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## **Recording changes to the stock of natural resources**

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**RECORDING CHANGES TO THE STOCK OF NATURAL RESOURCES**

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*The System of Integrated Environmental and Economic Accounting 2003 (SEEA), provides three options for recording changes to the stock of natural resources.*

*This paper examines these options, particularly their suitability in accounting for both renewable and non-renewable natural resources. It also considers the options in the context of previous London Group outcomes surrounding the treatment of discoveries of mineral and energy resources.*

*Ultimately a number of concerns are identified with the existing options, and therefore a fourth option is presented for consideration.*

## **Introduction**

1. The System of Integrated Environmental and Economic Accounting 2003 (SEEA) proposes multiple solutions to various environmental accounting issues. If SEEA is to be elevated to an international statistical standard, these sets of options must be restated as univocal accounting recommendations. Box 10.4 (SEEA Chapter 10) presents three options for recording additions and deductions from the stock of environmental assets:

- *Option C1 records the consequences of extraction of natural resources in the extended generation of income account leading to a depletion-adjusted operating surplus, but the corresponding increases in resources are shown in the other changes in assets account.*
- *Option C2 records both the consequences of extraction and additions to natural resources in the extended generation of income account. Additions cover both the natural growth of biological resources and discoveries and reappraisals of subsoil deposits.*
- *Option C3 is one where there are no entries for extraction and addition to natural resources in the extended generation of income account of those assets which have been reclassified as developed natural assets and which are therefore recorded in the same way as produced assets.*

2. As part of the update of SEEA, the London Group has previously considered and concluded on the treatment for *Identifying the income element of resource rent* (Box 10.1, SEEA Chapter 10), and *Recording mineral exploration and mineral deposits* (Box 10.3, SEEA Chapter 10). In particular, option B3 in Box 10.3 proposed the concept of a ‘developed natural asset’, which involves combining related mineral resource and mineral exploration assets, but this option has been rejected by the London Group. Given that option C3 is the rational consequence of option B3, the rejection of option B3 effectively removes option C3 from further consideration.

## **Environmental assets**

3. In order to appreciate the issues involved, it is essential to identify what constitutes an environmental asset, as well as the renewable / non-renewable distinction. SEEA identifies the following broad categories of environmental assets:

- Natural resources (consisting of mineral, energy, soil, water and biological resources);
- Land and associated surface water; and
- Ecosystems.

4. With the exception of mineral and energy resources, environmental assets are considered to be renewable. If they are used sustainably they have infinite lives. Mineral and energy resources however, are considered to be non-renewable. Once they are used they are gone forever. The renewable / non-renewable distinction is important, and will feature later in the consideration of the various options.

5. It is worth noting that the heading of SEEA Box 10.4 refers to the treatment of ‘environmental assets’, while each of the descriptions against the individual options relate to the narrower grouping of ‘natural resources’. The discussion in this paper generally relates to ‘natural resources’.

### **Environmental assets and the 1993 SNA**

6. In order to promote *integrated* environmental–economic accounting, as far as possible, the SEEA and SNA systems should be either consistent, or readily reconcilable. Where SEEA and SNA concepts differ, there should be sound reasons. For example, while SNA does not recommend applying a charge against production for the depletion of natural resources, SEEA can justify doing so on the basis that this provides a more appropriate view of the sustainability of current production.

7. Some of the SEEA environmental assets are also economic assets according to the 1993 SNA (i.e. they are entities functioning as a store of value over which ownership rights can be enforced by institutional units and from which economic benefits may be derived by the owner from holding or using it over a period of time exceeding one year). Clearly, much of mineral and energy resources fall into this category. Importantly, some biological resources are also economic assets, for example, fish raised on a fish farm, or plantation forests cultivated by an institutional unit. Where natural resources are economic assets, it is appropriate to follow SNA principles in recording changes to asset stocks.

8. The general position of the 1993 SNA is that a purely natural process without any human involvement or direction is not production in an economic sense (paragraph 6.15). For example, the growth of trees in a natural forest is not economic production, while the growth of trees in a timber plantation is production. As a consequence, the formation of mineral and energy resources does not constitute economic production as defined by the SNA. Similarly, natural growth of renewable natural resources does not constitute economic production unless it is organised, managed and controlled by institutional units.

9. The 1993 SNA treats the natural growth of ‘cultivated assets’ such as crops, trees, livestock or fish which are organised, managed and controlled by institutional units as economic production (paragraph 6.94). Generally, SNA requires that natural growth in these cultivated assets be recorded as an increase in inventories (work-in-progress). Such growth thereby enters the output of the producing unit (i.e. output as the value of sales plus changes in inventories including additions to work-in-progress). The exception to this rule applies where natural growth relates to cultivated assets that are ‘capital’ in nature i.e. assets that are used repeatedly or continuously for a period of time exceeding one year to produce other goods or services. Examples would include grape vines, dairy cattle and nut trees. Natural growth of such assets is recorded as own account capital formation (1993 SNA, paragraph 10.84). Therefore, whether the growth relates to cultivated assets of a current or capital nature, SNA requires that output be recorded as being produced continuously over the period of production.

10. The draft SNA93Rev.1 reaffirms these recommended treatments of the 1993 SNA.

## **Are non-renewable natural resources produced assets?**

11. The question of whether non-renewable natural resources should be treated as 'produced' or 'non-produced' was not explicitly decided upon at the London Group meeting in March 2007. However, that meeting considered and rejected SEEA Chapter 10 option B3 (a position later endorsed by UNCEEAA). This option required that the sum of mineral exploration expenditure and the mineral resource be attributed to a “developed natural asset” which would be recorded as a tangible produced asset. That is, option B3 effectively assumed that mineral exploration expenditure gives rise to (and forms part of the valuation of) the new mineral and energy discovery. The relevant issue paper presented to the March 2007 London Group meeting (*Depletion in the SEEA - Narrowing down the options*<sup>1</sup>) also suggested rejecting option B3. Its principal supporting argument was that discoveries of mineral and energy resources are not produced assets, and should therefore not form part of output and income. A summary of this argument follows.

12. The draft SNA93Rev.1 explicitly describes discoveries as non-produced, and accordingly recommends they enter the balance sheet through the SNA *other changes in volume of assets account*. Nevertheless, there are arguments against this treatment. In particular, other changes in volume of assets are considered to be beyond the control of the units involved, which suggests they are unexpected. However, in practice, new discoveries are often considered to be predictable, certainly not accidental or unexpected. New discoveries are also dependant on dedicated mineral exploration, which is clearly a productive activity.

13. The alternative is to treat new discoveries as produced assets, yet this appears to be even less desirable. To treat discoveries as produced assets requires the identification of a productive activity, and then the determination that the discoveries are in fact an output of that activity. It might be argued that new discoveries are the output of mineral exploration activity. But it is difficult to conceive of how the mineral exploration asset 'produces' new mineral and energy resources. Production is typically thought of as a process of *transforming* inputs into outputs. Using a conventional economic accounting perspective, it is difficult to conceive of how newly discovered mineral and energy resources have been produced at all, let alone by a process utilising knowledge assets.

14. Also, if mineral exploration 'produces' the new mineral and energy resource, the value of discoveries should be the price charged by the exploration enterprise to perform the exploration. That this is not true (in the great majority of cases) suggests that new discoveries are not the output of mineral exploration. Instead, it could be said that the output of mineral exploration is knowledge gained about the existence and nature of the deposit, rather than the deposit itself. And that this knowledge asset is used as part of the subsequent process of extracting the discovered deposits.

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<sup>1</sup> Comisari, P.

15. Had option B3 been accepted by the London Group, extractions and additions to mineral and energy resources would have been treated as if these resources were produced assets. That is, new discoveries would have been treated as the produced output of a capital good, and extractions treated as consumption of fixed capital. The rejection of option B3 effectively rules out option C3, a point made in SEEA (paragraph 10.67).

16. If we conclude that non-renewable natural resources are non-produced assets, an apparent asymmetry is introduced to our treatment of natural resources in the environmentally adjusted *production account* and income accounts. That is, we would require a charge against production and income to account for depletion of non-renewable natural resources, but would not consider new appearances of the same resources to be part of output.

17. When considering this ‘asymmetry’ in the proposed treatment, it is worth drawing an analogy with the treatment of produced capital in the SNA. If an entity were to receive the gift of a capital good (much in the same way that the environment provides ‘gifts’ of natural capital to the economy), how would this be treated? The capital good will not form part of the output of the receiving enterprise, nor is it recorded as income of the entity, though the entity may generate income from its use in production. The receiving entity will record this gift as a capital transfer received and as part of its stock of produced fixed assets in its balance sheet. Although the receiving entity records no output or income in respect of the capital transfer, it nevertheless records income and consumption of fixed capital (analogous to depletion) in its production account as the capital good is used in production.

18. While the discussion above makes specific reference to mineral and energy resources, these are effectively synonymous with ‘non-renewable natural resources’. And in any case, the treatment would extend to any other natural resources defined as ‘non-renewable’.

### **Depletion of renewable natural resources**

19. The ABS presented a paper titled *Depletion of renewable environmental resources*<sup>2</sup> to the December 2007 London Group meeting in Rome. The paper proposes that a meaningful measure of the value of depletion for SEEA may be to integrate values for net natural growth of renewable natural resources into resource rent, which is in turn offset by the value of economic depletion of these resources. This approach leads to three alternative outcomes for attributing resource rent of renewable natural resources in an accounting period:

1. Adjusted resource rent is entirely attributed to income;
2. Adjusted resource rent is split between income and depletion; and
3. Adjusted resource rent is entirely attributed to depletion.

20. These concepts and calculations can also be applied consistently to measuring depletion of non-renewable resources. As there is no natural growth/mortality recorded for non-renewable resources, revenue is split between income and depletion.

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<sup>2</sup> Bain, D.

## **Growth in renewable natural resources – an addition to output?**

21. As with non-renewable natural resources, there is no question that appearances of renewable natural resources must be reflected in the national balance sheet. The balance sheet is thus a powerful tool for analyses of sustainability. Our question here is one of how these appearances enter the balance sheet – since renewable natural resources fall within SEEA’s asset boundary, their appearance must take the form of either: an ‘output’ (i.e. via the SNA *production account*); or an ‘other volume change’ (i.e. via the SNA *other changes in volume of assets account*). As stated, the SNA position is that purely natural growth in a renewable natural resource does not constitute economic production. However, the treatment of cultivated natural resources in the 1993 SNA appears to provide some justification for SEEA to more generally treat growth in renewable natural resources as part of output and income.

22. As stated earlier, the 1993 SNA recommends that natural growth in ‘cultivated assets’ be treated as a process of production in the economic sense (paragraph 6.94). Because this natural growth is subject to direct ownership and control of institutional units, it is not considered to be a purely natural process lying outside the SNA production boundary.

23. Consequently, the case for treating growth of renewable natural resources as ‘output’ is stronger than for non-renewable natural resources. On the one hand, institutional units do not universally organise, manage and control the natural growth of renewable natural resources. However, if renewable natural resources are used sustainably, they potentially have infinite lives. That is, it is possible that human intervention may support growth of renewable natural resources and sustainable harvest. In that sense, natural growth of renewable natural resources is a process potentially strongly influenced by human actions, even if it is not necessarily subject to the direct ownership and control of institutional units.

24. With cultivated natural resources such as fish in a fish farm, or trees in a timber plantation, there is a strong degree of certainty that the enterprise that owns the resource will generate output and income from its natural growth. For fish stocks in the open sea or for native forests, the degree of certainty is not always as strong but there is nevertheless a reasonable expectation that much of these resources will ultimately be harvested. The expectation will be stronger for certain types of resources in certain locations. For example, there is a reasonable expectation that much of the growth in South-East Asia’s hardwood forests and certain fish species in Europe’s North Sea will ultimately be reflected as output of economic production.

25. However, even where there is no realistic expectation that a renewable natural resource will ultimately be harvested, SEEA could nevertheless choose to treat natural growth as part of output. One of the central tenets of sustainable development is the notion of maintaining natural capital ('keep capital intact'). Therefore, an information system (such as SEEA) used to inform our performance against the objective of maintaining natural capital for sustainable development, needs to fully account for natural capital formation. Natural capital formation must enter the SEEA system either as an 'output' of production or as an 'other volume change'. The 1993 SNA provides guidance on what constitutes an 'other volume change' and it is primarily about "the effect of unexpected events on the economic benefits derivable from assets" (paragraph 12.41). Examples of these types of changes overwhelmingly relate to decreases in assets, though increases in assets are certainly possible. But SNA makes clear reference to 'other volume changes' as being 'unexpected', 'untimely', 'unforeseen'. It is clear that natural growth in renewable natural resources is generally neither unexpected, untimely nor unforeseen. This suggests the appearance of a renewable natural resource could be viewed as a form of output within SEEA.

26. There is a key distinction between renewable and non-renewable natural resources which is relevant to this discussion. The *extant* stock of non-renewable natural resources cannot increase (except in geologic time frames) regardless of human intervention. That is, the extant stock of non-renewable natural resources is fixed. Human intervention can physically remove non-renewable natural resources, but cannot facilitate its growth. Discoveries and reappraisal of these resources do not affect their extant stock; they merely alter human perception of this stock. The same is not true of renewable natural resources, the growth of which can clearly be influenced by human intervention.

27. Treating the appearance of renewable natural resource as a form of output ensures symmetrical treatment of additions to, and removals from, renewable natural resources. That is, the removal of renewable natural resources is treated as a charge against production, and its net natural growth is treated as output of production. There is an intuitive appeal to this symmetry.

28. While it is suggested that net natural growth of renewable natural resources be treated as produced output, this does present a range of practical difficulties. A number of these difficulties are explored below.

29. The treatment of fish stocks, in particular, presents clear examples of the difficulties of regarding natural growth as production. Assume for example there is an increase in a fish stock such that net natural growth exceeds the harvest; should there be a positive adjustment to production and income? A positive adjustment to production and income within SEEA would raise the gross operating surplus of the fishing industry in the SEEA accounts above that recorded in the corresponding SNA accounts. The SEEA accounts could thus be interpreted as saying that income earned from the fish harvest is more sustainable than indicated in the corresponding SNA accounts. Since the SNA (implicitly) assumes that fish stocks in the open sea are infinitely abundant, this is a difficult result to interpret.



30. The mobility of many fish species is a particular issue. It is not only conceivable but very likely that growth in fish stock within the territorial waters of one country might be harvested by another country. For example, tuna stocks regularly move through the territorial waters of various South Pacific islands, but the major fishers of this tuna stock are from outside the South Pacific. If growth of tuna fish stock occurs in the territorial waters of a South Pacific island nation, what analytical purpose is served by increasing the environmentally-adjusted GDP of this nation, if another nation ultimately harvests this tuna stock?

31. Since water resources are both a SEEA natural resource and an SNA economic asset, it follows that treating uncontrolled growth in a renewable natural resource as output implies that rainfall constitutes a produced output (1993 SNA, paragraphs 1.23 and 1.24).

32. Does uncontrolled growth in renewable natural resources meet the test of Hicksian income? J.R. Hicks (1939) broadly defined income as that which we can consume today without becoming less well-off tomorrow. Since natural capital is included in our notion of wealth, it could be argued that anything which increases natural capital gives rise to income (in a Hicksian sense).

33. A closer examination of Hicks's thinking, however, raises some questions as to whether all increases in natural capital should qualify as income. Hicks stated that "The purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves". And that income should be a "guide for prudent conduct" in relation to consumption. Consequently, there is every justification for incorporating depletion of non-renewable natural resources into a Hicksian definition of income, because the using up of these resources leaves us demonstrably less well-off in the future. However, basing consumption behaviour on a notion of income that includes the value of rainfall and the movement of fish stock into our territorial waters does not appear to meet Hicks's view of 'prudent conduct'.

### **Applying options C1 and C2**

34. Option C1 charges the consequences of extraction of natural resources against income, giving rise to a depletion-adjusted operating surplus. However, this option does not consider additions to stocks of natural resources to be the result of productive activity. Instead it records additions in the SNA *other changes in volume of assets account*. For non-renewable natural resources, this treatment is the logical consequence of London Group's decision to reject option B3 at its March 2007 meeting.

35. This issue paper has contended that non-renewable natural resources are not produced assets and therefore new discoveries and reappraisals of these assets do not form part of output and income. If we accept this position, then option C1 proposes a treatment that is appropriate for non-renewable natural resources.

36. Applying option C1 to renewable natural resources however, gives an inappropriate measure of depletion because it excludes additions to renewable natural resources (e.g. net natural growth of forests and fish stocks) from the calculation of depletion. For renewable natural resources, these additions are required to develop an appropriate measure of a depletion-adjusted operating surplus. Net natural growth in renewable natural resources represents a physical increase in the asset, unlike discoveries of non-renewable natural resources which simply reflect improved human knowledge of mineral and energy resources. By ignoring net natural growth in renewable natural resources, the use of option C1 could result in large estimates of depletion, when in fact the stock of the renewable natural resource is increasing.

37. Option C2 also charges the extraction of natural resources against income, resulting in a depletion-adjusted operating surplus. However, unlike option C1, option C2 records the effects of additions (such as natural growth, discoveries and reappraisals) against output and income.

38. For non-renewable natural resources, this is contrary to the recent London Group decision that concluded reappraisals and discoveries of mineral and energy resources are not the result of productive activities, and therefore should not form part of production and income.

39. In the case of renewable natural resources, option C2 is conceptually appropriate. Additions such as regrowth of forests and fish stocks do indeed add to the stock of the asset. If the depletion measure is meant to represent the 'using up' of a resource, then net natural growth in renewable natural resources needs to be offset against the harvest of these resources in arriving at a depletion-adjusted operating surplus. This provides a more appropriate measure of the sustainability of production and income.

#### **A fourth option**

40. Following the discussion above, it is suggested that neither option C1 or C2 is universally appropriate. Specifically, option C1 is appropriate for non-renewable natural resources, but not for renewable natural resources. Option C2 is appropriate for renewable natural resources, but not for non-renewable natural resources. As such, a fourth option is proposed:

- *Option C4 considers separately the cases of renewable and non-renewable natural resources. For non-renewable natural resources, the consequences of extraction are recorded in the extended generation of income account leading to a depletion-adjusted operating surplus, but corresponding increases in these resources are shown in the other changes in volume of assets account. For renewable natural resources, both the consequences of extraction and net natural growth are recorded in the extended generation of income account leading to a depletion-adjusted operating surplus.*

41. By recognising the inherent differences between renewable and non-renewable natural resources, option C4 overcomes the limitations of options C1 and C2. In the case of non-renewable resources, recording discoveries and reappraisals of subsoil deposits in the SNA *other changes in volume of assets account* ensures this option is consistent with the thinking behind London Group's decision to reject option B3.

### **Conclusion**

42. Box 10.4 (SEEA Chapter 10) presents three options (C1, C2 and C3) for recording changes to the stock of environmental assets. This paper examines these options, ultimately concluding that none are entirely suitable. In particular, option C1 is appropriate for non-renewable natural resources, but gives rise to problems for renewable natural resources because of their capacity for natural growth. Option C2 accounts for natural growth of renewable natural resources, but involves an inappropriate recording of discoveries of mineral and energy resources as produced assets. Option C3 is the logical consequence of option B3 which was recently rejected by the London Group.

43. As a result, this paper proposes a fourth option (option C4) for consideration. Option C4 overcomes the limitations of options C1 and C2 by considering the treatment of renewable and non-renewable natural resources separately.

### ***Questions:***

***Do members agree that London Group's earlier rejection of option B3 effectively removes option C3 as a possible option?***

***Do members agree that SEEA should, in principle, view net natural growth in renewable natural resources as part of produced output?***

***Do members agree that option C4 is an appropriate alternative that overcomes the limitations of the existing options?***

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