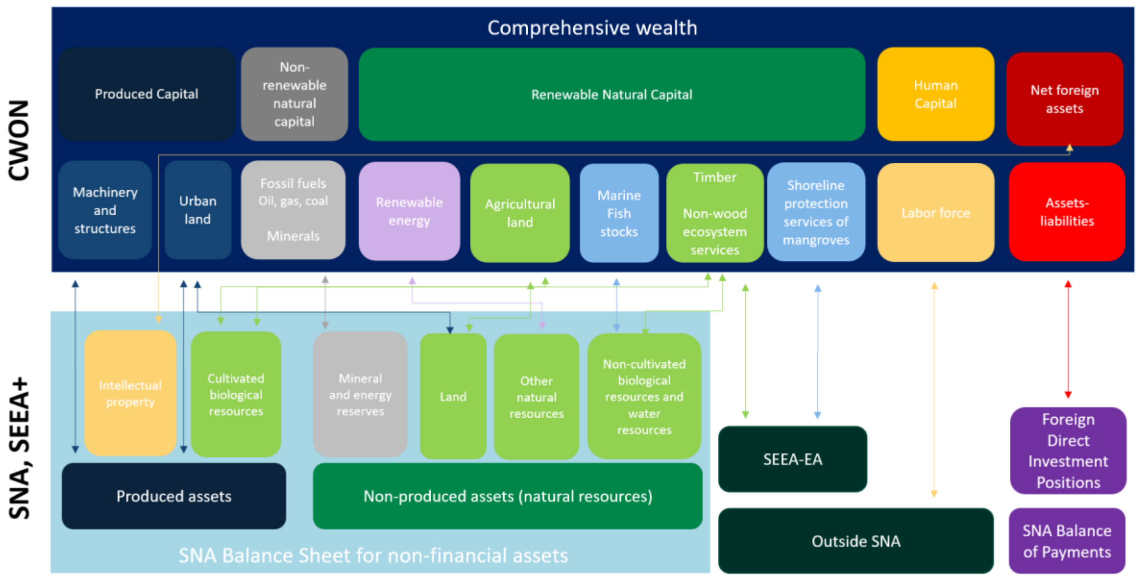
[3] The aggregate of Net Domestic Product, on the other hand deducts capital used up in production, but far few countries produce this metric. For a criticism of GDP see for example, Solow (1993), Dasgupta and Maler (2000), Arrow et al. (2004) and Dasgupta (2021).

[4] Aligned with the definition of the World Commission on Environment and Development (1987).

shares in nominal wealth).[5] Changes in real wealth per capita will, thus, be driven by (i) the depletion or accumulation of assets, (ii) changes in the productivity, or relative scarcity of assets, (iii) changing substitution patterns, and (iv) demographic pressures; all of which are important for analyzing the sustainability of economic progress. This is a substantial improvement to previous editions, which calculated wealth changes in constant prices using the GDP deflator.[6]

While the CWON methodology aims to align itself where possible with internationally accepted statistical standards and guidelines of the SNA and SEEA, the grouping of assets in CWON differs from the SNA as shown in Figure 1. The SNA first divides assets into financial and non-financial (real) assets, whilst CWON is mostly focused on non-financial assets. Within the category of non-financial assets, the SNA divides them further into produced and non-produced assets. Some "natural capital," such as plantation forests and aquaculture fish stocks, are also included as cultivated biological assets within the produced asset section, whilst they are grouped under renewable natural capital for CWON. On the other hand, the SNA treats all land as a non-produced asset, while urban land is included under produced capital for the purposes of the CWON database.[7]

Figure 1: The CWON wealth accounts (2024 release) and their relationship to the SNA and SEEA



Notes: Arrows represent where components of the CWON can be found in SNA system, including the non-financial asset balance sheet and Balance of Payments, accounts or in the SEEA EA (the SEEA CF is fully aligned with the SNA).
Source: Figure 1.5 in CWON (2024, *forthcoming*).

[5] This is true for composite asset portfolios, e.g. when computing total real wealth including all assets or for the main asset categories, but not single homogenous assets. Chapter **Error! Reference source not found.** of World Bank (2024) provides detail on the implementation of the chained Törnqvist volume index in CWON. For more technical details on the properties of the Törnqvist index, please refer to Dumagan (2002) and Diewert (1992).

[6] One key concern when using the GDP deflator is that (just like GDP) it only covers current flows of domestic production (not consumption) within a given country and excludes all imported goods or services. Take the example of a country whose production is heavily weighted towards oil, such as Nigeria or Saudi Arabia. In such cases, the GDP deflator will be driven by the price of oil, but not reflect the price of the goods that are consumed in that country, such as vehicles, machinery, or cell phones, many of which are imported.

[7] This choice is primarily driven by the methodology used, as urban land is estimated as a share of produced capital drawing on Kunte et al. (1998). This is a key area for improvement in future updates of the database.

Most of the assets covered in CWON are within the asset boundary of the SNA,[8] but the CWON wealth measurement is further extended to include ecosystem assets from the SEEA ecosystem accounting (SEEA-EA). Machinery and structures, fossil fuels, metals and minerals, urban and agricultural land, timber, and marine fish stocks are all clearly within the asset boundaries of the SNA. Renewable energy assets are not yet part of the SNA. However, guidelines for their inclusion, which were developed for the previous CWON report, were endorsed as part of the 2025 SNA revision process.[9] In addition, CWON has over time expanded the asset boundary to include key SEEA ecosystem accounts, such as allowing non-timber forest ecosystem services[10] (some of which may be in the SNA, e.g., non-wood forest products like mushroom harvesting, while others, such as recreation are not) into forests, important regulating services such as shoreline protection services capitalizing into mangroves (which may be partially attributed to property value in the SNA), and, with the fifth edition, experimental estimates of climate regulation provided by terrestrial ecosystems (which might be partly captured by the SNA to the extent that asset prices account for climate risks, but its non-market benefits are clearly not captured in the SNA).

CWON also includes other assets critical for sustainable development, notably human capital. The SNA does not provide the same entry points for human capital as it does for natural capital. It includes intellectual property, e.g., software and artistic originals as produced capital. In addition, some statistical offices have produced satellite accounts that address elements of human capital, and there is international cooperation in this area (UNECE, 2016). Guidelines on how the dimensions of education, human capital and labor could be included within the SNA were developed and endorsed as part of the ongoing 2025 SNA revision process.[11] Still, systematic measurement of human capital remains an even larger gap than that for natural capital, and CWON steps in to help close this gap.

The key limiting factor in expanding the asset coverage further is data availability. To ensure comparability across countries and over time, data are primarily sourced from global databases. However, these data usually have limited assets, country, and temporal coverage and often do not have the detail. For instance, aquaculture has become an important industry that now matches marine capture fisheries in terms of production volume and value (FAO, 2022). Given this, aquaculture-related ecosystem assets should be included in the CWON database, as they, in combination with other inputs, such as labor and produced capital (which are already captured by the SNA and CWON), contribute to benefits enjoyed by humans.[12] Yet a comprehensive assessment of the wealth arising from aquaculture is not possible today due to data limitations.[13] Similar data constraints have limited the coverage of renewable energy assets to

[8] The SEEA Central Framework asset boundary is fully aligned with the SNA asset boundary.

[9] https://unstats.un.org/unsd/nationalaccount/aeg/2022/M21/M21_14_WS11_Renewable_Energy_Resources.pdf

[10] The non-wood forest ecosystem services included in CWON include water services, recreation services, and non-wood forest products.

[11] https://unstats.un.org/unsd/nationalaccount/RAdocs/ENDORSED_WS4_Labour_Human_Capital_Education.pdf

[12] These assets include the equipment and installations (pens, ponds, etc.) used to farm fish (produced capital), the breeding stock and inventories of partially grown fish (also produced capital) and the ecosystem inputs to fish farming (natural capital). The value of the produced capital data used in aquaculture is, in principle, already captured in the produced capital values CWON draws from the Penn World Tables (PWT), so it may not need to be added. The value of the natural capital used in aquaculture, on the other hand, is missing from CWON and methods and data would have to be found to value it if it were to be added. This would require data on prices and production quantities, which are publicly available, and on costs, which are unfortunately rarely collected systematically.

[13] A first step in that direction was taken in the fifth edition of CWON by compiling pilot accounts for a subset of species and countries. A back-of-the-envelope calculation based on this pilot suggests that aquaculture-related natural capital may be four times more valuable than that of marine fish stocks.

hydroelectric resources in CWON 2024, as producer price data is not collected comprehensively enough for solar, wind, and geothermal assets.

For some assets there is also limited international guidance and implementation experience, especially in the context of wealth accounting, notably for ecosystem services. The development of valuation guidelines for ecosystem services is ongoing, and several key questions remain unresolved. A case in point are carbon retention services provided by terrestrial ecosystems, such as forests or mangroves, which play a key role in climate mitigation efforts. While it is possible to produce experimental monetary estimates at the global scale, there is no agreed approach on how to attribute these estimates at the country level due to its global public good nature. Nor is there unanimity on how to avoid double-counting when aggregating the value of carbon retention services with other assets.[14] These concerns are further elaborated below. Similar conceptual concerns arise when accounting for critical assets such as water,[15] which are further compounded by data and modelling constraints (Vardon et al., 2024). For these reasons, several important assets cannot yet be included in CWON's comprehensive wealth estimates, but there might be future opportunities as data availability improves, and the remaining conceptual issues are resolved.

1. Which ecosystem assets are currently incorporated?

The ambition of the CWON program is to measure wealth as comprehensively as possible, with past efforts focusing on including human capital and on expanding the coverage of renewable natural capital assets, including ecosystem assets. The inclusion of the latter was primarily "opportunistic", driven by data availability and the development of credible methods that align with SNA and SEEA valuation concepts. The CWON database currently includes two ecosystem assets: the non-wood ecosystem services provided by terrestrial forests and the coastal protection services provided by mangroves. For the valuation of these ecosystem assets, the net present value (NPV) of the annual service flow is estimated using spatial socioeconomic and biophysical data in line with SEEA-Ecosystem Accounting (SEEA EA) guidance, as described in more detail below.

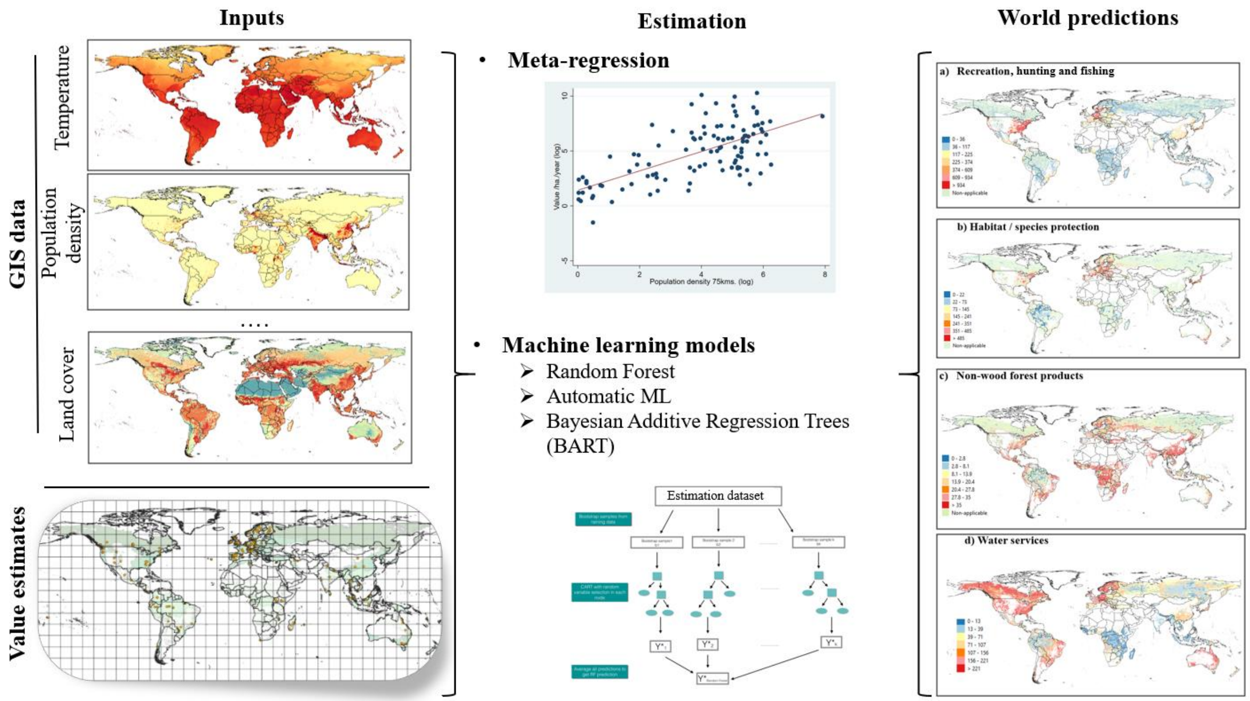
a. Non-wood forest ecosystem services

The value of non-timber forest ecosystem services for CWON 2024 is estimated by Siikamaki et al. (2023) using a meta-analytic predictive model, which combines regression and machine learning techniques to spatially estimate the value of the following three ecosystem services: (i) recreation, hunting, and fishing (referred to as "recreational"), (ii) non-wood forest products, and (iii) watershed protection (referred to as "water services"). The methodological approach builds on Siikamaki et al. (2015 and 2021), which includes a comprehensive review of the primary literature on non-wood forest benefits. For each selected study, the latitude and longitude is identified and then geo-linked to several socioeconomic, ecological, biophysical, and climatic features at the grid cell level (approximately 10km by 10km) using GIS (Figure 2, left panel). Siikamaki et al. (2024) then build alternative predictive models of the local value of forest non-wood ecosystem services by statistically examining the characteristics of the study areas as determinants of the value of non-wood forest ecosystem using meta-regression and machine learning (Figure 2, central

[14] It is reasonable to assume that the benefits of carbon retention are at least to some extent already captured in the prices of other assets currently included in CWON. To avoid double-counting, only non-market benefits should be included.
[15] The value of water is already partly accounted for in agricultural land and hydropower, but it is difficult to account for that contribution.

panel). Using a series of selection criteria the best model is then chosen to produce global predictions of the service areas (Figure 2, right panel).

Figure 2: General methodological approach



Source: Figure 3.1 Siikamaki et al. (2024)

The annual value of non-timber forest ecosystem services is estimated by multiplying total forest area by the sum of the per-hectare monetary values for the three benefit categories. The capitalized value of ecosystem services is equal to the present value of annual services. The present value of non-timber services is given by the following equation:

$$PV(S) = \sum_{t=1}^{T=100} \frac{S_t \cdot F_t}{(1+r)^t} \tag{1}$$

where S_t is the sum of per-hectare service values for the three benefit categories in year t, F_t is the total forest area in year t,[16] and r is the social discount rate of four percent.[17] Note that future rents are held constant for all assets at current-year (2020) values, which is a common assumption used whenever a residual value method (RVM)/NPV approach is used in CWON 2024. This means that future rents used in the NPV calculation reflect 2020 market conditions, policies, and expectations about the future, and in this

[16] No distinction is made between natural and planted forest.

[17] A constant uniform discount rate of four percent is used in CWON 2024 as in previous CWON reports (following World Bank, 2006), wherever discounting is required. This assumption is not ideal, since wealth estimates (especially for renewable natural capital and human capital) may be discounted over long periods of time, making the values sensitive to the choice of discount rate. Moreover, using a uniform discount fails to account for significant country-level differences in economic fundamentals (such as, interest rates, growth patterns, and risk) and social and individual preferences, as well as differences in risk, scarcity, or environmental or other externalities across assets (Dasgupta 2008; Dietz & Asheim 2012; Gollier 2019; Groom et al., 2022). More research is needed to determine how this might be improved in the future.

case no change in forest cover in the future. This is in line with recommendations in the SEEA-CF on the indirect valuation of natural assets (SEEA-CF, paras 5.133 and 5.134.). Given the infinite number of possible future trajectories of rents, this is the least subjective and most transparent assumption given the wide range of assets and countries in the CWON database.

The estimation of non-timber forest ecosystem services draws on a range of datasets, including total forest area from Forest Resources Assessment 2020 of the UN's Food and Agricultural Organization (FAO), annual service values per hectare of forest estimated by Siikamaki et al (2024) as the sum of recreational, non-wood forest products, and water services, and protected area boundaries from the World Database on Protected Areas developed by UN Environment Program (UNEP), World Conservation Monitoring Center, and IUCN. The CWON 2024 estimates of non-wood forest ecosystem services are available from 1995 through 2020 and are disaggregated by protected areas status. The latter is an important departure from the lower-bound approach used in CWON 2021 and earlier reports to estimate wealth in protected areas, which relied on opportunity cost values.

a. Mangrove coastal protection services

Mangroves provide coastal protection by reducing flooding and the resulting damage to produced capital and populations that would occur from storms if mangroves were absent (Figure 3). The "averted damage" valuation approach is widely used by economists and provides a rigorous foundation for estimates of flood risk and habitat benefits (Barbier, 2015; Beck, & Lange, 2016; Pascal et al., 2016; van Zanten et al., 2014). In this approach Menéndez et al. (2024) couple offshore storm models with coastal process and flood models to measure the flooding that occurs: (i) with and without mangroves, (ii) under cyclonic and non-cyclonic storm conditions, (iii) by storm frequency (return period) across the globe (i.e., 1 in 5-, 10-, 25-, 50- and 100-year events). These flood extents and depths are used to estimate the annual expected flood damage to capital stock by combing data from JRC (Huizinga et al. 2017) and Hazus (Scawthorn et al. 2006) flood depth damage curves.

Figure 3: Key steps and data for estimating the flood protection benefits provided by mangroves

Source: Figure 2.1 in Menéndez et al. (2024)

The annual expected benefits of mangrove coastal protection services are estimated by integrating the expected damage with the probability of the storm events and aggregating the data nationwide. The present value of mangrove benefits is estimated over a period of 100 years using the following equation.

$$PV = \sum_{t=1}^{T=100} \frac{AEB_t}{(1+r)^t} \tag{2}$$

Where PV is the present value, AEB_t are the annual expected benefits in year t, r is the discount rate of 4 percent.

This approach follows the same methodology used in CWON 2021 but uses new and updated past global mangrove distribution data from Global Mangrove Watch (GMW 3.0; Bunting et al., 2022). While the past mangrove data did not change greatly (1996-2015), all prior year models were rerun, and the results provided represent improvements on the prior CWON report in addition to the most recent yearly estimates (to 2020). The most significant difference in these datasets is that the improved GMW 3.0 shows a consistently greater global coverage than GMW 2.0 (about 7 percent greater). To consistently assess mangrove benefits over time, the flood models were re-run for all years using the new data, and new assessments of risk and benefits were developed.

2. Carbon Storage – Developments to Date

The global climate crisis is one of the most pressing sustainability challenges of our time, exacerbating existing social, environmental, and economic issues (Intergovernmental Panel on Climate Change (IPCC), 2023). From a mitigation point of view, terrestrial ecosystems, most notably forests, can play an important role (e.g., Grassi et al., 2017; Griscom et al., 2017), as they are able to both emit and absorb greenhouse gases (GHGs), acting as significant stores of carbon as well as carbon sinks (e.g., Cook-Patton et al., 2020; Jones et al., 2013). For these reasons, CWON 2024 evaluated to what extent the value of climate regulation services could be included in the global database and extend the asset boundary further.

There is now emerging guidance from the SEEA EA on how to measure global climate regulation from terrestrial ecosystems, which can help guide how such a service could be included in the CWON (Edens and Caparrós, 2023). The current consensus is to measure a single service, consisting of two components: *carbon sequestration*, which measures the net uptake of carbon by a given ecosystem asset, such as a forest or wetland, and *carbon retention*, which measures the avoided release of carbon – or put differently, the ability of the ecosystem to retain carbon and thus avoid climate damages. Users are advised to choose the measurement most suitable for their context (NCAVES and MAIA, 2022).

For a global assessment like CWON, carbon retention is the primary component of climate regulation services, as carbon stocks in forest and wetlands are typically not increasing for most countries (Bulckaen et al., 2024). If a country's forest is instead experiencing a clear expansion in its carbon stock, carbon sequestration should ideally be reported as an 'of which' item. Unfortunately, this is currently not feasible on the global scale (Pugh et al. 2020). Any changes in carbon retention services thus capture changes in carbon stored due to anthropogenic and other factors, as well as sequestration. In addition, carbon retention is the more policy relevant measure, as a loss in carbon due to, e.g., deforestation would lower carbon retention services. Similarly, ecosystems with high carbon stocks, such as tropical rainforests, would be assigned higher retention values, signaling the importance of conserving. This is not necessarily the case for carbon sequestration, which only captures changes in the carbon stock, not its level. This can lead to perverse incentives in natural resource management, where carbon sequestration would increase if a rainforest were replaced by, for example, a fast-growing bamboo.

Measuring carbon retention in biophysical terms is possible by estimating vegetation carbon stocks annually using the standard methodology developed by Gibbs and Ruesch (2008) and 2006 IPCC default factors (Bulckaen et al., 2024). To estimate vegetation carbon stocks, it is assumed that each terrestrial land cover class, with a few exceptions like water bodies, glaciers, and bare rock or soil, contributes to storing carbon to varying extents. The classes with the highest contribution to carbon stock are forests and wetlands, particularly mangroves, with each contributing proportionally to the total carbon stock of a given area. These estimates can then provide annual snapshots of the stock of carbon for each year, which will change due to land cover changes (and potentially land cover re-classification) as well as the occurrence of fire and anthropogenic factors.

Estimates developed for CWON 2024 show that the countries with the highest share in the global value of forest carbon are tropical or large countries, such as Brazil, the Democratic Republic of Congo, Russia, Indonesia, the United States of America, and Canada (Figure 4). Brazil being both vast and tropical accounts for the largest share in the total forest carbon value with 18 percent. The other large tropical countries – the Democratic Republic of Congo and Indonesia – make up around 7 and 6 percent, respectively. Combined with the three large land area countries – Russia, the United States, and Canada, these six countries make up nearly half of the global value of climate regulation services provided by forests, underscoring the importance of sustainable forest management in these countries.

Figure 4: Total global vegetation carbon stock (in megatons), 2020

Source: Bulckaen et al. (2024) All the code to obtain the results is available at https://github.com/integratedmodelling/im.nca.postprocessing/tree/main/aggregation_region

While the biophysical estimation is relatively straightforward given increasing data availability,[18] the monetary valuation of climate regulation services is much more challenging both from a conceptual and practical point of view. Here the objective is to express climate regulation as an annual service flow and to estimate the climate damages that are avoided by maintaining the ecosystem system as is. To do this, the total physical carbon stock (including, above and below-ground biomass and soil organic carbon) is valued to estimate the avoided monetized damages and subsequently multiplied by a rate of return to obtain an annuity. The main challenge is to determine a carbon price suitable to value climate regulation services in line with SNA and SEEA exchange value principles.

The SEEA EA does not provide specific guidance on this issue (UN et al. 2021, paragraph 9.32), but Edens et al. (2019) and the NCAVES and MAIA (2022) discuss the suitability of using different carbon prices, such as observed market prices, the marginal abatement costs of carbon, or the social cost of carbon (SCC) in the context of national accounting. As the carbon retention framing is based on the idea of avoided damages, the recommendation is to apply a SCC estimate. While market prices would be preferrable as they align with the exchange value principle of the SEEA EA, existing carbon markets are incomplete, making them unsuitable for a global assessment. Marginal abatement cost curves exist at the global scale, but measurement concerns with regards to the underestimation of costs and double counting limit their use in national accounting. However, even using a SCC is not without its complications:

- First, existing carbon markets are incomplete (see for example, the World Bank's carbon pricing dashboard)[19] and thus do not reveal the true economic damages avoided, with recent studies suggesting that both SCC estimates and appropriate carbon prices are magnitudes higher than existing carbon prices (e.g., Tol 2022, Drupp et al. 2023).
- Second, existing estimates for the SCC intend to capture the total economic value of an avoided ton of atmospheric carbon may often not be aligned with SNA and SEEA exchange value principles

[18] In particular, the increasing availability of land cover and forest carbon storage data has made possible static biomass models (Duncanson et al. 2019), such as Gibbs and Ruesch (2008), which estimates the total carbon for landscape patches. At the core of these methods is the landscape patch, for which carbon storage is assumed according to the ecoregion, forest type, and fire occurrence.
[19] https://carbonpricingdashboard.worldbank.org/

when future damages of that ton are valued according to some ethically motivated welfare principle.

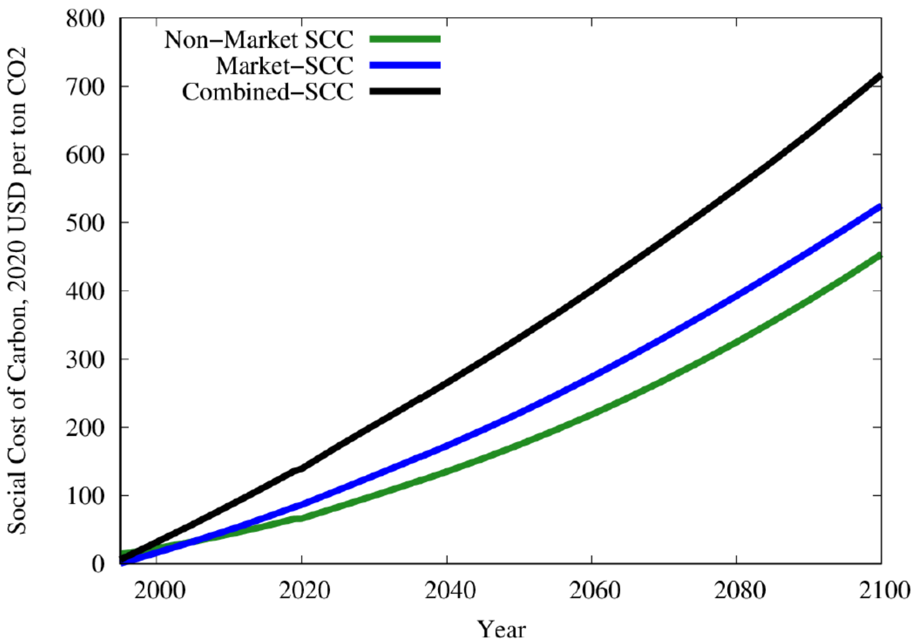
- Third, in the context of wealth accounting, it is important to avoid double-counting, as some assets, such as produced capital, agricultural land, and human capital, already included in CWON might already have climate regulation benefits priced in. However, the extent to which asset values might account for climate risks is subject to debate (e.g., Bakkensen and Barrage, 2021; Schlenker and Taylor, 2021; and Severen et al., 2018).

To avoid potential double counting, a tailor-made SCC was estimated Drupp and Hänsel (2023), which only captures the avoided monetized climate damages for the non-market sectors of the global economy. To estimate the non-market SCC three key assumptions were necessary. First, for the share of climate damages accruing to non-market goods, Drupp and Hänsel (2023) draw on a large-scale expert elicitation by Howard and Sylvan (2015) to calibrate the damage functions for market and non-market components using their mean estimate. Second, they assume a unitary elasticity of substitution between market and non-market goods (cf. Carleton et al., 2022; Rennert et al., 2022) as it is also applied for the valuation of other non-market assets such as health. Third, to estimate the non-market SCC for the 2020-2100 period future climate damages are discounted at an average rate of 4 percent to be consistent with the valuation of other market assets in CWON. The non-market SCC is also hindcasted for the 1995-2020 period as illustrated in Figure 5. This yields a non-market SCC of around USD66 for 2020 with a market SCC of USD86 and a total SCC of USD139,[20] which is in line with similar estimates by, for example, the US' Environmental Protection Agency.[21] As expected, the 1995 estimate of the non-market SCC is much lower at merely USD14 but it increases to as much as USD454 by 2100 to reflect the growing accumulation of GHG emissions and associated climate damages.

[20] Note that due to the assumed Cobb-Douglas substitutability between market and non-market goods, non-market damages from climate change can partly be offset by increased market good production and hence, the combined SCC is not equal to the sum of the market and non-market SCC.

[21] Their SCC estimate for 2020 is US120, but they use a discount rate of 2.5 percent and use a different model by Howard and Sterner (2017).

Figure 5: Pathways of the estimates for the non-market social cost of carbon, market social cost of carbon and the combined social cost of carbon from 1995-2100.



Source: Drupp and Hänsel (2023)

Given that the social cost of carbon measures the net present value of future damage costs calculated for a long-time horizon, the avoided damage costs need to be converted into an annual service flow. Following Turpie et al. (2017) the annualizing the social cost of carbon is calculated as follows:

$$ASCC = \frac{\delta * SCC}{1 - (1 + \delta)^{-t}} \quad (3)$$

, where the $ASCC$ stands for annualized social carbon cost, δ is the discount rate, and t is the number of years. . Based on these experimental estimates, the global value of carbon retention services has declined by 1.0 percent over the last two decades. This change was driven by a dramatic loss in global forest cover equivalent to nearly 36 million hectares, an area the size of Japan or Norway.

It is important to note that a global cost of carbon was chosen to reflect the global public good nature of carbon retention service, but this does not mean that the value of this public good is homogenous across the world. First, damages of global warming (and hence, the benefits of avoiding them) are distributed unevenly with poorer as well as hotter and lower lying countries being disproportionately affected (e.g., Burke et al., 2015, Kalkuhl and Wenz 2020). Second, purchasing power distribution is uneven, too. The "global" SCC estimate is dominated by a few richer countries, which implies that damages in poorer countries contribute less than proportionally to the global SCC estimate. However, it is not clear how to account for carbon retention services in country-level wealth estimates given that the production of the ecosystem service occurs at the country level, but the benefits are enjoyed globally. It is possible to derive country-level estimates (Ricke et al. 2018) and to downscale global estimates using benefit transfers (see Drupp and Hänsel 2023 for a discussion). The challenge is that this would require considering regional markets, local economic conditions, and most importantly social and ethical concerns. Given that to date, there is no agreed method to derive such country-specific estimates, this globally uniform SCC estimate highlights the magnitude of the global carbon retention services and each country's contribution to it. However, it does not reflect the attribution of the benefit of avoided climate damages nor the value of this global public good to a specific country.

To develop country-specific estimates of the value of carbon retention services, several conceptual issues thus still need to be resolved. First, more work is needed to inform the choice of carbon price to be used in the valuation. Second, additional theoretical and empirical research is required to assess the risk of double counting when including climate regulation (as well as other regulating services) in wealth accounts. While there is evidence that climate regulation services are partially captured in the valuation of other assets, more analysis is needed to systematically estimate this share and develop an approach to reattribute this value to ecosystem assets. Third, at this point, it is not feasible to derive country-specific estimates of the value of carbon retention services. To produce country-specific non-market SCC estimates, more refined data is required on the breakdown and distribution of climate damages into market and non-market damages at the country level, which also distinguish between use- and non-use value components. It will be further critical to assess which part of the market SCC should be captured to further lower the risk of double counting.

3. Relationship of the CWON with the evolving SNA and SEEA standards

a. Update to the System of National Accounts (SNA 2008)

The World Bank participates in the governance of SNA international statistical standards via the Inter-secretariat Working Group on National Accounts (ISWGNA) in a collaborative arrangement with four other international organizations: the IMF, Eurostat, the OECD and the UN[22]. Adherence to these and other internationally-endorse standards is key to assuring credibility, methodological robustness, coherence with available economic measures, and international comparability. Initial work for an update to the 2008 standards commenced in 2019, and while it has since expanded into other areas, proposals originally emphasized 3 primary workstreams, under the headings of Globalization, Digitalization, and Wellbeing and Sustainability.[23]

The Wellbeing and Sustainability Task Team engaged experts to develop new SNA Guidance in a range of areas, drawing on mature satellite account frameworks and related statistical standards. The wellbeing component, building on recommendations from the Stiglitz-Sen-Fitoussi report[24] and other wellbeing frameworks, encompasses new guidance on distributions of household income, consumption, saving and wealth consistent with national accounts, the unpaid service work of households, new detail on health and education and breakdowns of labor, employment and hours worked aligned with SNA measures.

New guidance addressing the sustainability of wellbeing focuses on an expanded capitals approach, encompassing human capital and natural capital, very much aligned with the objectives of the CWON and similar initiatives such as UNEP's Inclusive Wealth Report. In the case of environmental sustainability, some proposals build on advancements achieved in the System of Environmental and Economic Accounts (SEEA). An important example is the treatment of natural resource depletion as a

[22] The World Bank has recently assumed the role of Chair of the ISWGNA, which rotates among the participating organizations.
[23] For an overview of the status of the SNA update, please visit the UN website Towards the 2025 SNA.
[24] See Stiglitz, J.E., Sen, A. and Fitoussi, J.P. (2010).

cost of production, akin to the depreciation of produced capital, along with new emphasis on depletion-adjusted *net* production and investment aggregates. Other guidance targets new areas with potential future implications for the SEEA standards, such as renewable energy, the treatment of emissions trading schemes or accounting for biological resources.

The updated SNA manual, on track to become effective in 2025, will give heightened prominence to better accounting for wellbeing and sustainability. A new introductory chapter (chapter 2) on National accounts and measures of well-being and sustainability, immediately following the introduction to the manual, highlights how the SNA2025 can address these questions. New chapters on Measuring well-being and Sustainability explore these questions in further detail in the context of coherent and integrated accounting approaches for measuring stocks and flows in the SNA and harmonized SEEA standards.[25]

i. New SNA guidance on accounting for renewable energy

An important example where development undertaken for the CWON ultimately fed directly into the new SNA standards was the treatment of Renewable Energy Resources as assets. This new guidance, endorsed for inclusion in the SNA 2025 manual, recognizes renewable energy (geothermal, hydroelectric, solar, and wind resources used to generate electricity) as natural resource assets. This recognition is essential to inform the ongoing transition away from fossil fuels to renewable sources moving forward.

Among the salient points in the renewable energy methodology is the use of the residual value method, where the asset value is taken to be equal to the net present value of the future stream of rent, calculated as the difference between resource revenues and production costs, including returns to labor and produced capital. Where the residual value method is inappropriate due to subsidization or other market distortions, an alternative approach, known as the "least-cost alternative" method is recommended. This approach attempts to identify rents by comparing the cost of electricity generation with and without renewable resources. A separate asset class for renewable energy resources is recommended in the new SNA guidance, and the value of the asset is partitioned between governments (the legal owners) and renewable energy companies. This treatment is in accordance with principles of economic ownership -- the so-called *"split asset"* approach, also implemented across other natural resource categories in the new SNA.

Discussions in the development of the guidance addressed challenging questions such as the potential double count of renewable energy resources in land and other asset values. It was also important to clarify that the contribution of renewable energy resources is only accounted for in the case of active installations or sites.

[25] The material presented throughout the sections to follow is aligned with the concepts and characterizations described in the draft chapters for the SNA 2025. At the time of writing, the full draft manual was available for global consultation, to close in the fall of 2024, with an aim to finalize the manual for official endorsement by the Spring of 2025.

ii. Clarification of SNA valuation principles and methods

Other relevant new guidance[26] of note in the context of the CWON includes a clarification of SNA Valuation principles and methodologies.[27] The need for this clarification arose from discussions around the endorsement of international standards for ecosystem accounting, the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA), where differences in interpretation arose as to whether valuation principles applied were consistent with those recommended in the SNA. The guidance, therefore, endeavors to provide more precise clarification in SNA2025, elaborating the range of valuation methods already in use for SNA positions (stocks) and transactions (flows), with an emphasis on areas where exchange values (market transactions) are not directly observable and must be proxied via indirect methods. Among other things, it clarifies the concept of exchange value, highlighting that SNA valuation principles do not attempt to determine utility and, from a perspective of links economic theory, excludes consumer surplus. This clarification is increasingly relevant in the context of new elements recommended in SNA2025 to better address wellbeing and sustainability.

Given the objective of the new guidance is to *clarify* SNA valuation principles, fundamental concepts and methods remain unchanged in the SNA2025 manual. It does, however, provide recommended criteria for evaluating the appropriateness of alternative valuation methodologies to approximate exchange value, including methodological soundness, replicability, accuracy, comparability, data availability and simplicity. It is hoped that these clarifications will be useful moving forward in the integration of an expanded range of natural assets, including ecosystem assets.

b. Recent developments in the SEEA standards [28]

As is emphasized in the new SNA chapters on wellbeing and sustainability, the System of Environmental-Economic Accounting (SEEA) is a multipurpose statistical framework that describes the environment and its connections to the economy. The SEEA is presented in a series of interconnected documents that collectively provide statistical standards, international recommendations, and technical guidance. The SEEA complements the SNA via a coherent approach to the organization of data in monetary and non-monetary terms.

The SEEA's measurement boundary is broader than the SNA's, covering all environmental assets whether or not they are assigned an exchange value within the scope of the SNA sequence of economic accounts. While there are some overlaps in scope, there are many areas covered in the SEEA that are not accounted for in the SNA. The SEEA Ecosystem Accounting, for example, places direct focus on the measurement of ecosystems and the services they supply. It extends the measurement boundary for environmental assets relative to the SNA by including ecosystem assets and recording the flows of ecosystem services.[29] The SEEA EA are thus designed to provide a framework for coherent extensions to standard economic measures to support integrated analyses.

[26] Other examples of new SNA guidance relevant in the context of the CWON expanded wealth measures include guidance on the Valuation of mineral and energy resources, Accounting for biological resources and Labour, human capital and education.

[27] Interested readers should also refer to the SEEA technical report Monetary Valuation of Ecosystem Services and Assets for Ecosystem Accounting NCAVES and MAIA, 2022.

[28] For a comprehensive overview of the full body of SEEA standards, please see https://seea.un.org/

[29] These sections draw heavily from the SNA2025, Chapter 2 and other relevant chapter drafts.

A practical issue facing both compilers and users of statistics relates to the scope and timing of updates of the integrated body of SNA and SEEA standards. While a laudable future ambition, given the extensive conceptual development required and the diverse communities that must be engaged, it has to date not been feasible to synchronize update processes. This can lead to incoherences in effective standards until they can be brought into alignment.

After extensive consultation and development beginning with the endorsement of a workplan in 2018, standards for the SEEA Ecosystem Accounting were recently revised with the latest effective standard adopted in 2021. Previously characterized as experimental, the latest edition was characterized as a recognized statistical standard. The chapters on monetary valuation were not met with unqualified universal acceptance, however. Their inclusion in the published manual was characterized as the best available international statistical principles and methods and accompanied with further information and guidance on their implementation in the form of a technical paper (NCAVES and MAIA, 2022).

The latest edition of the SEEA Central Framework was endorsed in 2012. An update process was recently launched, and recommended priorities have been made available for global consultation. Priorities emphasize alignment with the revised System of National Accounts 2025, in addition to emerging demands for data in support of policy making in areas such as climate change, circular economy and biodiversity. Updated standards are targeted for endorsement in 2028.

c. Integration challenges for ecosystem assets in CWON wealth measures[30]

The CWON 2024 represents the fifth, progressively more developed and expanded iteration of the CWON database[31]. It was judged appropriate at this stage to undertake a comprehensive methodological review, reexamining sources and methods employed in prior iterations to chart a path for a potential regularized statistical program at the World Bank. Participants in the review included representatives from both the national accounts and environmental economist communities[32]. As noted, among its important outcomes was a rethink of the method for estimating real wealth measures, drawing directly on physical volumes in a chained Törnqvist volume ideal index formulation. Examples of other priorities identified, not all of which could be addressed in the CWON 2024, include the standard use of conservative baseline assumptions for future rents in the application of the net present value method, the treatment of subsidies in the estimation of resource rents, and the need for updated assumptions and models in the estimation of urban land.

In the context of the CWON 2024, efforts were made to implement innovative methods and push the measurement frontier in significant ways, to change the narrative vis-a-vis traditional economic measurement. As described in the previous section, an important step in this direction, ultimately not

[30] For a very helpful overview of the range challenges involved in accounting for ecosystem services and assets in the context of the SNA and SEEA standards, please see Obst et. al (2019)

[31] At the time of writing, targeted for release in September 2024.

[32] The authors are grateful to Robert Smith of Midsummer Analytics for his leadership of this review, and to the supporting team of international experts including Dr. Matthew Agarwala, Senior Research Associate, Bennett Institute for Public Policy, University of Cambridge and Senior Policy Fellow at the Tobin Centre for Economic Policy, Yale University; Ms. Karen Wilson, former assistant chief statistician for national accounts at Statistics Canada; and Dr. Rintaro Yamaguchi, Senior Researcher, Japanese National Institute for Environmental Studies.

deemed sufficiently developed for inclusion in the CWON 2024 database, was to define and quantify an ecosystem asset for carbon storage.

Considering this and other potential steps to expand the CWON asset base to measure large and complex ecosystem assets, a range of important ambiguities and challenges were encountered in related consultations. While they cannot be treated exhaustively in this paper, illustrative highlights are offered below.

Choice of valuation method and potential for double counting*:*

The CWON 2024 methodological review brought together diverse perspectives with respect to appropriate valuation leading to a spirited dialogue on the relative merits of *accounting prices*, favored by leading environmental economists and exchange values, the basis of valuation in statistical accounting standards in the SNA and the SEEA. According to the literature (Dasgupta 2021), accounting prices are conceptually superior in the analysis of the sustainability of welfare, as they represent the contribution an additional unit would make to *social wellbeing*, other things equal. Accounting prices can be shown to be equivalent to exchange values or observed market prices only in the absence of market distortions or externalities, which is seldom the case. Measurement at accounting prices, therefore, requires complex and specific estimation of the extent of market distortion or externalities on an asset-by-asset basis, a feat likely unachievable in the context of regularized ongoing statistical compilation. In practice, feasible analysis often falls back on available exchange value measures.

Statistical guidance in the SNA and SEEA standards, however, is clear on this point. For a consistent basis of valuation to aggregate monetary values for extended wealth concepts integrating new elements of natural capital, like ecosystem assets, the exchange value principle is fundamental. As noted earlier, exchange values do not presuppose the absence of market distortions, nor do they include consumer surplus. A hierarchy of recommended valuation approaches is laid out in practical guidance associated with the SEEA EA[33] for cases when exchange values are not directly observable via market transactions and must be proxied via indirect techniques. Criteria for evaluating alternative valuation methods in such cases are also elaborated in the new SNA 2025 guidance on valuation principles and methodologies.

On a separate but perhaps related point, there was also consideration of the extent to which ecosystem assets may be double counted in aggregation with other assets if their values are "internalized" in the prices of these assets. Taking the example of climate regulation, it could be argued that the prices of all produced assets are determined in market which relies on the assurance of a stable climate. While no consensus was ultimately achieved among experts consulted, the balance of opinion leaned in favor of the following key points:

- There is a potential for double counting which, albeit difficult to evaluate, is likely only an issue for *assets frequently traded on the market.* An example is the potential for land values to be influenced by the potential to generate renewable energy.

[33] See NCAVES and MAIA 2022 for specific recommendations on appropriate analytical and policy applications of SEEA-EA monetary measures.

- There is little likelihood of such values being internalized in the case of *pure externalities* (such as climate regulation) or *collective services* (such as flood mitigation or prevention of soil erosion by mangroves or forests), where the benefits do not accrue to the owner of the asset.
- The existence of assets, or specific conditions, that *influence the price of other assets* should not be interpreted as their values being internalized and therefore does not represent a double count. One need only think of examples within produced assets where such a phenomena exists. Examples include housing values influenced by proximity to public transit or schools, or public infrastructure required to protect property from extreme weather events. Current SNA treatment allows for the aggregation of such asset values in the measurement of investment and capital stock.

All these factors considered, in the practical choice of valuation methods, the potential for double counting must nonetheless be evaluated and minimized on a case-by-case basis. Because of the challenges involved in estimating the relative levels of monetary values, which serve as weights for physical volume changes in the estimation of real wealth, it has been suggested that emphasis be given to period-to-period changes over levels in presentation of results. Hence the appropriateness of emphasis in the World Bank program's title: The *Changing* Wealth of Nations.

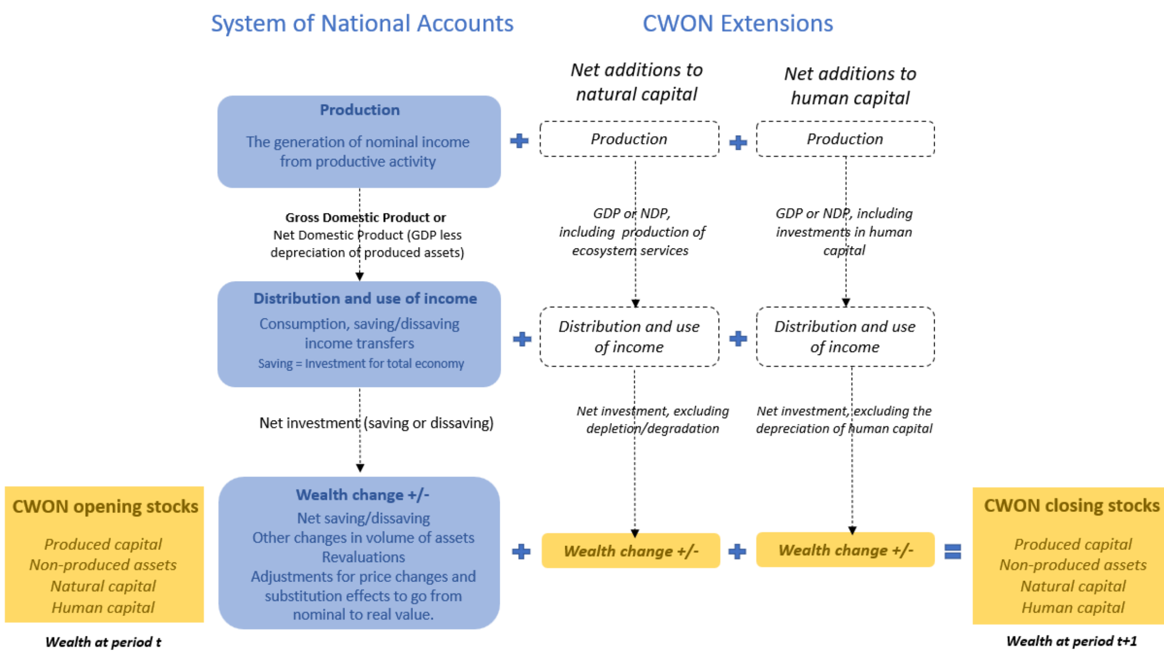
<u>Clarifying CWON wealth stocks vis-à-vis related underlying flows</u>*:*

While the CWON database covers an annual time series of the value and volume of wealth by asset type, the conceptual framework underlying wealth estimation and wealth change has its roots in the sequence of economic accounts elaborated in the System of National Accounts and SEEA standards. The underlying SNA *Stock-Flow-Stock* framework, while not fully elaborated in the CWON, is key to understanding the relationship of extended wealth concepts to traditional headline indicators such as the Gross Domestic Product (GDP). It is thus useful and important to illustrate for data users.

As shown in Figure 6 below, at a broad level, the extension of the asset boundary in the SNA sequence of economic accounts to include human capital and new elements of natural capital in the form of ecosystem asset has implications for other variables in the underlying sequence of economic accounts. The sequence begins with production and ends with wealth accumulation and is designed to measure a range of transaction flows leading to wealth change from one period to another. A fully elaborated framework aligned with extended CWON wealth concepts would also imply extensions to the production boundary, with implications throughout the sequence of economic accounts. Elements in yellow in Figure 6 indicate the current coverage of the CWON, which is restricted to real and nominal wealth aggregates and period to period change. Elements in blue illustrate the components of the SNA sequence of economic accounts, while dotted lined elements represent implied extensions to the CWON if a fully elaborated sequence of accounts were estimated.

When aggregate national wealth is considered, nominal wealth change from period to period can be decomposed into three key components: net saving (equal to net investment at a national level), revaluations due to price change, and "other changes in the volume of assets", which could be due, for example to catastrophic events or new discoveries in the case of natural resources. If feasible, estimation of these underlying flows would add considerable analytical value to the CWON database.

Figure 6: CWON wealth in the sequence of economic accounts



It is worthy of note that the World Bank maintains published estimates of adjusted net saving (ANS), the estimation of which dates back to the mid-1990s. While the ANS methodology was revised in 2023, the estimates are not conceptually aligned with the wealth concepts and methods in the CWON 2024. They are derived as net national savings plus education expenditure, less energy depletion, mineral depletion, net forest depletion and carbon dioxide and particulate emissions damage. In this respect, they integrate specific wealth extensions, along with elements of a “liability” approach to capital measurement. While commonly the focus of environmental analyses, the liability approach is not consistent with endorsed statistical standards.[34]

Initial steps have been taken to investigate the feasibility of developing updated estimates of adjusted net saving consistent with new CWON 2024 concepts and extensions and, if achievable, development of aligned estimates is worthy of future consideration.[35]

[34] For a proposed conceptual treatment of the liability approach in the context of the SNA, see Vanoli 2017. As noted, this direction was not adopted in the revision to the SNA standards, which emphasize an expanded capitals approach, and the integration of extended wealth values across complementary (SNA and SEEA) statistical standards.

[35] See Atkinson and Venmans (2023).

Wealth in real (volume) terms

While wealth volumes were not a feature of the SNA2008, the updated SNA2025 standards recognize analysis in volume and real terms (accounting for the effects of price change) as fundamental to understanding sustainability. As noted, an important innovation in the CWON 2024 was the introduction of a chained Törnqvist volume index, linking estimates in real terms to physical volumes in an ideal index formulation, better accounting for substitution effects via continuous updates to nominal weights. The introduction of this new method increased the relevance of real wealth measures for sustainability analysis.

An important challenge in the application of this method relates to accounting for quality change. The extent to which quality change can be reflected in real measures depends on whether physical volumes are available at a sufficient level of detail. In the context of the CWON, detail is constrained by available data in international databases used in estimation. Further investigation is needed to assess potential impacts of further quality adjustment and determine whether, if feasible with existing data sources, it is warranted in terms of material impact on the CWON database and related findings.

Currency conversion: market exchange rates vs Purchasing Power Parities (PPPs)

Given that the CWON is a cross-national database, where values are expressed in US dollars for comparison purposes, another dimension of price and volume measurement relates to currency conversion. Conversions undertaken at market exchange rates are not ideal since, they can be subject to distortionary market fluctuations, and they do not account for differences in price level across countries. In this respect, conversion at Purchasing Power Parities (PPPs) was undertaken on an experimental, alternative basis for more appropriate comparisons reflecting economic wellbeing.

The difficulty in the application of PPPs for CWON currency conversion relates to their construction and the availability of detail pertinent to wealth measurement in real terms. Wealth can be viewed from two alternative perspectives: 1) as a store of value for future consumption and 2) from the perspective of production, where different types of assets are viewed as productive factors. The latter perspective, while conceptually preferable, is not easily achievable with existing data.

PPP measures from the World Bank's International Comparison Program (ICP) are constructed on the basis price levels relating to expenditure based GDP. While these may be useful and appropriate for an interpretation of wealth as an aggregate store of value for consumption, it is inappropriate to apply them to individual wealth components, with different characteristics and implications for varying price levels across countries. Therefore, it is only feasible to undertake PPP conversions at an aggregate level for each country.[36] While nonetheless useful, this limits detail that can be presented in descriptive analysis.

4. **Implications for future SNA and SEEA statistical standards**

CWON compilation draws on available international databases and relies on available statistical standards for monetary valuation to integrate new elements of natural capital in the form of ecosystem assets. Challenges encountered in methodological development and estimation mirror what might be faced in a more generalized way by national statistical offices. As we hope to have demonstrated via our experiences in compilation, there has been a symbiotic and productive relationship between the ongoing

[36] See Inklaar, Gu and Diewert (2023).

development of the CWON database and the emerging SNA and SEEA standards relating to wellbeing and sustainability, emphasizing an expanded capitals approach.

Given the nascent quality of statistical principles and methods for the monetary valuation of ecosystem services and assets, improvements can only be realized as implementation experience matures. Its credibility must be reinforced via more generalized policy application. Conditions are ideal for achieving this, given the heightened policy interest in climate change and environmental sustainability.

While significant advancements have been achieved in conceptual development for ecosystem services and assets, practical questions inevitably continue to emerge as implementation broadens. It is hoped that best practices will emerge throughout this process, and the statistical community can continue to refine and document practical guidance to support national and international efforts. This will in turn demonstrate the viability of emerging standards, as has been illustrated by work to date on carbon storage in the context of the CWON.

As noted, further clarifying the application of exchange value principles and methods in the context of the SEEA-EA will be important. It is hoped the new SNA guidance clarifying these principles will be useful in this regard. To the extent that alternative estimation at accounting prices adjusting for market distortions and externalities can be feasibly regularized, differences between these and exchange value measures could serve as a useful gauge to measure the extent of market distortions.

An upcoming revision to the SEEA Central framework will prioritize, among other things, alignment with the new SNA standards on sustainability, and a new task team on practical implementation guidance coordinated by the OECD will serve as a forum for ongoing discussion. Harmonization of overlapping areas in the SNA and SEEA standards will continue to build on achievements to date to assure future potential for integrated extended measures.

5. Conclusion

At the time of writing, the CWON 2024 was targeted for release in September 2024. While significant advancement is achieved in this fifth iteration of the CWON, there remains much to be achieved. A range of future priorities were identified in the CWON 2024 methodological review, including needed data quality and methodological improvements, expansions to the range of ecosystem assets covered, and the alignment of World Bank estimates of adjusted net saving to the new expanded wealth concepts and methods.

After 5 progressively more developed and expanded editions of the CWON, each further demonstrating its value and viability, it is hoped the CWON can be regularized as an ongoing statistical program at the World Bank. This will enable the CWON to continue to play a role in statistical development for the global public good, providing policy relevant measures addressing key questions relating to global sustainability. As momentum builds, expanded statistical compilation at the national level will be supported by updated SNA and SEEA statistical standards for credible extended wealth measures encompassing human and natural capital “beyond GDP”.

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