19th Meeting of the Advisory Expert Group on National Accounts,
20, 26 April and 10 May 2022, Remote Meeting

Agenda item: 6

WS.8 Accounting for biological resources

Given all the issues and the complexities involved regarding the accounting for biological resources, this cover note has become quite substantial. To guide the reader, the following can be said about the structure of this cover note. The first section, the introduction, includes a summary of the issues and questions discussed in the Guidance Note. This is followed by a section on the main recommendations, which are summarised, in a slightly more elaborated form, in Section 8 of the Guidance Note. The third section contains the main divergent views regarding the recommendations made, including an initial response to these divergent views. The cover note concludes with a section listing the questions to the AEG.

Introduction

For biological resources, the 2008 System of National Accounts (2008 SNA) makes a distinction between cultivated and non-cultivated resources. If the growth and regeneration process of the biological resource is controlled by, managed by and under the responsibility of an economic agent, the growth is considered production, and the relevant resource is considered as a produced asset, i.e. a cultivated resource. If this criterion of control and management does not apply, and the growth relates to a *"purely natural"* process without any human involvement, in line with the definition of the SNA production boundary in paragraph 6.24, the growth of the biological resource is not production in an economic sense, and the asset is considered a non-produced asset, i.e. a non-cultivated resource. Examples relate to the unmanaged growth of fish stocks in international waters, the growth of trees in uncultivated forests.

In the Guidance Note, the following questions and issues are discussed in relation to the accounting for biological resources:

- The first issue concerns the general asset boundary for biological resources, first and foremost relating to possibly extending the asset boundary of the SNA in line with SEEA CF (and SEEA EA), by also recognising assets with a zero monetary value.
- The second issue concerns the delineation between cultivated and non-cultivated biological resources, and its impact on the recording of related transactions and positions.
- The third issue relates to the recording and valuation of biological resources, including the treatment of permits to use these resources. In this respect, the 2008 SNA is not always that clear and straightforward, and may need further clarification.
- The fourth item relates to the accounting for depletion. In the case of biological resources, this is further complicated, as – compared to the accounting for depletion in the case of mineral and energy resources – biological resources also have the potential of regeneration, resulting in a negative (net) depletion.
- Finally, a more generic issue is put on the table, i.e. whether the recording of some income from non-produced assets as rent, as opposed to the recording of income from produced assets as part of output, is still justifiable.

Recommendations

- In relation to the pros and cons of extending the **asset boundary for biological resources**, in line with SEEA CF, which would come down to an extension of the asset boundary in physical terms, it is recommended, in line with the results of the discussion in the 2020 meeting of the Advisory Expert Group (AEG) on National Accounts, *"... (to) recognize(d) 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".*
- In relation to the **distinction between cultivated and non-cultivated biological resources**, it is recommended to first make a distinction between migrating and non-migrating biological resources. For migrating resources, like straddling fish in open waters, it is proposed to always treat them as non-produced assets. For the non-migrating resources, it is recommended to take the continuum from intensely managed to totally undisturbed as a starting point for the recording of biological resources. For these non-migrating resources, the distinction would thus cease to exist between produced assets and non-produced assets.
- Related to the discussion on the previous recommendation, it is also recommended to treat **natural resources as a separate class of assets**, different from the traditional assets, as currently recommended in the SNA. Such a treatment would not only open the door for not having to make a distinction between produced and non-produced assets. It would also allow for more flexibility in the recording of all flows related to natural resources. Table A.2 in Annex 1 of the Guidance Note provides a first proposal for such a new class of assets, including the recording of the most relevant flows.
- Regarding the **recording of (cultivated) biological resources yielding once-only products**, it is recommended to split the value, compiled according to the Net Present Value of future resource rents, into a part representing the "pure" (building up of) inventories, and another part representing the underlying asset. Furthermore, it has been argued to classify both parts as biological resources, in separate subcategories, in line with the proposal in Table A.2 in Annex 1 of the Guidance Note.
- Regarding the **valuation of biological resources**, it is recommended to consider the Net Present Value of resource rents as an appropriate method, also in the case of providing (non-transferable) rights to use the resources at a price lower than the estimated resource rent. An exception is made for biological resources, the leases of which are auctioned in a fully competitive environment. In these latter cases, the resulting market values are considered as the best representation of the value of the relevant resources.
- Furthermore, assuming the appropriateness of valuing the resources with the Net Present Value method, it has been proposed to introduce a **split-asset approach**, in line with the recommendations made for mineral and energy resources (see guidance note WS.6). This proposal would also imply the recording of the (partial) handing over of rights to use for free or at prices below the resource rent, as a transfer of non-financial assets with a concomitant capital transfer.
- Regarding the **recording of depletion (and regeneration) of biological resources**, it is recommended to record positive depletion of these resources as a cost of production, while negative depletion, i.e. (net) regeneration of the relevant biological resources, is treated as gross fixed capital formation. This depletion would be allocated to the relevant economic agents in proportion to the generated resource rents.
- It is also proposed to reconsider the **difference in treatment between leasing produced assets versus leasing non-produced assets**. It is recognised that this would constitute a major departure from the 2008 SNA. However, for the arguments mentioned in the relevant

section of this guidance note, it is considered important to investigate this potential change in more detail.

- Finally, it is recommended to add substantial **clarifications** to the current guidance on the accounting for biological resources, in view of the significant increase in the knowledge of, and experience with, accounting for environmental assets, mainly because of implementation of SEEA, including the discussions leading up to the endorsement of the international standards in this area.

Divergent views

This section only contain the main divergent views, which could not be resolved. These divergent views are grouped together in two parts. Initial responses to these divergent views have been added at the end of each part. A full reflection of all comments and suggestions received, including follow-up discussions, is available upon request.

Part 1

One set of related comments relates to the following divergent views on the recognition of natural resources:

- Natural resources allocated by the use of a quota regime are currently not explicitly included in the SNA asset boundary, only the quotas are included if and only if they meet the condition of being transferable between institutional units. This points to two circumstances in the SNA: transferability as a necessary condition for including natural resources as assets and governments are regarded as the units that allocate common resources to the best uses. Government are not viewed as an economic owner of these resources unless it is evidenced by their use of the resources in production.
- A quota regime does not transfer the underlying resource between units, it only transfers the right to use the resource by allowing fishing, hunting or otherwise harvesting a specified volume of the resource. There is no evidence that the volumes distributed by fishing quotas are sustainable and this translates to the fact that a quota regime cannot be regarded as management of the resource without further qualifications.
- Natural resources are not assets in their wild state but might become assets by human intervention, that is, if they are not harvested and consumed within the same accounting period. Tradeable permits and quotas are assets in their own respect regardless of the underlying natural resource. Correctly recorded there will be no problem of double counting.
- Collective ownership is an ad-hoc solution introduced in SNA 2008 mainly to include the radio spectrum as part of the asset boundary. This was a mistake since the radio spectrum isn't used as an asset by government. The government only regulates the access to radio frequencies in order to avoid users interfering with each other. It is time to align the concept of collective ownership with the other parts of the SNA. The radio spectrum should be excluded from the asset boundary. In cases where there exist a genuine collective ownership of the resources used in production this can be recorded as a special unit like a joint venture with the stakeholders having shares in the collective operations.

The main reasons for these divergent views are further explained in a separate note, which is added as a separate addendum to this cover note. Furthermore, two specific questions

(questions 13 and 14) to the AEG have been added further below, in line with the request from the ones having expressed the divergent views.

In response to the above divergent views, the following is added:

- The divergent views imply a fundamentally different view on what constitutes an asset in the SNA. They also imply a very significant departure from the guidance provided by the 2008 SNA.
- Basically, the divergent views come down to the non-recognition of collective ownership by the government as a representative agent of the society as a whole. Furthermore, leaving apart the outright sales of natural resources which is not touched upon, it is argued that the accounting for natural resources should be limited to the rights to use, with the further limitation that these rights have to be evidenced by market transactions.
- Regarding collective ownership, it is not agreed that this is something introduced in the 2008 SNA, on an ad-hoc basis, to accommodate the recording of radio spectra. Although not easy to find, paragraph 10.10 of the 1993 SNA already included references to collective ownership, especially in relation to natural resources, as follows: "*First, it must be noted that the System's accounts and balance sheets are compiled for institutional units or groups of units and can only refer to the values of assets that belong to the units in question. Only those naturally occurring assets over which ownership rights have been established and are effectively enforced can therefore qualify as economic assets and be recorded in balance sheets.* ***They do not necessarily have to be owned by individual units, and may be owned collectively by groups of units or by governments on behalf of entire communities*** (emphasis added by the author). *Certain naturally occurring assets, however, may be such that it is not feasible to establish ownership over them: for example, air, or the oceans. In addition, there may be others that cannot be treated as economic assets because they do not actually belong to any particular units. These include not only those whose existence is unknown but also those, including uncultivated forests, that may be known to exist but remain so remote or inaccessible that, in practice, they are not under the effective control of any units"*. It can be added, however, that the 2008 SNA provides more specific general guidance on the concepts of ownership, importantly as part of the chapter 3 (paragraphs 3.21 – 3.29) on the main foundations of the SNA. Moreover, although in some cases legal ownership of government may not have been formally established, the government often typically acts as the economic owner, as it defines the conditions for the use of many natural resources.
- In paragraph 3.5 of the 2008 SNA, assets are defined as follows: *"… 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. It is a means of carrying forward value from one accounting period to another"*. Natural resources perfectly align to this definition. They generate a future stream of benefits, be it in the form of actually received rents on natural resources, or in the form of resource rents.
- In no way does the 2008 SNA limit the valuation of assets to those whose market values are explicitly revealed in observable transactions. The Net Present Value of future resource rents is explicitly mentioned as a way to value assets (see e.g., paragraphs 3.137 – 3.138 of the 2008 SNA), in the case market prices are not available. The existence of resource rents can be empirically demonstrated by measuring the extra returns (beyond normal returns to other factors of production) that exist where the resources are used for the production of resource commodities (e.g. timber, fish or renewable energy).
- Resource rents may arise from institutional arrangements. However, the arrangements as such do not matter that much. It is the existence of a resource rent, which can be

appropriated, in one way or another, by an economic agent, including the government as representing the society as a whole.
- Finally, it can be noted that the concept of (natural) assets is fully consistent with economic literature, such as wealth accounting and productivity growth accounting. In this literature, operating surplus, including resource rents, is considered as a return to capital. Identifying these capitals is therefore of particular analytical interest.

Furthermore, the following, more specific, response is added regarding the first two comments on fishing quota:
- The Guidance Note does not state that fishing quota are managed in a way as commonly understood. It only states that quota regimes, or other exclusive rights, may give rise to a positive value of resource rents, and thus to a positive value of the underlying assets.
- Furthermore, the Guidance Note does not imply that a quota regime leads to a transfer of underlying resources. If payments are made to the government for getting the rights to use, the resources stay on the balance sheet of the government. However, in the case the rent payments are well below the resource rents, it is recommended to apply a split-asset approach, similar to the recommendations made in the context of mineral and energy resources.

Part 2

Furthermore, the following two divergent views have also been expressed:
- Firstly, concerns were raised about the appropriateness of assuming that any difference between resource rents and the actual rents paid is to be looked upon as leasing the resources at a price which is below the actual value associated with the asset. The resource rents may well be overestimated, because all kind of hidden costs are ignored, while also the required returns on capital may be higher because of the associated risks. It is therefore preferable to assume that the actual rents paid are a good reflection of the resource rents, certainly in cases where the rights to use are auctioned.
- The second point concerns the recommendation to apply the split-asset approach, in cases where it is evident that the actual rents are well below the resource rents. Such an approach is not supported at all. Instead, it is proposed to record a capital transfer for the relevant difference at the inception of the agreement on the rights to use for a certain period of time. In the years to which these rights apply, the actual rents paid could be levelled up to the amount of the annual resource rents. The total amount of the natural resources in question would thus remain on the balance sheets of the government.

In response to the above divergent views, the following is added:
- Regarding the first point, paragraph 56 already includes a statement that rights to use, auctioned in a competitive environment, can provide an adequate reflection of the value of the resource rent. Such a statement is also included, implicitly, in paragraph 70, by referring to the existence of non-competitive environments. It is clear, however, there are cases in which one can observe differences between the calculated resource rents and the actual rents paid, which are very hard to explain, also taking into account other costs and/or another return on invested capital. Moreover, as argued in the Guidance Note, in the case of natural resources, perfect market conditions are often not prevalent. It then becomes a discussion which valuation is a better reflection of the economic value of the relevant natural resources: the Net Present Value of future resource rents, or the actual price paid.

- Regarding the second point, it can be noted that the Guidance Note already includes such an alternative way of recording (see foot-note 16 of the latest version of the Guidance Note). However, instead of suggesting a capital transfer at inception, it suggests an annual recording of a current transfer with a concomitant increase of the rent. This recording would have the advantage of not affecting government deficit/surplus.

In relation to the above divergent points, one question for the AEG has been added in relation to the alternative recording of the transfer element (see question 15).

Questions to AEG

The AEG is requested to reflect on the following questions:

- Question 1: Do you agree with only recording resources with zero, or very marginal, monetary benefits in extended accounts or supplementary tables, in line with SEEA CF, and not in the SNA?
- Question 2: Do you agree that migrating biological resources should always be considered as non-produced assets?
- Question 3: Do you agree that in the case of non-migrating biological resources a continuum from intensely managed to totally undisturbed should be taken as a starting point for the recording of biological resources, as a consequence of which the distinction between non-produced assets and produced assets ceases to exist for these resources?
- Question 4: If you don't agree with the above proposals, how do you want to distinguish, if at all, between cultivated and non-cultivated biological resources? On the basis of a very strict application of the significance of management practices? If yes, do you agree that these non-migrating biological resources should be treated as produced assets?
- Question 5: How do you look upon the proposal to treat natural resources as a separate class of assets, which will also allow for more flexibility in recording of the related flows (to be further elaborated)?
- Question 6: Do you agree with the interpretation of the Net Present Value of future resource rents as representing both an underlying asset and "pure" inventories, including the consequences for the interpretation of regeneration/natural growth and depletion/ extractions?
- Question 7: Do you agree that the Net Present Value of resource rents is an appropriate method for valuing biological resources, also in the case where (non-transferable) rights to use are provided at prices below the resource rent?
- Question 8: Do you agree with the split-asset approach, in line with the recommendations for mineral and energy resources? See also question 15.
- Question 9: Do you agree with the proposal for recording depletion, including the allocation of this depletion to economic agents in proportion to the generated resource rents?
- Question 10: Do you agree with the recording of (net) regeneration (or negative depletion) as gross fixed capital formation? Or would you prefer a recording as a negative cost element? Moreover, would you prefer a gross recording or a net recording of regeneration and (gross) depletion?
- Question 11: How do you look upon the proposal to further investigate the need for treating leasing of non-produced assets differently from the leasing of produced assets?
- Question 12: Do you agree to add more clarifications on the treatment of natural resources in the update of the 2008 SNA?

In addition, the AEG is requested to reflect on the following questions, which are raised in view of the divergent views:

- Question 13: How should transferability of natural resources in relation the SNA asset boundary be understood? Is it a necessary condition or are there cases when it is not relevant (migrating natural resources)?
- Question 14: How should collective ownership be understood in relation to natural resources? A corporation is collectively owned by the shareholders, does the concept collective ownership imply a joint ownership by the stakeholders of a specific natural resource?
- Question 15 (related to question 8): How do you look upon the alternative way of accounting for the transfer element, as raised in the third point of part 2 in the list of divergent views?

Some general views on Nature in the SNA revision (Accounting for Biological Resources, Emission Permits, Renewable Energy Resources, Radio Spectra, etc.)

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29/3/2022

Input to the Advisory Expert Group (AEG) on National Accounts' discussion on environmental-economic issues

1. The purpose of the SNA is not to measure welfare, but economic activity (e.g. 2008 SNA, §§1.1, 1.75).

2. *Nature* may be recognised in both the SNA and the SEEA as the seat and source of all *assets* and *natural inputs* in the most general terms[1], comprising every living and non-living natural thing or flow. Two sentences may be sufficient for that in the SNA, clarifying that dealing with physical aspects is one specific purpose of the SEEA.

3. Economic activity is, and must continue to be, strictly and clearly intended as *human* activity, which means that *Nature* does not enter the accounts as an agent.

4. Nature not being an agent means that *transactions* involving *exchange values* are fully recognised as relationships between economic agents, even when the valuable things that are transacted are in their natural state. Indeed, in these cases, transactions concern the *right to use* natural stocks or flows as natural inputs, not the stocks or flows themselves[2].

5. Building on the SEEA, a clear distinction must be drawn between, on the one hand *natural stock and flows, physical flows between nature and economy/society and within the economy* and, on the other hand *economic assets and goods and services and transactions*. Nature is a physical entity, from which *natural inputs* are derived. The economy is the realm of *economic (exchange) values*.

6. While Nature is not an actor in the SNA, it must be fully recognised as a contributor to all production and to the very existence of all economic assets *in a physical sense*. Its contribution, however, is never separable from that of human activity as a share in the physical output.

7. Nature is, indeed, the seat and source of all economically relevant stocks and flows and space; it is thanks to its laws that elements combine and recombine and energy flows; it is thanks to regulating ecosystem services that buildings are not swiped away; it is thanks to photosynthesis that humans can breathe and work and enjoy consumption goods, etc.

[1] The list of *natural inputs* of table 3.2 in the SEEA CF should be expanded to ecosystem services not already included there (only "provisioning services" are). This would also make clearer the status of such services in the SEEA EA, as there often is confusion between them considered objectively and them considered from the point of view of the exchange value of controlling them (economically appropriating them).

[2] This may indeed seem a subtle distinction, and one that may remain implicit, as long as it is clear that rights to use are and should be dealt with as economic assets of their own, without a need to look for the overall value of the underlying reserves, if these are not actually transacted or up for sale nor offered as a guarantee for liabilities (in which case, the written-down value is what counts).

8. Production does not escape, but uses the laws of Nature: human action only favours a desired configuration of the material world[3]. Production activities make an *economic use* of Nature.

9. The only way to transform any of these material aspects and organisation features of Nature (let us call it just "Nature") into *economic assets* is to establish *rights to use* them and make them subject, in chunks, to exclusive and transferrable property rights. The existence of these rights to use restricting access for those who do not hold them, we call "appropriation", along with the use itself where there is no explicit restriction (the economic use of Nature itself reveals the rights). This appropriation is the basis of the social relationship hinted to above, giving rise to rents of the kind of *resource rents*.

10. A single concept is sufficient for describing the nature of all economically significant relationships between humans and Nature: "extraction" or – preferably – "appropriation".

11. Not all economically significant uses of Nature are significant for the accounts, no matter how significant it may be for humans and the economy. This is for instance the case of atmospheric oxygen or nitrogen, or of sea water where there is plenty. Significance for the accounts only arises when restrictions give rise to rents.

12. Institutional arrangements determining the emergence of rents may be greatly favoured by limitations to access by natural restrictions (such as concentration in particular places, including quality differentials of the kind giving rise to Ricardian rents), by technological constraints (when specific knowledge and machinery are necessary to make a certain economic use of Nature), but may also be the exclusive source of restrictions that makes the use of Nature economically significant (e.g. emission cap-and-trade schemes make the use of the atmospheric space as a sink economically relevant).

13. There is no overall a-priori partition of Nature in the way economies tell apart rights to use on specific components or aspects of Nature and appropriate them, thus transforming them into economic assets. For instance, the restriction may be construed as concerning whole portions of land including the subsoil, the ecosystems present on the surface, and the air above them, or very specific resources such as for instance metal ores or the very space of an area (e.g. if nothing is allowed to the owner of a park, but levying a fee on entrance). This may pose practical problems in assessing ownership and avoiding double counting, but does not concern the most economically significant uses of Nature.

14. In synthesis, it can be said the *right to use* itself is the asset, not the underlying resources. It is the institutional arrangements embodied in the right to use (whether incorporated in a product or a tradable title), that make non-produced "things" valuable in exchange value terms, as they fix the conditions and price of access to them. It is the structure of the market (how imperfect competition for the appropriation of the right to use is) that determines the price.

15. Nature's contribution to production is not identifiable as a share *provided by nature* of the exchange value of output. Only the share of the exchange value of output, provided *to their owners by economic ownership of nature* (the rent), is identifiable. This share crucially depends upon institutional arrangements and market structures concerning the right to use Nature. It only informs about the allocation of income. While the physical results of human production efforts may crucially depend on Nature, and their exchange value depends in turn on these results, the SNA is only concerned with the exchange value of the output as a result of human efforts. The SEEA provides all useful elements to take Nature's role into account in analysis

[3] Quite successfully in many cases, and more and more, but not always!

such as e.g. productivity analysis, in terms appropriate for that kind of assessment, i.e. in physical terms.

16. A clarification is needed about the fact that resource rents do not contribute to added value in general, but only entail income transfers between economic units. A distinction must be drawn between (rights on) Nature as economic assets *for their owners*, where the *store of value* aspect prevails, and Nature as an asset for society, where the ability to provide repeated benefits aspect prevails (as pre-requite of production and consumption).

17. The SNA only deals with *actually existing* exchange values. This excludes hypothetical markets and the valuation as market exchanges of exchanges between nature and economy. Indeed, such valuations always concern the possible extraction of existing *consumer surplus* in the form of rents. These would be paid, under the hypothetical conditions, i.e. under a different *institutional arrangement* than the existing one, by the current economic owners, who use or enjoy them for free, to different economic owners[4].

18. Biological resources do not underly economic assets as long as they are not subject to alienable property rights. The existence of alienable property rights is manifest when the owners write their supposed exchange value in the ledger. Biological resources' physical growth increases the quantity of the rights to use held by their owners.

19. Governments are not the owners of all Nature that is not otherwise owned. They are subject to constitutions and laws and could not sell a lot of what Nature consists of, even if they wanted to. They do not represent society at large and even less so mankind. Rather, they are special actors in the economic arena. This is another example of how much institutional arrangements matter.

20. Production implies the use of labour and/or machines and results in economic output (when machines are used by humans to get a pure enjoyment result, the human activity involved is not labour). *Nature* does *per se* never provides *economic outputs*. Economic outputs only stems from production.

21. It would not be wise to attempt to put a monetary value on anything that is not in principle alienable, because the SNA should objectively reflect the economic effects of societal choices, void of all judgement about their welfare implications, instead of selecting as measuring rod of all results the meter of that specific institutional arrangement which is the market, i.e. exchange value. No attempt should be made to alter GDP in the direction of measuring a larger concept of "output" through it by including Nature's gifts as if they were products.

22. The SEEA must provide, on a par with the SNA, all the information elements about the status and economic use of Nature. The *extraction* of *natural resources, renewable energy*, and of some *other natural inputs* is always a production activity, since it takes labour or machines to extract them.

23. The use of regulating and cultural ecosystem services may happen in production, but it is not production. Whatever activities are carried out by humans on biological resources – be it protecting them or cutting them down – they are production activities recorded in the SNA.

24. The regeneration and natural decay of biotas may be influenced by humans in many different ways, in a range that goes – as for the degree of human intervention – from doing nothing to just protecting them and allowing growth and decay to happen naturally, up to

[4] As a corollary, in principle, the prices of similar goods, applied in the valuation of self-produced natural inputs, should be stripped from the resource rent component.

causing, selecting and accelerating growth (through ploughing, seeding, fertilising, using pesticides, weeding, pruning, exposing to artificial light, etc).

25. This range justifies a distinction between cultivated and non-cultivated biological resources only as a convention, while it is necessary to recognise the contribution of cultivation activities (including those instrumental to protection) at one end, as well as the contribution of Nature at the other end. As already pointed out, the contributions of Nature are not measurable in exchange value terms. The contribution of production is equal to its costs. The difference between the market value of biological resources and costs is the rent on the non-produced inputs taken for free (appropriated) from Nature.

26. A different and more important distinction is between economically used and non-economically used resources. Economically used biological resources, whether cultivated or not, may be available for use as raw material or for other economic uses, i.e. as elements of ecosystems whose services other than provisioning are also up for sale. There is no double accounting risk, as long as actual transactions are the basis for valuation.

27. The physical output of cultivation is not necessarily economically used, e.g. city gardens are cultivated and mostly free to the public. There is no rent on their use, so one could say that the value of their services coincides with what the municipality decides to spend in cultivation, i.e. with the revenue (output) of the cultivation activity. However, it is more correct to say that city gardens' services are not up for sale (cultivation expenses are paid though taxes, not fees) and since their value is not written down to guarantee the municipality's debt, the purpose of the cultivation activity is not economic use even if it is an economic activity . Some "cultivation" element is present in all biological resources, but clearly the expenditure on the protection of the Amazons should not be taken as a measure of its value or economic importance.

28. The right to exploit renewable energy resources – which in most actual cases is secured through nothing more than putting in place machinery to capture them – may give rise to rents, for example to the extent that better quality locations for wind and solar energy give – *ceteris paribus* – higher physical output. This rent may be captured by any of the economic agents involved: the landowner, if aware of the differential value of the location; the state, if it imposes a tax on the differential; the owner of the machinery, depending on its power on the machinery market; the company running the plant, if nobody cares or has any market power. In principle, unless the state (not the government!) claims property on wind or sunlight, it is however the landlord that appropriates the rent, as climate is a feature of the location.

Guidance note WS.8: Accounting for biological resources

Peter van de Ven, Lead editor of the update of the 2008 SNA[5]

Section 1: Introduction

1. For biological resources, the 2008 System of National Accounts (2008 SNA) makes a distinction between cultivated and non-cultivated resources. If the growth and regeneration process of the biological resource is controlled by, managed by and under the responsibility of an economic agent, the growth is considered production (adding to output), and the relevant resource is considered as a produced asset, i.e. a cultivated resource. In the case of a resource yielding repeat products, the resource is regarded as fixed capital, while in the case of a resource yielding once-only products, the resource is recorded as part of inventories. Furthermore, in line with this distinction, depletion and growth of these resources are either recorded as part of consumption of fixed capital and gross fixed capital formation, or as changes in inventories. The leasing of such resources is, in principle, recorded as output and intermediate consumption, and not as a receipt/payment of rent.

2. If this criterion of control and management does not apply, and the growth relates to a *"purely natural"* process without any human involvement, in line with the definition of the SNA production boundary in paragraph 6.24, the growth of the biological resource is not production in an economic sense, and the asset is considered as a non-produced asset, i.e. a non-cultivated biological resource. Examples relate to the unmanaged growth of fish stocks in international waters, the growth of trees in uncultivated forests. In these latter cases, only goods produced by catching the fish, felling the trees, or picking berries, etc. enter into the production boundary. Furthermore, the depletion and growth is recorded under other changes in the volume of assets, and the transfers related to leasing are recorded as rent.

3. In short, in line with the current guidance provided by the 2008 SNA, three main categories can be distinguished for naturally occurring assets in the form of biota (trees, vegetation, animals, birds, fish, etc.):

- resources which are controlled by, managed by and under the responsibility of an economic agent, to be treated as produced assets, i.e. cultivated biological resources (or inventories);
- resources which are owned by an economic agent who can derive economic benefits from them, but which are controlled and managed at hardly any, or very low levels of, engagement, to be treated as non-produced assets, i.e. non-cultivated biological resources;
- other resources, not meeting the criteria for being considered an asset, at least in monetary terms, in the 2008 SNA.

4. Although all of this looks relatively clear and straightforward, the opposite is true. Many questions come to the fore, and quite a number of issues require further clarification. The following questions and issues will be addressed in this guidance note:

- The first issue concerns the general asset boundary for biological resources. This first and foremost relates to possibly extending the asset boundary of the SNA in line with SEEA CF (and SEEA EA), by also recognising assets with a zero monetary value. It may also raise some more generic questions around the definition and valuation of assets, but these will be discussed in a separate guidance note on principles and methodologies for valuing transactions and positions.
- The second issue concerns the delineation between cultivated and non-cultivated biological resources.

[5] The author would like to thank the members of the area group on environmental-economic issues, which is part of the Task Team on Well-being and Sustainability, for their very useful comments and suggestions.

- The third issue relates to the recording and valuation of biological resources, including the treatment of permits to use these resources. In this respect, the 2008 SNA is not always that clear and straightforward, and may need further clarification. As in the case of mineral and energy resources, a split-ownership, or perhaps better to say a split-asset, approach is being proposed.
- The fourth item relates to the accounting for depletion. In the case of biological resources, this is further complicated, as – compared to the accounting for depletion in the case of mineral and energy resources – biological resources also have the potential of regeneration, resulting in a negative (net) depletion.
- Finally, a more generic issue is put on the table, i.e. whether the recording of some income from non-produced assets as rent, as opposed to the recording of income from produced assets as part of output, is still justifiable.

5. In addressing the above issues, reference will also be made to the System of Environmental-Economic Accounting, both the Central Framework (SEEA CF) and the recently endorsed guidance on Ecosystem Accounting (SEEA EA). Although SEEA is a system in its own right, complementary to the 2008 SNA, the objective has always been to arrive at consistency between the two sets of international standards, to allow for an adequate monitoring and analysis of interactions between the economy and the environment. This objective has become even more important in view of the increased emphasis on environmental sustainability. Moreover, SEEA often includes more detailed guidance when it comes to capturing natural resources.

6. The guidance note predominantly focuses on the recording of biological resources yielding once-only products, like timber and fish. Less attention is paid to resources yielding repeat products, mainly because the recording is less controversial. Furthermore, it shows that terminology is quite crucial in discussing and understanding what exactly is proposed. Therefore the Guidance Note starts, in Section 2, with explaining some of the terminology that is applied throughout the discussion. Subsequently, each of the five issues listed in the above are discussed, in Sections 3 – 7. Each of these sections first provides a short summary of the current guidance, followed by a discussion of the main issues and proposals for further consideration. Section 8 summarises the main proposals, and also includes the resulting questions to the Advisory Expert Group (AEG) on National Accounts. Annex 1 contains two tables, one providing a concise overview of the current guidance according to the 2008 SNA and another one with a summary of the proposals made in this guidance note. Annex 2 presents some numerical examples of the proposed recording, while Annex 3 provides a collection of the most relevant paragraphs in the 2008 SNA, SEEA CF, and SEEA EA.

Section 2. A short explanation of basic terminology

7. It shows that terminology is critically important in understanding the discussions on the accounting for biological resources, which in this note are limited to resources yielding once-only products. Below some terms are introduced and further explained.

8. In valuing cultivated biological resources, usually the Net Present Value of future resource rents is applied. This a forward looking concept, depending on the future path of natural growth and extraction of, for example, trees in the case of timber resources. In the 2008 SNA, this value is recorded as part of inventories, or more precisely work-in-progress, which seems to suggest that the value represents the value of standing timber, the value of timber that has been built up in the past. Actually, the Net Present Value of future resource rents consists of two elements:
- The "pure" inventories, related to the maturing of trees, which are felled at a later stage. This basically comes to down to an accrual accounting of output. Instead of accounting for output for the whole value of the resulting wood (after deduction of felling costs, clearance costs, etc.) at the

time the trees are felled, the output resulting from the annual growth of trees to be felled is allocated to the year of growth.[6]

- The value of the forest land, which can be estimated by the Net Present Value of future resource rents, adjusted for the above inventories. This item, in the remainder of the Guidance Note referred to as the underlying asset[7], can be looked upon as the asset providing capital services to the growth of trees. Insofar values for land are already explicitly included, the value of this land should be considered part of the underlying asset, otherwise one would run the risk of double counting. However, in practice, hardly any value will have been attributed to land as such, also because hardly any market transactions take place in forest land.

9. Furthermore, leaving apart changes in prices or other changes due to e.g. catastrophic events, positive changes in the above inventories are labelled natural growth, while negative changes are referred to as extractions. For the underlying asset, the terms regeneration and depletion are used.

10. The above delineation of cultivated biological resources is better aligned to the traditional notion of inventories, according to which, over time, the additions to inventories, recorded as output, equal the withdrawals from inventories. Furthermore, looking upon the underlying asset as an item providing capital services to the production of timber, which may be subject to regeneration or depletion depending on whether the balance of natural growth and extraction are beyond or below sustainable levels, also looks better aligned to traditional notions of capital. The concept of leasing is also more related to the leasing of the underlying asset, than to the whole, combined, asset. Finally, the notion of the underlying asset aligns nicely to the concept of ecosystem assets providing provisioning services (see also the discussion further below).

Section 3. The general asset boundary

Current guidance

11. When it comes to the question of whether or not biological resources, or biota, are considered as an asset, the criteria for the general asset boundary of the 2008 SNA need to apply. As stated in paragraph 3.30 of the 2008 SNA: "*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. It is a means of carrying forward value from one accounting period to another".* So, the biota must be owned by an economic agent, and benefits need to be derived from them.

12. Paragraph 10.167 of the 2008 SNA further clarifies economic ownership in the case of natural resources: "*Only those naturally occurring resources over which ownership rights have been established and are effectively enforced can therefore qualify as economic assets and be recorded in balance sheets. They do not necessarily have to be owned by individual units, and may be owned collectively by groups of units or by governments on behalf of entire communities. Certain naturally occurring resources, however, may be such that it is not feasible to establish ownership over them: for example, air, or the oceans. In addition, there may be others that cannot be treated as economic assets because they do not actually belong to any particular units. These include not only those whose existence is unknown but also those, including uncultivated forests, that may be known to exist but remain so remote or inaccessible that, in practice, they are not under the effective control of any units*". Furthermore, paragraph 10.182 of the 2008 SNA makes clear that, for example, virgin forests and fisheries within the territory of the country are to be considered as assets. Only if those resources are

[6] For a forest in a steady state, where extraction equals natural growth, the change in inventories would be equal to zero.
[7] The most suitable term for this underlying asset is discussed later in the Guidance Note.

not exploitable for economic purposes, currently or in the foreseeable future, they should be excluded.

13. Furthermore, the methodologies for valuing assets may shed some light on the interpretation of benefits. Here, paragraphs 13.20 – 13.24 of the 2008 SNA basically distinguish three ways to arrive at a monetary value for assets: (i) values observed in markets; (ii) values obtained by accumulating and revaluing transactions, often applied to fixed assets; and (iii) net present value of future returns. From these valuation methodologies, one can derive that the benefits primarily relate to monetary benefits, including production of goods for own final use.

14. In respect of the benefits from biological resources, the 2008 SNA first and foremost speaks about the benefits from the natural growth of goods, which in the context of accounting for ecosystem services and assets are referred to as *"provisioning services"* (see also below). However, although this is not mentioned explicitly, monetary benefits may also be derived from e.g. payments of entrance fees to natural parks. One may also think of carbon sequestration services provided by forest, in which case one starts to wonder about the recording of carbon offset, whereby consumers pay a premium on, for example, a plane ticket, and the airline company remits the payment to country B for them to plant trees. Such issues may become increasingly important, certainly if these payments and also payments for carbon emission permits will become more prominent. However, in this Guidance Note, the discussion is restricted to the provisioning services, such as timber and fish resources. As such, the proposals made in this guidance note do not intend to change the asset boundary in monetary terms for biological resources, as defined in the 2008 SNA.

15. SEEA CF, paragraph 2.17 provides the following definition of environmental assets: "*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".* However, when looking at the asset boundary in monetary terms, SEEA CF is in principle fully consistent with the 2008 SNA, as noted in paragraph 5.32: "*In the Central Framework, consistent with the SNA, the scope of valuation is limited to the benefits that accrue to economic owners. An economic owner is the institutional unit entitled to claim the benefits associated with the use of an asset in the course of an economic activity by virtue of accepting the associated risks. Further, following the SNA, 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".*

16. On the other hand however, the asset boundary in physical terms is quite different from the 2008 SNA. More precisely, paragraph 5.39 of SEEA CF states the following: "*In physical terms, the scope of environmental assets measured in the Central Framework may be greater than the scope of environmental assets measured in monetary terms following the SNA definition of economic assets. This is because there is no requirement in physical terms that environmental assets must deliver economic benefits to an economic owner. For example, remote land and timber resources should be included within the scope of the environmental assets of a country even if they do not currently or are not expected to deliver benefits to an economic owner".* In paragraphs 5.346 – 5.347, paragraph 5.395, and paragraphs 5.398 – 5.400, this is further specified for timber resources and aquatic resources.

17. Although it is stated that, in monetary terms, SEEA CF is fully consistent with the 2008 SNA, SEEA CF is often more precise and prescriptive in clarifying and interpreting the notions of economic ownership and economic benefits. For example, in the case of timber resources, the exclusions from the monetary asset boundary are very clearly outlined in paragraph 5.346 ff. Also in the case of aquatic resources, SEEA CF provides very useful guidance on how to deal with fish in the exclusive economic zone and fish in international waters. It remains to be seen whether these more precise descriptions can be considered as being (fully) consistent with the 2008 SNA.

18. The general asset boundary of SEEA EA in physical terms is fully consistent with SEEA CF. However, the starting point of the former standards for measuring natural capital is the concept of ecosystems, which are defined, in paragraph 2.6, as follows: *"Following the Convention on Biological Diversity (CBD) an ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".* These ecosystems provide services to humanity, for which, in paragraph 2.28, the following main categories are distinguished: "*provisioning services (i.e., those related to the supply of food, fibre, fuel and water); regulating and maintenance services (i.e., those related to activities of filtration, purification, regulation and maintenance of air, water, soil, habitat and climate); and cultural services (i.e., the experiential and non-material services related to the perceived or realized qualities of ecosystems whose existence and functioning enables a range of cultural benefits to be derived by individuals)"*.

19. Apart from the different asset boundary in physical terms, as stated in paragraph 1.39, "*a key difference between the SEEA EA and the SNA lies in the measurement of ecosystem services. In the SNA, these flows are outside the production boundary that establishes the set of goods and services that are the focus of measures of output, value added and gross domestic product (GDP)"*. The ecosystem assets, as providing capital services to a more extended set of goods and services, is thus broader than what is included in the SNA, and it is not the intention of this Guidance Note to extend the asset boundary in this way. However, some of these services, first and foremost provisioning services, are actually accounted for in the SNA. Also other services may (increasingly) add, directly or indirectly, to the monetary value of natural resources, as defined in the SNA.

20. Finally, as noted in paragraph 8.13 of SEEA EA, the principles and methodologies for valuing the ecosystem services, and thus also the value of the ecosystem assets, which are estimated using the Net Present Value of resource rents from ecosystem services, are based on an approximation of exchange values consistent with the SNA (see paragraph 3.118 of the 2008 SNA). In this respect, it should be noted however that there still is quite some dispute about the valuation methodologies which are applicable for this purpose.

Issues for discussion and proposals for further consideration

21. From the above discussion on the asset boundary, one can derive two points for discussion. The first one concerns the consistency of definitions, principles and methodologies for valuing transactions and positions, thereby recognising that SEEA EA targets a broader set of services than what is included in the SNA. More general considerations around the issue of valuation are dealt with in a separate guidance note, and are not further discussed here. On the other hand, however, some more specific issues around the recording and valuation of biological resources are dwelt upon in the next section.

22. The second point for discussion relates to the asset boundary in physical terms. If for some reason no monetary benefits can be derived from natural resources, they do not qualify as an asset in the SNA. On the other hand, SEEA also qualifies natural resources from which no economic benefits can be derived in the foreseeable future as being part of the (physical) asset boundary. One could distinguish three basic options when it comes to defining the asset boundary of biological resources in the context of the SNA:

- Record known biological resources which are owned in one way or another, both individually and collectively, always as an asset. This would also include resources with zero monetary benefits in the foreseeable future, but these resources would then be recorded with a value of zero.
- Make a distinction between biological resources that qualify versus those that do not qualify as an asset, but apply more strict criteria for the delineation of the latter category. Here, one could

think of the criteria applied in Eurostat and OECD (2017), i.e. biological resources do not qualify as assets, if they are not able to provide monetary benefits because of legal restrictions and/or very strictly applied economic reasons (impossibility in the foreseeable future to derive a positive economic return from the resources).

- Alternatively, one could simply disqualify all resources as being part of the asset boundary, if they have a value of zero, which is in line with the 2008 SNA. This alternative is more restrictive than the second option above, because in the definition of Eurostat and OECD (2017) one could still imagine including resources which currently have a value of zero, but which may potentially provide economic benefits in the future.

23. Apart from the advantage of a full alignment of the asset boundary in the SNA and the SEEA, also in physical terms, the first option would make room for an improved accounting of physical measures, which becomes more and more important in times of increasing attention for issues of environmental sustainability. It could also improve the possibility of accounting for e.g. changes in land use and its impact on physical and monetary measures of land. Moreover, it would result in a neater alignment with the accounting for ecosystems, by including those resources which may provide all kinds of ecosystem services without a monetary payment being involved. Natural parks, for example, may not have a monetary value derived from potential provisioning services, simply because of legal restrictions to use trees for timber production, but from an ecosystem services' perspective, they may provide substantial benefits in the form of e.g. recreational services or carbon sequestration services.

24. One could also argue that the current value of the asset being zero does not preclude the value from becoming non-zero in the future. Furthermore, in practice, a broader definition of physical assets would not matter that much, as it would not make any difference for compiling monetary stocks of biological resources. In addition, it can be argued that almost all biological resources do have some monetary value, albeit at very marginal levels, because people can derive minor economic benefits, in line with the production boundary of the SNA, from them. This could relate to, for example, picking berries and recreational fishing.

25. However, extending the asset boundary in physical terms, by including assets with no monetary value, would imply a significant re-definition of what constitutes an asset in the SNA. This does not look that attractive, from the perspective of wanting to provide clear and unambiguous guidance. One could also argue that the value added of having a complementary set of standards on environmental-economic accounting, which are consistent with the SNA when it comes to assets in monetary terms, is the perfect avenue for providing extended and/or supplementary information in physical terms, not only by linking the SNA to a broader set of assets in physical terms, but also by providing consistent information on other physical phenomena, such emissions to air and water.

26. This issue was already discussed at the 14th meeting of the Advisory Expert Group (AEG) on National Accounts. The AEG *"… 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".*[8] This basically means that there was not much appetite for extending the asset boundary in the central framework of economic accounts.

[8] See https://unstats.un.org/unsd/nationalaccount/aeg/2020/M14_Conclusions.pdf.

Section 4. The distinction between cultivated and non-cultivated biological resources

Current guidance

27. Although, as noted before, monetary benefits derived from natural resources may extend to other ecosystem services as well, the discussion in the remainder of this paper is restricted to provisioning services. Furthermore, the discussion on issues regarding valuing and recording biological resources is further restricted to resources yielding once-only products, such as timber and fish. Animals and plants yielding repeat products are less controversial, as the generation of these resources are typically controlled by, managed by and under the responsibility of an economic agent. Moreover, in these cases market prices are often available, which makes valuation much more straightforward. That is not to say, however, that some of the points addressed below may also be relevant for resources yielding repeat products.

28. For biological resources which are considered to be part of the asset boundary, both the 2008 SNA and SEEA CF make a distinction between cultivated and non-cultivated biological resources, depending on whether the growth (and regeneration) process of the biological resources is controlled by, managed by and under the responsibility of an economic agent. If the latter is the case, the natural growth is considered as output. If this is not the case, only the goods produced by catching the fish, felling the trees, or picking berries, etc. are recorded as output. In addition, the natural growth and regeneration as well as the extraction and depletion of cultivated resources is changes in inventories (i.e., in the case of resources yielding once-only products), while in the case of non-cultivated resources these items are recorded as other changes in the volume of assets. Moreover, in principle[9], leasing of produced assets is recorded as output and intermediate consumption, while the leasing of non-produced assets is recorded as receipts/payments of rent.

29. In defining the general production boundary, paragraph 6.24 of the 2008 SNA states the following: "*Economic production may be defined as an activity carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services. … A purely natural process without any human involvement or direction is not production in an economic sense. For example, the unmanaged growth of fish stocks in international waters is not production, whereas the activity of fish farming is production".* In further specifying the production boundary for agriculture, forestry and fishing, paragraph 6.136 of the 2008 SNA states that "*… the growth and regeneration of crops, trees, livestock or fish which are controlled by, managed by and under the responsibility of institutional units constitute a process of production in an economic sense"*.

30. Furthermore, paragraph 1.43 states the following: "*… the natural growth of stocks of fish in the high seas* ***not subject to international quotas*** (bold inserted by the author) *is not counted as production: the process is not managed by any institutional unit and the fish do not belong to any institutional unit"*. This could be interpreted as if the presence of international quotas is to be regarded as a sufficient condition for the natural growth to be considered as part of the production boundary, while in the case of truly open access to fish in international waters only the catching of fish enters the production boundary. The latter interpretation considering the presence, or not, of international quota, also makes one wonder about the recording of uncultivated forests, which are often under some form of control by the national government and cannot be used for e.g. timber production without an explicit permission provided by government. Here, it is assumed that the above quote is simply a slightly unfortunate phrasing, and should not be interpreted literally. International quota are thus not considered as a sufficient criterion for treating fish in open waters as produced assets.

[9] Here, the words "in principle" are used, because one may wonder whether in practice the leasing of some cultivated biological resources is actually distinguishable from the leasing of non-cultivated resources.

31. Apart from the differences in the recording of natural growth and regeneration, extraction and depletion, as well as leasing of biological resources, a major difference between cultivated and non-cultivated biological resources concerns the time of recording of output. In the case the growth and harvesting of e.g. crops take place in the same year, the output value can be put on a par with the value of the harvested products, resulting in a similar treatment of cultivated and non-cultivated biological resources. If however the resources take several years to reach maturity, the allocation of output over time may differ. In the case of cultivated assets, the natural growth will be recorded as output, while in the case of non-cultivated assets, output will only be recorded at the time of actual use, i.e. when felling the trees, catching the fish, etc. One could thus argue that the difference in recording output for cultivated and non-cultivated biological resources is a matter of timing. However, one also has to take into account that for some non-cultivated resources the whole idea may be to only use part of the natural growth in production, as a consequence of which there may be a significant difference between the growth of the resources and the actual use of these resources in production, also over longer periods of time.

32. As in the case of the asset boundary in monetary terms, the guidance on the distinction between cultivated and non-cultivated resources provided by SEEA CF aligns very well with the 2008 SNA. Both standards refer to the level of management practices and active human involvement in the growth of the biological resources. However, once again, SEEA CF is much more precise and prescriptive. Although it states, in paragraph 5.28, that *"in practice, it may be difficult to distinguish between cultivated and natural biological resources"*, in what follows for timber resources, in paragraph 5.349 and paragraphs 5.354 – 5.357, and for aquatic resources, in paragraphs 5.393 – 5.394 and paragraphs 5.408 – 5.410, one can derive a rather clear picture about how to define and interpret management practices.

33. More specifically, paragraph 5.354 of SEEA CF provides the following guidance on timber resources: "*For timber resources to be classed as cultivated, the management practices must constitute a process of economic production. This is likely to include activities such as (a) control of regeneration, for example, seeding, planting of saplings, thinning of young stands; and (b) regular and frequent supervision of trees to remove weeds or parasites, or to attend to disease. The level of these types of activity should be significant relative to the value of the timber resources and should be directly connected with the growth of the timber resources in question".* Here, one may only wonder about the qualification of the management activities being "*significant"* relative to the value of the timber resources. Whatever the case, it is clear that a quite distant and relatively inactive type of management will not qualify the relevant resources as being managed.

34. Other guidance has also been developed regarding the distinction between cultivated and non-cultivated resources. For example, Eurostat (2002a) on accounting for forests further clarifies *"direct control, responsibility and management"* as seeding and planting, thinning and other kinds of forest management. However, it goes on with stating that *"… forest management in Europe represents a continuum from intensely managed to totally undisturbed, and a clear-cut division into a cultivated and a non-cultivated category will always be difficult. Often, the data that would be needed to separate the stocks and related flows are not available. It was therefore decided not to distinguish between cultivated and non-cultivated timber"*. Furthermore, *"… inaccessible or low-productivity forests will usually not be managed intensively, and should be classified as not available for wood supply and thus non-cultivated".*

35. Furthermore, Eurostat and OECD (2017), with reference to Eurostat (2002b), suggests the following breakdown of forests:

- forests available for wood supply, cultivated;

- forests available for wood supply, not cultivated;
- forests not available for wood supply, related to legal restrictions; and
- forests not available for wood supply, not related to legal restrictions.

36. The first category would qualify as *"… cultivated for economic exploitation; they are managed and controlled by an institutional unit. Regular human intervention takes place"*, to be recorded as a produced asset. The second category concerns *"… forests that are in principle available for wood supply, but that are not harvested in practice. It concerns natural forests in which for many years no human intervention has taken place".* The third category *"… concern(s) forests areas where forestry for wood production is forbidden by legislation or other official measures. This can be the case for strict nature reserves, national parks or wilderness areas"*. Finally, the fourth category *"… contains non-protected forests that are, however, not suited for wood supply for economic reasons. Reasons might be that the physical productivity is too low or harvesting and transportations costs are too high to warrant regular wood harvesting. Examples could be mountain forests and swamps".* It is then noted that all forests from the second, third and fourth category are to be recorded as non-cultivated biological resources[10], because *"… the natural growth of the trees is not managed and controlled by an institutional unit and therefore does not generate output"*. [11]

37. More generally, it is (again) noted that *"in most European countries almost all the forests are considered as cultivated as they are managed by public or private institutional units. Only the protected areas and the forests not exploitable from a technical or an economic-convenience point of view are excluded from cultivated forests"*.

Issues for discussion and proposals for further consideration

38. As a starting point for the discussion on the delineation between cultivated and non-cultivated biological resources, it may be useful to make a distinction between migrating and non-migrating resources. Straddling fish in open waters, whether these waters may be part of the exclusive economic zone (EEZ) or not, would be the most obvious example of the first category. Other examples may relate to wild animals on land. For these migrating and freely moving resources, it is already quite difficult to fully exert ownership rights over the asset, unless quota regimes or other exclusive rights are explicitly put in place. Controlling and managing the growth of these resources is almost impossible. One could therefore argue that these migrating resources always qualify as being non-cultivated.

39. For the non-migrating resources, ownership rights over the assets are usually in place. The relevant assets may not be owned by individual economic agents, but in those cases the government typically exerts one or another form of collective ownership. For the issue regarding the distinction between cultivated and non-cultivated, however, as noted before, control and management over the growth of the resources is relevant. When taking the 2008 SNA as a starting point, one can basically distinguish two options for the delineation between cultivated and non-cultivated biological resources, depending on how to interpret the significance of management practices, i.e. when to consider the level of these types of activity as being significant relative to the value of the resources:

- Option 1: A strict application of the significance of management practices, in which case the biological resources are only considered as cultivated if they are more or less fully managed. In this case, very intensive human intervention would qualify the relevant resources as produced assets. In the case of timber resources, only plantations would then be considered as produced assets, while in the case of aquatic resources only fish farming would qualify as such. All other

[10] One could also argue that the third and fourth category do not qualify as an (economic) asset according to the 2008 SNA.
[11] It should be noted here that this quote can be misunderstood, as non-cultivated resources do generate output as well. However, the output is recorded at the time of felling the trees, and thus not recorded in line with the natural growth.

biological resources, for which management levels are relatively minor, would be recorded as non-produced assets.

- Option 2: The alternative is to record all (non-migrating) biological resources as being cultivated. Here it is assumed that the relevant resources do provide some benefits and that the growth process is, implicitly or explicitly, under some form of control and management by economic agents, either individually or collectively, i.e. that they qualify as produced assets.

40. In evaluating both options, one could argue that considerations around the recording of output are probably much more relevant than the exact classification of assets, as being produced or non-produced. There seems to be hardly any reason to not apply an accrual recording of output in both cases, i.e. for produced as well as non-produced assets. One of the most important assets used in the production of agricultural goods concerns agricultural land, which is considered as a non-produced asset. Yet no-one disputes the accrual recording of agricultural output, as the level of control and management over the growth of the agricultural products is the decisive criterion, not the classification of the assets used in production. Such a reasoning would also make the various options less controversial in cases where the value of the biological resources may be captured in the value of land, such as the case for forest land.

41. Whatever the case, both options have their advantages and disadvantages. One important point concerns the clarity of the guidance. Using option 1, one definitely needs adequate phrasing which avoids issues of delineation where one can observe a continuum from intensely managed to totally undisturbed, such as the example of European forests. This clarity can only be achieved in the case of a very strict interpretation, such as the one explained in the above.

42. An advantage of option 2 is that it aligns much better to the notion of ecosystem services, for which natural growth is the logical starting point. On the other hand, it is quite problematic to look upon growth of timber in natural forests as a human-induced activity. It is first and foremost nature that provides the input into the process of growth. Interpreted in this way, one could argue that (the growth of) all biological resources contain(s) a non-produced element.

43. In respect of option 2, one could also take the continuum from intensely managed to totally undisturbed as a starting point for the recording of biological resources. From this perspective, the most straightforward interpretation would be that the distinction between cultivated and non-cultivated ceases to exist, as ecologically speaking all biological resources are impacted by human activity (directly or indirectly). It would however be meaningful to distinguish the degree of human input versus natural inputs. The latter could be materialised by measuring output, and – in the case of resources yielding once-only products which is most relevant in this discussion – the growth in inventories, as the percentage of natural growth that is expected to be exploited in the foreseeable future. This would come down to an accrual accounting of production which currently is recorded at the time of removing the biological resources from nature.

44. Yet another option would be to use ownership as the distinguishing feature, rather than fully managed versus marginally managed. If a corporation owns land and essentially just lets the trees grow over time without any intervention, the fact remains that the company is still managing the resource, although not necessarily its growth. One could nevertheless consider treating these resources as cultivated. Biological resources which are collectively owned would then qualify as non-cultivated assets.

45. From a conceptual point of view, the option to take the continuum from intensively managed to totally undisturbed as a starting point, as presented in paragraph 43 in the above, looks most appropriate. It reflects economic reality, and leads to an accrual accounting of all natural growth that

at some stage will result in output of products derived from biological resources. It also acknowledges the fact that these products are the results of a combination of human activity and natural inputs. It would also result in a better alignment with the accounting for ecosystem services and ecosystem assets. On the other hand, as mentioned before, one has to realise that such a treatment may also have a significant impact on the distribution of output over time, and the recording of natural growth and extraction, regeneration en depletion as well as leasing of these resources.

46. From a measurement perspective, option 1 seems to be the most straightforward one. Although this may be less relevant for very cultivated regions like Europe, measurement of natural growth in other regions of the world would probably be much more problematic when applying option 2. All in all, the conceptually preferable option holds the middle ground. It however requires an estimate of the expected future exploitation, which then needs to be allocated to the years in which the natural growth has contributed to this exploitation.

47. The above discussion shows the complexity of making a clear distinction between produced and non-produced assets. Yet this distinction is quite critical in the 2008 SNA, as it does not only affect the recording of the relevant assets, but also the recording of output, capital accumulation and run-down, and leasing of these assets. The actual practice shows to be far more ambiguous than the implied dichotomy recommended in the current SNA. To get away from the current black and white approach, one could also opt for a more radical proposal by considering natural resources as a separate class of assets, different from the traditional assets, as currently recommended in the SNA. Treating natural resources as a separate class would open the door for not having to make a distinction between produced and non-produced assets.

48. Such a proposal is actually quite attractive, as – most certainly in the case of biological resources – the asset in question always contains an element of natural growth, not induced by human intervention. Moreover, it would provide the opportunity to classify the various flows related to natural resources in a way which is considered most relevant for these resources. . The time of recording of output, i.e. accrual recording versus recording at the time of felling trees or catching, could then be relaxed, and based on practical circumstances and the feasibility of measurement. Finally, it would give the accounting for natural resources the prominence it deserves, in a time and age where environmental sustainability is considered as one of the most important policy challenges. Table A.2 in Annex 1 provides a first proposal for such a new classification of assets, including the recording of the most relevant flows. Table A.1 shows the recording in line with the current guidance in the 2008 SNA.

Section 5. Recording and valuing biological resources, including the treatment of permits

Current guidance

49. As previously noted, according to the 2008 SNA, biological resources, whether cultivated or non-cultivated, should be recognised as assets, if ownership rights are established over them, either individually or collectively, and monetary benefits can be derived from them. When it comes to the latter, the valuation can be quite problematic, simply because observable market prices are not available.[12] The 2008 SNA does not provide much specific guidance beyond the general principles of valuing assets. It only notes, in paragraph 13.51 (and also paragraph 13.19), the following in relation to non-cultivated biological resources, water and other natural resources: "*As observed prices are not*

[12] In the case the rights to use the resources are auctioned in a competitive environment, one may be able to use the value of permits as an indication for the value of the underlying assets.

likely to be available, they are usually valued by the present value of the future returns expected from them".

50. In addition, paragraph 13.41 of the 2008 SNA states the following in relation to the valuation of inventories: *"Standing single-use crops (including timber) cultivated by human activity and livestock being raised for slaughter are also counted as inventories in work-in-progress. The conventional way of valuing standing timber is to discount the future proceeds of selling the timber at current prices after deducting the expenses of bringing the timber to maturity, felling, etc. …"*. This text is not very precise, and therefore may lead to different interpretations. It would have been preferable to simply phrase it as the Net Present Value of future resource rents. As such, it represents both the underlying asset (including forest land) and the pure changes in inventories, as defined in Section 2.

51. Furthermore, when discussing the treatment of resource leases, paragraph 17.310 of the 2008 SNA states the following: "*A resource lease is an agreement whereby the legal owner of a natural resource that the SNA treats as having an infinite life makes it available to a lessee in return for a regular payment recorded as property income and described as rent. The resource continues to be recorded on the balance sheet of the lessor even though it is used by the lessee. …".* This relates to non-cultivated biological resources. However, one may assume that a similar treatment is recommended for cultivated biological resources, although in the case of produced assets the relevant receipts and payments are to be recorded as output and intermediate consumption[13].

52. The guidance on valuation, provided in SEEA CF, is basically consistent with the 2008 SNA. However, in this case, for valuing, for example, timber resources, reference is simply made to the Net Present Value of resource rents. Furthermore, although this is not mentioned explicitly, at least to the knowledge of the author of this Guidance Note, when it comes to allocating biological resources, SEEA CF recommends a split-ownership, or a split-asset approach, in line with the recording of mineral and energy resources; see paragraph 5.216 – 5.224.

53. Where it gets more complicated, and certainly more controversial about how exactly one should interpret the current guidance, is the recording of leases of non-cultivated resources, and its impact on the recording and valuation of the underlying resources.[14] In this respect, paragraph 10.191 of the 2008 SNA states the following: "*Permits to use natural resources are third-party property rights relating to natural resources. An example is where a person holds a fishing quota and he is able, again both legally and practically, to sell this to another person"*. More details are provided in chapter 17 of the 2008 SNA; see paragraph 17.313 – 17.343.

54. Paragraph 17.314 provides further clarifications on different types of leasing, as follows: *"There are basically three different sets of conditions that may apply to the use of a natural resource. The owner may permit the resource to be used to extinction. The owner may allow the resource to be used for an extended period of time in such a way that in effect the user controls the use of the resource during this time with little if any intervention from the legal owner. The third option is that the owner can extend or withhold permission to continued use of the asset from one year to the next".* As explained in paragraph 17.315, the first option results in the sale of the asset. More relevant for the following discussion are the second and third option.

[13] Whether or not leasing of cultivated biological resources is relevant in practice also depends on how the underlying asset is looked upon. If one considers the underlying asset as being (non-produced) forest land, then leasing of cultivated biological resources is probably highly irrelevant.

[14] Again, it is noted that the following may also be relevant for the leasing of cultivated biological resources, although the 2008 SNA does not provide much specific guidance in this respect.

55. Paragraph 17.334 further exemplifies the case of fishing quotas: "*Fishing quotas may be allocated in perpetuity or for extended periods to particular institutional units, for example, where fishing is an established way of life and there may be little alternative economic employment. In such circumstances the quotas may be transferable and if so, there may be a well-developed market in them. Fishing quotas may therefore be considered as permits to use a natural resource that are transferable. They are thus assets in the SNA*". Here, it should be noted that recording a positive value for these permits should have a direct and equivalent impact on the value of the underlying natural resources, otherwise a double counting of the value of the relevant resource would result. Paragraph 17.315 states in relation to these permits, somewhat cryptic, that it *"… leads to the creation of an asset for the user, distinct from the resource itself but where the value of the resource and the asset allowing use of it are linked*".

56. The basic guidance provided in SEEA CF seems to be in line with the above guidance from the 2008 SNA. However, again, SEEA CF provides more details. In paragraph 5.128, when discussing alternative approaches to estimating resource rent, the following is stated: *"The access price method is based on the fact that access to resources may be controlled through the purchase of licences and quotas, as is commonly observed in the forestry and fishing industries. When these resource access rights are freely traded, it is possible to estimate the value of the relevant environmental asset from the market prices of the rights. The economic logic parallels the residual value method, since it is expected that, in a free market, the value of the rights should be equivalent to the future returns from the environmental asset (after deducting all costs, including user costs of produced assets)"*. Moreover, as noted in paragraph 5.129, if the access rights provide very long term or indefinite access to the assets, the market value of these rights may provide a direct estimate of the total value of the underlying asset. However, as noted in paragraph 5.130: "*In practice, in many cases governments may give the access rights direct to extractors for free or do so at a price that is less than the true market value. Further, trading of the rights may be restricted or prohibited. In these cases, there is no directly observable market valuation".*

57. All in all, the asset boundary for permits to use natural resources is basically restricted to the tradable ones[15]. This is true for the 2008 SNA as well as SEEA CF. It is far from clear, however, how permits to use biological resources affect the recording and valuation of the underlying assets, the (initial) valuation of which is often based on the Net Present Value of future resource rents. This issue, and other related issues, will be further discussed below.

Issues for discussion and proposals for further consideration

58. Some confusion may have been created in the current guidance of the 2008 SNA, by using less precise terminology. In the case of biological resources, such as timber and fish, one could distinguish two quite distinct types of assets, as explained in Section 2: (i) the pure changes in inventories, because of the maturing of trees, which basically comes to down to an accrual accounting of output, and the resulting building up of inventories; and (ii) the value of the underlying asset (including associated land), which can be estimated by the Net Present Value of future resource rents, adjusted for the above changes in inventories. If the underlying asset is not included in the value of associated land, then it is recorded as part of inventories in the case of cultivated biological resources, and as non-produced assets, more precisely non-cultivated biological resources, in the case the asset is considered to be non-cultivated (see paragraph 13.51 of the 2008 SNA.

59. In respect of the underlying asset, it is good to take note again of the general criteria for recognising an asset: (i) the establishment or effective enforcement of ownership rights by an

[15] This does not preclude the existence of a financial asset/liability, in the form of prepaid rents for a certain period of time; see the following discussion of issues and proposals for further consideration.

economic agent; and (ii) 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. As explained in Section 3, the assets do not necessarily have to be owned by individual units, and may be owned collectively by groups of units or by government on behalf of the entire community. Both the 2008 SNA and SEEA CF make clear that, for example, virgin forests and fisheries within the territory of the country are to be considered as assets, if they generate a future flow of monetary benefits, including resource rents.

60. A specific case may be fish in open waters or the high seas, and other migrating animals. These resources generally do not qualify as assets, unless they are subject to a quota regime. As noted before, it may thus be useful to make a distinction between migrating and non-migrating biological resources, such as forests for growing timber. Whereas forests are clearly subject to ownership and control by an individual economic agent, or by the government as the representative agent of a country, migrating resources can only be subject to control by the establishment of some kind of quota regime or any other regime providing exclusive rights. Without such a regime, one may assume that the catching of fish would be fully competitive, even for fish within the economic territory of a country, and the resources would probably not generate any positive resource rent, thus resulting in a zero monetary value, as a consequence of which they would remain outside the scope of assets in monetary terms.

61. Furthermore, using the term timber resources or fish resources may be slightly confusing, as the resource rents relate to the income generating potential of forest land and seas. Not timber but the forest is the underlying asset; not fish but the sea, or the permits provided under a quota regime (see later), is the underlying asset. As such, it is very much akin to provisioning services provided by ecosystem type of assets. Moreover, as noted before, in the case of timber, part of this value may well be included in the (potential) value of forest land, although in practice this is probably not the case, due to the unavailability of market prices for transactions in forest land, as a consequence of which alternative methodologies, such as the Net Present Value of resource rents will have to be applied to approximate the value of the relevant land[16]. It also makes one wonder whether this underlying asset is produced or non-produced, as it can be assumed that the main part of the asset value is related to the generation of resource rents from growing timber, which, most certainly in the case of non-migrating biological resources, in one way or another is driven by the management of the growth and regeneration process. In a certain way, one can look upon it as being similar to land improvements. This is in line with the proposal, in Section 4, to use the continuum from intensely managed to totally undisturbed growth, as a consequence of which the distinction between cultivated and non-cultivated resources, at least for non-migrating resources, ceases to exist.

62. The first type of asset, the pure changes in inventories, which is restricted to cultivated biological resources, concerns the building up of inventories through the accrual recording of output, in line with the natural growth of, for example, timber. Instead of recording output at the time of felling the trees in the case of non-cultivated biological resources, the output is distributed over time in line with the maturing of the trees. For non-cultivated biological resources, which fall within the asset boundary of the SNA, the inventories should be recorded, according to the current guidance of the 2008 SNA, under non-cultivated biological resources (together with the underlying asset), while the changes in these inventories, through natural growth and extraction (felling of trees, fishing, etc.), are recorded as other changes in the volume of assets (together with the regeneration and depletion of the underlying asset).

[16] These considerations regarding forest land probably also apply to agricultural land. However, unlike forest land, the price of agricultural land will most probably include the Net Present Value of the provisioning services provided by this type of land to the growth of crops and animals.

63. The above discussion on the underlying asset raises the question whether one should actually include the relevant value of timber resources in the item (forest) land. On the other hand, however, the use of the term timber resources or fish resources (fish quota) may be more appropriate, since it only relates to the relevant provisioning services, not including, probably up to this point in time quite insignificant, monetary values which may be derived from other services provided by ecosystems.

64. The above also raises the question on how to classify the relevant assets. Grouping all biological resources together – instead of recording a probably minor part under land, while the main part is recorded under (non-cultivated) biological resources – looks more attractive. In this respect, one could argue about the classification of fishing quota, as these assets relate to the establishment of access rights, and not to a physical asset per se. Here it is proposed to try to capture all these assets in one asset class, and to classify them under biological resources. If some value is estimated for forest land, which is not very probable, one should add this value to the value of the biological resources, which could also be defended as constituting the main part of the asset[17]. For the part which relates to resources yielding once-only products, a further distinction could then be made between the underlying asset, and the pure inventories. In line with what has been stated in paragraphs 47 and 48 of this Guidance Note, such a proposal for the classification of natural resources is presented in Table A.2 of Annex 1.

65. However, as noted before, it gets much more complicated, also in respect of interpreting the current guidance, when permits to use the relevant sources feed into the equation. To clarify the issues at stake, a numerical example will be used. In this example, the government establishes fishing quota for a period of 10 years. The resource rent derived from the underlying fish resources, initially owned by government, equals 45 per year. Government then decides to provide permits to use these resources, i.e. the fishing quota, for an annual payment of rent equal to 30, to be paid upfront for a total amount of 300 (i.e. 10 * 30).

66. In Table 1 below, four ways of valuing and recording positions on the balance sheets have been distinguished. In the first three cases, the quota are assumed to be not transferable, as a consequence of which they have no marketable value. In the last case, the quota are considered to be transferable. In all cases, the provision of the access rights leads to the emergence of financial claim of the fishing industry to government, for the amount of the upfront payment of rents (300).

- Case A: The full value of biological resources remains on the balance sheet of government.
- Case B: The amount of biological resources on the balance sheets of government is downgraded, in view of the actual rents being lower than the total resource rent.
- Case C: Similar to case B, the amount of biological resources in the books of government has been downgraded. However, now it has been assumed that the fishing industry has biological resources amounting to 150, which equals the Net Present Value of resource rents implicitly handed over by government (10 * 45 *minus* 10 * 30). This recording resembles the split-asset approach proposed for the recording of mineral and energy resources.
- Case D: In this case, it has been assumed that the permits are transferable, and that the market value approximates the difference between the accumulated amount of resource rents and the actual payments of rent.

[17] The alternative is to classify the underlying asset as a whole under (forest) land. Having this underlying asset in two different asset classes seems to be least preferable option.

Table 1: Valuing and recording biological resources

	Case A	Case B	Case C	Case D
Government				
- Biological resources	450	300	300	300
- Other accounts receivable/payable	-300	-300	-300	-300
Fishing industry				
- Biological resources	0	0	150	0
- Permits to use natural resources	0	0	0	150
- Other accounts receivable/payable	300	300	300	300

67. In assessing the pros and cons of the various options for recording biological resources, one also has to take into account how this approach works out in the case of recording depletion of the relevant assets as a cost of production, which has also been proposed in the context of mineral and energy resources. This is the topic of the next section. Here, the assessment of pros and cons is restricted to the resulting valuation of assets, as illustrated in Table 1.

68. Basically, the question of valuation boils down to whether one prefers a full accounting of the resource rent that is being generated by biological resources, or that one restricts the recording of biological resources, or related assets, to observable market transactions, such as the Net Present Value of actual rent payments and the market value of permits. Restricting the analysis to cases A, B and C, the value of the biological resources adds up to 450 in cases A and C. Case A is problematic, in the sense that the value of biological resources is inconsistent with the income appropriated by government. This is corrected in case C, by applying a split-asset approach, based on the appropriation of the resource rent by the legal owner and the extractor.

69. The resulting value of biological resources in case B adds up to 300, representing the Net Present Value of the actual payments made to government. This difference may become quite problematic in the case of fishing quota, which governments often provide for free, or at prices that are significantly below the (Net Present Value of) resource rents. In these cases, trading of the rights often may be restricted or prohibited, as a consequence of which there is no directly observable market valuation. A recording in line with case B in Table 1 would then result in a (close to) zero value of the biological resources.

70. In respect of the above discussion, it can be noted that actual market transactions in biological resources per se are very limited, while rights to use are often provided below the value of the Net Present Value of resource rents. This may be related to the issue of not appropriately accounting for the risks, and thus discounting the future income with a rate which is (substantially) below market perceptions. However, one should also acknowledge the fact that rights to use are often provided below the level of the generated resource rents for political reasons (e.g. in the case of fishing quota), due to monopolistic/oligopolistic markets, or simply because of corruption. Unless the leases are auctioned in a fully competitive environment, sticking to observable market transactions would then not only lead to a misrepresentation of biological resources, but also to a misrepresentation of the (implicit) transfers made by government, certainly in countries where good governance is less well developed.

71. Whatever the preferred option for recording biological resources and permits to use them, the 2008 SNA and SEEA CF need to be further clarified, certainly when permits are provided for free or at prices which are well below the capture of resource rents. As noted before, the 2008 SNA only says, in paragraph 17.315, that permits can lead to *"… to the creation of an asset for the user, distinct from the resource itself but where the value of the resource and the asset allowing use of it are linked*". This makes sense, if one looks at case D in Table 1. Having the recognition of a transferable permit to use natural resources should lead to an equivalent decrease in the value of natural resources. Otherwise, a double-counting would result. One could also interpret this as an implicit and indirect suggestion that the full amount of the Net Present Value of future resource rents should remain on the balance sheets.

72. Here, the 2008 SNA is interpreted in such a way that the handing over of these access rights for free, or the part that is provided for free, is to be treated as a hand-over of part of the biological resources with a concomitant capital transfer to the exploiter[18], as presented in case C in Table 1. Basically, this comes down to a split-asset approach, fully consistent with what has been proposed for mineral and energy resources[19]. In Annex 2, the numerical example of case C in Table 1 has been further elaborated in the form of a full set of T-accounts. Example 1 provides an illustration of a recording in line with the 2008 SNA, while example 2 introduces the split-asset approach.

73. Finally, one last point regarding the classification of the relevant assets, more specifically relating to the classification of transferable permits. As noted before, the recording of these permits has a direct (negative) impact on the amount of biological resources. Therefore, it is proposed that, as a minimum, the link with natural resources is further exemplified. This could be done, for example, by classifying the permits under biological resources, either or not as a separate category.

Section 6. Accounting for depletion (and regeneration) of biological resources

Current guidance

74. The fourth issue for consideration concerns the accounting for depletion (and regeneration) of the "underlying" biological resources. Before entering into a more in-depth discussion, it is good to first provide a quick overview of what exactly depletion entails in the context of renewable natural resources, and how this relates to the concept of degradation. In this respect, one has to be aware of the fact that depletion of biological resources differs from depletion of non-renewable natural resources, in that biological resources are also able to reproduce and grow over time. It is therefore necessary to consider both the impact of depletion and the impact of regeneration of these resources. Depletion can then be defined as levels of extraction that surpass sustainable yields.[20] As stated in paragraph 5.89 of SEEA CF, *"the focus in measuring depletion is on the availability of individual environmental assets in the future and changes in that availability due to extraction and harvest by economic units. There is a particular focus on the specific benefits that arise from the extracted materials, including the capacity of the extraction of the resources to generate income for the extractor"*.

[18] Instead of recording a hand-over of the asset and a concomitant capital transfers, one could also consider the recording of this handover as a reclassification.

[19] As yet another alternative way of recording, one could also record the difference between the resource rent and the actual rent paid as a subsidy received by the lessee, with a concomitant addition to the value of the rent paid. In that case, the amount of rent would be equivalent to the resource rent, and consistent with a recording of the full amount of the Net Present Value of future resource rents in the balance sheets of government. This has not been further elaborated in this guidance note.

[20] For more details on the estimation of sustainable yields, reference is made to paragraphs 5.81 – 5.87 of SEEA CF.

75. On the other hand, degradation is defined, in paragraph 5.90 of SEEA CF, as follows: *"… changes in the capacity of environmental assets to deliver a broad range of contributions known as ecosystem services … and the extent to which this capacity may be reduced through the action of economic units, including households".* Degradation is thus a much broader concept than depletion, in the sense that depletion typically relates to one type of ecosystem services, i.e. provisioning services, while degradation also looks at the extent and condition of other ecosystem services, such as regulating services (e.g., carbon sequestration, air filtration, water flow regulation) and cultural services (e.g., recreation). In the following, reference is consistently made to depletion, as provisioning services are the most relevant ones in the context of the recording of biological resources in the system of national accounts.

76. The above considerations are especially relevant for the underlying asset, not so much for the building-up of inventories. Regarding the latter category, as mentioned before, the recording, as recommended in the 2008 SNA, is as follows. If the relevant biological resources are considered as produced assets, then positive changes as a result of natural growth are recorded as output, leading to positive changes in inventories, while the subsequent extractions are recorded as negative changes in inventories. For the non-cultivated biological resources, the (natural) growth and extractions are recorded as other changes in the volume of assets.

77. When it comes to the underlying asset, the 2008 SNA does not provide much explicit guidance on the recording of the depletion (and regeneration) of biological resources. In the case of cultivated biological resources yielding repeat products, the regeneration and depletion is accounted for as gross fixed capital formation and consumption of fixed capital. Regarding resources yielding once-only products, first, a distinction has to be made between cultivated and non-cultivated resources. In the case of non-cultivated resources, as explained in paragraphs 12.19 – 12.20 and 12.27, the regeneration and depletion are recorded as other changes in the volume of assets. In this respect, it is also stated that it may not be possible to have a gross recording of additions and removals; in those cases, the resulting value should be recorded as either an economic appearance or an economic disappearance of non-produced non-financial assets. Here, it is also noted that the current text of the SNA could be clarified when it comes to the notions of natural growth/extractions and regeneration/depletion. In the case of the underlying asset for cultivated biological resources, the regeneration is recorded as additions to inventories, while the depletion due to the actual removals, and subsequent sales, are recorded as negative entries of inventories.

Issues for discussion and proposals for further consideration

78. At the start, it is good to acknowledge that, if one would consider, in line with looking at non-migrating assets such as forests and related timber as a continuum from intensely managed to totally undisturbed, thus basically abandoning the distinction between cultivated and non-cultivated biological resources, and considering all these resources as being produced, the way of recording regeneration and depletion is already covered. In line with the above paragraph, regeneration would be recorded as gross fixed capital formation, and depletion is considered to be part of consumption of fixed capital.

79. Returning to non-cultivated biological resources, it is proposed to account for depletion of these resources as a cost of production, similar to what has been proposed for depletion of mineral and energy resources. Moreover, in the case a split-asset approach is agreed, this cost of production should be allocated to the relevant economic agents, in line with the appropriation of resource rents.

80. The question then arises how to record the regeneration of these (non-cultivated) biological resources. A recording symmetric to positive depletion, i.e. recording it as a negative production cost,

looks counterintuitive. A recording as gross fixed capital formation, leading to an extension of the production boundary, seems more logical, but may be problematic as well. If one considers control and management of the growth of the relevant resources to be insufficient to qualify them as being produced, it would be hard to explain that the regeneration of the assets in question is to be regarded as the result of a production process. This would be even harder to explain for migrating biological resources governed by quota.

81. On the other hand, a recording of regeneration as gross fixed capital formation could be considered as being equivalent to the treatment of land improvements, albeit that in this case a clear distinction is made between the non-produced element (land in its original state) and the produced element (investments in improving the original land). Although, in the end, one only knows the value of land including improvements. It is usually not possible to say how much the improvements have actually added to this value. Looking at non-cultivated biological resources more specifically, one could also add that keeping these resources at a sustainable level, or even better at levels beyond sustainable yields, does require human intervention, be it in terms of managing and regulating these resources, or going beyond that by having direct interventions in the state of the environment.

82. More generally, one could also argue that *"fundamentally, … we are in the Anthropocene and the world is almost entirely managed now by human decisions to act or not to act. (there's no) sharp and useful production boundary anymore between the living "natural" world and the economy. If a forest is managed by allowing natural regrowth or by active plantation, seems to be a less important distinction than it might once have been"*. [21]

83. All in all, one can distinguish two options: either record the (net) regeneration as negative depletion, or record it as gross fixed capital formation. Here, a certain preference is given to the second option. Example 3 in Annex 2 provides an illustration of the recording of positive depletion (45, similar to examples 1 and 2) as a cost of production. Example 4 provides a numerical illustration of the recording of negative depletion (15 in this example) as an extension of the production boundary, by extending the notion of gross fixed capital formation.[22]

84. Furthermore, instead of the above treatment of the net result of regeneration and depletion as either a cost of production in the case of positive depletion, and gross fixed capital formation in the case of negative depletion, one could also think about disentangling the gross regeneration of biological resources as a positive, adding to the level of investment and output, and the full extraction as depletion, being recorded as costs of production. Such an alternative recording would need further conceptual thinking.

85. Finally, having a separate asset class for natural resources could provide more flexibility in the recording of (negative) depletion. First of all, it would allow for the recording of the run-down of the relevant assets as depletion, also in the case of cultivated biological resources, for which the current SNA prescribes the recording of consumption of fixed capital. Moreover, one would have more leeway to account for the regeneration of natural resources as either gross fixed capital formation or other changes in the volume of assets, depending on whether one considers the regeneration as linked to human intervention, or as a product of natural processes.

[21] Quote from an email correspondence with Adan Dutton (UK ONS).

[22] Please note that in the former case the term depletion is still used. Some may argue that it should become part of consumption of fixed capital. But then again, it is slightly different from the latter, because there is no direct relationship between the investments made and the depreciation over the asset's service live. An example of recording (net) regeneration as negative depletion has not been included, as it would simply replicate example 3, but with negative values.

Section 7. Aligning the accounting for leasing produced and non-produced natural resources

Current guidance

86. The final issue to be discussed in this note concerns the question whether the difference in accounting for leasing produced assets versus leasing non-produced assets is still a valid one. Here, as noted before, the distinction between produced and non-produced assets has significant ramifications for the recording of the relevant transactions and positions. One of the most visible ones concerns the leasing of assets. The income generated through the use of produced natural resources, including the income derived from leasing the natural resources, is recorded as a form of production, leading to the recording of output, while the leasing of non-produced natural resources is accounted for as a form of primary income, i.e. rent on natural resources. This does not only relate to biological resources, but to all (non-produced) natural resources, thus including land and mineral and energy resources.

87. Quoting again paragraph 17.310 of the 2008 SNA: "*A resource lease is an agreement whereby the legal owner of a natural resource that the SNA treats as having an infinite life makes it available to a lessee in return for a regular payment recorded as property income and described as rent. The resource continues to be recorded on the balance sheet of the lessor even though it is used by the lessee. By convention, no decline in value of a natural resource is recorded in the SNA as a transaction similar to consumption of fixed capital*". The reason for treating the leasing of these assets as rent, instead of the provision of services, seems to mainly relate to the point of these assets having an infinite life, thus not contributing to a process of production in the form of depreciation or consumption of fixed capital.

Issues for discussion and proposals for further consideration

88. At the start, it is good to acknowledge that the difference in recording of leasing produced assets versus leasing non-produced assets becomes less relevant, if one would agree on the distinction of a separate asset class for natural resources. Such a distinction would provide the flexibility to apply a similar treatment for leasing cultivated and non-cultivated biological resources. Moreover, as noted before, one can wonder whether the guidance on this difference in treatment is actually applied in practice.

89. Having said that, the more fundamental question still remains whether one could argue that also in the case of non-produced assets, the leasing could be accounted for as a form of production of services, instead of a recording it as primary income. An argument in favour of such a recording is the rather technical argumentation, in the current SNA, of an *"infinite life"* for recording this income as a rent. However, having a closer look at it, this actually only holds for land. It is unequivocally not true for mineral and energy reserves, while it may only hold for biological resources in the case of sustainable exploitation. The reasoning for mineral and energy resources having an infinite life seems to be a purely technical one, in the sense that depletion of resources is not considered as an input into the exploitation of the relevant resources, but is instead recorded as other changes in the volume of assets.

90. In the case of land, one can also make the point that the main part of land leasing, i.e. the leasing of land underlying dwellings and non-residential buildings, is implicitly recorded as part of output of housing services or rentals of offices. So, why not consider the remainder, mainly relating to rents on agricultural land, as output as well?

91. Furthermore, also in the case of other intellectual property products, such as licensing of e.g. software or the receipts of royalties for music originals, the process of generating income is not that

different from leasing natural resources. The process of producing the original leads to the creation of a produced asset different from the appearance of natural resources, but the subsequent process of generating income in the form of license fees and royalties is quite similar to generating income from leasing natural resources. Both require little labour input, in the form of checking the credentials of the client and administering the lease, in addition to the use of the underlying asset. Similarly, financial leasing generating output in the form of FISIM is also not that different from leasing of natural resources.

92. More generally, one could argue, as has been done in the above, that the whole distinction between produced and non-produced assets becomes more and more blurred. Here, one should acknowledge that, despite the apparent dichotomy between produced and non-produced assets in the 2008 SNA, this distinction is far less straightforward. Land has always been considered as a non-produced asset[23], but land improvements which are often an indistinguishable part of the value of the relevant land, are treated as produced assets. Also in the case of agricultural land and forest land, part of the value can be attributed to management activities and other direct interventions of humans. Another argument relates to (the value of) various intangible assets. The actual market value of these assets may go well beyond the value of accumulated investment expenditures, due to monopolistic circumstances, which are not that easy to explain as being a product of the more traditional perspective of producing goods and services.

93. On the other hand, it should be noted that the alternative recording of natural resource leases as output will change the recording of transactions in relation to these resources quite dramatically. Governments renting out natural resources would become market producers, at least for the activities relating to (the leasing of) natural resources. One also has to figure out how to account for leasing of e.g. mineral and energy resources, the income of which may be (partly) appropriated through joint ventures (equity income) and/or special tax arrangements. On the other hand, various changes in the recording of natural resources are already being proposed, e.g. the split-asset approach, including the accounting for depletion.

94. In Annex 2, the treatment of leasing, as output/intermediate consumption, instead of receipts/payments of rent, is presented in example 5. The example is using example 3 as a starting point. As becomes clear from example 5, it leads to a much more logical way of recording, certainly when also accounting for the costs of depletion/degradation. Obviously, when this treatment would become the preferred option, it would equally apply to land and mineral and energy resources, although one could consider an exception for truly non-produced, non-renewable natural resources whose regeneration cannot be affected by human interventions.

Section 8. Concluding remarks and summary of proposals and requests for feedback

95. This guidance note puts forward a number of proposals for changing the 2008 SNA, which in some cases may also have an impact on SEEA CF. In this section, all proposals are summarised, with more concrete requests for feedback added. To illustrate the proposals, two tables are included in Annex 1, one providing an overview of the guidance in the 2008 SNA, and another one presenting the proposals for changing the treatment of biological resources, including the distinction of a separate asset class for natural resources. At the end of this section, some practical aspects, mainly in terms of possible implementation, are shortly discussed.

[23] Even in the case of land per se, there are clear example of land creation by human intervention. See e.g. the Dutch saying: "God created the earth, but the Dutch created the Netherlands".

96. First of all, this guidance note discusses, in Section 3, the pros and cons of extending the asset boundary for biological resources, in line with SEEA CF. This would come down to an extension of the asset boundary in physical terms, to be included in either the central framework of economic accounts, or in extended accounts or supplementary tables. It would not affect the boundary in monetary terms, but it would involve the recognition of all known biological resources which are owned in one way or another, both individually and collectively, as an asset. It would thus also include resources with zero, or very marginal, monetary benefits in the foreseeable future, albeit that these resources would be recorded with a value of zero.

97. In respect of this issue, it should be acknowledged that it has already been discussed at the 14th meeting of the Advisory Expert Group (AEG) on National Accounts. The AEG *"… 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".*[24] This basically means that there was not much appetite for extending the asset boundary in the system of national accounts.

- ⇨ Question 1: Do you agree with only recording resources with zero, or very marginal, monetary benefits in extended accounts or supplementary tables, in line with SEEA CF, and not in the SNA?

98. In relation to the issue of the distinction between cultivated and non-cultivated, it has been proposed, in Section 4, to first make a distinction between migrating and non-migrating biological resources. For migrating resources, like straddling fish in open waters, it is proposed to always treat them as non-produced assets, as, apart from establishing quota regimes, there is no control and management over the growth of the resources. For the non-migrating resources, it has been proposed to take the continuum from intensely managed to totally undisturbed as a starting point for the recording of biological resources. For these non-migrating resources, the distinction would cease to exist between produced assets and non-produced assets. Ecologically speaking, one could argue that all biological resources are impacted by human activity (directly or indirectly) and are produced, at least to some degree. Output would then be measured as the percentage of natural growth that is expected to be exploited in the foreseeable future. This comes down to an accrual accounting of production, which in the case of non-cultivated assets currently is recorded at the time of removing the biological resources from nature. It would also significantly change the recording of regeneration, depletion and leasing of these resources.

99. The only viable alternative for distinguishing cultivated from non-cultivated resources would be a very strict application of the significance of management practices, in which case the biological resources are only considered as cultivated if they are more or less fully managed. Very intensive human intervention would then only qualify assets as being produced, e.g. for timber resources only plantations would be considered as produced assets, while for aquatic resources only fish farming would qualify as such. All other biological resources, for which management levels are not that intensive, would be recorded as non-produced assets.

100. Having said that, a more far-reaching proposal has also been put forward, in paragraphs 47 and 48 of this Guidance Note, to treat natural resources as a separate class of assets, different from the traditional assets, as currently recommended in the SNA. Such a treatment would not only open the door for not having to make a distinction between produced and non-produced assets. It would also allow for more flexibility in the recording of all flows related to natural resources. Table A.2 in Annex 1 provides a first proposal for such a new class of assets, including the recording of the most relevant flows.

[24] See https://unstats.un.org/unsd/nationalaccount/aeg/2020/M14_Conclusions.pdf.

- ⇨ Question 2: Do you agree that migrating biological resources should always be considered as non-produced assets?
- ⇨ Question 3: Do you agree that in the case of non-migrating biological resources a continuum from intensely managed to totally undisturbed should be taken as a starting point for the recording of biological resources, as a consequence of which the distinction between non-produced assets and produced assets ceases to exist for these resources? If yes, do you agree that these non-migrating biological resources should be treated as produced assets?
- ⇨ Question 4: If you don't agree with the above proposals, how do you want to distinguish, if at all, between cultivated and non-cultivated biological resources? On the basis of a very strict application of the significance of management practices?
- ⇨ Question 5: How do you look upon the proposal to treat natural resources as a separate class of assets, which will also allow for more flexibility in recording of the related flows (to be further elaborated)?

101. Regarding the recording and valuation of biological resources, including the treatment of permits to use them, a number of issues have been discussed in Section 5. First of all, it has been argued that the value, compiled according to the Net Present Value of future resource rents, should be split into a part representing the "pure" (building up of) inventories, and another part representing the underlying asset. Furthermore, it has been argued to classify both parts as biological resources, in separate subcategories, in line with the proposal in Table A.2 in Annex 1.

102. Another quite fundamental question concerns the appropriateness of applying the Net Present Value of resource rents, also in the case of providing (non-transferable) rights to use the resources at a price which is lower than the estimated resource rent, unless the leases are auctioned in a fully competitive environment. Furthermore, assuming the appropriateness of valuing the resources with the Net Present Value method, it has been proposed to introduce a split-asset approach, in line with the recommendations made for mineral and energy resources (see guidance note WS.6). This proposal would also imply the recording of the (partial) handing over of rights to use for free or at prices below the resource rent, as a transfer of non-financial assets with a concomitant capital transfer[25].

- ⇨ Question 6: Do you agree with the interpretation of the Net Present Value of future resource rents as representing both an underlying asset and "pure" inventories, including the consequences for the interpretation of regeneration/natural growth and depletion/ extractions?
- ⇨ Question 7: Do you agree that the Net Present Value of resource rents is an appropriate method for valuing biological resources, also in the case where (non-transferable) rights to use are provided at prices below the resource rent?
- ⇨ Question 8: Do you agree with the split-asset approach, in line with the recommendations for mineral and energy resources?

103. In Section 6, proposals have been included on the recording of depletion (and regeneration) of (non-cultivated) biological resources. It has been proposed to record positive depletion of these resources as a cost of production, while negative depletion, i.e. (net) regeneration of the relevant biological resources, is to be treated as gross fixed capital formation. This depletion would be allocated to the relevant economic agents in proportion to the generated resource rents.

- ⇨ Question 9: Do you agree with the proposal for recording depletion, including the allocation of this depletion to economic agents in proportion to the generated resource rents?

[25] See foot-note 17 for a possible alternative recording, as a reclassification.

- ⇨ Question 10: Do you agree with the recording of (net) regeneration (or negative depletion) as gross fixed capital formation? Or would you prefer a recording as a negative cost element? Moreover, would you prefer a gross recording or a net recording of regeneration and (gross) depletion?

104. Subsequently, in Section 7, it has been proposed to reconsider the difference in treatment between leasing produced assets versus leasing non-produced natural resources. It is recognised that this would constitute a major departure from the 2008 SNA. However, for the arguments mentioned in the relevant section of this guidance note, it is considered important to investigate this potential change in more detail.

- ⇨ Question 11: How do you look upon the proposal to further investigate the need for treating leasing of non-produced assets differently from the leasing of produced assets?

105. In the last decades, the knowledge of, and experience with, accounting for environmental assets has increased significantly, mainly because of implementation of SEEA, including the discussions leading up to the endorsement of the international standards in this area. On various places in the guidance note, references have been made to this guidance. Also questions have been raised about the exact interpretation of the current guidance provided by the 2008 SNA, most often in view of the knowledge that has been built up. So, whatever the opinion regarding the above proposals, it is proposed to add more clarifications on the treatment of biological resources in the update of the 2008 SNA.

- ⇨ Question 12: Do you agree to add more clarifications on the treatment of natural resources in the update of the 2008 SNA?

106. Finally, some remarks on the feasibility of the proposed changes. From a compilation point of view, the proposed changes to the 2008 SNA (and SEEA CF) do not give rise to major additional challenges, as compared to the current international standards, with the (possible) exception of two issues.

107. The first potential issue is related to the proposal to treat all biological resources as being produced, as a consequence of which one would need to make, for assets which are currently considered as non-cultivated biological resources, an estimate of the part of annual growth that will lead to actual production in the foreseeable future. On the other hand, one should also acknowledge that, in the case of accounting for non-cultivated biological resources according to the 2008 SNA, one also has to make an estimate of the resource rents generated from these resources, to arrive at a proper valuation of (the accumulation of) the relevant assets. Any estimating procedure for the future path of these resource rents would involve assumptions about future extractions of e.g. timber.

108. Finally, although the proposals for recording the leasing of biological resources are considered as a correct interpretation of the 2008 SNA and SEEA CF, some will look upon this differently. The main challenges from a compilation perspective may concern the estimation of the handing over of (part of) the biological resources for free, or prices below the resource rent, as a capital transfer. The shares of future resource rents that are being appropriated by the legal owner and the exploiter may not always be that easy to estimate. For further discussion of this problem, reference is made to guidance note WS.6.

Annex 1: Natural resources as a separate class of assets, with a focus on biological resources

Table A.1. The classification of biological resources according to the 2008 SNA

Code	Type of assets	Generation	Run-down	Value of assets	"Ownership"	Leasing
AN1	**Produced non-financial assets**					
AN11	**Fixed assets**					
…	…					
AN115	Cultivated biological resources					
AN1151	Animal resources yielding repeat products	Gross fixed capital formation	Consumption of fixed capital	Market price	Economic owner	Not relevant
AN1152	Tree, crop and plant resources yielding repeat products	Gross fixed capital formation	Consumption of fixed capital	Market price	Economic owner	Not relevant
AN12	**Inventories**					
…	…					
AN1221	Work-in-progress on cultivated biological resources	All changes related to natural growth and regeneration = positive change to inventories	All changes related to extraction and depletion = negative change to inventories	NPV of resource rents *minus* market price of permissions and land	Legal owner	Output (not stated explicitly)
AN2	**Non-produced non-financial assets**					
AN21	**Natural resources**					
AN211	Land					
AN212	Mineral and energy resources					
AN213	Non-cultivated biological resources	All changes related to natural growth and regeneration = positive other change in volume of assets	All changes related to extraction and depletion = negative other change in volume of assets	NPV of resource rents *minus* market price of permissions and land	Legal owner	Rent
AN214	Water resources					
AN215	Other natural resources					
AN2151	Radio spectra					
AN2159	Other					
AN22	**Contracts, leases and licenses**					
…	…					
AN222	Permission to use natural resources	Other change in the volume of assets	Other change in the volume of assets	Market price	Extractor	

Table A.2. Proposal for the classification of biological resources in the 2025 SNA

Code	Type of assets	Generation	Run-down	Value of assets	"Ownership"	Leasing
AN1	**Produced non-financial assets (excluding natural resources)**					
AN2	**Non-produced non-financial assets (excluding natural resources)**					
AN3	**Natural resources**					
AN31	**Land**					
AN32	**Mineral and energy resources**					
AN33	**Biological resources**					
AN331	Biological resources yielding repeat products					
AN3311	Animal resources yielding repeat products	Gross fixed capital formation	Consumption of fixed capital	Market price	Economic owner	Not relevant
AN3312	Tree, crop and plant resources yielding repeat products	Gross fixed capital formation	Consumption of fixed capital	Market price	Economic owner	Not relevant
AN332	Biological resources yielding once-only products					
AN3321	Migrating biological resources yielding once-only products[26]	Negative depletion = gross fixed capital formation	Positive depletion = depletion as a cost of production	NPV of resource rents *minus* value of work-in-progress	Split-asset approach (based on proportion in appropriation of resource rent)	Rent or output (depending on outcome of discussion on rent)
AN3322	Non-migrating biological resources yielding once-only products[27]	Negative depletion = gross fixed capital formation	Positive depletion = depletion as a cost of production	NPV of resource rents *minus* value of work-in-progress	Split-asset approach (based on proportion in appropriation of resource rent)	Rent or output (depending on outcome of discussion on rent)
AN3323	Work-in-progress on non-migrating biological resources	Natural growth = positive change to inventories	Extraction = negative change to inventories	Sum of positive and negative changes to inventories (valued at current prices)	Extractor	Not relevant
AN34	**Water resources**					
AN35	**Other natural resources**					
AN351	Radio spectra					
AN359	Other					

[26] Including permits to use the relevant resources.
[27] Including permits to use the relevant resources.

Annex 2: Recording of biological resources in the system of national accounts

This annex presents five examples for the recording of biological resources. In doing so, a simplified set of assumptions is made, as follows.

General information on the biological resources

1.	Stock of natural resources (at T = 0)		450
2.	Stock of natural resources (at T = 1) in examples 1, 2, 3 and 5		405
	Stock of natural resources (at T = 1) in example 4		465
3.	Resource rent		45
4.	Annual rents paid by the exploiter to government (accrual)		30
5.	Upfront payment of rents paid by the exploiter to government		300
6.	Appropriation of resource rent by the exploiter (= 3 – 4)	15	
7.	Depletion/degradation in examples 1, 2, 3 and 5	45	
	Depletion/degradation in example 4	(minus) 15	

Accounts of the exploiter:

1.	Output	100
2.	Compensation of employees	35
3.	Consumption of fixed capital	20
4.	Resource rent (= 1 – 2 – 3)	45
5.	Annual rents paid to government (accrual)	30
6.	Upfront payment of rents paid to government	300
7.	Stock of fixed assets (at T = 0)	200
8.	Stock of fixed assets (at T = 1)	180
9.	Cash flow (= 1 – 2 – 6)	-
	235	

Accounts of the legal owner (i.e., government):

1.	Annual rents received from the exploiter (accrual)	30
2.	Upfront receipt of rents from the exploiter	300
3.	Cash flow (= 2)	300

As can be derived from the numbers in the above, for reasons of keeping the example simple, the return on capital, including natural resources, is set equal to zero. Furthermore, it shows that the legal owner appropriates 2/3 of the resource rent derived from exploiting the resources, while the exploiter appropriates 1/3 of the related resource rent.

Furthermore, it is assumed that the transfer of rights takes place at the beginning of year 1. As a consequence, the amounts of natural resources and other accounts receivable/payable are affected by the initial transfer as well as the annual depletion/degradation and the annual payment of rent (accrual).

In the elaboration of the recordings below, both the accounts of the exploiter and those of the legal owner (i.e., government) are shown.

Example 1

Allocation of biological resources to legal owner, recording depletion/degradation as an other change in the volume of assets (recording according to 2008 SNA)

Accounts for the exploiter of natural resources

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Net operating surplus	45		

Distribution of income account

Rent on natural resources	30	Net operating surplus	45
Net saving	15		

Capital account

Acquistion of assets	0	Net saving	15
Consumption of fixed capital	-20	Net capital transfers received	0
Net lending/borrowing	35	Changes in NW due to saving and CT	15

Financial account

Cash	-235	Net lending/net borrowing	35
Other acocunts receivable/payable	270		

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	-235	Net worth	200	215
Other acocunts receivable/payable	0	270			
Fixed assets	200	180			
Natural resources (or permits)	0	0			
Total	200	215	Total	200	215

Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	30
Net saving	30		

Capital account

Acquistion of assets	0	Net saving	30
Consumption of fixed capital	0	Net capital transfers received	0
Net lending/borrowing	30	Changes in NW due to saving and CT	30

Financial account

Cash	300	Net lending/net borrowing	30
		Other accounts receivable/payable	270

Other changes in the volume of assets account

Depletion/Degradation of natural resources	-45	Changes in NW due to other changes in assets	-45

Balance sheet

Cash	0	300	Other accounts receivable/payable	0	270
Fixed assets	0	0	Net worth	450	435
Natural resources	450	405			
Total	450	705	Total	450	705

Example 2

Allocation of biological resources to legal owner and exploiter, based on the share of returns (split-asset approach), recording depletion/degradation as an other change in the volume of assets

Accounts for the exploiter of natural resources

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Net operating surplus	45		

Distribution of income account

Rent on natural resources	30	Net operating surplus	45
Net saving	15		

Capital account

Acquistion of assets	150	Net saving	15
Consumption of fixed capital	-20	Net capital transfers received	150
Net lending/borrowing	35	Changes in NW due to saving and CT	165

Financial account

Cash	-235	Net lending/net borrowing	35
Other acocunts receivable/payable	270		

Other changes in the volume of assets account

Depletion/Degradation of natural resources	-15	Changes in NW due to other changes in assets	-15

Balance sheet

Cash	0	-235	Net worth	200	350
Other acocunts receivable/payable	0	270			
Fixed assets	200	180			
Natural resources (or permits)	0	135			
Total	200	350	Total	200	350

Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	30
Net saving	30		

Capital account

Acquistion of assets	-150	Net saving	30
Consumption of fixed capital	0	Net capital transfers received	-150
Net lending/borrowing	30	Changes in NW due to saving and CT	-120

Financial account

Cash	300	Net lending/net borrowing	30
		Other accounts receivable/payable	270

Other changes in the volume of assets account

Depletion/Degradation of natural resources	-30	Changes in NW due to other changes in assets	-30

Balance sheet

Cash	0	300	Other accounts receivable/payable	0	270
Fixed assets	0	0	Net worth	450	300
Natural resources	450	270			
Total	450	570	Total	450	570

Example 3

Allocation of biological resources to legal owner and exploiter, based on the share of returns (split-asset approach), including accounting for depletion/degradation (positive depletion of 45)

Accounts for the exploiter of natural resources

Production and generation of income account

Compensation of employees	35	Output	100
Consumption of fixed capital	20		
Depletion/degradation of natural resources	45		
Net operating surplus	0		

Distribution of income account

Rent on natural resources	30	Net operating surplus	0
Depletion/degradation borne by government	-30		
Net saving	0		

Capital account

Acquistion of assets	150	Net saving	0
Consumption of fixed capital	-20	Net capital transfers received	150
Depletion/degradation of natural resources	-15		
Net lending/borrowing	35	Changes in NW due to saving and CT	150

Financial account

Cash	-235	Net lending/net borrowing	35
Other acocunts receivable/payable	270		

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	-235	Net worth	200	350
Other acocunts receivable/payable	0	270			
Fixed assets	200	180			
Natural resources (or permits)	0	135			
Total	200	350	Total	200	350

Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	0
Consumption of fixed capital	0		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
		Rent on natural resources	30
		Depletion/degradation borne by government	-30
Net saving	0		

Capital account

Acquistion of assets	-150	Net saving	0
Consumption of fixed capital	0	Net capital transfers received	-150
Depletion/degradation of natural resources	-30		
Net lending/borrowing	30	Changes in NW due to saving and CT	-150

Financial account

Cash	300	Net lending/net borrowing	30
		Other accounts receivable/payable	270

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	300	Other accounts receivable/payable	0	270
Fixed assets	0	0	Net worth	450	300
Natural resources	450	270			
Total	450	570	Total	450	570

Example 4

Allocation of biological resources to legal owner and exploiter, based on the share of returns (split-asset approach), including accounting for depletion/degradation (negative depletion of 15)

Accounts for the exploiter of natural resources

Production and generation of income account

Compensation of employees	35	Output (products)	100
Consumption of fixed capital	20	Output (GFCF in biological resources)	5
Depletion/degradation of natural resources	0		
Net operating surplus	50		

Distribution of income account

Rent on natural resources	30	Net operating surplus	50
Depletion/degradation borne by government	0		
Net saving	20		

Capital account

Acquistion of assets	150	Net saving	20
Gross fixed capital formation	5	Net capital transfers received	150
Consumption of fixed capital	-20		
Depletion/degradation of natural resources	0		
Net lending/borrowing	35	Changes in NW due to saving and CT	170

Financial account

Cash	35	Net lending/net borrowing	35

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	-235	Net worth	200	370
Other accounts receivable/payable	0	270			
Fixed assets	200	180			
Natural resources (or permits)	0	155			
Total	200	370	Total	200	370

Accounts for the government

Production and generation of income account

Compensation of employees	0	Output (GFCF in biological resources)	10
Consumption of fixed capital	0		
Net operating surplus	10		

Distribution of income account

		Net operating surplus	10
		Rent on natural resources	30
		Depletion/degradation borne by government	0
Net saving	40		

Capital account

Acquistion of assets	-150	Net saving	40
Gross fixed capital formation	10	Net capital transfers received	-150
Consumption of fixed capital	0		
Depletion/degradation of natural resources	0		
Net lending/borrowing	30	Changes in NW due to saving and CT	-110

Financial account

Cash	300	Net lending/net borrowing	30
		Other accounts receivable/payable	270

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	300	Other accounts receivable/payable	0	270
Fixed assets	0	0	Net worth	450	340
Natural resources	450	310			
Total	450	610	Total	450	610

Example 5

Allocation of biological resources to legal owner and exploiter, based on the share of returns (split-asset approach), including accounting for depletion/degradation (positive depletion of 45), and recording rent as output

Accounts for the exploiter of natural resources

Production and generation of income account

Intermediate consumption	30	Output	100
Compensation of employees	35		
Consumption of fixed capital	20		
Depletion/degradation of natural resources	15		
Net operating surplus	0		

Distribution of income account

Rent on natural resources	0	Net operating surplus	0
Depletion/degradation borne by government	0		
Net saving	0		

Capital account

Acquistion of assets	150	Net saving	0
Consumption of fixed capital	-20	Net capital transfers received	150
Depletion/degradation of natural resources	-15		
Net lending/borrowing	35	Changes in NW due to saving and CT	150

Financial account

Cash	-235	Net lending/net borrowing	35
Other acocunts receivable/payable	270		

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	-235	Net worth	200	350
Other acocunts receivable/payable	0	270			
Fixed assets	200	180			
Natural resources (or permits)	0	135			
Total	200	350	Total	200	350

Accounts for the government

Production and generation of income account

Compensation of employees	0	Output	30
Consumption of fixed capital	0		
Depletion/degradation of natural resources	30		
Net operating surplus	0		

Distribution of income account

		Net operating surplus	0
Net saving	0		

Capital account

Acquistion of assets	-150	Net saving	0
Consumption of fixed capital	0	Net capital transfers received	-150
Depletion/degradation of natural resources	-30		
Net lending/borrowing	30	Changes in NW due to saving and CT	-150

Financial account

Cash	300	Net lending/net borrowing	30
		Other accounts receivable/payable	270

Other changes in the volume of assets account

Depletion/Degradation of natural resources	0	Changes in NW due to other changes in assets	0

Balance sheet

Cash	0	300	Other accounts receivable/payable	0	270
Fixed assets	0	0	Net worth	450	300
Natural resources	450	270			
Total	450	570	Total	450	570

Annex 3: Relevant guidance included in SNA 2008, SEEA 2012 Central Framework, SEEA Ecosystem Accounting, and other documentation

SNA 2008

1.43 Certain natural processes may or may not be counted as production depending upon the circumstances in which they occur. A necessary condition for an activity to be treated as productive is that it must be carried out under the instigation, control and responsibility of some institutional unit that exercises ownership rights over whatever is produced. For example, the natural growth of stocks of fish in the high seas not subject to international quotas is not counted as production: the process is not managed by any institutional unit and the fish do not belong to any institutional unit. On the other hand, the growth of fish in fish farms is treated as a process of production in much the same way that rearing livestock is a process of production. Similarly, the natural growth of wild, uncultivated forests or wild fruits or berries is not counted as production, whereas the cultivation of crop-bearing trees, or trees grown for timber or other uses, is counted in the same way as the growing of annual crops. However, the deliberate felling of trees in wild forests, and the gathering of wild fruit or berries, and also firewood, counts as production. Similarly, rainfall and the flow of water down natural watercourses are not processes of production, whereas storing water in reservoirs or dams and the piping, or carrying, of water from one location to another all constitute production.

1.44 These examples show that many activities or processes that may be of benefit to institutional units, both as producers and consumers, are not processes of production in an economic sense. Rainfall may be vital to the agricultural production of a country but it is not a process of production whose output can be included in GDP.

1.46 Balance sheets are compiled for institutional units, or sectors, and record the values of the assets they own or the liabilities they have incurred. Assets as defined in the SNA are entities that must be owned by some unit, or units, and from which economic benefits are derived by their owner(s) by holding or using them over a period of time. Financial assets and fixed assets, such as machinery, equipment and structures which have themselves been produced as outputs in the past, are clearly covered by this definition. However, the ownership criterion is important for determining which natural resources are treated as assets in the SNA. Natural resources such as land, mineral deposits, fuel reserves, uncultivated forests or other vegetation and wild animals are included in the balance sheets provided that institutional units are exercising effective ownership rights over them, that is, are actually in a position to be able to benefit from them. Assets need not be privately owned and could be owned by government units exercising ownership rights on behalf of entire communities. Thus, many environmental assets are included within the SNA. Resources such as the atmosphere or high seas, over which no ownership rights can be exercised, or mineral or fuel deposits that have not been discovered or that are unworkable, are not included as they are not capable of bringing any benefits to their owners, given the technology and relative prices existing at the time.

2.60 Assets and liabilities are recorded at current values at the time to which the balance sheet relates, not at their original valuation. Theoretically, national accounts are based on the assumption that the values of assets and liabilities are continuously up-rated to current values, even if in fact uprating occurs only periodically. The appropriate valuation basis for assets and liabilities is the value at which they might be bought in markets at the time the valuation is required. Ideally, values observed in markets or estimated from observed market values should be used. When this is not possible, current values may be approximated for balance sheet valuation in two other ways, by accumulating and revaluing transactions over time or by estimating the discounted present value of future returns expected from a given asset (see also chapter 13).

3.30 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. It is a means of carrying forward value from one accounting period to another.

6.24 Economic production may be defined as an activity carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services. … A purely natural process without any human involvement or direction is not production in an economic sense. For example, the unmanaged growth of fish stocks in international waters is not production, whereas the activity of fish farming is production.

6.136 The growth and regeneration of crops, trees, livestock or fish which are controlled by, managed by and under the responsibility of institutional units constitute a process of production in an economic sense. Growth is not to be construed as a purely natural process that lies outside the production boundary. Many processes of production exploit natural forces for economic purposes, for example, hydroelectric plants exploit rivers and gravity to produce electricity.

6.138 Some plants and many animals take some years to reach maturity. In this case, the increase in their value is shown as output and treated as increases in fixed capital or inventories depending on whether the plant or animal yields repeat products or not. (There is more discussion of this distinction in chapter 10.) The value of the increase in the plants or animals should take account of the delay before the yield from them is realized as explained in chapter 20. Once the plant or animal has reached maturity, it will decline in value and this decline should be recorded as consumption of fixed capital.

7.153 The distinction between rent and the rentals receivable and payable under operating leases is basic to the SNA as rent is a form of property income and rentals are treated as sales or purchases of services. Rentals are payments made under an operating lease to use a fixed asset belonging to another unit where that owner has a productive activity in which the fixed assets are maintained, replaced as necessary and made available on demand to lessees. Rent is a payment made under a resource lease for the use of a natural resource. Not only is the type of asset leased different as between rent and rentals, so is the nature of the lease. The distinction between different types of leases is explained in part 5 of chapter 17.

7.154 Rent is the income receivable by the owner of a natural resource (the lessor or landlord) for putting the natural resource at the disposal of another institutional unit (a lessee or tenant) for use of the natural resource in production. Two particular cases of resource rent are considered, rent on land and rent on subsoil resources. Resource rent on other natural resources follows the pattern laid out by these two instances.

10.167 Only those naturally occurring resources over which ownership rights have been established and are effectively enforced can therefore qualify as economic assets and be recorded in balance sheets. They do not necessarily have to be owned by individual units, and may be owned collectively by groups of units or by governments on behalf of entire communities. Certain naturally occurring resources, however, may be such that it is not feasible to establish ownership over them: for example, air, or the oceans. In addition, there may be others that cannot be treated as economic assets because they do not actually belong to any particular units. These include not only those whose existence is unknown but also those, including uncultivated forests, that may be known to exist but remain so remote or inaccessible that, in practice, they are not under the effective control of any units.

10.182 Non-cultivated biological resources consist of animals, birds, fish and plants that yield both once-only and repeat products over which ownership rights are enforced but for which natural growth or regeneration is not under the direct control, responsibility and management of institutional units.

Examples are virgin forests and fisheries within the territory of the country. Only those resources that are currently, or are likely soon to be, exploitable for economic purposes should be included.

10.183 In the SEEA, this category is further split into aquatic resources, animal resources other than aquatic resources, tree, crop and plant resources. Aquatic resources are further split into aquatic resources in national waters including the exclusive economic zone (EEZ) and those in the high seas.

10.191 Permits to use natural resources are third-party property rights relating to natural resources. An example is where a person holds a fishing quota and he is able, again both legally and practically, to sell this to another person.

12.19 The natural growth of uncultivated biological resources, such as natural forests and fish stocks, may take various forms: a stand of natural timber may grow taller, or fish in the estuaries may become more numerous. Although these resources are economic assets, growth of this kind is not under the direct control, responsibility and management of an institutional unit and thus is not treated as production. The increment in the asset must then be regarded as an economic appearance, and it is recorded in the other changes in the volume of assets account.

12.20 In principle, natural growth should be recorded gross, and the depletion of these resources should be recorded as economic disappearance, as described below. This recording would be consistent with the separate recording of acquisitions and disposals described in the capital account. In practice, however, many countries will record natural growth net because the physical measures that are likely to be the only basis available for the recording are, in effect, net measures. These measures may be used in conjunction with a market price for a unit of the asset to estimate the value of the volume change to be recorded.

12.27 The depletion of natural forests, fish stocks in the open seas and other uncultivated biological resources included in the asset boundary as a result of harvesting, forest clearance, or other use beyond sustainable levels of extraction should be included here.

13.18 Ideally, observable market prices should be used to value all assets and liabilities in a balance sheet. However, in estimating the current market price for balance sheet valuation, a price averaged over all transactions in a market can be used if the market is one on which the items in question are regularly, actively and freely traded. When there are no observable prices because the items in question have not been purchased or sold on the market in the recent past, an attempt has to be made to estimate what the prices would be were the assets to be acquired on the market on the date to which the balance sheet relates.

13.19 In addition to values observed in markets or estimated from observed prices, values may be approximated for balance sheet valuation in two other ways. In some cases, values may be approximated by accumulating and revaluing acquisitions less disposals of the type of asset in question over its lifetime and adjusted for changes such as consumption of fixed capital; this generally is the most practical and also the preferred method for fixed assets, but it can be applied to other assets as well. In other cases, values may be approximated by the present, or discounted, value of future economic benefits expected from a given asset; this is the case for a number of financial assets, natural resources and even for fixed assets. With good information and efficient markets, the values of the assets obtained by accumulating and revaluing transactions should equal, or at least approximate, both the present, or discounted, value of the remaining future benefits to be derived from them and their market values when active second-hand markets exist. These three price bases are discussed below in general terms.

13.20 The ideal source of price observations for valuing balance sheet items is a market, like the stock exchange, in which each asset traded is completely homogeneous, is often traded in considerable volume and has its market price listed at regular intervals. Such markets yield data on prices that can be multiplied by indicators of quantity in order to compute the total market value of different classes of assets held by sectors and of different classes of their liabilities. These prices are available for nearly all financial claims, existing transportation equipment, crops, and livestock as well as for newly produced fixed assets and inventories.

13.21 For securities quoted on a stock exchange, for example, it is feasible to gather the prices of individual assets and of broad classes of assets and, in addition, to determine the global valuation of all the existing securities of a given type. In some countries, another example of a market in which assets may be traded in sufficient numbers to provide useful price information is the market for existing dwellings.

13.22 In addition to providing direct observations on the prices of assets actually traded there, information from such markets may also be used to price similar assets that are not traded. For example, information from the stock exchange also may be used to price unlisted shares by analogy with similar, listed shares, making some allowance for the inferior marketability of the unlisted shares. Similarly, appraisals of assets for insurance or other purposes generally are based on observed prices for items that are close substitutes, although not identical, and this approach can be used for balance sheet valuation. For a discussion of the special valuation problems associated with direct investment enterprises, see chapters 21 and 26.

13.23 Most non-financial assets change in value year by year reflecting changes in market prices. At the same time, initial acquisition costs are reduced by consumption of fixed capital (in the case of fixed assets) or other forms of depreciation over the asset's expected life. The value of such an asset at a given point in its life is given by the current acquisition price of an equivalent new asset less the accumulated depreciation. This valuation is sometimes referred to as the "written-down replacement cost". When reliable, directly observed prices for used assets are not available, this procedure gives a reasonable approximation of what the market price would be were the asset to be offered for sale.

13.24 In the case of assets for which the returns either are delayed (as with forests) or are spread over a lengthy period (as with subsoil assets), although market prices are used to value the ultimate output, a rate of discount must, in addition, be used to compute the present value of the expected future returns.

13.41 Standing single-use crops (including timber) cultivated by human activity and livestock being raised for slaughter are also counted as inventories in work-in-progress. The conventional way of valuing standing timber is to discount the future proceeds of selling the timber at current prices after deducting the expenses of bringing the timber to maturity, felling, etc. For the most part, other crops and livestock can be valued by reference to the prices of such products on markets.

13.51 Non-cultivated biological resources, water and other natural resources are included in the balance sheet to the extent that they have been recognized as having economic value that is not included in the value of the associated land. As observed prices are not likely to be available, they are usually valued by the present value of the future returns expected from them.

17.310 A resource lease is an agreement whereby the legal owner of a natural resource that the SNA treats as having an infinite life makes it available to a lessee in return for a regular payment recorded as property income and described as rent. The resource continues to be recorded on the balance sheet

of the lessor even though it is used by the lessee. By convention, no decline in value of a natural resource is recorded in the SNA as a transaction similar to consumption of fixed capital.

17.311 The classic case of an asset subject to a resource lease is land but natural resources are also generally treated in this way. An exception, when a long-term lease of land may be taken as the sale of the land is described in paragraph 17.328.

17.312 Payments due under a resource lease, and only such payments, are recorded as rent in the SNA. There is further discussion of leases on natural resources in the following section.

17.313 As noted above, in many countries permits to use natural resources are generally issued by government since government claims ownership of the resources on behalf of the community at large. However, the same treatments apply if the resources are privately owned.

17.314 There are basically three different sets of conditions that may apply to the use of a natural resource. The owner may permit the resource to be used to extinction. The owner may allow the resource to be used for an extended period of time in such a way that in effect the user controls the use of the resource during this time with little if any intervention from the legal owner. The third option is that the owner can extend or withhold permission to continued use of the asset from one year to the next.

17.315 The first option results in the sale (or possibly an expropriation) of the asset. The second option leads to the creation of an asset for the user, distinct from the resource itself but where the value of the resource and the asset allowing use of it are linked. The third option comes back to the treatment of the use as a resource lease. The difference in treatment between the second and third options was articulated in the context of the case of a mobile phone licence and that recommendation (see SNA News and Notes Volume 14, (United Nations, 2002)) is recapitulated before seeing how each of the three options relates to different types of natural resources.

17.329 If a unit is given permission to clear fell an area of natural forest, or to fell at its discretion without any restriction in perpetuity, the payments made to the owner constitute the sale of an asset. (The sale of forested land may be recorded as the sale of the timber and the land separately, depending on the intended use of each.)

17.330 The option to have a lease permitting felling at the lessee's discretion but subject to the restoration of the land, in an acceptable forested state, at some time in the future is improbable. It is more common for timber felling to be allowed under strict limits with a fee payable per unit volume of timber felled (stumpage). The limits are usually such that the harvest of timber is sustainable and so the payments are recorded as rent in the case of a natural forest.

17.331 Forests may also be produced assets, in which case the extraction of timber is treated as the sale of a product.

17.332 Illegal logging across national borders is prevalent in some countries. In such cases the quantity of timber extracted should be recorded as uncompensated seizure of a natural resource or cultivated asset, as the case may be.

17.333 Natural stocks of fish with an economic value are an asset and the same considerations apply to them as to other natural resources. It is not realistic to consider that permission would be given to exhaust fish stocks but illegal fishing may either reduce the stock below the point of sustainability or exhaust them altogether. In these cases, uncompensated seizure of the stock should be recorded.

17.334 Fishing quotas may be allocated in perpetuity or for extended periods to particular institutional units, for example, where fishing is an established way of life and there may be little alternative economic employment. In such circumstances the quotas may be transferable and if so, there may be a well-developed market in them. Fishing quotas may therefore be considered as permits to use a natural resource that are transferable. They are thus assets in the SNA.

17.335 An alternative regime is to issue a permit for a strictly limited period of time, less than a year, to a nominated institutional unit, often a non-resident. This is a common practice in some islands in the South Pacific, for example. In these cases the revenue from the licences should be recorded as rent as under a resource lease.

17.336 A licence for recreational fishing has long been considered, by convention, as payment of a tax. This treatment is not changed by the wider considerations for commercial fishing.

17.345 Within the SNA, even though the asset may be owned by different units at different times, when a balance sheet is drawn up, the whole of the value of the asset is attributed to one unit. For an asset subject to an operating lease, there is no ambiguity. The legal owner is also the economic owner and is the unit that shows the asset on its balance sheet. For an asset subject to a financial lease, the unit showing the asset on its balance sheet is the economic owner. The value of the asset is the present value of the future payments due to the legal owner plus the value of the asset at the end of the lease as specified in the lease agreement. This is consistent with the views that the value of the asset represents the stream of future benefits coming from the asset and the economic owner is the unit entitled to receive these benefits in return for accepting the risks associated with using the asset in production. For an asset subject to a resource lease, the value is shown on the balance sheet of the legal owner.

17.346 When licences to use natural resources such as radio spectra, land, timber and fish satisfy the "mobile phone" criteria, a separate asset, described as a permit to use a natural resource, is established. These assets are part of the subclass of contracts, leases and licences. They are then shown on the balance sheet of the licensee.

17.358 A permit issued by government to undertake a specific activity may be treated as an asset only when all the following conditions are satisfied:
a. The activity concerned does not utilize an asset belonging to government; if it does the permission to use the asset is treated as an operating lease, a financial lease, a resource lease or possibly the acquisition of an asset representing permission to use the asset at the discretion of the licensee over an extended period;
b. The permit is not issued subject to a qualifying criterion; such permits are treated as either taxes or payments for services;
c. The number of permits is limited and so allows the holder to make monopoly profits when undertaking the activity concerned;
d. The permit holder must be legally and practically able to sell the permit to a third party.

17.359 Even if all these conditions are satisfied, if in practice the permits are not on-sold, it is not relevant to record the permits as assets. If any of the conditions is not satisfied, the payments are treated as taxes without the creation of an asset in the category of contracts, leases and licences. …

SEEA 2012 Central Framework

2.17 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. Although they are naturally occurring, many environmental assets are transformed to varying degrees by economic activities. In the SEEA, environmental assets are considered from two perspectives. In the Central Framework, the focus is on individual components of the environment that provide materials and space to all economic activities. Examples include mineral and energy resources, timber resources, water resources and land.

4.178 Fishing quotas established by national and international agreement may be allocated in perpetuity or for extended periods to particular institutional units. In such circumstances, the quotas may be transferable and, if so, there may be a well-developed market for them. Fishing quotas may therefore be considered permits to use a natural resource that are transferable and in these situations, the quotas are considered assets in their own right.

4.179 Under an alternative regime, a permit is issued for a strictly limited period of time, less than a year, to a nominated institutional unit, often a non-resident. This is a common practice in some islands in the South Pacific, for example. In these cases, the revenue from the licences should be recorded as rent in the allocation of primary income account.

4.180 A licence granted to a household for recreational fishing is considered, by convention, as payment of a tax.

5.26 The cultivation of biological resources can take a wide range of forms. In some cases, the management activity is highly involved, which is the case for battery farming of chickens and the use of greenhouses for horticultural production. In these situations, the unit undertaking the production creates a controlled environment, distinct from the broader biological and physical environment.

5.27 In other cases, there may be relatively little active management as is the case, for example, with broad-acre cattle farming and the growing of plantation timber. In these cases, the biological resource is exposed constantly to, and interacts as a part of, the broader biological and physical environment. There are also situations in which the cultivation of various areas over hundreds of years has transformed the natural environment.

5.28 In practice, it may be difficult to distinguish between cultivated and natural biological resources. Relevant considerations in relation to timber resources and aquatic resources are presented in sections 5.8 and 5.9.

5.31 In principle, all of the benefits delivered by environmental assets can be valued in monetary terms. However, many complexities are associated with undertaking these broad valuations, including the quantification of the benefits themselves and the consideration of the value of benefits to society as a whole rather than only to individuals. These measurement issues are not discussed further in the Central Framework.

5.32 In the Central Framework, consistent with the SNA, the scope of valuation is limited to the benefits that accrue to economic owners. An economic owner is the institutional unit entitled to claim the benefits associated with the use of an asset in the course of an economic activity by virtue of accepting the associated risks. Further, following the SNA, 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.

Examples of economic assets include houses, office buildings, machines, computer software, financial assets, and many environmental assets.

5.33 The benefits underlying the definition of economic assets are economic benefits. Economic benefits reflect a gain or positive utility arising from economic production, consumption or accumulation. For environmental assets, economic benefits are recorded in the accounts in the form of operating surplus from the sale of natural resources and cultivated biological resources, in the form of rent earned on permitting the use or extraction of an environmental asset, or in the form of net receipts (i.e., excluding transaction costs) when an environmental asset (e.g., land) is sold.

5.38 In physical terms, the scope of environmental assets measured in the Central Framework may be greater than the scope of environmental assets measured in monetary terms following the SNA definition of economic assets. This is because there is no requirement in physical terms that environmental assets must deliver economic benefits to an economic owner. For example, remote land and timber resources should be included within the scope of the environmental assets of a country even if they do not currently or are not expected to deliver benefits to an economic owner.

5.39 In physical terms, the scope of environmental assets measured in the Central Framework may be greater than the scope of environmental assets measured in monetary terms following the SNA definition of economic assets. This is because there is no requirement in physical terms that environmental assets must deliver economic benefits to an economic owner. For example, remote land and timber resources should be included within the scope of the environmental assets of a country even if they do not currently or are not expected to deliver benefits to an economic owner.

5.40 Consequently, there may be environmental assets that are recorded in the Central Framework in physical terms which have no measured monetary value and are therefore excluded from environmental assets measured in monetary terms. Where such assets are recorded in physical terms, the quantities should be recorded separately from quantities of environmental assets that do deliver economic benefits to economic owners.

5.128 The access price method is based on the fact that access to resources may be controlled through the purchase of licences and quotas, as is commonly observed in the forestry and fishing industries. When these resource access rights are freely traded, it is possible to estimate the value of the relevant environmental asset from the market prices of the rights. The economic logic parallels the residual value method, since it is expected that, in a free market, the value of the rights should be equivalent to the future returns from the environmental asset (after deducting all costs, including user costs of produced assets).

5.129 Where the resource access rights that are purchased provide a very long term or indefinite access to the assets, the market value of the rights should provide a direct estimate of the total value of the asset rather than simply an estimate of the resource rent. In this case, no discounting of future flows of resource rent is needed. If the rights are for a more limited period (e.g., for one year in the case of entitlements), this can provide a direct estimate of the resource rent for that period.

5.130 In practice, in many cases governments may give the access rights direct to extractors for free or do so at a price that is less than the true market value. Further, trading of the rights may be restricted or prohibited. In these cases, there is no directly observable market valuation.

5.346 Timber resources may be found in a wide variety of places and may or may not be available to be felled and used as wood supply, i.e., to produce timber products or as fuelwood. Timber resources may not be available for wood supply due to the fact that the trees (i) are in areas in which logging

operations are restricted or prohibited; (ii) are in areas that are inaccessible or remote and hence where logging is not economically viable; or (iii) do not, from a biological perspective, belong to a commercially useful species.

5.347 While the timber resources that are not available for wood supply do not have an economic value, these timber resources remain in scope of timber resources in the SEEA in physical terms, as they fulfil the definition of environmental assets and may provide benefits. However, since these timber resources do not have an economic value, they are not recorded in the asset accounts for timber resources in monetary terms. Consequently, the volume of these timber resources in physical terms should be clearly identified so that appropriate alignment can occur between asset accounts in physical and monetary terms.

5.349 Timber resources are also found in other areas such as in orchards, rubber plantations, along roadsides and train tracks, and in city parks. Conceptually, the timber resources in all of these areas are also within the measurement scope of the SEEA. In practice, countries should determine the scope of their timber resource accounts based on the relative importance of the types of areas that provide timber resources. Timber resources from different types of areas should be clearly differentiated.

5.354 The treatment of timber resources as either cultivated or natural depends on the management practices applied to the areas in which timber resources are found. For timber resources to be classed as cultivated, the management practices must constitute a process of economic production. This is likely to include activities such as (a) control of regeneration, for example, seeding, planting of saplings, thinning of young stands; and (b) regular and frequent supervision of trees to remove weeds or parasites, or to attend to disease. The level of these types of activity should be significant relative to the value of the timber resources and should be directly connected with the growth of the timber resources in question.

5.355 In practice, a common initial basis for the determination of whether timber resources are cultivated or natural is the type of land on which the timber resources are found. For example, for forest land, those timber resources within primary forests would generally be considered natural timber resources, whereas those timber resources in plantations would be generally considered cultivated timber resources.

5.356 However, the rules by which different areas of forest land are differentiated may not align neatly to the production boundary of the SEEA. For example, pursuant to applying the definitions of different forest land as presented in section 5.6.4: as soon as primary forest is logged for the first time, it becomes other naturally regenerated forest and hence falls into a category of forest land that is likely to be a mixture of land under active management and control, and land in which human intervention is relatively infrequent. Also, in some countries, there are large areas of planted forests that are not managed directly or frequently where the trees are left to grow until ready to harvest. These trees would be considered natural timber resources following the SEEA production boundary, even though the term "planted forests" may immediately suggest a high level of economic activity.

5.357 Given the potential for forestry management practices to vary considerably across and within countries, it is recommended that countries determine the status of their timber resources as either natural or cultivated based on application of the production boundary considerations listed above. This process is likely to require assessment by type of area in which timber resources are found, including forest land, other wooded land and other land with wood supply.

5.393 Aquatic resources are an important biological resource. They include fish, crustaceans, molluscs, shellfish and other aquatic organisms such as sponges and seaweed, as well as aquatic mammals such

as whales. Aquatic resources are subject to harvest for commercial reasons as well as in the context of subsistence and recreational fishing activities. ….

5.394 In most parts of the world, fishing capacity has reached a level where unrestricted fishing will result in over-exploitation and lead to smaller catches and economic benefits than would be possible if the catch was managed in such a way as to prevent over-exploitation. In extreme cases, there is the risk of commercial extinction of some aquatic resources with attendant impacts on the aquatic ecosystem.

5.395 Asset accounts for aquatic resources organize information on the stocks and changes in stocks of the quantity and value of aquatic resources within a country's economic territory, including stocks within a country's EEZ or on the high seas over which the country holds ownership rights. In principle, all aquatic resources are in scope of the asset accounts in the Central Framework; but in practice, the scope is limited to those aquatic resources that are subject to commercial activity. Asset accounts cover both cultivated aquatic resources and natural aquatic resources, thus enabling a comparison of trends in both resources.

5.398 The aquatic resources for a given country comprise those resources that are considered to live within the exclusive economic zone (EEZ) of a country throughout their life cycles, in both coastal and inland fisheries. Migrating and straddling fish stocks are considered to belong to a country during the period when those stocks inhabit its EEZ.

5.399 When exploitation control over migrating and straddling fish stocks, and fish stocks that complete their life cycle in international waters (high seas), has been established and the access rights of a country to them are defined in international agreements, that portion of agreed access rights to those aquatic resources can be considered to belong to the country.

5.400 In some cases, international agreements specify explicitly the share of total catches that should be allocated to each country. When this is the case, each country's share of the stock of the common aquatic resource can be determined on the same basis. In the absence of specific information about the share of the common aquatic resource, the catch realized by a given country can be used as an indicator of the country's share.

5.408 The production boundary includes all activities carried out under the responsibility, control and management of a resident institutional unit in which labour and assets are used to transform inputs of goods and services into outputs of other goods and services. In the case of aquatic resources, the growth of fish in fish farms and other aquaculture facilities is treated as a process of production.

5.409 Aquaculture is defined by FAO as follows: Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms that are harvested by an individual or corporate body that has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms that are exploitable by the public as a common property resource, with or without appropriate licences, are the harvest of the fisheries.

5.410 Following the FAO definition of aquaculture, all aquatic resources produced within aquaculture facilities are considered cultivated biological resources. All other aquatic resources harvested as part of capture production processes are considered natural biological resources. In some cases, the life cycle of aquatic resources may start in an aquaculture establishment before transfer to the wild. In

other cases, fish are captured in the wild for further growth in aquaculture facilities. Following standard methods, the proportion of growth in the wild and the proportion of growth in aquaculture facilities should be separated and classified appropriately.

5.450 In theory, the value of the quota represents the NPV of the owner's expected income using the quota over its period of validity. If the aquatic resource is managed with such quotas and the quotas are valid in perpetuity, then the value of all quotas, at the market price, should be equal to the value of the aquatic resource.

SEEA Ecosystem Accounting

1.38 In broad terms, the connection between SEEA EA and the SNA lies in the application and adaptation of the national accounting concepts and principles for the purpose of accounting for ecosystem assets and their services. A summary of the most relevant concepts and principles is provided in Chapter 2. The SEEA, encompassing the SEEA Central Framework and the SEEA EA, provides a system that complements the SNA by using the same accounting principles to integrate physical and monetary measures concerning the environment in a way that allows for comparison to the data from the national accounts.

1.39 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). In addition, a key difference between the SEEA EA and the SNA lies in the measurement of ecosystem services. In the SNA, these flows are outside the production boundary that establishes the set of goods and services that are the focus of measures of output, value added and gross domestic product (GDP). The measurement of ecosystem services in both physical and monetary terms through ecosystem accounting thus provides measures that complement the estimates of output based on the SNA production boundary.

1.40 Further, the SEEA EA provides an approach to valuing the contribution of ecosystems consistent with SNA concepts and principles such that the monetary values can be used to provide complementary aggregates, such as of value added and wealth that take into account the supply and use of ecosystem services and are adjusted for ecosystem degradation and enhancement.

1.41 The derivation of complementary aggregates can be presented through a sequence of institutional sector accounts and balance sheets that build on the similarly labelled accounts in the SNA. Chapter 11 describes how these derivations can be undertaken. Two key aspects are that: (i) the degradation is allocated to the economic unit who suffers the loss of ecosystem services rather than to the economic unit who causes the degradation;[28] and (ii) a non-SNA quasi-sector labelled the "Ecosystem trustee" is introduced which holds stewardship over the ecosystem services that do not directly benefit an individual, private economic actor.

1.42 Other connections to the standard economic accounts can be developed including extended supply and use tables. In this case, there is particular interest in recording the use of ecosystem services by different economic units to better reflect the use of environmental assets as part of production and consumption patterns.

1.43 The SNA, as for all statistical methodology documents, is subject to revision on a periodic basis. Given the aim of ensuring alignment between the accounting principles and treatments in the SEEA and the SNA it will be necessary, from time to time, to revisit the treatments outlined in the SEEA EA. The need for maintaining alignment with the SNA is recognised in the SEEA EA research agenda.

2.6 Following the Convention on Biological Diversity (CBD) an ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Ecosystems change as a result of natural processes (e.g., succession and natural disturbances, such as a storm), wider environmental dynamics such as climate change, and because of direct human

[28] Alternative presentations which apply the polluter pays principle for the allocation of degradation are described in Chapter 12.

actions involving deliberate management or disturbance, such as the conversion of ecosystems to other uses, extraction of natural resources, and restoration and conservation activity.

2.12 The central logic of the ecosystem accounting framework builds from the definition of an ecosystem asset. A set of ecosystem accounts will encompass those ecosystem assets within a defined ecosystem accounting area. The ecosystem accounting area (EAA) is the geographical territory for which an ecosystem account is compiled. An EAA may be defined by, for example, the boundary of a country, a sub-national administrative area, a water catchment or a protected area. Within an EAA, the ecosystem assets will reflect different ecosystem types each with their own structure, function and composition and with associated ecological processes.

2.13 Information on the ecosystem types will be reflected in measures of ecosystem extent and ecosystem condition. Ecosystem extent is the size of an ecosystem asset. It is most commonly measured in terms of spatial area. Ecosystem condition is the quality of an ecosystem measured in terms of its abiotic and biotic characteristics.

2.14 Ecosystem assets supply a bundle of ecosystem services that reflect various ecosystem characteristics and processes as well as the ecosystem type, the extent, condition and location of the asset, and the patterns of use by economic units (including households, businesses and governments). 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 use. Further, economic and other human activity encompasses all forms of interaction between ecosystems and people including both in situ and remote interactions.

2.15 Benefits are the goods and services that are ultimately used and enjoyed by people and society. The benefits to which ecosystem services contribute may be captured in current measures of production (e.g., food, water, energy, recreation) or may be outside such measures (e.g., clean water, clean air, protection from floods).

2.16 In an accounting context, flows of ecosystem services are revealed in the sense of being observable interactions between economic units, people and ecosystems. Many of these interactions will not be reflected in exchanges in monetary terms, but nonetheless, some of the value of these interactions can be represented in monetary terms.

2.27 Ecosystem assets supply ecosystem services, either from a single ecosystem asset or by multiple ecosystem assets operating collectively. In this framing, ecosystem assets may be characterized as producing units. For accounting purposes, it is assumed that it is possible to attribute the supply of each ecosystem service to a single ecosystem type (e.g., wild fish provisioning services from a lake) or, where the supply of services involves more than one ecosystem asset of different ecosystem types(e.g., flood control services across a catchment), to estimate the contribution of each associated ecosystem type to the total supply.

2.28 Ecosystem services encompass a wide range of services and may be categorized into provisioning services (i.e., those related to the supply of food, fibre, fuel and water); regulating and maintenance services (i.e., those related to activities of filtration, purification, regulation and maintenance of air, water, soil, habitat and climate); and cultural services (i.e., the experiential and non-material services related to the perceived or realized qualities of ecosystems whose existence and functioning enables a range of cultural benefits to be derived by individuals). A reference list of ecosystem services for ecosystem accounting purposes is described in Chapter 6.

6.81 There is clear recognition that people source and use biomass from ecosystems in a wide variety of ways and for different purposes, including for food, fibre and energy. Sometimes biomass is harvested directly by a final consumer (e.g., subsistence production, households picking berries in a forest) but the majority of biomass is grown, harvested or accessed by farmers, foresters and fishers (economic units both small and large) that supply it to other economic units. Determining the appropriate treatment of the integral biomass provisioning services is complicated by the variety of biomass types and the range of ways in which people grow and harvest biomass from the environment.

6.82 Biomass provisioning services are ecosystem contributions to SNA benefits which take the form of food, feed, fibre and energy outputs produced and consumed by economic units. In line with treatments in the SNA, all biomass provisioning that is input to subsistence production of agriculture, forestry and fisheries should be included in the scope of ecosystem accounts. This includes for example the collection and harvest of non-wood forest products and the growing of vegetables in backyard gardens.

6.83 While all biomass harvested is considered an SNA benefit, the recording of these flows in the SNA makes a distinction between cultivated and natural (non-cultivated) production processes based on the extent to which an economic unit manages or controls the growth of the biomass. The range of natural and cultivated production processes recorded in the SEEA EA aligns with the scope of activity recorded in the SNA.

6.84 In natural production processes, all of the biomass that is harvested is considered the ecosystem contribution. Examples include harvesting of timber from natural forests, capture fishing from wild fish stocks and wild animals trapped and hunted (including bush meat). The measurement of the ecosystem service should be aligned with the gross quantity of biomass that is harvested, i.e., the gross natural resource input, following the SEEA Central Framework (section 3.2.2). This will be different from the total stock of biomass available for harvest and different from the biomass that is used in a subsequent production or consumption process. Thus, for example, felling residues and discarded catch should be considered as part of the ecosystem service flow. This treatment applies irrespective of (i) the length of time over which the biomass has been growing; and (ii) the nature of the product, (e.g., the gross biomass harvested includes honey from wild bees). Thus, focus is solely on the quantity of the biomass that is harvested or accessed since this reflects the total use (or input) of the ecosystem's resources. The services associated with the biomass from natural production processes are recorded during the accounting period in which they are harvested or accessed.

6.85 In cultivated production processes, joint production is considered to occur where the role of the ecosystem in supplying the biomass intersects with the activity (and associated human inputs, e.g., labour and produced assets) of people and economic units. The activities of economic units in this joint production process can be separated into those concerning the growth of the biomass (e.g., the application of fertilizers and pesticides) and those concerning the harvest of the biomass. The contribution of the ecosystem occurs up to the point of harvest.

6.86 There is a very wide range of cultivated production contexts. Thus, the extent of human activity in the management of biomass growth can be very high (e.g., for hydroponically grown strawberries) or very low (e.g., for lightly managed native forests). Depending on the type of biomass and the related product, the timing and context of the growth and harvest can vary significantly. Further, within each production context there is a wide variety of management practices and there may be more than one benefit that is generated. For example, the general activity of corn production may produce food as well as biomass for the production of energy; and cattle production will supply food as well as hides for leather and bones for fertilizer.

6.87 Notwithstanding this diversity of cultivated production contexts, the conceptual intent for ecosystem accounting is to identify the ecosystem contribution, i.e., to recognize that in different production contexts the relative role of ecosystem services will vary. The measurement of the ecosystem contribution in different contexts can be considered in two distinct ways. One approach uses the biomass harvested as the measurement focus for identifying the overall ecosystem contribution, and the other focuses on the various types of ecosystem contributions such as those concerning nutrients, water, soil retention, pollination etc. which will be used in different combinations in different contexts.

6.88 Under the first measurement approach, particularly when cultivated production is of high intensity, there may be a significant difference between the ecosystem contribution and the gross biomass harvested (Cerilli et al., 2020). This difference may increase due to, for example, additional fertilizer, enhanced seed varieties and intensified management even while the extent of the ecosystem asset under use decreases (e.g., through conversion to settlements). Biotic elements that contribute positively to biomass growth may also deteriorate (e.g., humus content). Compilers are thus encouraged to estimate the ecosystem contribution to cultivated biomass production processes especially where these might be changing over time. [29]

6.89 In practice, there is a considerable measurement challenge in either identifying all of the relevant individual ecosystem inputs or accurately measuring the ecosystem contribution to the gross biomass that is harvested in a way that reflects the diversity of cultivated production contexts and covers all types of biomass. Consequently, where the relative contribution cannot be estimated, the gross biomass harvested may be used as an adequate proxy measure for the flow of biomass provisioning services in cultivated production contexts, irrespective of the extent of human inputs and the intensity of management.

6.90 Whether the ecosystem contribution is measured directly or not, it is recommended that additional information is provided on the cultivated production contexts including, for example, data on the gross biomass harvested in intensive and extensive production contexts or via organic farming. Further, measurement by biomass type and by relevant ecosystem characteristic (e.g., by soil type, climatic zone), and data on variables such as soil fertility, soil water availability and fertilizer use is likely to assist in better understanding the relative ecosystem contribution. Such information may also be used to support estimation of the ecosystem contribution, for example by comparing yield levels between intensive and extensive or organic farming systems.

6.91 Under the second measurement approach, each relevant ecosystem service is measured directly with the intent to provide sufficient coverage of specific services such that the overall ecosystem contribution to the production of biomass is appropriately reflected. It is noted that under the first measurement approach these specific ecosystem services, such as pollination, may also be recorded but they are shown as intermediate services.

6.92 In line with SNA time of recording treatments, ecosystem services in cultivated production contexts are recorded progressively over the life of the biomass. Thus, services associated with timber production from plantation forests should be recorded progressively as the timber resources grow in line with the recording of the growth of this resource in the national accounts as a work in progress. Where multiple types of biomass are harvested from a single ecosystem asset over the course of an accounting period (e.g., through cultivation of summer and winter crops), all biomass harvested should be attributed to the same ecosystem asset.

[29] Methods have been developed for this purpose including input-output datasets, agronomic and agricultural production functions and energy/energy-based approaches. An example can be found in Vallecillo et al. (2019, Chapter 3) where an energy-based ratio is applied to assess ecosystem contribution and separate it from human input.

6.93 Both the measurement of the ecosystem contribution and the gross harvested biomass require a clear measurement target. A different measurement target is used for plants and livestock. For cultivated plants, the ecosystem services are measured in relation to the quantity harvested, for example quantities of corn, timber or apples. This flow is recorded as supplied by the relevant ecosystem and used by the economic unit managing the cultivation (e.g., farmer).[30]

6.94 For cultivated livestock, the measurement target is on the extent of the connection between the livestock and relevant ecosystem assets, primarily natural and cultivated pastures. Depending on the cultivation context, there may be some disconnect between ecosystems and the production of livestock and livestock products. Therefore, where the livestock production process does not involve direct connection with an ecosystem, as occurs, for example, in some forms of intensive chicken, cattle and pig rearing, no ecosystem services should be recorded. In these cases, the associated ecosystem services are limited to the ecosystem contribution to the production of feed and supplements (e.g., via hay, soybean meal, pellets, etc.) which would be recorded as crop provisioning services.

6.95 To ensure focus on the ecosystem contribution, it is recommended to measure the grazed biomass provisioning services as the primary ecosystem contribution. Other ecosystem contributions such as water supply and local climate regulation (e.g., trees providing shade and wind protection to livestock) may also be incorporated. These various contributions are recorded as final ecosystem services and no distinct livestock provisioning services should be recorded. It is also possible to measure livestock provisioning services reflecting the weight gain in livestock or the production of products such as milk and eggs. However, in these cases it is essential to estimate an ecosystem contribution since, especially in intensive farming systems as noted above, there may be very little direct connection with ecosystems in rearing livestock.

6.96 By extension, the livestock treatment applies to other animals (mainly fish) raised in aquaculture facilities (both marine and freshwater) whose cultivation involves the provision of feed inputs, including fish meal. Thus, the gross biomass harvested from aquaculture should not be used as a proxy for the ecosystem contribution. An exception arises where no feed or other inputs are provided (e.g., the farming of oysters). In these cases, the ecosystem service can be appropriately measured using the gross biomass harvested. Where aquaculture is undertaken without a direct connection to a surrounding ecosystem asset, no ecosystem services should be recorded.

6.97 To complete the description of the treatment of biomass provisioning services, four other commonly considered issues are noted.

• Links to cultural services. There are many instances in which the harvesting of biomass occurs in a recreational or cultural context. For example, people catch wild animals, especially fish, as part of their recreational activities and there may be traditional harvests undertaken by indigenous groups. If the harvest is retained for subsequent consumption, then the quantity of the associated biomass should be included as part of biomass provisioning services. At the same time, there will be a connection to the measurement of cultural services. In these instances, flows of cultural services should be recorded in addition to biomass provisioning services.

• Services related to wild fish provisioning services. For cultivated biomass provisioning services, it should be conceptually straightforward to attribute the service to a specific ecosystem asset since there will be a distinct location where the biomass is grown and harvested. For uncultivated biomass provisioning this may be more challenging, especially for fish biomass. In concept, for wild fish biomass,

[30] The subsequent sale of harvested outputs by the economic unit along the supply chain is recorded in the standard SNA production accounts. Double counting is avoided by ensuring that there are entries for both the supply and use of the ecosystem service and hence the net effect with respect to the farmer's value-added is unchanged but the contribution of the ecosystem is recognised.

the relevant supply location is the place at which the interaction with the ecosystem occurs – i.e., the place where the catch occurs. However, it is well recognized that there may be multiple ecosystems that are important in the growth of wild fish. To record their relative importance, intermediate services can be recorded reflecting the connections between ecosystem assets. This would include, for example, recording nursery services from seagrass meadows for certain species. The extent to which this measurement is possible will depend on the data available and levels of ecological knowledge.

• Trade in biomass products. Given the extent of international trade in agricultural, forestry and fisheries products, there will commonly be a large spatial disconnect between the location of harvest (where the ecosystem service is recorded), the location of subsequent processing and manufacturing, and the location of final household consumption. As explained further in Chapter 7, following accounting principles, the supply and use of ecosystem services is recorded in the location of harvest rather than recording the supply of ecosystem services in one location and use (albeit embodied in another product) in another location. Thus, there is no international trade in biomass provisioning services to be recorded. It is possible using input-output techniques to trace the flow of associated/derivative products within the international economy, for example to derive ecosystem service footprints.

• Losses in biomass production. A common feature in the harvesting of biomass is that not all of the harvested biomass is retained and used in the subsequent production process. These are referred to in the SEEA Central Framework as natural resource residuals and include felling residues, discarded catch and harvest losses. In the SNA, the focus is on the output ultimately sold by the producer and thus, in physical terms, the measure of output will be net of these losses. In the SEEA Central Framework, compilers are encouraged to record the flows in gross terms (SEEA Central Framework, section 3.3.2), since this reflects the actual flow of inputs from the environment. For ecosystem accounting, it is recommended that the principles of the SEEA Central Framework should be applied such that quantity of biomass provisioning services should be equal to the harvest in gross terms, i.e., before harvest losses, felling residues and discarded catch are deducted. Even though they are not finally used by economic units, in terms of progressing through the supply chain, they do represent contributions from the ecosystem into the production process.

8.13 In national accounting, the entries in the accounts in monetary terms reflect their exchange values as defined in the SNA. Exchange values are the values at which goods, services, labour or assets are in fact exchanged or else could be exchanged for cash (2008 SNA, para. 3.118). This section outlines the related principles from a general national accounting perspective and the following sections describe the application of these principles for ecosystem accounting.

8.14 For the vast majority of entries in the national accounts, exchange values are measured using data from observed transactions involving market prices. Market prices are defined as amounts of money that willing buyers pay to acquire something from willing sellers (2008 SNA, para. 3.119).[31] *The use of observed market prices implies that the accounts embody information about the revealed preferences of the economic units involved.*

8.15 Observed market prices are defined without expectation that the markets in which exchanges take place satisfy specific institutional arrangements or assumptions. 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, para. 3.119). Given this, the general interpretation in accounting is that market prices should reflect the current institutional context, i.e., the current market structures and associated

[31] The 2008 SNA notes a number of cases where actual exchange values do not represent market prices (e.g., in situations of transfer and concessional pricing (see paragraphs 3.131-3.134)).

legal or regulatory arrangements. Consequently, market prices used in national accounting will likely reflect the presence of various market imperfections from the perspective of economic theory.

8.16 While the majority of transactions recorded in the national accounts are based on observed market prices, there are several (often large) transactions for which market prices are not observed and therefore need to be estimated. Thus, in the national accounts, where market price-based transactions are not observable, alternative methods are used to estimate them and hence allow aggregation across market and non-market goods and services in the measurement of production and consumption.[32]

8.17 The SNA recommends various approaches, summarised below, and much practice has evolved. At the same time, in applying the SNA recommendations, compilers in different countries must consider their local context and institutional structures. For example, markets for the same good in different countries may be loosely or heavily regulated and hence different valuation approaches must be applied. Comparison of national accounts estimates across countries is possible notwithstanding the variation in institutional contexts and methods since the market price principle underpins the exchange values recorded in the accounts.

8.18 Two primary alternative methods are described in the SNA in relation to transactions in goods and services namely (i) market prices of similar or analogous items (adjusted for quality and other differences as required) (2008 SNA, para. 3.123); and (ii) where no appropriate market exists, prices may be derived by the amount that it would cost to produce them currently (2008 SNA, para. 3.135).

8.19 Cost-based techniques are commonly applied in estimating the value of government supplied services including education, health and defence. Indeed, they are required in the context of measuring accounting entries for public goods. In these cases, it may be assumed that the amount of expenditure embodies information about the revealed preferences of a country or community. At the same time, it is accepted that these values for public goods will not reflect the full social benefit arising from the provision of these collectively enjoyed services.

8.20 Transactions in assets are valued using the same approaches just outlined, either based on observed prices (e.g., sales of land) or using the two alternative methods. Exchange values of assets are also required to underpin entries in asset accounts and balance sheets, i.e., exchange values for each asset are required at the opening or closing of the accounting period. The ideal source of exchange values for assets at balance sheet dates are prices observed in markets (e.g., valuing share portfolios using market prices at balance sheet date). Where there are no directly observable prices from markets, the SNA describes two approaches for estimating the exchange value of an asset. The first is the written down replacement cost approach which recognises that the value of an existing asset (most commonly relating to produced assets such as buildings and machinery) at any given point in its life, is equal to "the current acquisition price of an equivalent new asset less the accumulated depreciation" (2008 SNA, para. 13.23). The second approach entails using "the discounted present value of expected future returns" (2008 SNA, para. 3.137). This second approach is of primary relevance for ecosystem accounting since there are no observable current acquisition prices of ecosystem assets that encompasses the range of ecosystem service values supplied by an ecosystem asset.

[32] Note that the use of these alternative methods to estimate exchange values highlights that the estimation of exchange values does not require the actual exchange of money (cash or equivalent).

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