Beyond valuation. Monetary aggregates for the SEEA-EA

Developing a broader outlook on economic values dependent upon ecosystems and their services, while preserving basic SNA principles and putting valuation in the correct perspective.

Paper prepared for the London Group, based on a presentation given at its XXVI meeting of October 2020 and on subsequent discussions, also considering the opinions heard at the extraordinary UNCEEA meeting of November 2020[1]

Aldo Femia, October 2020

Two hands clap and there is a sound. What is the sound of one hand?

(Zen Kōan)

We can't solve problems by using the same kind of thinking we used when we created them

(dubious origin, though usually attributed to Albert Einstein)

An expert is someone who knows some of the worst mistakes that can be made in his subject, and how to avoid them

(Werner Heisenberg)

Abstract

This paper is directed to all practitioners of *monetary valuation* of ecosystem services and assets – economists, national accountants, environmental accountants, as well as non-experts – interested in making ecosystems economically visible without giving in to the idea that ecosystem services are like any other product. It aims at delineating a scientifically and technically sound way out of ideological confrontation around the currently dominating approach which is precisely *valuation* intended as the search for *the* monetary value *of* ecosystems and their services.

We first discuss the application of the concept of *exchange value*, as specified in the SNA, to ecosystem services. This concept has an empirical basis in actual prices and other *observable* monetary flows, and a theoretical basis in the very concept of exchange. Compliance with basic principles rules out the direct application of the *exchange value* concept to the use of ecosystem services, although these may be object

[1] The critiques and proposals to the valuation parts of the SEEA EA presented here are an extension of those expressed in the presentation given at the London Group of which this paper is the follow-up . That presentation was based on the drafts of chapters 3-11, circulated for global consultation, but the main critiques expressed there remain valid, since not much has changed in substance, as for what concerns valuation, in the complete draft circulated thereafter, as discussed in session 3.5.

of transactions between economic units. A correct understanding of this concept leads to identifying in the *resource rent* the legitimate reference concept for the actual or hypothetical market value of ecosystem services. While this was acknowledged in chapters 8 and 9 of the SEEA EA as they were drafted at first, the shift to *observed price* as central concept for valuation in the subsequent complete draft is a serious conceptual error. Although *imputation* is no longer mentioned in the complete draft, a lot of different estimation methods continue being recommended in there, and – what's more important – their specific meanings are being obliterated and transformed into generic *exchange value*.

We also argue that valuation based on the rent concept is useful from a *distribution of income* point of view, but does not represent, in general, the *dependence* of economic values on ecosystems and their services, due to their essential characteristic of being *non-produced*. Valuation is therefore not able to provide figures relevant *in general* for decision-making.

We then expose the constructive part of our views, by highlighting the specific meanings of the estimates delivered by the different techniques, that are now used for valuation through imputation, but can and should be directly used *for what they are*. Indeed, imputation, while introducing an arbitrary and unnecessary twist in the meaning of the estimates, conceals a rich set of information concerning *monetary flows connected to ecosystem services*. These *values* are potentially very useful *per se*, and should be put directly at work in informing decisions. The importance of ecosystems for economic benefits is better represented as a set of *values*, which are primarily biophysical, but also include a plurality of economic values that may be measured in monetary terms.

In order to give satisfactory answers to the issues included SEEA EA research agenda, it is necessary to go beyond valuation as overarching concept, by recognising that the concept of economic value of ecosystems is a much broader one than that of capitalised market exchange value of ecosystem services.

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1. Introduction: the current situation – aim of this paper

After several years of experimentations, working papers, expert meetings, chapter drafts, complete drafts, global consultations, more meetings, negotiations… the revision process of the SEEA manual on Experimental Ecosystem Accounting – SEEA EEA – has gone through an important step, but is not complete yet. Indeed, while the UNSC removed "experimental" from the title of the manual, and "adopted chapters 1-7 describing the accounting framework and the physical accounts as an international statistical standard", chapters 8-11 "only" got the label of "internationally recognized statistical principles and recommendations for the valuation of ecosystem services and assets in a context that is coherent with the concepts of System of National Accounts"[2].

The issue of monetary valuation always had, and still has, great divisive power[3]. Not surprisingly, the responses to the global consultations on the SEEA EA, as well as the discussions in UNCEEA meetings and in the UNSC itself, while showing unanimity in favour of raising to a standard the status of the biophysical part of ecosystem accounts, clearly witnessed the split of the statistical community as for valuation[4]. This split is at the basis of the UNSC compromise decision – which as all compromises is not fully satisfactory for anyone.

A wide group of countries and experts is quite keen of valuation. Many of them are from the Commonwealth and/or stem from Academia, actively engage in implementation and spreading of ecosystem accounts and generously contributed to the development of the manual. We may call this group that of the "enthusiasts" or "investors". One of their strong arguments is that Nature's conservation will only be possible with an active involvement of economic powers like Ministers of the Economy, Central banks, Corporations, Investors… – briefly, of all those who count (money). Therefore, gaining attention from these powers is essential for well-oriented economic choices and policies. Since the only effective key to gaining this attention is displaying *monetary values*, then it is our duty to assign a monetary value to ecosystems and their services[5]. Otherwise, ecosystem values will be neglected altogether as they have been so far. Without this monetary value, decisions will be inefficient, because the existence of benefits from ecosystems would not be recognised and trade-offs could not be assessed[6]. In addition, they argue, "if we do not fix rules, everybody will do it the way it pleases them the most". Finally, and very importantly, they firmly reject any allegation that valuation be a way to put a price on ecosystems, because this is not what valuation is meant for in their intentions. The very valuable point in this position is the aspiration to overcome the "economic invisibility of nature", which is at the basis of many distortions in the allocation of resources. Therefore, they would have liked the UNSC to recognise chapters 8-11 as an international statistical standard as well.

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[2] Report should be available soon at https://unstats.un.org/unsd/statcom/reports/

[3] This is surely connected to many technical issues, but more than anything else it seems due to the ideological presupposes and implications of valuation. Indeed, the debate mirrors and crosses the more frankly political and centuries-long one, revolving around the extraction of economic value from Nature, a famous early round of which is the quarrel on forest's exploitation between John Muir (1838-1914) and Gifford Pinchot (1865-1946).

[4] . Unfortunately, no recording of the lively discussion at the UNCEEA is publicly available. Worth mentioning are especially those of July 2020, when six draft chapters had been made available (minutes available at https://seea.un.org/sites/seea.un.org/files/minutes_final.pdf), and of November, when a first complete draft was in front of us (minutes at https://seea.un.org/sites/seea.un.org/files/minutes_extraordinary_v5_clean.pdf)

[5] The intention of orientating policy in a direction favourable to ecosystems is no doubt a pious one, but hardly one conferring solidity to official statistics (see below).

[6] The way in which Global Consultations on draft chapters was presented (https://seea.un.org/sites/seea.un.org/files/documents/EEA/1_seea_eea_global_consultations_on_chapters_cover_note.pdf) , as well as some paragraphs in the SEEA EA draft itself, provide nice example of such taken-for-granted reasoning.

However, other countries and experts (let us call them "sceptics") got in the way. These have not been equally active in the revision. Throughout the SEEA EEA revision process, some of them did occasionally cast on the table one or the other of the many substantial and punctual questions and critiques that may undermine valuation, but recently no sceptic engaged seriously in proposing alternative answers to the legitimate aspiration to overcome "the economic invisibility of nature". Their positions are quite varied. Indeed, unlike enthusiasts, sceptics do not usually march united (this is not surprising: there always is one dominant idea and various critic perspectives), but in crucial moments they did hit united, supported by powerful counterarguments to valuation. Based on theoretical and/or working knowledge in the field, they challenge this idea from several perspectives – ethical, philosophical, epistemological, economic, technical, concerning decision-making theory and practice, methodology, suitability for official statistics. Their arguments touch upon the very meaning of the estimates of monetary values of ecosystems and their services; the validity of the supporting economic theory; the statistical reliability of the estimates; their usefulness for policy, etc.. Most of the questions they ask do not get satisfactory answers, and probably never will[7]. Their arguments draw on a large body of theory, literature and experience, which has accumulated through time. Unfortunately, the academia (and consequently most economists and statisticians) largely neglects this knowledge, which may needs dusting and oiling, but is valid now as it was in the past, when other similar attempts to put monetary values at the centre of the stage were also blocked thanks to the same arguments. Not all sceptics object to valuation itself, but only to its uptake by official statistics, based on the many methodological uncertainties and lack of precision of the estimates. Overall, they have so far been able to contain attempts to give valuation the same status of biogeophysical information, but will not be able to do so for long, unless they propose *something that is different from valuation but at least as convincing*.

As the 2020 UNCEEA discussions and conclusions prefigured, the 2021 UNSC witnessed a stalemate situation on the matter. Its outcome is ambiguous and can be stretched either way. On the one hand, it can be emphasized that valuation failed to reach the status of a standard; on the other hand, it is easy to neglect the distinction between parts of the manual having different statuses, and blur the concepts of "standard" and "internationally recognized statistical principles and recommendations". This ambiguity is detrimental not only for Ecosystem Accounting, but also for Environmental Accounting in general. In the longer run it may even impact National Accounting, considering that the UNSC – mistakenly – sentenced that "in a context that is coherent with the concepts of System of National Accounts" the "principles and recommendations for the valuation of ecosystem services and assets" of the SEEA EA are not only "internationally recognised", but also "statistical"[8].

The main purpose of this paper is to show that it is both possible and necessary to reconcile the two views at the level of the technical framing, setting aside all ideology and pre-constructed ideas, and to get to a sound statistical standard for satellite Accounts on Ecosystems, well rooted in – and

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[7] See e.g. Sarah Parks, John Gowdy "What have economists learned about valuing nature? A review essay", *Ecosystem Services*, March 2013, 3:e1–e10; Baveye, P., J. Baveye, J. Gowdy. 2013. "Monetary evaluation of ecosystem services: Getting the timeline right." *Ecological Economics* 95, 231-235 highlight "long-standing problems that have eluded solution over the last half-century and appear intrinsically unresolvable".

[8] The ongoing revision of the SNA already considers some environmental aspects. "Accounting for ecosystem assets is crucially important for capturing natural capital to a fuller extent. How and when this extension of the production and asset boundary can be reflected in the extended accounts for measuring wellbeing and sustainability depends on the future developments of the international standards, including their implementation in practice" (from Working Paper 2.6 of the Group of Experts on National Accounts, "A Broader Framework for Wellbeing and Sustainability in the *System of National Accounts* – guidance proposed by the Task Team on Wellbeing and Sustainability" (lead author Catherine von Rompaey), 10 August 2020. https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.20/2020/mtg1/2.6_Broader_Framework_for_Wellbeing.pdf)

systematically connected to – National Accounts.[9]. Valuation, as currently conceived and expressed in chapters 8-11 of the SEEA EA, leads the SEEA astray from being a consistent extension (satellite) of the SNA, turns it to a *variant* of the SNA, or "a system of its own" (something which would require a thorough reflection). However, *monetary values connected to ecosystems and their services* are too important to be left methodologically undetermined.

2. Ecosystem Accounting and Natural Capital Accounting: overlaps and differences

It is an unfortunate circumstance that the terms "Natural Capital" and "Ecosystems" are often used as if they were synonyms, notwithstanding the important differences between the two. On the one hand, the domain covered by Natural Capital (Accounting) is broader, as it includes both the living and interacting components of the natural environment and the non-living components which do not interact with ecosystems as long as they lye undisturbed in the subsoil. The first ones are dealt with the SEEA EA, the second with in the SEEA CF. On the other hand, the NC(A) perspective is narrower than that of the Ecosystems (and correspondingly of the SEEA EA), because it is the specific perspective of *economic value measurable in monetary terms*. Indeed, NCA and valuation are inseparably bound, while Ecosystem Accounting takes a wider perspective, from a scientific as well as from a framing of values. Monetary valuation of ecosystem services is necessary for *capitalization*. Valuation is the measurement of Nature as capital, through that of its services.

On a more philosophical level ("framing of values"), it should be clear that the perspective on ecosystems taken by NCA is instrumental and normative (i.e. it tends to dictate and impose a specific world view). It puts "capital", as a substantive, at the center of attention, and makes nature a mere adjective ("natural") for it. If we consider the six definitions of Natural Capital reported in a London Group document[10], we find that *the only element that distinguishes the concept from that of Nature, or (all) ecosystems is the instrumental perspective*, i.e. the way in which the "elements of nature" (however called or enumerated) are characterized: "…that directly and indirectly produce value or benefits to people" (UK Natural Capital Committee); "…that provide us with ecosystem goods and services" (International Institute for Sustainable Development); "…that yields a flow of valuable ecosystem goods or services" (Wikipedia); "…from [which] humans derive a wide range of services" (World Forum on Natural Capital); "…in their role of providing natural resource inputs and environmental services for economic production" (OECD statistical Glossary); "…that deliver socio-economic value through ecosystem services" (GLOBE natural capital initiative). If we chop away these characterizations, we are left with (poor) definitions of Nature itself. Monetary valuation is necessary for *capitalization*. Without valuation no measure of Nature as capital would be available.

Ecosystem accounting, on the contrary, primarily covers ecosystems - i.e. the living and non-living components of the natural environment, seen in their mutual interaction – *for what they are*, in hard-science-based terms. In, ecosystems are seen holistically, primarily in biophysical terms, and although Ecosystem accounting may provide the basis for valuation, valuation is not its main reason to be, as extent, condition and physical ecosystem service use accounts have meaning and usefulness of their

[9] This paper itself stems from the need to overcome some disturbing cognitive dissonances caused by being sympathetic with arguments from both sides: namely, on the one hand, that monetary values are important; and, on the other hand, that valuation is conceptually flawed.

[10] "Towards a definition of Natural Capital", Revised draft of 3 November 2014. https://seea.un.org/sites/seea.un.org/files/towards_a_definition_of_natural_capital_-_2nd_draft.pdf

own. Valuation of ecosystems could even be considered not belonging to EA properly said, but as a NCA way of using Ecosystem accounting. Instead, through time biophysical accounts have been proposed and realized, that deal with the functioning of ecosystems, with the circulation of elements (e.g. water, carbon, nutrients) within and between ecosystems, that are not (yet?) covered by the SEEA Ecosystem accounting, but would usefully complement extent, condition and physical services accounts. These would complete the description of the natural world in precise accounting terms, most needed for understanding where the problems come from and how we can tackle them. Examples of these accounts are the component accounts of the Natural patrimony accounts ("*comptes de patrimoine naturel*") dealing with "underground resources, sea water, atmosphere, continental water, soil, fauna and flora". Also the IPCC's Carbon and Other Biogeochemical Cycles accounting offers a reference for such accounts[11].

Appendix to Chapter 2: The well-minded case for valuation, what valuation achieves in practice, and our approach

Hardly any sensible person around the world has doubts about the importance, in order to accompany policy in the effort of protecting the very basis of life (let alone of economic activity), of harmonising the biogeophysical measurement of ecosystems, their role in supporting human life and activity and their changing health[12]. However, some, even many, authoritative and well-minded experts seem to think that all this is almost no use without monetary valuation. The reasoning leading to this conclusion may be stylised as follows. Decisions in the economic realm are what most counts for ecosystems. In the economic realm, those who count, count money, and are sensible to values expressed in money terms most than anything else. Ecosystems, however, currently are almost "invisible" in economic terms[13]. This is because their *contributions* to humankind are not expressed in money terms. What they give us – their services – has prices that are null or negligible, and fall short of signalling nature's value. This is the main reason why economic decisions largely neglect ecosystems. In order to overcome economic invisibility, therefore, a significant monetary value must be assigned to them, reflecting the benefits provided to humankind – and not just to the economy as currently described by the SNA – by ecosystem services. Therefore, valuation will lead to more nature-friendly decisions, while no valuation will conserve the economic invisibility of ecosystems.

We will not attempt a thorough discussion of this reasoning, which would require an articulated consideration of its many different existing versions. There are, however, some core elements, common to all versions, which we would like to point out and briefly discuss.

Overcoming the economic invisibility of ecosystems

Most notable is the idea – inherent to the above reasoning – that computed hypothetical values would have significant, ecosystem-friendly effects on economic decisions. If economic agents take decisions based on monetary computation of costs and benefits, they may commit themselves to include computed values of ecosystem services in their analysis. In this case, assigning monetary values to ecosystem services will eventually help take decisions that are more ecosystem-friendly provided the values assigned to ecosystem services are sufficiently high. This steering of decisions, noble as its intention may be, is clearly out of scope of official statistics. This would be sufficient to dismiss the

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[11] See e.g. Weber, J.L. (1986) http://www.numdam.org/article/JSFS_1987__128__137_0.pdf, and Ciais, P. et al. (2013) https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter06_FINAL.pdf

[12] "humanity can no longer afford to ignore its dependence on a thriving environment rich in life" (from the cover note to the Global Consultation on the draft chapters)

[13] Indeed, the SEEA EA "was developed to respond to a range of policy demands and challenges with a focus on making visible the contributions of nature to the economy and people" (final draft submitted to the UNSC, march 2021, page 1).

argument. But let us briefly consider it and question whether "overcoming the economic invisibility of nature" really favours more ecosystem-friendly choices. Surely, displaying monetary values connected to ecosystem services may itself inspire higher consideration for ecosystems in decision-making, especially public. Public agents may even decide to influence actual prices, to make sure that also private agents consider ecosystem values. However, the introduction of ecosystem's monetary values does by no means guarantee, by itself, that decision-making mechanisms more favourable to ecosystems will emerge. On the contrary, the introduction of terms or trade between ecosystems' and other values may convey a false sense of substitutability between values, and crowd-out other decision-making procedures, which are more appropriate in many actual circumstances. Such are, e.g., decisions based on the precaution principle, or on participative processes (such as in multi-criteria analysis), where a multiplicity of values with their different meanings for a multiplicity of actors are explicitly considered and discussed.

The choice of how to take decisions – especially public ones – is clearly a political one, and the introduction of monetary values is not neutral with respect to decision models.

Policy and statistics

The argument discussed above overlooks the fundamental distinction between "assigning a monetary value to ecosystem services" *as a policy (that introduces or changes actual transactions)* and as *a procedure for constructing statistical information*, and looks at valuation as a policy, i.e. a public action expressly aimed at *influencing actual transactions*. However, while the existence of values resulting from valuation as a statistical procedure *may* have effects on actual transactions, it may be argued, on the one hand, that simply *declaring* from the pulpit of National Statistical Offices that something has a monetary value will not make decisions change, and on the other hand that – whatever the actual effects of valuation – Official Statistics should never assume the objective of *influencing economic agents' behaviour*: this would be a challenge to the fundamental principles of official statistics.

Of course, the visible consequences in terms of monetary transactions of policies such as creating markets through institutional arrangements, or introducing payments from the public budget expressly linked to the ecosystem services provided, or taxing those who benefit from certain ecosystem services, will be recorded in SNA, and highlighted in SEEA CF activity accounts.

Mono-dimensional comparison between scalars

An implicit common feature of all versions of the well-minded case for valuation is the idea that the contribution of economics and accounting to decision-making is, or can, or should be, limited or reduced to a mono-dimensional comparison between scalars (of course expressed in the same unit - not even necessarily monetary, though obviously monetary). The cost-benefit decision-making model allows taking ecosystems and their services in account only if their benefits are expressed in money units, or in whatever other single unit that makes them and human-made capital and products comparable. The achievement of this comparability is at the heart of monetary valuation, it is its reasons to be. Such comparability is the yearned and well-deserved accomplishment of decennia of research, or as a poisoned fruit, according to the perspective one takes.

Values from valuation vs. prices: a fake distinction

It is important to see that the monetary values to which valuation leads have all the formal properties of prices. They are (said to be) the values **of** ecosystems and their services, or the (exchange) value these **have**, even if they are not prices paid for them in the actual reality. Values expressed in monetary terms are, in other words *an intrinsic characteristic*, *an inherent property* of ecosystems and their services. **This**

is what defines *valuation*, as opposed to other possible approaches to monetary values connected to ecosystems and their services. Values as conceived in the *valuation* approach can be (and are, in the monetary accounting tables of chapters 8-11, of the SEEA EA) summed, subtracted, exchanged with each other, ideally traded for human-made values and substituted with money in economic agents' portfolios.

Indeed, while most pro-valuation experts assure that values meant for overcoming the economic invisibility of ecosystems *should not* be mistaken and misused as prices, there is no guarantee that they will not. On the contrary, since they can, it is most likely that they will, at least as long as one premise of the reasoning is true, i.e. as long as the decisions that are important for ecosystems are taken by those who count money. *Estimated values* will not necessarily change the way decisions are taken; rather, the way decisions are taken may change *estimated values* into actual *prices*[14].

Hiding the most important information behind the monetary veil

It is also important to see that valuation cannot be done without quantity data from biogeophysical ecosystem accounts, on which to apply (impute) unitary values (i.e., as pointed out, scalar numbers which have all the formal properties of prices, and sometimes actually are prices). Such quantity data in turn require the parcelling out of ecosystems into ecosystem assets, and that the parcels be individually measured and counted. The choice is between putting physical asset and flow accounts (extent and condition, ecosystem services in physical terms) at the centre of the stage, or hiding them behind the curtains of monetary value. Unfortunately, most scholars are quite interested in having a final and *official* answer to the question "how much is a specific piece of Nature worth in money terms?"[15].

A specific and questionable theoretical background

Underlying valuation there is the standard (neoclassical) economic theory, according to which the utility or welfare value of something can somehow be positively related to its exchange value (especially in terms of *changes*)[16]. This applies neatly when markets are perfectly competitive and agents perfectly informed and able to compute (unbounded, Olympic rationality), and clearly such conditions are never satisfied. But let us go and assume there is such a relation, even if it is the weaker the further the real situation is from the ideal one.

Let us highlight here, *en passant*, how crucial this positive relationship is in a welfare-oriented interpretation of indicators such as GPD, and of monetary values in general.

This crucial relationship logically descends from the fact that exchange values embed information on peoples' preferences, is real to the extent that this is the case, i.e. to the extent that the said conditions are verified. The great charm of this theory and its application in accounting is all in the idea that prices are related to the well-being value of things, because they are formed through the free interaction of economic agents, who take decisions as to maximise their utility, i.e. as to achieve the maximum utility

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[14] See Mark Sagoff "On the economic value of ecosystem services", *Environmental values* 17, No. 2 (2008):239-257, www.environmentandsociety.org/sites/default/files/key_docs/ev_17no.2_sagoff_mark.pdf

[15] The SEEA EA is "only" about the components of Nature involved in the cycles of life (this seems a reasonable, short connotation of the delimitation of the domain of ecosystem accounting). To the extent that the treatment of these components in monetary terms is or should be coherent with the SEEA-CF and SNA treatment of non-living components, the extension of our reasoning to the latter is not imprecise. It only requires that the values already included in SNA and/or SEEA CF can be summed to those attributed to Ecosystems.

[16] See for example an influential paper in the SEEA EA revision process: Barton D.N., Caparrós A., Conner N., Edens B., Piaggio M., Turpie J. (2019). Discussion paper 5.1: Defining exchange and welfare values, articulating institutional arrangements and establishing the valuation context for ecosystem accounting. Paper drafted as input into the revision of the System on Environmental-Economic Accounting 2012– Experimental Ecosystem Accounting. Version of 25 July 2019. "Variations in welfare are approximated well by an ecosystem accounting measure […] based on (simulated) exchange values" (p.36).

level they can under the circumstances they are confronted with. This applies whatever the circumstances, and some positive relation between economic value and welfare holds, as long as some economic agents' choice is involved in determining the former.

To some extent, it is evident that the charm of valuation is a reflection of the charm of this tautology: when there are transactions in ecosystem services, the amounts of money involved, representing their economic value, can be taken as the expression of a positive contribution to well-being; when there are none they must be created: in practice through policies, or on paper through accounting. In the latter case, since the real world refuses to express the value of nature in those terms, it is considered the accountants' legitimate task to do it, as to complete the representation of welfare through economic value.

It should be clear – let us note at the margin – that the only legitimate valuation technique for non-marketed ecosystem services, in this perspective, would be one based on hypothetical, perfectly competitive markets (i.e. adopting the reference situation where the economic value-welfare relation is the strictest possible), which would lead to zero or very low values for most of these services, as only a *resource rent* could be reaped on them in this case (note that production costs are non-existing as the ecosystem services are non-produced). The application to ecosystem services of the pure and abstract theory that allows to refer exchange value to well-being has nothing to do with the real world and with what can be measured by statistics in general (as it refers to hypothetical situations) and leads to paradoxical results of irrelevance of non-scarce ecosystem services (on this, also see chapter 0).

The example of the Dasgupta review

> "Nature needs to enter economic and finance decision-making **in the same way** buildings, machines, roads and skills do. To do so ultimately requires **changing our measures of economic success**."
>
> "Nature's worth to society – the true value of the various goods and services it provides – is not reflected in market prices because much of it is open to all at no monetary charge",
>
> "in order to judge whether economic development is sustainable, an inclusive **measure of wealth** is needed. By measuring our wealth in terms of all assets, including natural assets, 'inclusive wealth' provides a clear and coherent measure **that corresponds directly with the well-being** of current and future generations. This approach accounts for the benefits from investing in natural assets and illuminates the trade-offs and interactions between investments in different assets"

Sentences similar to these can be read in many presentations of the SEEA EA, in the SEEA EA itself (not so blunt, of course), as well as in broadly acclaimed documents quoted in the SEEA EA. One such document surely is and will be the recently published *Dasgupta Review on the Economics of Biodiversity*, from whose "Headline messages" the above sentences are taken (emphasis added).

Such statements define a political programme. The first one limits severely – even contradicts – the also often read and heard call for "changing the way decisions are taken". The second may be connected to the first one and unfold as follows: nature is dissipated by humans because it does not enter decisions in the same way as buildings, etc.; nature does not enter decisions in the same way as buildings, etc. because market prices do not reflect nature's value; market prices do not reflect nature's value "because much of it is open to all at no monetary charge".

We are confronted with the "good old" theory that ecological crisis be due to a market failure, strictly understood as **inexistence of markets** for open-to-all-at-no-monetary-charge nature. Of the "broader institutional failure" that the Review acknowledges, only this inexistence is underlined. Not the existence and working of some other markets, nor the inexistence *in general* (i.e. including nonmarket ones) of adequate institutional arrangements (adequate=able to rationing access to the necessary extent).

So, if that's the ultimate (and only) reason for nature's dissipation, reflecting Nature's worth to society **in market prices**, i.e. pricing nature, is the way out of the ecological fever. This is straightforward as a syllogism. There *may* be good theory behind all this, and there is no need to challenge this here, but only to highlight that other, at least equally sound, schools of economic thought – the ones that more closely mingled with ecological science, such as evolutionist, institutionalist and some Marxist thinking - lead to a different political programme. These schools maintain that it is the working mechanisms of the economy, i.e. the principles on whose basis we manage the environment, that need to be changed, and that it is necessary to go beyond methodological individualism and choice based on relative prices, income maximisation and GDP growth - i.e. beyond markets' rationality as main rationing principle – and towards collective management of the commons, inherent values of nature, multidimensional well-being and corresponding indicators. In particular, these approaches maintain that "in order to judge whether economic development is sustainable", we need biophysical indicators, and that no weighting-aggregating, let alone one based on exchange (marginal) values, may tell us anything more than what is ultimately desired by present consumers. The latter's bounded rationality and knowledge and time and preference for the present satisfaction of needs may well prove to be unsustainable (i.e. there is no compelling reason why markets should fix the prices that lead to sustainable choices).

Nobel laureate Elinor Olstrom's lesson is forgotten, if after acknowledging that "we lack the institutional arrangements needed to protect global public goods, such as the ocean or the world's rainforests" pricing is considered a necessary – and not just a possible - one.

The transposition in accounting of the idea is that "to do so ultimately requires changing our measures of economic success", i.e. GDP (by extending measures of wealth to Gross Ecosystem Product and similar ones for other forms of capital)

These ideas:

- are based on confusion between policy and statistics;
- overlook the fact that we have specific instruments, much more appropriate than measures of economic success, to judge whether economic development is sustainable;
- wishfully imply that by changing the economic thermometer, i.e. blurring the meaning of GDP, is key to calming the ecologic fever;
- maintain economic success as unquestioned lighthouse of progress, by trying to refine, rather than redefine, it;
- re-propose monetary measures of wealth as measure of well-being and intergenerational equity;
- challenges the intrinsic multidimensionality of the beyond GDP and SDG approaches: beyond GDP they let us see more GDP, only with a sprinkle of green".

There is an alternative

We agree that that if the *dependence* of economic activities from Nature is not well measured and made visible in terms of monetary values, and not just in physical terms, important pieces of information will be missing. Information in monetary terms will always be required, e.g. on the economic resources involved in carrying out or refraining from carrying activities that impact ecosystems. Economic resources may be involved in various different ways: because at risk, or because potentially arising, because necessary, or actually used, for protecting ecosystems, and so on. We deem it therefore necessary that an alternative approach to *monetary values connected with Nature* stems from the critique of *valuation* as an approach, however radical this critique may be. The alternative to valuation must be viable not just as a compromise but as a real solution, i.e. one that is convincing on the conceptual level and may be adopted as a statistical standard.

The solution we propose in this paper is within reach in a reasonably short time as for the methodology. It refrains from putting all the eggs of the statistical community in the slippery and contentious basket of the concept of *monetary value of ecosystems and their services*. It is practically feasible at least as much as current monetary valuations, as it uses them, in a different way than valuation. It does not require much additional time and work for the finalisation of the new SEEA EA, as it "simply" requires a different interpretation and presentation of elements that are already in the current draft. It may also require bringing to the forestage, dwelling more, or specifying and developing some of these elements, and adding some. However, it does not require renouncing to important information, such as that on *monetary values connected to* ecosystems and their services, delivered by most estimation methods.

3. The System of National Accounts and the valuation of ecosystems and their services

3.1. Two premises and some anticipations

3.1.1. First premise: how does our discourse affect the valuation of assets

The SEEA EA derives ecosystem *assets* values from those of ecosystem *services* (by way of capitalisation through the Net Present Value concept, §2.44), coherently with SNA and SEEA CF principles. So, our discussion can be limited to valuation of current ecosystem services. The capitalisation castle will crumble if the service valuation basis is not solid enough.

The relation with the SNA definition of assets would merit a chapter of its own, based on the exclusions and inclusions established in the SNA, e.g. in §§10.166 and subsequent ones. But let us here only note that the SNA asset boundary includes only what provides economic benefits to their owners ("An asset is a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time"; SNA §3.30), while

> "The SEEA EA encompasses a broader asset boundary in physical terms than the SNA, reflecting the definition of environmental assets in the SEEA Central Framework wherein "*environmental assets are 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, para. 2.17)." (SEEA EA §1.39 – bold and underlining added).

The important difference, here, is in the beneficiaries: "owners" only in the SNA, "*humanity*" in the SEEA. All SEEA assets are SNA assets, but for:

- those that are unowned, but able to provide benefits to humanity at large;
- those that are owned, if unable to provide benefits to their owners (SNA §10.168), but nonetheless be able to provide benefits to humanity at large.

Moreover, since SNA assets encompassing ecosystems may also provide benefits to humanity at large, in addition to those they provide to their owners, the valuation of some SNA assets may be affected by the valuation of ecosystem services.

Summing up, what makes the difference only are the benefits not recognised as such in the SNA (so-called non-SNA benefits).

3.1.2. Second premise: monetary valuation of ecosystem services cannot be a practice based on pure convention

We would like to explicitly rule out the possibility that monetary valuation of ecosystem services be accepted as *a practice based on pure convention*, and re-affirm here the need for a generally valid value reference concept for valuation. On the one hand, if there was no such a need, the whole discussion of this paper would be useless, so let us dwell a bit on it. On the other hand, it is our impression that the conventional approach is in practice prevailing, as most practitioners of valuation don't seem to ask themselves what are they actually measuring but just go ahead based on some widely-shared practical rules and tools and name the results they obtain "the value of" this or that ecosystem service just because this is the common practice *(πρᾶξις)*.

Conventions are pragmatic, sensible solutions to practical problems of coordination. Everybody recognises that ecosystem services are important for the economy, but there is no established, official way of assessing their importance. So, why not just elevate some quantification rules (methods, tools), commonly in use already, to the status of universal reference? All assessments of economic value that comply with these rules will be comparable[17]. All in all, a statistical standard is a set of accepted rules, and it is universal agreement that legitimates them. The problem may seem similar to that of adopting a tool for measuring lengths – whether one based on the linear meter, on the foot, or on the *bu* (a measure in use in China during the Qin dynasty) – but it is not.

Indeed, even in the case of lengths, while the tool for measuring is conventional, the objects that are measured and the concepts of space and linear distance *exist independently from the tool*. Any given tool always has the same relationship with these concepts, a relationship that does not change from one measurement exercise, or measured object, to the other (so much that transposition of lengths from one to another tool is possible). If we accept monetary valuation of ecosystem services as a practice based purely on conventions, without specifying its logical basis and the pre-existing concepts that define what we measure, *we leave the very definition of what we measure to the tool (the method) we use*. The quantifications obtained by using the same method on similar objects are comparable with one another, but overall arbitrary and self-referential in nature, no matter how universal the agreement on the method. Indeed, they do not express an underlying concept that is common to different objects and methods, and therefore *they cannot be compared to quantifications obtained by using different methods and/or concerning different objects*. Otherwise, the measures they deliver simply would not be commensurable in general.

So the question arises, and cannot be begged, whether there is a common underlying reality to different ecosystem services, and what reasons are there to believe that different methods have the same basic relationship to that underlying reality. This would be the only guarantee that, e.g., directly observable prices and restoration costs, at least *tend to* assign the same value when applied to the same ecosystem service, and that the same method applied to different services at least *tends* to assign them values that are comparable with each other and with national accounts. Valuation literature, if anything, provides adverse evidence. The fuzziness and variety of concepts of monetary value of ecosystems and their services currently in use is there, plain to see for all those who wish, in the vast literature now available. Insisting on this, would only be destructive and not help find better ways to go. We will rather focus on conceptual aspects, such as the ones anticipated hereafter.

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[17] Of course it is necessary to accept that the economic relevance of ecosystem services can be quantified in monetary terms in the first place. Even if we recognise that *one very specific aspect* of this relevance can be quantified in these terms (we will see *which one*), we challenge the idea that money units may express this relevance in more general terms .

3.1.3. Some summary bullet points

- In "a context that is coherent with the SNA", there is no alternative to looking for *exchange value*s. The exchange values dealt with in the SEEA EA are *the values that ecosystem services actually have or would have if they could be traded of their own*;
- valuation of ecosystems and their services, as proposed in the final SEEA EA draft, is simply not coherent with SNA criteria, because the treatment is in contrast with the fundamental SNA concepts defining exchange value;
- the only correct reference concept for the measurement of the exchange value of ecosystem services in an SNA perspective is that of *resource rent,* extended from material natural assets to ecosystem services[18];
- therefore, valuation methods of ecosystem services are therefore correct only if they can be said to provide estimates of the resource rent;
- "all valuation methods proposed for assigning prices to environmental goods and services" – but the specific calculation the resource rent - "yield prices that are not consistent with and cannot be added to the market-based prices in the present system of national accounts" [19];
- resource rents on ecosystem services arise only to the extent that these are scarce;
- scarcity of ecosystem services (as of anything else) can be "natural", i.e. due to the physical unavailability in nature of quantities sufficient to satisfy all the demand arising at zero price, or "artificial", i.e. due to restrictions to access imposed by public or private human control on these resources;
- scarcity of ecosystem services, and therefore their resource rent, is not related to their importance under several respects, including aspects of their economic importance other than how much value their owner can extract from other economic agents by controlling or using them. By way of example, at least one among the most essential ecosystem services – that of maintaining an air composition that allows humans to breath at all – is not scarce and has zero exchange value;
- introducing SNA-coherent valuation is therefore not a way to capture the economic importance of ecosystems and their services, nor the *dependence* of economies from them, but only their exchange value, as determined by their scarcity and by the functioning of markets;
- observed values do not exist for the bare resource rent, but only for products embodying it or for tradable rights concerning ecosystem services;
- the change introduced in the SEEA EA final draft, with respect to the draft chapters – i.e. setting aside the resource rent as reference concept for exchange value, in favour of observed prices – is, in the light of the above, a fatal conceptual error;
- though SNA-coherent valuation, based on the resource rent, delivers information that is not in general relevant in terms of the economy's dependence on ecosystems, this same information is relevant in terms of the distribution of economic benefits among economic agents, as a consequence

[18] Ecosystem services, like produced services, are immaterial and therefore are produced only when there is a demand for them (a user using them). In other words, they cannot be stored (the products deriving from them can). Biomass provisioning services are a special case. The immaterial power of nature to arrange elements in a way that biomass arises is a service, an precisely an intermediate one, in the case of non-cultivated biological resources, and a final one in the case of cultivated biological resources.

[19] Quote from Olle Björk et al. (2016), *Making the environment count- Nordic accounts and indicators for analysing and integrating environment and economy,* TemaNord, Nordic Council of Ministers 2016).

of the exclusive access to ecosystems or appropriation of their services, that underlies the existence of resource rents.

3.2. Exchange value in the SNA

Measurement of exchange values is the core business of the SNA. The SNA does of course not deny the existence of values other than exchange value, but it is all built around exchange values, i.e. the "values at which goods, services, labour or assets are in fact exchanged or else could be exchanged for cash" (2008 SNA, 3.118). Indeed, the *exchange value* concept is so important in the SNA that it defines its object, along with other fundamental concepts such as, e.g., those of *production* and *transactions*[20]. Unless we want to go very far from home and lose the way back, these are concepts that we must handle with great respect for their intertwined theoretical, ontological and epistemological roots and premises.

3.2.1. Theoretical roots

As for the theoretical roots, although being – to the extent it aims at capturing an empirical reality – to a certain extent indifferent to theory, the SNA has them deep in economic theory, and especially in "neoclassical" thinking. While some *value theories* could lead to an altogether different way of measuring economic activity, the SNA applies the *exchange value* concept in a way that echoes Vilfredo Pareto's sarcasm about all distinction between *value* and *price*[21]. Benefits not revealed by actual prices (or at least by values closely related to market exchange value, e.g. production costs for non-market output) are out of the scope of SNA measurements in monetary units.

As for the ontological premises, the relevance of the *exchange value* concept ultimately relays on the fact that the transaction *reveals* – by its very being a voluntary expression of wills – that some satisfaction of needs takes places in both parties (contrary to what happens in the case of involuntary transactions). This is a quite philosophical concept, no doubt, but it is deeply embedded in the SNA, has solid juridical and theoretical bases, as *voluntariness* of exchange seems to be the only possible objective criterion for identifying economic *value* as something immanent in transactions, and delimiting the concept of transaction itself[22]. The economy is the realm of exchange and *voluntary* exchange defines also the realm of production. This has practical implications in the SNA, such as the fact that voluntary transactions are recorded as concerning products (for which a production process is defined) even when they are illegal, or supposed to be harmful, from points of view external to the transaction – e.g. under ethical or medical criteria – even for those who put them in place (see SNA §§ 3.91-3.98 on "externalities and illegal actions, explaining why externalities are not considered transactions and distinguishing among kinds of illegal actions that are and are not considered transactions"). This "moral agnosticism" of the system is parallel and coherent with the indifference for the market structure and the mechanism by which prices are formed (see below).

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[20] A transaction is "an economic flow that is an interaction between institutional units by mutual agreement or an action within an institutional unit that it is analytically useful to treat like a transaction, often because the unit is operating in two different capacities" (SNA §3.51).

[21] A. Montesano, "La teoria del valore dell'equilibrio economico generale", in Pasinetti, L. (editor), *Aspetti controversi della teoria del valore*, Il Mulino, Bologna, 1989. It can also be noted that within the same emerging neoclassical body of theory, a concept – that of *consumer surplus* – was introduced for *the Measurement of the Utility of Public Works* (Jules Dupuit, as early as in 1844) which has in common with the classical distinction the characteristic of not being a directly observable empirical "fact".

[22] SNA §3.7 "***A transaction is an economic flow that is an interaction between institutional units by mutual agreement or an action within an institutional unit that it is analytically useful to treat like a transaction, often because the unit is operating in two different capacities***" (emphasis in the original).

3.2.1. Empiricism and the third party criterion

As for epistemology, let us highlight that there is a sound empirical basis to all measurements in exchange value terms, whether done within or without the SNA. This basis consists of actual transactions in the real world[23]. All monetary measures – whether concerning observable or non-observable phenomena or variables – have a meaning (even from a subjective point of view), because they can be put in relation to substantive, micro-level, written down, actual transactions declared in money terms. For monetary measures – even purely hypothetical ones – to be meaningful, some exchange values must exist and be actually *observable* and *measurable* in money terms: "data on transactions provide the basic source material from which the values of the various elements in the accounts are built up or derived" (SNA §1.8). Beyond this basis, the inclusion of non-monetary, non-market and even hypothetical transactions is without limits as for their dimension. The major limits are of a conceptual nature, concerning *the possibility* that what is exchanged "could be exchanged for cash" (2008 SNA, 3.118). No application of the exchange value concept is possible to non-monetary, non-market or hypothetical interactions, if this potential exchangeability *for cash*, is not present. One case in which the absence of this possibility is adamantine is when the so-called "third party criterion" is not respected. "There is no ambiguity in the central framework of the SNA; […] Even with an extended production boundary, […] it is unlikely that services that cannot be performed by a third party such as eating, sleeping and exercising would be treated as part of the production boundary" (SNA, 29.146) [24].

The SNA is inspired by positivism and pragmatism from many points of view. If it had been designed as a system for the measurement of some "absolute" value, independent from institutional settings, it would be completely different. §8.20 of the SEEA EA final draft provides one example of its fundamental "objectivity", relevant for our discussion:

> Observed market prices are defined without expectation that the market in which exchanges take place satisfy a specific institutional arrangement or assumption. The 2008 SNA observes "a market price should not necessarily be construed as equivalent to a free market price; that is, a market transaction should not be interpreted as occurring exclusively in a purely competitive market situation. In fact, a market transaction could take place in a monopolistic, monopsonistic, or any other market structure." (2008 SNA, 3.119). Given this, the general interpretation of exchange values in accounting is that they should reflect the current institutional context, i.e., the current market structures and associated legal or regulatory arrangements. Consequently, exchange values will likely reflect the presence of various market imperfections from the perspective of economic theory.

By the way, these roots and premises are among the fundamental, intrinsic reasons why monetary aggregates having an objective and observable basis cannot be considered, nor adjusted to be, well-being indicators. At the same time, they belong to the epistemologically sound empirical foundations of the SNA: as a piece of statistics, respecting the fundamental principles of official statistics, it always tries and capture an actual reality, observable in the real world. This is the case even when transactions that do not actually involve money are dealt with, such as in the case of exchange values that are attributed to production for own-consumption, or estimated at cost of production (services of Public Administrations), as well as in the case of *potential* exchange values (i.e. hypothetical exchange value of potential transactions), represented by the estimated values of the stores of value (assets). The fact that

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[23] SNA §1.8 "Data on transactions provide the basic source material from which the values of the various elements in the accounts are built up or derived. The use of transactions data has important advantages. The first of these is that the prices at which goods and services are exchanged in transactions between buyers and sellers on markets provide the information needed for valuing, directly or indirectly, all the items in the accounts"

[24] The SNA, at least for the moment, excludes also some transactions that do seems to respect this principle but whose inclusion is doubtful for other reasons (e.g. unpaid household labour), which may be included without fundamentally shaking its conceptual basis, but would not be resilient to the inclusion of "transactions" openly violating it.

there is some coverage of non-observable transactions in the SNA, for which *imputation* of values or prices is practiced, should therefore not lead us into misunderstanding that imputation is legitimate in whichever case one observes something he may want to consider production. Not only these cases are well delimited and never exceed the third party criterion, but have a very factual and observable basis in the costs of the production activity that makes the transaction possible, such as for the services of public administration or in the deliberateness of the production act, such as in the case of home-grown carrots. The production boundary cannot be stretched beyond the third party criterion, and the exchange value of non-produced services has to be determined differently anyway (i.e. by calculating rents, as we argue below).

3.3. The fundamental error in the SEEA EA

§1.40 of the SEEA EA boosts that "the SEEA EA provides an approach to valuing the contribution of ecosystems consistent with SNA concepts and principles". Therefore, the monetary valuation concept applied in the SEEA EA is supposed to be the SNA exchange value concept. The criteria that delimit the field of applicability of this concept are those that identify what is an economic unit and what is not, what is a transaction and what is not, what is production and what is not. These criteria may be difficult to apply in some borderline cases, but the response when we apply the criteria to ecosystems and to human use of their services is clear beyond doubt.

In the intent to show that ecosystem services have an exchange value *of their own, t*he SEEA EA deals with ecosystem assets as if they:

- were *economic units*, i.e. entities having *their own* decisional power and will;
- engaged in *transactions*, which are deliberate acts of voluntary exchange between willing economic units, and in *production,* which is a deliberate act of an economic unit[25].

This attribution of the quality of institutional units, i.e. of entities having decisional ability, to ecosystem assets, radically challenges logic and evidence. As §2.30 states, "for a supply of final ecosystem services to be recorded, there must be a corresponding use by an economic unit". This is a tautology: it is the user that does everything. The ecosystem just happens to be there and gives to the user whatever it has, if asked for it, and as everybody knows gets no money in exchange. expresses no will, has no monetary production costs and determines no supply curve (the quantity supplied is not sensible to relative prices).

It would be correct, instead, to acknowledge that ecosystems are controlled, or simply used, by economic units. This is clear in other parts of the SEEA (especially when it comes to attributing the benefits, where the general government is identified as "trustee" for unowned ecosystems), but not straightforwardly followed. The services that economic units extract from the ecosystem may be considered as products that they will be able to sell at positive prices, if access for others to those services is restricted by natural scarcity, market structure or other institutional arrangements and if the third party criterion is respected. If they do not want to sell them, they may give them as gifts. It is like "the sound of one hand" of the famous Japanese Zen kōan: exchange value will arise in the relationship between economic units: whenever the hands of two of them will meet, then they will clap; when one hand grabs the ecosystem service, it produces no vibration in the world of exchange values.

So, either the SEEA EA claims to apply the SNA exchange value concept to situations where it cannot be applied, or it does refer to some other monetary value concept, e.g. to a conventional definition of value.

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[25] The reader may be misled by the absence of the terms "*economic units"*, "*transactions*"*, "production*" etc. in the current draft. Section 4.6 deals with this.

Whichever the case, it would merit to be highlighted with neon signs and signalled by fireworks, as it ultimately blows up the primary concept of *exchange value* itself as the result of the encounter of the of two self-determined, free, willing agents, as well other deeply intertwined SNA and SEEA concepts such as, e.g., those of *produced / non-produced* goods, services and assets as *distinct* and subject to different treatments as for valuation and of *natural inputs* (and unwanted *residuals*) and *products* as distinct objects of investigation (a SEEA CF-specific distinction).

3.4. Ecosystem services and benefits

Let us recall some basic definitions:

> ***"ecosystem services are the contributions of ecosystems to the benefits that are used in economic and other human activity***. In this definition, use incorporates direct physical consumption, passive enjoyment and indirect receipt of services. Further, ecosystem services encompass all forms of interaction between ecosystems and people including both in situ and remote interactions" (§6.9).

So, ecosystem services are *contributions* to benefits. Clearly, for any given benefit, there may be other, human-made, contributions, or not. But what are benefits?

> ***"Benefits are the goods and services that are ultimately used and enjoyed by people and society.*** The use of the term benefit in ecosystem accounting derives from, but is applied more broadly than, the SNA definition of an economic benefit, namely "*an economic benefit is defined as denoting a gain or positive utility arising from an action*" (2008 SNA, 3.19) where an action or activity concerns production, consumption or accumulation and utility concerns the satisfaction of a human need or an improvement in well-being. Thus, in ecosystem accounting, a benefit will reflect a gain or positive contribution to well-being arising from the use of ecosystem services" (§6.16).

Whatever the difference of SEEA EA's benefits and *economic* benefits as defined in the SNA – this difference is introduced but not at all made clear in §6.16 – it is clear that benefits are different from the exchange values attached to them. Moreover:

> "Benefits are classified as either SNA benefits or non-SNA benefits." (§6.17).

3.4.1. SNA benefits

> "SNA benefits are goods or services that are included in the production boundary of the SNA. Examples of SNA benefits include all food, water, energy, clothing, shelter and recreation services available for purchase. As contributions to SNA benefits, ecosystem services are readily seen as inputs into an existing production process and consequently SNA benefits can be seen as resulting from a joint production process involving ecosystems and various other inputs including produced assets and labour. It will often be useful to distinguish between other inputs involved in the supply of ecosystem services (e.g., the use of fertilizers in the growing of crops) and those involved in accessing or using ecosystem services (e.g., use of vehicles to drive to parks for recreation). In both contexts, the aim in ecosystem accounting is to isolate and record the ecosystem's contribution to the benefits received" (§6.17).

In the case of SNA benefits the *contributions* of ecosystems to benefits are partial. These contributions are not *additive* or otherwise *separable* components of benefits. This is what "joint production", as used here, means. Yet, the aim of EA is to isolate these contributions.

There is an evident and fundamental confusion between *benefits* and monetary *value* here. The contribution of ecosystems to *benefits as such* cannot be isolated, as the benefit would not exist if either the ecosystem or the "various other inputs including produced assets and labour" were not present. All are indispensable ingredients of the joint production activity. Indeed, at least in the case of SNA benefits, no *quantitative* answer exists to the question "what is the *contribution* of the ecosystem to benefits?".

Looking for the contribution as a share of the benefit is like trying to hear the sound of one single hand clapping.

The monetary value attached to the benefits (it exists by definition, as we are talking of SNA benefits) is a scalar numerical *projection* of the benefits into the realm of exchange values. This numerical entity can be split into additive components reflecting *the share of the value that is or may be appropriated by each production* factor, but this does not imply that the *benefit as such* can be split too, as its components are not additive. It would be arbitrary to establish any proportionality or other automatic relationship between those shares and the respective components. Institutional arrangements – enforcement of property rights, market structures, information asymmetries, etc. – are all that matters for the share of appropriated value[26].

The exchange values attached to SNA-benefits are already included in the national accounts. Therefore, as for the contribution of ecosystem services, we can only *highlight* the portion of these exchange values that is appropriated by their economic owners.

The SEEA EA highlights this portion by recording an output from the ecosystem and an input to the benefitting economic activity (see table 11.3 of the SEEA EA), thus having an increase of total output, but no increase of net output. Ecosystem services "are recorded as transactions between ecosystem assets (the suppliers) and economic units (the users)" (§2.30). National accountants may recognise in this treatment the creation of a notional unit, where the unit is the ecosystem (asset).

But it should be clear that ecosystems *cannot* be thought as economic units. They do not engage in economic transactions, they are not able to decide whether to give their services or not, not even whether to be there or not, they are not expressing will and not getting benefits from the exchange. No economist – especially if into utilitarianism – would ever dream of considering the use of an ecosystem service as a transaction: only economic units create exchange values, by the exchange act itself. Appling exchange values to an intercourse with nature is nonsense.

Let us then consider this notional unit as the part of the actual economic unit that owns/manages the ecosystem, and gives the service to the rest of the same unit. This treatment would be similar to that of some intra-unit flows of intermediate products that are recorded in European Satellite Accounts for Agriculture, such as e.g. the milk given to calves in the same unit where the cows produce the milk. This satellite-account's explicit and well-delimited exception to SNA rules (according to which these intra-unit flows are not recorded or netted out) is meaningful because milk is the property of the farmer who could potentially sell it instead of giving it to calves. But again, ecosystems have no similar choice. The choice to use its services is done by the using economic unit. The relevant question then is: is there a reason for swelling output, when the values concerned are already included in SNA values? Highlighting is not the reason. Indeed, once estimated, *ecosystem contributions to SNA-benefit can and should simply be highlighted as components of mixed income,* and precisely as rent. The latter treatment – the correct one in SNA terms – reflects clearly enough the fact that the ecosystem puts in its user's hands services that have exchange value, services whose use contributes to the user's income. *Having ecosystems as units, or notional units that control them and sell their "products", in the end, only blurs the national accounting reflection of the social relationship established by property rights on ecosystems, that contributes to determining rents and therefrom the distribution of income.*

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[26] We may anticipate, as a response to this, more refined reference to neoclassical economic theory, and speculations that concerned here are the *marginal* contributions to the benefits, not the total ones. This would be a substantial switch in the meaning of "isolating and highlighting the contribution of ecosystems to benefits". And of course, the very restrictive conditions that would allow identifying marginal contributions as additive and exhaustive components of the benefits resulting form joint production bring us far from reality and into a world of pure mathematical abstractions.

3.4.2. Non-SNA benefits

> "Non-SNA benefits are goods and services that are not included in the production boundary of the SNA. Examples of non-SNA benefits include clean air and flood protection provided by ecosystems. In line with the definition of benefits, the scope of non-SNA benefits for ecosystem accounting purposes is limited to the contributions to people and society" (§6.18).

Non-SNA benefits arise where there is no contribution other than that of the ecosystem service. No joint production happens here. This means that the ecosystem services are "used and enjoyed by people and society" *directly*, with no mediation of production activity. It should be clear that the benefits as such cannot be transferred. Nobody else can enjoy clean air for me in my place, and nobody else can fear that a flood may sweep me away in my place for me. It simply is not possible to express them in exchange value terms by their very nature, because *the third party criterion is not satisfied*

The fact that the services are enjoyed directly, however, does not prevent their potential exchange value from being appropriated. Much depends from institutional arrangements. If for example a beautiful mountain walk is accessible only at a fee, because an economic unit has monopoly rights over the area, the transaction does not have as object the ecosystem service "recreation", but the legal right to access the area. Through the sale of this legal right, the exchange value is appropriated by the owner of the area. Even if the owner cannot or does not want to ration access to the area based on a fee, however, there will be other economic units who will appropriate the exchange value of the service, e.g. prices of hotel rooms nearby will include a rent component for being near to a beautiful area accessible for free. In general, there are certain conditions for the use of ecosystem services. In order to enjoy clean air, I must be where clean air is. I may enjoy flood protection, if I live in a building that benefits from it. It is clearly possible, and it happens all the time, that these conditions be under the control of some economic units. In these cases, the controlling units will be able to reap the potential exchange value attached to the benefit. For example, dwellings in places with clean air and good flood protection will cost – *ceteris paribus* – more than other dwellings. In this case their owners will get a rent. When this happens, then there are SNA-benefits accruing to subjects different from those which enjoy the so-called non-SNA benefits.

Let us try and apply the same reasoning as for SNA-benefits. We may define a notional unit that *produces* or *manages* the ecosystem service, in order to highlight an otherwise non-observed transaction. Again, since this unit cannot be the ecosystem asset itself, let it be the part of the economic unit that "extracts" the resource and passes it on to the remaining part of the same actual economic unit. In a satellite accounting perspective (that of the European Satellite Accounts for Agriculture), and to the extent that the conditions for the exchange value not being not null are satisfied, when these parts of an economic unit could in principle be two different units, then the transaction could be a real one and it makes sense to attach a monetary value to it. When they cannot, the two hands (ecosystem and human being) clap, but produce no sound in the world of exchange values.

3.4.3. Conclusions on benefits and Gross Ecosystem Product

The distinction between SNA and non-SNA benefits in the SEEA EA draws an important line between what is already in the national accounts and what is (wrongly) considered additional "ecosystem product" in the SEEA EA. Ecosystem contributions to benefits may be concentrated and well visible, or diffuse and almost invisible to those who enjoy them. **In all cases, national accounts already include their market value**, if they have one, i.e. if they are scarce, as the owner, the user, or the economic unit who controls the conditions under which the service is used or enjoyed, will appropriate the exchange

value of the service, reaping a resource rent – sometimes through economic advantages that cannot immediately and exclusively be connected to specific ecosystem services[27].

An assessment of what the monetary values of SNA benefits really express is needed on a case-by-case basis, looking closely at ecosystem services definitions and "their" monetary value estimation methods. *Imputation* – the hidden soul of the valuation approach – obliterates the information potential of these monetary values by spreading a layer of *uniform generic value* over a multiplicity of different concepts, blurring them all. In general, it is worth noting that **all SNA values *depend* on** – i.e. no SNA value would exist without – some ecosystem service: all production is always *joint nature-human production* in this respect.

As for the exchange value of so-called non-SNA benefits, the idea that it be not included in SNA aggregates is a misunderstanding. Table 11.4 should have no Part C. Values for air filtration should be recorded in Part B of that table, and only to the extent that air filtration is a source of exchange value of the *conditions* for its fruition (e.g. higher prices of dwellings whose location is such that their owners benefit from the ecosystem services). Moreover – see next section – these values should be calculated and recorded as resource rents, i.e., not as additional output (with no value added) but as a highlighted part of existing value added. If the hidden exchange values of so-called non-SNA benefits were highlighted and recorded as output of the owners or managers of ecosystems, then there would be the need to record these values as costs for other economic units. This is simple when the services are used in production, while it takes one additional accounting somersault when the services are used directly by consumers, or by people and society at large: the values of the goods and services they purchase always includes a resource rent component that goes to those who control the conditions of enjoying ecosystem services, which is in turn produced by the owners of ecosystems and passed on to those who sell goods and services to final consumers.

All this has obvious implications for concepts such as *Gross Ecosystem Product*.

3.5. Observed values and resource rent

The SEEA EA refers to observed values or prices as the "most preferred method" for the determination of the exchange value of ecosystem services (§9.28). This will be readily recognised as an error by national accountants, as we are talking about the valuation of goods and services that are non-produced.

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[27] Diffuse services can be enjoyed by many people at the same time, as e.g. the provision of: oxygen by poseidonia prairies and forests; pollution abatement (air filtration) by urban parks and tree lines for those who live there; flood protection for the inhabitants of a whole valley by its surrounding slopes; the recreational service by a landscape, for all people who are in a certain area to enjoy. While the diffuse resource rents depending on them may be not significant or even null (as in the case of oxygen), their loss may imply the loss of substantial assets and benefits, e.g. the services of a building in valley that will be flooded for sure will have zero value, and so will the building itself. This asymmetry is present in the valuation methods proposed by the SEEA EA, e.g. it can be expected that the p*roductivity change method* deliver substantially different results from the *avoided damage costs method*. "Concentrated" ecosystem services may be more easily appropriated. Such are, e.g. a crop, a tree branch, a wild animal, a trek with a series of breath-taking views, such as the *three peaks* of Lavaredo in the Dolomites or the *Torres del Paine* in the Chilean Andes. In these cases the owners may exert an oligopolistic or monopolistic market power and fix whatever price they want. Economic theory asserts that the monopolist will fix a price that maximises its income. The State is a monopolist for various ecosystem services (it may even expropriate private owners if this is deemed necessary for other – economic and non-economic alike – reasons) for which it sets a zero price. In these cases, zero is the correct price for valuation, unless private appropriation of these free services in production gives rise to a positive rent (let us not consider negative rents due to negative externalities, i.e. ecosystem disservices). E.g. the State as manager of the Dolomites as a whole may not charge anybody with a fee for using the outdoor recreation service, but the hotel with the most astonishing view will charge a bit more, for a room overseeing the lake and the peak over it, than will another hotel (or even the same hotel for a different room) nearby having less marvellous views, and much more than a hotel in a squalid place. So: two things matter in determining the rent: the market structure and the degree of concentration / excludability of the ecosystem service. This rent is not a Ricardian one when the service is not diffuse and the market is not a free or contestable one, i.e. when there is oligopolistic or monopolistic market power: it is a rent from a dominant position, that only depends on the structure of property on the assets.

Indeed, as already emerged, the correct application of SNA principles implies recognising the concept of (*resource*) *rent* as the central one for an SNA-coherent valuation of non-produced resources such as ecosystem services. Rents are *never* observable per se, even in the cases where there is a market for the ecosystem service. Indeed, ecosystem services never are on the market as such nor could they be, as the discussion of section 4.3 above should have made clear. On the market we may find, instead:

1. the right to use an ecosystem service, or
2. SNAs benefit embodying the (physically inseparable) contribution of ecosystems.

Let us start from the second case. Using ecosystem services is a sort of extraction. This "extraction" always relies on the use of produced assets, goods and services, e.g. using the flood protection service requires the presence of buildings and people, and results in (allows) the production of dwelling services; the use of biomass provisioning service consists in harvesting, and yields agriculture, forestry and fishery products as result of the joint effort of nature and humans. When it is carried out within production activities, ecosystem services contribute to SNA benefits. In this case, resource rents are implicit in the price of goods and services obtained in production processes. The SEEA CF explains how to calculate these rents, i.e. how to tell apart what the resources would be worth, if they could stand "naked" on the marketplace. This is done starting from the value of products embodying them, by stripping the value of these products of the value of everything else that contributes to it: intermediate products, labour, services of capital… the resource rent, indeed, is a residual component of mixed income. When the extraction is carried out in consumption activity, these complementary inputs are not production costs, but consumption expenses themselves, and the benefit is a so-called non-SNA benefit. E.g. the recreational use of a free entrance natural park, usually requires travel, boots and time. If access to the place can somehow be restricted, the ecosystem service may become the object of an economic activity. This may be very simple, e.g. in the case that an entrance fee is imposed. In this case the product "entry to the park" will have a price (the fee) that embodies a cost component (legal entitlements, fences, guards, ticket boots… whatever is needed to enforce the property right) and a rent component. It may also be complex: a package including travel and entrance may be offered and the rent component will be hidden among travel costs, which will be production costs in this case. In all cases, if we strip the price of the bundle that includes the service from the other components, what remain is a rent stemming from the power of the owner to exclude others from the enjoyment of the services and to set the price (ownership and market power). I.e. the "naked" transaction concerning an ecosystem service is always about the right to use it. So we are left with case number 1 as the most general case.

In the first case we are dealing with non-financial non-produced assets. In this case, the difference between rent and observed prices consisting only in transaction costs[28]. These costs in principle will never be null, as even a handshake needs time which will be recognised as labour input in the SNA[29].

Besides these costs and the *resource* rent, observed prices may include, due to natural scarcity, some other rent element (e.g. from monopolistic power). In principle, the rent should be depurated of the

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[28] The rent may be seen as the basic price of the right to use the ecosystem service and transaction costs as trade margins (other margins are not applicable here). The owners of ecosystem assets may *invest* resources in their protection, in order to conserve the flow of services. The income from ecosystem services will in this cases have a component of capital remuneration. The measure of *investments* in ecosystem's protection, surely is a policy relevant monetary value.This measure and many related ones can be found in the integrated framework for activity accounts (a blend of two modules of the SEEA-CF, EPEA and EGSS). These are measures of the effort in ecosystem protection and resource management, that do not capture the *results* of the expenses, which are non-monetary in nature (exactly in the same way as cost-based valuation does not provide a precise measure of General Government production)

[29] If the handshake is between virtual entities, as usual in nowadays light-speed financial markets, then there may be no direct labour input but capital inputs only (the servers running the algorithms and "taking decisions" based on fraction-of-a-cent spreads that can be taken advantage of in fraction-of-a-second transactions. See Mario Agostinelli e Debora Rizzuto (2017), Il mondo al tempo dei quanti, Mimesis, Milano.

effects of the market structure, in order to find a resource rent that is expression at the same time of the natural scarcity and of the contribution to benefits from the resources. Hints to this can be found in SEEA CF 5.131 and SEEA EA §9.36, but since the SNA is agnostic about prices (see 4.2), the fact that "the values and prices estimated using this technique will reflect the current institutional context" may be ok for valuation. The problem is that the "signals" given by such prices are not the natural scarcity signals that would allow – according to neoclassical economists – to take socially efficient decisions on the use of resources. It may be difficult to assess whether rents depend on the natural scarcity of the resources - i.e. on physical limits to accessing and using them with the given technology – or on institutional arrangements that makes scarce a resource that would not naturally be scarce. In practice, market structure is a major determinant of rents, as monopoly or oligopoly, or control by general government are very common. In all these cases, prices do not derive from scarcity, rather scarcity and prices are two aspects of the same social choices: the quantity exchanged on the market is lower than it would be in perfect competition because a higher price is imposed, or the price is higher because a lower quantity is put on the market. Elements of rent due to market power may be very significant. Such elements depend on implicit or explicit allocation of rights to use the services, i.e. on political choices. If the government is able to impose a fee on the use of a service, it acts as a monopolist; if it pays compensations for the delivery of a service to its owner, it act as a monopsonist. In both cases the observed price – the amount of the fee or compensation – will be directly determined by policy. In principle, government may exert this power, and decide prices, over whatever resources, both those that would otherwise have zero observed value (i.e. non naturally scarce), and those that would otherwise have prices higher than observable ones. Moreover, even the choice of not intervening is a political choice. A price set by policy – e.g. through a cap-and-trade mechanism, or by payments for ecosystem services that would be not valued in a free market – cannot tell us much more than how much policy (not markets) values that asset (i.e. how much policy makes it scarce). In synthesis, exchange value of ecosystem services is often fully an outcome of policy. As a consequence, valuation cannot provide information useful for policy other than that on the status and effects of policy itself, as it will reflect rents that are determined by policy.

3.6. The exchange value of ecosystem services as a distributional issue

As seen before, ecosystem services are, to the extent that they contribute to economic benefits, like natural resources (and indeed, they include the provisioning of some natural resources). It is therefore appropriate to refer to the treatment established in the "Guide to Analyze Natural Resources in the National Accounts" by the IMF (2017)[30], whose accounting framework is not only "designed to be", but also is, "consistent with the SNA":

> "This framework treats the payments received by owners of natural resources for providing the right to extract those resources as rent. Treating these payments as rent makes them distributions of income, not purchases of services or taxes (in the case of payments to the government that owns the resources)" (§ 20).

So, the exchange value of ecosystem services defines a purely distributional issue, concerning the monetary benefits deriving from the economic appropriation of Nature.

[30] https://www.imf.org/external/pubs/ft/qna/pdf/na.pdf

3.7. The fundamental difference between capital (and produced assets in general) and ecosystems (non-produced assets), and between their respective services

As standard economic theory teaches, all things have an exchange value insofar as they are *scarce* in relation to given human preferences. Talking of assets, they have an exchange value insofar as their services are valuable as objects of transactions and therefore as long as the latter are *scarce* in relation to the needs that they can help fulfil (more precisely: in relation to the actual demand expressed on the basis of these needs and budget constraints). This is the very rationale for the NPV method, which uses a theoretical relation between the value of assets' and that of their services. The latter will tend to be such that the capitalised exchange value of their present and future streams on the one hand, and the market price of the asset on the other hand will tend to be equal, for if the first one was lower, no one would buy the asset, and if it was higher, everybody would buy it. From this perspective, as long as we do not focus on the fact that ecosystems and their services are not produced, no difference emerges between them and fixed capital assets, as well as between their respective services.

Like for fixed capital assets, the market price of the asset will also tend to be the same as the production cost of new identical capital, for if the latter was lower everybody would build new capital to get more of those valuable services, while if it was higher, nobody would. In other words, the price of fixed capital services depends on the conditions at which capital assets that provide them can be reproduced, as expressed by their current production costs. Replacement costs are in this case an expression of scarcity themselves, dynamic scarcity, scarcity mitigated by (re)production and replacement possibilities.

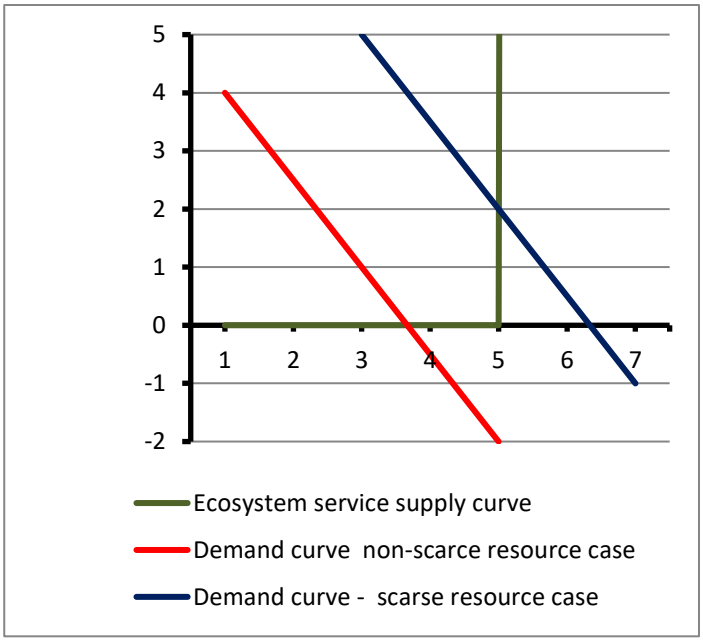
Services of ecosystem are different in that, being non-produced, and supposedly non-producible i.e. non-replaceable or expandable through production, the concept of production costs does not apply to them.

3.8. Scarcity as a key-concept

As already seen, scarcity of ecosystem services may be "natural" – giving rise to Ricardian resource rent[31] – or artificial (institutional settings: market power and governments rationing access).

Natural scarcity means that, for a given ecosystem service in a given place, the supply curve is totally inelastic to prices. More correctly, there *is* no supply curve (this is related to ecosystems not being economic units), but only a demand curve can be conceptualised. All demand can be met at zero prices up to a certain point, i.e. until *capacity* is saturated. After that, no economic effort may expand supply, because the service cannot be produced. The price, whether zero or higher, only depends on preferences and expectations on the users side, i.e. on demand only, and production costs do not play a role. The following figure shows the situation:

[31] David Ricardo defined rent as "that portion of the produce of the earth, which is paid to the landlord for the use of the original and indestructible powers of the soil. " ("On The Principles of Political Economy and Taxation", Chapter 2 "On rent"). Now we know that soil generative powers are destructible, but this is not relevant here. It is relevant that even at the time, as later in the SNA, the object of the transaction for which the owner of land gets a payment is the (right to) use these powers. The owner is able to get a rent because good land is scarce: "If all land had the same properties, if it were unlimited in quantity, and uniform in quality, no charge could be made for its use, unless where it possessed peculiar advantages of situation. It is only, then, because land is not unlimited in quantity and uniform in quality, and because in the progress of population, land of an inferior quality, or less advantageously situated, is called into cultivation, that rent is ever paid for the use of it" (ibid.).



Ricardian rents are due to the existence of ecosystem assets, such as e.g. land, of different qualities, providing different quantities of service per physical unit of assets. An analogous case may be that of the different landscapes that can be enjoyed by the users of different houses, which will be reflected in the prices of the houses or in their *rents*. These situations can be visualised as the existence of different assets, each with a different "supply" curve, equally vertical but placed at different distances from the origin according to the "quantity" of the service. This will give rise to differential rents, as the price will be established by the lowest quality resource being bought.

Finally, artificial scarcity due to rationing, i.e. to institutional settings, such as the existence of asymmetric power on markets or policy decisions, determines a price which is a different kind of rent, a monopoly rent. The latter is even less related to natural conditions than the former.

Let us consider the case of zero resource rent. In the SEEA EA the value or contribution of the ecosystem service to benefits are identified with the price that it would have of the market, which means, if we follow SNA principles, with the resource rent. Economic theory and empirical observation tell us that the market price of an ecosystem service that is not scarce would be zero in a free market – i.e. there is no resource rent that can be possibly isolated and possibly or ideally traded of its own. even if this service is essential for the existence of all SNA and so-called non-SNA benefits – think e.g. of oxygen provision by plants. **The notion that the value of some ecosystem services may be null or very low, is a consequence of introducing valuation, as zero or very low is what the market can recognise as value of resources that are not (yet) scarce.** This is how, trying to bring ecosystem services out of economic invisibility, their real economic importance as essential inputs to production and life is obliterated by the application of exchange value as a measuring rod. **If ecosystem services – their contributions to benefits – are looked at for what they are, i.e. if valuation is rejected, they emerge as essential inputs in "joint production" and literally invaluable.** Monetary units can still tell us what economic values *depend* upon which ecosystem services in a functional sense.

3.9. The exchange value of ecosystem services cannot reflect their "production costs"

Since ecosystems services' exchange value is determined by natural or institutional *scarcity* alone, is completely disconnected from the conditions of reproduction of ecosystem assets[32]. Indeed, production costs do not even exist, so that the conditions of reproduction of ecosystem assets are not represented at all in the exchange values of ecosystem services. This is different from the case of produced goods and services, which have a supply curve to bring the conditions of production in the discourse, in the vest of costs of production, and to co-determine exchange values. Whatever the exchange value of an ecosystem service, this price is fully unrelated to its costs of production, assuming for a moment that the expression "producing ecosystem services" is meaningful.

Moreover, since ecosystem services are generated by ecosystem asset's alone, if the parallel with capital has to be maintained, the costs of production of any given ecosystem service would be a share of the ecosystem asset's value, corresponding to the depletion connected to that services' generation and use. But the asset's value is constructed as NPV of the service's value in the first place, so the reasoning is circular as for what concerns the relation between production cost and value. Let us acknowledge that even if the reasoning is circular, current depletion equals the current rent only under special circumstances (respect of the Hotelling rule), as the discussion of SEEA CF Annex A5.1 on "The net present value method for valuation of stocks and the measurement of depletion for natural resources" shows, and underline that – whatever the discrepancy between depletion and rent, the higher the rent the higher the cost, by construction, and impact on net value added and income is negligible. There is no external reference other than preferences and scarcity to determine these values and no relation between them and the underlying functioning of the ecosystem that provides the services, i.e. the conditions that allow the services to flow from nature to humans. Failing to represent these conditions, makes prices, exchange values, NPVs etc. absolutely useless information for ecosystem-oriented policy.

It could be considered that, in equilibrium, the exchange value of an asset should be equal to its current or historical (discounted and depleted) production costs it. Of course, this cannot be a valid starting point determining for ecosystem services' production costs in general, as humans are not able to produce ecosystem assets: they can only spend some money to allow them regenerate themselves. Let us however assume for a moment that the expression "producing ecosystem assets" is meaningful, and that the money spent to allow an ecosystem regenerate is the production cost of what will be a produced ecosystem asset. Pre-existing ecosystem assets will always be necessary for this "production": it would be necessary to consider their production cost as well. This leads to an infinite regression, as there will always be a need for something non-produced that pre-exists to human action… the conclusion is that the economic value of ecosystem services simply cannot be expressed at all in monetary terms (whether exchange or welfare values), because it lies in another dimension, the biophysical dimension.

Appendix A to chapter 0: On the changes introduced in the final SEEA EA draft with respect to draft chapters

The most important change, introduced in the SEEA EA as submitted to the UNSC with respect to the draft chapters, concerns the removal of the resource rent from its central place as key reference concept for valuation. This removal introduces an inconsistency with the SNA that cannot be called extension,

[32] This is something that would be worth of a lot of reflections of its own, but let us not deviate from our main purpose now.

and amounts either to a technical error or to a deliberate choice of straying from the SNA[33,34]. The resource rent, indeed, is not only a valuation method for ecosystem services, but the only SNA-compliant value concept that can be taken as reference in this case. The latter is an implication of the fact that ecosystem services are not produced in SNA sense, i.e. they are not the result of a deliberate human activity of combining inputs to get an output, but are primary inputs that are available for free to the economy even when some form of rationing must intervene, because of natural or institutionally-induced scarcity.

References to the concepts violated in considering ecosystems as economic units etc., were plain to read in the draft chapters circulated for global consultations before the complete draft. We would be particularly glad about the changes in language in the complete draft – which we ourselves suggested – , if also the concepts, and not just their names, had been removed[35]. Indeed, the changes introduced in the complete SEEA EA draft do not solve the issues that the use of those concepts raises, but only veil the concepts, by e.g. no longer explicitly attributing the status of economic units to ecosystems and of products to ecosystem services, as well as by avoiding terms such as "imputation"… The reference to these and the other concepts mentioned above remains implicit, as the treatments applied did not change, and such treatments can only derive from the application of those concepts. It could not be otherwise, according to § 1.5:

> The SEEA EA applies the accounting principles of the System of National Accounts 2008 (2008 SNA) (United Nations et al., 2010), the statistical framework for the measurement of the economy.

Even more than ecosystems being said to engage in *transactions*, having as object their services, it is their being recorded as ***additional*** *production* in Supply-Use Tables, that makes it evident that the principles of National Accounting mentioned above, and especially the third party criterion, are violated.

§ 1.4 goes on with a bold statement: "by applying national accounting principles, the SEEA framework allows for a unique integration of data to support decision making.". We agree that there is a need for a unique integration of data to support decision making, but challenge the idea that the SEEA E(?)EA is an extension of the SEEA 2012 in the application of national accounting principles. We deem it important for integration and usefulness that national accounting principles are applied without forcing the system, and that the values to be calculated are correctly put in relation with basic national accounting principles in the first place, and with national accounting figures in the second. Using the results of many different estimation methods that deliver quite different pieces information as the expression of a homogeneous and summable generic exchange value is an error in the face of the SNA concept of values of services non-produced assets as rents as well as in the face of the mutual inconsistency of the different values that are estimated.

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[33] This must have been clear to the editor of the SEEA EA after reading the comments on draft chapters 8-11, and is clearly at the basis of the attempt to either fix the substantive problem by the use of language – which it does not succeed to do – or to create a new non-SNA-compliant, system of monetary valuation – which it in practice does, but without declaring it and which would merit an *ad-hoc* discussion. See the annex to

[34] A significant suppression of text, coherent with this change of horse in midstream, is that of all reference to the deduction of the value of economic inputs from observed prices, which is a necessary step in the "exposition *en plain air*" of the (resource) rent (draft chapter 9, §9.26: "In applying directly observed prices, it is important to clarify whether the price observed corresponds to the ecosystem service itself or whether input costs need to be deducted to arrive at a price for the ecosystem service").

[35] Rejecting a perspective on what is *production* which would take the system far not only from the SNA but also from economic reality does not imply that ecosystem services still may, under a different, non-SNA, point of view be considered as the result of *production* in a non-economic, exquisitely biophysical sense, based on the same Latin root of the word (*pro-ducere*, "bring forth"). This is the case, e.g. of the Human Appropriation of Net Primary Productivity, which is an important physical indicator never mentioned in the complete SEEA E(?)EA draft. The same applies to residuals in SEEA CF, which are produced in a physical sense but are not output in SNA sense unless they have positive exchange value.

As explained by this paper, we deem it possible to provide the users with relevant monetary values suited to reveal and display the economic importance of ecosystems, i.e. of our dependency on their services, without forcing the accounting system and betraying a basic principle (which also is a good common sense-principle) such as the notion of exchange value itself. The idea is simple: just recognise the specific meaning and usefulness of each of the several monetary estimates proposed for valuation in the SEEA E(?)EA and break free from the straightjacket of the quest for *the* monetary value of ecosystems and their services as a homogeneous and summable generic exchange value. The actual or potential exchange value of ecosystems and their services is just one among several actual exchange values connected to them, that can be found and isolated in SNA aggregates and one that does not even tell us much on our economies' dependence from them (indeed it is most interesting from a distribution of income point of view). The different estimation methods proposed in chapter 9 of the SEEA E(?)EA look for and deliver quite different pieces information on values present in the SNA, that are non-homogeneous and non-summable.

Appendix B to chapter 0: On environmental accounting in the ongoing SNA revision

We will here briefly consider the following three topics within the "environmental accounting" subchapter of the "well-being and sustainability" chapter in the SNA revision:

- " Accounting for Biological Resources "
- " Accounting for Economic Ownership and Depletion of Natural Resources "
- " Emission permits: the atmosphere as an asset ".

There is a need to consider the combined effects of the decisions that will be taken for each of these topics, keeping the ongoing developments in the Ecosystem Accounting area in mind. A general, sound, direction emerges from both sides of having the broadest possible recognition of environmental assets as a necessary basis for economic activity, even when very low or even null exchange values are attached to them because of their *non-produced* nature and of the residual nature of the income derived from them (*resource rent*).

The atmosphere as an asset

The atmosphere can definitely be considered an asset, but only in physical terms, not as a store of exchange value, as exchange value does not exist before exchangeability on the terms specified by the SNA, i.e. between two willing, free, self-aware economic units.

As all physical natural assets and ecosystems, the atmosphere could and should be recognised as an asset even if the exchange value of the right to discharge something into it was zero. It would have zero monetary (exchange) value, but would nonetheless be degraded as a physical asset by the change in its composition determined by those discharges, and this would nonetheless impact human lifes and economic activities.

Furthermore, it could be argued that governments are not regulating the use of the atmosphere, nor that of the climate regulation ecosystem service, but – indirectly – the use of the material inputs that cause CO2 emissions. By doing this, they create a different kind of non-produced assets, namely the rights to emit, who have a life of their own, whose underlying fundamental is not the quality of the atmosphere, but the need to use those inputs as fundamental and the will of governments to preserve the quality of the (purely physical) asset "atmosphere".

Accounting for Biological Resources

The intent here is extending "the asset boundary for biological resources, so that all known biological resources are treated as an asset". Since all cultivated biological resources are already treated as assets in the SNA, this only affects the treatment of some non-cultivated biological resources.

The Advisory Expert Group (AEG) that assists the Intersecretariat Working Group on National Accounts (ISWGNA) in resolving issues on the research agenda of the SNA and emerging research issues[36] "recognized the analytical usefulness of extending the asset boundary for the uncultivated biological assets or those resources with zero asset value, at least in physical terms, in supplementary tables or extended accounts"[37].

The terms thus established by the EAG identify the right perspective. An inclusion in SNA assets of all known biological resources would imply a need for valuing these non-cultivated biological resources for inclusion in the balance sheets. Since the economic importance of these resources does not lie in their exchange value, it would be misleading to have them included in the central framework of national accounts without a great deal of explanation about their specificities.

The current exclusion from the SNA asset boundary of some SEEA-CF's environmental assets implies an implicit recognition of the existence of public goods,. i.e. goods not subject to property rights. The SEEA E(?)EA proposal is to assign ownership of these assets to the government as a trustee. As long as they have zero exchange value and are recognised in physical terms only, the only need to assign ownership is to formally comply with the definition of assets.

The AEG highlighted that work is needed to clarify the boundary, between cultivated and uncultivated biological resources. In this respect, we strongly disagree with the idea of "treating all biological resources (cultivated and uncultivated) as produced assets", as the distinction between produced and non-produced assets is – as seen above – the crucial one.

This is coherent with the need to clarify "the scope of natural resources that are subject to CFC, depletion and degradation", highlighted by the AEG in relation to the "Accounting for Economic Ownership and Depletion of Natural Resources" topic.

Accounting for Economic Ownership and Depletion of Natural Resources

The resources concerned in this item are already recognised in the SNA and dealt with thoroughly in the SEEA-CF. They have actual positive exchange values so there is no doubt about the relevance of establishing economic ownership and also about applying the principle of split ownership of natural resources to the cases where this better reflects economic reality.

The Advisory Expert Group agreement to "re-classify depletion of natural resources from an economic disappearance in the other changes in the volume of assets account to a cost of production in the relevant current accounts" supports the "prominence of net measures" (of domestic production and income). We agree that these are important steps but also underline the importance of maintaining the "distinction between consumption of fixed capital (associated with produced assets) and depletion of natural resources (associated with non-produced assets)", parallel to the distinction between produced and non-produced assets.

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[36] https://unstats.un.org/unsd/nationalaccount/aeg.asp

[37] Eurostat C1/NAWG/2020/CN 1085, SNA UPDATE, For information and consultation, Item 3 on the list of documents for the National Accounts Working Group, 11-12 November 2020

As hinted above, the EAG recognises that "further work (in consultation with the SEEA community) is needed to determine the scope of natural resources that are subject to CFC, depletion and degradation of natural resources", and that it is necessary to "better articulate the differences in the concepts".

4. Overcoming reductionist temptations on physical ecosystem accounting

The ill-founded idea that valuing ecosystem services and assets nature-friendly decisions is a necessary and sufficient condition for better decision making in ecological terms leads to overlooking aspects of major and more immediate importance, and not to strive to develop the parts of ecosystem accounts that more strictly concern ecosystems as such. As an example, we may quote Eurostat's proposal, currently under discussion, to extend the Regulation on European Environmental Accounts (691/2011) to ecosystem accounts, including a basic ecosystem extent and a physical services account, leapfrogging condition and capacity, and putting the essential requisite that data be geo-referenced in an invisible background.

4.1. Ecosystem Accounting as a bridge between two worlds

Ecosystem Accounting may be seen as an attempt to complete the SEEA as regards the DPSIR model. The SEEA EA concerns ecosystem *State* (extent, conditions) and *Impacts* on it (change in extent, conditions, capacity) and on the anthropic system (services used, in physical terms and connected monetary values) as well as some elements of *Responses,* mixed up in monetary values (e.g. fees and compensations), mostly covered already (but – appropriately - not highlighted as "value of ecosystem services") by Environmental Activity accounts.

Completing the application of the DPSIR model in an accounting perspective provides a solid cultural mediation between natural science (which all must follow as for S*tate* and *Impacts* on nature) and economic accounting/political economy (*Impacts* on the economic system and *Responses* immediately measurable in economic terms). This is important as the primary objective of a statistical product – as is generally overemphasized in the case of the SEEA EA - is to provide the public and policymakers with policy-relevant information, and policy-relevant means to a great deal "for economic policy", where the latter is in turn supposed to be guided by political economy. It should be pointed out, in this respect, that it is a severe limitation, if not an error, to identify economic policy with market-based instruments. Moreover, the impact of economic and non-economic policies on ecosystems can simply not be measured in monetary terms, which may only capture the economic reflection of externality effects of ecosystems' state and change in state; similarly, the joint impact of economic and ecosystems' situation on human, social and institutional values can only be measured in terms intrinsic to these values, as recognised in the "framing of values" of the SEEA EA itself (see SEEA EA Section 2.4). Both realms of Knowledge (natural and socio-economic) have their own concepts, methodologies and language. Understanding the co-evolution of the two interrelated systems they study and making it sustainable requires highlighting cause-effect relationships between ecosystem assets (ecologic perspective) and service flows (economic perspective), while at the same time building language bridges among the two disciplines. Failing to do so would leave us with isolated photograms, while policy needs the full picture.

4.2. Observed supply and use of ecosystem services, and the importance of capacity

The two subsystems of the world – natural and (socio)economic - are connected through the so-called supply and use of ecosystem services. The latter – by the way - should be analysed in their physical dimension under the perspective of *Pressures* as well as under that of benefits (which are as sort of *Impact*), but the SEEA EA completely misses the point in this respect.

Now, we want to recall our discussion and graph of section 3.8 in order to highlight that, for the connection between the two systems that is established through ecosystem services as benefits to be significant of some underlying policy-relevant fact, the constraining factor of the supply-use relationship has be known and represented in the system. Indeed, it makes a lot of difference whether demand does or not exhaust the potential supply (*capacity*). In the case it does, the quantities observed, as for the flow of ecosystem services, it may express a situation of stress put on the concerned ecosystem resources. In case it does not, the degree to which the scarcity level is not hit by demand, may provide valuable information about the sustainability of that use (although sustainable level use will be usually lower than 100% of capacity and will usually be dependent on external factors such as the externalities of the using activities). Policy may decide in this case to create artificial, institutional scarcity, and move actual supply far from capacity. In the case of saturation of capacity, the signal is at least clear, that natural shortage is biting. In this case, policy may want to distribute access differently than on a market basis, especially if the service is an essential one in terms of living conditions. Aggregate figures for Ecosystem Accounting Areas will include and sum up all sorts of situations in this respect, from zero use to total saturation of capacity. This prevents the aggregation results from being interpretable other than as "the quantity of services actually used" without any further implication. We recognise, however, that while the absolute aggregated levels of the ecosystem services used is not very significant, their variation may be more interesting, if a clear interpretation as indication of the stress put on ecosystem resources *or* of the enhancement of ecosystems is granted, i.e. in case trends are univocal through space. Observational equivalence is a problem here: e.g. reductions observed may be due to voluntary lower use (reduced stress, better management/rationing …) or to involuntary restrictions given by loss of capacity.

Failure to represent the supply-use relationship in the system other than in terms of given equilibria puts in question the very usefulness of the representation, but for the identification, in the use table, of using activities (activities that depend on the service), which is useful *per se* but does not require a supply table that is balanced. The supply table's usefulness would be greatly enhanced by the inclusion, next to the measure of the actual flows of services provided by each kind of ecosystem, of that of potential flows (capacity), average saturation levels and number of elementary geospatial units where actual supply has been driven by demand up to saturation of capacity.

4.3. Conditions and capacity as pillar concepts for a bridge that leads to somewhere

It should be clear, from the above discussion, that condition accounts and capacity assessment are key concepts in a framing of ecosystem accounting where the ecosystem side "is taken seriously. For, if these are put aside and ecosystem services are put at the centre of the stage , so that all the emphasis is on the contributions to (economic) benefits – if, in other words, the sheer quantity of these contributions to benefits is represented as significant *per se* for policy – the ecosystem as such disappears from the radar of policy. Every time an ecosystem service supply-use table is realised, the well-minded case can adds to its quiver two broken arrows: a further proof of the obvious statements that economic values depend on nature's generosity and that it is therefore in our interest to treat it kindly, and (as for monetary values) a poor measurement for this dependency, that twists dependence into contribution.

It is of paramount importance that ecosystem accounts are developed paying attention in the first place to ecosystem extent and conditions and to their consequent capacity to provide services, even if in the limited perspective of the constraints they currently or foreseeably provide to economic activity.

4.4. Some examples

One important consideration with respect to this chapters' discussion is that immediate relations between the observed quantities of services used on the hand, and extent, condition and capacity on the other hand, are not univocal, and case-by case assessments are needed. For example:

- crop pollination is an intermediate service. Its use depends on availability of pollinators where demand is, i.e. on the state of ecosystems near cultivations. Its use has no effect on them, rather other pressures (use of pesticides) do. To the extent that fruit orchards sustain pollinators, there is a positive relationship between use of the service and state of the ecosystem that provides it;
- Agricultural production changes may be due to several causes, among which loss of soil quality (reduced capacity of biomass provision), but they may be (mostly are, in open economies) the effect of changing international trade and specialisation patterns;
- wood biomass use depends upon wood biomass availability: the effect of extent and condition on the actual service use=supply is not visible as long as wood is available for cutting. Use could be destructive or sustainable, or even enhancing the woods… specific assessment is required;
- wood biomass net growth may expresses growth of extent or condition of the forest or plantation ecosystems where it takes place – however nationals total may hide losses;
- fish provision is often associated with marine ecosystem degradation – requires specific assessment of sustainability of use;
- decrease in human-land-use-related services (soil erosion protection; hydrological regulation) is usually due to involuntary restrictions given by loss of capacity, as human demand rarely declines on the whole. Increase in the same services, for the same reason, are usually due to increased demand under capacity. Of course, the picture may be quite varied through different territories.
- Aquifers recharge (infiltration) is a measure of capacity for quantitavely sustainable downstream uses of water use; however, observed water flows may include changes is natural stocks...;
- Carbon sequestration and stocking services are related not just to wood biomass, but also to land use changes (including soil sealing) – overall trends of the service may conceal completely different problems and situations through the components of the carbon balance besides through territories;

These meaning uncertainties of observed physical ecosystem services flows extends and multiplies in the case of connected monetary values, whose changes also need interpretation in relation to their causes, of which the change of physical quantities of the services used is only one. For example:

- expenses for *nature-based tourism* depend upon income and preferences for it, and on landscape and naturalistic value (capacity to supply valuable recreation) as well as upon the general conditions in the markets of the inputs of the tourism activity – travel, accommodation … –, determined by external factors. Their change in value therefore may reflect changes in any of the markets involved, meaning nothing univocal in terms of environmental pressures and benefits;
- *flood risk management* depends on human presence in area at flooding risk – its increase is not necessarily good news, in that it usually depends on increased demand (land consumption, soil sealing) rather than of this service becoming available in places where it is needed and was lacking;
- exchange values connected to *water purification* may increase just because, having reached saturation, hypothetical restoration and defensive expenses enter the stage. Or because an ecosystem service payment scheme is introduce in order to avoid that demand hits capacity.

5. Institutional arrangements, policies and accounting: which monetary values are important for policy?

5.1. Institutional arrangements determine prices

It is important to recognise, as a starting point of a scientifically sound discussion, the central role of institutional arrangements in *creating* and defining exchange values[38]. Institutional arrangements concerning the management and appropriation of ecosystems and their services are important in more many respects than their implications in terms of exchange values of ecosystems, but let us focus here on these implications. Institutional arrangements are what determines – along with the nature of goods in terms of excludability and rivalry – the very existence or non-existence of (legal or illegal) markets in the first place[39]. This role is acknowledged in the SEEA EA:

> "While the use of directly observed values is the most preferred method, the resulting prices may provide accounting entries for the value of ecosystem services that might be considered low, i.e., where the monetary value of the contribution of the ecosystem is negligible. It is fundamental to recognise that this result is most likely a reflection of the existing institutional arrangements and is a result that is well-understood in the economic literature. For example, it is well documented that the resource rents for natural resources that are extracted in open-access contexts will tend to zero (Hartwick & Olewiler, 1998)". (§9.28)

It is remarkable that a subjective evaluation such as "low" enters the discussion at all: official statistics can legitimately[40] tell us only what ecosystem services are actually worth in exchange value terms, and not what their exchange value *should be*. And in fact:

> "provided the prices are from institutional arrangements that are sufficiently mature and large, the resulting prices should still be applied in ecosystem accounting since the core intent to show accounting entries that reflect the established market context and hence support analysis of the prices relative to those of other services and assets. To the extent that the recorded values are considered "low", there may then be an interest in estimating complementary values on the basis of alternative institutional contexts and market settings. These hypothetical values should not be recorded in ecosystem accounts but may be presented in complementary accounts (see Chapter 12)" (§9.29).

The "result that is well-understood in the economic literature", i.e. that observable (actual) prices are "a reflection of the existing institutional arrangements", has serious implications for the development of the accounting system. These implications are overlooked in the SEEA EA. The most evident blunder is the failure to acknowledge that existence of zero prices and inexistence of market transactions reflects, just as much as "low" prices, society's preference for certain institutional arrangements – namely for institutions other than markets.

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[38] The Dasgupta review on the Economics of Biodiversity provides a neat example: "Ecosystems that are global public goods raise problems, the solutions for which transcend national seats of governance. The Review points to the need for supra-national institutional arrangements. There are two broad classes of cases to consider. For those ecosystems (biomes, more accurately) that are located within national boundaries (for example, tropical rainforests), a system of payments to nations for protecting the ecosystems on which we all rely should be explored. For ecosystems that lie outside national boundaries (for example, the oceans beyond exclusive economic zones), imposing charges, or rents, for their use (for example, ocean traffic and ocean fisheries) and prohibiting their use in ecologically sensitive areas should be instituted. It may even be that the revenue generated from the latter system of international governance is able to pay for the former system of international governance." (page 7 of the Headline messages document).

[39] Institutional arrangements are ultimately related to individual and collective freedom, of which the range of possibilities that individuals have to interact with ecosystems and their services is one aspect.

[40] Scenarios and policy simulations should not be misunderstood as official statistics' accounting exercises.

5.2. Policies determine institutional arrangements, and therefore prices

Public policies basically are about institutional arrangements. As pointed out above, the role and functioning of markets are results of institutional arrangements, and therefore of public policies. Where markets exist, policies determine or influence prices through the market structure they allow, as well as through direct participation of public bodies in the markets. Policies also are crucial determinants of the distribution of ecosystem services between those appropriated ("extracted") by producers and those directly enjoyed by people and society. Policy may be:

a) directly concerned with ecosystems, based on biophysical values, and have economic consequences (including on prices and market values) that need be evaluated; or
b) primarily aimed at influencing prices and market values, and more specifically at:
    - mimicking markets (e.g. when payments or compensations are made by governments). In these cases the monetary value of the service is directly determined by policy (the existence of payments itself is an institutional arrangement);
    - influencing market prices, if markets exist (e.g. through taxation of ecosystem benefits appropriated, such as in the case where a company manages a highly appreciated outdoor-recreation-in-nature site and imposes a price on the right to enjoy it);
    - creating markets, e.g. assigning exclusive and transferrable rights of access to pre-determined quantities of an ecosystem service (such as in cap-and-trade policy schemes for air emissions) to economic units who may then impose a price on the service or get a rent from using it in production.

Policies of kind b) overcome the economic invisibility of ecosystems for sure and as a direct target, and use institutional arrangements instrumentally to this objective, which is supposed in turn to achieve efficient conservation and good long-run management results. Whether this is the case, is not up to us to judge. The different effects on income distribution and/or on economic agents' budget constraints, that the sub-types of policies b) may have, may be of interest for policy makers, as they are part of the bundle of outcomes, that such economic policies based on incentives and disincentives usually have.

What's most important for accountants to be aware of, is that *different policies/institutional arrangements have different effects on the exchange values recorded in the SNA*. Let us take as example some possible policies in a situation where community A lives in an area which provides benefits (through ecosystem services) to communities B and C:

a) providing, in kind, adequate living conditions to community A, in order to make sure that they can continue showing solidarity to communities B and C, by allowing the ecosystem to thrive and provide the latter communities with the ecosystem service they need;
b) compensating, in money, individuals of community A, for the income forgone for renouncing to develop the area;
c) having communities B and C buy the benefits from a company that is given the exclusive right to manage the ecosystem services of the area where community A lives; and
d) having communities B and C buy the benefits from several companies that are given the right to manage those services;
e) issuing, in limited number and through an auction, tradable allowances to carry out activities that damage the ecosystem where community A lives and reduces the flow of the service used by communities B and C.

Policy a) will not show as a specific item in the accounts, and the goods and services the government provides to A in compensation will be scattered in final public expenditure on various products, most of which probably do not qualify as environmental goods or services, although this expenditure should

probably be included in the governments' environmental protection expenditure. Final collective consumption and investments will be skewed towards non-market goods and services (as long as it is the government that produces the ones provided), satisfying community A's needs. As for information needs, policy a) needs to know what in-kind transfers (electricity, sanitation, health care, education…) as collective final consumption will help community A behave as to preserve the ecosystem, and will not endanger the ecosystem (otherwise the policy would be contradictory… let's assume this doesn't happen). Policy a) creates no price for the ecosystem service, but creates costs for its management.

Policy b) will show up in the secondary income distribution account and – reflecting the compensated individual's utilisation choices for the money received – in final expenditure for consumption and investments. Consumption will be skewed towards market goods and services, and probably towards products satisfying individual needs – or if you prefer, preferences – rather than collective ones; utility will thus be maximised, according to standard microeconomics, but community A may also spend the compensation money to develop in a way even not favourable to the conservation of the ecosystem assets the policy is meant to protect. Policy b) would need information on which individuals should be compensated for the policy to be effective, and how much. One may assume that this should be at least equal to the income the compensated individuals forego by not disrupting the ecosystem mechanisms upon which the service depends (it would not be market-rational for members of community A to accept less). Policy b) creates transactions (the compensations) whose total value is the one to be used in accounting for the value of the service.

Policies a) and b) may be financed through environmental taxes, maybe by taxing communities B and C for the benefits. In this case policy will have to know how much actual income do communities B and C get from the benefits, i.e. from using the ecosystem service in production, if this is the use. Otherwise, if it is something not entering production in any way (but recall the discussion about so-called non-SNA benefits) how much they would be willing to pay for it. In all cases, also these taxes may be considered a price paid for the ecosystem service enjoyed, and their total value, the aggregate value of that service.

Policies c) and d) create a market in the ecosystem service, that did not exist. We will ideally record a new product and maybe a new industry in our supply-use tables, and the rent extracted by the company or companies that transform or embody the physical ecosystem service in a product in the income accounts. Potential investors in this new market need to know how much communities B and C are willing to pay. The policymaker may be interested in the economic impact, and therefore need information on the expected volume of affairs for designing the policy. The difference between policies c) and d) is of course in the market structure – monopoly vs. oligopoly – and therefore in the price that will be charged for the service. The resource rent will be extracted from communities B and C (through *control of* the ecosystem services, not *from* the ecosystem service), but community A will not necessarily benefit from this. Conservation of the ecosystem service (not necessarily of the entire ecosystem) will in the end depend on how profitable the market is, unless the institutional arrangements include *ad hoc* clauses that exclude all possibility of degradation.

Policy e) – assuming it is aimed at maintaining certain levels of the ecosystem service – needs to know how much the service can be destroyed without major repercussions. It also creates a market, though not of the ecosystem service but – beyond certain thresholds – of the right to take part in destroying it (as an example, GHG emissions are destroying the climate regulation service of the global bio-geosphere). This policy will show up in the accounts as taxes collected at the moment of the auction, or sales of a non-produced service by the government, and then in the asset accounts to the extent that the allowances can be treasured.

5.3. Consequences for accounting

One point emerging from the examples above is that different policies need different information on different economic values connected to ecosystem services, because it is the policies themselves that determine the institutional context where these some of the values connected to ecosystem services acquire relevance and some others do not. Information on what compensations should be provided would be no use for a cap-and-trade policy, for example.

If consistently applied throughout the SEEA EA, the principle that "hypothetical values should not be recorded in ecosystem accounts" (§9.29), would rule out from the methods recommended for the core accounts some of the estimation techniques among those proposed in chapter 9 of the SEEA EA, and relegate them to use for complementary accounts only. By definition, being the results of policy scenarios and simulations these estimation methods do not give the actual exchange values of ecosystem services, but what their exchange value *would be* under specified circumstances – institutional arrangements – that are not those currently preferred by society[41]. For any given estimation method, the hypothetical exchange value will be fully determined by the hypothesised alternative institutional setting. It should be noted that whenever a value is imputed because no market exists, the hypothetical alternative institutional circumstance is that the market exists instead. Institutional arrangements such as the inexistence of markets actually are revealed to be the cause of "the economic invisibility of ecosystems" (see chapter 7). Supporters of valuation, who think the problem lies in "the economic invisibility of ecosystems", will find an implicit (tautological) policy recommendation in the obvious result that ecosystem services would have a higher market exchange value under institutional arrangements different from free-access – namely in favour of arrangements which *create* that exchange value, e.g. putting in place a non-competitive market for these services or having them paid by the public sector.

6. From *monetary values connected to* ecosystems and their services to the *value of* ecosystem services, and back

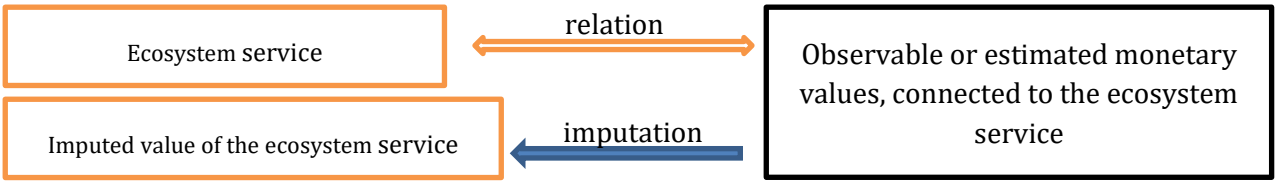
As seen in chapter 0, looking for the contribution of ecosystems is like looking for the sound one hand clapping. If the answer is the search itself – as the famous Japanese Zen kōan invites to understand – then we have to refrain from thinking that an answer exists to the question "what is the contribution of the ecosystem to production", and contemplate what we find while searching for it. And what do we find along the way? A lot of *monetary values connected to ecosystems and their services*.

The pivotal role in the present proposal is played by the difference between the concept of "monetary value **of** ecosystems and their services" and that of "monetary values **connected to** (or relevant for) ecosystems and their services". In order to fully grasp this difference, let us first recall the mechanics of the valuation process, which were explicit in the draft chapters and remain implicit but substantially unchanged in the final draft for the 2021 UNSC.

6.1. The valuation process

A simple sketch helps describe what goes on when valuation specialists enter into action.

[41] see Nobel laurate Elinor Olstrom's writings for what matters institutional arrangements, especially about commons.



Valuation as a cognitive process relies on *imputation,* i.e. the operation by which some observable or estimated monetary value *is assumed* (conventional definition) to be equal to the value searched for, i.e. the value of the ecosystem service, which is not observable.

Chapter 9 of the SEEA EA discusses how to construct market values where there are none because there is no market.

6.2. The difference between "monetary value of" and "monetary values connected to"

The use of the expression "*the* value *of* ecosystem service *x*" is quite widespread and most of the times – surely in the context of draft chapter 8-11 – this expression is used to mean "the exchange value that ecosystem service *x* would have if it was on the market". The SEEA EA clarifies that ecosystem services' value is a lot more than can be expressed in monetary terms (e.g. §2.53), but its one-dimensional perspective on monetary values encourages forgetting it, and most practitioners do not deem it necessary to use a more precise language[42].

In our language, the expression "*monetary values connected to* a particular ecosystem service" refers – besides obviously to the resource rents as actual exchange values of ecosystem services – to observed or estimated values of actual or potential transactions that somehow depend on that particular service.

Several different monetary values may be in principle – and in fact are – connected to any specific ecosystem service. In our approach, all of them deliver useful information on the economic value at stake. In the process set up in the valuation approach, it is always *one* ***or*** *the other* of these types of values that is (often arbitrarily) taken to represent the exchange value that a particular ecosystem service would have if it was on the market. Valuation is immune of fuzzy logic: any value is either the chosen one or not, and this choice decides *the* value of that particular ecosystem service. Fortunately, there are not many methods, among the 15 different ones mentioned in bold and described in chapter 9, that are deemed viable or suited for any specific ecosystem service. This all relates to a *conventional definition* of value, which is not the SNA definition, nor an extension of the exchange value concept.

Value in the valuation approach, is:

- ✓ a supposed mono-dimensional property of ecosystems and their services, which, by definition, cannot be expressed other than by a single number;
- ✓ a measure of the contribution of ecosystem service to benefits
- ✓ a single monetary value expressing exchange power that is in the hands of the owner of the ecosystem service.
- ✓ referred to the accounting period.

Economic values connected to a particular ecosystem service are:

- ✓ a plurality of monetary values, expressing several different concepts of economic value or, better, importance;
- ✓ measures of different economic phenomena each of which is potentially useful for policy and decision-making;

[42] Sooner or later nobody will know the difference, if everybody talks this way.

- ✓ measured in monetary terms;
- ✓ explicitly referred to losses from specified past events, to present costs or to future, expected or possible, losses and costs.

Both concepts are hypothetical. However, the first one is more hypothetical and prone to subjective choices than the second, as it entails the additional, non-obvious (and sometimes all but granted) step of imputation, setting the exchange value of the ecosystem service equal to one of the monetary values connected to it.

None of the two concepts excludes that other measures of the economic (instrumental) importance of that particular ecosystem service, such as the number of buildings protected from floods and the number of people living in them, are included in the reporting. Nevertheless this is not done in the SEEA EA, as if these other measures were subsumed by valuation. On the contrary, the approach proposed here invites to further enlarge the perspective on economic values connected to ecosystem services, going beyond the scope of monetary aggregates.

6.3. Dependency as a key concept

The following paragraph of the SEEA EA hints to the dependency concept, that is central in our analysis:

> 14.63 Although the focus of ecosystem accounting is on the services provided by ecosystems, there is also interest in understanding the significance of the relationship between ecosystems and standard measures of economic activity, such as GDP. For example, it may be of interest to understand the dependency of current measures of agricultural production on ecosystem service such as pollination. Such dependency measures could be focused around the direct impact (e.g., GDP 'at risk' in the absence of the pollination service), but may also take indirect (or supply chain) effects into account by measuring multiplier effects within the economy, using the extended supply and use table described in Chapter 11. In situations where the total value of ecosystem services (expressed as percentage of GDP) is low, it is possible that economic dependency could still be very high.

Understanding "the relationship between ecosystems and standard measures of economic activity" is, in our opinion, the best that satellite accounts, involving elements not recognisable (by nature or institution, and especially keeping the *third party criterion* in mind) in the core SNA, can do.

The following hypothetical situations provide some examples of dependency[43]:

a) the estimated value is that of actually existing economic flows or stocks, recognised in the SNA, which would disappear if the ecosystem service:
   1. disappeared, e.g. when a water purification service is destroyed and the water company goes broke[44];
   2. appeared, e.g. when trees newly planted in an urban area start providing air filtration services, so that the demand for health care services diminishes[45];

   in these cases, the (loss or coming into existence of) ecosystem service is connected to economic activity and value as possible cause for the latter's loss;

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[43] It is important to note that most of these situations are at the basis of valuation as proposed in SEEA EA's chapters, and we are not introducing new concepts, but only making clear those considered, *as per* the UNSC decision, in the " internationally recognized statistical principles and recommendations for the valuation of ecosystem services and assets in a context that is coherent with the concepts of System of National Accounts"

[44] Anticipating next chapter's discussion, it can be noted that this is the case of all flows embodying the contributions of ecosystem services as inputs, as well as of the flows considered in the avoided damage, travel costs, and productivity change methods, when negative changes in the input of ecosystem services are considered.

[45] This is the case of replacement or restoration costs.

b) the estimated value is one that does not currently exist, i.e. is not recognised in the SNA according to the principles explained in chapter 0, but could appear if the ecosystem service:

1. disappeared, e.g. when a water purification service is destroyed and is replaced by artificial filtration, or trees in an urban area die, air filtration services diminish, and demand for health care services increases;
2. appeared, e.g. when a water purification service is somehow naturally restored (e.g. by rewilding) and allows to newly withdraw water that wasn't fit for economic use before, or trees newly planted in an urban area allows the owners of nearby buildings to charge higher rents[46];

In all these cases, the connection is given by the fact that ecosystem services are necessary inputs for specific economic activities, or their presence or absence influences the value of economic activities. Also note that the cases are not mutually exclusive, so that situations can be imagined, where changes in the available basket of ecosystem services may imply complex changes in the economic structure.

6.4. Actual and hypothetical flows

Monetary aggregates connected to ecosystems and their services that are **actual flows** are often explicitly included in national accounts or satellite monetary environmental activity accounts. Such are, for example, costs borne for environmental protection, included in Environmental Protection Expenditure Accounts, taxes included in Environmental Taxes Accounts, production costs and values included in Environmental Goods and Services Sector accounts. Also resource rents, as already seen, are actual flows that can be highlighted in the National Accounts, as a genuine measure of the share of GDP appropriate by those who "capture" ecosystem services (NOT of the contribution of ecosystems to production, which consists in use values, i.e. physical, for which ecosystems gets no money in return)[47].

Other *monetary aggregates connected to ecosystems and their services* are **hypothetical flows**, e.g. losses, or additional costs if the service is replaceable, which would derive from losing ecosystem services or from having more of them... it only takes to scroll the list of estimation methods of chapter 9 and forget imputation, to be inspired on what applications can be thought of. This is what we do in the next chapter.

7. Monetary values connected to ecosystem services provided by SEEA EA valuation methods

Let us now discuss some specific *monetary aggregates connected to ecosystems,* starting from those given – before imputation gets in the way, changing their meaning – by the estimation methods included in SEEA EA chapters 9 and 12, to the extent allowed by the vagueness of the descriptions provided.

Our starting point is the observation that only in a few cases (prices directly observable or from similar markets; prices embodied in in market transactions) there are self-evident reasons for assuming that ecosystem services would be traded at more or less the price given by the method. We see no obvious reason, nor is any reason provided in the SEEA EA, for assuming it in other cases. As hinted above, in

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[46] This is the opposite case of a1, and can be exemplified by the productivity change method, in the case of positive changes in the input of ecosystem services.

[47] Ecosystems services that are public goods generate very diffuse or no rent, depending on whether it is a business or directly a household that benefits from them. If the service is a public good, it is not scarce, and the market is not artificially constrained to a non-competitive structure, then the rent is – as per economic theory – null.

these cases, we deem the values found through the estimation methods discussed to be the monetary measure of some *other* economic flows, or even stocks, that *depend* upon ecosystem services, or that are – more in general – somehow *connected to ecosystem services*. These economic flows have importance of their own, and the usefulness for decision-making of monetary information concerning them should be assessed on a method- and context-specific basis. This usefulness clearly depends on the nature of the connected economic activities, goods and services as well as the nature of the connection between them and ecosystem services. In this chapter we are concerned primarily with identifying the nature of the connection, using the dichotomies mentioned in previous chapters (actual/potential, costs/benefit, actual/hypothetical, loss/gain). Of course, not all of the intersections between the categories make sense.

The following sections use the same titles of the SEEA EA, chapter 9, and discuss the same methods.

One task left for future developments is putting the information provided by different methods in relation to policy options and possible uses in decision-making, and in public policy-making. We hint to some, but more can surely be thought of. Identification of the position of these values in SNA accounts is also an important task in a satellite accounting perspective.

7.1. Directly observable prices (SEEA EA §§9.27-9.32)

In the SEEA EA, this method – considered "the most direct method for measuring prices and estimating values for the accounts" – is introduced by way of examples. Let us take the first one: "for example, if a wetland provides services of water purification and the owners or managers of that wetland are able to charge the water company that abstracts the water for municipal uses, there is transaction in ecosystem services provided by the ecosystem that can be recorded" (§9.27).

The transaction is between two economic units. Owners or managers of that wetland – not the ecosystem – provide the action or inaction that is necessary to keep an essential feature (purity) of the water used by the company. The observed price of the product "water purification services of ecosystems" (which should definitely enter official classifications of products, as long as it is traded), can be considered representative of the exchange value of this ecosystem service only to the extent that it approximates the resource rent earned by the owners or managers of the wetland, i.e. to the extent that allowing the wetland purify the water does not require the use of significant additional, produced inputs. Other inputs, if all that is required is inaction (i.e. not developing the area), may consist of transaction costs only, such as e.g. services of lawyers for writing and enforcing the contracts. However, some action may be required, such as ensuring the wetland is not used as a dump by third parties. This may entail significant costs that are included in the price of the derived product (or even of a tradable asset representing it) but should not be considered part of the exchange value of the ecosystem service as such, even if the name of the derived economic flows would be the same as that of the service.

Let us assume, then, that this method is proposed for the cases where the income, which the unit "extracting" the service from the ecosystem and selling the derived product (or asset) gets, is almost 100% rent. This rent is unrelated to the ecological conditions of reproduction of the service, and the consequences of its existence in terms of income distribution may be significant, while the impact on aggregate net value added, with respect to a situation where the user gets the ecosystem service for free, is almost null, since the rent is lost by the buyer in favour of the seller.

This case is one where a value recognised in the SNA would disappear, if the service was lost. However, probably not just the amount paid for the service, but a great deal if not all of the value of the abstracted water would also disappear if this service was lost. So this valuation provides a poor measure of what's at stake.

7.1.1. Non-SNA values

Also the situation where the users of the service are consumers should not give rise, in case the exchange value of the ecosystem services is recorded separately as an output of the institutional unit that own and manage them, to new value added. Echoing our discussion of section 3.4.2 on so-called non-SNA benefits, this value is already present in SNA aggregates, as exchange value differentials between situations where ecosystem services are present with respect to those where they are lacking.

§ 9.30 states that "Prices may also be observed in relation to non-SNA benefits. For example, payments for ecosystem services (PES) may provide a direct measure of the value of ecosystem services". In general, however, the SEEA EA deems this not to be the case[48], and these payments are bound to be recorded as transfers in the SNA, as well as in Environmental Activity Accounts. However, the counterpart of the payment should be identified on a case-by-case basis: as long as the payment can be assigned to a specific ecosystem service, it seems reasonable that a market-like transaction be considered.

7.1.2. The strange cases of prices from carbon emission trading schemes, immature markets and too low monopoly rents

Prices from carbon emission trading schemes are dealt with in § 9.31. Here the whimsical concept that a market may be "not considered sufficiently mature" is introduced. In this case "an alternative is to use data on the marginal costs of abatement […] or data on the social cost of carbon"[49]. More down-to-earth, the idea that these prices have much to do with the economic (let alone the ecological) value of carbon sequestration services is quite bold, in the light not only of the fact that it is impossible to calculate the marginal benefit in terms of climate stability of one ton of carbon emission abatement, but also that prices are driven by arbitrarily decided institutional caps, based on often doubtful calculations of offset possibilities provided by conservation projects[50], and that their fluctuations may be heavily influenced by speculation[51].

It is also remarkable that the concepts of §§ 9.28 and 9.29, prescribing what to do when prices – even if observed – are "low", which we already discussed in section 5.1– are repeated (§9.32) in relation to the case of monopolistic or oligopolistic markets, where directly observed prices are bound to be economically more significant than in competitive markets ("where directly observed prices are considered not economically significant […] the observed price should not be used and alternative valuation methods should be applied. […] The use of prices from small or immature markets may not be sufficiently representative for use in ecosystem accounting"). This is completely arbitrary, and contradictory with the reiteration of the principle enounced in §8.20 (quoted in section 3.2 above), that "prices from monopolistic or oligopolistic markets are recorded in the national accounts without adjustment". Also, this treatment cannot be compared to the use of total production costs for the valuation of produced goods and services that are sold at prices that are not-economically significant (SNA §6.94), because here there are no costs of production, and therefore no benchmark reference for deciding what is economically significant and what not.

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[48] "most commonly, payments for ecosystem services and the associated institutional mechanisms are […] aimed at either supporting land managers in undertaking ecosystem restoration work or similar practices, or are aimed at implementing broader government social policies, for example concerning income support".

[49] These seem to be two further methods that are not even included in Ch. 9 of the SEEA EA.

[50] www.redd-monitor.org

[51] Also recall the discussion of appendix B on "the atmosphere as an asset".

7.2. Prices from similar markets (SEEA EA §§9.33-9.34)

In general, the idea that something (in this case, a market) that does not exist may be similar to something that exists, may be puzzling. However, the use of this method is straightforward in the case provided as an example ("when non-wood forest products (e.g., mushrooms) from one forest are marketed but those from a similar forest are not", §9.34). This is clearly one case where the method is used and the value of the products allowed by service is recognised in the SNA, so there is not much to say about it[52]. Its extension to non-provisioning ecosystem services, marketed in the case of some ecosystem (A) and not marketed (but used) others (ecosystem B), also does not seem problematic.

As the SEEA EA itself notes, "prices from similar markets will reflect prices of the existing institutional context in the same way as the directly observed values method" (§9.33). Indeed, the very fact that in case A the service has a price, is the reflection of an institutional context that is different from that of case B. Institutional arrangements make the difference between "type A" situations, where goods produced through ecosystem services (such as gathered mushrooms) and rights to access non-provisioning ecosystem services are the object of transactions *connected* to ecosystem services.

The method provides figures that represent the exchange value that the services of ecosystem B would have, if the right to use them was transacted within the same institutional context as for the same service of ecosystem A. Knowing this value may be useful for assessing an hypothetical policy in this direction. However, a complete assessment of the effects, based on national accounting aggregates, is necessary. Let us recall our discussion of so-called non-SNA services again. If the service is used in production, the owners of the ecosystem asset will have an additional output, and the users will have equivalent additional costs. If it is used in consumption, there will be a distribution effect from households to ecosystem owners, and from those who control the conditions of enjoyment of the services to the owners of ecosystems. Of course, this is only hypothetical, as if a policy had the same effects of a methodologically correct change in recording conventions. In reality, there are inertial forces that would probably imply imperfect compensation of the changes imposed by new institutional arrangements. But the value calculated with this system would provide interesting information on the *income shift* in favour of the owners, should the latter be able to impose the same market conditions as those prevailing for similar services of ecosystem A.

It can be noted that one case, where prices from similar markets are widely applied, is the carbon sequestration services case, discussed above. Indeed, the prices prevailing in emission trading are often extended to non-traded carbon sequestration services. However, as these are largely greater in quantity than traded ones, it is clear that if they were put on the market this would be flooded and the price would definitely be lower. Probably accounting should consider this kind of situations, and abandon static extrapolations in favour of thorough what-if reasoning (possibly in a general equilibrium framing, in cases on "new products" as pervasive as those that of SEEA EA ecosystem services). The policy usefulness of hypothetical estimates would greatly be enhanced.

7.3. Prices (and associated values) embodied in market transactions (SEEA EA §9.35-9.42)

The three methods of this section represent different ways to isolate the part of exchange value of existing SNA outputs, i.e. goods or services embodying ecosystem services, attributable to ecosystem services, i.e. excluding the value of economic inputs from that of those SNA goods and services. It seems

[52] Of course, we are talking about mushrooms that are gathered. Gathering mushrooms is a production act. If the mushrooms were not gathered (and used) not even the SEEA EA would bother about their value. So, "not marketed" means "not sold but used by the same institutional unit that gathers the mushrooms".

reasonable that there are different methods for doing this, as none of them is applicable to all situations. E.g., the resource rent method cannot easily be used in the case of dwelling services because the main input of these services is an asset whose value depends on the value of the dwelling services themselves, depending in turn on available ecosystem services (in this case, hedonic pricing is a more direct method to get to the rent they provide).

The text of *draft* chapter 9 was very clear about why this concept, and in particular that expressed by the resource rent, should be *the* reference concept for all SNA-coherent (not only in terms of "context" but also of concept) valuation of ecosystem services: «ecosystem service is defined as the contribution provided by ecosystem assets to benefits. Accordingly, the exchange value of an ecosystem service should only represent the ecological contribution of ecosystems, i.e. excluding all economic inputs (i.e. labour, produced capital and intermediate inputs)» (ch. 9 draft, §9.22).

It is worth noting that no marketed good could ever be realised without some ecosystem service, and that most ecosystem services are inputs in the production of marketed goods, so the concept behind the methods refers to a very general situation. This notwithstanding, these valuations provide, again, a poor measure of what's at stake, as they are unrelated to the ecological value of ecosystem services (and to a great extent, also to their social value), and are representative only of how income would be distributed if the institutional units owning or managing ecosystems were able to appropriate the corresponding rents.

7.3.1. Residual value and resource rent (SEEA EA §§9.35-9.36):

Resource rents, in the SNA, are payments receivable by owners of natural resources for providing the right to extract those resources (SNA §7.154). They are calculated as what remains of the value of output, after deducting the value of all economic inputs (SEEA CF Annex 5.1), and represent in our case the value at which the right to use an ecosystem service would be exchanged if put on the market before any economic input is applied to it. Of course, the very existence, and/or transferability, of such rights, are "institutional arrangements surrounding the use of the ecosystem", and "the values and prices estimated using this technique will reflect the current institutional context" (9.36).

According to §9.35 "the estimated residual value provides a direct value that […] can be used to derive a price that may be applied in other contexts". All considerations of the previous section apply to this case: the method estimates the actual or potential (the "other contexts" case) value transfer from the users of a service to the owner of the asset providing it. This is the information provided by the method. "Potential" means that if an economic unit using an ecosystem service for free is suddenly confronted with an owner reclaiming its right to get a rent from her property, the residual is the maximum amount she will be prepared and able to pay without going bankrupt.

7.3.2. Productivity change method (SEEA EA §§9.37-9.38)

Ecosystem services enter production functions in a number of ways. However, most of the times the availability of some ecosystem service is a pre-condition of production, and at the local level, an ecosystem service is either present or not. This method, based on marginal changes, is applicable only in the cases where such changes are conceivable, both on the side of the ecosystem services (quantity can in principle change continuously, there is no threshold effects) and on the side of production (smooth production function). Moreover, the method is valid when, as theory prescribes, the factors of production are remunerated according to their marginal productivity. Finally, the production function must respect other restrictive conditions for the output to be exhausted (i.e. entirely distributed to the owners of factors of production) by this remuneration pattern applied to all factors (which is a condition of logical consistency of the estimate). In the limited number of cases where these conditions hold, when

the "marginal value product is multiplied by the physical quantity of the provided ecosystem service" (where "provided" means "used=supplied"), an estimate is obtained, of what the owner of the resource would get as a rent, equivalent to that given by the residual value method.

§9.38 of the SEEA EA informs that "The productivity change method has been used to price the services provided by water and other inputs in agriculture, e.g., pollination".

7.3.3. Hedonic pricing method (SEEA EA §§9.39-9.42).

Suppose a government wants to tax the owners of buildings as to make them pay different rates on the rents they get, or on the asset's values, depending to the source of this value, e.g. by imposing a higher rate on the additional income derived from the asset being in a very favourable location, exploiting lots of common goods ecosystem services, such as e.g. a house with a great view on a mountain, easily accessible for recreational purposes, with slopes whose soil is firmly held by woods that host majestic secular trees and filter the waters that emerge pure and fresh from a nearby spring… this would be the method fit for use in order to know how much of the property income or imputed welling services can be considered a rent on ecosystem services.

7.4. Prices based on revealed expenditures in related goods and services (SEEA EA §§9.43-9.48)

7.4.1. Averting behaviour method (SEEA EA §§9.44-9.45)

This method, which was called "defensive expenditure" in the draft version of chapter 9,"is based on the assumption that individuals and communities spend money on preventing or mitigating negative effects and damages caused by adverse environmental impacts" (§9.44). This is "considered a lower bound estimate of the benefits of mitigation, since it can be assumed that the benefits derived from avoiding damages are at least equal to the share of costs incurred to avoid them" (§9.45).

An interesting point to consider here is the relation to environmental activity accounts. While the expenditure will fall into environmental protection expenditure when it is directed to preventing/mitigating impacts *on ecosystems*, the expenditure considered in this method is directed to prevent or mitigate the subsequent retroactions ("negative effects and damages") *on the social system*. A whole functional satellite accounts, "twin" of the EPEA, could be designed around the latter. The interesting thing is that, once again, we are confronted with actual transactions and with the value of existing *activities*. The meaning of the aggregates provided by these estimates is clear enough as it is a measure of the economic value of activities that would disappear if lacking ecosystem services were to appear.

7.4.2. Travel cost method (SEEA EA §§9.46-9.47)

According to the SEEA EA, this method – which was called "Consumer expenditure approach" in the draft version of chapter 9 – is not suited for ecosystem accounting purposes, as it includes the consumer surplus. However, we argue, if what we want to know is a monetary equivalent of the resource rent, this surplus is exactly what we are after. Indeed, if we consider the recreation activity as a production activity that the user of the ecosystem service carries out for its own consumption (it could not be otherwise, for lack of transferability of the enjoyment), once all costs of inputs other than the ecosystem service itself (expenditures incurred to reach recreational sites, entrance fees, etc.) are deducted, what's left is the equivalent of a rent, that the consumer exchanges with herself.

At the same time, this "rent" cannot be considered equivalent to the exchange value of the recreation service, i.e. the amount of money for which the users would exchange the recreation experience, as the

hypothesis of exchanging a personal experience such as recreation is nonsense. We are behind the boundaries of the SNA, irremediably[53].

A most interesting feature of the method is that the expenditures incurred by households or individuals to reach and access a recreational area has in itself the meaning of how much the economy depends on certain ecosystem services, i.e. what would be lost in economic terms if the ecosystem service was lost (or if it was impossible to use it, such as e.g. due to restrictions during the current pandemic). Background data on travel, appropriately transformed, inform on how much pollution is connected to the use of the recreation service. These probably are pieces of information of a certain importance for policy-makers, whilst the consumer surplus would be a faint representation of the importance of recreation to people.

7.5. Prices based on hypothetical expenditures or markets (SEEA EA §§9.48-9.54)

The group of methods presented in the SEEA EA under this title includes those "based on estimating the expenditures that would be expected to be made if the ecosystem service was no longer provided or was, in fact, sold on a market" (9.48). The relation to our framing of monetary values connected to ecosystem services is explicit.

7.5.1. Replacement cost (SEEA EA §§9.49-9.50)

The replacement cost method tells us no more and no less than "the cost of replacing the ecosystem service by something that provides the same contribution to benefits". Clearly, we must understand "the same" as referring to the specific qualitative, and possibly localisation, terms as the ecosystem service and not as any generic contribution to benefits. This information is *per se* surely useful for policy, but it is not at all evident why this potential cost should be equal to the rent on the ecosystem service. Let us recall section 3.8: up to a certain point ecosystem services are given without restrictions for free, therefore substitutes enter the local scene only beyond that point (capacity), and only if demand is such that the rent is above production costs of substitutes. Only in this case, the market of the ecosystem service and that of the substitute can be considered a single market, so that the prices of the two are the same (at least in quality-adjusted terms). It would in any case be an error to extend this value to situations where there is no scarcity of the ecosystem service as such and no need for substitutes.

7.5.2. Avoided damage costs (SEEA EA §§9.51-9.53)

Similar to replacement costs, the avoided damage costs method tells us no more and no less than "the costs of the damages that would occur due to the loss of these services". In this case we have no emerging activity, but only loss on both the ecological and the economic side. Since "the avoided damage method is particularly useful for regulating services such as soil erosion control and flood control, air filtration, and global climate regulation services", and the one (not very appropriate, as it refers to emerging activities) example given is "the value of air filtration services [that] may be related to avoided health costs to governments", we cannot help think that this kind of estimates provide a good occasion for making the SEEA EA even more useful, by allowing connections to the social dimension: how many additional dead, wounded and homeless would there be, besides the money values of lost structures, cost of human lives to insurance companies and the like. These connections should be made explicit and accurate accounts in physical terms for these "dependent variables" should be kept.

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[53] It can be shown that, if the experience could be embodied in a pill rather than actually enjoyed by the producer (no longer necessarily a consumer), and sold to other consumers, the volume of exchanges in the pill market would be lower than the consumer surplus.

7.5.3. Simulated Exchange Value (SEV) method (SEEA §EA 9.54)

This method "estimates the price and the quantity that would prevail if the ecosystem service were to be traded in a hypothetical market". It "requires combining the information on the demand function with a supply function and an appropriate market structure (institutional context)". The arbitrariness of the hypothetical institutional context is evident, unless the estimation is made *ad hoc* on a specific policy project. Of course, capacity cannot be exceeded, so whatever the institutional context, this can imply changes only if it restricts supply under its natural maximum. The information provided by the method is about the entity of the rents that would shifted between institutional units, depending on the institutional context crated by that policy.

7.6. Other valuation methods (SEEA EA §§9.55-9.64)

Besides the 10 (!) methods discussed above, The SEEA EA introduces "a range of valuation methods that are found in the environmental economics and ecosystem services valuation literature". We will not discuss them here, as the SEEA EA itself gives no certainty about the methodological status of their results with respect to SNA principles. Indeed, "if data based on these methods are considered for compilation purposes, then they should be checked consistency with exchange value principles and adjusted as required before use in the accounts". Since consistency pertains in these cases to the data, and not to the methods, there is no point in discussing the methods under this perspective. Let us only hint to meanings they could have under a non-valuation perspective on economic values connected to ecosystem services.

7.6.1. (Shadow) project cost (SEEA EA §9.56)

Some specific production activities may enhance ecosystems and create value added and employment at the same time: "asset reconstruction (e.g., providing an alternative habitat site for threatened wildlife); asset transplantation (e.g., moving the existing habitat to a new site); and asset restoration (e.g., enhancing an existing degraded habitat). There is no need, in our approach, to restrict the evaluation of the costs of providing a certain ecosystem service to "shadow" projects, i.e. to projects aimed at replacing lost or degraded ecosystems. On the contrary, information on the immediate and long-term economic benefits of such projects highly informative for policy. To the extent it does exist, it is already contributing to overcoming the economic invisibility of ecosystems.

7.6.2. Restoration cost (SEEA EA §§9.57, 12.31-12.41)

Estimating the costs that would need to be incurred to restore a damaged ecosystem to its conditions at a certain point in time (e.g., as the SEEA EA considers, at the beginning of the accounting period), seems to be another hypothetical exercise that is worth trying in order to provide policy with relevant information. Strangely enough, whilst the task, put this way, appears evidently– like many others seen so far – an inappropriate one for official statistics, it becomes appropriate if it is put as "estimating the exchange value of ecosystem services to be used in accounting in a context that is coherent with the SNA".

Restoration costs are discussed in the SEEA EA in chapter 12 (§§12.31-12.41). They are considered an attempt to "measure the cost of degradation directly", rather than the value of ecosystem services, in order to conclude that "this approach can provide a means to estimate a cost of degradation but it cannot be easily combined with direct measures of the value of ecosystem services and associated values of ecosystem assets as described in the ecosystem accounts since there is no particular reason that the estimated restoration costs will align with the estimated loss of future flows of ecosystem services. Nor

is there a reason that the estimated costs will reflect the social willingness to pay for the future ecosystem services" (12.41).

7.6.3. Opportunity costs of alternative uses (SEEA EA §9.58)

The opportunity costs of alternative uses express «the forgone benefits of not using the same ecosystem asset for alternative uses», i.e. «what has to be given up for the sake of securing the ecosystem services». This is useful for e.g. a government willing to use market instruments, rather than command and control, and looks for compensations (payments for ecosystem services) to those who otherwise use up the ecosystem, adequate for them not to be tempted to go for the alternative uses. The case is one where the emergence of economic activities would imply a loss of ecosystem services that must be avoided.

7.6.4. Stated preference methods (SEEA EA §§9.59-9.62)

These methods "do not directly reveal exchange values (§9.59) but provide "the willingness to pay (WTP) for an ecosystem service or willingness to accept (WTA) payment for its loss". By "combining information on WTP or WTA of a range of recipients of the service, it is possible [...] to derive an exchange value using an SEV approach". The remarks made for the SEV apply.

7.6.5. Prices from economic modelling (SEEA EA §9.63)

These methods, besides being unspecified *a priori,* "are not likely to be suitable for use in ecosystem accounting".

7.6.6. Qualitative methods (SEEA EA §9.64)

As the SEEA EA itself clarifies "these methods are generally not designed for the derivation of monetary values". However, qualitative assessment is a necessary step for all of the cases considered above.

8. Conclusion and way forward

The need of enlarging the boundary of economic analysis and accounting to ecosystems and their services should not lead to the reduction of the ecological system surrounding the economy to a set of *economic units*. This would be inconsistent not only with the SNA, but also with the logic of the SDGs, and even with the "international statistical standard" part of the SEERA EA itself, which allows the recognition of intrinsic values that are *per se* worthy of protection and enhancement in ecosystems. The enrichment of the analytical framework with variables that can only be measured in non-monetary terms is a fundamental evolution of the combined SNA + Satellite Accounts framework, bringing it more in line with the needs of well-being and sustainability measurement. On the contrary, valuation – i.e. measuring the actual or potential exchange value *of* ecosystem services – is so reductive that the most information useful for decision-making that it provides is that on the income distribution effects which the buying and selling of ecosystem services on the market brings or may bring. *Valuation* is indeed a monoculture approach to economic information on ecosystems[54], to which we oppose accounting and statistical support to economic *evaluation*, based on the dependencies of produced exchange values from ecosystem services, as expressed by the different methods discussed in the previous chapter. Data on the economic values that are at stake are an important complement to information on extent, condition of ecosystems and on physical use of ecosystem services by economic activities and

[54] Reference here is to the letter from the Natural Capital Coalition to George Monbiot: https://naturalcapitalcoalition.org/dear-george-we-cannot-take-a-monoculture-approach-to-the-conservation-of-the-natural-world/

households, helping understand *how* we depend on nature and not just how much of the social product can be appropriated by controlling nature. Such an information system can possibly be extended to non-monetary well-being indicators, whose values also depend from ecosystem services. An integrated accounts/indicators framework by ecosystem service and ecosystem assets can be conceived, integrating SDG indicators as far as possible, and drawing on experiences like the Italian Equitable and Sustainable Well-being framework (Benessere Equo e Sostenibile - BES).

The problem remains, with most of the economic evaluations presented above are hypothetical in their nature, i.e. they answer "what-if?" questions. To determine what the market value of the ecosystem service would be if there was a market for it (naked) means that the researcher's mind must imagine a *hypothetical* market and its functioning, and determine what price would the ecosystem service have if transferable property rights were enforced and the economic unit having economic ownership over it was to sell it. Is this something for official statistics? For sure this is not usual practice in core national accounts. However, a majority of Countries and International Organisations even want *valuation* based on such figures, so we may assume that removing the whimsical step of imputation should not be a problem (unless the ideological aspect of valuation prevails). Hopefully, also others, justly reluctant as for valuation, will find that the figures proposed by the various estimation methods are interesting, if not important. We deem it important to supply users with this kind of information, provided the framing is correct. Being hypothetical in nature, we see them as experimental statistics, and more specifically as experimental satellite national accounts for the *evaluation* of ecosystem services under an economic perspective.

Annex: Research agenda for the SEEA EA – proposals

The following proposals for topics to be included in the SEEA EA research agenda have been put forward by Italy to the UNCEEA in January/February 2021, along with several other minor changes to the same document. Although these – to the best of our knowledge – these have not been considered for inclusion by the editorial board, and may be in some cases surpassed or solved by the reasoning above, it is worth recalling them here, for future use by an hopefully emerging ecosystem accounting community, having a broader perspective on monetary values connected to ecosystems and their services.

Application of the SNA exchange value concept – reference concept

The SEEA EA provides a clear measurement boundary related to ecosystem services, that may support a consistent approach to the monetary valuation of ecosystem services and ecosystem assets for accounting purposes. The concept of exchange values is well-established in national accounting but it has been less commonly applied in environmental valuation, where alternative economic valuation perspectives are applied.

The SEEA EA in its current version adopts observable prices as the reference concept for valuation. According to some experts, a correct application of the SNA exchange value concept leads to identifying in the resource rent the specific reference concept appropriate for valuation. This is connected to the non-produced nature of ecosystems and their services. Observable prices are deemed by those experts as referring in practice to economic benefits that embody also the contribution of ecosystem services besides other components. If so, observable prices have to be stripped (netted) from the value of all other contributions in order to get to the notional value that ecosystem services would have if they could be traded "naked" on the market.

Appropriateness of estimation methods

The estimates provided by the methods described in chapter 9 for the cases where no actual market exists for ecosystem services are dealt with in the SEEA EA as empirical correlatives of the exchange value that ecosystem services would have if there was a market for them. Whatever the reference concept for this hypothetical market value (see previous point), the relationships need to be explored in depth.

In particular, some methods deliver data on actually existing exchange values, included in the SNA, that depend upon ecosystem services. As the relationship between these values and the exchange values of ecosystem services is not straightforward nor can it be assumed that the variables are equal, this issue needs further consideration. Explicit consideration of the logical links and economic principles that allow (or not) to take the estimates of the first as suitable proxies of the second is necessary.

Price formation mechanisms for hypothetical markets (market structures)

The SEEA EA requires imputation in a large number of cases. Since by definition for ecosystem services there are no production costs, which could provide an "objective" basis for imputation, it is required to simulate markets for the ecosystem services that have no market of their own but may be embodied in products, or directly enjoyed by consumers.

Depending on the assumptions on the price-formation mechanism, and in particular on the degree of competitiveness on the simulated markets, different prices will result from estimations. The SNA does not provide orientation in this regard, since no similar problem may occur within its production boundary. It does not prescribe a reference market structure for the prices allowed in the system, and real-world prices and transactions are used in valuation independently of how they are formed. For many non-market transactions included in the SNA, actual markets on which these could take place exist. In most of these and in many other cases, no market may exist for the same or similar items (e.g. national defence), but observable production costs exist, providing a strong link with actual exchange value flows present in the system. These are rarely the cases with ecosystem services.

For free-access resources (ecosystem services) a perfect competition hypothesis would lead to zero value estimates, while a monopolistic, or public policies of rationing, may impose artificial scarcities and create higher prices. This indeterminateness of the supply curve is transferred to the system, as long as no logical basis is specified for its derivation. Since a market structure or price formation mechanism is always implicit in the estimation method and reference situation adopted for each particular ecosystem services (i.e. in the data used for imputation), there is the urgent need of exploring whether the same assumptions are justified with reference to an hypothetical market for non-traded ecosystem services.

Additivity of monetary values connected to ecosystem services

The range of estimation methods described in chapter 9 is quite wide and different methods cannot a priori be deemed to deliver estimates that have equivalent meanings. It is necessary to clarify how they can be all referred to an entity ("exchange value of ecosystem services") that must be conceptually homogeneous. Non- homogeneity would have repercussions on the possibility to add up the values of different services provided by a single asset, and ultimately to determine a value for the asset through capitalisation (NPV).

Position in the SNA of monetary values connected to ecosystem services

The estimation methods described in chapter 9 deliver estimates that – besides being possibly used for imputation of ecosystem services' values – have meanings of their own, in that they measure the

exchange value of specific goods and services affected or somehow related to ecosystem services. Identifying these specific values in SNA tables would add perspective to monetary ecosystem accounts and open the way for alternative approaches to measuring monetary aggregates connected to ecosystem services beyond imputation-based valuation.